A COMPENDIUM OF LIVESTOCK AND FISHERIES RESEARCH HIGHLIGHTS IN NEPAL

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Preface

Livestock and fisheries sector constitutes an important component of national agriculture system in Nepal and provides significant contribution to national gross domestic product, rural economy and livelihoods of the majority of the population. This sector is important not only for overall sustainability of the agriculture sector but also for the household income, family nutrition and self employment for large segment of the population. Improvement in the production and productivity of this sector will provide substantial growth in overall economy and improvement in the livelihoods of the people dependent on this sector.

Research on constraints and potentials of the livestock and fisheries sector for its improvement has been initiated in the country since last few decades, but generally it is still in its infancy. Although, the information generated is limited, there is however, a lack of cataloguing system to review on existing knowledge and information, which could provide a review on the overall status of the research outputs in the country.

This compendium on livestock and fisheries research highlights in Nepal has been prepared with the aim of bringing together all available knowledge and information in a single volume to produce a comprehensive document for the researchers, knowledge seekers, reviewers, research planners and extension workers. It is hoped that the document will provide an overall review of what has been researched in Nepal, its outcome and the areas where research needs to be focused in future. To make the review easier, the research summary are grouped according to the research topic and further sub-grouping has been done wherever necessary. We hope that the compendium will be a valuable source of information for all involved in livestock and fisheries research and development.

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1. BOVINE

1.1 HEALTH

An attempt to identify *Fasciola* species in Palpa, Nepal

Lohani MN and MK Jaeckle (1982). An attempt to identify *Fasciola* species in Palpa. *Bulletin of Veterinary Science and Animal Husbandry*, **10-11:**1-7

Liver fluke specimens were collected at five slaughter places of Tansen, Palpa, Nepal, during July- August 1981. These were collected within one hour after the slaughter. The samples were washed with water and preserved in 4% Formal saline solution. Identification was done by Hoerning Institute of Parasitology, University of Bern. A total of 181 liver flukes of 24 animals (22 buffaloes and 2 goats) were identified. No. of liver flukes collected from individual animals ranged from 2- 13 no. The findings revealed 29(16%) *Fasciola hepatica*, 126(69.6%) *Fasciola gigantica* and 26(14.4%) intermediate form. Infestation with *Fasciola gigantica* was exclusively found in 4 animals. In 15 animals an intermediate form were found. Mixed infestation in all age groups (1-3, 4-6, 7-10 and 11-14 yrs) distributed evenly. *F. gigantica* was the most important species found exclusively in western region of Palpa (Mujhung-1 case and Juthpaua- 3 cases).

Incidence of Liver fluke in Cattle and Buffaloes at Livestock farm of IAAS

Dhakal IP and DB Nepali (1983). Incidence of Liver fluke in Cattle and Buffaloes at Livestock farm of IAAS. *Journal of the Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan*, **4**(1 and 2): 15-18

An investigation was carried out at the livestock farm of IAAS, Rampur, to study the incidence of *Fasciola gigantica* infection in cattle and buffaloes. Faecal samples from 130 animals of different age groups were tested. The numbers of eggs/gram of faeces of infected animals were counted monthly for a period of 3 months. Adult cattle and buffaloes had a higher incidence of infection with greater number of eggs/gram of faeces than did the young stocks.

The epidemiology of Fasciolosis in the Koshi hills of Nepal

Morel AM and SN Mahato (1986). The epidemiology of Fasciolosis in the Koshi hills of Nepal. *Special issue Published on the Occasion of 2nd National Veterinary Coference,* **14:**27-35

The epidemiology of *Fasciola gigantica* was studied in the intermediate and definitive host and the epidemiological cycle was determined. *Lymnaea auricularia race rufescens luteola* were identified as being responsible for the transmission of *F. gigantica* in the Koshi hills of Nepal. The ecology of the snail was studied at 9 different habitats in Hattikharka Panchayat. Mature infection in the snail was detected from May to Aug and again in Nov.

Evaluation of Carbon tetrachloride (CTC) drenching against Fascioliasis in pocket area of mid western hills in Nepal

Joshi BR (1987). Evaluation of Carbon tetrachloride (CTC) drenching against Fasciolosis in pocket area of mid western hills in Nepal. *Technical Paper N. 87/15*, Lumle Agriculture Center (LAC), Lumle, Kaski, Nepal

The prevention of Fasciolosis in the ruminant population of Jhobang village (3500m asl) in Kaski district was evaluated. All the ruminant population of the village was drenched with CTC at the recommended dose rate during the month of April, and the result was monitored for a year. The evaluation of the drenching programme was done after a year. The results indicated that CTC was not suitable for mass drenching due to the problems of toxicity associated with it.

The 9% reduction in overall prevalence of the disease might be due the sampling error during the 12 months post drenching analysis rather than due to CTC drenching.

Prevalence of Fasciolosis (Liver fluke) in the animals at different altitudes of mid western hills of Nepal

Joshi BR (1988). Prevalence of Fasciolosis (Liver fluke) in the animals at different altitudes of mid western hills of Nepal. *Journal of Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan,* **9:**111-114

Prevalence of Fasciolosis (liver fluke) in cattle and buffaloes of 6 villages located at 3 different altitudes (900-2200 m) of 2 hills was evaluated. Faecal samples were collected randomly from a sample representing at least 10 of the adult population and were examined by standard sedimentation method. The overall prevalence rate of Fasciolosis in these animals was found to be high (above 50% in five villages and low in one village). The prevalence rate remained unchanged during summer and winter period and it was found to be influenced by geographical situation and cropping pattern in that area. The change in altitude showed very little effect upon the prevalence of the disease in Salija and Bajung hill. The difference in disease prevalence could be due to the differences in the cropping pattern of these 2 villages.

Evaluation of rice straw as a potential source for Fasciola infection of ruminants in Nepal

Joshi BR (1989). Evaluation of rice straw as a potential source for Fasciola infection of ruminants in Nepal. *Proceedings of the 2nd National Veterinary Conference*, **15:**38-45

Rice straw is a major source of forage for ruminants during the winter period in the mid hills and plains of Nepal. In this area, the prevalence of Fasciolosis is also reported to be high even in stall fed animals. In the present experiment, fluke free buffaloes were used as tracer animals in an attempt to study the role of rice straw as a possible source of Fasciola infection in ruminant livestock. It was found that feeding rice straw, even after its storage for 2 months, produced the disease in the tracer animals. Thus, indicating the possibility of rice straw as one of the means of Fasciola infection in Nepal. The significance of these findings for the epidemiology of the disease discussed.

Efficacy of Triclabendazole (Fasinex) against chronic Fasciolosis in buffaloes

Joshi BR (1992). Efficacy of Triclabendazole (Fasinex) against chronic Fasciolosis in buffaloes. *Proceedings of the 3rd National Veterinary Conference*, Nepal, 10-12 Aug, 1990, **19-20:** 45-49

Three buffalo calves identified to be infected with Fasciola spp by faecal examination were drenched with Fasinex 10% suspension, at a the dose rate of 12 mg/kg body weight, and were stall fed on tree fodder for the whole experimental period. The animals did not recover and were again re-drenched twice at an interval of 35 and 21 days at the same dose rate. Even after the 3rd drenching, the animals were still found to be suffering from Fasciolosis. On slaughter, adult flukes were recovered from their livers. The reasons for the inefficiency of Triclabendazole in buffaloes are not understood. Until further research is carried out it is suggested that the drug should not be recommended for the treatment of Fasciolosis in buffaloes.

Efficacy of Triclabendazole against Fasciolosis in buffaloes

Mahato SN and K Rai (1992). Efficacy of Triclabendazole against Fasciolosis in buffaloes. *Veterinary Review,* **7**(1):17-20

An experiment was conducted to evaluate the efficacy of Triclabendazole against *Fasciola gigantica* in naturally infected buffaloes. The results indicated that the drug was not effective against *F. gigantica* infection in buffaloes at the dose rate of 12 mg/kg body weight gain orally. When the dose rate was increased to 24 mg/kg body weight, the drug was found to 100 percent effective. Although no clinical evidence of drug associated toxicity was noticed in the treated animals, it is not advisable to recommend the dose rate of 24 mg/kg body weight for the treatment of Fasciolosis in buffaloes until its pharmacokinetics and toxicological aspects are further investigated.

Prevalence and treatment of Fasciolosis in cattle and buffaloes in Dhankuta district

Shrestha EK, RP Thakur, IP Dhakal and SN Mahato (1992). Prevalence and treatment of Fasciolosis in cattle and buffaloes in Dhankuta district. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Dhankuta, Nepal, **7**(2)**:**47-49

The prevalence of Fasciolosis in cattle and buffalo was studied in the lower hills (300-900 m) in Dhankuta district. The prevalence rates ranged from 15.4 to 31.7% in cattle and 20 to 87% in buffaloes depending on the age groups of the animals and ecological conditions of the area; the higher prevalence rates were recorded in older animals and in areas which were ecologically suitable for snail habitats, the efficacy of Triclabendazole against natural infections with *Fasciola gigantica* was evaluated in a field study using 84 buffaloes and 54 cattle. The efficacy was measured on the basis of reduction in eggs/gram of faeces. The findings of the study showed 38 and 100% efficacy of the drug against Fasciolosis in buffaloes and cattle respectively at the dose rate of 12 mg/kg body weight. The dose rate of 24 mg/kg was found to be 100% effective in buffaloes. In all the dose rates no evidence of drug associated or side effects were noticed clinically.

Incidence of Liver fluke, Subclinical Mastitis and Brucellosis in adult cows and buffaloes

Dhakal IP and MD Salman (1992). Incidence of Liver fluke, Subclinical Mastitis and Brucellosis in adult cows and buffaloes. *Journal of Institute of Agricultural and Animal Science (IAAS*), Rampur, Chitawan, **13:**109-113

An investigation was conducted during 1991-92 to find out the prevalence of Liver fluke, subclinical mastitis and brucellosis in Hariyana cows and Murrah buffaloes stationed at the livestock farm of Institute of Agriculture and Animal Science, Rampur. Out of 19 cows and 40 buffaloes examined 31.57% and 37.5% were affected with Liver fluke; 31.57% and 40% were infected with subclinical mastitis and 15.78% and 17.5% were suffered with brucellosis, respectively. Highest number of cows and buffaloes were affected with brucellosis and mastitis. Murrah buffaloes were found to be infected by liver fluke, subclinical mastitis and brucellosis in younger age than Hariyana cows.

The effect of Fasciolosis on some biochemical parameters in indigenous cattle and buffaloes in Dhankuta district of east Nepal

Bhattarai PC, IP Dhakal and DB Subba (1993). The effect of Fasciolosis on some biochemical parameters in indigenous cattle and buffaloes in Dhankuta district of east Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **8**(2)**:**63-65

A study was conducted to identify the effect of Fasciolosis on the level of some biochemical parameters in the blood serum of cattle and buffaloes. The results showed that the Fasciola infection in cattle and buffaloes significantly ($P<0.05$) decreased the levels of total serum protein, serum albumin and serum copper and increased the levels of serum globulin. However, the effect of Fasciolosis on the serum levels of calcium, magnesium and inorganic phosphorus was insignificant.

Prevalence of flukes in cattle and buffaloes in Surkhet district

Parajuli B (1993). Prevalence of flukes in cattle and buffaloes in Surkhet district. *Proceedings of the 4th National Veterinary Conference of Nepal Veterinary Association,* 17-19 Nov, 1992, **21-23:** 72-75

The prevalence of Fasciola and Paramphistome infestations in cattle and buffaloes in a mid hill village of Surkhet district was studied. Out of 185 cattle and 37 buffaloes examined, 60.5% of cattle and 83.8% of buffaloes were found to be positive for flukes on faecal examination. In cattle, prevalence of Fasciolosis and Paramphistomiasis were 42.2 and 25.4%, respectively, whereas those for buffaloes were 56.8 and 35.1% ,respectively.

Relationship between snail population and Liver fluke incidence in ruminants at Rampur, Chitawan

Singh DK and SK Sah (1994). Relationship between snail population and liver fluke incidence in ruminants at Rampur. Chitawan, *Journal of Institute of Agriculture and Animal Science (IAAS),* Research Reports (1992-93), Rampur, Chitawan, pp 137-142

A survey was conducted in the low lands of the livestock farm of IAAS, Rampur, Chitawan, during 1992/93 to investigate the relationship between snail population and liver fluke infestation in ruminants. The liver fluke infestation was 48.57, 28.57, 25 and 21.28% in buffaloes, cattle, sheep and goats respectively. Higher infection rate of liver fluke was observed during September (50%) followed by October (43.75%) and January (35%). The snail population was negatively associated to rainfall, the highest population being in February and March (22 snails/13m^2). None of the metrological factors had significant positive correlation with the incidence of liver fluke in different species of animals. Also, there was no significant negative correlation between liver fluke infestation and snail population.

Prevalence of Fasciolosis in farm animals in Far Western Development Region

Shrestha SP (1996). Prevalence of Fasciolosis in farm animals in Far Western Development Region. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, 7-9 May, 1996, pp 223-226

The prevalence rate of Fasciolosis both in large and small ruminants of Kailali, Dadeldhura, Bajura, Achham and Baitadi districts of far western region of Nepal were studied. Total faecal samples of 1994, 1001 and 1166 from cattle, buffalo and sheep and goats were examined for Fasciola ova of which 656, 460 and 411 were positive, respectively. The prevalence of the disease was 47, 46 and 35% in cattle, buffalo and sheep and goats, respectively. Prevalence of

Fasciolosis in large ruminants is higher in comparison to small ruminants due to managemental practices.

Prevalence of Fasciolosis and efficacy of various anthelmentics in buffaloes of rural areas of Kathmandu district

Ghimire NP and NPS Karki (1996). Prevalence of Fasciolosis and efficacy of various anthelmentics in buffaloes of rural Kathmandu. *Proceedings of the 5th National veterinary Conference*, Nepal, 11-13 Sep, **24:**108-111

Coprological examination revealed a high prevalence of Fasciolosis in the adult buffalo population of rice belt area (82-94%) of Nanglebhare and Lapsiphedi VDCs of Kathmandu district. An evaluation showed that the efficacy of available anthelmintics was in the order of Rafoxamide (67%), Oxyclozanide (65%), Triclabendazole (52%) and Abendazole (48%) against Fasciolosis in buffaloes.

Strategic drenching against Fasciolosis in cattle in the western hills of Nepal

Shrestha HK and HD Joshi (1997). Strategic drenching against Fasciolosis in cattle in the western hills of Nepal. *Bulletin of Veterinary Science and Animal Husbandry*, **25:**27-36

Fasciolosis is the most important parasitic diseases of cattle and buffaloes causing heavy economic losses in Nepal. More than 50% prevalence of the disease has been reported in cattle and buffaloes in different parts of the country. Under Nepalese condition, the major risk period of the disease is between September to February. A study was carried out to evaluate the effectiveness of a strategic drenching against Fasciolosis in cattle in controlling the disease in the western hills of Nepal. Thirty Fasciola infected cattle in each of the 4 villages (2 in the mid and 2 in the low hills) were randomly divided into 2 groups. Animals in the treatment group were drenched with 2.5% Albendazole suspension and 12 mg/kg body weight (110-130 ml/cattle) once in November and 2nd time in February, and the animals in the other group were left untreated. Faecal samples were collected at monthly intervals and were examined by standard sedimentation method for the presence of Fasciola eggs. The experimental animals were also scored for their body condition before and 3 weeks after each drenching. The strategic drenching reduced the overall infection in treated animals. In the mid hills, the strategic drenching was very effective in controlling the infection in cattle for whole year. However, in the low hills, it was not equally effective in controlling the infection as in the mid hills. The likely reason for this could be difference in the feeding management influencing the severity and frequency of the infection in the 2 altitudes. The effect of strategic drenching on the body condition of cattle was significant only in the low hills for Feb drenching. Farmers' response to the strategic drenching, in general, was good with some improvement in body condition and milk production. Study on economic benefits by strategic drenching of cattle in different agro-ecological zones is the further area of research.

Verification of strategic drenching programme against Fasciolosis in buffaloes under stall fed management system in the low and mid hills of Nepal

Gautam DC, RK Kadariya and DP Rasali (1997). Verification of strategic drenching programme against Fasciolosis in buffaloes under stall fed management system in the low and mid hills of Nepal. *Working Paper N. 97/40,* Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

A total of 125 indigenous buffaloes were selected from 4 sites in 3 districts of the western hills of Nepal known to be Fasciola endemic region during 1993. About 30 animals positive for Fasciolosis were selected from each site randomly comprising 15 in treatment group and 15 in

control group. Animals in the treatment group were drenched with Albendazole 2.5% w/v in the month of February and faecal samples from all the animals both in control and treatment groups were examined at the interval of 30 days by standard sedimentation method. Body conditions of the individual animals were measured before and after drenching. The prevalence of Fasciolosis after the February drenching was reduced to as low as 13% in the treatment group when compared with control group where prevalence rate was 49% and this difference was highly significant (P=0.0002). February drenching reduced the Fasciola prevalence rate considerably for about 5 months. The body condition of the animals was significantly different between the groups (P=0.000), whereas the body condition of the animals between the sites were not significantly different (P=0.082). October drenching showed significant differences both in prevalence rate (P=0.006) as well as body condition of individual animal (P=0.006). February drenching would help for the improvement in the production level in buffaloes as it was able to keep animals free of infestation for an extended period and also coincides with the feed scarcity period and late lactation stage of buffaloes. However, a 2nd drenching at the end of October or November would be necessary for effective control of Fasciolosis in the buffaloes population managed in the farmers' condition. But to control Fasciolosis from highly endemic areas perhaps more than 2 drenching schedule/animal/year might be useful.

February drenching against Fasciolosis and its effect on body condition of buffaloes in the western hills

Gautam DC, SC Ghimire, RK Kadariya and DP Rasali (1997). February drenching against Fasciolosis and its effect on body condition of buffaloes in the western hills. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 24-25 Sept, 1996, pp 78-84

A total of 95 indigenous buffaloes were selected in the year 1993 for 3 villages in 3 districts of the western hills known to be Fasciola endemic region. At least 30 animals positive for Fasciola eggs in faeces were selected randomly from each site comprising at least 15 animals each in treatment and control group. Animals in the treatment group were drenched with Albendazole 2.5% w/v in the month of February, and faecal samples from all the animals both in control and treatment groups were examined at an interval of 30 days by standard sedimentation method. Body condition of individual animal was scored before and after drenching. The prevalence of Fasciolosis after February drenching was reduced to as low as 4% in the treated group when compared with control group where the prevalence was 49%. This difference was highly significant (P=0.000). The prevalence of Fasciolosis remained low in treated animals for more than 6 months. The body condition score of animals was significantly different between the groups one and half month (P=0.000) and 8 months (P=0.000) post drenching, whereas the condition scores of animals across the sites were significantly different only 8 months post drenching (P=0.000) but not one and a half months post drenching (P=0.082). February drenching would help for the improvement in the production level in buffaloes as it was able keep animals free of infestation for an extended period and also coincides with the feed scarcity period and late lactation stage of buffaloes. However, 2nd drenching at the end of October or November would be necessary for effective control of Fasciolosis in the buffalo population managed in the farmers' condition. However, some modification and further investigation is required in the proposed control strategy for some specific locations of the mid hills.

Verification of strategic drenching against Fasciolosis in cattle in western hills of Nepal

Shrestha HK and HD Joshi (1998). Verification of strategic drenching against Fasciolosis in cattle in western hills of Nepal. *Working Paper N. 98/15*, Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

Fasciolosis is the most important parasitic disease of cattle and buffaloes causing heavy economic losses in Nepal. More than 50% prevalence of the disease has been reported in cattle and buffaloes in different parts of the country. Under Nepalese condition, the major risk period of the disease is between Septebmer - February. A study was carried out to evaluate the effectiveness of a strategic drenching against Fasciolosis in cattle in controlling the disease in the western hills of Nepal. Thirty Fasciola infected cows in each of the 4 villages (Pakuwa in Parbat district, and Kundule in Baglung district in the low hills) were randomly divided into 2 groups. Animals in the treatment group were drenched with 2.5% Albendazole suspension at 12 mg/kg body weight (110-130 ml/cow) once in November and 2nd time in February, and the animals in the other group were left untreated. Faecal samples were collected at monthly intervals, and were examined by standard sedimentation method for the presence of Fasciola eggs. The experimental animals were also scored for their body condition before and 3 weeks after each drenching. The drenching schedule was found to reduce the overall infection rate in treated animals. In the mid hills, the strategic drenching was very effective in controlling the infection in cattle for the whole year. However, in the low hills, it was not equally effective in controlling the infection as in the mid hills. The likely reason for this could be the difference in the feeding management influencing the severity and frequency of the infection in the 2 altitudes. The effect of strategic drenching on the body condition of cattle was significant only in the low hills for February drenching. Farmers' response to the strategic drenching, in general, was good with some improvement in body condition and milk production.

Prevalence of Paramphistomosis in cattle in the Koshi Zone of Nepal

Mahato SN and K Rai (1992). Prevalence of Paramphistomosis in cattle in the Koshi Zone of Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **7**(2):63-64

Prevalence of Paramphistomosis in cattle of 4 VDCs located in Terai and 1 VDC in the hills was evaluated. The overall prevalence rates were found to be 32.5% in the Terai and 22.2% in the hills. The highest prevalence rate was recorded in Letang VDC which might be a reflection of the wide spread permanent snail habitats due to the year round irrigation facilities in the area.

Prevalence of gastro intestinal Helminthic infections in ruminants in Dhankuta district

Thakuri KC and SN Mahato (1990). Prevalence of gastro intestinal Helminthic infections in ruminants in Dhankuta district. *Proceedings of the 2nd National Workshop on Livestock and Fisheries in Nepal, Khumaltar, Lalitpur,* 11-16 March, 1990, pp 120-125

The seasonal prevalence of Fasciola, Paramphistomes, Strongylids, Strongyloides, Trichuris and Moniezia in cattle, buffalo and goats in Dhankuta district was determined between August 1985 and 1987. The method of examination was faecal egg counts using differential flOatation. In cattle, the highest prevalence (59%) was recorded in January for Fasciola followed by Strongylids (20%) in September, Paramphistomes (20%) in August, Strongyloides (6%) in July and August, and Trichuris (9%) in June and July. The EPG ranged up to 3200 for Fasciola, 900 for Strongylids, 700 for Paramphistomes and 100 for Trichuris. Similarly, for buffaloes the highest prevalence of Fasciola was recorded in Jan (63%), Paramphistomes (17%) in July, Strongylids (11%) in Aug, Trichuris 99%) in June, July and Moniezea 12% in July. The EPG values ranged up to 2300 for Fasciola, 600 for Paramphistomes, 900 for Strongylids, 700 for Trichuris and 900 for

Moniezia. In goats, the prevalence of strongylids was highest (67%) in Sep whereas the prevalence of Strongyloides, Fasciola, Trichuris and Moniezia reached peak levels of 30, 23, and 10% respectively. The maximum values of EPG were 1300 for Fasciola, 300 for Paramphistomes, 2300 for Strongylids, 1100 for Strongyloides, 500 for Trichuris and 500 for Moniezia.

Occurrence of Helminth parasites in ruminants of Kathmandu valley

Shrestha SP (1996). Occurrence of Helminth parasites in ruminants of Kathmandu valley. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, 7-9 May, 1996, pp 215-222

The study on the occurrence of Helminth parasites in ruminants of Kathmandu valley shows that prevalence rate is more than 75% both in large and small ruminants. For the 1st year the positive percentage of Helminth parasites were 82.5, 83.89 and 75.91 respectively for buffaloes, small ruminants and cattle. And for the 2nd year the positive case in percentage were 82.26, 77.22 and 75.07 respectively for buffaloes, small ruminants and cattle. Paramphistomes infestation was higher in cattle in comparison to Fasciola whereas in case of buffaloes it was opposite.

Prevalence of Helminth parasites in lactating cattle in Madhyapur Thimi Municipality of Bhaktapur.

Sapkota RC, S Shrestha, S Bhusyal, S Adhikary and S Paudel (2006). Prevalence of Helminth parasites in lactating cattle in Madhyapur Thimi Municipality of Bhaktapur. *Green Field Journal of Himalayan College of Agricultural Sciences and Technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **4**(2)**:**58-64

A study was conducted in Dec 2006 to determine the prevalence of helminthes in lactating cattle. The faecal examination was done by sedimentation as well as flOatation methods. The examination was conducted at parasitological Lab of Himalayan College of Agricultural Sciences and Technology. The study showed the Helminth prevalence of 26%, among which Paramphistomum, Strongyle and Fasciola were common. The study revealed that 11.76% of infected animals had double infection (i.e. Fasciola and Paramphistomum: Paramphistomum and Strongyle). The order of Helminth infection observed in this study was Paramphistomum > Strongyle > Fasciola > Fasciola and Paramphistomum = Paramphistomum and Strongyle.

Intestinal Helminth parasites of buffaloes brought to Kathmandu for slaughtering

Mukhia G, R Gupta and GR Pant (2007). Intestinal Helminth parasites of buffaloes brought to Kathmandu for slaughtering. *Nepal Journal of Science and Technology,* Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, **8:***89-92*

The present study was carried out to find out the prevalence of intestinal helminthes in 262 buffaloes during July to August 2006. Both sedimentation and flOatation techniques were used for the detection of Helminth ova. Helminths belonging to 27 species were observed. These were of Trematode 10 species belonging to 8 genera, nematode 15 species belonging to 12 genera and Cestode 2 species with one genus. The overall prevalence of helminthes was found to be 83.96%. The prevalence of Trematode, Cestode and of nematode was 90.9%, 14.54% and 49.09% respectively. Trematodes, like *Dicrocoelium lanceatum* and *Ornothobilharzia turkestanicum* were reported for the first time from Nepal from buffaloes. Although, *Skrjiabinema ovis*, *Fischoederius elongates*, *Chabertia ovina*, *dactyocaulus spp* and *Capillaria spp* have been reported from various hosts such as sheep, cattle and goat but, they were identified here for the first time from buffaloes. Mixed infectious were observed among 140 positive samples. Among Trematodes, *Dicrocoelium lanceatum* and *Fasciola hepatica* were found in large number. Among Cestodes, *Moniezia benedeni* and among nematodes *Toxocara vitulorum* were found infecting in buffaloes.

Strategic Piperazine drenching against Toxocara vitulorum infection of buffalo calves

Joshi BR and SC Ghimire (1993-95). Strategic Piperazine drenching against *Toxocara vitulorum* infection of buffalo calves. *Proceedings of the 4th National Veterinary Conference of Nepal Veterinary Association*, 17-19 Nov, 1992, **21-23:**91-96

Ascariasis was found to be a major disease affecting buffalo calves early in their life and was found to be prevalent in the mid hills of Nepal. A strategic control programme with Piperazine for Ascariasis of buffalo calves was tested and its efficacy evaluated. The control programme reduced the infection rate in treated calves, and a significant difference in growth rate was observed among the calves of treated and untreated groups at 45 and 75 days of age. Strategic drenching of buffalo calves with Piperazine at the recommended dose rate of 200 mg/kg body weight at 15, 45 and 75 days of age are recommended to check the losses due to this disease.

Verification of strategic drenching against Ascariasis in cattle calves in the mid hills of Nepal

Joshi HD, HK Shrestha and BR Joshi (1997). Verification of strategic drenching against Ascariasis in cattle calves in the mid hills of Nepal. *Working Paper N. 97/32*, Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

A study was conducted to verify the strategic drenching with Pyrental pamOate and piperazine against Ascariasis in cattle calves in the mid hills of Nepal during July 1994 to June 1995. The prevalence rate of *Toxocara vitulorum* was found to be 43% in cow calves. *Pyrental pamOate* drenching at 15 days of age was found to be 100% effective whereas piperazine drenching at recommended dose rate was effective in 87% of Ascariasis cases in calves. A significant difference in growth rate was observed among the calves of Pyrental pamOate treated group and farmers management group. Strategic drenching of calves with Pyrental pamOate at recommended dose rate of 250 mg at 15 days of age is recommended to check the losses due to Ascariasis.

A comparative study of antibiotics, mineral mixture and anthelmintics feeding on the growth and Endoparasitic load of the buffalo calves

Nepali DB and DK Singh (1993). A comparative study of antibiotics, mineral mixture and anthelmintics feeding on the growth and Endoparasitic load of the buffalo calves. *Journal of Institute of Agriculture and Animal Science (IAAS)*, Research Reports (1985-1991), Rampur, Chitawan, pp 390-394

An investigation was carried out for a period of 4 months to ascertain and compare the effectiveness of antibiotics, mineral mixture and anthelmintics feeding on the growth and Endoparasitic load of the buffalo calves. The overall mean daily gain was highest (353±66.46 g) in calves that were provided with a combination of all three items mentioned above (TR1). A daily gain of 333.5±86.87g was observed in TR2 group (anthelmintics + antibiotic), 295.8±38.75 g for TR3 (anthelmintics + mineral block) and the least (287.5±127.69g) was observed in Tr4 (control) group. Statistical analysis showed no significant difference among these weight gains. Stool tests showed Strongyloide to be the most common species followed by Moneizie. The egg counts did not show a regular trend. Overall total egg count was highest (1450/g) in TR3 followed by TR2 (1375/g) and TR1 (17.5/g). It revealed that different drugs in combination were superior for daily weight gain of buffalo calves and controlling internal parasitic infestation than any one lacking.

Eurytrema cladorchis: an obscure parasite of ruminants in Nepal

Mahato SN (1987). *Eurytrema cladorchis*: an obscure parasite of ruminants in Nepal. *Proceedings of the 2nd National Veterinary Conference*, Nepal, **15:**67-72

Eurytrema cladorchis is a little known parasite of ruminants. It was 1st reported in China in 1965 and its existence passed almost unnoticed elsewhere until 1981 when it was reported for the 1st time in Nepal. The morphology of *Eurytrema cladorchis* is presented from the specimens from cattle and goats in the hills of eastern Nepal. The pathogenic and clinical manifestations are also reported with a brief discussion on its life cycle.

An outbreak of Stephanofilarial dermatitis in buffalo calves: A case report

Mahato SN (1992). An outbreak of Stephanofilarial dermatitis in buffalo calves: A case report. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **7**(2):67-69

An outbreak of Dermatitis in buffalo calves occurred at PAC, Dhankuta. An examination of skin scrapings revealed that *Stephanofilaria spp*, possibly *S. assamens*is was responsible for the etiology. Topical application of 0.08% aqueous solution of ivermectin for 6 days brought about a complete cure of the lesions within 3 weeks.

Occurrence of blood parasites in Banke district: A clinical study

Adhikari BN, K Karki and R Gyanwali (1997). Occurrence of blood parasites in Banke district: A clinical study. *Bulletin of Veterinary Science and Animal Husbandry*, Nepal, **25:**55-57

Blood smears from 20 animals (9 cattle, 8 buffaloes, 1 horse and 2 dogs) presented to the District Veterinary Hospital, Banke and suspected clinically for Haemoprotozoan diseases were screened for blood Protozoans. Of them, blood parasites were detected in thin blood smears of 5 animals comprising of 1 cattle, 3 buffaloes and 1 dog, Babesia, Anaplasma and Trypanosoma were detected in buffaloes, whereas only Anaplasma in a cattle and Babesia in a dog were detected. These findings confirmed the occurrence of 3 major blood Protozoans in the mid western Terai of Nepal.

Study on blood protozoan disease in cattle of eastern Terai region

Shrestha SP and UM Singh (1999). Study on blood protozoan disease in cattle of eastern Terai region. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agricultural Research Station, Lumle, Kaski, Nepal, 26-28 June, 1999, pp 123-125

Blood protozoan diseases constitute the greatest hindrance to the growth of cattle production in the Terai region of Nepal. A study was conducted to find the prevalence of protozoan diseases in the eastern Terai. Microscopic examination of blood smears were collected from 83 crossbred dairy cattle having high fever. It revealed that 11 (13.25%) positive for *Theilaria spp*, 8 (9.64%) for *Babesia spp* and 5 (6.02%) for *Anaplasma spp*.

Babesiosis in Cattle: A case Report

Ratala DR, UM Singh and P Manandhar (1990). Babesiosis in Cattle**:** A case Report. *Special issue published on the occasion of the 3rd National Veterinary Conference*, Aug 10-12, 1990, **17&18:** 35-37

A causative agent of bovine Babesiosis, *Babesia bigemina* was detected in two crossbred cattle and one calf belonging to farmers from Chabahil, Kathmandu. Clinical recovery was obtained by treating these sick animals with Berenil. Reoccurrence of the Babesiosis was not recorded during the observation period of two months.

Identification of livestock ticks in the eastern hills of Nepal

Thakuri KC, RP Thakur and K Rai (1993). Identification of livestock ticks in the eastern hills of Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **8** (2)**:**47-49

A study to identify the species of livestock ticks in the eastern hills was conducted during 1991/92. Altogether 5 genera of ticks were identified (Boophilus, Rhipicephalus, Haemaphysalis, Ixodes and Aponomma) of which Boophilus, Rhipicephalus, and Haemophysalis were the major genera found in all animal species. Among the various species, *Boophilus microplus* was the most frequent tick in cattle. The infestation rate of different species of ticks and the possibility of tick borne protozoan diseases in the area are discussed.

Epidemiological investigation of subclinical bovine mastitis in the eastern hills of Nepal

Jha VC, RP Thakur, JN Yadav and LB Rai (1993). Epidemiological investigation of subclinical bovine mastitis in the eastern hills of Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **8** (2):35-39

A study was conducted during 1991/92 in Ilam and Dhankuta districts of the eastern hills of Nepal to investigate the prevalence of subclinical mastitis (SCM) in cows and buffaloes. Milk samples from 388 apparently healthy cows and 150 buffaloes were examined using the sodium Lauryl Sulphate and Teepol Test (SLST). The SLST test positive milk samples were further subjected to total Leucocyte count, bacteriological examination and antibiotic sensitivity testing. The results of the study indicated that the prevalence rates of SCM in cows and buffaloes were 18.8 and 21.3%, respectively. The maximum prevalence rate in both species was in single quarter. The effect of lactation number on the prevalence of SCM in cows was in an increasing trend as the lactation number increased. There was no significant difference in the prevalence rate due to the effect of age or stage of lactation in both the species. Leucocyte count of SLST positive quarter milk samples revealed 90% cows and 87.5% buffalo's quarter milk samples having Leucocytes count more than 500,000/ml of milk. On bacteriological culture, the *Staphylococcus spp* (36.1%) followed by *Escherichia coli* (17.3%), *Streptococcus spp* (15.8%) were the most commonly encountered isolates. Gentamycine, Tertracycline, Chloramphenicol, Oxytetracycline and Neomycin were the most effective drugs whereas Cloxacillin, Penicillin and Ampicilin were the least effective drugs against the majority of the isolates.

Epidemiological investigation of subclinical bovine mastitis in western Chitawan of Nepal

Dhakal IP and KR Tiwari (1993). Epidemiological investigation of subclinical bovine mastitis in western Chitawan of Nepal. *Journal of Institute of Agriculture and Animal Science (IAAS*), Research Reports (1985-1991), Rampur, Chitawan, pp 427-434

An experiment was conducted at the IAAS livestock farm of Rampur, Chitawan in the year 1990/91 to determine the prevalence of subclinical mastitis in cows and buffaloes by using California Mastitis Test (CMT) and bacteriological examination. Of the 100 apparently healthy cows (30) and buffaloes (70) examined. 30% of the cows and 35.71% of the buffaloes had SCM. On quarter basis, 20.83% from cows and 23.2% from buffaloes were found to have SCM. Percentage incidence of CMT scores revealed that score 1 positive sample were found more in both species as compared to score 2 and 3. In cows, 9.23% and in buffaloes 8.1% of CMT negative samples were found culturally positive. The main organisms encountered in SCM were *Staphylococci* and *Streptococci*. In buffaloes, the rear quarters were infected more frequently that the fore quarters. CMT positive samples were found highest in the 5^{th} lactation (24.32%) in cows and in the 5^{th} and 6^{th} lactation (22% each) in buffaloes. Mastitis pathogens were found

maximum in the 4th lactation (22.5%) in cows, and in 5th lactation (21.85%) in buffaloes. In cows maximum number of animals was infected in the age group of 6-8 years whereas, in buffaloes greater incidence rate of mastitis was observed in animals between 9-10 years of age.

Influence of air Temperature and Precipitation on the incidence of clinical and environmental mastitis in the three dairies

Acharya KP (1993-95). Influence of air temperature and precipitation on the incidence of clinical and environmental mastitis in the three dairies. *Proceedings of the 4th National Veterinary Conference*, **21-23:**64-71

Influence of air temperature and precipitation on the incidence of clinical mastitis or environmental mastitis in three dairies was studied for a period of four years (1982-1985). Out of 4074 clinical mastitis cases, 2325 (57%) were environmental, 320 (7.9%) cases were contagious, and 1429 (35.1%) cases were clean. Monthly clinical mastitis infection rates and monthly environmental mastitis infection rates of dairy I was not significantly associated ($p>0.01$) with air temperature or precipitation. These rates of dairy II were significantly associated ($p<0.05$) with the weather parameters. Monthly clinical mastitis infection rates and monthly environmental mastitis infection rates of dairy III were significantly associated with the weather parameters but the association was very poor.

Prevalence of subclinical mastitis in buffaloes at drying off and post calving stages

Dhakal IP (1994). Prevalence of subclinical mastitis in buffaloes at drying off and post calving stages. *Veterinary Review* Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **9** (2) and **10** (1):18-22

This study was conducted to estimate the prevalence of subclinical mastitis among the buffalo population of Chitawan valley, Nepal at drying off (DO) and Post Calving (PC) stage. A total of 170 buffaloes and 680 quarters were examined for subclinical mastitis at DO and 134 buffaloes and 544 quarters were followed up and studied at PC stage. At DO, the frequency of individuals that showed CMT positive scores was 19.56% and in comparison to the PC stage (9.18%). In subclinical mastitis milk, Somatic Cell Counts (SCC) were significantly higher ($p<0.01$) at DO that at the PC stage. At DO period 50.44% quarters were observed to be culturally positive whereas at the PC stage 47.62% quarters were culturally positive. Staphylococci were found to be the most prevalent organisms accounting for 22.5% at DO and 17.64% of the total isolations at PC stage. It is followed by Streptococci at DO and non Coli form gram negative bacilli at PC stage. Coli form bacteria was isolated at higher percentage at PC stage (10.47%) that at DO (6.02%). Subclinical mastitis quarters were diagnosed on the basis of either SCC positive and culturally positive or CMT score greater or equal to one and culturally positive. On an animal basis, 27.35% of the animals suffered from subclinical mastitis at DO and 16.16% at PC stage. On a quarter basis, 14.85% of the quarters at DO and 10.47% at the PC stage were having SCC 3000000 cells/ml and culturally positive whereas 12.5% at DO and 5.69% at the PC stage were having CMT score 1 and above and culturally positive.

Bacterial species isolated from clinical bovine mastitis and their antibiotic sensitivity patterns

Jha VC, RP Thakur and JN Yadav (1994). Bacterial species isolated from clinical bovine mastitis and their antibiotic sensitivity patterns. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **9** (1):21-23

Ninety eight CMT positive milk samples from 18 cows and 27 buffaloes with clinical mastitis were subjected to bacteriological examination and antibiotic sensitivity test. *Staphylococcus spp*

(39.2%) followed by *E. coli* (16.7%) were the most commonly encountered bacteria. The majority of the isolates were highly sensitive to Gentamycin, Kanamycin, Neomycin, Oxytetracycline and Chloramphenicol whereas resistant to Cloxacillin and Ampicillin.

Drug selection and use of clinical mastitis in buffaloes

Dhakal IP (1996). Drug selection and use of clinical mastitis in buffaloes. *Proceedings of the 5th National Veterinary Conference*, 11-13 Sept, pp 45-56

A study was carried out at veterinary teaching hospital**,** Institute of Agriculture and Animal Science, Rampur during 1994 to 1996 to determine the prevalence rate, etiological agent, antibiogram pattern and efficacy of some potential antibiotics for the treatment of clinical mastitis in buffaloes. This study revealed that majority of the buffaloes at 1st lactation and within 3 months of lactation was affected with clinical mastitis. 47% of the quarters were positive to California Mastitis Test (CMT). Coliform (305) was the most frequently isolated organisms followed by Staphylococcus. Non coli form gram negative bacilli and Streptococcus spp. Results indicated that majority of the buffaloes were affected with clinical mastitis at summer and monsoon season in comparison of winter season. Antibiogram revealed that majority of the isolates were sensitive to Gentamycine, Chloramphenicol, Enrofloxacin, Ciproflaxacin and Cephotaxamine. However, most of the isolates were resistant to Ampicillin and Cloxacillin. Among the various drugs use in the treatment Gentamycin (Gentin), Enrofloxacin (Meriquin), Ciprofloxacin (Ciprobid) and Cephotaxamine (Taxim) were having good results against the isolates of gram positive and negative bacteria. Efficacy of the drug in the field condition revealed that Gentim injection intramammary as well as parental and Meriquin injection only by parental administration are proved to be most effective in comparison to other antibiotic preparations tested.

Study on prevalence of subclinical mastitis in Kathmandu valley

Khakural GP (1996). Study on prevalence of subclinical mastitis in Kathmandu valley. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, 7-9 May, 1996, pp 185-188

186 milk samples were collected from the cattle of Kathmandu valley for examination of mastitis. 32 (17.2%) milk samples were positive on California Mastitis Test (CMT) and 151 (81.18%) milk samples showed high percentage of Leucocyte count (>0.5 million/ml). Subclinical mastitis was observed in almost all farms from where milk samples were taken for the examinations. Bacteriological examinations of milk samples showed total 57 bacterial and fungal isolates out of which 20 isolates were *E. coli*, 6 Streoptococci, 18 Staphylococci and 10 funguses.

Prevalence of clinical mastitis in cattle and buffaloes under farmers' management systems in the western hills: A survey report

Joshi HD and HK Shrestha (1996). Prevalence of clinical mastitis in cattle and buffaloes under farmers' management systems in the western hills: A survey report. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Khumaltar, Lalitpur, 7-9 May, 1996, pp 232-240

A questionnaire survey was conducted to determine the prevalence of clinical mastitis in cattle and buffaloes in the western hills of Nepal. A total of 605 cattle and buffaloes (112 cattle and 493 buffaloes) calved between July1991 and June 1992 was recorded on the basis of clinical symptoms to determine the prevalence of bovine Clinical Mastitis (CM) in relation to associated factors. In buffaloes the prevalence of CM was found to be 17.1% in Murrah cross breeds, 8.8%

in locals and 8.3% in local cattle, There was no CM in Jersey cross cattle. The parity and lactation stage were found to be significant influencing factors for prevalence of CM in buffaloes; the prevalence of CM was highest (17.6%) during the 1st lactation and declining in the successive lactations. 80.9% of CM was recorded in the 1st month of the lactation. Considerable seasonal variation in the prevalence of CM was recorded with 75.9% of the cases found during summer (June-September) and only 5.5% in winter (December-February). Among the 85 quarters infected, 28.2% teats lost their production permanently. Increasing trend of CM was found in cattle at lower altitudes whereas in buffaloes the problem was highest (11.9%) in mid hill followed by low hills (9.5%) and high hills (8.7%). Clinical mastitis was found to be same in both stall and semi stall fed (10%) systems whereas it was found to be lower (2.2%) in extensive management systems.

Investigation on clinical mastitis in cattle and buffaloes in the western hills of Nepal

Joshi HD, BR Joshi and HK Shrestha (1997). Investigation on clinical mastitis in cattle and buffaloes in the western hills of Nepal. *Working Paper N. 97/11*, Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

Investigation on Cinical Mastitis (CM) in cows and buffaloes was conducted during 1994/95 in the western hills of Nepal to identify micro-organisms involved and to assess the efficacy of antibiotics recommended. A total of 14 animals (18 cows and 56 buffaloes) suffering from mastitis were reported by the farmers. Clinical mastitis was found in 127 teats of the animals. Milk samples from infected teats were subjected to bacteriological examination and antibiotic sensitivity test. Bacteriological examination revealed that 112 (88.2%) teat milk sample had microbial growth. of which 76 (68%) had single microbial infections and 32% had mix infections. Coliforms (25%, particularly *Klebsiella pneumonia* and *Eschurchia coli*) followed by *Strptococcus spp* (19.6%) and *Staphylococcus spp* (9.8%) were the most commonly encountered organisms. In the antibiotic sensitivity Gentamycin was found to be more (79.4%) effective than Oxytetracycline (61.8%), Cotrimoxazole (48,5%) and Ampicillin (22.5%). Whereas, Strptomycin, Cloxacillin and Penicillin were found to be least effective. Among in vitro effective antibiotics in vivo effectiveness of Gentamycine was found to be 94% followed by Tilox (87%), Oxytetracycline (86%), Floclox-L (80%), Pendistrin – sh (75%), combination of Oxytetracycline and Gentamycine(605) and Biotrim (50%). Intra mammary administration of Wokadine alone at the rate of 15 ml of 1% solution/teat once daily for 4 days was found to be effective for the treatment of mastitis caused by yeast in 3 animals. Higher incidence of CM was found in the 1st lactation of animals (64.4%) particularly during monsoon (July-Sep) season (71%). Significantly higher ($P<0.001$) incidence of CM was found, during the 1st week of 1st calving (78.1%), animal without having suckling calf (69%), and animal raised under stall fed management system (86.3%) than the 2nd week above post calving, animal with suckling calf (31%) and animal raised under semi stall and extensive management systems (11and 3%), respectively. In average 1.482 liter milk loss/day/animal was found during the infection period and 755 ml of milk recovery (in an average) was found one week after the treatment.

Factors influencing clinical mastitis in cow and buffaloes in the western mid hills of Nepal

Joshi HD, BR Joshi and HK Shrestha (1997). Factors influencing clinical mastitis in cows and buffaloes in the western mid hills of Nepal. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 24-25 Sep, 1996, pp 85-92

A study on Clinical Mastitis (CM) in cows and buffaloes was conducted during 1994/95 in the western mid hills of Nepal to identify the micro organism involved and to select in vitro effective antibiotics for the treatment. A total of 74 animals (18 cows and 56 buffaloes) affected

by mastitis were reported by the farmers. CM was found in 127 teats of the animals. Milk samples from infected teats were subjected to bacteriological examination and a direct antibiotic sensitivity test. Bacteriological examination revealed that 112 (88.2%) teat milk samples had microbial growth, of which 76 (68%) had monomicrobial infections and 32% had mixed infections. Among monomicrobial infections Coliforms (particularly) *Klebsiella pneumoniae* and *Escherichia coli* 25%) followed by *Streptococus spp* (19.6%) and *Staphylococcus spp* (9.8%) were the most commonly encountered organisms. In the direct antibiotic sensitivity test Gentamycin was found to be more effective (79.4%) than Oxytetracyclin (62%), Cotrimoxazole (48.5%) and Ampicillin (22.5%). Whereas Streptomycin, Cloxacillin and Penicillin were found to be least effective in the tested milk samples. Higher incidence of CM was found in the first lactation of animals (64.4%) particularly during the monsoon (July-September) season (715). A significantly higher (P<0.001) incidence of CM was found during the first week after calving (78.1%), in animals without a suckling calf (69%), and in animals raised under stall fed management system (86.3%) than during the second and later weeks post calving, in animal with suckling calf (315) and in animals raised under semi stall and extensive management system (11% and 3%, respectively).

Prevalence of sub-clinical mastitis in cows and buffaloes in the western hills of Nepal

Joshi HD and BR Joshi (1997). Prevalence of sub-clinical mastitis in cows and buffaloes in the western hills of Nepal. *Veterinary Review*, Animal Health Research Division, Tripureswor, Kathmandu, Nepal, **12** (1):1-6

Milk samples from 85 apparently healthy cows and 363 apparently buffaloes were tested using the Sodium Lauryl Sulphate Test (SLS) and Whiteside test in the field. The test positive milk samples were subjected to Leucocyte count and bacteriological examination. The results of investigation showed that the prevalence of SCM in cows and buffaloes were 30.6% and 32.2%, respectively. Higher prevalence of SCM was recorded in cows and buffaloes (46% and 39.6%, respectively) in the mid hill area than the low and high hills. Similarly, stall -fed animals were found to be more affected than the free grazing animals. Likewise, the prevalence of SCM in cows and buffaloes was in an increasing trend in the successive lactations. The prevalence of SCM was found significantly higher in cows and buffaloes without a suckling calf than those with calves. Infection of one teat was found to be common in both species. Among the bacteriologically positive samples, single bacterial species was found in 79.6% of samples, while mixed bacterial growth was recorded in 20.3 % of samples. Among the isolated bacteria Staphylococcus *aureus* was found in highest proportion followed by mixed infection of *Streptococcus spp* with other organism. Among the SCM affected animals, 15% cows and 3.4 % buffaloes developed clinical mastitis in their subsequent lactation.

Epidemiological investigation on clinical mastitis in cattle and buffaloes in the western hills of Nepal

Joshi HD, BR Joshi and HK Shrestha (1998). Epidemiological investigation on clinical mastitis in cattle and buffaloes in the western hills of Nepal. *Veterinary Review*, Khumaltar, Lalitpur, Nepal, **13:** 12-15

Investigation on Clinical Mastitis (CM) in cows and buffaloes were conducted during 1994/95 in the western hills of Nepal to identify micro-organism involved and to assess the efficacy of antibiotics recommended. A total of 74 animals (18 cows and 56 buffaloes) suffering from mastitis were reported by the farmers. Clinical mastitis was found in 127 teats of the animals. Milk samples from infected teats were subjected to bacteriological examination and antibiotic sensitivity test. Bacteriological examination revealed that 112 (88.2%) teat milk sample had microbial growth, of which 76 (68%) and single microbial infections and 32% had mix

infections, Coliforms (25%, particularly *Klebsiella pneumoniae* and *Escherchia coli*) followed by *Streptococcus spp* (19.6) and *Staphylococcus spp* (9.8%) were most commonly encountered organisms. In the antibiotic sensitivity Gentamycin was found to be more effective (79.4%) than Oxytetracyclin (61.8%), Cotrimoxazole (48.5%) and Ampicilin (22.5%) and Streptomycin, Cloxacillin and Penicillin were found to be least effective. Higher incidence of CM was found in the first lactation of animals (64.4%) particularly during monsoon (July-Sep) season (71%), significantly higher (P<0.001) incidence of CM was found, during the first week of first calving (78.1%), animal without having a suckling calf (69%), and animal raised under stall fed management system (86.35).

Efficacy of herbal preparation (Mastilep) for the prevention of bovine mastitis

Sah KD and IP Dhakal (1998-1999). Efficacy of herbal preparation (Mastilep) for the prevention of bovine mastitis. *Journal of the Institute of Agriculture and Animal Science (IAAS),* Rampur, Chitawan, **19-20:**119-124

A study was conducted at Veterinary hospital of IAAS, Rampur, Chitawan during 1997 to determine the prevalence rate, etiological agents, antibiogram pattern of Subclinical Mastitis (SCM) and Clinical Mastitis (CM) as well as to evaluate the efficacy of Mastilep for the prevention of SCM and CM in bovine population of western Chitawan, Nepal. A total of 106 quarters milk samples of 29 buffaloes and 23 cattle collected from both apparently healthy and clinical mastitis animals were found to be positive for either SCM or CM. The results of this study indicated that the prevalence rate of bovine SCM (67%) was much more than that of CM (33%). Bacteriological examination showed that Coli form (305) was the most frequently isolated organism followed by *Staphylococcus spp* (255); non coli form gram negative bacilli (17%) and *Streptococcus spp* (15%). Antibiogram revealed that majority of the isolates were sensitive to Ciprofloxacin (87%), Gentamycin (78%) and Chloramphenicol (62%) and resistant to Erythromycin (35%) and Ampicillin (285). Efficacy of the herbal drug in the field condition revealed that Mastilep is a good herbal gel topical mammary preparation for the control of SCM. Similarly, a broad spectrum parenteral antibiotic preparation plus Mastilep was found good for the prevention of CM. It prevented 80% of the SCM cases and almost 67% of the CM cases in this study. The efficacy was greater in first time cases which were not treated by any previous therapy. Mastilep was also found beneficial in restoring milk yield.

Antimicrobial Sensitivity of Microorganisms Isolated from Buffaloes with Subclinical Mastitis

Dhakal IP and MP Kapur (1989). Antimicrobial Sensitivity of Microorganisms Isolated from Buffaloes with Subclinical Mastitis, Journal of Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan, **10**: 33-39

A study was carried out to find out the in vitro chemotherapeutic sensitivity of 10 commonly used antimicrobial against *Staphylococcus aureus, Staphylococcus epidermidis, Streptococcus dysgalactiae, Streptococcus bovis* and *Escherichia coli* isolated from 50 apparently healthy buffaloes. Of the 16 *Staphylococcus aureus* isolates tested 100% were sensitive to Furadantin, 94% to Oxytetracyclin, Chloramphenicol, Cloxacillin, Neomycin and Oleandomycin followed by Streptomycin (56%), Penicillin (44%), Ampicillin (31%) and Polymixin B (19%). Amongst the 40 *Staphylococcus epidermidis* strains, 100% were sensitive to Neomycin, whereas 98, 95, 90, 73, 63, 63, 55 and 43% were sensitive to Oleandomycin, Cloxacillin, Chloramphenicol, Oxytetracycline, Furadantin, Penicillin, Polymixin B, Ampicillin and Streptomycin, respectively. All the seven isolates of *Streptococcus dysgalactiae* were sensitive to Oxytetracycline, Chloramphenicol, Cloxacillin, Ampicillin and Oleandomycin, whereas 72, 57 and 57% were sensitive to Neomycin, Furadantin and Polymixin B, respectively. Of the 26 *Streptococcus bovis*

strains, 84, 80, 73, 62, 54, 46, 27 and 19% were sensitive to Cloxacillin, Ampicillin, Oxytetracycline, Chloramphenicol, Oleandomycin, Penicillin, Neomycin, Furadantin and Streptomycin, respectively. Both the isolates of *E. coli* were found sensitive to Furadantin, Streptomycin, Oxytetracycline, Chloramphenicol, Ampicillin, Polymixin B and Neomycin but showed resistant to Penicillin, Cloxacillin and Oleandomycin.

Antimicrobial sensitivity pattern of micro-organisms isolated from bovine mastitis in the western hills of Nepal

Joshi HD, BR Joshi and HK Shrestha (1999). Antimicrobial sensitivity pattern of micro-organisms isolated from bovine mastitis in the western hills of Nepal. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, 26-28 June, 1990, pp 142-147

Micro-organisms isolated from the clinical and sub clinical cases of bovine mastitis from hills of western Nepal during 1996/97, were tested for their in-vitro antimicrobial sensitivity by rotary disc diffusion technique. The in-vitro antimicrobial sensitivity pattern of the micro-organisms showed that Chloramphenicol, Gentamycin, Neomycin and Cephalexin were most effective antibiotics against most of the isolated micro–organisms whereas, penicillin were highly effective against gram positive micro-organisms only. The moderately effective were Tetracyclin, Cotramaxizole, Streptomycin and Oxytetracyclin. These findings will be helpful for the clinicians to decide on the selection of antibiotics for the treatment of bovine mastitis cases.

A review of indirect rapid test for screening sub clinical mastitis suitable for field condition

Joshi HD and BR Joshi (2000). A review of indirect rapid test for screening sub clinical mastitis suitable for field condition. *Review Paper N 2000/1*. Lumle Regional Agricultural Research Centre, Lumle, Kaski, Nepal

The available literatures on screening tests for Sub Clinical Mastitis (SCM) were reviewed for the selection of a suitable test which could be used under field conditions in Nepal. The findings of the other workers were collected to understand study and develop a suitable test for Nepalese conditions. Results and opinion of different workers about these tests were found to be varied. Among the reviewed test methods Bromothymol Blue (BTB) filter paper test, White Side Test (WST) and Sodium Lauryl Sulphate Test (SLST) were found to be handy and could be selected for development and verification.

Sensitivity, specificity and predictive values of indirect rapid tests for diagnosis of sub clinical mastitis

Joshi HD and BR Joshi (2000). Sensitivity, specificity and predictive values of indirect rapid tests for diagnosis of sub clinical mastitis. *Seminar Paper N. 2000/24*, Agriculture Research Station, Lumle, Kaski, Nepal

A study was conducted during 1999 to identify most suitable rapid field test for the diagnosis of sub clinical mastitis in cows and buffaloes in mid hills of Nepal. A total of 715 teat milk samples from 200 apparently healthy animals, consisting of 16 cows and 184 buffaloes were subjected to screening sub clinical mastitis my Mastrip test, Modified Whiteside Test (MWST) and Sodium Lauryl Sulphate Test (SLST). The sensitivity, specificity and predictive values of these tests were compared with combined standard test consisting of cell count and bacteriological examination. SLST and MWST were found to be superior to Mastrip test. The specificity of MWST, SLST and Mastrip test were found to be 92.3, 91.6 and 85.8%, respectively, whereas, the sensitivity of SLST, MWST and Mastrip test was 92.3, 83.6 and 51.5% ,respectively. The

predictive values of MWS test and SLS test were of similar type (88.7%). Though MWST reagent was easier to prepare that SLST reagent, both SLS and MWS tests were compared to standard test. Either MWST or SLST could be used for screening sub clinical mastitis in cows and buffaloes under the field conditions of Nepal.

Preliminary study on the effect of post milking teat dipping on incidence of mastitis in high yielding dairy cows at Kundhar village, Pokhara

Joshi BR and HD Joshi (2001). Preliminary study on the effect of post milking teat dipping on incidence of mastitis in high yielding dairy cows at Kundhar village, Pokhara. *Seminar Paper N. 01/5,* Agricultural Research Station, Lumle, Kaski, Nepal

Mastitis is an economically important production disease of lactating animals and is even more important in high yielding dairy animals. In Nepal, the clinical form of mastitis is being treated with antibiotics but not always with success, however, there has not been any approach for the control of the equally important sub clinical form of disease. The present paper reports the findings on teat dipping approach for the control of mastitis in dairy cows. The programme was implemented for 9 months on farmers' animals at Kundhar village of Kaski, district, Nepal. The results of the showed that regular teat dipping in Povidine Iodine reduced the incidence of sub clinical mastitis by 70% from the initial infection rate. Similarly, there was a significant reduction on the incidence of clinical mastitis recorded during the teat dipping year as compared to the previous year. These findings suggest the useful role of teat dips in controlling mastitis of dairy animals. The findings need to be verified further with larger sample size so that the technology could be further evaluated and disseminated for field use.

Clinical mastitis in different breeds of cattle and buffaloes at Chitawan, Nepal

Subedi K and IP Dhakal (2002). Clinical mastitis in different breeds of cattle and buffaloes at Chitawan, Nepal. *Journal of the Institute of Agriculture and Animal Science (IAAS),* Rampur, Chitawan, **23:**65-69

Two hundred fifty cattle with 620 quarters and 212 buffaloes with 493 quarters were examined for Clinical Mastitis (CM). Coliform was the most frequently isolated organism followed by Staphylococcus in all breeds of cattle and buffaloes. In cattle, 56% animal with 35% quarters and 44% buffaloes with 27% quarters were found positive for CM> Holstein Friesian cross (65%) and local buffaloes (52%) were found most susceptible with CM among breeds of cattle and buffaloes. The affection with CM was common at monsoon season followed by summer in breeds of cattle. Similarly, the affection with CM was found common t monsoon season followed by winter season in breeds of buffaloes. This study revealed that most of the breeds of cattle were found susceptible to CM at 2nd calving while breeds of buffaloes were affected at 1st calving. Affection with CM was the highest within first month of lactation in both of the species. Antibiogram revealed that majority of the isolates were most sensitive to Gentamycin followed by Chloramphenicol, Tetracyclin and Ampicilin.

Response of teat dipping on incidence of mastitis in high yielding dairy cows

Joshi BR (2002). Response of teat dipping on incidence of mastitis in high yielding dairy cows. *Seminar Paper N. 2002/13*, Agriculture Research Station, Lumle, Kaski, Nepal

The present paper reports the findings on teat dipping approach for the control of mastitis in dairy cows. The evaluation was carried out for 9 months on 42 lactating cows of Kundhar village for the 1st year and then on 76 lactating cows from three villages (Kundhar, Batulechaur and Hemja) and livestock farm of Agriculture Research Station, Lumle, Kaski, Nepal for 2nd year. The results of the study showed that, with the regular use of teat dips with Povidine Iodine for

10 months, the incidence of sub clinical mastitis was reduced by 70% in the 1st and 68.5% in the 2nd year from the initial infection level. Similarly, there was a significant reduction on the incidence of clinical mastitis in the animals when teat dipping was parasitized. These findings suggest the useful role of teat dips in controlling mastitis of dairy animals. The present findings need to be disseminated in the wider areas of commercial dairying for the effective control of clinical and sub clinical mastitis in dairy animals.

Normal somatic cell count and subclinical mastitis in Murrah buffaloes

Dhakal IP (2003). Normal somatic cell count and subclinical mastitis in Murrah buffaloes. *Proceedings on 7th National Conference of Nepal Veterinary Association*, Tripureswor, Kathmandu, Nepal, 5-7 Nov, **24:**91-98

This study was conducted to investigate the normal somatic cell count and to define subclinical mastitis in Murrah buffaloes. Data were collected from sixty clinically normal buffaloes stationed at five farmers of Chitawan Nepal and Buffalo Research Centre, Hissar, India. Somatic cell count was measured using the Newmann-Lampert staining technique. The upper limit of somatic cell count was determined ≥ 200.000 /ml of milk based on the mean ± 2sd of a total somatic cell count. Somatic cell count of right front and right hind quarters were significantly higher than left front and left hind quarters. Subclinical mastitis was diagnosed on the basis of samples with somatic cell counts ≥ 200.000 /ml and positive bacterial cultures. Subclinical mastitis was found in 21.7% buffaloes and 8% of the quarter foremilk samples. Neutrophil count was significantly higher in subclinical mastitis milk.

Comparative study on Povidine Iodine cream and Povidine Iodine solution against sub clinical mastitis of dairy cattle under farmer's management in Nepal

Thapa S and BR Joshi (2010). Comparative study on Povidine Iodine cream and Povidine Iodine solution against sub clinical mastitis of dairy cattle under farmer's management in Nepal. *Proceedings on 9th onference of Nepal Veterinary Association*, Veterinary Complex, Tripureswor, Kathmandu, Nepal, 22-24 April, 2010, pp 51-56

A field study conducted on lactating dairy cattle in Piple and Thakre VDCs of Dhading district showed that both cream based and solution based preparations of Povidine Iodine were equally effective in reducing the level of sub clinical mastitis in dairy cow. This was clearly evident by significant reduction in somatic cell counts in both groups as compared to the control animals. Furthermore, the somatic cell count decline was not different between cream based application and solution based application (teat dipping) of Povidine Iodine, which suggests that ointment based application was also equally effective as the Povidine Iodine teat dips against sub clinical mastitis of dairy cattle. The cream based application is easier for use in the field conditions minimizing the problem of spilling over, regular topping up and insufficient application of the chemical for teat dipping. As compared to dipping ointment based preparation is cheaper, easier to handle and transport and compatible to the traditional practices of small holder dairy farmers, thus helping in reducing the prevalence of clinical and sub clinical mastitis of dairy animals under Nepalese farming system.

Sub clinical bacterial mastitis (SCM) in cattle of eastern Terai of Nepal

Yadav S and SN Deo (2010). Sub clinical bacterial mastitis (SCM) in cattle of eastern Terai of Nepal. *Proceedings on 9th Conference of Nepal Veterinary Association*, Veterinary Complex, Tripureswor, Kathmandu, Nepal, 22-24 April, 2010, pp 57-63

This study was conducted from October 2006 to March 2007 in Regional Veterinary Laboratory, Biratnagar, Nepal to investigate the incidences of Sub Clinical Mastitis (SCM) in Biratnagar sub metropolitan city and nearby villages of Morang and Sunsari districts.

Altogether 190 lactating crossbred cattle were selected on random sampling basis. After testing the milk samples of 190 cattle (760 quarters), by California Mastitis Test (CMT) and modified White Side Test (MWT) 13.6% animals and 5.9% quarters were found to be affected sub clinically. Staphylococci (37.7%) were the most prevalent bacterial isolates found during the culture of positive samples. Enrofloxacin (88%) was found to be the most potent antibiotic in antibiotic sensivity test.

Early detection of subclinical mastitis among the dairy buffaloes

Dhakal C, IP Dhakal and BP Upadhyaya (2010). Early detection of sub clinical mastitis among the dairy buffaloes. *Proceedings on 9th Conference of Nepal Veterinary Association*, Veterinary Complex, Tripureswor, Kathmandu, Nepal, 22-24 April, 2010, pp 64-69

Mastitis is one of the most important economic diseases and continues to have major socioeconomic impact on dairy husbandry throughout the world. Subclinical Mastitis (SCM), with no gross lesion is the most serious form of mastitis which is 15-40 times more common than the clinical mastitis. Buffaloes are the major source of milk production in Nepal; hence the study focusing on buffaline mastitis concerns a lot for the subsistence farming system of Nepal. A total of 162 quarter of fore milk samples of buffaloes were collected to study the effectiveness of electrical conductivity in detecting the subclinical mastitis in dairy buffaloes. The mean Electrical Conductivity (EC) of milk in different Somatic Cell Count (SCC) threshold showed a continuous increase with increasing SCC threshold. Both parameters SCC and EC studied were increased for mastitis quarters with major and minor pathogen than in the quarter with no growth of organisms. Infected quarters had significantly higher mean values for the SCC ($P<0.001$) and EC ($P<0.001$) that non infected quarters. Staphylococcal infection had significantly higher mean values for SCC ($P<0.01$) and EC ($P<0.01$) than the minor pathogen. The minor pathogen had also significantly ($P<0.01$) higher mean SCC, higher mean EC than normal quarters but the difference was non significant ($P>0.05$).

Staphylococcus species isolated from different pathological conditions and their antibiotic sensivity pattern

Yadav JN, RP Thakur and VC Jha (1994). Staphylococcus species isolated from different pathological conditions and their antibiotic sensivity pattern. *Veterinary Review,* Pakhribas Agricultural Centre, Pakhribas, Dhankuta, Nepal, **9** (2) and **10** (1):31-32

The laboratory records of Staphylococcus isolates from different pathological conditions in animals and their antibiotic sensivity pattern were analyzed. Three hundred and eight pathological samples from different livestock species were collected. The samples were subjected to bacteriological examination and the isolated Staphylococcus species were identified and further tested for antibiotic sensivity. The results of the study revealed that 30.8% samples were positive for different Staphylococcus species. Among the Staphylococcus isolates, *Staphylococcus aureus* were isolated (20.5%) most frequently.

Haemorrhagic Septicaemia (HS) carrier status of cattle and buffaloes in the Koshi hills of Nepal

Jha VC (1997). Haemorrhagic septicaemia carrier status of cattle and buffaloes in the Koshi hills of Nepal. *Working Paper N. 97/203,* Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal.

A study was conducted on the carrier of HS in cattle and buffaloes in the Koshi hills. For this study Naso Pharyngeal Swabs (NPS) and Retro Pharyngeal Lymph nodes (RPL) from 293 buffaloes were collected. Similarly, NPS and blood samples from 157 cattle were collected. Bacteriological examination of NPS and RPL of buffaloes and NPS of cattle were negative for

Pasteurella multocida. Eighty serum samples of cattle were subjected to indirect Haemagglutination test and ELISA to assess the antibody against *P. multocida*. The results revealed that 41.4% unvaccinated and 60% vaccinated cattle were positive for antibody against *P. multocida* type 6:B.

Incidence of Anthrax in Kathmandu valley

Mishra U, A Pradhan and UM Singh (1993). Incidence of Anthrax in Kathmandu valley. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, **8** (1):26-28

Sudden death and oozing out of unclotted blood from the natural orifices of animals has been reported previously from various parts of the country. Only recently, however has anthrax been confirmed by lab diagnosis. Anthrax was confirmed for the first time following an outbreak of the disease among cattle in Kathmandu valley in December 1992. Incidence was subsequently recorded in cattle, buffalo, horse and pig in acute forms. Antibiotics were tried in the last moment without success, but vaccination to all contact animals with live attenuated anthrax spore vaccine (Sterne strain) and strict hygienic precaution halted the outbreak.

Contagious Bovine Pleuropneumonia (CBPP): a disease of potential significance for Nepal

Shrestha HK, DP Rasali and HD Joshi (1994). Contagious Bovine Pleuropneumonia (CBPP): A disease of potential significance for Nepal. *Seminar Paper N. 94/15*, Lumle Agricultural Research Centre, Lumle, Kaski, Nepal

CBPP is an economically important disease of cattle and buffaloes caused by *Mycoplasma mycoides* sub species *mycocides* (small colony type). There are so far no published reports of research work carried out this disease in Nepal. The disease being endemic in some parts of Indian sub continent, the possibility of its existence in the country, the need for its identification, its epidemiological pattern, diagnostic methods and the future areas of research on CBPP are discussed in this paper.

Detection of *Mycobacterium paratuberculosis* in the farm animals in the western hills of Nepal

Joshi HD and BR Joshi (1999). Detection of *Mycobacterium paratuberculosis* in the farm animals in the western hills of Nepal, *Veterinary Review*, Animal Health Research Division, Tripureswor, Kathmandu, Nepal **14:**29-31

A study was conducted to detect the specific antibodies to *Mycobacterium paratuberculosis* in the farm animals in the western hills of Nepal. Serum samples of 115 buffaloes, 98 cattle, 29 sheep and 32 goats were subjected to screening against Johne's disease using enzyme immunoassay kit. Specific antibodies to *M. paratuberculosis* were detected in the serum samples of 34% buffaloes and goats, 27% cattle and 24% sheep. These findings are discussed and area of further study suggested.

Detection of *Leptospria hardjo* antibodies in infertile cattle and buffaloes in the western hills of Nepal

Joshi HD and BR Joshi (2000). Detection of *Leptospria hardjo* antibodies in infertile cattle and buffaloes in the western hills of Nepal. *Veterinary Review*, Animal Health Research Division, Tripureswor, Kathmandu, Nepal, **15:**46-49

A total of 200 blood serum collected from animals (consisting of 114 cow and 86 buffaloes) showing various problems associated with bovine infertility were screened for *Leptospria*

hardjo antibodies by Microscopic Agglutination Test (MAT). The result showed that *Leptospria hardjo* (bovis) antibodies were present in a total of 8.5% of the serum samples examined. According to the animal species, the antibodies were collected in 11% of the cows and 5.5% of the buffalo samples. These findings and clinical significance of the problem are discussed.

Determination of the duration of immunity in buffaloes vaccinated with alum precipitated *Pasteurella multocida* vaccine

Joshi BR and HD Joshi (2001). Determination of the duration of immunity in buffaloes vaccinated with alum precipitated *Pasteurella multocida* vaccine. *Working Paper N. 01/14*, Agriculture Research Station, Lumle, Kaski, Nepal

Haemorrhagic septicemia (HS), a highly fatal disease of bovines is widely prevalent in Nepal causing considerable economic loss. Currently the disease is prevented by vaccination with alum precipitated vaccine after the outbreak. The preventive vaccination strategy against this disease has not been developed in absence of epidemiological information and protective immune response of available vaccines. The present study was conducted to evaluate the immune response of buffaloes to vaccination with alum precipitated vaccine against HS. The response of buffaloes to a single vaccine varied between the animals and the protective immunity was recorded for 3 months in most of the animals. There was no relation of Indirect Haem Agglutination Titre (IHAT) with the protective immunity of the animals. Despite the absence of protective immunity an anamnestic response to challenge vaccine was evident even after 6 months of the 1st vaccination.

Characterization of *Pasturella multocida* isolated from outbreaks of Haemorrhage septicemia in cattle and buffaloes in the western hills of Nepal

Joshi HD and BR Joshi (2001). Characterization of *Pasturella multocida* isolated from outbreaks of Haemorrhage septicemia in cattle and buffaloes in the western hills of Nepal. *Seminar Paper N. 01/13,* Agriculture Research Centre, Lumle, Kaski, Nepal.

Haemorrhagic septicemia is a highly fatal disease of bovines in Nepal. The disease is reported throughout the country causing significant economic loss. Outbreaks of HS were recorded in some of the villages of Kaski and Parbat districts during the year 1998, 1999 and 2000. Those outbreaks were investigated to isolate and identify the causative microorganism. Most of the outbreaks were reported after the death of animals. A total of 19 samples from dead animals and one from HS suspected animal were subjected to laboratory investigations and characterization. Twelve isolates were identified as *Pasteurella multocida* and all were found to be serotype B_2 on capsular somatic typing.

Tuberculosis and Johne's disease in Murrah buffaloes and their relationship with mastitis and Brucellosis in Chitawan

Dhakal IP and KR Tiwari (1994). Tuberculosis and Johne's disease in Murrah buffaloes and their relationship with mastitis and Brucellosis in Chitawan. *Journal of institute of Agriculture and Animal Science (IAAS),* Research Reports, Rampur, Chitawan (1992-93), pp 100-107

An investigation was conducted at the IAAS, Rampur, during 1992-1993 to find out the prevalence of Tuberculosis (TB) and Johne's disease (JD) in buffaloes and their relation with mastitis and brucellosis. A total of 146 Murrah buffaloes from the IAAS farm (39) and Mangalpur village (107) were examined for TB and JD/ Twenty four buffaloes from IAAS farm and 21 buffaloes from the village were also examined for sub clinical mastitis and brucellosis, respectively. Out of 39 buffaloes tested at IAAS farm, only 10.25% had severe infection of TB and 25.64% had JD. Similarly, out of 107 animals tested at Mangalpur village, 16.82% were positive

for TB and 2.8% positive for JD. Maximum number of animals was affected with JD at IAAS farm and with TB at Mangalpur village. Higher infection of TB in village buffaloes may be due to lack of grazing land which results crowding of animals and disseminating diseases. Of the 45 animals tested at IAAS farm and Mangalpur village, 37.77% and 24.44% animals were affected with sub clinical mastitis and brucellosis, respectively. In this study, 8.88% buffaloes were having concomitant infection of TB + mastitis; 6.66% JD + brucellosis; 4.4% TB + JD; TB + brucellosis and JD + mastitis. Only 2.22% buffaloes were affected with mixed infection of TB + JD + mastitis and TB + JD + brucellosis.

Prevalence and risk factors assessment of bovine Tuberculosis in the buffer zone of Koshi Tappu Wildlife

Lamichhaney S and S Thapaliya (2008). Prevalence and risk factors assessment of bovine Tuberculosis in the buffer zone of Koshi Tappu Wildlife. *The 5th National Conference on Science and Technology, Nepal Academy of Science and Technology (NAST),* Khumaltar, Lalitpur, 10-12 Nov, 2008

Koshi Tappu Wildlife reserve is the home for the remaining population of wild buffaloes (*Bubalus arnee*) in Nepal that live in close association with domestic animals and people around its buffer zone. This has increased the risk of zoonotic diseases such as tuberculosis that can be transmitted between people, wild buffaloes and domestic animals. Across sectional study was conducted among 128 domestic buffaloes belonging to 94 households around the buffer zone of Koshi Tappu wildlife reserve to investigate the frequency and risk factors responsible for bovine tuberculosis (BTB) infection. Tuberculin test among the selected buffaloes was conducted using single intradermal test (SITD). 15 buffaloes (11.71%; 95% CI: 6.71 to 18.59) were found positive to tuberculin test. 12 of 33 tested herds had positive react showing positive herd rate (PHR) to be 36.37% (95% CI: 20.4 to 54.88 %). Age of the buffalo (P=0.014) and lactation (P=0.024) was found to be significantly associated with infection. Duration of domestic buffaloes grazing inside the reserve was also found to be significantly associated with the infection (P=0.029). But no statically significant association (P>0.05) was observed between reactor buffalo and human tuberculosis cases in the households. The habit of milk and meat consumption of the people was affected by their occupation (P<0.0001). Although the level of education influenced the habit of milk consumption (P<0.05), it did not have impact on the habit of meat consumption (P>0.05). Less than half (38.3%) of the respondents knew about BTB, and only 30.8% of the respondents were conscious of its transmission from domestic buffaloes to human and wild animals. Presence of reactor buffaloes and lacking knowledge about BTB in public revealed the community and the animals in the area at risk bovine tuberculosis infection.

Status and strategies for the control of major infectious diseases of livestock in Nepal

Khatiwada RK, NP Ghimire, KC Thakuri and S Karki (2010). Status and strategies for the control of major infectious diseases of livestock in Nepal. *Proceedings on 9th Conference of Nepal Veterinary Association*, Veterinary Complex, Tripureswor, Kathmandu, Nepal, 22-24 April, 2010, pp 1-7

Infectious diseases have been considered as the major threat of livestock industry in Nepal. The epidemiological status and trend of major infectious diseases of livestock has been analyzed using secondary data from year 2000 to 2009, obtained at Veterinary Epidemiology Centre from all 75 District Livestock Services Office. Foot and mouth disease (FMD), Peste Des Ruminants (PPR), classical swine fever, Haemorrhagic Septisemia and Black Quarter (BQ) were found to be most frequently occurring five infectious diseases among the top ten reported animal disease. Emerging epidemics like Highly Pathogenic Avian Influenza (HPAI) with serious

consequences to food security, food safety, public health and trade owing the huge socio economic impact had been observed as constant threat in the recent years. Appropriate control strategies including the need for public private partnership, regional cooperation, harmonization and capacity building of National Veterinary Services as per OIE guidelines has been recommended for prevention and control of infectious diseases of livestock in Nepal.

The comparative efficacy of 10 percent formalin and 10 percent zinc sulphate foot baths for the control of bovine foot rot

Parajuli B (1987). The comparative efficacy of 10 percent formalin and 10 percent zinc sulphate foot baths for the control of bovine foot rot. *Proceedings of the 2nd National Veterinary Conference*, **15**:46-52

Comparative efficacy of 10% V/v formalin and 10% zinc sulphate foot baths for the control of bovine foot rot was studied. Both foot baths were found effective, however, zinc sulphate proved superior to formalin to cure the severe lesions and formalin was better in hardening the hoof keratin and healing of the mild lesions

Some observations on an outbreak of Foot and Mouth disease in a village of Saptari district, eastern Nepal

Acharya KP (1990). Some observations on an outbreak of Foot and Mouth disease in a village of Saptari district, eastern Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **5:**1-2

An epidemiological investigation on an outbreak of FMD disease in a village of Saptari district indicated the morbidity rate of 60.2% in cattle, 57% in buffaloes and 43.5% in goats. The differences in milk production between FMD positive and negative buffaloes were found to be highly significant ($P<0.005$). Milk production of the affected buffaloes during infection and after they had recovered was also found to be significantly lower ($P<0.005$) than that of pre infection period. Calves born from FMD affected buffaloes were 20 times more likely to die within 2 months of their life as compared to those born from unaffected buffaloes.

The situation of Food and Mouth Disease in Nepal

Gongol GN (1998). The situation of Food and Mouth disease in Nepal. *Veterinary Review*, Nepal Agricultural Research Council (NARC), Khumaltar, Lalitpur, Nepal, **13:**28-29

Food and Mouth disease (FMD) is endemic in Nepal causing heavy economic loss. Epidemics are reported from all parts of the country. Although 4 serotypes O, A, C and Asia-1 are isolated from the country, the predominant serotypes are O and Asia -1. The present approach to control the epidemics is the vaccination of animals by imported multivalent vaccines; however, the response is not always satisfactory due to various reasons.

Emergence of new FMD virus strains in Nepal

Adhikary BN and KC Thakuri (2005). Emergence of new FMD virus strains in Nepal. *Nepalese Veterinary Journal*, Nepal, **28:**109-113

Among the 7 different serotypes of FMD virus, serotypes O, A, C and Asia 1 have been detected in Nepal. FMD outbreak due to serotypes O has been found to be the most predominant type (71%) followed by Asia 1 (16%), A (10%) and C (3%). However, outbreak of FMD serotype C has not been recorded in the country since 1996. Different Topotypes and genotypes of serotype O have also been isolated by World Reference Laboratory (WRL), Pirbright from the samples sent from different countries. Pan Asia was a new and virulent strain of serotype O that belonged to the

near East South Asia (NE-SA) Topotype and was identified from India in 1990. Among the 159 samples collected during 2003 for serotyping, 6 samples were sent to WRL, Pirbright for laboratory confirmation and anthegenic characterization. The test at WRL confirmed them to be of serotype O. On further characterization, Pan Asia strain was isolated from the sample taken from Kathmandu valley, which belonged to the Middle East South Asia (ME-SA) Topotype. A different strain IND 2001 (further phylogenetic analysis yet to confirm this strain) was also isolated from the sample taken from Sunsari, which belonged to the same Topotype. Hence, emergence of such new strains of FMD virus has necessitated for a laboratory based detailed epidemiology study, which will be helpful to understand the epidemiology, develop the vaccine and vaccination strategy for the country.

Epidemiology of Foot and Mouth Disease in Nepal

Giri R, P Prasain and V Makarov (2010). Epidemiology of foot and mouth disease in Nepal. *Proceedings on 9th Conference of Nepal Veterinary Association*, Veterinary Complex, Tripureswor, Kathmandu, Nepal, 22-24 April, 2010, pp 116-123

Foot and mouth disease (FMD) is endemic in Nepal. The details of epidemiology of FMD in Nepal were set out in this work. FMD was studied in different species of animal by season of the year, regions, ecozones, and virus serotypes. The study was carried out by using monthly epidemiological reports on the disease from 75 districts to Veterinary Epidemiology Centre, Directorate of the Animal Health, Kathmandu, Nepal from 2000 to 2007. The results were processed and analyzed with the use of the computer program Microsoft Office. FMD was ranked first in terms of the number of outbreaks, the number of affected and dead animals in the structure of the major infectious and invasive diseases in Nepal. The predominant serotypes responsible for epidemic outbreaks of FMD in Nepal were O, A and Asia-1 which were identical to other countries in South Asia. Cattle and buffaloes were the most susceptible animals for FMD in Nepal, whereas sheep and goats were relatively less susceptible. Hill and Terai ecozones of Nepal were the most stressful areas and persistent disadvantage for the disease. Far west and central regions were most vulnerable. Although the outbreak of FMD was reported all the year round, high incidence of FMD was noticed twice a year: in April – June and December (the movement of animals in previous religious activities). Vaccination was recommended to all susceptible animals at first in Far western development region adding other regions in the next years using trivalent vaccine, containing virus serotypes O, A and Asia -1 to acquire the herd immunity for successful FMD, prevention and outbreak.

Preliminary study of Khari disease of buffalo in Baitadi district

Ratala DR, P Manadhar and GR Pant (1992). Preliminary study of Khari disease of buffalo in Baitadi district. *Proceedings of the 3rd National Veterinary Conference*, 10-12 Aug, 1990, **19-20:**55-62

A chronic disease of unknown etiology in buffalo, locally known as Khari disease with high morbidity and mortality was reported from Darchula district in Jan, 1988. A similar condition was also reported from Baitadi in Apr 1989. A survey of incidence of Khari disease in buffalo in Baitadi and Darchula districts was conducted. The data revealed that 34.7% morbidity and 26.2% mortality rate due to Khari disease among the buffalo in the survey areas. High incidence of Khari disease in the winter months especially during the critical feed shortage was confirmed. The morbidity and mortality rate of Khari disease in stall fed buffalo was found 36.5 and 28.5% respectively while these were only28.2 and 17.9% in grazing buffaloes. Out of 28 skin scraping microscopically examined 27 (96.4%) samples demonstrated psoroptic mites. These mites' morphologically resembled *Psoroptes natalensis* is but further validation is needed. 5 samples of necrosed were obtained from the hoof and inoculated in blood agar and

sabourauds media yield no growth. Clinical examination of 57 buffaloes in various locality of Baitadi district conducted psoroptic mange was not the only cause and some soil borne bacterial infection was also suspected. 25 clinically affected buffaloes treated with ivomec @ 200 mcg ivermectin/kg body weight by subcutaneous route responded well and recommended for the treatment of Khari disease.

Study on Khari disease in buffaloes of Baitadi and Darchula districts of Nepal

Singh UM, SP Shrestha and GR Panta (1996). Study on Khari disease in buffaloes of Baitadi and Darchula districts of Nepal. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, 7-9 May, 1996, pp 143-161

Khari disease is also known as Chaukhuri or Dhulkhule locally. It is a serious disease of only milch buffaloes. The disease is apparently not seen during rainy season when there is ample lush green grass and pasture and morbidity is reported to be high compared to mortality as reported by farmers. Khari disease has been reported from 14 VDCs of Baitadi district. Most of the sick animals showed skin lesions and presence of heavy nit's infestation. Blood smear examination did not reveal any blood parasites however there were Eosinophilia and Monocytosis. Examination of the skin scrapings revealed presence of Psoroptic mange mites. Serum samples from sick buffaloes revealed Ca, P and magnesium to be in normal range. Experimental infection in 3 buffaloes with blood and skin scrapings showed only the development of skin lesions during 1st 4 months and became normal after 5 months of inoculation/application.

Study of Khari disease of buffaloes in Baitadi district

Singh UM, VC Jha, SN Mahato and D Chaudhary (1999). Study of Khari disease of buffaloes in Baitadi district, *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research iin Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, 26-28 June, pp 117-122

Blood and serum samples from 16 (12 sick and 4 healthy) animals were collected for Haematological and biochemical examination. There was no significant difference in Haematological and biochemical values but lower phosphorus values were recorded both in affected and normal animals. Out of 162 buffalo 13 (8.02%) buffaloes had only skin lesions, 9 buffaloes (5.55%) had skin lesion with hoof deformity, 11 buffaloes (6.8%) had skin lesion, emaciation and abducted limbs, 2 (1.2%) were found infertile and 13 (8.02%) recovered after Ivermectin injection. The culture of dried hay, maize stover and hoof powder revealed *Aspergillus spp* whereas the rice straw revealed *Rhizopus stolonifer* species fungus.

Occurrence of Khari like disease in farm ruminants in Dhading district of Nepal

Khakural GP (2003). Occurrence of Khari like disease in farm ruminants in Dhading district of Nepal. *Proceedings on 7th National Conference of Nepal Veterinary Association*, Tripureswor, Kathmandu, Nepal 5-7 Nov, **24:**130-133

In Maidi VDC of Dhading district, an outbreak of Khari disease in domestic farm ruminants were recorded with the symptoms of powdery hoof, itching of skin, lameness scaly and cracked skin, katla (heavy layer of dead skin), low production of milk and slow body growth, slowly leaning and thinning, curved body posture and ultimately death. Laboratory investigation showed the problem of Psoroptes and larva of Stephanofilaria in skin scraping, Paramphistomum and Strongyle eggs in fecal sample and low range of inorganic phosphorous (2.28) in blood serum was recorded. The symptoms and epidemiological findings suggest that the outbreak was due to Khari like disease.

Assessment of possible involvement of ground radiation in the development of Khari disease in buffaloes of Darchula and Baitadi districts

Khanal DR, BR Shah, DB Parajuli and H Awasthi (2008). Assessment of possible involvement of ground radiation in the development of Khari disease in buffaloes of Darchula and Baitadi districts. *5th National Conference on Science and Technology,* Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, Nepal, 10-12 Nov, 2007, pp 188-195

An exploratory investigation was carried out by a team of a senior veterinary scientist and radiation scientist at Khari disease affected sites of Darchula and Baitadi districts of Nepal in coordination with respective DLSOs. Using portable dosimeter (RGD 17091) ground radiation dose rate at Khari hit area was measured. Ground radiations in these 2 districts were found to be higher (max of 15 μ sv/hr) than other parts of the country (0.3-1μ sv/hr). Moreover, indoor radiation inside buffalo shed was higher the outside radiation. This finding is suggested of why Khari affected buffaloes reportedly showed improvement allowing them to graze than keeping indoors which might be due to less accumulation of radiation in open grazing environment. More detailed study with respect to Khari disease and its linkage with ground radiations is warranted to fully elucidate the implication of radiation in the development of Khari disease in lactating buffaloes and in other mammalian species including human.

Management of Khari syndrome with Pentasulphates under Animal Health Research Division, Khumaltar

Khanal DR, H Awasthi, BL Kunwar, BR Sah and AP Knight (2011). Management of Khari syndrome with Pentasulphates under Animal Health Research Division, Khumaltar. Proceedings of the National Outreach Woring Group Workshop, Khumaltar, laitpur, 19 May, 2011, pp 58-62

A multidisciplinary team comprosed of Senior Research Veterinarians, the Extension Veterinarians, District Livestock Officials, Technical Staffs and Radiation Physicist carried out a series of field and laboratory investigations over the last four (2006-2010) years by visiting 441 disease affected buffaloes in far western Nepal. Multidisciplinary investigations of a three decades old problem of Khari disease syndrome in lactating buffaloes have revealed the comples nature of the disease with the involvement of multiple causative factors namely: malnutrition componded by hypophosphaemia and Selenium intoxication, heavy parasitic infestions, prolonged exposure to chronic radiation inside the poorly ventilataed sheds, lack of access to green forages and feeding of potentiality toxic plants like oaks, pines and rhododendrons in the dry season. Blood, hair, chalky powder from the affected hooves, water, forages and soils for laboratory analysis of Selenium (Se) were collected from the Khari syndrome area. Comparatively higher levels of Se were found to be present in blood (1.65 mg/kg, max), hair (2.92 mg/kg, max), and chalky powder from the affected hooves (3.63 mg/kg, max; soil (2.49 mg/kg, max), forages (4.37 mg/kg, max) and water (0.032 mg/kg, max). The serum biochemical analyses in Khari affected buffaloes revealed significant reduction in phosphorous level ($P<0.01$), and significant elevation in serum creatinine ($p<0.05$) and alkaline phosphate ($p<0.065$) levels compared to controls. Gross radiation was measured using a portable dosimeter both inside and outside the animal sheds constructed from local rock in Khari affected areas in 2007 and 2008. The average gross radiations inside the shed (1.92±0.78μ Sv/hr) were significantly higher ($p<0.01$) than outside the shed (1.48±0.64μ Sv/hr). When Se specific antidotes, Pentasulfates were fed to Khari affected buffaloes @ 30-45 g/dayhead for 30-45 days during winter along with anti flukicide therapy, dramatic improvement resulted in 70% of the Khari affected animals.

Normal Haematological and biochemical values of indigenous cattle in the eastern hills of Nepal

Subba DB, RP Thakur, NP Kushwaha, LB Rai and PB Thapa (1993). Normal Haematological and biochemical values of indigenous cattle in the eastern hills of Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **8** (2):42-46

The normal Haemato-chemical values have been established in six different age wise and sex wise groups of apparently healthy local cattle. None of the Haematological parameters were significantly affected by sex except WBC which was significant at P<0.05. The effect of age on WBC, Neutrophil and lymphocytes were highly significant at P<0.001; PCV and Monocytes at P<0.01 and HB, RBC, Eosinophils and Basophils at P<0.05. However, the absolute values and the ESR were significant. Likewise, age has a significant effect (P<0.001) on the bio-chemical parameters except Ca and Fe which were highly significant at (P<0.001) and K significant at P<0.05. Both age and sex have significant effects on Ca and Fe and insignificant effects on Na.

Normal Haematological and Biochemical values of indigenous buffaloes in the eastern hills of Nepal

Subba DB, RP Thakur, LB Rai, NP Kushwaha and PB Thapa (1994). Normal Haematological and biochemical values of indigenous buffaloes in the eastern hills of Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **9** (1):7-9

Normal Haemato- chemical values have been established for male and female buffaloes in 2 different age groups (<=1 year, >1-5 years) and for female only in > 5 years age of apparently healthy indigenous buffaloes in the eastern hills of Nepal between the elevation of 900-2100 m asl. None of the Haematological parameters were significantly affected by sex except MCHC which was significant at P<0.05. Age did not have a significant effect on Hb, PCV and MCHC; however, the effect of age on ESR, RBC, MCV and MCH was highly significant (P<0.01). The differential Leucocyte counts such as Basophils and Monocytes were significant but Neutrophils and lymphocytes were highly significant (P<0.01) and Eosinophils significant (P<0.05) with the age of the animals. However, age has also no significant effect on the levels of Pi, TP, Na, K, Mg and Cu. The levels of serum protein fractionates (albumin and globulin) were highly significant (P<0.01) and serum Ca of Fe levels significant (P<0.05), respectively.

Haematological values of indigenous cattle in Central Development Region

Singh UM (1997). Haematological values of indigenous cattle in Central Development Region. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 24-25 Sep, 1997, Pp 112-114

Normal Haematological values of 2 age groups (1-3 years and > 3 years) of indigenous cows from Dhanusha district were established. Blood samples were collected during winter season to estimate hemoglobin, total RBC, total WBC count and packed cell volume and differential Leucocytes count. None of the Haematological parameters were significantly affected by age factor except DCE, DCL and DCP which were significant at (P<0.05).

Hematological and some serum biochemical values of clinically healthy buffaloes in Chitawan

Kobayashi K, DK Singh and IP Dhakal (2003). Hematological and some serum biochemical values of clinically healthy buffaloes in Chitawan. *Proceedings on 7th National Conference of Nepal Veterinary Association,* Tripureswor, Kathmandu, Nepal, 5-7 Nov, **24**:72-77

This study was performed to survey the standard hematological values and some serum biochemical parameters in Nepalese buffaloes. Blood serum samples were obtained from buffaloes raised in IAAS and neighboring villages. Packed cell volume, total and different white blood cell count, blood urea nitrogen, calcium, inorganic phosphorous, aspartate aminotransferase, alanine aminotransferase and serum protein were measured. Differences were found between IAAS and village animals in some parameters. Change with age and differences from Friesian cow also recorded.

The prevalence of Enzootic Bovine Haematuria in the hills of eastern Nepal

Mahato SN (1983). The prevalence of enzootic Bovine Haematuria in the hills of eastern Nepal. *Technical Paper N. 83/66*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

This was the 1st attempt to study the prevalence of Enzootic Bovine Haematuria (EBH) in Nepal. A total of 544 clinical cases of bovine Haematuria were reported from Apr 1979 to March 1983 and 171 cases were recorded during Sep 1982 in the 11 Village Panchayats of Dhankuta, Tehrathum and Taplejung districts. The overall prevalence of the disease in the Panchayats under study was estimated to be 0.79%. Presence of erythrocytes in the urine, clinical features and urinary bladder lesions seen in the affected animals seemed to be typical of EBH. The condition has been attributed to Babesiosis in the past due to lack of proper diagnostic facilities in remote hills.

Preliminary observations on enzootic Bovine Haematuria in the hills of eastern Nepal

Mahato SN (1986). Preliminary observations on enzootic Bovine Haematuria in the hills of eastern Nepal. *Special issue Published on the Occasion of 2nd National Veterinary Conference*, **14:**36-41

Preliminary clinical, pathological and epidemiological findings of enzootic bovine Haematuria in Dhankuta, Terhathum and Taplejung districts of eastern Nepal are reported. Affected animals suffered from intermittent chronic Haematuria and progressive anaemia. Haematuria was due to Haemorrage from Tumours in the urinary bladder. Histopathological examinations revealed the condition to be a case of Trisitional cell carcinoma. The incidence of the disease appeared to be most frequent during Jan to March and least in June and July. Cattle in the age group of 7-10 years were found to be mostly affected. The affected animals had grazed local grasses growing in forest and grazing lands, supplemented by crop residues and tree fodder. The forests and grazing lands in this area are abundantly covered with *Eupatorium adenophorum*, *Artemisia vulgaris* and various species of ferns including *Asplenium spp*, and *Pteridium aquilinum*; the latter being incriminated as a cause of enzootic bovine Haematuria by various workers.

Investigation of Bovine red water in the Koshi hills of Nepal

Hopkins NCG and SN Mahato (1985). Investigation of Bovine red water in the Koshi hills of Nepal. *Bulletin of Veterinary Science and Animal Husbandry*, **13:**1-4

Simple lab tests may be used to differentiate between Haematuria and Haemoglobinuria in cattle with red water. Results from the Koshi hills indicated that Haematuria is the prevailing condition. No *Babesia spp* parasites have been found. The results demonstrate that Enzootic

Bovine Haematuria is the disease condition responsible for bovine red water and make it unlikely that Babesiosis is a disease problem. Cattle presented with red water should be examined as described and a confident diagnosis made.

Sero- prevalence of Brucellosis in cattle and buffaloes in the Koshi hills of Nepal

Jha VC, RP Thakur and JN Yadav (1993). Sero- prevalence of Brucellosis in cattle and buffaloes in the Koshi hills of Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **8** (1):17-19

A study on sero-prevalence of brucellosis among cattle and buffaloes was carried out in the 4 districts of Koshi hills. The Rose Bengal Plate Test (RBPT) and Serum agglutination Test (SAT) were used. The overall prevalence rate of brucellosis in cattle and buffaloes were found to be 1.28 and 1.93% respectively. There was a relatively high prevalence rate among cattle with a history of abortion (22.225) but no positive cases were found in aborted buffaloes.

Sero surveillance of Brucellosis in cattle and buffalo in Chitawan

Pradhan A (1996). Sero surveillance of Brucellosis in cattle and buffo in Chitawan. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, 7-9 May, 1996, pp 227-231

A total of 1245 blood samples were collected randomly for the study of Brucellosis. Out of these samples 42 (3.37%) cases were positive for Brucellosis. All the positive cases were female cattle. 48 aborted cases were recorded. Out of 48, 13 cases were positive for Brucellosis. Prevalence of Brucellosis varied from village to village. Laxmipur, Kesherbagh, Deonagar, Gaurigang, Jyamirye, Lankhu, Bhuzard, Rampur Livestock farm, Deoghat, Geetanagar, Vijayanagar and Naranghat showed 3.1, 1.15, 0.66, 3.7, 3.37, 17.07, 11.29, 66.66, 7.4, 1.69, 2.08 and 12.5%, respectively.

Detection of *Brucella abortus* antibodies in infertile cattle and buffaloes in the western hills of Nepal

Joshi HD and BR Joshi (2001). Detection of *Brucilla abortus* antibodies in infertile cattle and buffaloes in the western hills of Nepal. *Working Paper No. 01/11*, Agriculture Research Station, Lumle, Kaski, Nepal

A total of 200 blood serum from infertile animals (consisting of 144 cows and 86 buffaloes) showing various problems associated with bovine infertility were screened for *Brucella abortus* antibodies by Enzyme Linked Immunosorbant Assy (ELISA) and Rose Bangal Plate Test (RBPT). The result showed that *Brucella abortus* antibodies were present in a total of 3% of the serum samples examined. According to the animal species, the antibodies were recorded in 5.5% of the cows. Among the identified infertility problem, 46.1 % cases of the total aborted cows were positive for brucellosis but none of the samples from buffaloes were found with Brucella antibodies in this study. This findings and clinical significance of the problem are discussed.

Occurrence of Uterine Torsion as a cause of Dystocia in buffaloes in Chitawan valley of Nepal

Bhattarai TC and DP Rasali (1993-95). Occurrence of Uterine Torsion as a cause of Dystocia in buffaloes in Chitawan valley of Nepal. *Proceedings of the 4th National Veterinary Conference of Nepal Veterinary Association*, 17-19 Nov, 1992, **21-23:**88-90

All of 41 cases diagnosed as uterine torsion among a total of 117 cases of Dystocia in buffaloes attended in Chitawan valley between May 1991 and Aug 1992 were investigated. The results showed that majority of the uterine torsion cases (58.54%) occurred in Murrah crossbreds,

followed by 34.15% in local buffaloes but the occurrence was least (7.32%) in purebred Murrah. The occurrence of torsion was highest (41.46%) in the 2nd parity followed by 39.96% in the 3rd parity. Majority of the torsion cases (56.1%) were also associated with complete stall feeding system of management indicating the trend that buffaloes are more prone to the condition under confinement. The findings also revealed that all of the torsion cases attended was clockwise in uterine rotation and most of them (60.88%) had greater than 180 degree of rotation.

Characteristics of vaginal prolapse in buffaloes

Sah SK and T Nakao (2002). Characteristics of vaginal prolapse in buffaloes. *Journal of the Institute of Agriculture and Animal Science* (IAAS), Rampur, Chitawan **23:**71-75

Prolapse of vagina is one of the important maternal abnormalities during pregnancy in cattle and buffaloes. A field investigation was carried out to show clinical characteristics of vaginal prolapse in buffaloes in Nepal as related to parity, stage of pregnancy, seasonal variation, and degree of the prolapse, complications, treatment and prognosis. Fifty seven percent of 26 buffaloes with vaginal prolapse were heifers and cows in the first lactation. Fifty seven percent of the cases were in seven months of pregnancy or later. About three quarters of the cases were diagnosed during a period between June and Oct, including rainy season. Twelve cases (63%) of the nineteen had history of vaginal prolapse in previous gestation periods. A half of the buffaloes were showing prolapse of the vagina even when they were in standing position and showing moderate or vigorous straining. After the conventional treatments with Ca and P, 23 buffaloes retained the replaced vagina and calved normally. One of them aborted while the vagina was retained. While the other 2 buffaloes with severest degree of the prolapse showing severe edema with injury and cyanosis, the prolapse recurred due to strong continuous straining and died subsequently. Early detection and prompt treatment at a less progressive degree of the prolapse may be imperative to control the vaginal prolapse in buffaloes.

A clinical study on anoestrus buffaloes in southern Nepal

Sah SK and T Nakao (2010). A clinical study on anestrus buffaloes in southern Nepal. *Proceedings of the 9th Conference of Nepal Veterinary Association*, Veterinary Complex, Tripureswor, Kathmandu, Nepal 22-24 April, 2010, pp 47-50

Anoestrus is one of the most important reproductive disorders in dairy buffaloes. The clinical feature of anestrous in buffaloes, however, has not been well described. The objective of this study was to describe the causes of anoestrus in buffaloes and reproductive performance after treatment under the field condition in southern Nepal. Of the 135 anestrous buffalo, 61.4% had true anoestrous with ovarian dysfunction and 33.3% had silent ovulation. In 111 buffalo heifers, 76.6% were in true anoestrous and 18.9% had silent ovulation. Duration of anoestrous after calving was longer than 6 months in 83%. And 61.5% of the buffalo had durations longer than 10 months. The interval between the last breeding and diagnosis of anoestrous was more than 5 months in 67.4% of buffaloes and heifers. Treatment of anoestrous with prostaglandin F $F_2\alpha$ in buffaloes and heifers with the corpus lustrum resulted in a higher pregnancy rate within one (P, 0.01) and two months ($P<0.05$) after treatment as compared with treatment with vitamin/mineral mixture. Buffalo cows and heifers with inactive ovaries bearing a dominant follicle were also successfully treated with gonadotropin releasing hormone, resulting in a pregnancy within one month after treatment ($P<0.05$). In conclusion, predominant causes of anoestrous in dairy buffaloes in this region was true anoestrous with inactive ovaries, and the duration of anoestrous after calving as well as breeding was extremely long. Routine reproductive examination and adequate hormone treatment may improve the reproductive performance of these buffaloes.

Diseases of cattle and buffaloes in the Koshi hills of Nepal: a retrospective study

Thakuri KC, SN Mahato and RP Thakur (1992). Diseases of cattle and buffaloes in the Koshi hills of Nepal: a retrospective study. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **7** (2):41-46

Records of 91562 clinical cases (75412 cattle and 16510 buffaloes) attended over period of 5 years at the Veterinary Hospitals of 4 Koshi hill districts were analyzed. The major clinical conditions encountered were parasitic diseases, infectious diseases (bacterial and viral) and general debility. Digestive disorders and conditions caused by trauma and minor surgical affections were also of significance. It was concluded that the most pressing constraint for improving cattle and buffalo productivity in the Koshi hills are parasitic diseases. The control measures need to be focused against Helminth parasites and infectious diseases are discussed.

Economic analysis of animal diseases in Nepal

Lohani MN and DP Rasali (1993-95). Economic analysis of animal diseases in Nepal. *Proceedings of the 4th National Veterinary Conference*, **21-23:**8-21

The available secondary data on animal diseases situation in Nepal were analyzed. The results showed that animal diseases inflicted an economic loss of about NRs 845 million annually in the country. Morbidity and mortality accounted for 59.43 and 40.57% of the total loss, respectively. Similarly, the shares of the parasitic, viral and bacterial diseases to the total loss were 56.39, 33.31 and 9.72%, respectively. About 71% of the total morbidity loss occurred in mountains, whereas it was 16.38% in the hills and 12.51% in the Terai in 1981/92. The corresponding figures for mortality losses are 64.12, 24.0 and 11.89%. Economic losses due to diseases in buffaloes, cattle, pig and sheep accounted for 47.57, 18.46, 18.81 and 12.09% of the total, respectively. The contribution of goats and poultry put together was 3.07% to the total loss. The weight age of morbidity and mortality, and the economic ranking of diseases differ in different livestock species. The public sector resource allocation for animal health input supplies is only about 2% of the total economic loss from diseases.

Common diseases of livestock at Pathivara VDC of Sankhuwasava

Dhakal IP, R Jha and B Basnet (1996). Common diseases of livestock at Pathivara VDC of Sankhuwasava. *Proceedings of the 5th National Veterinary Conference*, Nepal, 11-13 Sep, **24:**95-99

This study was conducted during June and July, 1995 to evaluate the livestock heads/household, prevalence of internal parasites, blood protozoa and common diseases of livestock at Pathivara VDC. The number of cattle, goats, sheep, buffaloes and pigs/household were 3.65, 2.71, 2.61, 1.55 and 1.07 respectively. Prevalence of parasitic infections were higher in sheep (100%), goats (85%) and pigs 980%) than cattle (68%) and buffalo (72%). Nearly 6% of cattle and 1% of buffaloes were positive for babesiosis. Highest calf mortality was recorded during summer and rainy season (45%) in comparison to winter (37%) and spring (125). Majority of the calf mortality was due to Ascariosis, Diarrhea, Dysentery and poisoning. In case of cattle and buffaloes, Fasciolosis and FMD were the most common diseases followed by non specific disease like Diarrhea and Dysentery. In sheep foot lesions were the most common followed by liver fluke, gid and pneumonia. In pigs, swine fever was most common followed by mange and Ascariosis. In case of poultry, most serious problem was sindure (red mites) and bacillary white diarrhea (BWD). Field visit of Pathivara VDC by the expert team felt that there should be a strong linkage between DLS and Makalu Barun Conservation Project (MBCB) for implementing any new programs.

Health management situation of dairy cattle and buffaloes in the eastern Terai region of Nepal

Paudel KP and KP Acharya (1996). Health management situation of dairy cattle and buffaloes in the eastern Terai region of Nepal. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, 7-9 May, 1996, pp 162-175

A dairy based farming system survey which health management was one of the major components was conducted this year in Basantapur and Mahanapur, Saptari. Farmers group meetings, animal health camps and Regional lab reports on major diseases supplemented information for the completion of this study with the objective to identify areas of research and service for improvement of health of dairy animals in the ETR. Farmers identified FMD, parasitic infections, HS and BQ to be the most important diseases followed by mastitis, anthrax, reproductive disorders and Haemoprotozoan infections. The findings of the animal health camps, Morang and Regional lab reports also invariably show similarities with the survey findings. Calf mortality in Saptari was found to be and 14.1% in cattle and buffalo respectively for which worms, calf scour and pneumonia were the major causes. Among reproductive disorders, repeat breeding was the most important ailment. Farmers' ignorance to season and frequency of vaccination and drenching to their animals, non availability of some of the important drugs and vaccines and misuse of hormones and high antibiotics were some of the problems with the present veterinary practices. Some of the potential areas of applied research on treatment, prevention and control of major diseases are suggested.

Nutritional manipulation to prevent milk fever- A review

Shrestha SK, G Muhammad and M Sarwar (1996). Nutritional manipulation to prevent milk fever- A review. *Proceedings of the 5th National Veterinary Conference*, Nepal, 11-13 Sep, **24:**35-41

The basic principle dietary manipulation to prevent milk fever is to provide high plasma calcium level at the time of parturition to overcome the sudden high demand of calcium. The supplementations of anionic salts just do the same. The anionic salt brings about a mild acidosis in the body thus increasing the rapid absorption of Ca through intestine and bone Ca resorption. Thus the extra cellular level of Ca increases which helps in coping with the demand of Ca particularly in the early lactation. To be surer of prevention of the disease, anionic salts should be supplemented with high Ca diet so that sufficient amount is absorbed through intestine. Among the anionic salts ammonium salts NH_4Cl and NH_4SO_4 may be used commonly as it is cheaper and effective as any other anionic salts.

Selenium: its role in livestock health and productivity

Khanal DR, O Anthony and K Dacvim (2010). Selenium: its role in livestock health and productivity. *The Journal of Agriculture and Environment*. Ministry of Agriculture and Cooperatives, Singha Durbar, Kathmandu, Nepal, **11**:

Selenium (Se) is an essential metalloid trace element that has a very narrow margin of safety between the toxic and deficient doses in animals and humans. This paper highlights about the benefial and harmful of selenium in livestock productivity and health besides presenting some information on its relation to Khari disease of buffaloes in Baitadi and Darchula districts and way to mitigate toxic effects of selenium in buffaloes.

Study of Tail Gangrene disease of cattle and buffaloes in eastern Terai region

Singh UM (1997). Study on Tail Gangrene disease of cattle and buffaloes of eastern Terai region. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 24-25 Sep, pp 115-116

A total of 165 sick animals with tail gangrene disease were recorded in 5 districts vet hospitals (Morang, Sunsari, Saptari, Siraha and Dhanusha) there were more sick buffaloes (75.14%) than the cattle (24.84%). More crossbred animals were affected in Morang and Sunsari districts and more of local breeds in Saptari, Siraha and Dhanusha district. Adult animals (>3 years) were affected more compare to younger one (1-3 yrs). This disease was seen more during winter and summer (December-May).

Study of Tail Gangrene disease of cattle and buffaloes

Singh UM (1999). Study of tail gangrene disease of cattle and buffaloes. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, 26-28 June, pp 114-116

Out of 270 cows and 65 buffaloes examined for tail gangrene, there were 5 (1.85%) cows and 3 (4.6%) buffaloes positive to the disease. The skin scrapings collected from the affected tail of buffaloes were negative for any mange mites. Histopathological examination of the affected tail revealed severe infiltration of leukocytes, denudation of epidermis and severe necrosis of dermis. Two samples revealed Sacrocysts embedded in muscle issue.

Antibiotic resistence: A concern to veterinary and human medicine

Ghimire SR (2001). Antibiotic resistence: A concern to veterinary and human medicine. *Nepal Agricultural Research Journal (SAS/N)*, **4-5:**66-69

Bacterial resistence to antibiotics occers even without use of antibiotics. Antibiotic use exerts a selective pressure to the bacterial flora that helps in the emergence and development of antibiotic resistance. Antibiotics are used worldwide both in Veterinary and human medicine The wide spread use of antibiotics in human and animal raised the concern about development of resistant and multiresistant bacteria that possess a potential danger to animals and men as resistance may cause treatment failure. Resistance may be natural or acquired. An acquired resistance is due to transfer of extrachromosomal genetic material (R plasmid) and is very important. The R plasmids are spread to other bacterial cells by transformation, transduction, conjugation and transposition. Transmitted antibiotic resistance in disease causing bacteria may cause zoonotic infections and resistant non-infectious bacteria may serve as a reservoir of R plasmids for the pathogenic organism. This paper highlights the mechanism of development of resistance in bacteria and means to minimize it.

Zoonotic disease problem and control strategy in Nepal

Gongol GN (2003). Zoonotic disease problem and control strategy in Nepal. *Proceedings on 7th National Conference of Nepal Veterinary Association*, Tripureswor, Kathmandu, Nepal, 5-7 Nov, **24:**25-33

Zoonoses are those diseases and infections, which are transmissible between man and animals. Although there are more than 100 zoonotic diseases and infections around the world but there are 12 well documented zoonotic diseases of public health importance in Nepal. There is a lack of reliable epidemiological information on zoonoses expect rabies and Japanese encephalitis. Food borne illness and intoxications due to consumption of food of animal origin are thought to be emerging zoonotic diseases in Nepal. It will not be a surprise if any new vector borne

zoonotic diseases will emerge in Nepal as an impact of global warming effect. The importance of zoonoses and veterinary public health (VPH) is ever increasing in Nepal as a result of increased human animal relationship, popularization of livestock and poultry farming in rural and peri urban areas, increased consumption of livestock products and expansion of livestock related industries. The role of Veterinarians in food safety, consumer protection and animal welfare is still grossly underestimated. Unfortunately, there is no appropriate government policy and program for zoonoses control. There is an urgent need of harmonizing national food safety standards with international standards, SPS measures in the context of Nepal's accesion to WTO membership. A holistic approach is needed for zoonoses control and enhancement of Veterinarian's role in food safety and national welfare. An independent VPH institution should be established at the national level with proper mandate and budgetary provision. Government instutions will have to play a greater role in disease surveillance execution of regulatory functions, formulation and implementation of appropriate policy and strategy for zoonoses control in next 20 years. Specific disease control programme with legislative support should be formulated and executed on a zonal basis. Residue monitoring programme should be launched immediately to protect national livestock industries and promote export of value added livestock products in the international market. There should be a permanent forum of medical and veterinary personnel for exchange of information and ideas regarding proper diagnosis, surveillance and control the zoonoses. Extensive public awareness activities should be launched with the involvement of NGOs at the community level.

Role of Veterinarians in safety of foods of animal origin

Aryal SR, KP Paudel, RP Thakur and BR Joshi (2003). Role of veterinarians in safety of foods of animal origin. *Proceedings of the 7th National Conference of Nepal Veterinary Association*, Tripureswor, Kathmandu, Nepal, 5-7 Nov, **24:**43-48

Access to safe and wholesome food is a prerequisite for health and well being of people. The primary objective of Veterinarian in food safety is to prevent transmission of diseases to man through food and food products of animal origin, and to ensure that consumers receive a safe wholesome, nutritive and acceptable food. Veterinarians can play a major role in diagnosing and tracing the pathogens in the stock and eliminating them from the environment for healthy animal and safe food production. However, in Nepal, healthy animal and safe food production from cattle is too complex, therefore requires unique measures for addressing religious sentiments. For other species meat inspection is the primary responsibility of the Veterinarians to protect public from food borne diseases. Likewise, Veterinarians can play major role to inspect milk to prevent it from deterioration and to supply safe and wholesome milk to the people. Veterinarians also have roles for food inspection and food safety in disasters and providing appropriate information about epidemiological situation, vaccination, treatment, withdrawal period, drugs, or chemicals used in food animals. Veterinarians can educate the public as well as the personnel involved in food production, processing and distribution and regulate licensing of establishments producing safe food. Veterinarians can offer the necessary professional expertise for healthy animal production that is important for safe food. Their responsibility to protect the public health from food borne zoonoses can be achieved by active involvement in food production and inspection. Veterinarians should be interested to food hygiene otherwise animal health – safe foods – human health can not be achieved. Whether veterinarians are presently involved in, and given technical and legal responsibility for accomplishing these tasks should be a matter of national concern, and the government and other sections of the society should consider in with priority.

Annual consumption of veterinary medicines and feed supplements in Nepal

Singh S and S Bhandari (2003). Annual consumption of veterinary medicines and feed supplements in Nepal. *Proceedings of the 7th National Conference of Nepal Veterinary Association*, Tripureswor, Kathmandu, Nepal, 5-7 Nov, **24:**49-56

A survey was conducted by making a visit to each importer of foreign companies and marketing offices of Nepalese companies to find out their annual sales of Veterinary medicines and feed supplements in two consecutive FY 2001 and 2002. The total quantity of antibiotic, anthementics, anticoccidials, salfonamides, nitrofurans were calculated in terms of active ingredients and the vitamins, minerals, amino acids and probiotics were calculated in the form of powder or liquid that they were available in the market. The total quantity of each category is multiplied by their respective retail price and the total amount of money invested was calculated. The findings of this study showed that total among of veterinary medicines and feed supplements worth NRs 492 million is consumed annually in Nepal. Out of this, drugs worth NRs 81.74 million (19.89%) are produced in the country and drugs worth NRs 410.92 million (80.1%) are imported. This percentage shared by the categories of drugs – vitamins, minerals, amino acids and probiotics is 38.24% followed by Ayurvedic preparations 15.05%, anthelmentics 14.36%, antibiotics 13.15%, anticoccidials 5.2%, sulphonamides 4.09%, performance enhancers 2.3%, toxin binders 1.98%, nitrofurans 1.54%, liver tonics 2.32% and, miscellaneous preparations 2.8%. Nepal seems to be a huge consumer of veterinary medicines and feed supplements. Further study is necessary to access the public health aspect of the use of these preparations and their cost effectiveness too.

Animal health services to rural poor for poverty alleviation

Rajwar NB and P Mainali (2003). Animal health services to rural poor for poverty alleviation. *Proceedings of the 7th National Conference of Nepal Veterinary Association*, Tripureswor, Kathmandu, Nepal, 5-7 Nov, **24:**57-61

Despite the numerous development efforts and slight improvement in per capita income over the last decade, approximately 40% of Nepalese population continues to live in object poverty. Various reports claim that poverty in Nepal perpetuates itself because of unequal distribution of resources. The goal of 10th five year plan has been set for poverty reduction, which is clearly indicated in poverty reduction strategy paper of His Majesty's Government of Nepal. Decentralization alone cannot solve the problem unless the desired services reach to the poorest segment of the society. Hence, DLS (department of Livestock Services) has initiated the Village Animal Health Workers (VAHWs) programme in all 75 districts of Nepal since last two decades to provide veterinary services for rural farmers. In addition, the department has been rendering livestock and veterinary extension services to rural community at their doorsteps through appropriately prepared messages through different media and means of communication.

Strengthening Veterinary services at the farmers level in rural areas

Shrestha RM, B Sharma and D Sedai (2003). Strengthening Veterinary services at the farmer's level in rural areas. *Proceedings of the 7th National Conference of Nepal Veterinary Association*, Tripureswor, Kathmandu, Nepal, 5-7 Nov, **24:**62-66

Livestock rearing is not only an integral component of agricultural system of Nepal, but also an important contributor to national and household economy of rural Nepal. The modern Veterinary services initiated in the country some 65 years back, has developed the widespread network throughout the country. However, despite the efforts of the HMG of Nepal, The service has not reached to all national livestock population especially in the remote regions of the

country. The ratio of animals to Veterinarians and Paraveterinarians is still very high; the approach of Village Animal Health Workers (VAHW) has been adopted by the government with the objective of providing the minimum and basic animal health services to the wider animal population of the remote regions. This paper deals with these issues and recommends the strategies for improving the veterinary services in the country.

Study of bacterial contamination in raw meat of different species of animals in Kathmandu valley

Shrestha RD, DR Adhikary and P Manandhar (2003). Study of bacterial contamination in raw meat of different species of animals in Kathmandu valley. *Proceedings of the 7th National Conference of Nepal Veterinary Association*, Tripureswor, Kathmandu, Nepal, 5-7 Nov, **24:**116-125

A total of 61 samples of different animals were collected from different species of Kathmandu. Out of 61, 18 samples were from buffalo, 14 from goat, 20 from poultry and 9 from pig. *E coli*, *Staphylococcus aureus, Bacillus spp, Streptococcus fecalis, Citrobacter spp, Pseudomonas aerugenosa, Proteus spp* and *Salmonella spp* were the most isolated bacteria rom raw meat. The study showed the hygienic and sanitary condition of meat production and slaughter management was very poor.

Research note on the common diseases of livestock and poultry in Chitawan

Dhakal IP (1984). Research note on the common diseases of livestock and poultry in Chitawan. *Journal of Institute of Agriculture and Animal Science (IAAS*), Rampur, Chitawan, Nepal, **5:**115-120,

The study was conducted to investigate common disease of livestock and poultry in Rampur and its vicinity. Records at the private Veterinary clinic, Rampur, showed that farmers were more likely to seek help for diseases in buffaloes than in other stock. Parasitic diseases were more prevalent in comparison to the other categories of the disease. Liver fluke, ascariasis, haemonchosis, anorexia, diarrhea and dysentery, tympany, hemorrhagic septicemia, mastitis anoestrous, cervicovaginal prolapse, dystocia, milk fever, naval abscess, fracture and poisoning due to *Ageratum congoides* were the most common livestock diseases. Fowl cholera, Coccidiosis and Ascariasis were recorded commonly in poultry.

Common diseases of livestock in Chitawan district of Nepal

Dhakal IP and M Kharel (1988). Common diseases of livestock in Chitawan district of Nepal. *Journal of the Institute of Agriculture and Animal Science (IAAS)*, Rampur, Chitawan, **9:**69-74

The livestock case load during the period of 1981-83 brought to Chitawan Veterinary Hospital and its three sub centers, namely Gunjanagar, Bhandara and Madi was 29.877. The number of cases reported in cattle, buffalo, goat, sheep and swine were 13554, 11807, 4151, 199 and 166 respectively. Cattle, buffaloes and goats were the most common animals brought into the hospital; and its sub centers. The most common diseases diagnosed by the Veterinary persons and their assistants were liver fluke, FMD, Roundworm, Pneumonia, Haemorrhagic Septicemia and Mastitis. Indigestion, Tympany, Diarrhea and Dysentery, Anoestrous, Mange, Milk Fever, Wound and Abscesses were also common diseases recorded in this district.

Policy, Legal and institutional reforms required for livestock services in Nepal in context of WTO membership

Mahato SN (2003). Policy, Legal and institutional reforms required for livestock services in Nepal in context of WTO membership. *Proceedings of the 7th National Conference of Nepal Veterinary Association,* Tripureswor, Kathmandu, Nepal, 5-7 Nov, **24:**8-14

The animal health and livestock services act, the drug act and the animal feed act are the main legislations which are relevant to the WTO's agreement on the application of sanitary and phytosanitary measures related to animal health and zoonosis. Review of these acts revealed that there is an urgent need to formulate and enact a new Veterinary drug act. Also, it was found that it is desirable to amend the existing animal health and livestock services act and the animal feed act so that there are in conformity with the standards set by the OIE and Codex alimentarious commission. Department of livestock services appeared to be the main institution to implement SPS measure related to animal health and zoonosis. However the existing structure was developed when there was no Veterinary legislation in existence and the department was mainly involved in enhancing livestock production and productivity in the country. In the context of being the member of WTO, the DLS will have to play more important role in enforcement of the legislations, formulation and application of internationally acceptable national standards for quality control of animals. Animal production inputs and products of animal origin and effective control of zoonoses and economically important diseases of animals. Furthermore, the DLS will have to play the role of livestock industry and trade facilitators over and above safeguarding the health status of the national herd. Therefore, the DLS will require redefining its role and reforming in its structure in order to perform the new roles effectively and efficiently without putting any extensive financial burden on the government.

Outbreak of Otorrhoea in buffaloes in mid eastern region of Nepal

Singh S and NK Yadav (2005). Outbreak of Otorrhoea in buffaloes in mid eastern region of Nepal. *Nepalese Veterinary Journal*, **28:**128-134

This study was conducted during outbreak of Otorrhoea, reported around, Janakpur area during September-November, 2000, to determine the prevalence rate, microbiological involvement and response to different antiseptics and antibiotic therapy. The results of this study showed that only buffaloes were infected with this epidemic. Out of 622 buffaloes examined, 136 (21.86%) buffaloes were infected. Bacteriological examination revealed that, *Streptococcus Sp.* As the most prevalent (42.85%) organism, followed by mixed infection (28.57%) of Staphylococcus sp. (21.42%) and *Corynebacterium sp.* (7.14%). The recovery time from treatment with different antiseptic and antibiotics revealed no significant difference. Both treated and untreated animals recovered completely within 5-18 days. The economic losses, which occurred, were about 20-25% decrease in milk production and cost involved in treatment.

Traditional Chinese Veterinary medicine, concept and practices

Sharma B and BN Chaulagain (2005). Traditional Chinese veterinary medicine, concept and practices. *Nepalese Veterinary Journal*, **28:**114-117

Traditional Chinese Veterinary Medicine (TCVM) is a scientific summary of the rich experience of the Chinese struggle against disease since 4000 years back. This is a new concept of disease diagnosis and treatment and based on dynamic balance of body and external environment. Zang organs consist of heart, lung, liver, spleen and kidney. Fu organs consist of gall bladder, stomach, small intestine, large intestine and urinary bladder. Yin-Yang and five element theory are two fundamental principles of TCVM. Yin and Yang are 2 aspects of the unity of opposite things. The

five elements include the most basis elements in nature such as wood, fire, earth, metal and water. TCVM holds that the animal body maintains a relative dynamic balance among viscera and tissues and between the body and its external environment in which contradictions may cause disease. The etiology may be six exo-pathic factors such as wind, cold, summer, heat, dampness, dryness and fire. Pathogenesis may include the struggle between the vital and evil, imbalance of Yin and Yang and disorders of ascending and descending qi. Treatment is based on wholesome by using Chinese herbs, acupuncture and moxibustion.

Expansion of animal health and breeding services from private sector: CLDP experience

Paudel KP, RM Shrestha and S Paudel (2008). Expansion of animal health and breeding services from private sector: CLDP experience. *The 5th National Conference on Science and Technology,* Nepal Academy of Science and Technology(NAST), Khumaltar, Lalitpur, Nepal, 10-12 Nov, 2009

In Nepal, it is estimated that only 1/5 of the farm households have access to animal health service. The quality of the service is also seldom monitored and regulated. The regulatory mechanism is almost non- exist. The existing government policies support and recognize the need for promotion of veterinary service network from non-government/private sector. Towards materializing this policy into action, Community Livestock Development Project is promoting expansion of animal health and breeding services from private sector in 43 districts. In this context, Government role has to change from service provider to, more importantly, a facilitator and regulator of the veterinary services. Accessibility to effect health and breeding services is the key to successful commercialization of the livestock farming. In this paper status of some of the field practices, their trends and some of the important issues associated with professional progression, regulation, and sustainability of the practices are presented. It is estimated that private practitioners accomplish about 16% of the total AI services in the country. The details of strategies, approaches, and support mechanism that Community Livestock Development Project adopts to promote private sectors are discussed. Creation of a conductive environment for level ground competition among government and non government/private vet practitioners appears essential. Networking of these practices involving graduate veterinarians for professional references and adoption of regulatory mechanism are important challenges that need strategic attention to gain professional progression and harmony. Suggestions are made for recognizing private practices as essential part of the National Veterinary Service System and their regulation through a national regulatory body.

A clinico-pathologic evaluation of buffalo calves intoxicated with Gandhe jhar (*Ageratum houstonianum mill*)

Pal P, S Singh, P Kuswaha and DK Singh (2008). A clinico-pathologic evaluation of buffalo calves intoxicated with Gandhe jhar (*Ageratum houstonianum mill*). *The 5th National Conference on Science and Technology,* Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, Nepal, 10-12 Nov, 2008.

Six buffalo calves were experimentally intoxicated with Gandhe jhar aiming to know the clinico-pathological progression of toxicity caused by this plant. Animal were examined clinically, haematologically, bio-chemically, grossly and microscopically. Clinical signs included anorexia, weakness, abdominal pain, mild blOat, recumbency, hypothermia and terminally respiratory distress. Three calves were photosensitive. Appearance of signs in calves varied greatly from 48 hrs to 7 weeks. The clinical course lasted from 11-15 hrs. Hematology revealed a significant reduction ($P<0.05$) in Hb, total erythrocyte count, PCV and no change in total WBC count after onset of symptoms. Biochemically, ALT, AST, direct bilirubin, total bilirubin, total protein, BUN, and creatinine showed significant increase ($P<0.05$), whereas significant reduction ($P<0.05$) in

albumin and glucose was seen after onset of symptoms. Gross lesions included mildly enlarged hemorrhagic liver in 3 calves that died acutely and fibrous scares were present in 3 calves which died chronically. The gall bladder was distended and edematous. Hemorrhage was seen in visceral organs including GI tract and abomasum of all calves. Diffused hemorrhages were present in intestine and mesentery. Coccyfemoral joints had sero sanguinish fluid in acutely died calves and straw colored fluid in chronic cases. Microscopically, liver revealed massive necrosis and mild biliary proliferation in acutely died animals whereas periportal fibrosis, hepatic vacuolation and megalocytosis were seen in chronic cases. These findings suggested that Gandhe jhar produces toxic effect in the liver similar to pyrrolizidine alkaloids. Liver biopsy along with concurrent serum liver enzyme activities can be optional test for diagnosis of *a houstonianum* toxicosis

Epidemiological situation of animal rabies and its control strategy in Nepal

Karki S and KC Thakuri (2010). Epidemiological situation of animal rabies and its control strategy in Nepal. *Proceedings of the 9th Conference of Nepal Veterinary Association*, Veterinary Complex, Tripureswor, Kathmandu, Nepal, 22-24 April, 2010, pp 105-110

Rabies is an acute, fatal, preventable viral disease of mammals most often transmitted through the bite of a rabid animal and impacts public health, livestock and wildlife. Rabies is endemic in Nepal and is maintained in two interrelated cycles namely urban and sylvatic. With more than 200 people dying in Nepal annually, rabies is a serious public health concern. The animal rabies situation from 2000 to 2009 was analyzed and control strategy has bee proposed on the basis of the epidemiological information. Large ruminants were found to be the highest number dying among the animals clearly indicating the economic importance of rabies in Nepal. Hills were found the most affected among the eco zones while month wise during February showed of more cases and Jhapa district being most affected. Mass vaccination of the dog with effective management of dog population in community participation, public awareness and effective epidemiological surveillance backed by legislation shall have positive impact in reducing the cases of rabies both in livestock and human.

Prevalence of *Salmonella spp* in retail meat shops in Kathmandu

Upadhyaya M, P Manandhar, N Poosaran and R Fries (2010). Prevalence of *Salmonella spp* in retail meat shops in Kathmandu. *Proceedings of the 9th Conference of Nepal Veterinary Association*, Veterinary Complex, Tripureswor, Kathmandu, Nepal, 22-24 April, 2010, pp 124-132

A cross sectional study was conducted from November 2008 to May 2009 to estimate the prevalence of *Salmonella* in retail meat shops in Kathmandu. The methods followed were ISO 18593:2004 for swab sample collection, ISO 6579:2002 for *Salmonella* isolation and manufacturer's instruction (SIFIN®, Germany) for serotype identification. A questionnaire was used to collect information on some of the risk factors of shops likely to be associated with *Salmonella* identification. A total of 492 environmental swab samples (164 chopping board samples, 164 knife samples and 164 table samples) from 82 retail meat shops were analyzed. The prevalence of *Salmonella* positive shops were 40.2% (95% CI: 29-51). The isolation rates of *Salmonella* from chopping boards (36%), knives (32.9%) and table (25%) were not significantly different ($P<0.05$). Retail meat shops were 1.9 times more likely to yield *Salmonella* in the evening (38.2%) as compared to the morning (24.4%) ($P=0.001$). *S. typhimurium* (54.5%) was the most common serotype found in retail meat shops followed by *S.enteritidis* (16.9%), *S. Haifa* (13.6%), *S. Virchow* (10.4%), *S. agona* (3.9%) and *S. enteric* (0.6%). Among the risk factors examined, hygiene status of shop, type of shops, number of person handling meats, number of knives used, number of kinds of meat sold and number of

kinds of meat sold using different numbers of knives were individually significantly (P<0.05) associated with Salmonella contamination in the retail meat shops. After univariate analysis of these risk factors, a final logistic regression model with Salmonella yes or no category of shops as outcome variable identified 4 significant predictors. Odds ratios, indicating the likelihood increase of a shop to achieve Salmonella positivity status were 10.17 for multiple persons rather than a single person involved, 7.66 for open rather than closed shops, 9.44% for use of several rather than one knife and 5.18 for single kind of meat using several knives. The results of this investigation revealed that retail meat shops to a noticeable extent were Salmonella contaminated, with a considerable degree of cross contamination between meats, personnel and equipment used during a day in processing of meats.

1.2 NUTRITION

The use of urea treated straw in feeding lactating hill swamp buffaloes

Oli KP and NP Shrestha (1986). The use of urea treated straw in feeding lactating hill swamp buffaloes. *Paper Presented at the First Farming Systems Working Group Meeting*, Pokhara, Nepal, Aug 11-13, pp 255-263

Hill swamp buffaloes fed on urea treated straw achieved better weight gain and produced significantly higher milk yields (P<0.05) compared with those fed on conventional diets during the dry season. Theoretically both diets appeared deficit in DCP and adequate in ME. Therefore, the study indicated a further investigation on the digestion and metabolism of conventional feed resources available in the hilly areas of Nepal. Supplementing urea treated straw with conventional feeds during dry season increased the voluntary intake of straw by 30% and resulted increase in milk yield by 21% compared with buffaloes fed with conventional diets. Such a rise in intake cannot be justified by the rise in milk production. Therefore, restricted level of feeding needs attention. The farmers' acceptance of this new practice was very high. This concludes that in intensively cropped areas, the use of urea for treating straw and other crop residues during the dry season could be beneficial in maintaining body weight and increased milk production.

Effects on intake and milk yield of cows fed on urea treated paddy straw

Bajracharya JP (1986). Effects on intake and milk yield of cows fed on urea treated paddy straw. *Nepalese Journal of Animal Science, (NASA)*, **2**(2):1-12

The simple animal feeding trial was conducted to study the intake and milk yield of seven crossbred lactating cows randomly divided into three groups fed with untreated, 2% urea treated and 4% urea treated chopped paddy straw *ad libitum*. A simplest test was used to compare the results recorded. The average dry matter intake (kg/d) and milk yield (L/d) of cows fed with urea treated paddy straw were found significantly greater than that of cows fed on untreated paddy straw alone. The average daily dry matter intake of cows fed with untreated 2% urea treated and 4% urea treated were 4.65, 7.13 kg and the daily milk yields were 2.99, 3.88 and 4.51 liters, respectively. An average weekly milk yield comparison was also made between the present experimental cows and the diary herd of the Khumaltar Livestock Farm (1984/85).

Effect of urea treated paddy straw on milch buffalo

Shrestha NP and TS Dhaubadel (1987). Effect of Urea treated paddy straw on milch buffalo. *Nepalese Journal of Animal Science, (NASA)*, **3**(3)**:**11-19

Sixteen milking buffaloes randomly grouped into 4 treatments – 4% urea treated paddy straw, 1.5 % urea sprayed paddy straw, silage and untreated paddy straw supplemented with 1.5 kg

more concentrate. 19% more milk was obtained from 1.5 % urea sprayed group than untreated one and this difference was found to be significant at 0.1% level. However, no significant difference was detected from 4% urea treated group. The silage fed group yielded 34% more milk (significant at 0.1% level) than control group. The silage treatment was significantly better than rest of the treatment.

Supplementation of straw-based diets for lactating buffaloes in the eastern hills of Nepal

Chemjong PB, BB Kshatri, SR Shrestha and PP Rai (1990). Supplementation of straw based diets for lactating buffaloes in the eastern hills of Nepal. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 11-16 March, 1990, pp 111-116

An experiment was conducted to study the effect of supplementing straw based diets for lactating buffaloes. Four treatments were compared: A, 1% urea; B, 5% mustard cake; C, 0.1% common salt and D, chaffing and soaking straw in water. Four local buffaloes at a similar stage of lactation were selected near each of eleven service centers in the Koshi hills. The experiment was conducted from Jan to March 1989. During an initial 2 weeks period the buffaloes were given concentrate (according to the normal farm practice) plus un-supplemented straw. Then for a 4 weeks period the animals were given straw according to one of the treatment listed above plus concentrate. In the final 4 weeks period buffaloes were again given concentrate plus un- supplemented straw. Throughout the experiment, straw was provided ad libitum and farmers also fed small quantities of green fodders. During the treatment period the voluntary intake of straw increased by 39, 38, 30 and 29% for the 4 treatments, respectively, and milk yield increased by 34, 33, 11 and 2% compared with the initial period. Analysis of variance showed that treatment had a highly significant effect on increase in milk yield ($P<0.001$). Comparison of the means with the T test showed that treatments A and B (1% urea and 5% mustard cake) resulted in significantly higher ($P<0.001$) milk yields than treatments C and D (0.1% common salt and chaffing and soaking in water).

Economic value of urea treated straw fed to lactating buffaloes during the dry season

Chemjung PB (1990). Economic value of urea treated straw fed to lactating buffaloes during the dry season. *Nepalese Journal of Animal Science (NASA),* **6:**35-46

An experiment was conducted to study the effects of feeding urea treated rice straw to lactating buffaloes in The Koshi hills. Six pairs of similar buffaloes on farm were selected. All animals were given a conventional diet based on rice straw for 4 weeks, then one of each pairs of animals was given 15-20 kg/day of urea treated rice straw for a period of 4 weeks, while the control group received untreated rice straw. In final 4 weeks period all animals were given the conventional diet. Feeding straw treated with 4% urea increased voluntary intake of straw by 25% and milk yield by 1.6 lit/day compare with buffaloes fed conventional diet containing untreated straw, milk production remained elevated after the 4 weeks treatment period had finished. The results showed that buffalo fed urea treated straw achieved better weight gain, and milk yield increased significantly ($P<0.01$) compare with the control animals. During the treatment period, the net benefit was NRs 4/day, and the incremental rate of return was 46%. More over, in the 4 weeks following the treatment period, the net benefit was NRs 10/day. Ensiling rice straw with 4% urea can be recommended as an economic practice for small farm in the hills of Nepal

Effect of rice straw utilization of treatments with ammonia released from urea and direct feeding (supplementation) with urea by cattle heifers

Pandey SB and SM Pradhan (1991). Effect of rice straw utilization of treatments with ammonia released from urea and direct feeding (supplementation) with urea by cattle heifers. *Proceedings of the 1st National Workshop on Animal Science Convention (NASA),* Lalitpur, Khumaltar, Nepal, Jan 14-15, 1991, pp 56 - 61

Eighteen Jersey and crossbred (European X Nepali breed) cattle heifers initially about 286 kg LW and 29 months of age were divided into three groups on the basis of age and live weights. Three experimental rations viz. 1. Untreated rice straw ad libitum + 2 kg CM + Mineral lick (RS), 2. Urea supplemented rice straw ad libitum + 2kg CM + Mineral lick (USERS) were given at random to each group of animals. RS (Rice straw), USRS (Urea supplemented rice straw) and UTRS (Urea treated rice straw) had 9.7, 19.0 and 11.0 % crude protein contents. Intake of DM, OM, NDF, ADF, Cellulose, Hemicelluloses, Lignin, CP, Mineral/ and Water, CP balance, L W again, and digestibility of DM, NDF, Cellulose, and Hemicelluloses were not found significant/y different between Rest, USRS and UTRS. However, UTRS had significantly higher ($P<0.05$) OM and ADF digestibility than RS, and RS and USRS, respectively. Although the mean difference in the daily LW gain of the animals receiving RS, USRS and UTRS was not significant, L W gain tended to be higher on the groups of animals receiving USRS and UTRS.

Use of urea as a protein supplement in ruminant feeding: A review

Aryal IK and NP Shrestha (1992). Use of urea as a protein supplement in ruminant feeding: A review. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **7**(1):1-5

Shortage of feed is the main constraint in ruminant production in many developing countries. Crop residues which are abundantly available are low in essential nutrients especially protein, and digestible energy. Ruminant animals have a unique ability to convert non protein nitrogen to protein. The use of urea as a protein supplement has been found to be beneficial in ruminant production if basic guidelines are followed to prevent toxicity. In Nepal, since urea and molasses could be made available, the existing low quality straw could easily be utilized more efficiently by ruminants through supplementation with urea and molasses provided farmers and the extension support series are fully aware of this technology.

Urea and mineral supplements for cattle crossbred (European x Nepali) male calves fed rice straw basis diet

Panday SB and AP Sainju (1994). Urea and mineral supplements for cattle crossbred (European x Nepali) male calves fed rice straw basis diet. *Nepalese Journal of Animal Science (NASA)*, **8**(8)**:**31-42

Twelve, 8 months old male cattle calves of mean live weight 121.8 ±5.90 kg were divided into 3 groups on the basis of live weight and one of the 3 treatments was allocated at random to one calf within each group. The experimental ration were: 1. chaffed rice straw ad libitum + 300 g mustard cake + 300 g rice bran + 50 g molasses and 10 Nacl/kg air dry straw at feeding (Mo); 2. chaffed rice straw ad libitum + 300 g mustard cake + 300 g rice bran + 50 g molasses + 10 g urea + 29.5 g major minerals/kg air dry straw at feeding (Mo MMi), and 3; chaffed rice straw ad libitum + 300 g mustard cake + 300 rice bran + 50 g molasses + 10 g urea + 29.5 g major minerals + 0.5 g trace minerals (MOXCMI). The experimental period was of 13 weeks. The experiment was conducted to examine the effect of urea, molasses and minerals on the intake, digestion and live weight gains of cattle male calves fed rice straw basis ration. All the rations had the CP level above 7%. The average daily intake either in the absolute terms or in the

intakes /unit live weight, water intakes, and apparent digestibility were not found significantly difference between the rations. However, daily average CP balance and daily average live weight gains were found significantly difference between the experimental rations (P<0.05)

Effect of feeding urea and molasses treated rice and wheat straw diet on body weight gain and carcass characteristics of male buffalo calves

Shrestha HR, BS Kuwar, P Mandal, MS Thapa and SB Pandey (1997). Effect of feeding urea and molasses treated rice and wheat straw diet on body weight gain and carcass characteristics of male buffalo calves. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 24-25 Sep, 1997, pp 55-65

Sixteen crossbred Murrah male buffalo calves between 12-18 months of age were divided in to 4 groups A, B, C and D (4 animals in each). Group A were fed diet 1 containing 4 % urea and 4 % molasses treated and ensiled chaffed rice straw ad lib with 1kg concentrate and 100 g. mineral mixture per animal per day. Group B with diet 2 containing 4 % urea and 4 % molasses treated ensiled chaffed wheat straw ad lib with 1kg concentrate and 100 g. mineral mixture per animal per day, Group C with diet 3 containing 1 % urea and 4 % molasses freshly treated chaffed rice straw ad lib with 1kg concentrate and 100 g. mineral mixture per animal per day, and Group D with diet 4 containing 1 % urea and 4 % molasses freshly treated chaffed wheat straw ad lib with 1kg concentrate and 100 g mineral mixture per animal per day for a period of 120 days. Dry matter (DM) intake per 100 kg live weight per day was found highest in group A (3.03kg) followed by group C (2.94 kg), group B (2.69 kg) and group D (2.39 kg). Similarly, feed efficiency ratio (Kg live weight: DM intake) was found highest in diet 1 (1:15.78), followed by diet 3 (1:17.57), diet 2 (1:27.33) and diet 4 (1:86.4). Effect of diet in total body weight gain was found highly significant (P < 0.001).The growth rate per day was found highest in diet 1 (340 g) followed by diet 3 (240 g), diet 2 (127 g).However, the effect of diet D on the animals was found negative (-37g/day). Dressing percentage is found highest in group B (46.34 ±2.08) followed by group A (42.17 ± 2.08), group D (41.44 ± 2.08) and group C (40.36 ±2.08).But, there is no significant effect in dressing percentage and different carcass characteristics such as offal, bone and digestive tract etc.

Effect of feeding urea treated rice and wheat straw on total and straw dry matter intake and milk yield of lactating buffaloes under farmers' conditions

Khanal RC, DB Gurung and RK Kadariya (1997). Effect of feeding urea treated rice and wheat straw on total and straw dry matter intake and milk yield of lactating buffaloes under farmer's conditions. *Working Paper N. 97/62*, Lumle Agricultural Research Center (LARC), Lumle, Kaski, Nepal

Two experiments were conducted to study the effect of urea treated of rice and wheat straws on feed intake and milk yield of lactating buffaloes in their late lactation in various out-reach research sites of LARC under farmers management conditions in 1995 and 1997.Farmer's perception to the technology was also collected at the end of the experiment. Dry matter intake (DMI) from urea treated rice and wheat straws was not improved significantly (P>0.05). However, feeding urea treated rice straw increased straw DMI by 14.2% and total DMI by 10.63% units over the untreated rice straw. Similarly the increase in treated straw and total DMI was 20.18 and 17.40% units over the untreated wheat straw fed animals. There was a significant effect (P<0.01) of feeding urea treated rice and wheat straw on the milk yield of lactating buffaloes during late lactation under farmers conditions. Buffalo milk yield was also significantly affected by breed (P<0.01), lactation (P<0.01) and parity (P<0.01) of the animals. General response of the farmers about the technology and their observed effect on animal performance was also very positive. Since the experiments were conducted under farmer's

management conditions, its acceptance by the farmers and its relevance to them is relatively high. However, the farmers pointed availability of urea to be the major limitation of the technology.

Effect of pre-treatment of crop residues on the nutrient composition and in situ dry matter degradation in local male buffaloes

Khanal RC and RS Rana (2001). Effect of pre-treatment of crop residues on the nutrient composition and in situ dry matter degradation in local male buffaloes. *Proceedings of the 4th National Animal Science Convention (NASA)*. Kathmandu, Nepal, pp 87-95

There was a significant effect ($P<0.05$) of chemical pre-treatments on the nutrient composition of all 3 Fibrous crop residues (FCR) types. Organic matter (OM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL) and cellulose were found significantly ($P< 0.05$) reduced after treatment of FCR with Ca $(OH)_2$ and NaOH Treatment with 2% urea increased ($P<0.05$) CP content of the FCR but soaking FCR overnight in water did not have any effect on nutrient composition. Only NaOH had significantly ($P<O.05$) increased DM disappearance from the nylon bags. Its effect was clearly seen after 24 h of incubation in the rumen. Disappearance of DM of all 3 FCR types with and without pretreatment was more than 55%. A slight reduction in washing loss was observed by soaking in water over the control. Although potential degradability was above 60% in all the cases, effective degradability at c = 0.05 was less than 50% except in NaOH treated samples. Therefore, degradation kinetics was significantly ($P<O.05$) improved by NaOH treatment but not urea or soaking in water.

Response of lactating buffaloes when fed with treated or untreated rice straw with Badahar supplementation

Rana RS, N Amatya, R Jalan and PK Jha (2001). Response of lactating buffaloes when fed with treated or untreated rice straw with Badahar supplementation. *Proceedings of the 4th National Animal Science Convention (NASA)*, Kathmandu, Nepal, 2000, pp 114-119

In this study, the response of animals in milk yield to Badahar supplementation was significantly higher than the animals fed solely with rice straw. However, the intake of rice straw was higher in animals fed on untreated or dry rice straw. Other parameters like fat %, solid- not-fat (SNF), corrected Lacto-meter reading (CLR) and total solids (TS) of milk were considered in the study. There was no significant difference in SNF and CLR among all four groups. However, the effect of feeding Badahar was significant on fat% ($P<0.01$) and TS content of milk ($P< 0.05$). The values were higher for Badahar feeding animal.

Crop Residues utilization for Ruminant Feed

Jha PK, RS Rana, RC Khanal and BS Shrestha (2001). Crop residues utilization for ruminant feeds. *Technical Paper N. 2001/6*, Agriculture Research Station, Lumle, Kaski, Nepal

A participatory Rural Appraisal (PRA) survey conducted at eight different sites of Research Command Areas (RCA) of ARS, Lumle revealed that crop residues were the major source of feed for livestock. February to April (Falgun-Baisakh) was the most critical scarcity period for livestock feed. The survey combined with the secondary data source revealed that 1398 thousand MT of fibrous crop residues (FCR) is produced which meets about 36.65% of DM requirement of the ruminants in 11 western hill districts. Various pre treatment methods were applied to improve the quality and /or utilization of FCR. Pre treatment of FCR with $Ca(OH)_2$ and NaOH significantly ($P<0.05$) reduced organic matter (OM), crude protein (CP), neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL) and cellulose content. Treatment with 2% urea increased CP content of the FCR but soaking FCR over night in

water had not any effect on nutrient composition. However, only NaOH had significantly increased dry matter (DM) disappearance from the nylon bags but not by soaking in water or 2% urea. Its effect was clearly seen after 24 h of incubation in the rumen. Animal performance (lactation) studies were carried out with supplementation of concentrate, Badahar (A*rtocarpus lakooocha*) and urea molasses mineral block (UMMB) on FCR based diet. Supplementation of concentrates @ 1 kg per every 2 kg milk produced on wheat straw, rice straw and maize stover based diets showed that milk yield of lactating buffaloes (5-7 month of lactation) could be increased by 63.5, 36 and 27.41% respectively over the initial yield. Similarly, supplementation of Badahar to the lactating buffaloes with and without pretreated crop residue (rice straw) revealed that milk yield increased significantly ($P<0.001$) with supplementation of fodder tree leaves. Supplementation of UMMB to the lactating buffaloes fed on millet straw based diet improved milk production significantly whereas this effect was not evident on rice straw and wheat straw based diet.

Effect of concentrate supplementation in milk production of lactating buffaloes fed on crop residues based diets

Jha PK, Rana RS and Shrestha BS (2002). Effect of concentrate supplementation in milk production of lactating buffaloes fed on crop residues based diets. *Proceedings of 5th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, July 10-11, 2002, pp 31-36

The study was carried out at three different districts Tanahun, Syangja and Myagdi sites of the command areas of Agriculture Research Station, Lumle. The result of concentrate supplementation on rice straw, wheat straw and maize stover based diet revealed that milk yield of lactating buffaloes increased by 36.0%, 63.5% and 27.4%, respectively as compared to control group during the supplementation period. In addition, milk fat percent increased from 5.9 to 7.5, 5.7 to 7.8 and 5.8 to 6.05 on concentrate supplementation in rice straw, wheat straw and maize stover based diets, respectively. The chemical analysis of these crop residues showed that the highest nitrogen content was found in maize stover followed by rice straw and wheat straw.

A comparison between milk yields of cows given sun dried or ensiled millet straw

Hill R, BR Joshi, AH Harding and RK Kadariya (1999). A comparison between milk yields of cows given sun dried or ensiled millet straw. *Veterinary Review*, Animal Health Research Division, Tripureswor, Kathmandu, Nepal, **14**:34-36

Two groups of cows (Twelve Jersey crossbred cows in the latter part of their lactation), balanced for milk production, were allocated to sun dried or ensiled millet straw as the sole forage, fed along with appropriate amounts of concentrate feed. Milk yield was significantly greater from ensiled than sun dried straw, though the volume increase was relatively small. The intake of Dry Matter (DM) of silage was very viable probably reflecting the variation in silage quality given to the animals.

Use of fresh or ensiled sugarcane tops in lactating buffaloes

Mandal P and RD Pundit (2004). Use of fresh or ensiled sugarcane tops in lactating buffaloes. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal,* Kathmandu, Nepal, 1-2 July 2004, pp 119-121

Sugarcane is one of the main cash crops of Nepal. This crop is grown in whole Terai and mid-hill. This covers 43000 ha of land and the sugarcane tops is about 17% of 1552000-Mt sugarcane, which could full-fill the demand of green fodder during dry season to some context

if fed by making silage. Therefore, this study was conducted in farmer's field. Six farmers having milch buffaloes of similar parity were selected for this study. The buffaloes were divided into two groups with three replications. Group 1 was fed ensiled sugarcane tops with 2 percent urea and group 2 was provided fresh sugarcane tops in mid lactation period. Both groups were provided other regular feed. The milk yield was recorded for 90 days. The milk yield was found non- significantly different.

Effect of different tree fodder on milk production in buffaloes

Shrestha NP and B Pakhrin (1990). Effect of different tree fodder on milk production in buffaloes. *Special issue published on the occasion of 3rd National Veterinary Conference*, 10-12 Aug, 1990, **17-18:**46-51

Lactating buffaloes on farms were given one of 6 different tree fodders Tanki (*Bauhinia pupurea)*, Nimaro (*Ficus auriculata*), Kutmiro (*Litsea monopetala*), Raikhanim (*Ficus semicordata)*, Khasrekhanim (*Ficus cunia*) and Syalphusro (*Grewia oppositifolia*) for a period of 2 weeks. For all fodders except Nimaro milk yield increased above the initial value by 0.2 to 0.5 kg/day when tree fodders was fed. The reasons for the decreased milk yield resulting from feeding Nimaro were thought to be due to its poor digestibility and the presence of high amounts of hemicellulose and tannins.

Green Oat and maize silage based diet for dairy cow

Panday SB, NK Ranjit and HR Shrestha (1990). Green Oat and maize silage based diet for dairy cow. *Nepalese Journal of Animal Science (NASA)*, **6**(6)**:**25-33

Two groups of lactating cow with an average live weight of 312±7.3 kg was fed diets continue either 26% green Oat or 26% maize silage, in an experiment at Khumaltar. Measurements were made of intake and digestion of DM and milk yield of these animals. There was no significant difference in the intakes of DM, OM, NDF, Hemicellulose, Lignin and CP between the two diets. However, ADF and cellulose intakes of the green Oat diet were significantly lower than those of maize silage diet (approximately 8 and 25% respectively). Milk yield (FCM, 4% fat) was similar for both groups of cows given either green Oat or maize silage based diet.

A comparative study of tree fodders and maize silage supplementation on growth performance of buffalo heifers

Paudel GR, DB Nepali and DB Singh (1994). A comparative study of tree fodders and maize silage supplementation on growth performance of buffalo heifers. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **9**(1):12-14

An experiment was conducted to know the effect of feeding maize silage, ipil-ipil (*Leucaena spp*.) and Khanayo (*Ficus semicordata var. montana*) on the growth performance of Murrah buffalo heifers. The average daily weight gain was 461 gm, 420 gm and 408 gm for silage, Khanayo and ipil-ipil fed group respectively. No significant difference was found between the groups and/or to periods with respect to DM and TDN intake. This indicated that ipil-ipil or Khanayo could replace maize silage to obtain similar growth performance.

Response of Urea Molasses Mineral Block (UMMB) licks on milk production in lactating crossbred cattle

Mandal P, BS Kuwar, HR Shrestha and MS Thapa (2000). Response of UMMB licks on milk production in lactating crossbred cattle. *Proceedings of the 3rd National Animal Science Convention*, *(NASA),* Jawalakhel, Lalitpur, Nepal, Aug 27-28, 1997, pp 85-89

Six recently calved lactating crossbred dairy cattle with similar parity were divided into two groups comprising three in each group with similar management system and feeding regime. Group 1 was given Urea Mineral Molasses Block (UMMB) by partially replacing concentrate mixture and Group 2 was fed with calculated concentrate mixture (control) for a period of 150 days to find out the response of UMMB in milk production. At the end of the trial, it was found that the milk yield of UMMB fed animal was significantly different ($P<0.05$) than that of control group. Similarly, a positive correlation ($r=0.42$) was found between the UMMB intake and milk production.

Effect of supplementing Urea Molasses Mineral Block (UMMB) on the performance of lactating crossbred dairy cows

Pandey SB, RC Khanal and SK Khanal (2000). Effect of supplementing urea molasses mineral block (UMMB) on the performance of lactating crossbred dairy cows. *Proceedings of the 4th National Workshop on Livestock and Fisheries Research in Nepal,* Pakribas, Dhankuta, Nepal, April 24-26, 2000, pp 105-112

The effects of supplementing Urea–Molasses–Mineral Block (UMMB) on the performance of lactating crossbred dairy cows were investigated. The result revealed that in comparison to control group, there were significant increases ($P<0.05$) in total dry matter intake (DMI) (from 8.37±0.50 kg to 11.1±0.96 kg) and straw DMI (from 3.06±0.12 kg to 4.11±0.26 kg) in UMMB supplemented group. Like that there were significant increases in the daily milk yield ($P<0.05$) from 3.93±0.84 kg (control group) to 6.08±0.76 kg (treatment group). There were also significant increases in 4% FCM yields ($P<0.05$) and solid not fat (SNF) contents ($P<0.05$) from 9.03% ±0.49 to 9.4%±0.12. Although there was no significant difference in the fat contents of the milk from the experimental animals (3.85%±0.59) there was a tendency of higher fat content in the milk of groups of animals supplemented with UMMB.

Reproductive performance of dairy buffalo receiving supplements of Urea Molasses Multi Nutrient block

Tiwari ICP, JL Yadav and NR Devkota (2008). Reproductive performance of dairy buffalo receiving supplements of Urea Molasses multi nutrient block. *The 5th National Conference on Science and Technology*, Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, Nepal, 10-12 Nov, 2008

Buffaloes are pre dominant dairy animals in Nepal and contribute major role in milk production. However, poor nutrition limits their productive and reproductive efficiency. The effects of supplementary feeding of urea molasses multi nutrient block (UMMB) prepared by easy cold method were assessed during different phases of reproduction in dairy buffaloes during 2007/08. Supplementary feeding during the pre partum period improved post partum reproductive efficiency in terms of 1st estrus (34 vs. 48 days), and conception rate (30% vs. 0%) when compared to non supplemented control. Pre partum UMMB supplementation also improved the post partum yield. Supplementation with UMMB in buffalo calving at a young age included higher proportion (71% vs. 14%) through exhibit estrous during the 1st 50 days post partum, compared to non- supplemented control. Milk yield was greater and peak milk yield

was maintained for longer duration with UMMB supplementation during the post partum period. Similarly, in anestrous adult buffalo, supplementation with UMMB induced ovarian activity in 40% buffaloes during the summer season and in 90% buffaloes during winter seasons. UMMB prepared by cold method was economical and easily adoptable by marginal farmers. Results are discussed with supplementation UMMB in improved milk production and reproductive efficiency when offered during the pre partum period, post partum period, or in late lactation to anestrous buffaloes.

Effect of UMMB supplementation during winter on the milk production and its composition and infertility in dairy cattle in hill management production system

Upreti CR, BK Shrestha and B Ghimire (2010). Effect of UMMB supplementation during winter on the milk production and its composition and infertility in dairy cattle in hill management production system. *Nepal Journal of Science and Technology,* Nepal Academy of Science and Technology *(NAST),* Khumaltar, Lalitpur, **11:**71-78

Two groups, each containing 10 lactating crossbred Jersey cows were used to evaluate their feeding response on their milk production level and its quality in the mid hill's livestock production and management system. Ten infertile jersey cows were also selected for infertility study. The objective of the study was to evaluate on the response of UMMB feed supplements in two management systems on the milk production, composition, and correction in infertility problem. Two sites of different management systems, namely Saradabatase and Nala in Kavre district, were used to conduct the research for two years. Research was conducted during winter from Feb to Apr 2007 and 2008 for 60 with 7 days adjustment period in each site. Ten lactating dairy cattle were supplemented with UMMB and 10 without UMMB for 30 days. In each location, both groups were recorded for their milk yield and milk quality (milk fat and SNF %). After 30 days, group A was stopped to offer block group and B was started to supplement UMMB for 30 days. Two kg blocks were fed in UMMB feeder to control the intake. In Nala site (site A), 25% green grass was offered. But in Saradabatase (site B), rice straw was used as basal diet with or without small amount of green grass as per availability. Among the total eight repeatedly breeding jersey cattle, 25% came into heat and conceived due to positive effect of UMMB. Body condition score was improved from 3.5 to 4 due to the effect of UMMB supplementation. A simple economical calculation was done to find out the net income. A net daily profit of NRs 10.77 /animal in Saradabatase and 5.96 in Nala was recorded with the UMMB fed group compared to control group. Study has concluded that UMMB as a feed supplement in the mid hill management is economical for winter-feeding. UMMB supplementation is one of the means to correct infertility problem and for better body condition score in dairy cattle.

The effect of medicated and non medicated Urea Molasses Multi Nutrient Block (UMMB) supplement against nematode infection and milk production and milk composition

Sah IN, JL Yadav and BK Shrestha (2010). The effect of medicated and non medicated urea molasses multi nutrient block (UMMB) supplement against nematode infection and milk production and milk composition. *Proceedings of the 9th National Conference of Nepal Veterinary Association,* Kathmandu, Nepal, 22-24 April, pp 43-46

An experiment was conducted for 4 weeks on crossbred lactating cattle at IAAS livestock farm to find out the effect of medicated and non-medicated UMMB supplementation on nematodes load, milk yield and milk composition. For this, eight crossbred cattle of 3rd to 4th parity and between 2nd to 3rd months of lactation were selected and were allocated into four equal groups. Group A was kept as control, group B was supplemented with UMMB 400 g/cow/day for 28 days, Group C with medicated pineapple UMMB on 1st day and same as group B, rest of the days

and group D with medicated albendazole UMMB on 1st day and same as group B, rest of the days. The blocks were prepared manually by hot method. The ingredients were 40% molasses, 10% urea, 4% mineral mixture, 6% mustard cake, 4% salt, 14% cement and 22% rice bran. For medicated UMMB pineapple leaves powder @ 200mg/kg body weight and albendazzole 2 7.5 mg/kg body weight was used. At the end of the experiment, nematodes load decreased by 92.85%, 77.77% and 25% in albendazole, pineapple and plain UMMB group, respectively. Milk analysis was done by lacto scan and milk yield was found to be increased by 12.19% in plain UMMB group, 13.81% in pineapple-medicated group, and 16.66% in albendazole-medicated group and decreased by 6.25% in control group. Similarly, fat, SNF, lactose and protein was increased by 24.32%, 2.93%, 2.57% and 3.77%, respectively as compared to control group. There was no significant change in milk composition between medicated and non-medicated groups.

Effect of mineral supplementation on milk yield in buffaloes

Shrestha NP, PB Chemjong, SR Shrestha, PP Rai, SP Neopane, BB Khatri and IK Aryal (1992). Effect of mineral supplementation on milk yield in buffaloes. *Working Paper No. 26*, Pakhribas Agriculture Center (PAC), Pakhribas, Dhankuta, Nepal

An experiment to assess the effect of mineral supplementation on milk yield in buffaloes was conducted in four Koshi hill districts. The buffaloes of the treatment group were given the minerals containing sodium chloride @ 66 g/day mixed with *Khole*. The milk yield was recorded for one lactation period. The total milk yield was significantly higher in the treatment group ($P<0.05$). However, no significant differences in dry matter and crude protein intake were observed ($P>0.05$) between control and treatment groups.

Effect of mineral supplementation on displays of oestrus in cattle maintained at high altitude

Clinch NJL (1993). Effect of mineral supplementation on displays of oestrus in cattle maintained at high altitude. *Working Paper N. 93/6,* Lumle Agricultural Centre (LAC), Lumle, Kaski, Nepal

The use of one hundred and twenty four mature cows was obtained by the livestock section member of field staff stationed in Histan Mandali VDC. The animals were randomly divided into four equal groups. Age and parity of each animal was noted to ensure that equal representation of different classes of stock occurred. All animals were managed under the existing system of management. Among the four groups, group A (Control) received farmer's dose of one handful of salt every 15 days, group B received 20 g of salt per day and farmer's dose, group C received 30 g of bone meal and 20 g of salt per day and farmer's dose, group D received 50 g of mineral agrimin and 20 g of salt per day and farmer's dose over a period of 3 months (August-October), coinciding with the peak breeding season. Supplementation of mineral mixture at the recommended dose rate significantly increased the number of animals displaying overt signs of oestrus.

Report on mineral block supplementation to lactating buffaloes

Ghimire RP and SR Shrestha (1996). Report on mineral bloc supplementation to lactating buffaloes. *Working Paper N. 96/157*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

Effect of mineral block supplementation on lactating buffaloes were conducted in 7 outreach sites of the Mechi and Koshi hill districts between 1990 and 1992. Two years result of mineral block supplementation indicated that the treated buffaloes produced more milk than a control

group following 3 months supplementation. Fluctuation in milk production was found from June to Aug in the 1st year. Milk was continuously greater throughout the 2nd year in the supplemented groups than the control groups. Intake of food was increased, earlier conception and improved health of the buffaloes and their calves was observed after mineral supplementation. An effect of feeding minerals was a poor milk taste due to the dilution of block in the milk. The mineral block in the village was not available and whatever available purchasing of mineral block reported to be beyond the farmers' economic capacity.

Short term feeding trial of Pashu Poshak at three sites of Nuwakot and Kavre districts

Shrestha TP (2005). Short term feeding trial of Pashu Poshak at three sites of Nuwakot and Kavre districts. *Green Field Journal of Himalayan College of Agricultural Sciences and Technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **5**(1):27-35

Short term feeding trial (STFT) of Pashu Poshak (feed supplement) was initiated at 3 sites of Nuwakot and Kavre districts in Nepal. The average age of the experimental animals was 7 years. Animals with early lactation period were preferred more than animals with late lactation period. Average milk production of experimental animals in each morning and evening was 2.9 lit and average fat content was 6.8%. The average days in milking of these animals were 172 as most of these animals had already crossed peak period of milk production and approaching towards drying out as nearly 50% of these animals had already been mated. The control animals were milking animals with 2nd, 3rd and 4th lactation period. The average days in milking of these animals were 174/ each animal was fed in an average 8.6 kg of dry fodder, 12.8 kg of green forage and 3.8 kg of home made feed supplement with concentrate. Average milk production in the morning was 2.3 lit and in the evening 2.5 lit. Average fat % was 6.2. There was cent percent reduction in feed wastage and every animal had remarkably increased the appetite. On an average, 0.5 and 1 lit of milk yield was increased in 57 percentage of the experimental animals. Similarly, fat percentage was also increased in 72 percentage of the animals. Body weight and body reserve were improved as well. All farmers appreciated the changes seen in experimental animals and everybody appreciated Pashu Poshak. Some control animals had already discontinued evening milking. Dried animals were already sold as the participating farmers felt that it was not economic to maintain dry animals.

Productive and reproductive performances of different livestock species in response to GT 1000 animal feed supplementation

Tiwari MR, BS Shrestha, BR Acharya and BR Pokharel (2006). Productive and reproductive performances of different livestock species in response to GT 1000 animal feed supplementation. *Green Field Journal of Himalayan College of Agricultural Sciences and Technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **4**(2): 47-57

Experiments were carried out on cattle, buffalo, goats and piglets to evaluate the effect of GT 1000 on productive and reproductive performances of the animals in different villages and farms of Gorkha, Tanahun and Kaski districts of western hills during FY 060/61. A total of 24, 30, 30 and 16 cattle, buffalo, goats and piglets, respectively were divided into 2 groups by using complete randomized design (CRD). Cattle and buffalo of the trial groups were supplemented with 20 g GT 1000/head/day for a period of 60 days while the other group was kept as control. After 60 days, the groups were swapped and the animal's previously supplemented group was kept as control, whereas the animals in previous control group received the same amount of GT 1000 for 60 days. Similarly, goats and piglets of experimental groups were supplemented with 10 g GT 1000/head/day for 3 months and 45 days, respectively while the rest was under farmers feeding regime (control). In case of piglets, groups were swapped over after 45 days of supplementation. The response of GT 1000 was found positive for cattle in middle and early

stage of lactation whereas in buffaloes there was slightly increment of in milk yield during supplementation in their early lactation. The fat content of buffalo milk increased from 6.9 to 8.14% whereas it ranges from 4.49 to 4.76% for cattle during supplementation period. The supplementation of GT 1000 in goat feeding increased their body weight from 11.67 to 15.25 kg as compared to non supplemented groups (11.67 to 13.86) during 3 months. In case of piglets, a total weight difference of 1.66 kg was recorded during 45 days.

Fattening cost of buffalo calves through dried brewer's grains to replace concentrate mixture

Nepali DB, SK Kafle and MR Kolachhepati (1995). Fattening cost of buffalo calves through dried brewer's grains to replace concentrate mixture. *Proceedings of the 2nd National Animal Science Convention (NASA)*, Lalitpur, Nepal, Aug 7-10, 1995, pp53-56

A study of 75 days was carried out on 15 Murrah buffalo calves at Livestock Farm of the Institute of Agriculture and Animal Science, Rampur, Chitawan, to see the effect of replacing concentrate mixture of their diet through dried brewer's grains (DBG) on fattening cost. The overall fattening cost and cost to produce one kilogram of body weight were NRs.36.36; NRs.20.78; and NRs.23.02 for T1, T2 and T3, respectively. DM consumption by the animals to gain one kilogram of live weight for the respective treatments were 14.0, 9.0 and 11.3 kg, respectively. It was concluded that the dried brewer's grains could replace up to 25% crude protein of the concentrate mixture of the diets of buffalo calves satisfactorily.

Reconditioning of young male buffaloes for meat production

Mandal P, HR Shrestha and BS Kunwar (1997). Reconditioning of young male buffaloes for meat production. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, Sep 24-25, 1997, pp 187-193

Sixteen young male buffaloes ranging from 12-15 months old were procured from Janakpur livestock market of Terai. They were of approximately similar body weight (about 130 kg), height, breed (nondescript Murrah crosses), age (12-15 months) and other parity. These animals were divided into 4 treatment groups with 4 replications. All groups were managed in the same management condition with standard ration. Slaughtering was done by local method just by hitting on the head and just behind the back on 0 day, 15 days, 30 days and 45 days in treatment, 1, 2, 3 and 4 respectively. Data was analyzed by using ANOVA in SAS. At the end of experiment, it was found that the effect of rearing 30 days and 45 days was highly significant difference ($p<0.01$) on whole meat, daily body gain, dressing percentage with better economy. Others were found non-significant.

Effect of plane of nutrition on meat production from buffalo calves

Nepali DB, SB Singh and NP Joshi (1998). Effect of plane of nutrition on meat production from buffalo calves. *Journal of Institute of Agriculture and Animal Science (IAAS),* Research Report, (1985-91) Rampur, Chitawan, Pp150-155

A study was conducted to determine the effect of different plane of nutrition on meat production in 12 male buffalo calves for 210 days. Three treatments consisted of pasture only (T1), 2.5 % urea molasses liquid diet + green supplement diet (T2) and complete ration (T3). Daily body weight gain recorded for these groups were 186 ± 12.45 (T1), 142 ± 27.2 (T2) and 309 ± 64.72 (T3) grams. Daily gain for the group on T3 diet was much higher compared to the groups on T1 or T2 diets ($P < 0.01$). At the end of the experiment, one calf from each treatment groups were randomly selected and slaughtered. Dressing Percentage was highest for T3 (92.7Kg and 48 .5 %) and followed by T1 (69 .4 Kg and 44.2 %) and T2 (62.4 Kg. and 42.9 %).

The total cost per Kg live weight gain was highest for T2 (Rs.29.03) followed T3 (NRs 18.43) and T1 (NRs 5.37).

Preliminary investigation on early weaning and artificial rearing of buffalo calves

Rana RS, DP Rasali and RC Khanal (1998). Preliminary investigation on early weaning and artificial rearing of buffalo calves. *Veterinary Review*, Nepal Agricultural Research Council (NARC), Khumaltar, Lalitpur, Nepal, **13:**34-36

A preliminary trial on early weaning and artificial rearing of buffalo calves was conducted at ARS, Lumle livestock farm. Four new born calves were allocated to each of 3 treatment groups of feeding and management regimes. The findings of the study showed that buffalo calves could be successfully weaned after one month of birth and reared by feeding on locally made concentrate mixture. Based on the preliminary findings obtained from this study, further in depth investigation into its technical and socio economical aspects is warranted.

Effect of concentrate feeding on meat production of male buffalo calves

Shrestha HR, BS Kuwar and MS Thapa (1999). Effect of concentrate feeding on meat production of male buffalo calves. *Proceedings of 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, 26-28 June, 1999, pp 214-220

Eight male buffaloes of 30 months of age were divided into two groups A and B, containing 4 animals in each. Group A was fed 2 kg concentrate feed per day per animal along with ad-lib green grass. Group B was fed only adlib green grass. Both of the groups were kept in this feeding regime for 135 days. Dry matter intake per kg live weight was found to be 19.06 kg in group A where as in group B it was 168.16 kg. The body weight gain per day is 389.00 and 34.00 gm/day/animal in group A and group B, respectively. The dressing percentage of group A was 42.00 ± 1.8 and in group B it was 32.9±1.8.

Fattening of male buffalo calves for meat production

Rana RS, N Amatya and HR Shrestha (1999). Fattening of male buffalo calves for meat production. *Veterinary Review,* Animal Health Research Division, Tripureswor, Kathmandu, Nepal **14**:1-6

Meat production potential and carcass characteristics of 8 local male buffalo calves studied by feeding a group of 4 calves (treatment group) with concentrate ration at the rate of 2.32 kg/day (an average) for a period of 157 days and another group of 4 calves (control group) under traditional village feeding practices. The average DM intake and the initial body weight of both groups were similar at the beginning of the experiment. However, during the trial period, the final body weight of treatment group was significantly higher ($P<0.05$) than that of the control group i.e. 267 and 225 kg respectively. Dressing and meat percentage of the treatment group was significantly higher as compared to control group i.e. 33.38: 13.54:1 vs. 18.16:3.68: 1 respectively. Economically, a single buffalo of treatment group produced a net income of NRs 4154, which was significantly higher than of control group (NRs 2288).

Economics of replacing whole milk with unconventional milk replacer for calf rearing

Kuwar BS and HR. Shrestha (1999). Economics of replacing whole milk with unconventional milk replacer for calf rearing. *Proceedings of 3rd National Workshop on Livestock and Fisheries Research* in Nepal, Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, pp 208-213

Two milk replacers (one containing limited whole milk and containing butter milk) were compared with whole milk in 3 weeks old calves up to 4 months of age for growth rate and

economic performance. There was no significant difference between diet groups for growth rate. But there was a saving of NRs. 2,384 per calf fed milk replacer containing buttermilk and NRs 2,141 per calf fed milk replacer containing limited quantity of whole milk over whole milk feeding. It was possible to successfully wean the calves at 3 weeks of age and subsequently raise them by feeding milk replacer, concentrate and green grasses.

Studies on the effect of different feeding management on growth performance of Murrah buffalo heifers

Mandal P, RB Shah, RD Pandit, BP Budhnagaria and RS Mandal (2000). Studies on the effect of different feeding management on growth performance of Murrah buffalo heifers. *Proceedings of the 4th National Workshop on Livestock and Fisheries Research in Nepal*, Pakhribas, Dhankuta, Nepal, April, 24-26, 2000, Pp 127-131

This study was carried out to evaluate the feeding management on growth performances in buffalo heifers. Twelve female calves of Murrah buffalo were selected having dams were of same breed, similar lactation number and milk production of previous lactation. They were divided into two treatment groups (individual feeding and group feeding). Similar feed was provided to them throughout the study. All management practices were applied regularly (drenching, vaccination etc). Individual feeding was found effective ($P<0.01$) than the group feeding from 7 months to 24 months of age.

Development of Technologies for Buffalo calf Rearing and Fattening

Jha PK (2003). Development of Technologies for Buffalo calf rearing and Fattening. *HRP Project Completion Report*, Regional Agricultural Research Station, Lumle, Kaski, Nepal

Based on the survey report relating to technical and socio economic constraints on buffalo calf raising and fattening in the western hills (Command areas of Lumle Agriculture Center), it came to know that there exist critical lack of technical knowledge about buffalo calf rearing. Therefore, a trail was conducted with the objective to develop appropriate buffalo calf rearing and fattening technologies. Drenching against the liver fluke and vaccination against HS and BQ showed low rate of calf mortality as compared to untreated calf groups. Trail on weaning and artificial rearing of buffalo calves revealed no significance difference in growth rate of calves suckled by their mother or fed with substitute and starter ration. Likewise feeding concentrate to male buffalo calves at 60: 40 (concentrate: roughages) ratio on dry matter requirement basis resulted higher daily live weight gain(747 g/day)as compared to other treatment group, 50:50 and 40: 60 ratio group.

Study on the effect of concentrate feeding on different traits in buffalo heifers

Mandal P and SB Shrestha (2004). Study on the effect of concentrate feeding on different traits in buffalo heifers. *Proceedings of 5th National Animal Science Convention (NASA)*, Kathmandu, Nepal, October 15-16, 2003, pp 173-176

Twelve Murrah female calves with almost similar birth weight and reared on same management and weaned at six months of age were kept on this study. The calves were divided into three treatment groups with four replications. The concentrate was given @ 5%, 20% and 35% of required DM to the treatment 1 (control), 2 and 3, respectively. The body weight was recorded weekly up to three month of age, fortnightly up to 6 months of age and monthly after 6 month of age. The body weight gain was observed 285 g/d; 308 g/d and 453 g/d from ration fed @ 5%, 20% and 35%, respectively at the age of 24 months and were significant at 5% level. However, maximum body weight gain noted 593 g per day from ration fed @ 35% concentrate and found highly significant at 1% level during 6-12 months of age.

Fattening buffalo calves for economic meat production

Bastola BR, HR Shrestha, MS Thapa and NP Osthi (2006). Fattening buffalo calves for economic meat production. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 1-2 July, 2004, pp 140-145

Nine male buffaloes of similar age group of about one year were tested in farm condition after 3 weeks adaptation period for fattening with CRD design in 3 treatments groups. These animals were fed different composition of ration according to their body requirement ,T1- mixed grass and straw ad libitum, T2- mixed grass and rice straw + concentrate ration (roughage, concentrate ratio 70:30 in DM basis) and T3- mixed grass and rice straw + concentrate ration (roughage, concentrate ratio 50:50 in DM basis) for a period of 140 days. The daily weight gain of calves in T1, T2 and T3 groups during observation period were 202, 455 and 618 g/day, respectively, which was statistically significant ($P<0.05$). The initial body weight of the calves was taken as covariate. The DM intake among treatments was found 3.63, 3.57 and 3.82 kg/day in experimental period, the difference being statistically non- significant. The net benefit obtained were NRs 3850.0, 4519.0 and 4127.0 from T1, T2 and T3, respectively in a fattening period of 140 days.

Effect of different level of concentrate mixture feeding on growth performance of buffalo calves

Tiwari MR, BS Shrestha, IP Acharya and BR, Acharya (2006). Effect of different level of concentrate mixture feeding on growth performance of buffalo calves. *Green Field Journal of Himalayan College of Agricultural Sciences and Technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **4**(1):60-71

In the farm of Regional Agricultural Research Station, Lumle a fattening trial was conducted (266 days) on 10 buffalo calves randomly dividing them into two groups with four animals in each group to find the appropriate period of fattening and concentrate level for fattening. Concentrate mixture for both groups was used manufactured by Hetauda Cattle Feed. For treatment 1, 50% dry matter requirement as per body weight (@2.5 kg/ 100 live weights) was fulfilled by concentrate mixture whereas for the treatment 2, only 30% dry matter requirement was provided by concentrate mixture. Initial body weight of experimental animals (treatment 1 and 2 was 78.4 ±2.9 and 77.6±7.9 kg, respectively) which was not significant between groups ($P=0.92$) that increased to 207.6±3.3 and 181.4±8.7 kg for the respective groups after 266 days of feeding. Carcass study of male buffalo calves revealed that the dressing (51.75%) and meat percentage (40.2) of Treatment 1 was higher than that of Treatment 2 (48.38 and 36.31 dressing and meat percentage respectively) whereas, bone percentage of Treatment 2 (11.22%) was higher than that of Treatment 1 (10.7%). Economical analysis of experiment revealed that optimum fattening period was up to six months because the highest profit was recorded (NRs 65 and 56.06/kg live weight gain for Treatment 1 and 2, respectively) during that period.

Economic analysis of fattened male buffalo calves for meat production at Saudiyar, Dang, Nepal

Devkota NR (2010). Economic analysis of fattened male buffalo calves for meat production at Saudiyar, Dang, Nepal. *Nepalese Journal of Agricultural Sciences, Himalayan College of Agricultural Sciences and Technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **8:**130-136

A field level experiment on forage based fattening of male buffalo calves was accomplished in Saudiyar VDC of Dang district, during 2006 and 2007 with the objective to find out the cost effectiveness of the technology generated from the fattening experiment. Accordingly 20

buffalo calves around 8 months of age were divided into 2 equal feeding groups; one group of animals were fattened only with forage while the other group were fattened by supplying limited amount of concentrate in addition to the forages. In each of the group half of the animals were fattened only for 180 days, and remaining half were fattened up to 300 days after the start of the experiment. The gross margin analysis was done and cost per kg meat production, gross margin per kg meat production and the benefit cost (BC) ratio were calculated. The findings revealed that the cost per kg meat production was increased when fattening period was lengthened from 180 days to 300 days under both fattening management, where it was not much affected by feeding management. The gross margin per kg meat production and BC ratio were quite similar under both feeding management when fattened for 180 days, but were higher value of gross margin per kg meat production was obtained under forage based feeding when fattened for 300 days. The findings of the analysis revealed that early fattening up to 180 days after 8 months of age would be economically better than fattening up to 300 days. Furthermore, the findings also revealed that there is a scope of improving the fattening performance of male buffalo calves even if fattening is done based in forage feeding only.

Effect of steaming up of crossbred dairy cows during the late pregnancy on the economy of milk production

Shrestha HR, BS Kuwar, P Mandal and MS Thapa (1997). Effect of steaming up of crossbred dairy cows during the late pregnancy on the economy of milk production. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, May 7-9, 1996, pp253-258

In this trail, the effect of supplying extra feed during the last pregnancy period of dairy cattle in coming milk production was tried to investigate. Data of milk production of cows and growth rate of their calves was analyzed by using ANOVA. It was found that the effect of 4.5 kg concentrate feeding during the last two months of pregnancy on the milk yield of respective lactation was significantly better ($P< 0.01$) than 4.0 kg, 3.5 kg & 3.0 kg concentrate feeding. Economic analysis of all these feeding regimen was made and it was found that 4.5 kg concentrate feeding during last two months of pregnancy was most economical (NRs. 6,806.1 net profit / 305 days of lactation) than other feeding regimes.

Feeding practices for lactating buffaloes in Sharadanagar village, Chitawan

Pant SS, NP Joshi and KP Gajurel (1994). Feeding practices for lactating buffaloes in Sharadanagar village, Chitawan. *Journal of Institute of Agriculture and Animal Science (IAAS*), Research Reports (1992/1993), Rampur, Chitawan, pp 116-126.

A study was conducted with the objectives of finding out the status of feeding practices for lactating buffaloes. Methodology comprised of informal survey with the credible members of randomly selected 27 households covering nine households from each of three wards on the basis of landholding size (< 1 bigha, 1-3 bighas and > 3 bighas).Assessment of common species and proximate quantity of roughages and concentrates were made in order to find out the prevailing feeding practices. Results showed that common grasses and fodders were Siru (*Imperata spp*.), Kans (*Saccharum spp*.), Banso (*Paspalum spp*), Maize (*Zea mays*) and Oat concentrates. Inclusion of rice straw as a major feeding resource was common in the entire land holding group. There was no marked difference in these feeding practices in terms of animal species and quantity among the different landholding groups. Likewise, dry matter requirement (15 kg /day/buffalo) was found deficit in all types of landholdings i.e. 8.24kg for < 1 bigha, 8.49 kg for 1-3 bighas and 8.32 kg for > 3 bighas, respectively.

Fodder biomass production from Badahar and response of its feeding on lactating buffaloes

Paudel, KC and DP Rasali (1996). Fodder biomass production from Badahar and response of its feeding on lactating buffaloes. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, May 7-9, 1996, pp14-25

A study on fodder biomass production from Badahar (*Artocarpus lakoocha*) and feeding trial to study the response of feeding of Badahar leaves on lactating buffaloes were conducted in the farmers' homesteads on the western hills of Nepal. The relationship between the size of tree and fodder biomass production for Badahar investigated in a lopping trial carried out at Jhobang village (1100m asl), Kaski district, during the winters of 1991 and 1992 showed that diameter at breast height (DBH) gave the best prediction of fodder biomass production. The regression equation derived on the basis of two years data from 50 trees of 3-50cm DBH is Ln biomass = -2.8+2.16 Ln DBH (R2=95%). Of the total fodder harvested in farmers' practices in Nepal, 65% leaves and 35% twigs. Feeding trials have shown that approximately 70-80% of the fresh fodder is palatable to buffalo. The response of feeding Badahar leaves on milk yield, butterfat content and health condition of Murrah cross buffaloes showed a significantly higher milk yield during the Badahar feeding period (4.09 kg/day) compared to other periods (3.2-3.4 kg/day). The average linear response for all the animals to feeding Badahar was 0.069-litre milk/day. No significant effect of Badahar was detected on percentage butterfat content in the milk. However, the total butter fat production was higher due to an increase in overall daily milk yield during Badahar feeding period. All the buffalo owners reported that feeding Badahar leaves improved the animals' health condition, increased milk and butter fat production. No negative effect of feeding Badahar was noticed. The careful selection of farm animals, the provision of an adequate period to detect the effect of tree fodder on animal performance and the need to test many other preferred tree fodder to find their relative feed value are recommended.

Effect of feeding frequency on milk production of crossbred dairy cattle

Kunwar BS, HR Shrestha and P Mandal (1996). Effect of feeding frequency on milk production of crossbred dairy cattle. *Proceedings of 1st National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, May 7-9, 1996, pp 246-252

The milk production of these animals in both lactations was analyzed by General Linear Model Procedure. After analyzing the data and keeping the effect of breed, lactation and season on milk production of these experimental animal was no significant (Pr>01.). It was found that the effect of three times feeding of concentrates on milk production was significant (P< 0.05).

Effect of feeding cotton seed meal on intake, digestibility and performance of crossbred dairy cows

Panday SB, RC Khanal, RS Rana and SK Khanal (1999). Effect of feeding cotton seed meal on intake, digestibility and performance of crossbred dairy cows. *Proceedings of 3rd National Workshop on Science and Technology*, Royal Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, Nepal, March 8-11, 1999, pp 1071-1075

A feeding cum lactation trial was conducted at the Livestock Research Complex, Khumaltar, Lalitpur to study the response of lactating crossbred dairy cows to feeding Cotton Seed Meal (CSM) on performances such as dry matter intake, milk yield and apparent digestibility of the rations for a period of 39 days. Replacement of CSM was made at 25% of the concentrate mixture. A general trend of reduced feed intake was observed but there was no significant

effect on total Dry Matter Intake (DMI), milk yield and apparent digestibility when 25% of the concentrate mixture was replaced with CSM. However, a significant reduction (P<0.01) in roughage (both rice straw and green grasses) intake was observed in CSM fed cows. There was a small but not significant increment in average milk yields, 4% fat corrected milk yield, fat, solids not fat and total solids content in the milk of CSM fed cows. Cows in both the treatment groups gained some weight at the end of experiment. It indicated that up to 25% can be given to lactating crossbred cows without any adverse effects on their general performance.

Effect of prepartum concentrate feeding on milk production in dairy buffaloes

Mandal P (2002). Effect of prepartum concentrate feeding on milk production in dairy buffaloes. *Proceedings of the 5th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, July 10-11, 2002, pp 37-40

Twelve pregnant Murrah buffaloes of similar lactation number were divided into four treatment groups A, B, C and D randomly. They were provided the concentrate @ 3.5, 3.0, 2.5 and 2.0 kg, respectively twice a day. This concentrate was given prior to 60 days of calving. The milk yield was recorded daily two times for a peak lactation period of 120 days and found highly significantly difference in group A, B, C and D.T1 Group produced milk 1522 liters and T4 group produced only 962 liters in 305 days. Similarly the birth weight was found significantly difference. It is recommended that the animal, which is in pregnancy, should be fed more than 3 kg concentrate feed depending upon the condition of milking buffalo at least two months prior to two months of calving.

Promotion of low cost fodder based milk production systems using Canadian forage Sorghum hybrid-30 for the livelihood of the smallholders' dairy farmers of Nepal

Sapkota RP, PS Panday and JC Gautam (2007). Promotion of low cost fodder based milk production systems using Canadian forage sorghum hybrid-30 for the livelihood of the smallholders' dairy farmers of Nepal. *Proceedings of the 8th National Outreach Research Workshop*, Khumaltar, Lalitpur, Nepal, 19-20 June, 2007, pp 409-418

Dairy enterprises are growing business, contributing the livelihoods of over 50,00,000 smallholders. The dairy cattle and buffaloes, raised on concentrate based feeding systems are contributing to higher cost of production. Farmers are finding difficulties to sustain the dairy farming due to increasing feed cost, but are compelled to continue in absence of other suitable means for livelihoods. Fur sustainable and more competitive marketing, the production cost needs to be drastically reduced. Various attempts have been made to reduce the cost of production; growing fodder and pastures is a recent intervention and cultivation of fodder crops like Oat, vetch, Stylo, Napier is quite common. Contrary to the traditional fodder crops, the Canadian forage sorghum hybrid-30 is most suitable as a substitute to expensive concentrate feed; developed in Canada and tested by Nepal Agricultural Research Council (NARC). Since 2005, ABTRACO has been supporting small dairy farmers to practice cost effective milk production systems using CFSH-30 cultivation jointly with Department of Livestock Services (DLS) and NARC; supported by CCO/Nepal. During 2005/06, a total of 240 demonstration plots (each 500 m^2) established in 8 districts (Ilam, Jhapa, Sunsari, Chitawan, Lalitipur, Kavre, Rupandehi and Banke) and 500 packets of mini kits were distributed in 4 districts (Dhanusa, Mahottari, Siraha and Sarlahi). Forage production sub groups, comprising 30 smallholders' dairy farmers with 50% women members formed; training on forage production and management provided and required quantity of seeds for three successive seasons supplied to grow year round fodder. The performance and contribution of CFSH-30 ensured fodder supply, with the estimated yield 50 Mt GM/ha, demonstrated that it can effectively substitute of expensive concentrate feed and greatly contribute to reduce cost of

combined with awareness towards year round fodder cultivation, animal health services and marketing development to lead the nation towards the competitive market oriented economy and improved livelihoods of small dairy farmers.

Effect of green fodder supplementation on cost of milk production in lactating animals

Munakarmi PB, KK Shrestha and KP Aryal (2009). Effect of green fodder supplementation on cost of milk production in lactating animals. *Proceedings of 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 128-132

Farmers have practiced to feed their animals concentrate along with crop residues such as paddy straw, maize stover and some green grasses. Inclusion of concentrate in the daily feed is expensive which results into increased the cost of milk production. In order to produce economical livestock products the alternative is to feed ruminants green forage at adequate quantities. The farmers cultivate Oats (*Avena sativa*) and Vetch (*Vicia sativa*) in mixture as winter fodder, Teosinte (*Euchlaena mexicana*) and Cowpea (*Vigna sinensis*) in mixture as summer fodder crop. Similarly, Napier (*Pennisetum purpureum*), Ryegrass (*Lolium perenne*), Setaria (*Setaria anceps)*, Paspalum (*Paspalum dilatatum*) and White clover (*Trifolion repens*) are cultivated as perennial forage crop while Kimbu (*Morus alba*), Ipil ipil (*Leucaena leucocephala*) as fodder tree for feeding milch animals. The result on economical parameters indicated that inclusion of 35-40 kg green fodder in daily ration of milch buffaloes gave the highest net profit of NRs 42.0/day and helped in reduction of concentrate by 66%.

Study on the performances of dairy crossbred cattle on different feeding regimes

Pradhan SM, MS Thapa and KP Shivakoti (2009). Study on the performances of dairy crossbred cattle on different feeding regimes. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 238-240

This study was conducted to find out the appropriate feeding regime for crossbred (Nepali x Jersey) cattle at Khumaltar. Three different daily rations were formulated based on their body weight. The treatments were i) T1=2/3 DM requirement from green forage (Oat) + 1/3 DM requirement from concentrate mixture ii) T2=2/3 DM requirement from roughage (50% green Oat + 50% rice straw) + 1/3 DM requirement from concentrate mixture and iii) T3= 2/3 DM requirement from roughage (rice straw) + 1/3 DM requirement from concentrate mixture. The study was conducted in crossover design with 3 cows as one replicate for 3 weeks. After 3rd week, the animals were changed to next treatment group. One-week adaptation period was provided for the next treatment. No significant differences in milk yield were observed among 3 different treatment though the average milk yield in T1 (6.3 l/day) was higher than in T2 and T3 (5.4 and 4.5 l/day). On feed cost basis per liter milk production cost from T1 (NRs 12.03) was the cheapest.

Traditional feeding practices of buffaloes in the Koshi hills

Gatenby RM, SP Neopane and PB Chemjong (1989). Traditional feeding practices of buffaloes in the Koshi hills. *Technical Paper N. 89/99*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

Forty-five farmers keeping buffaloes were questioned. About 40% of herds were stall fed, but 60% grazed an average of 6 hrs/day. The quantity of food provided to each buffalo averages 25 kg/day, and there was a negative relation between grazing time and amount of food provided. Even at the end of dry season, about 60% of the food was green fodder, predominantly tree fodder. Other fodder was grass, rice straw, green maize plants, millet straw, maize stover and husks. A small quantity of concentrate was always fed, mainly crop byproducts such as maize

and rice bran, mustard cake, brewer's residue and vegetable waste. Boiled water was added to the concentrate.

Analysis of ruminant feeding system (cattle and buffaloes): the case of Kavre district

Bhattrai U (2005). Analysis of ruminant feeding system (cattle and buffaloes): the case of Kavre district. *Proceedings of the Workshop on Fodder Oats, Fodder Technology Packages and Small Farm Income Generation*, Kathmandu, Nepal, 8-11 March, pp 73-76

Kavre is a major milk-producing district of Nepal but dairy stock, both cattle and buffaloes generally have yields well below their breed average. There was little or no grazing land and livestock were fed on cut fodder during summer but in the cool, dry winter, the bulk of their ration was coarse crop residues. These rations were seriously deficient in protein and this limits milk yield. Increased fodder production and use of perennial legumes could palliate this protein scarcity.

Feeds and feeding situation of livestock in the Terai region of Nepal

Yadav JL and NR Devkota (2005). Feeds and feeding situation of livestock in the Terai region of Nepal. *Proceedings of the Workshop on Fodder Oats, Fodder Technology Packages and Small Farm Income Generation*, Kathmandu, Nepal, 8-11 March, pp 83-90

This paper describes the commonly available feeds and feeding for ruminants in the Terai and the scope to improve nutritive value of fodders, and the productivity of animals. Feeding was largely based on rice straw and other crop residues, wild grasses and herbs were dominant feedstuffs, distribution of which varied according to season and land utilization pattern. The year round supply of quality feed was very deficient; milk supply droped drastically in winter when green feed was scarce. Improvement of situation may be by: (1) greater use of improved forage (on existing crop land, marginal lands and river/channel bank); (2) treating crop residues so that as much as energy is economically possible is extracted from, and (3) by focusing research on genetic improvement of crop residues.

1.3 BREEDING

Historical accounts of animal breeds and breeding activities at the Institute of Agriculture and Animal Science, Rampur, Chitawan, Nepal

Kharel M and S Tiwari (1992). Historical accounts of animal breeds and breeding activities at the Institute of Agriculture and Animal Science, Rampur, Chitawan. *Journal of Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan*, **13:**129-132

This study reviews the introduced animal breeds and breeding activities made at IAAS Livestock Farm in the past. The former name of IAAS livestock farm was Rapti Livestock Farm established in 1962, which handed over to IAAS by His Majesty's Government of Nepal in 1978. Improved breeds of animals were introduced and breeding activities were also initiated during the establishment stage of the farm. In the early years of 1960's, the improved breeds of cows such as Red Sindhi, Jersey crossbreeds and Haryana cattle were introduced from Singha Durbar, Kathmandu and Rohtak and Calcutta of India, respectively. The Jersey crossbreeds and Red Sindhi and their crossbreeds were removed from the farm as the Haryana cattle performed better. A pair of Haryana bulls was also brought from Tarahara Farm. Several studies recommended Haryana cattle for intensive crossbreeding with Jersey and Holstein Friesian. There were about 10 Jersey x Haryana crossbreeds which were superior to pure Haryana cows. Murrah buffaloes were introduced from Jiri Livestock Farm of Nepal, Rohtak and Calcutta of India in 1964 and 1968, respectively. Later on, bulls were also introduced from Tarahara Farm,

Gandaki Agriculture Development Project, Khairenitar, Tanahun and Livestock Development Farm, Lampatan, Pokhara for breeding purpose. However, the improvement in productivity of Murrah buffaloes could not be observed. In early 1970's, Jamunapari goats were introduced to IAAS Livestock Farm from Etawah, India but the total stock was collapsed due to the disease. In 1980's, Khari Local goats collected from Nawalpur and Chitawan were raised. They had slow growth rate with high fecundity. The US-ISRAEL CDR supported research program entitled "Increased Meat Production in Goat Through Crossbreeding" operated at IAAS during 1986-92 introduced two Damascus and two Member bucks from Israel and the project left 50 crossbreeds in the IAAS Livestock Farm. Kage sheep collected from the different pockets of Kathmandu valley and were introduced to IAAS Livestock Farm in 1984. Two 50% Boarder Leicester crossbreed rams were introduced from Livestock Development Farm, Lampatan, Pokhara to produce 25% Boarder Leicester crossbreed from Local Kage ewes. The body weight of the crossbreeds was increased by 37% and performed well. The Hampshire, Yorkshire and Landrace breeds of swine were introduced from Australia. Yorkshire and Landrace crossbreeds became more popular than Hampshire. Boars from Livestock Development Farm, Lampatan, Pokhara and Phi-one and Tamworth from Pakhribas Agriculture Centre were also introduced to improve crossbreeding. New Hampshire, Leghorn, Light Sussex, Key Stone and Red Bangkok breeds of chicken were also introduced and the Key Stone and Red Bangkok were being raised. White Pekin, Muscovy and the Local (Black and White from Madi, Chitawan) ducks were made available at the farm. Muscovy duck performed better but this breed disappeared slowly. The guinea fowls were called out due to their poor laying and breeding performance. Various breeding activities could not be effective due to the lack of sound program, strong institutional commitment and essential resources.

Production systems, animal genetic resources and livestock research in Nepal

Wilson RT (1995). Production systems, animal genetic resources, and livestock research in Nepal. *Proceeding of the 2nd National Animal Science Convention (NASA),* Lalitpur, Nepal, Aug 7-10, 1995, pp 92-99

The major characteristics of Nepali small farm production systems with particular reference to livestock and their feed supply are described. Nepal's animal genetic resources were extremely diverse (at least 17 species) and have multiple production functions. They have not yet been characterized but were widely believed to be unproductive and of inferior genetic merit. These beliefs were not founded on comparative research or on the several production objectives (including adaptability to the local environment) for which animals were kept. Research in the past has been along classic lines, carried out on station and not always related to the real problems of small farmers. Further research areas should be identified in collaboration with farmers and the extension services, should be mainly applied and adaptive in nature and should be carried out in collaboration with farmers on their farms (on farm technology testing) as well as research stations.

Role of women and education in the conservation of genetic resources in hills of Nepal

Luitel CP (1998). Role of women and education in the conservation of animal genetic resources in hills of Nepal. *The 4th Global Conference on Conservation of Domestic Animal genetic Resources*, Birendra International Convention Center, Baneswor, Kathmandu, Nepal, 17-21 Aug, 1998

Women have occupied about half of the total population of Nepal. They provide a significant contribution to the economic upliftment of their families. They are not only involved in household affairs, but also play a vital role in agricultural activities_especially in livestock raising. In this particular context any efforts that are to be conducted to alleviate poverty must

stress the needs of women as the producer and income generator rather than only the consumer of social services. Due to the dynamic nature of society, the role of women should also be dynamic and be accordingly. Most of the women of Nepal, especially those who are involved in agricultural activities, are illiterate. They have not got any opportunity to take part in training of livestock management. In practice, however, they are highly responsible for animal care and feeding. Despite the abundance of food available for the livestock, they can not provide it in a balance manner. As a result, animals suffer from malnutrition seriously. The production and the productivity of the livestock are badly affected. Chronic malnutrition of this kind results in genetic degradation, which is difficult to recover from. It has been found that women provide 60-70% of the labor to the livestock sector. Their stability at home permits them to provide regular services to their livestock. There are various local populations of livestock and poultry in Nepal. They are well adapted to the local environment. Various experiments on exotic breeds have shown that they have difficulty adjusting to the local ecological and social environment. In the hills, cattle, buffalo, goats, sheep, pigs and poultry are widely scattered and are dominated by indigenous populations. Balance feeding and proper management livestock is possible through the education of women. To accomplish this, a local, national and international campaign is necessary.

Role of women and education in the conservation of genetic resources

Pathak L and U Karki (1998). Role of women and education in the conservation of genetic resources. *The 4th Global Conference on Conservation of Domestic Animal genetic Resources*, Birendra International Convention Center, Baneswor, Kathmandu, Nepal, 17-21 Aug, 1998

The importance of animal production, the situation of animal biodiversity, conservation needs of biodiversity and the role of women and education in the conservation of animal genetic resources, with special reference to Nepal, are described. Farm animals play an important role in subsistence agriculture and world food security. Their contribution ranges from 30-40% of global food and agriculture production. Around 25% of the total agricultural outputs are derived from livestock population in the developing countries. It is estimated that 52% of the cultivated area in developing countries, excluding China, is farmed exclusively with draught animals. The rate of increment of animal products seems to be very high. That is, 127% for meat and 331% for egg in the developing countries during the last 20 years. Yet the demand for animal protein is increasing. To meet this demand, various endeavors are being made to maximize productivity of farm animals. For this purpose, various high yielding breeds of different species have been developed and propagated, because of which various low productive, but locally well adapted native breeds of different countries, are endangered. It appears that a number of native breeds of animals are already extinct. Women are heavily involved in animal production activities. Their role in livestock production seems very important irrespective of the countries and ecological zones. Women mostly perform care and management of farm animals. The women farmers perform almost all the activities concerning small animal production, especially in the subsistence farming. The women's role in the subsistence farming, where diversified animal species are kept, is crucial. In case of Nepal, women farmers have fulfilled more than 60% of the labor requirement in livestock production. But their involvement in the livestock development program is very low. Women can play an important role in the conservation of animal genetic resources if they are focused properly while launching the conservation program. Three seems to be an urgent need for conserving animal genetic resources available at different localities of the world. To fulfill this need, people's participation and global cooperation seems to be very essential. Women should never be neglected while thinking about people's participation. Education can play a very important role to make peoples participation most effective. While conducting education programs for farmers, methods should be selected such that people could easily understand the message.

The conservation program in- situ should always be associated with the welfare program for the concerned people. To conserve genetic resources available in the developing countries, cooperation of the developed countries may be very essential to achieve success.

Policy and strategy for the management and use of farm animal genetic resources in Nepal

Pradhan SL, L Sherchand, NP Shrestha and BKP Sah (1998). Policy and strategy for the management and use of farm animal genetic resources in Nepal. *The 4th Global Conference on Conservation of Domestic Animal genetic Resources*, Birendra International Convention Center, Baneswor, Kathmandu, Nepal, 17-21 Aug, 1998

The diversity of genetic resources in Nepal is shrinking due to the adoption of policy in introducing exotic blood such as Jersey, Holstein and Brown Swiss cattle, Murrah buffalo, Polworth and Border Leicester sheep, Jamunapri, Barberi and Sannen goats, Hampshire, Landrace and Yorkshire pigs and New Hampshire and Austrolop poultry without paying attention to the indigenous animal germplasm. The study and development of local breeds has received low priority in the past even after signing the document in the earth summit, 1992. The present paper highlights long term policies and strategies for the efficient management and use of currently available farm animal genetic resources in Nepal.

Legal instruments for domestic animal resource conservation in Nepal

Oli KP (1998). Legal instruments for domestic animal resource conservation in Nepal. *The 4th Global Conference on Conservation of Domestic Animal genetic Resources,* Birendra International Convention Center, Baneswor, Kathmandu, Nepal, 17-21 Aug, 1998

It is well known that the varied eco-systems and management practices have resulted in a diversity of livestock and poultry populations. A number of domestic animals have an important role in the national economy. These include Lulu cattle, Dhorel sheep, Khari goats, hill buffalo and a number of other species. Policy to declare ownership of these resources and safeguards to prevent their erosion are vital for conservation. Legislation to control trade, transit and erosion of endangered domestic animal genetic resources need to be developed. Cooperation at the international, national and regional levels with realistic penalty is essential to enforce such legislation.

Livestock conservation and Nepal's biodiversity action plan

Yonzan P (1998). Livestock conservation and Nepal's biodiversity action plan. *The 4th Global Conference on Conservation of Domestic Animal genetic Resources*, Birendra International Convention Center, Baneswor, Kathmandu, Nepal, 17-21 Aug, 1998

Indigenous livestock breeds safeguard rural households from stochastic events like crop failures by providing a wide variety of food and food products, in other words, food security. However, economic stresses combined with reproductive disorders are considered major factors for the loss of indigenous breeds. As it is not possible to conserve or preserve all the existing breeds, *in situ* breeding schemes are perhaps the best strategy to maintain livestock in a sustainable way. To develop a framework with a vision to sustain Nepal's biodiversity, five key areas are important for the maintenance of biodiversity: forest, wetland, rangeland, and agriculture biodiversity and livestock genetics. The national biodiversity action plan, in conjunction with the several Ministries and concerned line agencies, is in the process of developing programs for maintaining and conserving gene pools through policies, research and farm based conservation. In this regard, the following are suggested: 1) creating guidelines and policies through a national livestock conservation and breeding policy, 2) surveys and

inventories of domestic animal are the basis to prioritize their management and areas with endangered breeds should be considered as " hot spots", 3) unavailability of statistics on the population decline of indigenous breeds of cattle have necessitated indigenous livestock improvement; and 4) implementation of a genetic improvement program (*ex-situ* conservation) for breeds that are threatened with extinction. As these programs will not be limited to physical areas, identifying missing cross sectoral links, safeguarding indigenous knowledge on livestock through intellectual property rights, and proper valuation of Nepal's livestock genetics are suggested to bring our both traditional and new partners including rural communities who have been the custodians of agriculture biodiversity and livestock genetics in the Nepal – Himalayas.

Income generation through conservation of animal genetic resources in Nepal

Shrestha JNB and C Hansen (1998). Income generation through conservation of animal genetic resources in Nepal. *The 4th Global Conference on Conservation of Domestic Animal genetic Resources*, Birendra International Convention Center, Baneswor, Kathmandu, Nepal, 17-21 Aug, 1998

Sustainable development of livestock and poultry resources has contributed to the culture, lifestyle and religion of Nepal for generations. Today these activities are being constantly challenged by forces, both internal and external, in the name of development and western values. Urban migration, population explosion, unemployment of educated and skilled individuals, massive degradation of the environment increased reliance on imported goods and services, pollution, erosion of resources and concentration of wealth among a few individuals are all factors affecting the growth of the nation. It is common to observe that benefits derived from indigenous knowledge and breeds are set aside in favor of advanced technology and improved breeds. Indigenous breeds which demand less input, can compliment resource conservation efforts by generating adequate income to support a comfortable lifestyle in the rural areas. This activity could be further enhanced by utilizing all of the renewable resources available such as traditional tools and knowledge for raising livestock and poultry, tapping the energy in cow dung for fuel and fertilizer, animal power for transportation and to plough the field, marketing of value added animal byproducts, supply of fresh produce from indigenous animals to the local markets, maintenance of genetic variability, demonstration of daily chores to tourists and the introduction of farm parks based on indigenous animals. Development efforts cannot be targeted to the needy unless availability of credit is based on using as collateral the knowledge and experience of the indigenous population. Women have always played an important role in the feeding and care of indigenous livestock and poultry. This role can be further enhanced by educating and training the workforce that will eventually drive agriculture to the 21th century. The traditional approach of supporting the family by working away from home can be replaced through the increased wealth generated by concentrating the resources and activities closer to home. The aim should thus be to improve the environment, health and standard of living of the population under the concept of the family as a "corporation". It is through these activities that development aid can help eliminate poverty and identify animal genetic resources and the tools of the trade to compliment sustainable development and traditional values in harmony with the environment.

Role of indigenous farm animal genetic resources in poverty reduction in Nepal

Sah BKP and BR Joshi (2003). Role of indigenous farm animal genetic resources in poverty reduction in Nepal. *Proceedings of the 7th National Conference of Nepal Veterinary Association,* Tripureswor, Kathmandu, Nepal, 5-7 Nov, **24**:34-42

Of many indigenous livestock breeds, only 26 breeds of farm animal genetic resources (FAnGR) have been partially studded and identified so far in Nepal Out of 2526 indigenous breeds of FAnGR, there are 8 breeds of cattle (Lulu, Achhami, Khaila, Pahari, Terai, Siri, Yak and Chauri), 4 breeds of buffalo (Lime, Parkote, Gaddi and Arna), 4 breeds of goat (Khari, Terai, Sinhal and Chyangra), 5 breeds of sheep (Lampuchhre, Baruwal, Kage, Dhorel and Bhyanglung), 3 breeds of pig (Hurrah, Chwanche and Bampudke) and 3 breeds of poultry (Sakini, Ghatikhuile and Dumse), indigenous breeds of livestock contribute to sizable proportion Towards the livestock GDP. These animals are mainly reared and utilized by the rural population where poverty is pervasive. A respective review on role and sustainability of indigenous breeds of livestock has been made for policy formulation, and implementation of conservation and utilization strategies for poverty reduction in rural population. The concerned stakeholders have already realized an endeavor to this end and some work has also been initiated with promising results. Results on status, constraints and potentials of these indigenous FAnGR for future use with special reference to poverty reduction has been analyzed and presented in this paper.

Genetic improvement of dairy cattle to meet farmer expectation for food security

Paudel KP and A Shah (2010). Genetic improvement of dairy cattle to meet farmer expectation for food security. *Proceedings of the 9th National Conference of Nepal Veterinary Association*, Kathmandu, Nepal, 22-24 April, pp 35-42

Genetic improvement with increased milk productivity of dairy animals is one of the permanent changes that farmer can achieve for ensuring food security. This paper reviews past efforts undertaken in Nepal for genetic improvement of dairy animals and analyzes the prevailing breed improvement programs. Adoption of breed improvement programs, based on scientific principles for three decades, could have adequately substantiated some genetic improvement in milk productivity. However, the annual growth of milk production of about 3.06%is attributed to increase the number of crossbred cattle and buffaloes per sector. There is no evidence to support the fact that productivity of dairy animals has increased over years. Developed countries achieved exceptional increase in milk productivity through adoption of 1) permanent and unique identification of the animals, 2) percentage recording, 3) recording of milk yield and other traits of economic importance, 4) artificial insemination, and 5) statistically advanced genetic evaluation and selection based on the performance. Same scientific principles are applicable also in Nepal to achieve genetic improvement. From past efforts, some of positive developments so far include creation of infrastructure for semen laboratory, acceptable level of improvement in conception rates from AI, execution of dairy cattle improvement project and increasing involvement of private sector in the delivery of services. It is important to note that lack of clear policy on dairy animal breeding, use of breeding stock of inferior genetic merit, more focus on sires, lack of breeding plans, and lack of resource centers have adversely influenced genetic improvement. Similarly, inefficient mechanism for distribution of semen and liquid nitrogen and ignorance of farmers' role in the management of the institution responsible for breeding management are also important issues. Based on the farmers preference it is recommended that a major revamping is necessary to transform national livestock breeding center into a financially sustainable autonomous corporate body with involvement of farmer representation in its organizational management.

Evaluation of local and crossbred buffalo for morphological body parts, productive and reproductive performance in Bajura district.

Shrestha S and NP Shrestha (1997). Evaluation of local and crossbred buffalo for morphological body parts, productive and reproductive performance in Bajura district. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 24-25 Sep, pp 40-46

Data taken on 73 local buffaloes and 27 Murrah crossbred buffaloes were from different villages of Bajura district. The morphological body parts of buffaloes were measured by the authors while the production and reproduction performance were based on the questionnaires to farmers. The data were analyzed to evaluate the local and Murrah crossbred buffaloes for their physical body measurements and production, reproduction performance. The analysis revealed that in most of the body parts of local buffaloes were significantly smaller than those of crossbred buffaloes. The females were smaller than males but were not significant in most of the body measurements. LS means for age at 1st calving of local (5.14±0.64 years) and crossbred (4.09±0.46 years) differ significantly ($P<0.05$). The average daily milk production of Murrah crossbred buffalo (3.36±0.35 lit) were significantly higher ($P<0.001$) than the daily milk production of local buffalo (2.13±0.35 lit). The lactation yield (300days lactation length) were significantly higher ($P<0.001$) in crossbred buffaloes (1008 lit) than those of local one (639 lit).

Present status of indigenous buffalo genetic resources in the western hills of Nepal

Rasali DP (1998). Present status of indigenous buffalo genetic resources in the western hills of Nepal**.** *The 4th Global Conference on Conservation of Domestic Animal genetic Resources*, Birendra International Convention Center, Baneswor, Kathmandu, Nepal, 17-21 Aug 1998

Over 1/5 of the population of Nepal's 3.1 million water buffaloes (*Bubalus bubalis*) are found in the western hills. Over 90%of them are estimated to be the indigenous population. Based on their external morphological features, the indigenous buffaloes are identified as *Lime, Parkote* and their intermediate type. External morphological features in a total of 206 indigenous milking buffaloes at 12 village sites of the western hills were assessed. It was found that the shapes of the horns, chevron marks and body size differed significantly ($P<0.05$) across the villages possibly due to considerable genetic variations. Further investigation into the breed types and their morphological variations are underway. A cytogenetic study on 15 indigenous buffaloes including *Lime*, which were suspected in the past to be of swamp type, revealed that all of them were, in fact, of the riverine type with ($2n=50$) chromosomes. The buffaloes are generally the best looked after animals raised under stall fed to semi-stall fed conditions in the western hills. An analysis indicated that the low production and productivity for milk and meat has been the core problem of buffalo production leading to importation of their products and even the live animals. To this core problem, undernourishment of buffaloes, inadequate number and quality of buffaloes available for meat, their low productivity potential for milk and their poor health status are the underlying attributes. The average age at 1st calving, calving interval, 305 days lactation yield and milk fat percent of the indigenous buffaloes were 50.5 months, 574 days, 995 liters and 7.2%, respectively in the first cycle milk recording of 1993 and 52.6 months, 529 days, 926.4 liters and 7.2%, respectively in the 2nd cycle recording of 1995. The lactation yield of the indigenous buffaloes, though considered low, was fairly comparable to those of various Murrah blood levels. In order to alleviate the constraints of low productivity of the indigenous buffaloes for their genetic conservation and efficient utilization through systematic breeding, a comprehensive phenotypic, genetic and socio-economic evaluation of the indigenous buffaloes is warranted.

Breeding strategy for genetic improvement of indigenous buffaloes in western hills of Nepal

Shrestha BS (2004). Breeding strategy for genetic improvement of indigenous buffaloes in western hills of Nepal. *Proceedings of the 5thNational Animal Science Convention (NASA)*, Kathmandu, Nepal, Oct 15-16, 2003, pp 197-204

Majority of the buffaloes found in western hills of Nepal are Lime, Parkote and their intermediate crosses, though Murrah crossbred buffaloes also constitute the herd to a certain degree. Buffalo breeding system is indiscriminate. Farmers use bulls for mating whichever are available in the village nearest to them. The adoption of artificial insemination is low (<1 %). Practice of early disposal of male calves is common. These practices are accountable for overall decline in the buffalo productivity. Cross breeding with Murrah (either AI or natural mating) is the existing strategy adopted for genetic improvement. But the level of farmer adoption is low. The present study revealed a great deal of variation within indigenous breeds in terms of lactation performance ranging from 300 to 2300 liters of milk of the indigenous buffaloes in the western hills of Nepal.

Indigenous buffaloes: their potential, existing breeding system and genetic improvement in the western hills of Nepal

Shrestha BS and N Amatya (2004). Indigenous buffaloes: their potential, existing breeding system and genetic improvement in the western hills of Nepal. *Proceedings of the 4th Conference on Science and Technology*, Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, Nepal, March 23-26, 2004, pp 192-200

Buffalo (*Bubalus bubalis*) is an important livestock species under the mixed farming system in Nepal. Three phenotypes of indigenous buffaloes have been identified, all of them being riverine type (2n=50). There has not been any systematic approach for productivity improvement of buffaloes in Nepal. The only approach adopted so far is crossbreeding indigenous stock with Murrah bulls, which is distributed in the villages by DLSO or brought by farmers from Terai region of Nepal or India. In most of the instances, the imported bulls are not proven sires; neither there is any system of selection and use of superior bulls. A large proportion of farmers, who still keep indigenous buffaloes, are mostly unaware of keeping superior breeding animals for improvement in production traits and are using whatever, are available within or nearby village. The coverage of artificial insemination (AI) in buffaloes is quite low and is concentrated in accessible areas with market potential. Record keeping is virtually nonexistent except in the few government/ NARC farms. Besides, the extent of early male calf disposal is very high in some part of western hills of Nepal further limiting chances of selecting superior male for breeding. The extent of within breed variation in milk production potential of indigenous buffalo types has been found to be very high producing 300 to 2300 lit milk in a standard lactation of 305 days with a mean yield of 962 lit and 1022 lit for Lime and Parkote buffaloes in the western hills. This suggests that improvement in milk production within indigenous buffaloes could be achieved if proper selection scheme is embarked upon.

The indigenous farm livestock and their untapped potential for subsistence farming conditions of Nepal

Joshi BR and BS Shrestha (2004). The indigenous farm livestock and their untapped potential for subsistence farming conditions of Nepal. *Proceedings of the 4th National Conference on Science and Technology,* Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, Nepal, 23-26 March, 2004, pp241-251

Despite being the country with highest livestock population per unit of cultivated land in Asia Nepal still depends heavily on import of livestock and livestock products for her national requirements. The livestock development programs initiates some 5 decades ago primarily focused in urban and peri - urban areas and directed mainly on introduction of exotic blood on our indigenous stock without evaluating the inherent potentials of our native socks and realizing our farming conditions. After the attempts of ago many years, it has now been evident that under the existing farming conditions of Nepal, the purebred exotic animals could not produce to their potentials and their crossbreds produced similar to our native animals in most of the farm animal species. The development efforts in the past primarily focused to limited area and population leaving the vast area and population of the country untouched of the development benefits. The trust on "Bikashe or improved" animals greatly ignored the indigenous species, and the continued deterioration of indigenous animals since generations remained unhindered. However, lessons learnt from our livestock development efforts has now become apparent that our national strategies on livestock development needs to be reoriented with increased focus on improvement of nutrition, health and breeding management of indigenous livestock species rather than on introduction of exotic breeds, which will be sustainable, equitable and adaptable by common mass of the country. This paper highlights these issues with case studies and suggest for new approaches for sustainable livestock development in the country.

Conservation of wild buffalo (Arna): Strategies and practical approach

Mandal P and NP Shrestha (1998). Conservation of wild buffalo (Arna): Strategies and practical approach*. The 4th Global Conference on Conservation of Domestic Animal genetic Resources*, Birendra International Convention Center, Baneswor, Kathmandu, Nepal, 17-21 Aug 1998

The wild buffalo of Arna (*Bubalus arnee*) has almost disappeared or reached endangered stage in the world. There are only 1500 wild buffaloes estimated all over the world. They are being conserved at Koshi Tappu Wild Reserve through government intervention. It is said that a few decades ago there were 150 animals in the reserve. At present number has been estimated at 50. The number is decreasing day by day. The factors affecting the decrease in the population of Arna are mainly the deterioration of forest pasture area, increases in the population of domesticated animals allowed to graze in the same pasture, crossing of local buffaloes with Arna, lack of managerial practices and ignorance of conservation. Area are a most precious and rare breed of buffalo and should be conserved by controlling the local buffalo population grazing in the area, providing them with feed resources and other management, otherwise the number of Arna will continue to decline.

Identification, characterization and conservation strategy of Gaddi buffalo

Pokharel PK, BS Kunwar, SP Neopane and NP Shrestha (1998). Identification, characterization and conservation strategy of Gaddi buffalo. *The 4th Global Conference on Conservation of Domestic Animal genetic Resources,* Birendra International Convention Center, Baneswor, Kathmandu, Nepal *17-21 August, 1998*

Gaddi is a well-recognized and potential buffalo breed of the Far Western region of Nepal. They are mostly found in Dadeldhura, Baitadi and Doti districts at an elevation of about 1500-4500

m asl and scattered in a 5482 sqm area of this belt. They are good milkers and good grazers on the slopes of mid hills and high hills of this region. It is estimated that out of 101500 buffaloes found in these areas, approximately 16000 buffaloes are Gaddi and about 50000 would be their crosses with Murrah, Lime and Parkote breeds. Gaddi buffaloes are black in color with white round patches on the forehead. Occasionally they are also found in brown and light brown color. They have a long face and flat head with long, half-curved horns. They are compact and massive with an angular body shape and sloped hip position. A morphological growth and production performance of this breed seems to be better that other local breed of buffaloes (Lime and Terai buffalo). The average body length, height at wither, heart girth and height at hip bone of Gaddi buffaloes are 141, 131, 195 and 122.7 cm. respectively, which are significantly different ($P<0.01$) from Lime and Terai buffaloes. As good milkers they have well developed udders and prominent milk product veins. Average daily milk product yield for the first three months when farmers allow two teats for suckling to the young born calves after parturition has been recorded at 4.69 lit and the daily milk product yield becomes 4.62 lit when calves are allowed the suckle only one teat during the next three months. Since the last two decades, the Department of Livestock, as part of its upgrading program of local animals, has been introducing a large number of exotic sires from different countries (especially Murrah buffaloes from India). In the case of the Terai buffalo of the plains adjacent to India, farmers are achieving a good result from these Murrah crosses whereas with Gaddi crosses from Murrah the result is quite different. The Gaddi crosses have poor acclimatization and adaptation capabilities. They have low milk product production and poor growth rate. At the same time the number of pure Gaddi buffalo will be extinct in the near future. Thus, a conservation and development strategy should be developed with appropriate breeding practices including a selection and nucleus-breeding plan for the preservation of this breed.

Evaluation of native buffalo (Gaddi) for phenotypical characteristics and production performances

Neopane SP PK Pokhrel and S Shrestha (1999). Evaluation of native buffalo (Gaddi) for phenotypical characteristics and production performances. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, pp 237-240

A study was initiated with the objective of characterization and evaluation of productive performance of Gaddi buffalo in the far western region. Results revealed that Gaddi buffaloes are black in color with white round patches on the forehead. They have a long face and flat head with long, half-curved horns. Morphological growth and production performance of Gaddi buffaloes appeared to be better than Lime and Terai buffaloes and similar with that of Murrah. They are a good milk yielder (about 3 liters milk/day/animal) with a lactation length of more than a year. This study suggests that Gaddi buffalo should be promoted for milk production.

Indigenous Nepalese Buffaloes with special reference to Gaddi

Pokharel PK and SP Neopane (2007). Indigenous Nepalese Buffaloes with special reference to Gaddi. *Nepal Journal of Science and Technology*, Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, Nepal, **8:**41-47

A study on indigenous buffaloes was undertaken in the far western region of Nepal to understand the production potential, body conformation, reproductive performances, nutritional management, health and housing practices with the aim of making future strategy for their improvement. Quantitative and qualitative information were collected from various sources and interaction with farmers. Semi structured questionnaire survey, key informant survey, and transect walk were made in the areas of Gaddi buffalo. Among three identified

buffalo breeds, namely Gaddi, Lime and Parkote and one which are under study Terai in the country, Gaddi buffalo was found heavier, lengthier and bigger in body size (P>0.01), and docile in temperament. Gaddi buffalo is well known in the far western districts of Doti, Dadeldhura and Baitadi. It is also widely raised in adjoining districts like Kanchanpur and Kailali. About 92% of the observed population of Gaddi buffalo was found black in color and remaining were brown and light brown. Morphologically the breed looks like Indian Murrah. White round patches on the middle of forehead and semi curved horns are its distinguishing character. The breed is well adapted in the mid to high hills and mountains of the region with diverse climatic conditions. Average age at puberty, age at 1st calving and calving interval were 3.8, 5.7 and 2 years, respectively. Milk yield of this breed was comparatively better than the local breeds and ranged from 2.5 50 5.5 lit/day in on farm condition where low input management system was common. Major problems regarding buffalo farming in the region were lack of pure breeding bulls, uncontrolled mating and negative selection, feed scarcity during dry season, poor technical knowhow and preventive health management. This paper discuss on the overall Gaddi management system, its distribution, status in relation to conservation, positive attributes and suggests future improvement plan.

Prediction equation of body weight from body measurement of different genotypes of buffalo

Shrestha NP and BA Parker (1994). Prediction equation of body weight from body measurement of different genotypes of buffalo, Nepalese *Journal of Animal Science (NASA)*, **8**(8)**:**59-67

The least square mean estimate from a maximum of 794 animals for body weight and body measurements from a maximum of 717 animals were used to construct prediction equations for body weight from age and body measurements. Separate prediction equation basis on age, height, heart girth and body length were developed for each genotypes. The age and heart girth were the most important 2 factors contributing for growth and thus the polynomial models were fitted and quadratic effect of age and heart girth was found to be important component to be included in the prediction equation. The prediction for each 4 genotypes was developed for determining the body weight from age and heart growth including quadratic function in the model.

Models for predicting the equation for lactating curve

Shrestha NP and BA Parker (1994). Models for predicting the equation for lactating curve. *Proceedings of the 2nd National Conference on Science and Technology*, Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, Nepal, June 8-11, 1994, pp 221-227

The daily average weekly yield of milk production of lactation from genotypes of buffaloes was used to fit in the various models that best describe the lactation milk curve. The model fitted were linear, quadratic, quadratic cum log, inverse polynomial, gamma function, exponential function and parabolic functions. These seven models were fitted with all the 4 genotypes of buffaloes and the prediction equations were developed for each genotype. The inverse polynomial model was found to be the best model to describe the lactation curve in the 4 genotypes. The goodness of fit of above function was compared by using the values of coefficient of determination (r2) for all the models and the inverse polynomial models had highest (R2) 96.0 Philippine Carabao, 99.5 for Murrah, 98.5 for Phil-Murrah, 96 for Phil- Ravi buffaloes among all the R- square values obtained from the different models fitted to each genotypes.

Genetic parameters estimation of growth curves parameters and body weight at growing and mature stage of buffaloes

Shrestha NP and PA Parker (1995). Genetic parameters estimation of growth curves parameters and body weight at growing and mature stage of buffaloes. *Nepalese Journal of Animal Science (NASA)*, **9:**1-9

The estimated of heritability of asymptotic body weight was 6.02±0.37. The heritability estimates of body weight at inflection and age at inflection were 0.62±0.37 and 0.58±0.36, respectively. The phenotypic relationship of body weight at 12 months with asymptotic body weight; age at inflection and weight at inflection were very low (-0.50 to 0.42). The relationship of body weight at 18 months body weight with asymptotic weight at inflection and age at inflection were 0.2, 0.2 and -0.44. The relationship of age at inflection and asymptotic inflection was (0.63±1.85) high but with very high sampling variance. The genetic correlation of body weight at 2 months with asymptotic weight, weight at inflection and age at inflection were 0.51, 0.50 and 0.52, respectively. The genetic correlation of body weight at 18 months and asymptotic body weight at inflection and age at inflection were 0.04, -0.04 and -0.61, respectively. This indicated that selection of 18 months body weight is better than selection on 12 months body weight.

Performance of monsoon calvers buffaloes across genotypic and non-genotypic factors under farmers management in western hill districts of Nepal

Rasali DP, DB Gurung and ER Yadav (1997). Performance of monsoon calvers buffaloes across genotypic and non-genotypic factors under farmers management in western hill districts of Nepal. *Veterinary Review*, Animal Health Research Division, Tripureswor, Kathmandu, Nepal, **12**(1); pp 17-20

Recording of lactation and reproductive performance in 264 buffaloes with different levels of exotic Murrah blood that calved during monsoon and managed under farmers management was undertaken in the year 1993/94. The standard 305 day lactation yield was significantly influenced by blood level (P= 0.0000), altitude (P=0.0002) and parity (P= 0.0000) but not by management system, The least- squares mean milk yields in local, 25-49%, 50-74% and 75% Murrah crossbred buffaloes were increasing order of 1012.7±39.8. 1190.5±60.2, 1440.2±50.8 and 1872.2 ± 124.6 liters, respectively. Among all the milk- recorded buffaloes, milk yield was 1493.2±73.6 liters in the low hills, followed by 1393.5±62.8 liters in the high hills and 1250.2±48.9 liters in the mid-hills. The overall least squares mean of milk fat percentage in 257 buffaloes at around 5-6 month of their lactation was 7.1±0.3, which was not significantly different across the factors considered. The lactation length was significantly influenced by altitude (P=0.0031) and parity (P=0.0072). The median value of lactation length in the low hills was over 375 days followed by 331 and 327 days in the mid hills and high hills, respectively. The overall least-square means of age at first calving, calving to first service period and calving interval were 53.8 ±1.5 months, 87.4±9.3 days and 556.1±46.4 days, respectively but among these traits only calving interval was significantly different across management system as it was shorter (P=0.0029) under stall-feeding management (498.2±41.0 days) than under the semi stall-feeding (614±54.1days).

Evaluation of native buffalo for phenotypic characteristics and production performance

Shrestha S and SP Neopane (2000). Evaluation of native buffalo for phenotypic characteristics and production performance. *Proceedings of the 4th National Workshop on Livestock and Fisheries Research in Nepal*, Agricultulture Research Station, Pakhribas, Dhankuta, Nepal, April 24-26, 2000, pp 210-213

With the objectives of characterization and evaluation of native buffalo Parkote breeds. A survey work in Dolakha district was made in 1999/2000. Amongst the morphological characters, body length, wither height and heart girth was 130.5, 122.7 and 175.6cm respectively. These results on morphological characters indicated that the local buffaloes located in Dolakha district are medium in body size and are similar in size with Lime and Terai buffalo. Amongst the production parameters, the age at 1st calving and calving intervals was 61 and 19 months respectively. The milk production was 3.3 liter/day but there was a wide variation in milk production suggesting improvement in average milk production can be achieved by selecting higher milk producing buffaloes.

Morphological characteristics of indigenous buffaloes in the western hills of Nepal

Shrestha BS, N Amatya, RM Singh, PK Jha, BR Acharaya and KB Gurung (2003). Morphological characteristics of indigenous buffaloes in the western hills of Nepal. *Development of Suitable breeding strategies for indigenous buffaloes in the western hills of Nepal. Final Technical Report HARP PP-78/00,* Regional Agricultural Research Station, Lumle, Kaski, pp 21-26

Lime and Parkote are the two distinct buffaloes types found in western hills of Nepal along with intermediate cross between them. Lime buffaloes are comparatively smaller with grey or brownish cOat and skin color with typical sickles shape horn and characteristics chevron marks (white cOat) in and around the neck and briskly region. The mean body length, body weight, withers height, chest girth, horn length and face length of lime buffaloes were 125 cm, 373 kg. 121cm, 44cm and 47 cm respectively. Whereas Parkote buffaloes are black in color with typical sword shape horns without any chevron markings. The mean body length, body weight, withers height, chest girth, horn length and face length of Parkote buffaloes were 130 cm, 389 kg. 121cm, 75cm, and 48 cm, respectively.

Estimation of genetic and non genetic parameters of productive and reproductive traits of Murrah buffaloes

Shrestha R, M Kharel, MR Kolachhapati and SP Neopane (2009). Estimation of genetic and non genetic parameters of productive and reproductive traits of Murrah buffaloes. *Nepalese Journal of Agricultural Sciences,* Himalayan College of Agricultural Sciences and Technology (HICAST*)*, Gathaghar, Bhatkatapur, Nepal, **7**:76-83

Data on productive and reproductive traits of Murrah buffaloes maintained at IAAS livestock farm over 21 years (1983-2003) were used to find out the horizontal, vertical and cross sectional effects. The least square analysis revealed that year of calving had significant effect on all traits at 0.1% level of significance except lowest yield at 1% level of significance and days to attain pick yield at 5% level of significance. The season of calving had significant ($P<0.001$) effect on peak yield, calving interval, lactation length, dry period and days to attain peal yield. However, lactation yield, daily yield, lowest yield and persistency were no significant ($P>0.05$). Similarly, parity had significant effect on days to attain peak yield, dry period, lowest yield, calving interval, persistency and peak yield ($P<0.001$). However, it had no significant effect on lactation yield, daily yield and lactation length ($P>0.05$). Age of 1st calving had significant effect on lactation yield, daily yield, peak yield, lowest yield and persistency at 0.1% and DAPY at 5%

level of significance, but no significant (P>0.05) on calving interval, lactation length and dry period. The heritability estimate of persistency of milk and lactation length were 0.138±0.122 and 0.483±0.389, respectively whereas calving interval, lowest yield, dry period, days to attain peak yield and daily yield were 0.290±0.234, 0.127±0.115, 0.210±0.171, 0.058±0.073 and 0.027± 0.052, respectively. The phenotypic correlation of calving interval with daily yield was -0.203±1.237 whereas, genotypic and phenotypic correlation of calving interval with lactation length were 0.700±0.289 and 0.471±0.289, respectively. However, genotypic and phenotypic correlation between lactation length and peak yield were -0.451±1.243 and 0.032±1.243, respectively. Similarly, phenotypic correlation of peak yield with days to attain peak yield was 0.112±2.304, respectively.

The Yak: an indigenous animal of Asian highland

Paudyal RM (1994). The Yak: an indigenous animal of Asian highland. *Veterinary Review* Pakhribas Agricultural Centre, Pakribas, Dhankuta, Nepal, **9**(2) and **10** (1):13-17

This paper reviews the origin, domestication, distribution, general appearance and types of yaks found in Asia. Consideration is also given to their natural habitat, nomenclature, and special consideration is given to the taxonomic position of the domesticated and wild yaks. The number of yaks in China is approximately 12 million or about 85% of the world total; China thus stands in first place in Yak population. The Yak is a strong, hardy animal can thrive in a very cold (-50^0C) climate, and is also resistant to hypoxia. Yaks are often interbred either with the humpless (*Bos Taurus*) or with the Zebu (*Bos indicus*) as both Yak and cattle have the same number of chromosomes (diploid number = 60). Such crossbreds are superior to both cattle and Yak in terms of their production. However, the Yak has existed for centuries and remains an important animal in the Asian highlands.

Yak and Chauri breeding and management practices in eastern Himalayan Region of Nepal

Kharel M (1995). Yak and Chauri breeding and management practices in eastern Himalayan Region of Nepal. *Proceeding of the 2nd National Animal Science Convention (NASA)*, Aug 7-10, pp 73-77

This study was conducted around Sagarmatha National Park Area in late winter season. The Yak and their crossbred herds were objectively visualized and studied entering Lukla and making actual visits on the way to Namche- Syangboche-Khumjung for complete understanding of their breeding and management practices through individual contact method. Secondary data relevant to the study, related documents and maps were also used as accessory resource materials for this study. From the study it was found the Yak/Nak herding is one of the most importantly recognized farming in the high terrain of sub Himalayan region of Nepal. Although this farming is being handled by traditional and uneducated Sherpa community since long time ago, yet some scientific reasoning are found being blended in their practices. There are a number of mating options, out of which farmers are adapting to the one which are the best suitable them. The various type of farming which are identified as being independently in Sagarmatha National park Area is:

- Yak/Nak producer cum raiser
- Dimjo Chauri/Zhopkyyo producer (breeder)
- Dimjo Chauri raiser
- Dimjo Zhopkyo raiser
- Urang Chauri/ Zhopkyo producer (breeder)
- Urang Chauri raiser, and
- Urang Zhopkyo raiser

They differ independently to one another in terms of their objectives, management practices and ownership. Although Dimijo crossbred seems to be superior in productive and reproductive performance to Urang for the people of lower belt, Urang is recommended than Dimjo because if its advantage on adaptation in wide range of climatic conditions over Dimijo. Selected Yak bull preferably with white color can be imported from Tibet and should be used for mating purposes for genetic improvement of new generations

Basic physiological parameters of the Yak and Chauri: A Review

Paudel RM (1995). Basic physiological parameters of the Yak and Chaunri. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **10**(2)**:**10-14

The Yak is animal with a promising economic future, and it is the only domesticated bovine of high altitude (>3000 m asl). It has been endowed physiologically to live even at temperatures below -55^{0}C with scanty feed resources. A low gestation period (254 days) with low birth weight (9.2 kg) is adaptive measures to the high altitude. Mature body size and productive status of yaks in different countries vary. Small body size (180-390 kg), poorly developed sweat glands, long calving interval (616 days), and a thick layer of subcutaneous fat and two types of hair (coarse and fine) which work as an effective insulator against the low temperature, are all also adaptive measures to the high altitude and cold environment. Very little research has so far been done to understand the physiological adaptation to high altitudes with low temperatures, and to improve productivity through scientific breeding and management systems.

Yak and Chauri management and production system in Asia – A Review

Paudel RM (1996). Yak and Chauri management and production system in Asia – A Review. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **1**(2):51-53

This paper reviews the general management, feeding practices and breeding management of Yak and Chauri in Asia. Consideration is also given to their natural breeding and crossbreeding with conventional and non conventional bovine. Yak and cattle both have same number of chromosomes (2n=60) and crossbred easily. The chromosome number of Frontails and Gaurus (*Bos bibos*) is reported to be 2n=58, but both are known to cross with yak. Scientific reason for this is not known. Crossbreeding with domestic cattle of fine breeds has given good results. There is a need for well planned management, feeding and breeding techniques for exploiting the economically valuable characteristics of Yak and their hybrids.

Morphological characteristics and production and reproduction performance of Yak and Nak

Shrestha BS, KB Chhetri, NP Shrestha and L Serchand (1996). Morphological characteristics and production and reproduction performance of Yak and Nak. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, May 7-9, 1996, pp 73-80

A study was conducted to know the morphological characteristics and productive /reproductive performances of Yak/Nak at Kobang VDC of Mustang and Syangboche Yak Farm. It has been recorded that the cOat color of Yak / Nak was variable dominated by black followed by enough number of black body patches or spots on various body parts. It is of compact body no or very small hump and tight dew lap.The body length of Yak and Nak are being found 114.6$\pm$12.1cm and 119 $\pm$12.1cm, respectively. Like that body weight of Yak and Nak (male and female) 192.90$\pm$ 40 Kg, and 220.97$\pm$47.7 Kg were found. Similarly, birth weight of calves, wool production and pack performances were also described. In case of reproductive performances,

age at first calving 4.68 ± 0.75 years, gestation period 254±8.26 days and calving interval 1.53±0.48 years were found. The lactation yield of milk of Nak calving in the month of May was maximum i.e. (93.27± 5.01 Kg).

Yak, Lang, mountain cattle and their crossbreds: breeding and transhumance systems in east Nepal

Kharel M (1998). Yak, Lang, mountain cattle and their crossbreds: breeding and transhumance systems in east Nepal. *The 4th Global Conference on Conservation of Domestic Animal genetic Resources,* Birendra International Convention Center, Baneswor, Kathmandu, Nepal, 17-21 Aug, 1998

Yak, Lang, mountain cattle and their crossbreds were evaluated by observing and measuring breed characteristics. Existing breeding and transhumance systems of these species in the sub Himalayan region of Nepal were assessed by conducting interviews with experienced Yak/Nak herders (mainly Sherpas) in the highland pasture and forest range. Morphological measurements of different breeds of cattle found in that region such as Yak-Nak, Lang-Kirko, mountain cattle, Dimjos and Urangs were taken where ever possible and their typical characteristics were differentiated. The Lang, which is the descendent of Tibetan dwarf cattle, is hump less and a distinctly smaller bovine species (96 cm wither height) as compared to mountain cattle (112 cm). Yak and Nak as well as Lang –Kirko are in an endangered stage in Nepal. Because of the availability of 2 to 3 breeds in the same geographical region, a number of mating options exist. Among them, Lang crossed with yak and Nak crossed with mountain cattle in the upper and lower belts of the Trans Himalayan region to produce Dimjo and Urang, respectively, are the most predominant crossbreeding has more incentive in comparison to pure breeding; hence the population of purebreds of most of the breeds is declining day by day. Even in crossbreeding, a system of terminal mating is being adopted. Between Dimjo and Urang, the former is well adapted in the upper belt and hence preferred by the farmers of that region. Various types of herding and ownership of Yak-Nak, Lang, mountain cattle their varieties were identified. Typical transhumance systems of each of them were explored. Since Yak and Lang are almost in an endangered stage in Nepal, the immediate concern of international institutions involved in the conservation and protection of rare breeds/ species is needed to maintain natures biodiversity and to sustain the livelihood of the community inhabiting that region.

Morphological characteristics and production, reproduction performance of Lulu cattle of Mustang district

Rana RB, BS Shrestha and NP Shrestha (1996). Morphological characteristics and production, reproduction performance of Lulu cattle of Mustang district. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, May 7-9, 1996, pp 81-88

The Lulu, hump less, cattle breed is smaller in size as compared to Pahari cattle, requiring less amount of feed but producing milk as par that of Pahari cattle with maximum of 2.5 liter/day at the peak of lactation. The average live weight of mature Lulu cattle was 124.75 ± 3.68 kg. The height at wither of Lulu cattle (87.22 ± 0.78 cm) and height at hip bone (87.74 ± 0.66 cm) are found. Similarly, the body length (99.38 ± 17 cm shoulder point to pin bone) and chest girth (114.22 ± 1.55 cm) of Lulu are being recorded in this study.

Characterization of Lulu cattle in high mountains of Nepal

Neopane SP, BS Kuwar and HD Joshi (2002). Characterization of Lulu cattle in high mountains of Nepal. *Proceedings of the International Seminar on Mountains – Kathmandu*, March 6-8, pp 638-641

Lulu is a small sized cattle found in high mountains of Nepal. This is the only breed of cattle in the country that is hump less. This breed is hardy and can thrive in cold environment and can provide milk even in small quantity of feed given. In recent years, this breed is crossed either with Yak in high mountains or with hill cattle in lower beat causing sharp reduction in number of pure breed. A systematic study was carried out in Mustang district (2590-3550 m asl) to characterize this breed and assess the production system of these animals. The average height at wither, height at hipbone, body length and chest girth were 92.7±6.7, 96.8±7.5, 102.9±9 and 119.7±10.8 cm, respectively. Blood samples from 31 lulu cattle in Mustang district were collected and subjected to chromosomal study. Karotyping study of these animals revealed that lulu cattle have 60 chromosomes in diploid. Male had a large sub metacentric x chromosome and a small sub metacentric x chromosome. Karotyping results indicated that the lulu cattle belong to Taurus type.

Morphological characteristics and production, reproduction performance of Achhami cattle

Shrestha S, BS Shrestha and NP Shrestha (1996). Morphological characteristics and production, reproduction performance of Achhami cattle. *Proceedings of the* 1st *National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, May, 7-9, 1996, pp 62-72

Achhami cattle, a typical dwarf breed specially found in the hills of Achham district, were selected to study. It has black dominating body c0at color. In most of the body parts, Achhami cattle were significantly smaller than other breed Pahari and Siri cattle but the tail and switch length of Achhami cattle are significantly longer than Pahari cattle. For ear length, forefeet above knee and forefeet below knee, Achhami cattle were not significantly different from Pahari cattle. The highest (49.36%) and the lowest (3.44%) difference between Achhami and Pahari were observed for body weight and forefeet below knee, respectively. Parity wise highest milk production was obtained from 4th to 6th lactation ranging from 0.5 to 1.25 liters per day.

Status of conservation and utilization of Achhami cattle

Mahato R, N Amatya and SP Neopane (2009). Status of conservation and utilization of Achhami cattle. *Procedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 303-306

Achhami is an indigenous cattle breed located in the far western region of Nepal. This is claimed as the smallest cattle breed in the world. This has several positive attributes such as hardy to many economically important diseases, adaptable to local environment and can produce even in low input system. However, the baseline survey of this study showed these cattle is now in endangered stage with population of only 863 in Achham district. Realizing the fact, a study was initiated in 2006 with an objective for its conservation and utilization. This paper emphasizes the phenotypic and productive performance of Achhami cattle. The results showed that adult weight was 150±0.47 kg and body length, heart girth and height girth were 100, 116 and 86 cm, respectively. The average daily milk yield was 1.5±0.47 lit with lactation length ranges from 180 to 270 days. Achhami cattle matures sexually at 36 months and age at 1st calving is 46 months. 55 cattle were included for milk recording in Achham district. The results obtained through monitoring for 5 months (Mangsir to Chaitra) showed that Achhami

cattle produced 1.5 lit milk/day ranging from 0.5 to2.4±0.85 liters. The great variation in milk production and tremendous declination in the population of this breed needs the serious attention of all the responsible authority.

Economic potential and role of Terai cattle in the conservation of domesticated animal genetic resources in Nepal

Paudel KP (1998). Economic potential and role of Terai cattle in the conservation of domesticated animal genetic resources in Nepal**.** *The 4th Global Conference on Conservation of Domestic Animal genetic Resources*, Birendra International Convention Center, Baneswor, Kathmandu, Nepal,17-21 Aug 1998

Economically cattle are the most important domesticated animal species in the Terai region of Nepal. Based on field observation, research review and analysis of secondary data on productivity and production systems, this paper assesses the economic importance of Terai cattle. Also reviewed is the effect of the cattle raising system on the conservation of other important domesticated animal species, especially on competition of cattle with domesticated and wildlife animal species for the feed and fodder resources base and their role in disease transmission and epidemiology. Available evidence suggests that the unproductive portion of the cattle population exerts identifiable negative impact on the production and productivity of other livestock including some economically important wildlife species. In conclusion, the present cattle raising system needs to be streamlined towards reducing the cattle population through improved breeding programs, selection and /or crossbreeding on a mass scale. An intensified management system through adoption of stall feeding, scheduled vaccination and de-worming will help minimize the present negative impact of the system on other domesticated and wild livestock species.

Influence of season, parity, hormonal and blood metabolites on embryo recovery in cattle

Pradhan R and N Nakagoshi (2009). Influence of season, parity, hormonal and blood metabolites on embryo recovery in cattle. *Journal of the Himalayan College of Agricultural Sciences and Technology (HICAST),* Gathaghar, Bhaktapur, Nepal, **7:**96-107

Livestock plays a vital role in providing household nutritional security and increase in income. It has been intensified recently to the extent catching up with the industrial production level. Due to the growth of population in the world, a key issue in future food security will be the use of scarce land and water resources. With the consideration of scarce land use and environmental pollution, hormonal technologies have to be applied to shorten the calving interval and collection of embryos. Besides hormonal treatment, several other factors such as parity, season and blood metabolites have to be considered for the collection of good quality embryos. There is no single factor that can be manipulated which will consistently improve embryonic survivability. But, by managing genetics, nutrition, parity, stress and hormonal factors the incidence of embryonic loss can be decreased considerably. The parity, season, hormonal and biochemical concentrations influenced in postpartum Japanese black cows. Cattle which were more than 4 parities produced more numbers of total transferable and freezable embryos than other parities. Even though more numbers of embryos were recovered during winter, good quality of embryos can be produced in all season in super ovulated Japanese cattle. The hormone, EB used for super stimulation treatment appeared to be acceptable for oocytes collection and embryo quality. The oocytes quality depends on the concentration of NEFA, TP, ACAC, T- chol, Pl in the CIDR treated suckling Japanese Black cattle. Cattle population like Yak, Lulu is in the verge of extinction in Nepal. These types of breeds can

be increased by synchronization and embryo collection with the consideration of blood metabolites.

Artificial induction of lactation in a hill buffalo in Nepal

Joshi BR and SC Ghimire (1992). Artificial induction of lactation in a hill buffalo in Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **7**(1): 30-31

A sterile hill buffalo aged about 8 years of age was treated sub-cutaneously for 7 days with estrogen and progesterone hormones at a dose rate of 0.1 and 0.25 mg/kg body weight respectively. This was followed by dexamethasone 20 mg intramuscular on days 12, 13 and 14. Udder secretion started on day 13 and turned to normal milk from day 22 onwards. However, the yield obtained/day was only 505 ml despite a significant improvement in feeding and animal body condition. Though this study indicated the possibility of inducing artificial lactation in hill buffaloes, it was not economically viable with the present therapeutic procedures, which require further investigation.

Effectiveness of artificial insemination in buffaloes in Nepal

Sherchand L (2000). Effectiveness of artificial insemination buffaloes in Nepal. *Proceedings of the 3rd National Animal Science Convention (NASA)*, pp 127-129

Random sampling of 30 artificially inseminated animals in each 13 districts was taken with the objective to find out the effectiveness of AI in Nepal. Door to door recording of conception of each sampling animal was carried out by the AI technicians. Results showed that average conception rate in cattle to be 24.5% on total AI basis with the variation from 10.7 to 44% and average conception rate in buffalo to be 32% ranging from 21-45%. Low conception rate may be due to untrained technicians, poor heat detection, poor handling of AI equipment including some, and lack of monitoring at the AI centers.

Pogesterone concentrations in blood ser and milk whey of Murrah buffaloes for the first four weeks of pregnancy in Nepal

Upaddhya K, M, R Yadav, T Sato and K Kaneko (2010). Pogesterone concentrations in blood ser and milk whey of Murrah buffaloes for the first four weeks of pregnancy in Nepal. *Proceedings of the 9th National Conference of Nepal Veterinary Association*, Kathmandu, Nepal, 22-24 April, pp 146-148

The progesterone (P_4) concentration in buffaloes in Nepal was investigated. Monitoring of six buffaloes showed that the mean of the P_4 concentration in sera was lowest on day 0, gradually increasing to a peak on day 14 from 0.41 ng/ml to 1.62 ng/ml, and that the mean of the P_4 concentration in milk whey was lowest on day 0, gradually increasing to a peak on day 14 from 0.03 ng/ml to 0.46 ng/ml, respectively, for the first four weeks of gestation.

Conception rate of artificially inseminated cattle in Biratnagar

Sankhi KP (1993). Conception rate of artificially inseminated cattle in Biratnagar. *Proceeding of the 4th National Veterinary Conference of Nepal, Veterinary Association*, 17-19 Nov, 1992, **21-23**:45-48

To study the conception rate in cows of different breeds, AI was carried out and only those animals in which pregnancy diagnosis was made were considered for this study. 132 cows and heifers were confirmed pregnant after 1st insemination of 217 animals resulting in 60.8% conception rate. Likewise, 16.59% animals required 2nd insemination while remaining animals

needed more than 2 inseminations. Number of inseminations per conception was 1.72, and male and female calf ratio was 1:1.44

Estrus synchronization of cattle with prostaglandin through different routes of administration

Sankhi KP and SS Capitan (1993). Estrus synchronization of cattle with prostaglandin through different routes of administration. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **8** (2): pp 40-41

The estrus synchronizing effect of prostaglandin analogue was studied in 20 non -lactating and normally cycling cows. Cows exhibited estrus at mean intervals of 81±11.65, 82.2±14.7 and 72.8±1.32 hrs after a single injection of prostaglandin F_2 α analogue through intraovarian, intrauterine and intramuscular routes at the dose regimen of 0.1, 0.5 and 2 ml, respectively. There were no significant (P>0.05) differences among the 3 prostaglandin treated groups in terms of the time interval to estrus occurrence. The number of animals exhibiting estrus after each treatment was the same. No animal in the control group displayed estrus before day 19 of the estrus cycle. Pregnancy diagnosis by rectal palpation at 2-3 months after AI confirmed 80, 60 and 60% conception rates in the prostaglandin treated groups through intramuscular, intrauterine and intraovarian routes, and 60% in the untreated groups, respectively.

Effect of Gonadorelin in cows and heifers associated with reproductive problems

Sankhi KP (1996). Effect of Gonadorelin in cows and heifers associated with reproductive problems. *Proceedings of the 5th National Veterinary Conference,* 11-13 Sep, **24:** 42-45

Gonadorelin was used in 32 cows and heifers during treatment of some exotic and crossbred cattle suffering from reproductive disorders. 8 out of 12 anestrous cows and heifers exhibited oestrus after one or two injection of Gonadorelin at the dose regimen of 0.5 mg and 0.25 mg, respectively. Of 7 cows cysts of 4 cows were regressed when the drug was administrated once or twice @ of 0.5 mg/animal. Of 13 repeat breeder cows and heifers 6 animals did not repeat the estrus after intramuscular injection of the same drug at the dose rate of 0.5 mg and 0.25 mg/animal. Pregnancy was confirmed after 50 days of AI in 5 out 8 anestrous cows (62.5%), 3 out of 4 cows with cystic ovaries (66.7%) and 6 out of 13 repeat breeder (46%) cows.

An attempt to synchronize oestrus in on station and on farm local cows in the western mid hills

Rasali DP (1997). An attempt to synchronize oestrus in on station and on farm local cows in the western mid hills. *Bulletin of Veterinary Science and Animal Husbandry*, **25**:46-52

A trial was conducted to test the technique of oestrus synchronization in 10 local cows each of on station group kept under stall feeding and on farm group kept under semi stall feeding managements in the mid hills of western Nepal. The cows of both the groups were given 5 ml each of Prosolvin (intervet) containing Luprostiol 7.5 mg/ml, a Prostagladin F_2 alpha analogue intramuscularly 2 times at 11 days apart during summer of 1996. At 72 hrs of the 2nd Prosolvin injection all the cows were inseminated with frozen semen of Jersey bulls. As a result of the fact that the cows of on station group received better feeds and fodder than those of the on farm group, body condition scores (1-9 scale) were 6.1±0.5 in the former group and 3.7±0.3 in the latter, and their girth measured body weights averaged 245.6±10.8 kg and 168.1±7.6 kg respectively. Both these parameters were significantly different (P<0.05) between the groups. The median values of duration taken for oestrus expression following 1st and 2nd instances of Prosolvin injection were not significantly different between the 2 groups. However, oestrus signs such as vaginal discharge, bellowing, frequent urination and vulva being moist and pink

were particularly following the 2nd injection was significantly higher (P<0.05) in on station group. The Haematological parameters such as RBC count, WBC count PCV%, Hb g% with their means 7.3±0.4 million/ml, 9.3±0.5 thousands /ml, 41.4±1.5% and 16.6±0.6 g% in on station group respectively were significantly higher (P<0.05) than those in the on farm group. The very low pregnancy rate of 26.3% suspected due to some faults in AI needs further investigation before technology could be recommended for use in mass insemination of cows under our conditions in the western hills.

Infertility problem of dairy animals in western Nepal

Sankhi KP (1999). Infertility problem of dairy animals in western Nepal. *Workshop on Infertility in Dairy animals*, Nepal Agricultural Research Council, Animal Health Research Division, Tripureswor, Kathmandu, 21 Jan 1999, pp 1-7

Out of 700 breedable cows and heifers 79 cattle were found with different types of reproductive disorders of which anoestrus (21), cysts (18), repeat breeding (36), freemartins (3) and uterine tumors (2) were the problems. Similarly, different reproductive problems of buffaloes diagnosed in the infertility camps were anoestrus (390); repeat breeder (55), and ovarian cysts (15), Nutritional deficiency and parasitic infestation were the major causes of anoestrus. Forty one buffaloes with anoestrus as perceived by the farmers were diagnosed normally, cycling, in heat or pregnant. Likewise infertility problems of 17 and 20.1 percent cows and buffaloes in the hills of western region are reported by LARC researchers. Few animals were found even to be positive with *Brucella abortus* antigen in their study. Infertility problems of 15-20 % cattle and buffaloes particularly exotic and cross breed cows are reported in Rupandehi district. Vitamins and minerals supplementation particularly vit A, D, E and phosphorus injection and GnRh were found effective in including estrus in 2 cows and heifers out of 17 treated animals. Ten of them were diagnosed pregnant. Similarly, GnRh, prostaglandin and luteinzing hormone demised the cysts of 11 cows out of 18 treated ones and 10 of them were found pregnant. Likewise, 14 out of 36 cows and heifers with repeating breeding problems were found pregnant. Likewise, 14 out of 36 cows and heifers with repeat breeding problems were found pregnant. When they were treated intrauterine infusions of Povidone Iodine, antibiotics and even respective hormones in few cases.

Artificial induction of lactation in dry and repeat breeding crossbred dairy cows in Nepal

Kunwar BS and HR Shrestha (2000). Artificial induction of lactation in dry and repeat breeding crossbred dairy cows in Nepal. *Proceedings of the 4th National Animal Science Convention (NASA)*, pp 66-70

Four dry crossbred Nepalese hill cattle (brown Swiss x Nepali hills and Jersey x Nepali hill) with history repeat breeding were used in this experiment. They were divided into group A and B. The animals in group A were injected subcutaneously with Estradiol – 17 β at 0.1 mg/kg body weight/day and progesterone (4 pregnene-3, 20 dione) at 0.25 mg/kg body weight /day in 12 hrs interval for 7 days (Estradiol : progesterone ratio 1:2.5), whereas animals in group B were injected at 1:estradiol: progesterone ratio. Five minutes udder massage was performed each morning and evening from day 15 to 21 to stimulate lactation. All animals were successfully induced into lactation. From day 22 the animals were milked twice daily. Milk samples were taken for initial 4 weeks and analyzed for fat and SNF content. Estradiol and progesterone at 1:2.5 combinations was found more effective for induction of lactation in crossbred Nepalese hill cattle than at 1. The adjusted 305 days lactation yield of group an animals ranged from 759 to 2466 lit, which was 32.9 to 112.4% of previous lactation average, whereas in B group the adjusted milk yield was 39 to 71% of the previous lactation average. The fat and SNF contents

of the treated animals fluctuated for the 1st few days but stabilized at the level of herd mated after 3 weeks of induced lactation.

Study on infectious causes of infertility and its management in crossbred and exotic cattle in Nepal

Jha VC (2005). Study on infectious causes of infertility and its management in crossbred and exotic cattle in Nepal. *Nepalese Veterinary Journal*, **28:**25-31

This study was aimed to evaluate the extent of infertility problem and to isolate, identify the specific and nonspecific agents causing infertility in crossbred and exotic cattle in Nepal. The treatment responses of antiseptic and antibiotics in repeat breeders and aborted cases have also been evaluated. 118 serum samples collected from the repeat breeder and aborted cows were subjected for antibody detection of *Brucella abortus*, *Leptospira hardjo*, Infectious Bovine Rhinotracheitis/Infectous Pustular Vulvovagintis virus and Chlamydia psittaci which showed that 0.8% samples were positive for the presence of antibody for *B. abortus,* 9.3% for *L. hardjo* and 50.8% for Infectious Bovine Rhinotracheitis/Infectious Pustular Vulvovaginitis virus. No sample was positive for *C. psittaci*. The cervical and uterine samples tested for Trichomonads microscopically, revealed no positive case. *Escherichia coli, Bacillus spp* and *Staphylococcus aureus* were major bacterial species isolated from cows having vervicitis and endomeritis. The treatment response of cows with pathological condition of endometritis, and/or cervicitis was found promising. Out of 28 cases treated, 19 (67.8%) cows became pregnant. Therefore, the treatment therapy applied in this study can be a promising therapy for the treatment of cases with infectious form of infertility of microbial origin.

Status of embryo transfer in cattle in Nepal

Rana RB, SP Neopane and AB Shah (2009). Status of embryo transfer in cattle in Nepal. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 307-309

Embryo transfer (ET) which is advanced in reproduction technology initiated in the country in cattle using Jersey frozen embryos imported from New Zealand for the 1st time in Nepal in 2003.This was initiated in joint collaboration of NARC and DLS with some support from Winrock International. Cattle from Bovine Research Program, NARC and the farmers' herds in the Kathmandu valley were used for transferring embryos. Later, more animals both from farmers' herds and from government farms in different parts of the country were transferred with embryos by DLS and NARC. A total 130 cattle were embryo transferred with Jersey embryo so far in the country. The result showed that conception rate from ET is low (13.85%), but the techniques for transferring embryos in cattle has been established in the country. The paper includes the latest information about the status of ET done in the country.

Assessment of the infertility situation in cows and buffaloes in the western hills of Nepal

Rasali DP, DH Joshi, HK Shrestha and DC Gautam (1998). Assessment of the infertility situation in cows and buffaloes in the western hills of Nepal. *Working Paper N. 98/40*, Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

A study was carried out through a questionnaire household survey and a series of infertility camps to investigate the situation of infertility, their types and extent in cows and buffaloes in the western hills of Nepal. The sampling framework of household survey comprised of 52 local and 50 crossbred cows, 45 local and 39 crossbred buffaloes from 4 sample villages of high hills, 38 local and 37 crossbred cows, 39 local and 39 crossbred buffaloes from 6 villages of mid hills,

and 47 local 40 crossbred cows, 53 local and 49 crossbred buffaloes from 5 sample villages of low hills. The survey results showed that the overall occurrence of the infertility problems in cow 17%, of which repeat breeding (9.5%) and anoestrus (4.2%) were the major ones. The frequency of overall infertility problems was significantly higher (P<0.05) in completely grazed cows (60%) than in stall fed (16.9%) and semi stall fed (16.1%) cows. The cows in the low hills had significantly higher (P<0.05) occurrence of anoestrus (9.2%) than those in the high (2%) and mid hills (1.3%). The household survey results also showed that the overall occurrence of infertility problems in buffaloes was 20.1%, of which the repeat breeders (9.8%), anoestrus (9.5%) and the silent heater (7.2%) were the major ones. The frequencies of the overall infertility and repeat breeding were significantly different (P<0.05) across the factors – altitude and management systems, whilst the silent heat problem was significant 9P<0.05) across the parity. The buffaloes in the low hills had the highest frequency of the overall infertility (26.5%) and repeat breeding (15.7%) as compared to those in the mid hills (20.4 and 7.5% respectively) and those in the high hills (10.1 and 4.3%, respectively). Stall fed buffaloes also had higher frequency of the overall infertility problem (23.7%) and repeat breeding (12.9%) than in the semi stall fed buffaloes (1.7 and 2.75, respectively). The repeat breeding was highest in the 4th parity among parities whilst the silent heat cases were higher in the 1st and 2 parities as compared to the subsequent ones. The survey results also indicated that the overall occurrences of abortion and Dystokia were 5.7 and 2.7%, respectively in cows, and 4.9 and 3.8 % respectively in buffaloes. The altitude was significant (P<0.01) for the frequency of abortion in cows with the highest occurrence in the high hills (11.8%), whilst the management system was significant (P<0.05) for the frequency of abortion in buffaloes with the semi stall fed buffaloes having the higher frequency (9.1%) than the stall fed ones (3.2%). The frequency of abortion in cows also tended to be higher in the 3rd or higher parity. For the adoption of infertility treatment in the western hills, only the crossbred cows or buffaloes were given one or more infertility treatment, although it was indifferent across other factors altitude, management and parity. The investigation of lab samples collected from the cows and buffaloes in a series of infertility camps organized in a number of village sites of the western hills yielded some preliminary findings. The results indicated that none of the Haematological means values were significantly different between local and crossbred cows and buffaloes across the types of infertility problem diagnosed. The serum inorganic phosphorous level was higher (P<0.05) in the crossbred than in the local cows and buffaloes, but it was not significantly different across the infertility problem diagnosed. However, the total phosphorous level was significantly higher in the Murrah crossbreds than in the local buffaloes (P<0.01), and was 8.87±0.46 g% in uterine infectious, 7.09±0.61% in persistent corpus luteum in buffaloes, which were both significantly different (P<0.05). Bacteriological investigations revealed that a total of 129 isolates were identified. Of them, *Corynebacterium spp, Pseudomonas aerugenosa, Streptococcus pyogenes, Nocardia spp, Listeria spp* and yeast (*Candida albicans*) were identified in 3.8, 4.6, 3.1, 0.8 and 5.4% of the samples respectively. Serological investigations in 63 crossbred and 17 local cows using Enzyme Linked Immuno Sorbent (ELISA) revealed 8.7% cows (2 local and 5 crossbred cows) positive with *Brucella abortus* antigen.

Factors affecting conception rate of artificial insemination in cattle and buffalo

Shrestha S and SP Neopane (1999). Factors affecting conception rate of artificial insemination in cattle and buffalo. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, 26-28 June, 1999, pp 249-254

Artificial insemination (AI) program has been an important part of genetic improvement programme in the country. 42 districts have been covered with AI more particularly in cattle and with lesser extent in buffaloes. A study was undertaken to determine the effectiveness of AI

in cattle and buffalo in 6 districts (Siraha, Jhapa, Ilam, Rasuwa, Nuwakot and Salyan). A survey work was done using the structured questionnaire. Results indicated that amongst 5 factors (district, species, breed, farmers experience and type of insemination) breed and farmers experience were important source of variation for conception rate (CR). Amongst the breed, local had the lowest CR (15.4%). Farmers having used AI more than 3 years found the highest CR in their animals (69.7%). Although not significant AI done by technicians had higher CR than that done by officers.

A study on infertility problems of crossbred dairy cattle and buffalo in the milk shed area of Jhapa district

Sapkota D (1999). A study on infertility problems of crossbred dairy cattle and buffalo in the milk shed area of Jhapa district. *Workshop on Infertility in Dairy Animals in Nepal*. Nepal Agricultural Research Council, Animal Health Research Division. Tripureswor, Kathmandu, Nepal, 21 Jan 1999, pp 8-10

From this study, infertility has direct effect on inter calving period i.e. > 16.38 months. The difference between normal and prolong inter calving period is > 4.5 months. Increase in inter calving due to anoestrus and repeat breeding means increase in dry period. The ultimate result is tremendous due to loss of milk yield of local cattle & buffalo 2.5- 3.20 liters /day/cow, where as improve cattle /buffalo are 7.64-8.47 liters per day / cow, respectively. Thus, the economic loss due to infertility can be under control by means of better plan of nutrition, strategic parasitic control means, improve husbandry and proper treatment regime against infectious form of infertility.

Study on bovine abortion and repeat breeding in cattle and buffaloes

Jha VC and DR Khanal (1999). Study on bovine abortion and repeat breeding in cattle and buffaloes. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, pp 138-141

A household survey was conducted in 383 houses of Chitawan, Pokhara and Bhairahawa. A total of 1187 cattle and 531 buffaloes were surveyed from the above localities. Overall incidence of abortion was 4.72 and 2.07% and repeat breeding 9.26 and 0.37%, respectively in cattle and buffaloes.

Investigation on infertility in cattle and buffaloes in Nepal

Dyson D, B Sharma and GR Pant (2000). Investigation on infertility in cattle and buffaloes in Nepal. *Veterinary Review*, Animal Health Research Division, Tripureswor, Kathmandu, Nepal, **15:**7-9

A preliminary study to investigate the causative agents of infertility in cattle and buffaloes was carried out in Nepal during 1999-2000. Serum samples were collected from the animals, showing reproductive problems, from different districts of Nepal. These samples were tested in the laboratories of UK to detect antibodies against infectious diseases and to determine the level of protein and minerals in the animals. Antibodies against infectious bovine Rhinotracheitis, Neospora and *Leptospria hardjo* were detected in serological tests. In addition, biochemical tests revealed deficiencies of Cupper, Selenium, Manganese and low blood urea.

Studies on normal fertility status and factors associated with bovine infertility in the hills of Nepal

Joshi BR, HD Joshi and BS Shrestha (2001). Studies on normal fertility status and factors associated with bovine infertility in the hills of Nepal. *Technical Paper N. 2001/4*, Agriculture Research Station, Lumle, Kaski, Nepal

Infertility has been regarded as an important problem of cattle and buffaloes in Nepal, but its actual extent is as yet unknown as the normal fertility indices of our animals under the existing management system are yet undefined. Hence as it is important to define the normal indices of the national herd, some attempts have been made in present study to define these indices for western hill districts. In general, indigenous cattle had the poorest fertility status than the exotic cross cattle or buffaloes. The average age at first mating, age at first calving, calving interval and calving to conception period in indigenous cattle were 46, 58, 21.5 and 11 months, respectively, while the respective figures for exotic crossbred cattle were 26.7, 43.5, 13.5 and 6.7 months, respectively. Similarly, in indigenous buffaloes the age at first mating, age at first calving, calving interval and calving to conception period were 46, 55, 17 and 6.4 months, respectively while respective figures for crossbred buffaloes were 44.6, 56.4, 17.7 and 6.5 months, respectively. These figures were not significantly different between the buffalo breeds. The distribution pattern of cattle and buffaloes on these parameters indicates that some 25% cattle and 10% buffalo population, which are beyond the normal range of fertility parameters, need urgent attention for improving their fertility status considering the population mean + 1SD of the concerned parameter as normal. The problems of repeat breeding (3% and 5.4% in cattle and buffaloes), abortion (less than 1% in both cattle and buffaloes), Dystocia (less than 1% in both cattle and buffaloes) and others (e.g. metritis) were of lesser significance in the population. The contributing factors for the fertility were found to be management and particularly the nutrition management of the animals as well as breed characteristics. Disease and other clinical problems although were significant for individual farmers and animals were found to affect the overall fertility at relatively lesser extent. The prevalence of Brucellosis and Leptospirosis were 3 and 8.5% of the total sample tested from so called infertile animals. Response to nutritional supplementation to the identified infertile or sub fertile animals was positive (50% animals successfully conceived), though the results were inconclusive and require further in depth investigation. The study indicates the need to define the normal fertility indices for our condition and to assess the overall fertility status of the national herd, so that the problem could be dealt in a broader context. It is also important to identify the major factors of infertility and address them accordingly.

Assessment of quality of frozen semen used for artificial insemination

Paudel KP, A Shah, LP Ghimire and BR Joshi (2004). Assessment of quality of frozen semen used for artificial insemination. *Proceedings of the 2nd SAS/N Convention*, Kathmandu 30 July – 1 Aug, 2003, pp 362-365

With an objective to explore the role of frozen semen in female infertility cases, 36 frozen semen straws comprising 20 cattle and 16 buffaloes bull semen from Rupandehi, Kaski, Morang and Jhapa districts were examined in vitro for the assessment of fertilizing ability of the semen used for artificial insemination. The seminal parameters studied included sperm cell motility percent, live and dead cell count and hypo osmotic swelling test (HOST) response using standard protocols. Motility percent was assessed by microscopic examination at 40 x magnification at 35 to 37^{0}C by observing proportions of the motile cells at 5 different spots on a slide. Nigrosin-eosin strain is used for the differential count of live and dead sperm cells. Hypo-osmotic sperm response was determined by incubating semen sample at 37^{0}C for 60 minutes in a hypo-osmotic solution (consisting of sodium citrate and fructose; 150 mosmol) and observing

the osmotic changes in the sperm cells. Based on the above 3 parameters there is a significant difference in semen quality among bulls for both the species (cattle and buffaloes) however, no significant degree was evident between the samples from semen production source (Pokhara), transit storage (Semen bank Bhairahawa) and the field level (DLSO and LDC samples) implying ideal storage conditions of semen during distribution and storage. In general the quality of the semen sued for AI is below the recommended norms of the DLS. The study strongly recommends that a thorough andrological and seminal investigation of the bull used for semen collection be performed before their introduction as a source of frozen semen for AI. In case of buffalo bull semen as the post thaw quality of semen extended in citrate based buffer was found to be very poor the study also suggests for further exploration on the suitability of other extenders based on zwitter in buffers.

Initial chromosomal analysis of indigenous buffaloes in the western hills of Nepal

Rasali DP, RK Patel and HD Joshi. (1998). Initial chromosomal analysis of indigenous buffaloes in the western hills of Nepal. *Veterinary Review*, Nepal Agricultural Research Council (NARC), Khumaltar, Lalitpur, Nepal, **13:**30-33

Blood samples were collected from fourteen indigenous buffaloes of western hills of Nepal kept at Lumle Farm. They were processed for lymphocyte culture within 50 hours of collection in RPM1-1640 media supplemented with foetal calf serum, antibiotics and a mitogen at National Dairy Development Board, Gujrat, India. The cultures were harvested at 72 hours. Prepared slides were then screened under microscope. Results indicated that all the buffaloes, which showed Lime type phenotypic features, had Karotypes with 50 chromosomes resembling to riverine buffaloes.

Presence of variant chromosome 3 in the infertile water buffaloes (*Bubalus bubalis*)

Patel RK and VK Khoda (1998). Presence of variant chromosome 3 in the infertile water buffaloes (*Bubalus bubalis*), *Veterinary Review*, Nepal Agricultural Research Council (NARC), Khumaltar, Lalitpur, Nepal, **13:** pp 25-27

Cytogenetic investigations were carried out on a group of 16 river buffaloes of different age groups with history of infertility. Except one buffalo of 9 year of age, none of them calved even once. An unusual variant of chromosome number 3 ((3P+) with enlarged additional C-band positive segment in the proximal region of short term of one of the homologues was observed in 6 local buffalo heifers/ buffaloes which had either one or both small and smooth ovaries without follicles. This variant 3P+ was found to be related to infertility problems in all 6 buffaloes. Rest of all buffaloes with normal karotype had normal sized ovaries. The reasons for their infertility may be non-genetic. Cytogenetic analysis of 6 buffaloes with variant 3P+ revealed 8% aneuploidy and 1.4% polyploidy cells. The polymorphism in chromosomes 3 due to the presence of heterochromatin material on proximal region of P arm might be related to the higher incidence of meiotic disturbance leading to aneuploidy and failure for oogenesis which might be reason for infertility.

Karyotypes and chromosomal aberration of indigenous buffaloes in the western hills of Nepal

Joshi HD, BS Shrestha, RM Singh and BR Pokharel (2003). Karotypes and chromosomal aberration of indigenous buffaloes in the western hills of Nepal, Development of Suitable breeding strategies for indigenous buffaloes in the western hills of Nepal. *Final Technical Report, HARP PP-78/00,* Regional Agricultural Reseacrh Station, Lumle, Kaski, Nepal, pp 27-30

The indigenous buffaloes (both Lime and Parkote) found in the western hills of Nepal are riverine type with 2n= 50 chromosomes. Karotyping revealed that five pairs of autosomes are sub – metacentric and 19 pair's autosomes areocentric. Both sex chromosomes (X and Y) are acrocentric X being longest and Y being one of the shortest chromosomes. Numerical abnormalities were not found in all of 9 bulls from superior dams intended to be used for breeding in the village, while structural abnormalities could not be detected. Further work on cytogenetic study particularly on detection of chromosomal abnormalities among the animals intended for widespread breeding use need to be carried out.

Mitochondrial DNA analysis of Nepalese domestic dwarf cattle Lulu

Takeda K, M Satoh, SP Neopane, BS Kunwar, HD Joshi, NP Shrestha, H Fujise, M Tasai, T Tagami and H Hanada (2004). Mitochondrial DNA analysis of Nepalese domestic dwarf cattle Lulu. *Nepal Animal Science Journal, (NASA)*, **75:**103-110

Dwarf Lulu cattle, the only *Bos taurus* type of cattle in Nepal raised under severe environments in the mountainous zone of that country. In the present study measurement traits, cytogenetic and molecular genetic characteristics of the Lulu cattle are investigated. Blood samples were collected from 31 animals in four villages (altitudes 2590-3550m asl) in southern part of Mustang. The Lulu cattle had a normal karyotype with 2n+ 60, XY or XX. Only one made examined had large submetacentric X – chromosome and a small submetacentric Taurine type Y chromosome. The mitochondrial DNA (Mt DNA) genotypes were analyzed by PCR mediated restriction fragment length polymorphism; displacement (D) loop region PCR mediated single strand conformation polymorphisms, and D loop region sequences. Many base substitutions were found in the D loop region, suggesting that the Lulu cattle originated from at least 10 maternal lines. Three types of Mt DNA from these cattle were found, the *Bos taurus* type (n=23), the *Bos indicus* type (n=6), and the *Bos grunniens* type (n=2). In the village at the lowest altitude, four of the five cows were of the *Bos indicus* type. These results indicated that Mt DNA types of the Lulu cattle mostly belong to *Bos taurus*, but have been hybridized with *Bos indicus* cattle in lower elevation regions of their maternal lineage.

Ascorbic acid and chlorpromazine reduce cryopreservation induced damages to crossbred bull spermatozoa

Paudel KP and S Kumar (2004). Ascorbic acid and chlorpromazine reduce cryopreservation induced damages to crossbred bull spermatozoa. *Proceedings of the 4th National Conference on Science and Technology (NAST)*, Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, Nepal, 23-26 March, 2004, pp 30-240

Infertility associated with cryopreserved semen is a severe problem in crossbred cattle in the Indian subcontinent. A study on fresh, pre-freeze and frozen-thawed spermatozoa was undertaken to assess the cryodamages and evaluate the effectiveness of some natural antioxidants (ascorbic acid and catalase), chlorpromazine (amembrane stabilizer) and their combination on reducing the damages during freezing. Thirty two ejaculates from 4 bulls were collected, processed and diluted in tris -fructose - egg yolk - glycerol extender (control). Treatment groups included addition of 10 mM ascorbic acid (T1) , 0.1 mM chlorpromazine (T2), 200 IU/mL catalase (T3), 10mM ascorbic acid + 0.0 mM chlorpromazine (T4) and 200 Iu/mL catalase + 0.1 mM chlorpromazine 9T5) in the control extender. Cytomorphological studies were performed by using fluorescent probes for simultaneous detection of livability and acrosomal integrity. Hypo-osmotic sperm swelling and nuclear chromatin decondensation tests were performed to assess the functional status of the sperm. Acrosomal enzymes (Hyaluronidase and Acrosin) and lipid peroxidation level were assayed by colorimetry.

Cryodamages were quantified based on the alteration on cytomorphological, functional and biochemical parameters in frozen – thawed sperms from those in fresh ones. Cryopreservation induced damages were severe as reflected by reduction in acrosome intact live sperms by 52%, HOs response by 47% Hyaluronidase by 34% and Acrosin activity by 54%, and increase in MDA by three fold in the frozen thawed than those in fresh sperms. Among the treatment groups T4 (ascorbic acid + chlorpromazine) was the most effective followed by T1 (ascorbic acid) and T3 (catalase) in reducing cryodamages. It is recommended for in vivo assessments that ascorbic acid alone or in combination with chlorpromazine be added in the extender for semen production for artificial insemination.

Review on application of biotechnology in animal breeding for improved productivity in domestic animals of Nepal

Neopane SP and PK Pokharel (2008). Review on application of biotechnology in animal breeding for improved productivity in domestic animals of Nepal. *The 5th National Conference on Science and Technology,* Nepal Academy of Science and Technology (NAST), Kathmandu, Nepal, 10-12 Nov, 2008

Animal biotechnology can be understood as a branch of science that alters and /or controls the genetic and reproduction process in animals. This altering/controlling process leads to increase in production and productivity of animals, help to identify distance between breeds/species, and supports to conserve endangered and valuable livestock breeds and species. New developments in animal biotechnology have been slow in coming. Making genetic changes in animals have been considered a difficult task, as generally productive performances of animals is controlled by not only a single genes rather many. To locate several genes for productive traits and use it are the money consuming task and long term support from the governments is utmost essential. With regards to usefulness of biotechnology, several tools, techniques and technologies have been used in the country for several purposes. The major usefulness for which animal biotechnology works have been done appears to be geared towards i) improving the productivity, ii) improving breeds/animals, iii) conservation of biodiversity, and iv) utilization of biodiversity. Use of male reproduction biotechnology (artificial insemination) has been successful in increasing the milk productivity by 300 to 400 percentage in indigenous cattle and 100 to 200% in indigenous buffaloes. Similarly, productivity in other species has been improved using Artificial Insemination (AI). Recently female reproduction biotechnology (embryo transfer) has been made in cattle in the country with a success. Several other important tools such as iso-enzyme analysis and genetic distance have also been used. For the conservation and utilization of animal biodiversity, characterization of several breeds in domestic animals (Lulu, Achhami and Yak in cattle; Lime, Parkote and Gaddi in buffaloes; Terai and Khari in goats; Kage, Baruwal and Bhyanglung in sheep; Hurrah and Chwanche in pigs) has been made at biochemical level. Characterization of Lulu cattle has been done at DNA level. These works have contributed a lot of better understanding of indigenous breeds of domestic animals in the country leading to their utilization. The other important aspect of the paper is that it includes major findings and works done in the animal biotechnology, gaps and constraints associated with it and more importantly strategies and way forwards for improvement and optimum utilization of indigenous breeds are highlighted and suggested.

Cytogenetic studies in indigenous livestock breeds in Nepal

Gorkhali N and SP Neopane (2009). Cytogenetic studies in indigenous livestock breeds in Nepal. *Proceedings of the 7th National Workshop on Livestock and Fisheries Researchl in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 310-316

Nepal has many domestic livestock population, which are adapted to their particular environments, resistant to many diseases and are suitable to low input management system. If

the purity of indigenous stock could be maintained as a reservoir of genes, they may be of great value for future. Twenty-five indigenous livestock breeds were identified so far. Most of the indigenous breeds are characterized in phenotypic level. However, cattle breeds, Lulu and Yak; goat breeds such as Terai and Khari; sheep breeds such as Baruwal, Kage and Bhyanglung and buffalo breeds such as Lime, Parkote and Gaddi are characterized in chromosomal level. The Lulu cattle had a normal karotype with 2n=60, XY or XX. Male had a large sub-metacentric X chromosome and small sub metacentric Y chromosome. In case of buffaloes, Lime and Parkote from western development region have 5 pairs of sub-metacentric autosomes, 19 pairs of acrocentric autosomes and a pairs of sex chromosome. In male, X chromosome was the largest Acrocentric, whilst the Y chromosome was one of the smallest acrocentric chromosomes. There is breed wise variation in karotype. In Gaddi buffalo, even though the number of chromosome is same, there is structural variation. In Terai goat, metaphasic spread of the chromosomes has 29 pairs of autosome and a pair of sex chromosome. Among the sex chromosome, X chromosome was larger metacentric while Y-chromosomes were smaller Telocentric type. The karyotype organization of the three identified sheep of Nepal was found to be same with chromosomes 2n=54. If we can characterize each and every descript and non-descript breed in phenotypic and genetic level, we would be able to develop breeding policy for each native commodity and thereby, further action on indigenous breed like promotion and utilization can be done.

1.4 PRODUCTION AND MANAGEMENT

Livestock research outreach priorities in Nepal

Upadhaya RM (1990). Livestock research outreach priorities in Nepal. *Paper presented in 1st National Research Outreach Conference*, 23-25 Jan, 1990, pp 74-87

The traditional animal grazing system has come to almost at a point where it is no more possible to provide even the minimum survival requirements. Stall feeding is more increasing and the production of roughages such as grasses, legumes and tree fodder at the end and around the farm has become a necessity. Improvement in the palatability and nutritive value of crop by products and residues, and supplementation with low cost locally available concentrate mixture would help to improve the nutritional level of livestock. The best motivation to farmers has been found to be the direct additional income which they get from certain enterprises. High yielding superior animals and an assures market with reasonable price guaranty is therefore required. The outreach research should be directed to take appropriate technology package aimed at meeting the above needs. On station research should be directly related to the need of the farmers as indicated above.

Monitoring of the productivity and production systems of animals at high altitude pastures

Shrestha NP (1993). Monitoring of the productivity and production systems of animals at high altitude pastures. *Working Paper N. 93/74*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

Animals at high altitude pastures are efficient at utilizing remote plant resources into meat, wool, power, milk and milk byproducts such as ghee, chhurpi and khowa, etc. However, little detailed information on the productive performance of these animals is available. The present study has therefore been carried out in order to quantify information about the animals' production systems, and their productivity at high altitude pasture sites. Preliminary results showed that the annual off take was 14, 17, 12, 9 and 14 % and mortality was 7, 10, 20, 3 and 13% for cattle, buffalo, sheep, goats and Chauri, respectively. The growth rates of Baruwal sheep from birth to 1 year and Kage for 11 months were 66 and 40 g/ day, respectively. The

average wool yield for Baruwal and Kage sheep were 744 and 400 g/shearing. The average milk yields for cattle and buffalo were 326 and 653 lit for lactations of 8 and 10 months, respectively

Livestock extension: the experience of Lumle Agricultural Research Centre

Gurung DB (1995). Livestock extension: the experience of Lumle Agricultural Research Centre. *Proceeding of the 2nd National Animal Science Convention*, Lalitpur, Nepal, Aug 7-10, pp 135-142

The livestock extension services of Lumle Agricultural Centre (LARC) provides necessary technical advice to the farmers and also manages the supply of necessary inputs and services in its Extension Command Area (ECA) to support the adoption of livestock technologies. Livestock extension has, thus introduced improved breeds emphasizing six species, namely buffalo, cattle, sheep, goats, chicken and rabbit. When technologies are generated by LARC's livestock section they are verified in particular villages of the ECA and technologies adopted are further disseminated throughout the different ecological zones. It has been found that numerous factors such as physical and geographical conditions, degree of subsistence orientation, progressiveness of the farmers farming system, socio-economic conditions, as well as the ethnicity availability of technology, communication, literacy, motivation, input support and shortage of labor, can greatly influence the effectiveness of extension services. Thus, while implementing livestock extension activities these factors were considered. Moreover, priority was placed upon those technologies that can generate substantial income for the farmers. It has also been observed that the acceptance of improved technologies varied from region to region and amongst different ethnic groups within the ECA. In addition, one of the key elements of success in the livestock development has been the group approach of its extension through the Village Livestock Development Committees formed amongst the farmers in the ECA.

Adoption of improved large ruminant breeds in Lumle Agricultural Research Center's extension command area: A logistic regression analysis

Gurung HB, Rasali DP, Vaidya AK and Rana RB (1995). Adoption of improved large ruminant breeds in Lumle Agricultural Research Center's extension command area: A logistic regression analysis. *Proceedings of the 2nd National Animal Science Convention (NASA)*, Lalitpur, Nepal, Aug 7-10, 1995, pp 66-72

The study is a synthesis of findings of results of three different studies viz. large ruminant crossbreeding program assessment study (1993), research impact study (1994), and census survey of Lumle Agricultural Research Center's Extension Command Area (199I). The study has primarily attempted to identify the factors affecting adoption of improved cattle and buffaloes using a logistic regression analysis (stepwise forward method). Six variables viz. household food balance. Breeding bull distribution program, number of large ruminants (LS unit) interaction between number of large ruminants and livestock system, feed source, and sex of household head significantly affected adoption of improved breed of buffalo. Similarly, in cattle adoption of improved breed was affected by agro-ecological zone, food balance, feed source. Livestock feed balance, breeding bull distribution program, and interaction between number of large ruminants and feed balance, of these variables and correlation of the adoption of improved breed varied with the category of feed source. However, food balance, number of large ruminants, and interaction between number of large ruminants and feed balance was positively correlated whilst the rest of the variables were negatively correlated with improved breed adoption. Striking result of the study are that wealthier class of farmers and farm households with Kudo/mixed feed source have adopted improved breeds of both species, Negative correlation of breeding bull distribution program with adoption of improved animal

by farm households residing in program villages is indicative of diffusion of the technology to villages without breeding bull distribution program, attributing to the success of the program.

Animals, environment, Prosperity and healthy citizens

Singh NB and NP Ghimire (1996). Animals, environment, Prosperity and healthy citizens. *Proceedings of the 5th National Veterinary Conference, held at 11-13 Sep*, **24**:1-5

The role of livestock in the socio-cultural fabric of Nepalese society and its contribution towards the economy of the country is discussed. The paper describes the direct and indirect contribution of livestock towards preserving the environment by way of providing alternative to fuel wood and improving soil fertility. The important role of livestock products in the health of human beings is highlighted.

Evaluation of package of practices on livestock productivity under farmers' management in the western hills of Nepal

Amatya LK and RK Kadariya (1997). Evaluation of package of practices on livestock productivity under farmers' management in the western hills of Nepal. *Working Paper N. 97/41*, Lumle Agricultural Research Centre, Lumle, Kaski, Nepal

A study was conducted from 1991 to 1993, to evaluate the performance of integrated package of practices under the farmers' condition in 4 on – farm research sites, 2 off station research sites Kewarebhanjyang and Yamphaphant and 2 outreach research sites Jhobang and Malunga, respectively of Lumle Agricultural Research Centre. The introduced practices were involved feed quality through improvements in crop by-products, forage cultivation and mineral feeding, and control methods of diseases. Productivity of in terms of milk yield of lactating animals and growth rate of small ruminants were measured. The difference in milk yield between lactating buffaloes of treatment and control groups found to be significantly different with a mean of 3.95±0.09 and 3.7±0.11 lit/day respectively. There was no difference in ground roughages, tree fodder and salt intake between groups. The growth rate of lambs of treatment group with 56±0.28 g/day was found to be significantly higher than 51±3 g/day in case of lambs of control group. A need for simplified study on the adoption of the technologies and the factors governing by empowering the farmers is suggested.

Livestock management situation under farmers' household in the western hills of Nepal – Report on Samuhik Bhraman

Rana RS, N Amatya, MB Nepali, BR Joshi and HD Joshi (2000). Livestock management situation under farmers, household in the western hills of Nepal – Report on Samuhik Bhraman. *Working Paper N. 2000/6,* Agriculture Research Station, Lumle, Kaski, Nepal

A samuhik bhraman was conducted by a multidisplinary team of livestock experts in 8 sites located in the research command areas of Agriculture Research Station, Lumle in the western hills of Nepal using Rapid Rural Appraisal (RRA) technique. The joint trek of the study revealed that the crop residues were the major source of feed for livestock throughout the visited areas with supplementation of fodder tree, green grasses and kundo (local concentrate) as available. February-April (Falgun –Baisakh) were the most critical livestock feed scarcity periods. Fodder tree like Kimbu (*Morus alba*), Kavro (*Ficus lacor*), Khasre Khanayo (*Ficus cunia*) and Badahar (*Artocarpus lakoocha*) were potential resources of feed for livestock during this dry period. Farmers of river basin to low hill were dependent on communal forest for the same. The complete stall feeding and semi stall feeding was prevalent from river basin to mid hill and migratory management system was predominant in high hills. It was found that the parasitic problem particularly liver fluke and infertility in large ruminants were causing more economic

losses. Liver fluke infestation might be due to the source of animal feed and it was more prevalent to lower and mid hill regions particularly in irrigated and wet areas than in high hill areas. The main cause of infertility in large ruminants might be due to inadequate feed. Summing up, nutrition was the constraint, affecting adversely to the health of livestock.

Situation analysis of livestock sub system: A case of Phulbari VDC, Chitawan, Nepal

Devkota NR, D DevkOata and HN Bhandari (2001). Situation analysis of livestock sub system: A case of Phulbari VDC, Chitawan. Nepal. *Journal of Institute of Agriculture and Animal Science (IAAS)*, Rampur, Chitawan, pp 157-168

Both household survey and PRA approaches are commonly used to collect primary information in the field of natural resource management. However, stress on the use of either one approach alone is more common with the ignorance or avoidance of the other. Use of both PRA and survey methods as a combined approach to generate primary information focusing on situation analysis has been proposed in this paper. Accordingly situation analysis of livestock sub system in the Phulbari VDC, Chitawan district, Nepal was carried out to understand locally available natural resources base in relation to livestock rising, and to assess role of livestock to the household income generation in the Gopalgunj area of Phulbari VDC. Commonly used PRA tools such as social/ resource mapping, transect walking, and ranking were employed to generate qualitative information, while precisely developed but short listed questionnaire was used to produce quantitative information from household survey employed in the purposively selected wards. Findings revealed that PRA tools were more powerful to generate information through informal process of discussion and participation, while formal household survey helped to quantify that qualitative information. By the use of combined approach situation analysis for the livestock sub system was better accomplished. Accordingly, key problems related to the livestock raising were identified:

- Low level of animal population and productivity
- Unavailability of sufficient fodder/feeding materials, and
- Lack of appropriate improved breeds.

Findings also revealed mean number of milking buffalo limited to 1 per house, while goat number was comparatively higher (3±1.4, 3±1.6 for local and improved, respectively). This study suggested that appropriate PRA tools could be used to generate qualitative information to meet the objectives, it is more relevant and appropriate to validate such information through the use of household survey as well, but best possibly with the use of short listed and precisely developed questionnaire.

Livestock production and policies in Nepal

Karki NPS and NP Ghimire (2003). Livestock production and policies in Nepal. *Proceedings of the 7th National Conference of Nepal Veterinary Association,* Tripureswor, Kathmandu, Nepal, 5-7 Nov, **24**: 1-7

Nepalese livestock sector contributing about 31% to AGDP has been considered as a major contributor for poverty alleviation in remote rural areas. At national level, an increasing population growth rate of 1.12% in cattle, 1.93 in buffaloes, 2, 03% in goat, 4.55% in pig and 4.7% in poultry between the years 1992-2002 has been recorded. This growth rate was higher in districts where programs for commercial livestock products are developed. The per capita availability of livestock products is 48.46 lit of milk, 8.39 kg of meat and 22 eggs per annum. The livestock products are not enough to meet the dietary requirement. Livestock production losses due to diseases and parasites account worth around NRs 845 million. Nepal, as a member of WTO has an obligation to reform its Veterinary services according to OIE guidelines. Several acts related to livestock products have been promulgated yet they fail to address

adequately the international requirement. Quality control on livestock products is not sufficiently addressed. Competitive price and quality requirement are the concern of market in Nepal which improvement in public services.

Optimization of livestock holding using linear programming technique: A case study from mid hills of Nepal

Das R and GP Shivakoti (2005). Optimization of livestock holding using linear programming technique: A case study from mid hills of Nepal. *Green Field Journal of Himalayan College of Agricultural Sciences and Technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **3**(2):145- 156

The crop livestock integrated farming system practiced in hilly regions of developing countries depends to a greater extent on the ecosystem as a whole. The importance of animals as an agent of nutrient cycle, sources of rural energy in terms of draft power and fuel as well as major contributor of the farm economy, has resulted into increased population of ruminant stock in these regions creating threats to the sustainability and productivity of the land resources. Therefore, this paper is an attempt to formulate optimum herd size compatible to different resource holding farm categories within the sub watershed in mid hills region of Nepal using linear programming (LP) technique. The LP analysis revealed that the farmers of large, medium and small categories of farms can optimize their livestock holding with combination of 3 livestock Unit (LU) buffaloes and 4 LU goats, 2 LU buffaloes and 4 LUgoats and 1 LU buffaloes and 4.4 LU goats, respectively with maximum return to the farm family without exerting pressure on the fragile nature resources.

Bio energy production: A threat on the animal industry in Nepal

Upreti CR, BK Shrestha and B Ghimire (2008). Bio energy production: A threat on the animal industry in Nepal. *The 5th National Conference on Science and Technology*, Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, Nepal, 10-12 Nov, 2008

Feed ingredients as food and feeds are used by human beings and animal species in Nepal. But in the recent years, these ingredients are used to produce bio fuel for vehicles. These bio fuels are (i) ethanol produced from cereal grains such as maize and (ii) bio diesel produced mainly from soybean and other grain oil seeds. This situation is definitely reducing the food availability to the human and feeds to the animal species. Use of feed ingredients for bio energy production was started in Brazil in 1970 and immediately expanded in USA and EU countries. About 23% of maize production in USA is being used for ethanol production. Bio fuel production practices are gradually adopted by other countries such as EU nations and even in China and India. In near future this practice is diverting huge amounts of feed ingredients to the bio fuel plants which ultimately create feed shortage for both human and animals. This situation will also directly affect animal industries in Nepal with shortage of feed ingredients. Currently, Nepal requires 463672 ton of animal feed ingredients each year out of which maize requirements is 194742 ton. Presently, of the total maize requirement as feed ingredients; total 45% (87.634 ton) is imported from India to meet the requirements. Similarly, soybean is another summer grain legume which is a major source of protein, oil, vitamins and essential minerals in animal feeds. Annually, 20961 ton of soybean is being produced in the country while 51003 ton is required for animal feed. Annually, 98% of soybean is being imported (49983 ton) from India. This situation reflects that these feed ingredients are not adequate for the nation. If Nepal will divert the ingredients for bio fuel production, the animal industry will be directly threatened. If Nepal has to go for bio fuel production, there is a need to develop alternative feed resources using largely available crop co products (cakes), by products (rice bran), crop residue (straw, stover, oil crop residue etc) to reduce the dependency of livestock poultry and fish on the grain

crops. Possible strategy to develop the alternative feed resources for bio fuel has been suggested in this paper.

Livestock management status at Imadol, Lalitpur district

Joshi R, S Bhandari and P Kattel (2009). Livestock management status at Imadol, Lalitpur district. *Nepalese Journal of Agricultural Sciences published by Himalayan College of Agricultural Sciences and Technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **7:**144-146

The study was conducted to study the status of livestock management using simple random sampling method. Semi-structured questionnaire followed by interview was tested for primary data collection. It was revealed that only 3.5% of the respondents had vaccinated their animals against FMD. Natural method of breeding and stall feeding were common practices with cattle kept in closed housing system. Green forage is predominant feed fed to the animals. Owing to poor management daily milk production / cattle was very low (4.84 l).

A note of cattle research in Nepal

Aryal MP and BS Shrestha (2009). A note of cattle research in Nepal. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 172-180

Cattle are important livestock species contributing considerably to the national economy in the form of milk, manure and draft and drought power. Recognizing the importance in national level, attention has been given to enhance the production and productivity of cattle farming through the intervention of feeding, breeding, manage and health care. The findings on cattle research were reviewed aiming to facilitate in streaming the upcoming research and development efforts in this sector. This particular review is based on the abstracts documented in the workshops proceedings, various journals and compendium of the agricultural research prepared by the NARDF. The major focus of the breeding and genetics research on cattle has been on the phenotypic measurement and evaluation of reproductive performance of different breeds. However, study on breeding tools like artificial insemination, oestrus synchronization, embryo transfer, and molecular characterization at DNA level has also received some attention. The feeds and feeding studies have been found focused on supplements, replacement feeding, utilization of crop residues and non conventional feed resources. Very limited studies carried out on plant secondary metabolites like tannins. On the other hand, existing systems of production and management were studied in different locations of the country along with recording of growth and production performance of exotic and crossbreds. However, adequate information on draft animals and draught power technology seem still lacking. The studies on cattle health have tried mainly to understand the epidemiology, etiology, treatment and control strategies of fascioliasis, mastitis and infertility with patches of work on other disease conditions and drug efficacy. Major findings of the accomplished research on cattle were discussed briefly and future strategy suggested.

A short note on the estimation of the milk yield of a cow

Pradhan SL (1985). A short note on the estimation of the milk yield of a cow. *Nepalese Journal of Animal Science (NASA)*, **1**(1)**:**13-18

Milk production data of all lactation periods of 23 first crossbred cows (Brown Swiss 50% x Nepali hill cattle 50%) have been used to compute the relationship between the actual milk yield and the yield estimated by the recordings made at intervals of one month, two months and three months respectively. The milk yield estimated by the use of milk recording every

three months is sufficiently accurate for predicting the milk yield of a cow to assess its genetic merit for field use.

Compositional changes in colostrums preserved with Propionic acid and subsequent storage

Chaudhary NP and PK Nagpaul (1990). Compositional changes in colostrums preserved with Propionic acid and subsequent storage. *Nepalese Journal of Animal Science (NASA)*, **7**(7): 19-24

The compositional changes in colostrums preserved with propionic acid and subsequent storage at ambient temperature for one month were studied. The surplus colostrums sample preserved with 1% Propionic acid remained in good condition throughout the period of 30 days in spite of increase in acidity. Cholesterol Immunoglobulin was reduced up to the 1st 7 days of storage. Fat, SNF and Total solids remained unchanged during storage. Protein content after an initial decrease up to 1st 7 days remained unchanged throughout the storage period. These changes were observed to be dependent on storage time.

A comparative study on the production performances of the crossbred dairy cattle

Shrestha HR, RP Shrestha and SM Pradhan (1991). A comparative study on the production performances of the crossbred (F1) dairy cattle. *Proceedings of the 1st National Animal Science Convention (NASA), Lalitpur*, Nepal, Jan 14-15, pp 77-81

Forty local non-descript cows were allocated into 4 groups and artificially inseminated with the imported frozen semen of 4 dairy cattle viz Jersey, Holstein Friesian, Brownswiss and Ayreshire. Produced F1 crossbred females were maintained in the same management. The reproductive and productive performances along with reproductive disorders were monitored up to the 6th lactation of an individual animal. Nepali non-descript x Holstein F1 crossbred showed earlier calving at the age of 27±3.5 months. Shortest calving interval (13.8± 0.4 month) was found in Nepali non-descript x Jersey. The highest 4% FCM of 1745 lit/lactation was found in Nepali non-descript x Holstein F1 crossbred. The highest number of Dystocia and retained placenta were shown by Nepali non-descript x Holstein and Nepali non-descript x Brownswiss F1 crossbred, respectively.

Production of local and 50% Jersey crossbred cows under farmer's traditional management in the western hills of Nepal

Joshi BR, RK Kadariya, NPS Karki and DB Gurung (1992). Production of local and 50% Jersey crossbred cows under farmer's traditional management in the western hills of Nepal. *Working Paper N. 92/15,* Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

The lactation milk yield of 36 local and 22, 50% Jersey crossbred cows were measured in four hill villages of the Extension Command Area of Lumle Regional Agricultural Research Centre (LRARC) in western Nepal from January 1989 to May 1991. The mean total milk yield of 50% jersey crossbred was found to be 1100 ± 96 lit/ lactation compared to321 ± 33 lit/ lactation for local cows. The difference is highly significant ($P<0.01$). The average daily milk yield of the crossbreds was estimated to be 3.8 lit and that for local cows was 1.3 lit. Thus, the crossbred cattle yielded 3.4 times more milk/lactation and 2.9 times more milk /day than that of local cattle. The average length of lactation was 287 ± 14 days in the crossbred cattle which was significantly higher than that of 242 ± 12 days in local cattle. The calving conception interval in local cows was longer (179 ± 16 days) than in the crossbred cows (149 ± 29 days). The average calving interval of the crossbreds was 429 ± 29 days whereas that for local cows was 459 ± 16 days. Neither difference was significant. The peak calving period for both breeds was month of

July. Only 10% of local cows were yearly calvers whereas 43% of the crossbreds were yearly calvers. The overall average calf mortality was 9.5% in local cows and 7.5% in the crossbreds. This difference was not significant. The daily individual feed intake for both breeds did not differ significantly (P>0.05). It is concluded that the use of the jersey breed for upgrading local cattle is an effective method of increasing milk production in the western hills of Nepal.

Impact of crossbred cows on the economy of small farmers and their contribution in Gitanagar VDC of Chitawan

Karki U (1995). Impact of crossbred cows on the economy of small farmers and their contribution in Gitanagar VDC of Chitawan. *Nepalese Journal of Animal Science (NASA)*, **9**:28-40

In an attempt to study the impact and performance of crossbred cattle raised by small farmers was made. Fifty respondents having at least one crossbred cow were randomly selected from Keshar Bag village of Gitanagar VDC of Chitawan. The information was collected with the help of suitable pre-tested questionnaire. From this study, the perception of 86% respondents towards crossbred cattle raising was positive. However, 10 and 4 % respondents showed a negative and natural perception, respectively, which revealed positive of this enterprise on the economy of small farmers. The average gross income of farmers from the sell of milk was NRs 26292.0/lactation. The crossbred cattle were stall fed and major feedstuffs were rice straw, wheat bran, commercial ration and seasonal green grasses. Major problems faced by the farmers were lack of quality breeding bull, low price of milk, expensive feed, interest rate of loan and high incidence of diseases and parasites. The average age at puberty of crossbred cattle was 17.39±0.90 months, age at 1st calving 27.73±0.82 months, post partum heat 2.93±0.19 months. Commencement of pick yield 17.40±1.29 days after parturition, dry period 62.95±1.97 days, and lactation milk yield 2691.59±86.07lit/lactation.

Study on the effect of early weaning on the growth rate of crossbred she-calf

Shrestha HR, P Manual, RP Shrestha and BS Kunwar (1995). Study on the effect of early weaning on the growth rate of crossbred she-calf. *Proceedings of the 2nd National Animal Science Convention (NASA), Lalitpur, Nepal*, August 7-10, 1995, pp124-126

Four groups of crossbred (Jersey, Holstein Friesien, Brown Swiss and Ayreshire) calves were weaned at 2, 3, 4 and 6 months of age .The treatments to all groups till the weaning were same. First puberty was observed in-group B. at the age of 10.15±1.2 months with a body weight 135±12.6 kg. Maximum body weight 195.3±10.2 was found in-group C at the age of 12.33 ± .03 months. So, weaning at 4 months of age is recommended to save labor, time and money.

Production performance of local hill cows and their crossbreds of various Jersey blood level bands under farmers' management conditions in three western hill districts

Rasali DP, DB Gurung and ER Yadav (1996). Production performance of local hill cows and their crossbreds of various Jersey blood level bands under farmers' management conditions in three western hill districts. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, *May 7-9, 1996,* Pp 116 -129

A study involving milk recording and reproductive performance monitoring was undertaken during the year 1993/94 to evaluate the production performance of local hill cows and their crossbreds of various Jersey blood level bands under the farmers' feeding and management conditions of Myagdi, Parbat and Kaski districts in the western hills. A total of 183 cows, which calved during monsoon, were milk-recorded for standard 305-day lactation yield. Among these 163 cows were available for lactation length recording, 153 cows for milk fat test around 5-6

month of lactation, 163 cows for age at first calving, 125 cows for calving interval and only 44 cows for calving to first service. The lactation yield was significantly influenced by blood level band (P=0.0000) and the management system (P=0.0105). The least squares means of lactation yield was lowest in local cows (460.2±96.8 liters), followed by 25-49% Jersey crossbreds 798.1± 100.0 liters) and 50-74% Jersey (1035.9±97.7 liters). The highest yield was in 75% Jersey (1506-7242.4 liters); whilst all stall-fed cows showed the highest yield (1156.6±83.2 liters) followed by semi stall-fed cows 975.8 ±73.5 liters). The overall least-squares mean milk fat percentage at 5-6 month of lactation was 5.1±0.5, which was not significantly different across blood level band, altitude and management system. The lactation length was significantly different across genotype with 50-74% Jersey having the highest median value (298.49 days) followed by 25-49% Jersey having the 75% Jersey (250.00 days) and local cows (221.94 days). The age at first calving was significantly influenced by blood level (P=0.0006) with the local cows calving at the highest least-squares means age (50.1±4.1 month), followed by 25-49% Jersey 44.6±4.1 month), 50-74% Jersey (38.4±3.1 month) and 75% Jersey (28.9±15.1 months). The lest-squares means of calving interval and calving to first service period in the milk-recorded cows were 515.6±68.6 and 100.0±24.2 days, respectively both of which were not significantly different across blood level, altitude and management system.

Influence of body size on milk production of dairy cows

Sharma B (1996). Influence of body size on milk production of dairy cows. *Proceedings of the 5th National Veterinary Conference, 11-13 Sep*, **24**:19-24

A total of 30 multifarious cows (22 Friesians and 8 Jersey) with similar milk fat (MF) yields were selected for the experiment with an objective of examining the importance of difference in body size on their efficiency of producing milk. Body weight (BW) of the cows ranged between 310-565 kg and they were between 4-7 years old. The experiment was designed as a 25 grazing trial in which the cows were divided into 3 size groups- large, medium and small, 10 cows in each group (8 Jersey in the small group). The 3rd groups of the cows were offered generous daily herbage allowance (mixture of high quality perennial Rye grass and White clover) and grazed side by side in separate parts of a paddock. It was found that the medium group (Friesians) ate 3.9% less DM, produced 2.8% less milk energy and were 2.6% more feed efficient than the large group: the small group (mainly Jersey) ate 13.4% less DM, produced 8.7% less milk energy than the medium ones and were 5.1% more efficient. However, the accuracy of the results may have been reduced due to breed effects and therefore warrants further investigation within the same breed.

Growth performance of different exotic crossbred cattle at Khumaltar Farm

Thakur R and BS Kuwar (1997). Growth performance of different exotic crossbred cattle Khumaltar, farm. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 24-25 Sep, 1997, Pp 32-35

Data on body weight at 3, 6, 9 and 12 months recorded at Khumaltar farm were analyzed to know the growth rate of different genotypes of crossbred cattle. It was found that the birth weight of calves were not significantly different for the sex. Similarly the body weight gain of calves of different exotic crossbreds of cattle was also non significant, however, there was considerable difference in it with genotypes. The birth weight of 75% BS x N was the highest (26.83±1.19 kg) followed by 50% Jersey x BS x Nepali, 75% Jersey x Nepali (21.4±1.3 kg), 50% Jersey x Aur x Nepali (19.65±3.1 kg) and then 50% Jersey x HF x N (15 kg) and the 75% Jersey x N had the better growth rate weighing 130.66±10.7 kg at 12 months of age.

Economic assessment of crossbred dairy cattle farming under farmers' management at Imadol, Lalitpur, Nepal

Shrestha HR, BS Kunwar, P Manual and MS Thapa (1997). Economic assessment of crossbred dairy cattle farming under farmers' management at Imadol, Lalitpur, Nepal. *Veterinary Review*, Animal Health Research Division, Tripureswor, Kathmandu, Nepal, **12**(1): 10-13

An economic assessment of crossbred cattle managed under farmers management was made at imadol village of Lalitpur district, Nepal Twelve farmers selected randomly from this village were provided with one crossbred pregnant heifer. The animals were reared under the farmer's management system. Weekly visits were made to monitor and to record the data related to feeding, milk production and health care. Veterinary services and artificial insemination were provided free of cost. After recording the data for a lactation period of 395 days it was found that the average cost of milk production per liter was NRs 16.7 (ranging from NRs 11.3 to 30.1) and the average profit per cow per day was NRs 17.9 (ranging from NRs – 18.5 to 43.8).

Evaluation of farmers' dairy herd in Chitawan district

Pokharel PK, S Shrestha and NP Shrestha (1997). Evaluation of farmer's dairy herd in Chitawan district. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 24-25 Sep, 1997, pp 29-31

A study of crossbred animals in Chitawan district were undertaken to investigate the phenotypic measurement and production performance. Jersey and Holstein crosses were 2 common crossbred, which are getting popularity in the district. The least square means of milk production (lit/day) and fat content (%) were 11.13±0.74 and 3.77±0.08, respectively from Jersey crosses 16.65±1.02 and 3.79±0.11 ($P<0.05$), respectively for Holstein crosses. The growth performances of these breeds were comparatively better than those crossbred from another districts. The Holstein cross showed bigger morphological features ($P\geq0.05$) than Jersey crosses. No significant results were noted related to mastitis and infertility.

Evaluation of different genotypes of crossbred native hill cattle with frozen sire breeds for milk production, reproduction and growth performances

Shrestha NP, BS Shrestha and HR Shrestha. (1997). Evaluation of different genotypes of crossbred native hill cattle with frozen sire breeds for milk production, reproduction and growth performances. *Nepal Agriculture Research Journal (SAS/N)*, **1**(1):62-70

This study was undertaken to determine the suitability of different genotypes of crossbreed cattle in Khumaltar Cattle Farm. Lactation milk yield was significantly affected by the genotypes ($P<0.001$). The least square means of milk yield of 75% Brown Swiss was the highest (2631.6±152 kg.) followed by 75% Ayreshire (2478±318 kg) and 75% Jersey 1945.9±131kg). The 50% Ayreshire yielded 2163±95 kg. Milk followed by 50% Holstein 1882±86kg) and 50 Jersey 1796±136). 50% Brown Swiss yielded the lowest milk 1625±89kg.) Among all the 50% crossbreeds, for three crossbred type's viz. Brown Swiss, Ayreshire and Jersey, ¾ grade of the crossbred were superior to ½ grades in terms of milk production. The age at first service was also found significantly affected by the genotypes ($P<0.05$). The overall calving interval of 75% Jersey was the lowest (443.1±50.89 days) and that of 75% Ayreshire was the highest (652±152days). The birth weight of calves were not significantly different for the sex, but differed with the genotypes ($P<0.001$). The birth weight of 75% Brown Swiss was the highest 26.11±0.89 kg and that of 50% Ayreshire was the lowest 16.55±0.89.

Effect of calving season on the growth performance rate of crossbred calves

Shiwakoti KP, BS Kunwar and HR Shrestha (1999). Effect of calving season on the growth performance rate of crossbred calves. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal,* Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, pp 226-228

This study was conducted to find out the appropriate season of calving in terms of growth rate of calves. Forty five calves born at Bovine Research Program, Khumaltar in 2054/55 and 55/56 in different season were recorded. They were grouped into 4 seasonal group A, B, C and D (Baisakh-Asar, Srawan-Aswin, Kartik-Poush and Magh- Chaitra), respectively. Among the 45 calves 16, 10, 13 and 6 calves were recorded in group A, B, C and D respectively. Higher growth rate was observed in group C (107 kg of total body weight) at the 6 months. The lower growth rate was recorded in group A (76.1 kg of total body weight) It is necessary to observe continuously the age at 1st calving and the adult body weight of the calves.

Effect of calving season on the growth rate of crossbred calves

Shiwakoti KP, HR Shrestha and BS Kunwar (2000). Effect of calving season on the growth rate of crossbred calves. *Proceedings of the 4th National Workshop on Livestock and Fisheries Research in Nepal,* Agriculture Research Station, Pakhribas, Dhankuta, Nepal, *April 24-26, 2000, p*p 53-55

In our country cattle are breeding in any season of the year. The most effective season of calving is not yet known in our livestock farming management system. This present study showed that the growth rate of calves is found better born during the months Kartik to Poush than the other months of the year. The mortality of calves and treatment cost is comparatively low in this season. So it seems more beneficial to synchronize the calving season during Kartik to Poush with appropriate breeding practice. Seasonal effect on milk production was also found higher on the cows those calving during Kartik to Poush.

Observation of behavior of cattle grazing *Leucaena* species and grass pasture

Tara PC (2000). Observation of behavior of cattle grazing Leucaena species and grass pasture. *Proceedings of the 5th National Animal Science Convention (NASA)*, pp 52-60

The of behavior of cattle grazing *Leucaena pallida, Leucaena leucocephala* and the *Leucaena hybreid* KX2 along with single grass (*Brachiaria decumbens*) pasture was observed for 8 weeks. There was a similar range of grazing time with no significant differences in mean grazing time between the treatments. Mean daily grazing time was about 7 hours in all three pastures. Grazing time in weeks 6-8 was longer than for other weeks due to the declining herbage mass of both *Leucaena* and the grass. Cattle spent more time in grazing Signal grass that any *Leucaena* species. Mean time spent grazing *Leucaena leucocephala* and Kx2 was not significantly different but time spent grazing *L. pallida* was significantly lower than the time spent grazing other two *Leucaena*. Steers preferred *L. leucocephala* and Kx2 compared to *L. pallida*. This indicates that Kx2 was not only similar in palatability with *L. leucocephala* but was also longer lasting.

Productivity and production system of Chauri: A case study at Guphapokhari sites of eastern hills of Nepal

Shrestha NP (1997). Productivity and production systems of Chauri: A case study at Guphapokhari sites of eastern hills of Nepal. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 24-25 Sep, pp 135-142

Chauri were introduced from Solukhumbu area for generations whereas, yaks were introduced by Tibetans migrated from Tibet during 1973. Chauri and Yak farming have now however

become a major source of income for farmers in Guphapokhari areas and has greatly influenced high altitude farming systems. The present study was, therefore, carried out to quantify information about the production systems, and productivity of Chauri with problem perspective due to introduction of new species at Guphapokhari high altitude pasture sites. Results showed that the mean annual herd offtake of Chauri was 29.8% and mortality was 8.8%, respectively. Higher percentages of males (Zhopa) are disposed from the herd as males are extensively used as pack animals in the high altitude areas. The mortality rate of Chauri has been reported to be highest from unidentified disease. The average milk yield/lactation for Chauri was 387±85 lit for a lactation of 8.4 months. The average calving interval and gestation length were 353±45 and 275±21 days, respectively. Although, the productivity of Chauri seems to be reasonable to the Guphapokhari site, its introduction has created conflict in the grazing systems in these areas with other species. If the present trend continues, there is every possibility that all the grazing land would be deteriorated in future.

Evaluation of productive performance of Yak at Solukhumbu

Neopane SP, PK Pokharel and S Shrestha (1999). Evaluation of productive performance of Yak at Solukhumbu. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, pp 262-265

Yak is high altitude dwelling animal found mostly in the northern Himalayan belt of the country and plays a significant role in the life of Himalayan people. A study was undertaken to evaluate the productive and reproductive performance of Yak at Syangboche farm. Data obtained from the farm were analyzed using the least squares analysis techniques. Results indicated that gestation length of Yak (257 days) was similar with that of other cattle but calving interval was substantially longer (642 days) than the other cattle. Average milk yield recorded was less than 1 liter/day. Results indicated that records available at the farm were not adequate to estimate the genetic and non genetic factors affecting the productive performances and hence more records with pedigree information are required for the study.

Productive and reproductive performance of Yak at Syangboche farm

Neopane SP, KC Devkota and S Shrestha (2000). Productive and reproductive performance of Yak at Syangboche farm. *Proceedings of the 4th National Animal Science Convention (NASA)*, pp 61-65

Yak (*Bos grunniens*) is high dwelling animals and is located in the northern Himalayan border of the country. They are multipurpose animals kept for milk, manure and draft. They have not been well suited because of remoteness and geographical limitations. This study was undertaken to evaluate the productive performance of Yak at the station condition and assess the effect of non-genetic factors on production parameters. For this, records collected at Syangboche farm were monitored and the data analyzed. The results showed that the milk yield was less than a liter/day. The least square means of lactation milk yield (1-7 lactation) was 76.9±18.4 litter with a lactation length of 98.5±9.53 days. Milk yield increased up to 4th lactation and then declined lactation number of the dam; season and year of birth were used as fixed effects for birth weight, milk production and reproductive traits. Year was a significant source of variation for birth weight ($P<0.001$), lactation milk yield and lactation length ($P<0.01$). Other factors did not affect the above mentioned traits. Weights at 0, 4 8 and 12 weeks were 10±10.242, 17.8±11.64, 23.8±12.53 and 31.5±13.03 kg, respectively. Amongst the reproductive characters, age at 1st service, age at 1st calving, gestation length and calving interval were 1354±188, 1619±82.3, 257±8.88 and 624±18.2 days, respectively. The records were not adequate to assess the effect of both environmental and genetic factors on other important production parameters. However, the preliminary analysis showed that there is a

wide variation in the performance traits (weights, milk production and reproductive traits) indicating an ample scope for genetic improvements. It is suggested to improve the recording system at the farm so as to have data set with complete information. This would help in analyzing data for both non-genetic and genetic effects and eventually help in making a plan for brining improvement.

A study on income generating opportunities on Yak production in high hills and mountains of Nepal

Joshi KR (2009). A study on income generating opportunities on Yak production in high hills and mountains of Nepal. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 323-332

The main objective of this study was to identify the income generating opportunity in high hills and mountain people through the yak production. The study was conducted from mid July to September 2005. The study area have been covered Taplejung, Sankhuwasava, Solukhumbu, Okhaldhunga in the eastern, Dolakha in central, Humla in the mid western and Darchula and Bajhang in the far western region of Nepal. Yak (*Bos grunniens*) is multipurpose animal raised at altitudes from 3000–5000 m asl. Methodologies and different tools have been used and multidisciplinary team was formed for the study. Solukhumbu district had highest number of Yak and Chauri 18565 (52.62%) and Bajhang has least number of Yak and Chauri 195 (0.55%). Similarly, it has highest number of Yak 3977 (43.1%) and Bajhang had lowest number of Yak 34 (0.40%). In herd composition breeding adult female were highest (33.8%) and breeding male were lowest (3.3%). Solukhumbu had highest number of Chauri (9279). Similarly, in herd composition, breeding adult female were highest (33.9%) whereas heifers were lowest in number (2095). Bajhang had the lowest number (79). Yak cheese made in cold environment that is very popular because it is very tasty as compared to other cheese made in other countries. Rearing crossbred Chauri calves also give income-generating opportunities in high hills and mountains. There was a great demand of Chauri calves in Tibet (China) from Solukhumbu. Average cost of adult Yak and Nak were NRs 28,000.0 and 23,000.0, respectively. Nak gives 240-300 lit of milk whereas Chauri gives 750-900 lit of milk per lactation in Solukhumbu district. Solukhumbu has potential to produce 43978-lit milk from Nak and 424716 lit of milk from Chauri, which comes out to be 52% of total milk produced. The consumer price for Yak and Kanchan cheese in the market is NRs 300 and 280.0/kg. In district Solukhumbu and Dolakha the farmers' main source of income were from livestock of NRS 6000 and 65000. In district Dolakha, the farmers' main source of income was from livestock. At present, cheese production is a commercial enterprise. There are high marketing opportunities of Yak cheese in South Asia regional Countries (SARC) as well as European countries. Yak cheese is expected to European country in higher scale. It will help to earn foreign currency. The study recommended that training programme should be conduct to produce quality cheese by farmers. Chauri calf is highly demanded in Tibet so they can be exported to Tibet that helps to income generate. Chauri breeding programme should be carried out in livestock farm, Solukhumbu by Nepal Agricultural research Council and department of Livestock Services.

The use of draught animals in different cropping system in eastern hills of Nepal

Oli KP, (1986). The use of draught animals in different cropping system in eastern hills of Nepal. *Nepalese Journal of Animal Science (NASA)*, **2:**35 -43

The use of draught animals in hills agriculture system based on different crops was investigated.

Draught animals are used only for a period of 2 months for agriculture work. The rest of the time they are merely a tax on the economy. In this study nutrition of draught animals did not

appear to be a major limitation. Other aspects of draught animals, such as harnessing, use of improved plough and tillage operation require further investigation. The potential use of draught for other type of work in the hill agriculture system is also discussed.

A comparison of the work performance of Jersey crossbred and local oxen in the Koshi hills of east Nepal

Pearson RA (1990). A comparison of the work performance of Jersey crossbred and local oxen in the Koshi hills of east Nepal. *Technical Paper N. 90/130*, Pakhribas Agriculture Center, (PAC), Pakhribas, Dhankuta, Nepal

Four pairs of draught oxen (two locals and two-jersey crossbred) were studied when they ploughed Bari land on local farms. Work done, distance travelled and body temperature of each ox was measured continuously over a 5 h working day. A different team worked each day, completing at least eight days works each. The Jersey crossbred, particularly the longer legged type, had a higher rate of work than the local oxen in this study. They did significantly more work and covered a greater distance during the day. The absence of a hump in the crossbred oxen had no effect on the position of the yoke or the way the oxen pulled when ploughing. The longer legged type of Jersey crossbreed tended to work more erratically than any of the other teams. This did make them difficult to manpower on small terraces, unlike the other teams, which worked steadily throughout the day. The crossbred oxen required more rest periods when ploughing than the local oxen. When fed according to local practices and given the same amount of feed as local oxen, Jersey crossbreds tended to do less well. The tall Jersey crossbreds can be difficult to pair up for work with other oxen, as many of the local oxen available are shorter. Although there are disadvantages to keeping Jersey crossbreeds for work, their favorable work output suggests that the introduction of the Jersey crossbred in the hills is unlikely to be detrimental to the performance of the work oxen population.

A survey of local and Jersey crossbred draught oxen in the hills of east Nepal

Gatenby RM, R Anne Pearson and TB Limbu (1990). A survey of local and Jersey crossbred draught oxen in the hills of east Nepal. *Technical Paper N.90/128*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

A survey was conducted in 7 Panchayats in Dhankuta and Taplejung districts of eastern Nepal in Feb, March and June11989. Every farmer with 1 or more Jersey crossbred oxen was included in the survey. Neighboring farmers with only local oxen were also interviewed. A total of 40 farmers were interviewed, 23 with Jersey crossbred oxen and 17 with only local oxen. Altitudes ranged from 1700 to 1890 m, and farm size from 0.2 to 7.5 ha. The number of oxen/farm varied between 2 and 5; 85% of farmers had 2 oxen. Fifty nine local and 28 Jersey crossbred oxen were included in the survey. Seventy two percent of farmers owned cows as well as oxen, but only 28 % of draught oxen were born on the farm. The majority of oxen are purchased. The age of draught oxen ranged from 3 to 18 years. Oxen are 1st used for work when they are about 3 years old. Oxen are commonly lent or rented out to neighbouring farmers. The farmers with Jersey crossbred oxen had slightly bigger farms and owned slightly more oxen than those with only local oxen. The oxen in the survey were a variety of colors. It was not possible to distinguish the Jersey crossbreds by their color, but the local oxen had a more pronounced hump than the crossbreds. The body dimensions of the Jersey crossbreds were similar to those of local oxen, but the body condition scores showed that the crosses were slightly thinner than the local oxen. For both genotypes of oxen, about 78% had good temperament and 22% had a bad temperament. The farmers showed a mild preference for Jersey crosses. The frequency of health problems was greater in crossbred than local animals ($P<0.05$). All farmers give concentrate food to their animals when they work. The average quantity is about 2 kg/day.

Oxen work on an average every 4th day during cultivation seasons. They work for an average of 7hrs/day. Oxen are used in several seasons of the year and for a variety of tasks including ploughing, harrowing, threshing rice, sowing maize behind the plough, ploughing after seeding and levelling the rice field. The average length the yoke was 119 cm, distance apart of oxen when ploughing was 68 cm, and length of plough shaft was 233 cm.

A survey report of draught animal technology system in Nepal

Kunwar BS and NP Shrestha (1997). A survey report of draught animal technology system in Nepal. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 24-25 Sep, 1997, pp 179-186

A household survey was undertaken to study the draught animal production and utilization system in Nepal. After household survey in certain districts of hills and Terai region of Nepal, it was found that total number of draught animal increased when land size increased but number of draught animal/ha decreased when land holding size increased. Nutrient availability to draught animal was adequate for maintenance but deficit for work. Average use of draught animal/day for different agricultural operations and transportation was 96.3 days only. Land covered/day on working 5 hrs/day was found to be 0.1 ha in hills and 0.13 ha in Terai. Ploughing equipment weighed 14.72 kg. The hill cattle, Terai cattle and buffalo which have been extensively used for agricultural operations, weigh 224.16±kg, 268±11.75 kg and 333.12±9.37 kg respectively.

Draught animal use and possibility of single oxen pulled plough in Nepal

Kunwar BS and HR Shrestha. (1999), Draught animal use and possibility of single oxen pulled plough in Nepal. *Veterinary Review*, Animal Health Research Division, Tripureswor, Kathmandu, Nepal, **14**: 1-17

A survey was carried out in the hills and Terai of Nepal to study the use of draught animals. It was found that farmers with 0-1 ha land holding had 1.9 draught animals per holding which increased subsequently as land holding size increased. Energy supply to the draught animals was sufficient for maintenance but was deficit when they were at work. Draught animals were costlier in Terai region than in Hills. They were kept on training at the age of 3 to 3.5 years and were used up to 15 years of age. Average minimum width of terraces in the hills was found 2.7 m making difficult to use double oxen in agricultural operations. On an average, draught animals were used for 51 days in Hills and 141 days in Terai per year. Average land covered per day was found 0.10 ha and the weight of ploughing equipment was 14.7 kg. The average body weight of draught cattle was found to be 224.2 kg in Hills, 268.6 kg in Terai and that buffaloes were 333 kg. Expected draught power of these animals was assumed to be 26.8 kg, 32.2 kg and 39.9 kg, respectively. An on-station trial was conducted to assess the possibility of single oxen pulled plough. A harness and a plough that could be drawn by single ox were prepared and two 2.5-year-old crossbred bullocks were trained on it. In total they cultivated 1 ha of maize land in 15 days, working two hours per day. No visible adverse effect on body condition was observed in these animals during the cultivation period indicating the possibility of use of single oxen for cultivation.

Performance of Murrah buffaloes at livestock farm, Rampur, Nepal

Prakash B (1979). Performance of Murrah buffaloes at livestock farm, Rampur, Nepal. *Journal of the Institute of Agriculture and Animal Science (IAAS)*, Rampur, Chitawan, **2**(3):11-20

The present investigation was conducted at the livestock farm, Rampur, with a view of to assess the performance of Murrah buffaloes under Chitawan conditions. The performance was found

to be poor with regard to milk production, age at 1st calving, calving interval and dry days. The average age at 1st calving, average 1st lactation yield, average all lactation production, average calving interval and average dry days for 1968-1978 were found to be 50.5 months, 1013 kg, 1095 kg 445 days and 164 days respectively.

Village livestock (Bovine) farming and its problems in Sharadanagar Panchayat, Chitawan

Tulachan PM, KR Tiwari and HL Whittier (1983). Village Livestock (Bovine) Farming and Its Problems in Sharadanagar Panchayat, Chitawan. *Journal of Institue of Agriculture and Animal Science (IAAS),* Rampur, Chitawan, **4**:7-14

This paper describes some village livestock production systems focusing on large ruminants (Bovine) and investigates some of the basic constraints of livestock production in six wards of Sharadanagar Panchayat. Animal feeds and fodders are the main constraint of livestock keeping followed by the problems of diseases and internal parasites. Internal parasites and haemorrhagic septicaemia are the most commonly reported diseases. On a milk production basis, buffalo are found economically more productive than cows.

Evaluation of lactation records of Murrah buffaloes of Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan, Nepal

Kharel M and DB Nepali (1984). Evaluation of lactation records of Murrah buffaloes of IAAS, Rampur, Chitawan, Journal *of the Nepal Institute of Agriculture and Animal Science (IAAS)*, Rampur, Chitawan, Dec 1984, **5:** 105-114

The lactation and herd records of five years (1979-1984) of the Murrah buffaloes of livestock farm, IAAS, Rampur with the population of about 100 individuals were studied. The average yield of milk /lactation was 1048.1 lit. Similarly the average age of first calving, lactation length, dry period and calving interval were found to be 57.6 months, 314, 159 and 465 days, respectively. The average mortality was 11.7 %. The cause of a poor performance was probably due to defects in breeding policy and management practices.

A comparative study of the different types of buffaloes at the Livestock farm, Lampatan, Pokhara

Shrestha NP and SB Panday (1988). A comparative study of the different types of buffaloes at the Livestock farm, Lampatan, Pokhara. *Nepalese Journal of Animal Science (NASA)*, **4**(4):66-80

The various information collected from past sixteen years were used to evaluate Murrah, cross (Murrah x Local) and local breeds of buffaloes at the Livestock farm, Lampatan. The highest calving percentage (about 89%) of these buffaloes was found to occur from July to October and the lowest calving percentage (about 10%) from December to April. The estimated milk yield of Murrah (1204.4±208.57 liters/ 214.±19.4 days) and Local (583.9±103.87 liters/222.7±26.9 days) breeds of buffaloes, respectively. Average dry days between two lactation were highest in Murrah (327.2±57.2 days) compared to cross (237.4±40.2 days) and local (226.3±70.10 days) buffaloes. The local buffaloes (5.5±1.69 years) were found to have lowest average calving age when cross (7.0±0.22 years) and Murrah (7.9±2.47 years) breeds of buffaloes were compared. In the comparison of the average post-partum fertile period between three breeds of buffaloes, Murrah (0.7±0.22 years) had the highest followed by local (0.4±0.01) and crosses (0.3±0.19). Finally, the average lactation interval of Murrah (about 20 months) was higher by 29 and 20 percentage units than cross (about 14 months) and local (about 16 months) breeds of buffaloes.

Birth weight and growth rate of Murrah and crossbred buffalo calves

Shrestha SL (1990). Birth weight and growth rate of Murrah and crossbred buffalo calves. *Nepalese Journal of Animal Science (NASA)*, **6**(6):53-58

A study of the birth weights and growth rates of buffalo calves during a 5 year period at Livestock Research Station, Lampatan, Pokhara showed that performance to 18 months was similar for Murrah calves and 50% Murrah – 50% local crossbred calves. The overall average birth weight was 28 kg and weight at 18 months was 203 kg.

Early weaning of buffalo calves and its effect on the calf and buffalo performance

Singh DB and CD Yadav (1991). Early weaning of buffalo calves and its effect on the calf and buffalo performance. *Proceedings of the 1st National Animal Science Convention (NASA)*, *Lalitpur, Nepal, Jan* 14-15, 1991, pp 96-100

Thirty Murrah Buffaloes calved within 4 month interval was divided into three groups. Two groups had suckling calves for the period of 6 and 4 months, whereas in the third group, ten calves were weaned at birth and reared artificially. The calves in three groups had a satisfactory growth rate and there was no mortality in the calves. Calves in early-weaned group consumed 599 kg of whole milk/head including 18 kg of colostrums. The buffaloes in weaned group had to be offered an extra allowance of 1 kg. Feed daily to each buffalo cow for milk let down. The weaning of buffalo calves at birth did not effect of the milk yield, survival and growth rate of weaned calves up to 26 weeks of age. A shorter postpartum estrous in weaned group indicated a beneficial effect of weaning.

Buffalo production in Nepal

Shah SG (1992). Buffalo production in Nepal. *Bulletin of Veterinary Science and Animal Husbandry*, **10-11:**41-47

Elevation and cooler climate along with other environmental factors such as nutrition and management affected 1st calving age, calving interval and lactation yield in both local and Murrah buffaloes. Observation on reproductive traits, however, indicate the occurrence of better genotype for milk production at warmer climate or the Himalayan mountain type as classified by Epstein (1977) has low milk production potentiality.

A preliminary assessment of the influence of age, season and level of milk production on the mortality rates of buffalo calves

Shrestha EK, RR Gyawali and IP Dhakal (1992). Preliminary assessment of the influence of age, season and level of milk production on the mortality rates of buffalo calves. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **7**(1):14-16

A study of buffalo calf mortality was undertaken in two villages in Chitawan district and at the livestock farm of the Institute of Agriculture and Animal Science (IAAS) during 1988-90.out of 372 buffalo calves born in the two villages, the overall mortality rate was 13.7 % but this varied between male calves (20 %) and female calves (8.9 %). Corresponding mortality figures at the Institute of Agriculture and Animal Science (IAAS) farm were first month followed by the age 3 to 6 months (3.8 %). Calf mortality was generally higher during autumn (5.1 %) and winter (3.5%). The mortality rate for buffalo calves was also higher among calves of low-yielding buffaloes (6.2 %) than for calves of high yielding buffaloes (2.4 %).

Effect of season and stage of lactation on milk lactose and chloride content in Murrah buffaloes

Dhakal IP and SB Singh (1992). Effect of season and stage of lactation on milk lactose and chloride content in Murrah buffaloes. *Proceedings of the 3rd National Veterinary Conference, 10-*12 Aug, 1990, **19-20**:3-19

An experiment was carried out to determine the effect of season and stage of lactation on milk lactose and chloride content in Murrah buffaloes. A total of 37 buffaloes at different lactations were used in the experiment. The concentration of milk lactose recorded was higher during summer (5.2±0.04) and autumn months (5.23±0.06) as compared to the winter (4.58±0.07) and spring (4.53±0.07). Milk lactose contents were higher during lactation (4.94±0.1) than in the colostrums stage (4.02±0.16) and the dry off period (4.68±0.13). The milk lactose level raised slightly at the start of lactation and decline continuously throughout the rest of the lactation period. Milk lactose concentration showed an increase up to the 3rd lactation and decreased in later lactations. The concentration of chloride (gm/100ml) were higher during autumn (0.117±0.002) and summer (0.110±0.002), as compared to spring (0.104±0.002) and winter (0.096±0.004). In contrast to lactose, milk chloride concentration was found higher during colostrums stage (0.124±0.002) and drying off period (0.134±0.004) than during lactation (0.108±0.003). The level of chloride increased in later lactations.

Comparative study on milk production of local and 50% Murrah crossbred buffaloes under on farm conditions

Joshi BR, RK Kadariya, NPS Karki and DB Gurung (1992). Comparative study on milk production of local and 50% Murrah crossbred buffaloes under on farm conditions. *Veterinary Review,* Pakhribas Agriculture Centre, Pakhribas, Dhankuta, Nepal, **8**(2):50-52

Production performance of local and 50% Murrah crossbred buffaloes under farmer's traditional management has been evaluated in the Extension Command Area (ECA) of Lumle Regional Agricultural Research Centre (LARC) from January 1989 to May 1991. Milk production was monitored by regularly recording at fortnightly intervals throughout the lactation. It was recorded that under a uniform management system, the 50% Murrah crossbred buffalo produced 1469 ± 132 lit of milk in a lactation length of 352 ± 17 days as against the production of 873 ± 49 lit of milk by local buffalo in a lactation of 352 ± 17 days. The average daily milk of the crossbreds was 4.5 lit which is 1.6 times more than the local buffaloes (2.5 lit). Average calving conception interval (224 ± 30 days) and calving interval (524 ± 30 days) was similar in both crossbred and local buffaloes. Peak calving period for both breeds was during the month of July. The daily individual feed stuffs intake for both breeds did not differ significantly (P>0.05). The potential for increasing milk production of the country by upgrading local animals is discussed and it is concluded that this is a viable method for increasing national milk production.

Performance evaluation of farmers' buffalo herd in Chitawan, Nepal

Kolachhapati MR, NR Devkota and DB Nepali (1993). Performance evaluation of farmers' buffalo herd in Chitawan, Nepal. *Journal of the Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan*, 1**4:**97-101

Information on production and reproduction traits of the two genetic groups viz., local and Murrah x local crossbred were collected with the help of a suitable questionnaire in 2 villages of Chitawan district. Milk production performance of local as well as crossbred was higher than earlier reported. The average lactation milk yield of local and half-bred was 966.76±50 and

1627±76.61 lit in 10.74 and 10.42 months, respectively. Milk yield from the crossbred buffalo was about 50% higher, and age at 1st calving was shorter (4.69±0.07 years) in comparison with the local (4.91±0.08 years).

Performance study of Murrah crossbred and local buffaloes in Mangalpur and Saradanagar VDCs, Chitawan Nepal

Kolachhapati MR, NR Devkota, NN Joshi and DB Nepali (1993). Performance study of Murrah crossbred and local buffaloes in Mangalpur and Saradanagar VDCs, Chitawan Nepal. *Journal of Institute of Agriculture and Animal Science (IAAS),* Research Reports (1985-1991), Rampur, Chitawan, pp 280-285

Information on production and reproduction traits of the two genetic groups viz, local and Murrah x local crossbred were collected with the help of a suitable questionnaire from two VDCs in Chitawan Milk production performance of local as well as crossbred animals was very high as compared to the findings of the other researchers. The average lactation milk yields of local and crossbred buffaloes were 1305.076±50.006 and 1927.95±76.618 lit in 10.74 and 10.42 months, respectively. Crossbred buffalo had nearly 50% higher milk yield and the age at 1st calving was shorter (4.69±0.07 years) when compared to local buffaloes (4.91±0.08 years). Other traits studied did not differ significantly. The attitude of the farmers towards Murrah breed was neutral in upgrading the local breeds of buffaloes.

Comparative performance of local and Murrah buffaloes with their crossbreds under farmers' management in Mangalpur, Chitawan

Sharma M, M Kharel, MR Kolachhpati, IP Dhakal, NP Joshi and KP Gajurel (1994). Comparative performance of local and Murrah buffaloes with their crossbreds under farmers' management in Mangalpur, Chitawan. *Journal of the Institute of Agriculture and Animal Science (IAAS),* Research Reports (1992-93), pp 130-136

A survey was conducted in Mangalpur VDC, Chitawan during 1992 to compare the performance of local and Murrah buffaloes and their crossbreds. The information was collected from randomly selected 100 farmers using an interview schedule. The age at first fertile mating was significantly ($P<0.05$) different among the breeds. Inter calving period in Murrah was higher and significantly ($P<0.05$) different from local and crossbreds. Post-partum estrus was close in all the breeds. The age at first calving in local was higher and significantly ($P<0.05$) different from Murrah and crossbreds. In all the breeds higher percentage of estrus was found during the months of Aug and Sep and higher percentage of calving was found during the months of July and Aug. Daily milk yield and lactation length in Murrah were higher and significantly ($P<0.05$) different from the crossbreds and local breeds. Phenotypic correlations between the lactation yield. Lactation length and daily milk yield were positive and significant ($P<0.05$). Phenotypic correlations of dry period with daily milk yield and lactation yield were negatively significant ($P<0.05$). Body length, wither height, neck length and face length were longer in crossbreds than Murrah and local breeds. Heart girth and ear length were higher in Murrah than local and crossbreds.

Performance of Murrah crossbred buffaloes in rural areas of Chitawan

Kolachhpati MR, M Sharma and BK Karna (1994). Performance of Murrah crossbred buffaloes in rural areas of Chitawan. *Journal of the Institute of Agriculture and Animal Science (IAAS)*, Research Reports (1992-93), Rampur, Chitawan, pp 143-150

A study was conducted in Mangalpur VDC, Chitawan, to know the performance of Murrah crossbred buffaloes. Sixty five farmers were randomly selected having at least one lactating

Murrah crossbred buffalo. A performance record book was distributed to individual farmers for keeping the records of their buffaloes. One year was divided into 4 season's viz. rainy (July-September), winter (October-December), spring (January-March), and summer (April-June). The milk production performances was much higher than the results of other researchers and also much higher than the performances of local buffaloes indicating marked improvement in production performance of village herds through crossbreeding programme. But the reproductive traits such as age at first service, age at first calving and post-partum estrous were higher in the village buffaloes than the results reported by other researchers. These traits can be improved by proper breeding, feeding and management practices. Mating frequency was higher during rainy season followed by winter and summer seasons. The milk composition of the crossbred buffaloes was as per the results of the Indian herds and seasonal variation was observed in the content of milk fat. The performance of crossbred buffaloes in this study was as follows: lactation milk yield =1238±63.41 lit; daily milk yield = 3.65±0.13 lit; lactation length = 333±7.49 days; age at first service = 1445±83 days; age at first calving = 1860±83 days; post-partum estrous = 125±10 days; fat content = 6.86±0.18%; SNF=9.44±0.05% and total solid = 16.27±0.21%.

Relationship of production performance characteristics of Murrah buffalo with the calving at different seasons

Dhakal IP and KR Panday (1995). Relationship of production performance characteristics of Murrah buffalo with the calving at different seasons. *Proceedings of the 4th National Veterinary Conference of Nepal Veterinary Association*, 17-19 Nov, 1992, **21-23**: 22-33

A study of 351 lactation records of Murrah buffaloes spread over a period of 13 years (1979-91) stationed at livestock farm of the IAAS, Rampur, Chitawan were studied for performance traits, and 484 calving were analyzed for calf survivability up to 1 year age groups. Average values for lactation yield, lactation period, dry period and calf survivability were evaluated for 1st 10 lactations. The maximum number of calving was found during autumn followed by summer, winter and spring. The average lactation yield was 785 lit. Milk production varied from 140 to 2080 lit. The average lactation length and dry period were 292 and 232 days respectively. The higher lactation yield observed in the 1st (836 lit) and 2nd (827 lit) lactation 836 compared to other lactations. Similarly the average lactation yield were 1176, 944, 784 and 747 lit and average lactation length were 305, 288, 306 and 283 days for spring, winter, summer and autumn calving, respectively. The average subsequent dry period of Murrah, buffaloes calving in winter, spring, summer and autumn were 306, 182, 244 and 264 days, respectively. The influence of calving season on lactation milk yield was found statistically significant ($P<0.01$). However, it was found no significant with lactation and dry period. Similarly parity had significant effect ($P<0.01$) on milk yield. Lactation milk yield was positively correlated ($r=0.44$) with lactation period and negatively correlated ($r=-0.13$) with dry period. The overall calf survivability percentage was 84% but this varied between different seasons of calving and age group of the animals. The highest rate of survivability was obtained on spring calving (93%) followed by summer (91%), autumn (75%) and winter (53%). The calf survivability was found minimum up to 3 months of age (58 to 66%) and maxim um (85 to 89%) from 3 months to 1 year of age. Survivability was slightly higher in female but did not differ significantly from that in male.

Milk recording of monsoon calving cows and buffaloes across exotic blood levels under farmers' management conditions in the Lumle Agricultural Research Center's extension command area

Rasali DP, DB Gurung and ER Yadav (1995). Milk recording of monsoon calving cows and buffaloes across exotic blood levels under farmers' management conditions in the Lumle Agricultural Research Center's extension command area. *Working Paper N. 95/26*, Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

A study involving milk recording and reproductive performance monitoring was undertaken in cows and buffaloes in the LARC's Extension Command Area (ECA) during the year 1993/94 to evaluate the performance of cows and buffaloes across exotic blood levels under the farmers' management conditions. The standard 305 days lactation yield recorded in 183 cows which calved during the monsoon was significantly influenced by blood level (P=0.0000) and the management system (P=0.0105). The least square means of lactation yield was lowest in local cows (460.2±96.8 lit), followed by 25-49% Jersey crossbreds (798.1 ±100 lit), 50-74% Jersey (1035.9±97.7 lit) and the highest yield was in 75% Jersey (1506.7±242.4 lit), whilst those stall fed of all the cows showed the highest yield (1156.6±83.2 lit), followed by semi stall fed cows (975.8±73.5 lit). The overall least squares mean milk fat percentage recorded in 153 cows around 5-6 months of lactation was 5.1±5 which was not significantly different across blood level, altitude and management system. The lactation length recorded in 163 cows were significantly different (P<0.0058) across genotype with 50-74% Jersey having the highest median value (298.49 days) followed by 25-49% Jersey (268.84 days), ≥75% Jersey (250.0 days) and local cows (221.94 days) in that order. The age at first calving recorded in 163 cows was significantly influenced by blood level (P=0.0006) with the local cows calving at the highest least square mean age (50.1±4.1months), followed by 25-49% Jersey (44.6±4.1 months), 50-74 jersey (38.4±3.1 months) and ≥75% Jersey (28.9±15.1 months). The least square means of calving interval recorded in 125 cows and calving to first service period recorded in 44 cows were 515.6±68.6 and 100±24.2 days, respectively which were both not significantly different across the factors considered. The standard 305 days lactation yield recorded in 264 buffalo cows which calved during monsoon was significantly influenced by blood level (P=0.0000), altitude (P=0.0002) and parity (P=0.0000) but not by management system. The least square mean yields in local 25-49, 50-74% and ≥75% Murrah crossbred buffaloes were in increasing order of 1012.7±39.8, 1190.5±60.2, 1440.3±50.8 and 1872.4±124.6 lit, respectively, whilst that among all the buffaloes milk recorded in the low hills was 1493.2±73.6 lit followed by1393.5±62.8 lit in the high hills and 1250.2±48.9 lit in the mid hills. The overall least squares mean milk fat percentage in 257 buffaloes around 5-6 month of their lactation was 7.1±0.3 which was not significantly different across the factors considered. The lactation length was significantly influenced by altitude (P=0.0031) and parity (P=0.0072). The median value of lactation length in the low hills was over 375 days followed by 331.43 and 327.04 days in the mid hills and high hills respectively. The overall least squares means of age at first calving recorded in 228 buffaloes, calving to first service period recorded in 145 buffaloes and calving interval recorded in 201 buffaloes were 53.8±1.5 months, 87.4±9.3 days and 556.1±4 days, respectively but among these traits only calving interval was significantly different across management system with shorter (P=0.0029) under stall feeding management (498.2±41 days) than under the semi stall feeding (614.1±54.1 days).

An analysis of adoption of crossbred Murrah buffaloes amongst stallholders farmers in the Western hills of Nepal

Gurung HB and DP Rasali (1996). An analysis of adoption of crossbred Murrah buffaloes amongst stallholders' farmers in the western hills of Nepal. *Proceeding of the 8th AAAP Animal Science Congress, Oct 13-18, hosted by Science Council of Japan*, **2:**1104-1105

The distribution programme benefits to farmers residing in non- breeding center villages and a crossbreeding adoption rate of 9.2% is considered satisfactory. However, adoption of crossbred buffalo is inevitably wealth related warranting reconsideration for reorienting the crossbreeding programme to target the poorer sections of the farming community. Feed shortage and increased feed requirement is an adoption constraint, implying a necessity to launch concurrent programme to augment feed resource base and crossbreeding to promote wider adoption of crossbred buffaloes. The improvement in feed resources base should also alleviate, to some extent, the labor problem perceived by the farmers.

Performance recording of lactating local and crossbred cows and buffaloes of various exotic breed blood levels under farmers' management in the western hills

Rasali DP, DB Gurung and ER Yadav (1998). Performance recording of lactating local and crossbred cows and buffaloes of various exotic breed blood levels under farmers' management in the western hills. *Working Paper N. 98/39*, Lumle Agricultural Research Centre (LARC), Kaski, Nepal

A performance recording study involving lactating cows and buffaloes of local and exotic crossbred blood levels which calved after July 1995 and were raised under stall fed and semi stall fed management of farmers in 10 different village sites located in the high hills (>1600 m asl), mid hills (900-1600 m asl) and low hills (<900 m asl). The least squares (LS) analysis of variance for lactation reproductive traits were conducted using Harvey's software package for these performance traits in the western hills was conducted starting from July 1995 to June 1997. Thirty local cows and five <50% Jersey crossbred, twenty four 50% Jersey crossbred, four >50 -75% Jersey crossbred, thirteen 75% Jersey crossbred and two > 75% Jersey crossbred cows were considered for their performance recording study. The results showed that the genotypes of exotic blood level was highly significant (P<0.001) for 305 days standard lactation yield. Although the trait had an erroneously high CV%, its LS mean was lowest in the local cows and highest in >50-75% followed by 75% Jersey crossbred cows with their values, 566.06±124.39, 2518.3±342.73 and 1601.48±183.05 liter, respectively. None of the factors considered were significant of variation (CV) were 4.75±0.36 and 30.04%, respectively. The overall means of lactation length, calving to 1st service, age at 1st calving and calving interval were 328.86±30.52 days, 138.85±34.81 days, 44.87±3.12 months and 372.24±49.96 days, respectively, whilst their CV were 41.01, 64.11 and 38.33, respectively. A total of 234 local buffaloes and twenty four <50% Murrah crossbred, ninety 50% Murrah crossbred, two >50-75% Murrah crossbred, sixty one 75% Murrah crossbred and seven >75% Murrah crossbred buffaloes were considered for their performance recording study. The results showed that the standard lactation yield was highly significantly different (P<0.001) across the factors the exotic blood level, location altitude, management system and parity but not across the season of calving. The overall mean of 305 days standard lactation in buffaloes was 1273.91±46.6 lit, whilst the local buffaloes had this yield 874.72±30.72 lit which increased with the increase of exotic blood level with the highest yield, 1593.99±128.93 lit in the >75% Murrah crossbred buffaloes. Buffaloes in the low hills yielded significantly (P<0.001) higher (1335.16±47.8 lit) than in the mid hills (1212.65±51.8 lit). Those under stall feeding yielded higher (1345.01±45.77 lit) than under semi stall feeding (1202.80±56.34 lit). The LS mean standard lactation yield was increasing with the increase in parity number up to the 4th parity. The

overall mean of milk fat was 6.6±0.2% which was not significantly different across any of the factors except the exotic blood level which showed significant (P<0.01), which could be due to the lower values in the 2 exotic blood levels with vary small sample sizes. The overall mean of the age at 1st calving was 55.76±1.29 months, whilst it was significantly lower (P<0.05) in stall fed buffaloes (54.08±1.27 months) than in semi stall fed ones (57.44±1.64 months). The traits lactation length, calving to 1st service and calving interval showed their overall means 370.89±15.63, 199.08±22 and 478.7±32.87 days, respectively.

Factors affecting the lactation curves in the hill buffaloes and their Murrah crossbreds raised under farmers management in the western hills of Nepal

Rasali DP and AH Harding (1998). Factors affecting the lactation curves in the hill buffaloes and their Murrah crossbreds raised under farmers management in the western hills of Nepal. *Nepal Agriculture Research Journal (SAS/N)*, **2**(1):1-7

A milk recording study on a total of 470 milking buffaloes that calved during the monsoon of 1993 and 1995, comprising 314 indigenous hill buffaloes and 156 numbers 50- 74 % Murrah crossbreds raised under farmer's management was carried out in the western hills. The milk recording on individual buffalo was initiated from the 7th day of their calving. The lactation curve were fitted to examine the effects of genotype, management system, parity of the animal and year of recording by regression analysis carried out using Woods (1967) Gamma function for fortnightly milk recording at a total of 38 points in time during the lactation period. The length of lactation which was used as a covariate for adjusting its effect on the regression models was significant particularly across the coefficients b and c. The regression coefficients of Wood's Gamma function, a= (Log_e A), b and c were 1.5393, 0.1792 and 0.05655 respectively, for local hill buffaloes, while they were 1.8514, 0.1944 and 0.05606 respectively for Murrah crossbreds. The results indicated that genotype had the largest effect followed by parity (P<0.001) particularly on the regression coefficient "a" representing the initial rising phase of the lactation curve, as shown by their mean squares, 10.0986 and 2.0849 respectively. For management comprising stall feeding and semi stall feeding, milk yield differences tended to become smaller with time during the lactation period. Year of milk recording was significantly important for all the three coefficients, "a" (P<0.05) in the initial phase of the curve, "b" and "c" (P<0.001) in the latter declining phase of the curve. This work being 1st report on lactation curve in indigenous buffaloes in the hills of Nepal should lay the foundation for future work to establish the lactation curves to represent many situations.

Long term productive and reproductive performance of Murrah buffaloes of Nepal

Shrestha R, M Kharel, M Kolachhpati and SP Neopane (2007). Long term productive and reproductive performance of Murrah buffaloes of Nepal. *Green field Journal of Himalayan College of Agricultural Science and Technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **5(1)**:36-40

The compilation of 21 years (1983-2003) lactation record of the Murrah buffaloes maintained at the IAAS livestock farm , Rampur was collected and analyzed to assess the production and reproduction traits i.e. lactation milk yield, calving interval, lactation length, dry period, average daily milk yield, peak yield, lowest yield, days to attain peak yield and persistence. The average lactation yield was 954.25 lit. Similarly, calving interval lactation length, dry period was found to be 465.78, 294.15 and 171.88 days respectively. Whereas the average daily milk yield, pick yield, lowest yield, days to attain pick yield and persistency were found to be 3.22, 5.48, 1.16, 45.18 and 27.61 lit, respectively. The causes of overall poor performance of were due to poor care and management practices and defects in breeding management. Moreover,

the lactation milk yield was decreasing years after years. It could be the reason of deterioration farm condition years after years regarding feeding and overall management.

Effect of cooling on growth and physiological parameters of buffalo calves

Nepali DB, M Kharel and KR Tiwari (1989). Effect of cooling on growth and physiological parameters of buffalo calves. *Journal of Institute of Agriculture and Animal Science (IAAS)*, Rampur, Chitawan.**10:**49-56

A study was conducted to determine the effect of cooling on growth and physiological parameters of buffalo calves. Daily live weight gain observed was the highest for the group kept inside corrugated sheet roof shed with wallowing (412 g) as compared to the group kept inside the thatched roof shed (306 g) and corrugated sheet roof shed but not wallowed (281 hm). However, the values did not differ significantly. The correlation between environmental temperature with respiration rate, pulse r Effect of cooling on growth and physiological parameters of buffalo calves and rectal temperature were found to be highly significant (P) in all three housing and management systems. It appeared that higher temperature had adverse effect on normal physiological functions than other parameters.

Effect of three system of housing on some blood and physiological parameters of buffalo calves

Nepali DB, OP Mehta, MP Singh and NPS Sastry (1990). Effect of three system of housing on some blood and physiological parameters of buffalo calves. *Nepalese Journal of Animal Science (NASA)*, **7** (7)**:**25-36

Two different sets of study were carried out to see the mode of effect of housing on the physiological and blood parameters of 8-18 months old buffalo heifer calves covering almost entire seasons of a year hot dry (15 April-13 June), hot humid (14 Jun-12 August), mild cold (15 October-13 December) and severe cold (14 December-11 February). Respiration rate differed significantly due to housing conditions at 9 AM recording but not at 2 PM. Seasonal differences were highly significant. The pulse rate tended to be higher during cold seasons ($P<0.01$). Similarly, rectal temperature differed significantly ($P<0.05$) at 2 PM but not 9 AM in all seasons. The significantly greater mean values of hemoglobin (14±0.56, 16.07±1.32 and 13.85±0.20 g %) and Haematocrit (42.33±0.53, 41.4±1.45, 41.81±17) for shed + open, shed and loose house group, respectively, were observed during mild cold season. Serum Na + was found to be highest during hot humid which was not true with K+ content. Chloride content was not significantly affected. Bicarbonate content in general increased when ambient temperature decreased. However, none of these parameters were significantly affected with housing regimes. The P^H values could not be considered as a major index to indicate whether animals are under stress when exposed for short period of time. In general, loose house tended to be the most desirable types.

Effect of altitude, management system and parity on the production performance of monsoon calving hill buffaloes

Rasali DP (1996). Effect of altitude, management system and parity on the production performance of monsoon calving hill buffaloes. *Proceedings of the 5th National Veterinary Conference*, 11-13 Sep, **24**:25-34

Data from a milk recording study conducted in the western hill districts of Parbat and Kaski during 1993-94 were analyzed to evaluate the performance of indigenous hill buffalo cows calving between mid July and mid Sepember 1993 and reared under framer's management. The three factors examined were location altitude, management system and parity of the

animal. The analysis revealed that the overall least squares (LS) means of age at 1st calving of 108 buffaloes, calving interval of 108 buffaloes, 305 days lactation yield of 131 buffaloes and fat content in milk of 126 buffaloes were 50.5±1.9 months, 574±40 days, 995±44 lit and 7.2±0.4%, respectively with their coefficient of variation of 18.4, 34.6, 25.6 and 27.6% , respectively. Among the three factors considered, only the effects of altitude on age at 1st calving and 305 days lactation yield were statistically significant. The LS means for age at 1st calving were 54.7±2.4, 48.2±2.1 and 48.6±3 months in high, mid and low hills, respectively (P=0.0242), and those for lactation yield were 995±57, 875±49 and 1116±68 lit in the high, mid and low hills, respectively (P= 0.0008). There was also considerably wide variation in the lactation yield range between and within altitudes. The results indicated the trend that reproductive performance of the hill buffaloes was relatively more efficient and their lactation yield higher in the low hills as compared to the high hills.

A comparative study in the productive performance of the indigenous hill buffaloes raised under farmers' management in the western hills of Nepal

Amatya N, DP Rasali, RS Rana and R Jalan (2000). A comparative study in the productive performance of the indigenous hill buffaloes raised under farmers' management in the western hills of Nepal. *Seminar Paper N. 2000/9*, Lumle Agricultural Research Station, Lumle, Kaski, Nepal

A study was conducted on 266 indigenous hill buffaloes in the research command area of Agricultural Research Station, Lumle in 4 agro ecological domains viz. Hill hills (1600-2300 m asl), mid hills (1000-1600 m asl), low hill (600-1000 m asl) and river basin (240-600 m asl). The study showed that the milk yield of Lime was although marginally higher, Parkote in river basin and low hill. However, the difference was not significant (P>0.05). Similarly, no statistical difference was found in respect of reproductive performance traits (age at 1st service, calving interval and calving to 1st service) between the 2 indigenous breeds.

Performance evaluation of local buffaloes under farmers' management system: A case study of mid hills and outer Terai of Nepal

Sharma M, MR Kolachhapati and M Kharel (2001). Performance evaluation of local buffaloes under farmers' management system: A case study of mid hills and outer Terai of Nepal. *Journal of Institute of Agriculture and Animal Science (IAAS)*, Rampur, Chitawan, **21-22:**151-156

Growth and reproductive performance of local buffaloes raised under farmers management system was studied in Lamjung, Syangja and Bara districts during the year 1998 and Sankhuwasava district during the year 1995. Both informal studies and direct measurement techniques were employed to generate information. The finding revealed that on an average body length, wither height and heart girth of buffaloes were 126.1±4.6, 121.9±4.7 and 167.7±9 cm, respectively in Lamjung, 115.7±13.5, 120.1±6.6 and 170.2±13.3 cm, respectively in Syangja, 120.6±2.5, 130.3±7.5 and 173.7±15.6 cm, respectively in Bara, 131.8±2.5, 122.0±10.3 and 168.3±10.6 cm, respectively in Sankhuwasava. Similarly milk yield of buffaloes of those locations was 3.1±0.9, 2.4±0.7, 3.3±0.8 and 2.2±0.8 lit/day Lamjung, Syangja, Bara and Sankhuwasava, respectively. Likewise, age of puberty was found at 4.4±1.1, 4.3±1.4, 4.2±0.9 and 4.9±1.6 years of age while first calving occurred at 5.2, 5.1, 5.4 and 5.8 years of age for Lamjung, Syangja, Bara and Sankhuwasava districts, respectively. Similarly, calving interval 2.1±0.5, 1.6±0.5, 1.5±0.6 and 2.2±0.9 years for Lamjung, Syangja, Bara and Sankhuwasava districts, respectively was possibly associated with long dry period (5.0±1.6, 4.9±0.8, 4.2±1.7 and 4.9±2.8 months for Lamjung, Syangja, Bara and Sankhuwasava, respectively) and long lactation length 1.5±0.4, 1.1±0.3, 1.0±0.3 and 1.2±0.2 years for Lamjung, Syangja, Bara and

Sankhuwasava districts, respectively. This study also revealed that higher frequency of matting during June to Nov with higher percentage of calving from May to Oct in all those districts of Nepal. The buffaloes were brownish black colored, dry and rough skinned local type. This information's thus provided basic facts about performance of local buffaloes raised under farmers' management systems, which seems for the need of important in terms of breed performance compared to the other improved buffalo.

Performance study of Gaddi buffalo in the Far Western Region of Nepal

Mishra K, SP Neopane and R Kandel (2002). Performance study of Gaddi buffalo in the Far Western Region of Nepal. *Proceedings of the5th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, July 10-11, 2002, pp 111-114

The results of Karyotyping revealed that Gaddi buffaloes were riverine consisting of 50 (2n =50) chromosome. The average daily milk yield was 2.9 litters. The overall age at first calving, gestation length and calving interval was found to be 55.5±1.3 months, 311.8±0.4 days and 644.8±14.6 days, respectively. It was observed and experienced that number of Gaddi buffaloes are decreasing due to indiscriminate breeding practices (they are being crossed with Murrah) and if the process continues Gaddi buffalo will be extinct in near future. It is therefore essential to promote and conserve the breed for their better and sustainable production.

Indigenous buffalo bull management system in Nepal: Case study of Tanahun and Makwanpur districts

Singh SB (2004). Indigenous buffalo bull management system in Nepal: Case study of Tanahun and Makawanpur districts. *Proceedings of 5th National Animal Science Convention (NASA)*, Oct 15-16, 2003, Kathmandu, pp 231-240

The study revealed that Nepalese buffalo bull keepers own a wealth of knowledge and have expertise in many aspects in buffalo bull keeping. Bulls in general are fed adequately. But Falgun to Jestha-Asar (mid-March to June) is the critical feed deficit period. Bulls are prepared about a month before the breeding season by feeding raw mustard oil, chicken eggs. They are fed with increased amount of concentrate feed during the breeding season. There is increasing trend of buying a breeding bull only for a breeding season, after which the animal is sold out for slaughter. National policy with proper strategies is needed to encourage keeping bull for more service years.

Production performances of indigenous buffaloes in the western hills of Nepal

Shrestha BS, N Amatya, RM Singh, PK Jha, BR Acharaya and KB Gurung (2005). Production performances of indigenous buffaloes in the western hills of Nepal. *Nepal Journal of Science and Technology,* Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, Nepal, **6**:121-128

A study was carried out in the western hills to identify the production potential of indigenous buffaloes in order to develop breeding strategy for genetic improvement in Nepal. Production and reproduction performances of indigenous buffaloes were monitored in 8 different sites of western hills during 2001-2003. The morning and evening milk production of indigenous buffaloes were recorded within 5 days of calving for the 1st time subsequently at monthly interval. Reproductive performance was calculated based on the farmers' response on the buffaloes under recording. The standard 305 days lactation yield (LSM) of Lime and Parkote buffaloes were 962 and 1022 lit respectively which was statistically non significant. The average yields of buffaloes at different locations were highly significant (P=0.000). The least square means of lactation yields at Simichaur-Gulmi was the highest (1429 lit) followed by

buffaloes at Argali-Palpa (1142 lit) and Risingpatan – Tanahun (1068 lit). The buffaloes at Baughapokhari, Palpa were found to be have lowest (805 lit) standard 305 days lactation yield. There was great variability in the lactation performance of indigenous buffaloes ranging from 300-2300 lit. The age at 1st calving, calving interval and calving to mating intervals in Lime and Parkote buffaloes were 4.56 years, 600 days, 198 days and 4.48 years, 604 days and 213days, respectively. The production records have clearly indicated the possibility for improvement in indigenous buffaloes through selection. The implies that selective breeding for genetic improvement would be the supplementary option to the present cross breeding strategy with imported Murrah bulls or its frozen semen particularly for remote hills of Nepal.

Evaluation of different lines of indigenous buffalo breeds and their improvement

Mandal P, MD Jha and R Pariyar (2009). Evaluation of different lines of indigenous buffalo breeds and their improvement. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 317-319

Five indigenous breeds of buffalo (Lime, Parkote, mid hill Local, Terai local and Arna (wild buffalo) were evaluated for various traits. Higher calving age and more calving interval were found in mid hill local 50 months and 20 months and Terai local. The higher milk yield was recorded from Parkote (752 lit/lactation) followed by Lime, mid hill local, Terai local and Arna as 681, 549, 483 and 379 lit/lactation, respectively. The birth weight weights of calves were recorded 24, 28, 29 and 32 kg for Lime, Parkote, mid hill local, Terai local and Arna, respectively

Production and marketing dynamics of milk: a case study of Chitawan district, Nepal

Timilsina KP and PP Regmi (1983). Production and marketing dynamics of milk: A case study of Chitawan district, Nepal. *Journal of Institute of Agriculture and Animal Science (IAAS),* Rampur, Chitawan, Nepal, **4**:28-32

Production and marketing dynamics of milk was studied in Phulbari VDC of Chitawan, Nepal during 2005. Milk production aspects was assessed from randomly selected 80 farms, by employing proportionate stratified sampling technique and were grouped based on number of milking animals and size of land holding. Likewise 12 marketing agents consisting of two collection centers, two chilling centers, two processing plants, and six retailers were selected for the marketing related information. The findings revealed that total milk production increased significantly if there was an increase in number of milch cows, total land use, and average lactation period. The higher marketing efficiency was found in personal selling followed by private and DDC marketing. In spite of the higher margin of DDC produced milk, its demand compared to private diary milk was more because of its reputation among the consumers. The logistic regression model showed that the milk price (p-0.020), market security (p-0.022), and quick payment (p-0.048) were important factors for determining location of selling. In more than 60 percent of the production activities, involvement of women was higher than men, where as in marketing activities, involvement of male was higher. High price of feed was the major constraint of milk production, where as low milk price and frequent disturbances were the major marketing constraints, yet findings indicated that there is still a high potential of milk production in Chitawan with suitable production and marketing adjustments.

Perception of farmers in selling milk to Institutional and non institutional markets: A case study of Saradanagar VDC, Chitawan

Mishra RP, T Gautam and GP Dahal (1995). Perception of farmers in selling milk to Institutional and non institutional markets: A case study of Saradanagar VDC, Chitawan. *Journal of Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan*, *Research Reports* (1993-94), pp 193-200

This study was designed to identify the perception of farmers for selling milk at institutional and non institutional markets and to compare the net benefits gained in Saradanagar VDC in Chitawan. Majority of milk sellers were Brahmins and Chhetries, and other ethnic groups were in minority. Literacy rate, age group, and family size were similar for both institutional and non-institutional marketers of milk. Most of milk sellers were small land holders (<one ha). The net benefit gained by non-institutional marketers over the average cost of production was significantly higher (NRs 3.57/ lit) than that of institutional marketers (NRs 0.37/lit). The major reasons behind the selection of institutional market by the farmers were collective payment, less risky, limited capacity of local market etc. Attractive price was the major reason for selecting local market followed by easy escapement of standards. Lower price and milk holidays during the flush season were found as the major limitations of institutional market.

Dairy Development in Nepal

Mainali P (2003). Dairy Development in Nepal. *Proceedings of the 7th National Conference of Nepal Veterinary Association,* Tripureswor, Kathmandu, Nepal, 5-7 Nov,**24**:5-18

Dairy development in Nepal began in 1860 AD; with introduction of improved cows from UK followed by establishment of Veterinary dispensary in 1939AD was cheese factory and milk processing plant in 1953AD. Today dairy sector has grown as an important commercial venture with the production of 1200 thousand Mt of milk with a processing capacity of about 600000 lit/day. Huge quantity of dairy product importation and milk holidays are the major problems presently encountered for sustainable development of dairy sector; immediate attention through suitable policy formulation and implementation is urgently needed.

Milk production and marketing system of Kavre district

Dhungana D (2005). Milk production and marketing system of Kavre district. *Green Field Journal of Himalayan College of Agricultural Sciences and Technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **5**(1):99-100

The study on milk marketing systems in Kavre district was done to find out the constraints and opportunities with which milk producers have been facing. Though farmers of Kavre district responded that they have been generating significant income from the sales of milk and the road linkage had widened the market opportunity, it was not so in reality. Due to high production cost, insecure market, shortage of feeds and fodder, high incidence of diseases, lack of skilled manpower and quality services, and the economic benefit from this sector was far from satisfactory. These problems could be curtailed to some extent if the proper marketing policies are hammered out, providing knowledge to local farmers on milk production, animal health and improved feeds and feeding practices and services of skilled manpower made available. It is evident that average total cost is a decreasing function of number of dairy animals. Similarly, annual net profit of average household size was observed NRs 32596.12. It was of course not much remunerative to the large farmers albeit it was found positive. Farmers who had no option of conducting other business besides raising few dairy animals were observed as marginal ones. Therefore, they were not bothered about increasing milk

production by selecting superior breed. Their only purpose of raising animal was to get milk for their family consumption and to obtain manure so as to reduce the use of chemical fertilizer in their land. Hence, the livestock plays an important role in manuring their field and thereby minimizing their expenses on chemical fertilizer. This explanation clearly reflects that there is a dire need for changing and implementing the existing policy of the government for the upliftment of marginal farmers. The small farmers responded the either the price of their produce should be raised or interest charge on loan should be decreased to benefit them. The other avenues for earning more profit from dairy animals were genetic improvement, credit facilities and marketing support.

Mitigating milk holiday problem in Nepal: Diagnosis and prescription

Pokharel PK (2005). Mitigating milk holiday problem in Nepal: Diagnosis and prescription. *Nepalese Veterinary Journal*, **28**:58-67

Production and supply of milk has seasonal trend in Nepal with high production during July to Nov. During this period production exceeds beyond he processing capacity of dairy industry, resulting in drop in milk purchase during certain days of week, referred to as milk holidays. A study was undertaken in Dhankuta, Ilam, Makwanpur and Kaski districts of Nepal in order to investigate the severity and economic losses of the problem. Situation in milk collection and supply of 4 different Milk Producers Cooperatives (MPC) studied, and 129 consumers from Fikkal, Dharan, Hetauda and Pokhara markets were interviewed. Production of milk during flush season ranged from 313 to 1529 lit/days whereas in lean season it went down to 47 to 141 lit/day in studied MPCs. March to June are the critical months for milk production and productivity of dairy animals, during which, supply of milk to dairy development cooperation (DDC) is significantly reduced. Milk holidays were observed for up to 11 days a month causing high economic loss to dairy farmers and cooperatives. Among the available milk products in the market, the five most demanded dairy items were whole milk, yoghurt, ghee, cheena and khuwa, and the less preferred were cheese, chocolate and ice cream. Preference of consumer on indigenous milk products necessitates the production of these particular products at farm level; where the problem of surplus milk or milk holiday is severe.

Storage study of processed cheese foods and processed cheese, its effects on rheological characteristics

Thapa TB and VK Gupta (1990). Storage study of processed cheese foods and processed cheese, its effects on rheological characteristics. *Bulletin of Veterinary Science and Animal Husbandry, Special issue published on the occasion of the 3rd National Veterinary Conference*, **17-18:**52-56
Rheological measurements were carried out in the processed cheese food and processed cheese samples stored 37± 1^0c. During storage, hardness increased cohesiveness and springiness mostly decreased, and adhesiveness, gumminess and chewiness showed varying trend in processed cheese foods and processed cheese samples.

Effect of processing temperature and ingredients in the preparation of Gundpak – a Khowa based dairy product

Adhikary PP and P Sapkota (2008). Effect of processing temperature and ingredients in the preparation of Gundpak – a Khowa based dairy product. *Nepal Journal of Science and Technology,* Nepal Academy of Science and Technology (NAST), Khumaltar, Laitpur, Nepal, **9**:57-64

Gundpak an indigenous Khowa based dairy products is prepared especially in Kathmandu valley. It is prepared by locally available raw materials like Khowa, sugar, Gudh, ghee, edible seeds, dried fruits, etc. In this study, the temperature for cooking and raw materials used were

optimized. The chemical composition of Khowa showed that 26.2% moisture, 28.3% fat, 20.2% protein, 3.6% ash, 21.7% carbohydrate and 73.8% total solid. The final product Gundpak was analyzed chemically. It contained 24.57% moisture, 31.53% fat, 18% protein, 3.9% ash, 23% carbohydrate and 73.43% total solids. According to sensory evaluation Gundpak prepared by the incorporation of 20% sugar, 2.5% Gudh, 10% ghee and cooked at temperature of 120^0 C was selected as the best product.

Effect of milk fat level in quantity and quality of Paneer and utilization of whey

Panday N (2009). Effect of milk fat level in quantity and quality of paneer and utilization of whey. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research* in Nepal, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 172-180

Dairy production is an integral component of Nepalese farming system. Milk holiday is the emerging problem of dairy sector mainly due to inability of the existing dairy industries to utilize all fluid milk during flush season. Farmers do not have alternatives to utilize milk holidays, which cause enormous economic losses to the milk producing farmers. Paneer making may be an alternative to utilize surplus milk during flush season, the by product of which contains high protein and could be utilized for human consumption. The present study was undertaken to investigate the quality and economic aspects of paneer making from buffalo mil containing different fat levels (6.0, 3.5 and 2%). The study revealed that the paneer yield was highest (18%) from the milk containing the highest fat content (6%) compared to milk containing lower fat (16.6 and 10%, respectively) from milk containing 3.5 and 2% fat. However, economic analysis revealed that milk containing 3.5% fat was more economical for paneer making compared to milk containing either 2 or 6% fat. Overall acceptance was also better for paneer made from milk containing 3.5% fat.

Effect of packaging materials and modified atmosphere packaging on the shelf life of Khowa

Acharya PP and J Agrawal (2010). Effect of packaging materials and modified atmosphere packaging on the shelf life of Khoa. *Nepal Journal of Science and Technology,* Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, Nepal, **11:**87-94

Preservation of freshly prepared Khoa was carried out at room temperature (25 ± 1^0c) and refrigerated temperature (5 ± 1^0c) by using different packaging materials such as LDPE, aluminium foil / PVC and three layer laminated (polyster / met. BOPP/LDPE) in different conditions viz normal and shrink. All of the packaging materials on both conditions showed no significant difference except normal LDPE on mean sensory and chemical parameters of Khoa during storage at 5 ± 1^0c whereas it showed highly significant difference at 25 ± 1^0c among three packaging materials. Three layer laminated sample showed significantly higher sensory quality, high pH, low acidity, peroxide value (PV), free fatty acid (FFA) and lower microbial count than other two packing materials. Similarly, shrink packaged sample showed better quality in terms of sensory and microbial attributes of Khowa compared to normal packaging. No colonies of yeast and mold, coli form were during the storage period. Shrink packaged Khowa in three layer laminated increased storability to 27 days at 25 ± 1^0c against three days for unpacked ordinary Khowa.

Study on different fat levels on the quality of chhurpi prepared from cattle and buffalo milk

Sah DN (2010). Study on different fat levels on the quality of chhurpi prepared from cattle and buffalo milk. *Proceedings of the 9th National Conference of Nepal Veterinary Association*, Kathmandu, Nepal, 22-24 April, Pp 133-139

A study was carried out to standardize the method of manufacturing of chhurpi on the basis of fat percentage of cow and buffalo milk. On the basis of market survey, three different combinations recipes for cow (0.20%, 0.50% and 0.80%) and for buffalo milk (0.20%, 0.50% and 0.80%) were selected for optimizing the process for preparation of chhurpi. The chhurpi preparation included skimming of milk, pasteurilization, cooling to 62^0C, inoculation of citric acid using 2% and coagulation occurs until clear whey obtained after 15-20 minutes. The $1/3^{rd}$ whey was obtained after coagulation and filtered using a muslin cloth. The curd was cooked for 15 minutes, wrapped in muslin cloth. The curd were pressed over night and dried in a room temperature on shade for 14 days. The process optimized product was selected on the basis of best sensory scores by using 9 point hedonic rank sum method. The chhurpi having 0.8%fat content in cow and buffalo skim milk chhurpi highly acceptable product in which gumminess of cow milk with significant ($p<0.05$) improvement in sensory attributes. This experimentally prepared optimized chhurpi were analyzed in laboratory and compared its quality with control product. Parameters used to monitor to the quality of chhurpi were chemical (moisture%, fat%, protein %, total ash%, lactose% and acidity %) and microbial quality (yeast and moulds). The physiochemical parameters showed that there was significant ($p<0.05$) variation in moisture, fat, protein and total ash and lactose were no significant ($p>0.05$). The yeast and mould count in process optimized product and control product of cow and buffalo milk chhurpi did not showed significant ($P>0.05$) difference in the initial and final count of yeast and moulds. The product yield obtained was higher in more fat concentration i.e. 3.98% and 4.055 of cow and buffalo milk prepared chhurpi, respectively. The higher percentage yield occurred to the cow and buffalo milk having high percentage of fat. The average selling price of process optimized chhurpi was found NRs 206.56 per kg and average market price of chhurpi was found NRs 210 per kg in the study area.

2. SHEEP AND GOATS

2.1 HEALTH

Efficacy of Ivermectin against the nasal leech

Mahato SN and RP Thakur (1987). Efficacy of Ivermectin against the nasal leech. *Proceedings of the 2nd National Veterinary Conference*, **15**:15-23

In vitro and in vivo trials were carried out to evaluate the efficacy of Ivermectin against the nasal leech, *Dinobdella ferox*. The results of in vitro trials indicated the leech is highly susceptible to Ivermectin even at very low concentration. The intramuscular and subcutaneous injections of Ivermectin at the dose of 200, 400 and 600 mg/kg body weight to the experimentally infected sheep and goats failed to expel the leeches from the nasal passages. However, the intranasal application and the method in which the leeches were allowed to be exposed to Ivermectin solutions were found to be effective to secure the expulsion from the nasal passages of the infected animals

Nasal leeches in goats in the hills of Nepal

Mahato SN, KC Thakuri and RM Gatenby (1989). Nasal leeches in goats in the hills of Nepal. *Technical Paper N. 89/119*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

Nasal leech infection in goats is a common parasitic problem in Nepal but published literature about this condition is scanty. Between 1985 and 1988, a series of on station and on farm studies were carried out on its epidemiology, clinical manifestations and treatment. The leeches recovered from the nasal passages of goats were identified as *Dinobdella ferox*. Permanent water pools between 900 m and 1800 m above sea level were found to be the natural habitats of the leech. The young leeches which are abundant in the habitats during the dry season (Dec to May), 1st attach themselves to the nostrils of animals drinking there, and then migrate to the nasal passages. With the onset of the monsoon (mid June) the leeches drop back into water from the nasal passages to complete further stages of their life cycle. For goats, the highest prevalence was found in migratory herds. New infections were recorded from Dec to mid May with the peak prevalence of 50% in March. In order to investigate the clinical manifestations, goats were experimentally infected with young leeches. The infected animals had nasal discharge of a blood tinged viscid mucous and sneezed frequently. Intermittent epistaxis started from 4-8 days post infection. After 15 days, the leeches protruded through the nostrils frequently which caused great annoyance to the infected animals. In the later stages of infection when the leeches were greatly enlarged (up to 160 mm x 40 mm), mouth breathing and dyspnoea were observed. Infection with 8 or more leeches caused anemia. In a therapeutic trial, direct application of 10 ug/ml ivermectin solution effectively expelled the leeches. However, intramuscular and subcutaneous injection of Ivermectin at dose rates of 200. 400 and 600 µg/kg body weight failed to expel the leeches from the nasal passages.

The use of anthelmintics in migratory flocks

Owen OD (1987). The use of anthelmintics in migratory flocks. *Technical Paper N. 87/12*, Lumle Agricultural Centre (LAC), Lumle, Kaski, Nepal

This paper reviews the principles of helminthes control and their application to migratory flocks, it then reports on 2 trails conducted in the migratory flocks of west Lamjung. Drenching of the adult ewes appears to have brought lambing forward by one month in one flock, with the result that the lambs are 2 kg (115) heavier by mid May. This is not repeated in a similar flock and routine drenching of mature ewes is not recommended. Drenching of lambs and growing

sheep appears to have led to an increase in weight of up to 8% in one year old ewes and 13% in male lambs. Twice a year drenching is therefore recommended for young animals. The timing of drenching in relation to the principles of Helminth control and the results of these trials and earlier work conducted at LAC is discussed.

Effect of drenching with Anthelmentic on the weight gain of sheep

Neopane SP and NP Shrestha (1997). Effect of drenching with Anthelmentic on the weight gain of sheep. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Laitpur, Nepal, 11-16 March, 1997, pp 121

A broad spectrum anthelmintic, Nilzan (Levamisole + Oxyclozanide) was tested to determine its effect on the weight gain of sheep in Dang district in the inner Terai of mid western Nepal. Ten sheep initially aged 4 to 5 months were drenched with anthelmintic once at the beginning of the experiment and were given second dose 8 weeks later. Ten sheep of similar age were kept as a control. All the sheep grazed for 6-7 hrs/day in the same communal area. The duration of the experiment was 16 weeks. There was a significant increase in the mean daily weight gain of the treated group compared with the untreated group. The average daily weight gain of the treated group was higher by 76 and 55% than the untreated group in 0-8 and 9-16 weeks, respectively. The difference in weight gain between the two groups was statistically significant ($P<0.01$).

Agar gel diffusion test to detect Fasciola infection in goats

Mishra K and SN Mahato (1999). Agar gel diffusion test to detect Fasciola infection in goats. *Nepal Agricultural Research Journal (SAS/N)*, **3**(1)**:**42-44

This study was undertaken to investigate the possibility of using Agar gel precipitation test for diagnosing the early infection in field condition. The serum of Agar gel precipitation test was taken from 15 castrated goats aged between 6-8 months (approx 10-12 live weight) which were infected with *F. gigantica* metacercariae for this experiment. Sera from infected goats in which the eosinophil counts were high and showed precipitation lines 3 WPI. The precipitation lines were observed on all test sera up to WPI. However, these lines became fainter or absent after 20 WPI.

An Outbreak of acute Fasciolosis in goats in Udayapur district

Jha VC and GR Pant (2003). An Outbreak of acute Fasciolosis in goats in Udayapur district. *Proceedings of the 7th National Conference of Nepal Veterinary Association, Tripureswor, Kathmandu, Nepal*, 5-7 Nov, **24:**112-115

Fasciolosis has been considered to be widely prevalent among goats in Nepal. During the months of January to March 2002, an outbreak of a disease in goats of Beltar VDC of Udayapur district was reported. The epidemiological information, clinical findings, postmortem findings and laboratory investigations clearly confirmed the disease outbreak in goats was due to the acute Fasciolosis

The effects of parasitic gastroenteritis (PGE) in sheep productivity under intensive grazing management in the mid hill region of western Nepal

Joshi BR (1991). The effects of parasitic gastroenteritis (PGE) in sheep productivity under intensive grazing management in the mid hill region of western Nepal. *Paper presented at 4th National Congress of Veterinary Parasitology,* Anand Gujrat, India 22-24 November

The effects of parasitic gastroenteritis (PGE) on the body weight and wool yield of sheep in the intensive management system at mid hill region of Nepal has been investigated. It was found that body weight and wool yield was significantly different ($P<0.05$) in parasitized and clean sheep. It was also found that under an intensive management system, parasitic gastroenteritis (PGE) had a significantly ($P<0.05$) detrimental effect on the survival of animals. A strategy for the effective control of PGE is suggested.

The epidemiology, effects and possible control strategies for parasitic gastroenteritis of small ruminants in the hills of Nepal

Joshi BR (1996). The epidemiology, effects and possible control strategies for parasitic gastroenteritis of small ruminants in the hills of Nepal. *Proceedings of the 1st National Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, 7-9 May, 1996, pp 143-161

The findings of a series of field studies on the epidemiology and clinical significance of gastrointestinal nematodes in sheep and goats reared under the sedentary and migratory managements in the hills of Nepal are presented. Amongst 18 nematodes species identified from these animals, *Trichostrongylus spp* were most prevalent, followed by *Ostertagia spp* in the migratory and *Haemonchus contortus* in the sedentary flocks. Worm burdens of migratory animals were higher than those of sedentary flocks, but faecal egg counts were generally lower, possibly due to the higher proportion of hypobiotic larva and better plane of nutrition in the migratory animals. Between the animal species, higher worm burdens were recorded from sheep than from goats reflecting the differences in their grazing behavior and the greater dependence of sheep on grazing as compareded to browsing goats. Faecal egg counts and the use of tracer animals indicated that the main period of transmission was from April-October. Sub sets of animals protected by intensive anathematic treatment showed the greater weight gain response of 57-114% in sheep and 93-160% in goats than those managed under farmers' management. Based on the epidemiological findings, the possible approaches for the control of gastrointestinal nematodes are suggested for sedentary and migratory flocks.

Comparative efficacy of Fenbendazole, Mebendazole and Krimos powder against natural infection of gastrointestinal nematodes of goats

Thakuri KC, RP Thakur and R Rai (1994). Comparative efficacy of Fenbendazole, Mebendazole and Krimos powder against natural infection of gastrointestinal nematodes of goats. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal**, 9**(1):1-3

A study was conducted to evaluate the comparative efficacy of Fenbendazole, Mebendazole and Krimos powder (an ayurvedic preparation) against naturally occurring gastrointestinal nematode infections in goats at, PAC, Dhankuta. The efficacy of drugs was evaluated on the basis of absence of eggs in faeces or the decrease in their number by the 14th day post treatment. Among the 3 drugs tested, a single drenching with Febendazone at the dose rate of 10 mg/kg body weight was found to be superior (100%, 100% and 33% effective against Strongyles, Strongyloides and Trichuris respectively followed by Mebendazole at the dose rate of 10 mg/body weight) against gastrointestinal nematode infection in goats. Krimos powder was ineffective to treat the goats infected with gastrointestinal nematodes. The percentage of efficacy of the 3 drugs against different species of gastrointestinal nematodes is discussed.

Effects of parasitic gastroenteritis in goats under sedentary management in a low hill village of western Nepal: A clinical review

Joshi BR (1994). Effects of parasitic gastroenteritis in goats under sedentary management in a low hill village of western Nepal: A clinical review. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **9**(1)**:**18-20

Parasitic gastroenteritis is one of the major causes of productivity loss in goats in Nepal. This reports records a case of parasitic gastroenteritis in goats under a sedentary management system in a low hill (below 900 masl) village of Kaski district of western Nepal. The major symptoms affected goats were diarrhoea, bottle jaw, loss of appetite and inability to move. Examination of 12 representative faecal samples from the affected herd showed heavy infection of gastrointestinal nematode. The major parasites recorded in the gut wash of one slaughtered goat (infected goat from affected herd) were *Haemonchus spp* (49.4%), *Trichostrongyles spp* (43.5%) followed by *Oesophagostomum spp* (4.2%), *Ostertagia spp* (2.5%) and *Bunostomum spp* (0.4%). Possible causes of infection and their effective control measures have been also discussed.

The need and the strategies for gastrointestinal nematode control in the sheep and goat population of Nepal

Joshi BR (1996). The need and the strategies for gastrointestinal nematode control in the sheep and goat population of Nepal. *Proceedings of the 5th National Veterinary Conference*, 11-13 Sep, -24 pp 59-70

Sheep and goat raising an important component of subsistence farming system in Nepal, contributing meat, wool, farm manure and cash. Among the various factors responsible for limiting the productivity of these animals, gastrointestinal nematodes have been regarded as the important cause. In a serious of field studies, sub clinical parasitism was found to be common in both sheep and goats reared either under the sedentary or migratory management. This infection was responsible for the reduction in body weight gain by 57-114% in sheep and 93-160% in goats and the mortality up to 33% in sedentary lambs. The main period of pasture infection was confined to the wet summer months between April-October with a very low of infection during rest of the year. *Trichostrongylus spp w*ere the most prevalent species followed by *Ostertagia spp*, in the migratory and *Haemonchus contortus* in the sedentary animals. The flocking places and the alpine pasture constituted the main foci of infection in the migratory animals whereas; the community grazing areas were the source of infection for the sedentary animals. Considering the epidemiological pattern of the infection, the control strategy for gastrointestinal nematodes should be the protection of susceptible growing lambs and kids during wet summer months and the treatment of adults and yearlings in both species by late autumn or early winter, so that the animals could be maintained worm free or with minimum level of infection during the winter and dry summer months.

Epidemiology of gastrointestinal nematode infection in sheep and goats reared under transhumance management in the Himalayan foot hills of western Nepal

Joshi BR and DE Jacob (1996). Epidemiology of gastrointestinal nematode infection in sheep and goats reared under transhumance management in the Himalayan foot hills of western Nepal. *Seminar Paper 96/30,* Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

Epidemiological studies of gastrointestinal nematode infection in the transhumant sheep and goats conducted for 12 months from February 1993 showed that infection at a low level occurs throughout the year with the main period of pasture infection confined between April-October

relating closely with the rain fall pattern. Grazing areas around the flocking places "Kharkas" and the alpine pastures constitute the main foci of infection. *Ostertagia nianquingtanggulaensis*, followed by *Trichostongylus spp*, were the predominant nematodes recovered from the animals with *Haemonchus contortus* infection confined to early summer months. Pasture infection of different nematode species varied according to the seasons and altitude range. Mixed infection of *H. contortus, Ostertagia spp* and *Trichostrongylus spp* was recorded below 23oo m asl, *Trichostrongylus spp Ostertagia spp* between 2300-3500 m asl and only *Ostertagia spp* above that altitude. The proportion of hypobiotic larvae showed two peaks, the 1st during March-April and 2nd in Sepember-October, while hypobiosis was not recorded in June and July. The faecal egg counts in ewes also showed two peaks, 1st during May and the 2nd in January with lowest intervening point in August, whereas, the trends in lambs, kids or adult goats were less conspicuous and of lower magnitude.

Gastrointestinal nematode fauna of sheep and goats in the hills of Nepal

Joshi BR (1997). Gastrointestinal nematode fauna of sheep and goats in the hills of Nepal. *Veterinary Review,* Animal Health Research Division, Tripureswor, Kathmandu, Nepal, **12** (1)**:**30-32

A total of 20 gastrointestinal nematode species were recovered from the slaughtered sheep and goats reared under migratory and sedentary managements in the western hills of Nepal. Nematode fauna recovered from migratory animals was more diverse than from the sedentary animals reflecting a wider area covered for grazing by former. Migratory sheep harbored the highest number of nematode species followed by migratory goats and only ten species were recovered from sedentary goats. *Trichostrongylus axei* was the commonest nematode species recovered from both species in either systems followed by *T. colubriformis and Teladorsagaia circumcincta. Whereas, Ostertagia nianquingtanggulaensis, O. leptospicularis, Teladorsagia davtiani, T. trifurcata, Grossospiculagia occidentalis, Skrijabinema ovis* and *Chabertia ovina* were recovered from migratory animals only.

Gastrointestinal nematode infection of small ruminants and possible control strategies in the hills and mountains of Nepal

Joshi BR (1998). Gastrointestinal nematode infection of small ruminants and possible control strategies in the hills and mountains of Nepal. *Veterinary Review*, Nepal Agricultural Research Council (NARC), Khumaltar, Lalitpur, Nepal, **13:**1-5

Control of gastrointestinal nematodes is only successful if the treatment regime is scheduled according to the local epidemiology of helminth infection, which is governed by climatic conditions and animal management system adopted in the area. In Nepalese, hills and mountains sheep and goats are raised under sedentary and migratory management respectively and the epidemiological pattern of infection is more or less governed by the availability of moisture on the ground. The strategic control programme of gastrointestinal nematodes in sheep and goats thus aim to protect the animals during the wet monsoon months. An additional drenching prior to dry winter months would also help to reduce the production losses during the lean winter months.

Evolution of anthelmintic resistance in nematode parasites with special reference to Benzimidazole resistance in *Haemonchus contortus*: A Review

Shrestha HK (1998). Evolution of anthelmintic resistance in nematode parasites with special reference to Benzimidazole resistance in *Haemonchus contortus*: A Review. *Veterinary Review*, Nepal Agricultural Research Council (NARC), Khumaltar, Lalitpur, Nepal, **13:16**-20

Benzimidazoles have been extensively used for removal of nematode parasites from livestock because of its high efficacy and broad spectrum nature covering wide range of worm parasites. Development of resistance in parasites against this group of anthelmintics is increasing and may render them useless. This paper reviews the evolution of anthelmintic resistance in nematode parasites with special reference to Benzimidazole resistance in *Haemonchus contortus*. In Helminth parasites, development of resistance against anthelmintics is the result of selection for resistant individuals under the selection pressure exerted by application of anthelmintics. Benzimidazoles act primarily by binding with affinity to the parasite beta-tubulin and depolymerise the tubulin-microtubule complex and in resistant individuals, there is reduction in the level of high affinity binding of Benzimidazole to beta-tubulin, and hence parasites are able to tolerate the drug. Under selection pressure with Benzimidazole, only the resistant individuals survive and pass on the genetic characteristics to their offspring. The alleles conferring susceptibility are lost from the population and those conferring resistance increases in the population. Thus, there occurs a quantitative change in the parasite gene pool which results in the evolution of parasite from a susceptible population to a resistant population.

Response of migratory sheep and goats to single anthelmintic treatment during early winter month in Lamjung district of west Nepal

Joshi BR and HD Joshi (1999). Response of migratory sheep and goats to single anthelmintic treatment during early winter month in Lamjung district of west Nepal. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski Nepal, 26-28 June, 1999, pp 99-106

The responses to single anthelmintic treatment with Ivermectin injection at early winter was evaluated in a flock of migratory sheep and goats of Ghanpokhara village of Lamjung district. The positive response of the treatment was evident in both species and age groups but the magnitude was variable. While the treated ewes maintained their body weight throughout the winter, the controls lost about 7% of their body weight. In the lambs the response was even more spectacular as the treated lambs gained 233% higher body weight than the controls. The response of adult goats was in the similar trend as the ewes but the weight gain difference in the treated and untreated kids was similar magnitude. These findings indicated that a single anthelmintic treatment of the migratory sheep and goats at the beginning of the winter will have significant positive effect for improving the productivity of the flocks.

Gastrointestinal Helminth infection in migratory sheep and goats of Nepal

Joshi BR (1999). Gastrointestinal Helminth infection in migratory sheep and goats of Nepal. *Seminar Paper N. 99/11*, Agriculture Research Station, Lumle, Kaski, Nepal

A significant population of sheep and goats in Nepal are reared under migratory management in which, mixed flocks of sheep and goats migrate to the high altitude alpine pasture of Himalayas during the wet summer months from the villages at the lower altitudes. Gastrointestinal nematode infection is regarded as one of the important health problem in

these animals. Epidemiological and production affects studies conducted for a period of one year, showed that the main infection period was confined between April-October months relating closely to the rain fall pattern and moisture availability. Grazing area around the flocking places and the alpine pastures constitute the main foci of infection. *Ostertagia nianquingtanggulaensis* followed by *Trichostrongylus spp* were the predominant nematodes with *Haemonchus contortus* infection confined only to early summer months at the lower altitudes. Pasture infection of different nematode species varied according to the seasons and altitude range. While mixed infection of *H. contortus, Ostertagia spp* and *Trichosstrongylus spp* was recorded below 2300 m asl, only *Ostertagia spp* were recorded above 3500 m asl altitude. The faecal egg counts in the ewes were consistently higher than in nannies, but the seasonal trend was similar. The effects of infection on animal productivity studied in pair matched groups of lambs and goat kids maintained worm free by regular anthelmintic treatments showed that body weight gain of worm free lambs and kids was respectively 110 and 87 percent more than that of the animals kept under farmers' traditional management. The results of the present studies show that the pattern of gastrointestinal nematode infection in migratory sheep and goats is seasonal and causes considerable loss in production. Hence, to reduce the losses, the animals (especially the growing animals) should be protected during the main infection season.

Infection and effects of gastrointestinal nematodes in Sinhal and Khari goats raised under the migratory and sedentary managements in Nepal

Joshi BR (1999). Infection and effects of gastrointestinal nematodes in Sinhal and Khari goats raised under the migratory and sedentary managements in Nepal. *Veterinary Review*, Animal Health Research Division, Tripureswor, Kathmandu, Nepal, **14**:18-22

Sinhal goats are raised with Baruwal sheep as mixed flocks under migratory management in the high altitude villages and Khari goats are reared at the lower altitude villages of Nepal as separate flocks under sedentary management. A study on the epidemiology and clinical significance of gastrointestinal nematode infection in goats raised in both managements showed that, mean worm burden, fecal egg counts and worm species composition were different between the systems. Migratory Sinhal goats had significantly higher worm burden than the sedentary Khari goats during all seasons, but this difference was not reflected the fecal egg counts of the animals, which has significantly higher in the sedentary Khari goats than in the Sinhal goats. In Both systems, infection was at sub clinical level; however, the weight gain response of worm controlled goat kids was significantly greater than the untreated kids managed together in both management systems. The daily body weight gain of worm controlled Khari kids was 51 g as compared to 23 g in untreated kids, while in the Sinhal kids the mean daily weight gain of worm controlled kids was 26 g as compared to 14 g in untreated kids.

Gastrointestinal nematode infection in Sinhal and Khari goats raised under migratory and sedentary managements in Nepal

Joshi BR (2000). Gastrointestinal nematode infection in Sinhal and Khari goats raised under migratory and sedentary managements in Nepal. *Seminar Paper N. 2000/23*, Agriculture Research Station, Lumle, Kaski, Nepal

Goats are raised either under the migratory or sedentary management in Nepal. Migratory management is practiced in the high altitude villages in which mixed flocks of Baruwal sheep and Sinhal goats migrate to the alpine pastures, while at the lower altitude, separate flocks of Khari goats are kept under sedentary management. A study on the epidemiology and clinical significance of gastrointestinal nematodes in goats raised under both management conducted for a period of 1 year between 1992-93, showed that although the mean worm burden in migratory goats was significantly higher than that of the sedentary goats in all seasons, the

faecal egg counts were higher in sedentary animals. In both systems, the infection was at sub clinical level; however, the weight gain response in worm controlled kids was significantly higher than the untreated animals managed under the farmers' management. In the sedentary system, the treated kids gained 8.9 kg body weight over a period of 6 months in comparison to 3.7 kg in the untreated animals, while in the migratory management, the body weight gain of treated kids was 9.1 kg in comparison to 5 kg in the untreated controls over a period of 1 year. Despite the lower worm burden, the clinical effect of infection was more severe in sedentary goats than in the migratory goats. These findings are discussed and the control strategy is suggested.

Evaluation on genetic resistance of three native Nepalese sheep breeds against *Haemonchus contortus* infection

Joshi BR (2000). Evaluation on genetic resistance of three native Nepalese sheep breeds against Haemonchus contortus infection. *Proceedings of the 1st SAS/N Convention, Kathmandu*, March 29-31, 1999, pp 219-227

The genetic resistance of three Nepalese sheep breeds namely, Kage, Baruwal and Lampuchhre was studied against *Haemonchus contortus* infection by primary and challenge infection of *H. contortus* larvae. The parasitological and Haematological response of these breeds indicated the relative superiority of Kage animals than the Baruwal or Lampuchhre breeds against *H. contortus* infection. The superior resistance of Kage breed was expressed by lower worm establishment, lower faecal egg counts, lower worm recovery and higher Eosinophil response than the Baruwal and Lampuchhre breeds.

Efficacy of Titepati, Lazzabati and Supari against gastrointestinal nematodes of goats

Aryal SR and SP Shrestha (2004). Efficacy of Titepati, Lazzabati and Supari against gastrointestinal nematodes of goats. *Proceedings of the 2nd SAS/N Convention*, Kathmandu, 30 July- 1 Aug, 2003, pp 366-368

A study was conducted to evaluate the effects of herbal medicine Titepati (*Artemesis vulgaris*), Lazzabati (*Mimosa pudica*) and supari (*Areca catechu*) against gastrointestinal nematodes in goats. Sixty naturally infected goats were selected on the basis of EPG count and divided into 5 groups, randomly, Titepati, Lazzabati and Supari were found 70.09, 59.26 and 44.53% effectively reduce the EPG count where as albendazole was found 86.36% effective. The comparison of means for EPG reduction and weight gain showed that there was no significant difference ($P>0.05$) between Titepati and albendazole (positive control) where as both of them were significantly different ($P<0.05$) with the negative control. Thus Titepati may be a probable alternative drug against GI nematode in goats.

Anthelmintic treatment of sheep and goats for production improvement in Karnali region of Nepal

Khakural GP, DN Dhungana, SP Shrestha and YK Shrestha (2005). Anthelmintic treatment of sheep and goats for production improvement in Karnali region of Nepal. *Nepalese Veterinary Journal*, **28:**121-123

Livestock farming specially sheep and goat husbandry is very potential agricultural enterprise in Karnali region of Nepal; however, the overall productivity is low. There are multidimensional problems, complex in nature, associated with declining sheep and goat population and their productivity. These problems are diseases, shortage of feed stuffs, indiscrimate breeding, shepherding problem, predation and poisoning, trapping and stealing. The study was undertaken on control of internal parasites (gastrointestinal nematodes) by drenching with

Fenbendazole (@ 5 mg/kg body weight) in 167 sheep and goats (sheep=88 and goat=79) and its effect on growth of sheep and goats. Before drenching, prevalence of parasites was 87.5% in sheep and 45.5% in goats. Sheep were more infested than goats because sheep graze and goats browse the vegetation. The parasitic burden was reduced after drenching but the drenching response was not very remarkable as the weight gain was low (0.6 kg) despite drenching, possibly because, this season (winter) is the feed scarcity season of the year.

A study of growth rate of goats in the Terai of Nepal

Mctaggart RM and FC Wikinson (1982). A study of growth rate of goats in the Terai of Nepal. *Bulletin of Veterinary Science and Animal Husbandry*, **10-11:**30-32

This study showed that the growth rate of young Terai goats fed berseem and kept relatively worm free was nearly 100 g a day. This was about 3 times the growth rate when the some goats later grazed natural pasture. The Terai goats thus do have a potential for higher growth rates if nutrition can be improved. The effects of parasitism could not be defined. An initial 12% increase in live weight response was obtained by treatment to remove a light infestation of worms. However self cure occurred in the untreated goats and there was no reinfestation

Eimeria (Coccidia) species of sheep and goats prevalent around Lumle Regional Agricultural Research Centre

Bohara KB, HD Joshi and ER Yadav (1992). Eimeria (Coccidia) species of sheep and goats prevalent around Lumle Regional Agricultural Research Centre. *Working Paper No. 92/13*, Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

A study was undertaken between Aug to Oct 1991 with the objective of identifying prevalence of the pathogenic species of Eimeria in sheep and goats in the area of Lumle Agricultural Research centre (LARC). Eight species of Eimeria in sheep and eight in goats have been identified. Those identified for sheep are, *E. faurei*, *E. ovinoldalis*, *E. crandallis, E. ahsata, E. marsica, E. intricate and E. parva*, and for goats, *E. apsheronica, E. arloingi, E. caprina, E. christenseni, E. hirci, E. nenakohlyakimovae, E. caprivine* and *E. kocharli*

The effect of Coccidiosis on growth of goats

Thakur RP and K Rai (1998). *The effect of Coccidiosis on growth of goats*. *Working Paper N. 98/231*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

A study was carried out to measure the effect of Coccidiosis on growth rate in goats at PAC. A total of 22 goats aged approximately 2 months old were used in this study. The goats were naturally infected with coccidian but all were treated with anthelmintics. They were randomly divided into two equal groups; goats of one group were treated with commonly used Coccidiostats (Sulmet and Amprolium) at recommended dose levels whereas another group was kept as control without treatment with coccidiostat. Faecal samples of both groups were examined daily for 5 days before treatment and on 7, 14, 21, 28 and 35 days post treatment. Oocyst per gram of faeces (OPG) and body weight gain goats of both groups were recorded on these days. The results showed that neither of the Coccidioctats were 100 percent effective against Coccidiosis. However, the drugs greatly reduced the faecal output. Analysis of the data showed significant ($P<0.001$) effect of treatment on OPG at 7, 14 and 28 days post treatment. However, the effect of treatment on OPG at 21 and 35 days post treatment was non-significant. Analysis of variance showed non-significant effect of treatments on body weight but the analysis of covariance showed significant ($P<0.05$) effect of treatment on body weight at 21 and 35 days post treatment.

Verification trial Bozo and Titepati solution in control of ectoparasite in goat

Shrestha YK, NL Tamrakar and SP Shrestha. (1999). Verification trial Bozo and Titepati solution in control of ectoparasite in goat. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal,* Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, pp 107-109

A study was conducted to verify the use of Bozo and Titepati for the control of ecto-parasites. Use of 20% and 40% Bozo (*Acorus calamus*) solution was effective in controlling ectoparasites in goats. It is easily available, economical and easy to handle. Titepati (*Artemisia japonica*) solution was less effective than the Bozo solution in control of the ecto-parasites. Three locally available herbal plants namely '*Bozo, Sisno and Titepati*' were made to 10%, 20% and 40% solutions in weight/volume basis. The in vitro result revealed that *Bozo* solution killed all the ectoparasites within 2.5 hrs, *Sisno* within 3 hrs while, *Titepati* killed only lice within 5 hrs but not ticks.

Mange infestation and its treatment in Sinhal goats of migratory flocks of Lamjung and Kaski districts of western Nepal

Ghimire SC, BR Joshi and HD Joshi (1998). Mange infestation and its treatment in Sinhal goats of migratory flocks of Lamjung and Kaski districts of western Nepal. *Veterinary Review*, Nepal Agricultural Research Council (NARC), Khumaltar, Lalitpur, Nepal, **13**:6-11

Mange of goats in the migratory flocks of Nepal is an endemic disease causing significant economic loss. Outbreaks of mange were recorded in some of the migratory flocks of Lamjung and Kaski districts of Nepal during the year 1990/91. These outbreaks, in some of the flocks, were investigated to elucidate the nature of the disease. The morbidity and case fatality rate of mange in 3 village flocks ranged from 14.9-49.4 and 32.7-62.2, respectively. Young animals were more affected than the adults, and the mortality due to the disease was higher in colder winter months. Sheep in contact with mange infested goats were not affected while in contact dogs and humans were transiently affected. The mite species involved were identified as *Sarcoptes scabiei* and *Chorioptes bovis*. These epidemics were treated with Ivermectin and Malathion and efficacy of both treatments was evaluated. Both subcutaneous injection of ivermectin at the rate of 200 mg/kg body weight, and dipping in 0.5% Malathion prevented further death and spread of the disease, and completely cured the mild infestations, but severely infected animals required further treatment.

Sero-prevalence of brucellosis in sheep in the Koshi hills of Nepal

Jha VC, JN Yadav and LB Rai (1992). Sero-prevalence of brucellosis in sheep in the Koshi hills of Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **7**(1)**:**11-13

A study of sero- prevalence of brucellosis among sheep in the 4 districts of Koshi hills was carried out. The Rose Bengal Plate Test and Serum agglutination test were used. Twenty (2.7%) out of 730 samples were serologically positive for brucellosis. No positive cases were found in Dhankuta district. There was a relatively high prevalence rate among sheep with a history of abortion (18.55). The differences in prevalence rate between sedentary and migratory flocks, and male and female sheep, were found to be non significant. The existence of brucellosis in the Koshi hills is attributed to indiscriminate breeding practices, an absence of animal quarantine facilities, poor disease control management and a general lack of knowledge about the disease among farmers.

Sero- prevalence of Brucellosis in goats in the Koshi hills of Nepal

Jha VC, RP Thakur and JN Yadav (1993). Sero- prevalence of brucellosis in goats in the Koshi hills of Nepal, *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakribas, Dhankuta, Nepal, **8**(2)**:**60-62

A study on sero-prevalence brucellosis among goats in the 4 Koshi hill districts was carried out. The Rose Bengal Plate Test and serum Agglutination Test were used for testing the serum samples. Thirty six (3.7%) out of 813 samples were serologically positive for brucellosis. Highest prevalence rate (7.95) was found in Terhathum followed by 6.7% in Bhojpur, 1.2% in Dhankuta and 0.9% in Sankhuwasava districts. The prevalence rate of brucellosis among aborted goats was 5.9% followed by 5.4% in repeat breeders. The occurrence of this disease could be related to poor disease control management, general lack of knowledge about disease among farmers and lack of vet support services in the field of disease investigation.

Experimental study on the pathogenicity of *Mycoplasma agalactiae* in the respiratory tract of goats

Pradhan A, MN Sinha, CB Prasad, KCP Singh and BK Sinha (1993). Experimental study on the pathogenicity of *Mycoplasma agalactiae* in the respiratory tract of goats. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **8**(2):66-67

Mycoplasma agalactiae isolated from the lungs of goats with respiratory trouble was found pathogenic to goats in an in vitro trial. Although none of the goats died, all of them succumbed to respiratory infection and showed respiratory distress accompanied with coughing and fever. Persistent isolation of Mycoplasma and microscopic lesions in the lungs revealed that the organisms could cause chronic respiratory problem.

Respiratory diseases with special reference to Mycoplsmosis in goats in the eastern hills of Nepal

Jha VC and T Beier (1996). Respiratory diseases with special reference to Mycoplsmosis in goats in the eastern hills of Nepal. *Proceedings of the 5th National Veterinary Conference,* 11-13 Sep, 24, Pp 71-74

Among the disease of goats reported by the farmers in the eastern hills, 23.3% of cases were respiratory problems. The analysis of goat postmortem records of Pakhribas Agricultural Centre (PAC) showed that deaths due to pneumonia were 31.6% of all deaths. None of the bacterial species isolated from the lung samples of the goats at PAC, except *Pasteurella haemolytica* (5.2%) are considered as major cause of pneumonia. An attempt was made to isolate mycoplasmas from the goats of the PAC livestock farm and from village goat flocks. One hundred and thirty six nasal swabs from goats having purulent/serous nasal discharge and 9 lung and pericardial fluid samples from postmortem cases were collected and subjected to Mycoplasma isolation at PAC at PAC Veterinary laboratory. 25 nasal swabs and 4 lung and pericardial fluid samples were found to be positive for Mycoplasma. With further laboratory confirmation and species identification at the Federal institute for Health Protection of Consumers and Veterinary Medicine, Jena, Germany, 8 samples have been identified to date. The identified species are *Mycoplasma mycoides* subspecies mycoides (LC), *Acholeplasma laidlawii* and *Mycoplasma arginini*. This is 1st time the presence of Mycoplasma in goats of Nepal has been confirmed. A detailed investigation on the actual causes of respiratory diseases in goats needs to be carried out.

Studies on serotypic distribution of *Dichelobacter nodosus* isolated from migratory flocks of Nepal and response of Baruwal sheep to monovalent footrot vaccine

Ghimire SC and HD Joshi (1994). Studies on serotypic distribution of Dichelobacter nodosus isolated from migratory flocks of Nepal and response of Baruwal sheep to monovalent footrot vaccine. *Working Paper N. 94/55*, Lumle Agricultural Research Center (LARC), Lumle, Kaski, Nepal

A total of 323 sheep and goats from 42 migratory mixed flocks of 3 districts of Gandaki zone of Nepal were sampled for isolation and characterization of Dichelobacter *nodosus*. *D. nodosus* was isolated from 112 sheep and 19 goats. Of 682 isolates serogrouped by the slide agglutination test, the majority (89.4%) were of serogroup E. Serogroups B and C accounted for 3 and 4% respectively, and 17 isolates (2.5%) could not be classified into any of the serogroup (A-1) of the Australian classification system. All the isolates of serogroup E tested were found to be elastase positive whereas all of serogroup C and untypable isolates were elastase negative. Serogroup B isolates were found to be both elastases positive and negative. Vaccination trial reported in this study indicates that Nepalese Baruwal sheep could respond well to monovalent footrot vaccine. The curative efficacy of an oil adjuvant monovalent footrot vaccine was calculated to be 79%. However, complete recovery in vaccinated responders was apparent only after a month of booster vaccine. The serological response of naturally infected sheep was significantly different from that of sheep without prior exposure to the disease when the first dose of the same vaccine was given to them ($P<0.025$). However, such difference was not apparent after the booster dose of vaccination ($P=0.3$).

Epidemiological study on footrot transmission in the migratory flocks of Nepal

Ghimire SC (1994). Epidemiological study on footrot transmission in the migratory flocks of Nepal. *Working Paper N. 94/56*, Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

Migratory sheep and goats flocks of Kaski and Lamjung districts in the western development region of Nepal, where footrot is epidemic, were monitored throughout the period of migration to and from alpine pastures for two consecutive years to study the epidemiological aspects of the disease transmission. During 1991, whole population of two flocks of one village (Ghanapokhara) were inspected and recorded, while during 1992, a sample of 160 sheep and 36 goats from 10 different flocks of 3 villages (Siklis, Tangting and Ghanapokhara) were inspected. It was found that the period of upward migration through the forest (May-June) to be the most favorable period for footrot transmission (more than 60% sheep and around 30% goats infected). The alpine pastures, though wet, were found not to be conducive, while a low level of transmission was recorded during descending migration through the forest (October-November). The period of transmission was found to coincide with the increasing rainfall. The study also examined the role of leech bites in footrot transmission. Leech bites were found not to be a predisposing factor under dry housed conditions, but their role under natural conditions was not investigated. Both Baruwal sheep and Sinhal goats were found to be affected with footrot. However, when compared to sheep, significantly low proportion of goats was found to be infected, indicating goats to be more resistant to footrot than sheep.

Report on foot rot eradication program

Shrestha HK and SC Ghimire (1996), Report on foot rot eradication program. *Working Paper N. 96/43,* Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

Foot rot, which has been prevalent in the migratory flocks of sheep and goats of Kaski, Lamjung and Manang districts of Nepal since 1960s, has been controlled to a greater extent than before

using intensive treatment campaigns, sero-group specific vaccination and restriction on the movement of flocks or animals from infected to non infected areas. During the years 1992/93, 1993/94 and 1994/95, campaigns were organized four or five times mainly during winter and dry months (November to May) and once during August at alpine pastures. Treatment campaigns were concentrated and more frequent in the flocks in high prevalence area, i.e. villages between Seti and Rudi river of Kaski district and between Rudi River and Khudi Khola of Lamjung district. The Manang flocks, which had remained clean for few years had reinfection during January, 1993 and were inspected and treated subsequently. After each annual cycle of the treatment campaigns, infection declined in almost every flock except in a few isolated flocks in an area and the infection was reduced to $P<0.01$ in all the area. From the range of 0.5 -9.92% infection in sheep and 0.38-2.12% in goats in January/February, 1993 in the four foot rot affected areas of Kaski, Lamjung and Manang districts, the infection has reduced to a range of 0-0.35% in sheep and 0-1.13% in goats during Nov, 1994. There was an increase in the foot rot infection in goats particularly in east Lamjung area, which were all not covered by sero-group specific vaccination. But at the end of the year's campaign in during April-May, 1995, all flocks were made free of clinically infected animals and were expected to return free of infection from alpine pastures. A seminar on "Foot rot Eradication Program in sheep and goats in Nepal" was organized in December, 1993 in Kathmandu, and government staff were actively involved in the foot rot eradication program from 1994/95 campaigns. An anaerobic culture facility was established at Regional animal Disease Diagnostic Laboratory, Pokhara to carry out foot rot bacterial culture works. District level foot rot workshop was held in Lamjung to inform shepherds, people and local leaders about the programmes and gain their cooperation in the program. A review on the foot rot eradication program was carried out during December 1994 found that the project has been successful and recommended continuation of the project.

Recent approach to footrot management in migratory sheep and goats in the western hills of Nepal

Ghimire SC (1997). Recent approach to footrot management in migratory sheep and goats in the western hills of Nepal. *Seminar Paper N. 97/21*, Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

Virulent footrot was introduced into the country in the sixties through imported rams. The disease has been established in migratory sheep and goat's flocks of 3 districts, Kaski, Lamjung and Manang of Gandaki zone, before the institutional control programmes were started in 1975. Original control programmes which principally consisted of inspection and treatment of affected animals several times during the dry winter months and culling of affected animals before the flocks went on migration, through successful in preventing the spread of the disease to new areas and in eradicating the disease from several affected flocks were unable to prevent the consistent reoccurrence of the disease in some other flocks. Recently, the possibility of managing the disease by the use of specific vaccine was investigated. An intensive bacteriological investigation identified the presence of only 2 serotypes (B and E) isolates involved in cases of virulent footrot in these flocks, a vaccine containing only these 2 antigens was formulated and evaluated. Comparative investigations identified the superiority of such specific vaccine over the commercial multivalent footrot vaccines. Animals vaccinated with the specific vaccine in April, just before the migration commenced, were generally protected during the whole period (approximately 6 months) of migration. The specific vaccination was combined with treatment of affected animals in dry winter months and culling of non responders before the flocks left the villages for alpine pastures. The virulent footrot has not been observed, both on clinical and bacteriological examination, for the last 3 years i.e. since the 2nd year of the vaccination programme. Further work is ongoing to determine whether the

disappearance of the virulent disease from these flocks is due to eventual elimination of virulent strains of serogroup B and E against which the vaccine was directed.

Foot rot in goats and its transmission to sheep

Ghimire SC, JR Egerton and OP Dhungyel (1998). Footrot in goats, and its transmission to sheep. *Article N. 98/3*, Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

Virulent footrot naturally affects both sheep and goats. However, due to lack of evidence on natural transmission of footrot between sheep and goats, it was not known whether the strains of *Dichelobacter nodosus* are hosted specific. This study was therefore designed to determine infectivity of ovine and caprine strains of *Dichelobacter nodosus* for both sheep and goats. Sheep and goats were challenged experimentally with the 2 strains and subsequently transmission experiments were conducted on pasture. Both sheep and goats strain successfully infected both small ruminants under experimental conditions. Animals so infected transmitted footrot to other sheep and goats grazed together in pasture plots. A significantly smaller proportion of goats ($P<0.05$) were infected compared with sheep when challenged with either strain. Goats were slower to develop footrot when exposed to donor animals on pasture, and lesions in goats were less invasive than sheep. We suggest that inter digital skin of goats having a thicker stratum corneum, is less likely to be predisposed to infection by conditions which are sufficient to predispose sheep. The study provided the 1st direct evidence on transmission of footrot between sheep and goats in nature and reinforced the need to include goats in sheep footrot eradication programmes.

Footrot transmission in migratory flocks of western Nepal during descending migration through forest

Ghimire SC (1998). Footrot transmission in migratory flocks of western Nepal during descending migration through forest. *Bulletin of Veterinary Science and Animal Husbandry*, **25**:38-45

Two migratory flocks (GP2 and GG2) of Ghanpokhara village of Lamjung district where footrot was endemic were observed for footrot lesions during various stages of migration in the year 1993. These flocks left the village in April ,free of infection. When inspected at alpine pastures in August, none of the sheep were affected with footrot whilst the infection in goats was 5.4 and 10.4% in GP2 and GG2, respectively. In November both sheep and goats of 2 flocks were affected with footrot. The prevalence of the disease was 14.7 and 16.5% respectively in sheep and goats of GP2 and 9.7 and 5.1%, respectively in sheep and goats of GG2. These observations period the direct evidence on transmission of footrot during descending migration through forest (October-November). Previous studies (Ghimire and Egerton, 1996) have identified that the period of ascending migration through the forest (May-June) also to be favorable for footrot transmission. Therefore, both the periods of ascending and descending migration to and from the alpine pastures are the risk periods for footrot transmission in these flocks. Any effective preventive measures implemented to control footrot in migratory sheep and goats of Nepal should protect them for whole period of 6 months (May-November) spent on migration.

Normal biochemical values of indigenous sheep in the eastern hills of Nepal

Subba DB, SN Mahato and RP Thakur (1994). Normal biochemical values of indigenous sheep in the eastern hills of Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **9**(2) and **10**(1)**:**27-28

Normal biochemical values have been established in apparently indigenous sheep (Kage) in the eastern hills of Nepal between the elevations of 1100 to 1900 m asl. The normal values (at

mean 0±2 SD) observed in this study were in the range of 0.97-3.27 mmol inorganic phosphorous, 15.2-27.6 g albumin, 47.3-76.7 g total protein, 25.1-56 g globulin, 123-146 mmol Na, 3.76-7.86 mmol K, 1.18- 10.89 mmol Ca, 0.52-1.32 mmol Mg, 5.98-20.63 µmol Cu and 49-172 µmol Fe per liter of serum. There was no significant effect of age on the biochemical parameters in either sex groups.

A retrospective study of goat diseases in the eastern hills of Nepal

Thakuri KC, SN Mahato, RP Thakur and RK Grill (1994). A retrospective study of goat diseases in the eastern hills of Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **9**(2) and **10**(1)**:**1-6,

Records of 41994 clinical cases of goats (7769) at Pakhribas Agricultural Centre (PAC) and (34175) in the district Veterinary hospitals) attended at PAC and the Veterinary hospitals of seven hill districts of eastern Nepal over a period of eight years were analyzed. The major clinical conditions diagnosed both at PAC and in the districts were parasitic diseases (74.9% at PAC and 72.7% in the districts) and febrile conditions of unknown origins (12% at PAC and 10.6% in the districts). Digestive disorders and general debility in the districts and major infectious diseases diagnosed at PAC were also of significance. It was concluded that the most pressing constraints for improving goat health and productivity are parasitic diseases (Helminth parasites) and febrile conditions of unknown origins (respiratory diseases). Future goat healths programmes need to tackle the major goat health constraints are discussed.

Report on some causes of death in goats

Jha VC, KC Thakuri, JN Yadav and LB Rai (1993). Report on some causes of death in goats. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **8**(1)**:**11-13

The postmortem records from 1985-1991 maintained at PAC Veterinary clinic were analyzed to identify the causes of death in goats. Of 266 goats, the major causes of death recorded were Pneumonia (31.6%), Enteritis (14.7%) and Coccidiosis (10.5%). Maximum cases of goats presented for PM was between July to January (75.6%). Among all the age group, the highest percentage of death (41.4) was recorded in young kids (0-3 month) with 63.1% of death due to pneumonia.

Preliminary observation of effectiveness of Sodium Thiosulphate against Aconite poisoning in migratory sheep and goats

Shrestha HK (1996). Preliminary observation of effectiveness of Sodium Thiosulphate against Aconite poisoning in migratory sheep and goats. *Proceedings of the 5th National Veterinary Conference,* 11-13 Sep, pp75-81

A field study on Aconite poisoning in migratory sheep and goats and the effectiveness of Sodium Thiosulphate in its treatment was carried out in the alpine pastures of Kaski district during Aug 1994. Cases of natural poisoning in 16 flocks of Kaski and west Lamjung inspected during footrot campaign were recorded. The poisoned animals were randomly allocated to 4 different treatment groups. The poisoning cases were found to be 3.22 and 2.17% in sheep and goats respectively and the difference was significant ($P<0.05$). Age and sex had significant influence on poisoning ($P<0.05$). Young sheep and goats (<1 year of age) were poisoned more often than the young adults (1-2 years of age) and the adults (>2 years of age). Similarly, male sheep and goats were poisoned more often than the female. The percentage of natural recovery without any treatment was found to be 41% in sheep and 58% in goats. In sheep, 30 ml of 5% Sodium Thiosulphate (L/V) and 10g of Sodium Thiosulphate oral gave 100% recovery

(P<0.001), but in goats both 10 and 5 mg of Sodium Thiosulphate oral gave lower response (87 and 67% respectively). On logistic regression analysis, the recovery rate was found to have been influenced by treatments (P=0.005), but not by species, age or sex of the animal. Further study on experimentally poisoned sheep and goats with lethal doses of Aconite is recommended to verify these treatment responses.

Efficacy of Sodium Thiosulphate against Aconite poisoning in migratory sheep and goats.

Shrestha HK and SC Ghimire (1996). Efficacy of Sodium Thiosulphate against Aconite poisoning in migratory sheep and goats. *Working Paper N. 96/8*, Lumle Agricultural Research Centre (LARC), Kaski, Nepal

A field survey on Aconite poisoning in migratory sheep and goats and the efficacy of Sodium Thiosulphate as an antidote against the poisoning was carried out in alpine pastures of Kaski district in1994. Poisoning cases in migratory sheep and goats were 3.22 and 2.17% of the total population of sheep and goats in the flocks. The difference in poisoning cases between the 2 species was found significant (P<0.05) which may be due to the difference in susceptibility to the poisoning and selective feeding habits. Age and sex were also found to have influenced the poisoning significantly (P<0.05). Young sheep and goats (, 1year of age) were poisoned more often than the young adults (1-2 years of age) and adults. This may be due to the fact that the young animals are exposed to the poisonous plants for 1st time in their life and have less resistance to the poisonous effect and, also required small amount of Aconite plants for toxic effect. The percentage of recovery without any treatment (natural recovery) was found to be 41% in sheep and 58% in goats, whereas, with any treatment the recovery rates were 79 and 74%, respectively. In sheep, 30 ml of 5% Sodium Thiosulphate intravenous (i/v) and 10 g of Sodium Thiosulphate oral gave 100% recovery (P<0.001; exact test), but in goats both 5 and 10 g of Sodium Thiosulphate gave poor response (67 and 87%) (P<0.05). On logistic regression analysis, the overall recovery rate was found to have influenced only by treatments (P=0.005), but not by species, age or sex. The effectiveness of the treatment was found in the order of 30 ml of 5% Sodium Thiosulphate solution i/v, 10 g of Sodium Thiosulphate oral and 5 g of Sodium Thiosulphate oral.

An observation of goat health at Agriculture Research Station (ARS) Bandipur

Khakural GP and GD Neopane (1997). An observation of goat health at ARS Bandipur. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 24-25 Sep, 1997, pp 93-95

Health records on goats maintained at ARS Bandipur during 2047/48 to 2053/54 were compiled to assess the major diseases responsible for high mortality in kids. Treatment records for both kids and adults were used. Data were pulled for both sexes. Major causes of goats' diseases on station were due to round worm, pneumonia, enteritis and metritis (33.79, 23.96, 15.23 and 7.66%). The relationship of birth weight to the kids' survival prevailed the positive relationship. Birth weight 1-1.5 kg had highest kid mortality (52.36%) and lowest mortality to the 2.5 kg birth weight (2.14%). The preliminary study emphasized to control the parasite to get the economic return from goat.

Assessment of the deleterious effects of feeding cardamom leaves to sheep

Mahato SN, KC Thakuri and JN Yadav (1989). Assessment of the deleterious effects of feeding cardamom leaves to sheep**.** *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **3**:1-3

A feeding trial to assess the deleterious effects of cardamom leaves on sheep was conducted. The leaves were found to be highly unpalatable to sheep, with the average dry matter intake

being 2.22 g/kg body weight/day. Intake of this level for a week produced no adverse clinical signs in the sheep.

Collection and identification of poisonous plants in mid western region of Nepal

Aryal SR and UM Singh (1999). Collection and identification of poisonous plants in mid western region of Nepal. *Veterinary Review,* Animal Health Research Division, Tripureswor, Kathmandu, Nepal, **14:** 26-28

A questionnaire survey was conducted to collect and identify poisonous plants in 8 districts of mid western region of Nepal. Twenty poisonous plants were collected and identified. Among them Angeri (*Lyonia ovalifolia*), Ankhe (*Calotropiss gigentiea*), Pyauli (*Reinwarddtia indica*) were the most commonly poisonous plants. Most of these plants were poisonous at the early stage of plants. Sheep and goats were mostly affected. According to the farmers most of the poisonous plants killed the animals within the 12 hrs of ingestion.

Study on incidence of respiratory disease in goats and its causes in relation to management condition

Jha VC (1999). Study on incidence of respiratory disease in goats and its causes in relation to management condition. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, pp 133-137

A survey was conducted in 3 selected study sites and ARS, Goat, Bandipur in Tanahun district for the study of respiratory disease in goats and its causes in relation to management systems. The data on disease problems in goats, system of goat keeping and management conditions etc were recorded as a preliminary study. The treatment case recorded of the DLSO of Tanahun and ARS (Goat), Bandipur were analyzed for identifying the disease problems in goats. On the bacteriological examination of the nasopharyngeal swabs and lungs sample, the bacteria isolated were *Escherichia coli, Streptocoocus spp, Staphyloccocus spp, Proteus spp, Pasteurella haemolytica* and *Mycoplasma spp*. The existing goat rearing practices in the villages of Tanahun district might contribute to respiratory diseases

Study on morbidity and mortality due to PPR of goats at Agriculture Research Station (Goat), Bandipur

Khakural GP and CR Upreti (1999). Study on morbidity and mortality due to PPR of goats at ARS (Goat), Bandipur. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, pp 148-152

A total of 264 goats at ARS (Goat), Bandipur, Tanahun, Nepal were involved in the study. PPR was fatal to the goats in the station. The morbidity and mortality rate was 38.3 and 27.3% of total population. A total of 101 goats were suffered out of which 72 died. In totality kids died more (58.3%) than hogget's (12.5%) and adults (29.2%). Number of death was not enough to compare within the breeds. In goat Khapari (50% Jamunapari x 50% Khari) was more sensitive as compared to the Khari and Sinhal. The mortality percentage reduced to 28.7% (29 heads). During the course of treatment using Meriquine, Ambiplex, Vimeral, Penicillin bolus or Kaolin 20% solution orally and through anus. Aminophyline, Electrocare intravesous drips helped to reduce the effects of virus. Separation of sick animals and good sanitation using insecticide and time was effective to control the disease.

An investigation on pox like outbreak in goats in Kailali district of Nepal

Nirmal BK (2000). An investigation on pox like outbreak in goats in Kailali district of Nepal. *Veterinary Review*, Animal Health Research Division, Tripureswor, Kathmandu, Nepal, **15:**43-45

Sheep and goat pox is one of the notifiable diseases in Nepal. The outbreak of goat pox occurred in Rajeepur of Kailali district during May 2000. The study on epidemiology and clinical features was carried through several visits to the outbreak sites with intervals. This disease was observed first time in far western region of Nepal. This disease was reported in local goats after some Ajmeri breed of goats were imported from Rajasthan, India. Clinical features of goat pox were quite evident, though mortality was very low (2-3%) but it caused abortion in pregnant goats. Secondary bacterial infection and maggot infestation caused heavy production loss in goats. Pneumonia was quite common in affected animals. Lab examination revealed almost all animals were having parasitic infestation and increased Leucocyte counts. Secondary bacterial infection was treated with antibiotics like Oxytetracyclin, Fortified Penicillin and Gentamycin in and topical dressing of wounds as well as with corticosteroids and analgesics, the disease spread through neighboring villages but with mild severity.

Preliminary study on diseases, with special reference to respiratory problems in goats in Tanahun district of Nepal

Jha VC (2001). Preliminary study on diseases, with special reference to respiratory problems in goats in Tanahun district of Nepal. *Proceedings of the 1st SAS/N Convention,* Kathmandu, March 29-31, 1999, pp 254-257

A questionnaire survey was conducted in the 3 selected study sites and ARS, Bandipur for the preliminary study on diseases, with special reference to respiratory problems in goats of Tanahun district. Data on the purposes of goat keeping, problems of goat keeping, disease problems in goats, system of goat keeping etc were recorded. The treatment case records of the DLSO of Tanahun and ARS, Bandipur were analyzed for identifying the disease problems in goats. Among the various disease problems in goats, internal parasitic and respiratory diseases were accounted to be the first two major diseases of goats. The bacteriological examination of the nasopharyngeal swabs and lungs sample from goats detected were: *Esherichia coli, Streptococcus spp, Proteus spp, Pasterurella, haemolytica spp* and *Mycoplsma spp.*

Surveillance of goat disease in the western hills of Nepal

Khakural GP (2003). Surveillance of goat disease in the western hills of Nepal. *Nepal Journal of Science and Technology*, Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, Nepal, **5**:37-40

A survey was conducted to compile disease records maintained at DLSOs of Syangja, Tanahun, Regional veterinary Diagnostic laboratory in Pokhara and ARS, Bandipur. Records maintained for 3 years (1996-99) were compiled in collaboration with veterinary officers working in the districts and laboratory. Among 6094 diseases record, parasitic diseases (48.29-63.75%) were found to be the major constraint in goat production. High occurrence of internal parasites (77.37-89.74%) was recorded once during autumn and gain during spring. Although, infection of ectoparasites (10.26-22.63%) was recorded throughout the year, the infestation was found to be high once during Aug and September and again during April and May. Therefore, control measures against these parasites should at least be taken twice a year 1st in the beginning of autumn and nest in the beginning of spring seasons. Minor surgical condition (3.16-13.39) was in 2nd place followed by febrile condition of unknown origin (10.2-12.19%) was in 3rd place. Diseases related to digestive disorder were mainly due to the over feeding (i.e. succulent

leguminous feed stuffs and concentrate feed), helminthes, coccidian parasites, and use of unclean water and diarrhea appeared mainly during March-April (11.17% case) and July-August (9-15%). Tympany occurred throughout the year almost in the same trend. Fern and fern- like feed stuffs caused red water disease (urological disease) in all sites. In both the sites retention of placenta was recorded to be one of the problems which might be due to improper feeding particularly of selenium and vitamin E deficient diet during pregnancy. PPR and rabies were main infectious disease (12.5-70.13%). Further studies have been suggested in order to formulate an effective control strategy against internal parasites conducting a detail epidemiology of specific parasites. Nevertheless, very little work has been done on ectoparasites of goats in Nepal; hence a further study needs to investigate effective control measures against them. A study is needed to improve the housing and management of goat to minimize the general wound and eye infections. Further study on the etiology of respiratory diseases in goats has been suggested to study.

Study on efficacy of different combination of drugs to reduce kid mortality

Khakural GP and D Adhikari (2008). Study on efficacy of different combination of drugs to reduce kid mortality. *The 5th National Conference on Science and Technology,* Nepal Academy of Science and Technology (NAST), 10-12 Nov, 2008, Kathmandu, Nepal

Maximum mortality of kids was recorded in Barbari (32%) and Khari (30.64%), followed by Kiko (27.27%), Sinhal (25%), Kija (25%) and Jamunapari (23.25%) goats, respectively. Cause of death was attributed to lack of milk, pneumonia, and internal parasites including coocidial infection. A total of 47 fecal samples were examined for presence of parasitic eggs and coocidial occysts. Coocidia were positive in 12 (25.5%) samples while Strongyle spp was found in 3 samples only (6.35%), Histopathological examination of lungs samples revealed that initial stage of pneumonia in 3 samples while one showed severe stage of pneumonia. Organisms isolated from18 tissues samples (lung and liver) from dead kids were *Diplococcus sp, Staphylococcus sp, E coli* and *Enterobacter.* Enrofloxacin, Norfloxacin and Gentamycin were found resistant to these organisms. Maximum number of samples was found positive for coocidia and Amprolium was found effective for kids. Three care bulus was found effective to control diarrhoea in kinds. Cotrimoxazole was found effective to control high fever cases with pneumonia.

Clinical laboratory investigation of moldy maize and fodder poisoning in goat in Kathmandu valley an investigation report

Karki K, P Manandhar, S Manandhar and P Koirala (2010). Clinical laboratory investigation of mouldy maize and fodder poisoning in goat in Kathmandu valley an investigation report. *Proceedings of the 9th National Conference of Nepal Veterinary Association,* Veterinary Complex, Tripureswor, Kathmandu, Nepal*,* 22-24 April, 2010, pp151-153

An outbreak of a syndrome of unknown etiology associated with the feeding of mouldy maize grain and green fodder occurred to the male goats in a flock of 2000 brought for Dashahara festival during October 2008 in Kathmandu valley. A total of 52 goats suddenly became ill with symptoms of anorexia, apathy, diarrhoea and ruminal stasis. On clinical examination tentative diagnosis was made as mouldy corn poisoning. Clinical pathological findings included mild focal erosions to severe; diffuse coagulative necrosis of the mucosa in the rumen, reticulum, omasum and congestion with hemorrhages in the abomasums. Liver had shrunken appearance, pale to yellowish discoloration with distended gall bladder, petechial hemorahage in the kidneys, small intestine and with excessive mucus. Laboratory examination of tissue samples of maize fodder revealed *Penicillium spp* and *E. coli.*

Status of caprine paratuberculosis at organised and unorganised farms of Nepal

Singh UM, BNTripathi and OP Paliwal (2007) Status of caprine paratuberculosis at organised and unorganised farms of Nepal Indian Journal of Animal Sciences, **77(**9):852-854

A prevalence study on caprine paratuberculosis was carried on clinical samples collected from organised and unorganised goat farms of Nepal. Three organised farms(Fartm I,II and III) were screened. The over all incidence of the disease at organised farms (goats maintained in small groups by farmers in vilages) were9.4% (29), 1.6 5(5), 14.2% (44) and 8.1% (25) by the faecal examination, faecal culture, ELISA and AGID tests. In organised farms, 6.9% (19) goats were positive for acid fast bacilli in the faecal smears and none in the faecal culture and faecal PCR. 6.66% (17) goats were positve in the ELISA and only1 (0.39%) goat was positive in the AGID. The study confirms the presence of paratuberculosis in goats of Nepal

Effect of feeding sericea lespedeza leaf meal in goats experimentally infected with *Haemonchus contortus*

Joshi BR, DS Kommuru, TH Terrill, JA Mosjidis, JM Burke, KP Shakya, JE Miller (2011). Effect of feeding sericea lespedeza leaf meal in goats experimentally infected with *Haemonchus contortus. Veterinary Parasitology*, **178**: 192–197

Effect of sericea lespedeza[SL; *Lespedeza cuneata* (Dum-Cours.) G.Don.) leaf meal feeding was evaluated in two experiments in indoor reared goats with experimental infection of *Haemonchus contortus* larvae. In the first experiment, ten 8–10 month old male Spanish and Alpine cross kids pair matched for body weight and age were fed SL or Bermuda grass[BG; *Cynodon dactylon* (L.) Pers.] hay one week before infection and were infected with 5000 *H. contortus* L3. The animals were maintained on the same diet for the remaining period and were slaughtered 28days post-infection (DPI) to determine the establishment of incoming infective larvae. Goats fed SL had lower establishment ($P < 0.05$) of *H. contortus* larvae than that of the control goats fed BG hay. In the second experiment, twenty-five 8–10 months old male Alpine cross, Saanen, Nubian×Saanen and Spanish kids reared in confinement on BG were experimentally infectedwith5000 *H. contortus* L3. On 35DPI, the animals were allocated to two groups after blocking by fecal egg count (FEC), and one group was fed SL leaf meal ($n = 13$), and another control group remained on BG ($n = 12$). Four goats/group were slaughtered successively on days 7,14, and 28 days post SL feeding, except on day 7,when five SL fed goats were slaughtered. Fecal egg counts and blood packed cell volume (PCV) were measured at weekly intervals and worm count, female worm fecundity, worm length and mucosal eosinophils, mast cells and globule leucocytes were measured after slaughter. Goats fed SL had a lower FEC ($P < 0.05$) one week after feeding, as compared to those fed on BG, and the values remained at low level thereafter. Similarly, PCV was also significantly affected by feeding ($P < 0.01$),and feeding and time interaction($P < 0.05$). However, worm burden, female worm fecundity, parasite length, and mucosal inflammatory cell count were similar between the groups. Feeding SL reduced the establishment of infective larvae and FEC of *H. contortus* in experimental studies and this plant could be used for biological control of parasite infection under field conditions to limit the harmful effects of the parasites in goats.

2.2 NUTRITION

The response of migratory sheep and goats to strategic mineral supplementation

Owen OD (1987). The response of migratory sheep and goats to strategic mineral supplementation. *Technical Paper N. 87/10*, Lumle Agricultural Centre (LAC), Lumle, Kaski, Nepal

Mineralized salt licks were fed to a flock of migratory sheep and goats over the period of greatest nutritional stress from February to April. This seems to have resulted in earlier lambing/kidding, with 81% of lambs and 83% of kids being born before the end of Poush, compared with only 60% and 73%, respectively a year earlier. The difference was significant ($P<0.05$) for lambs, but due to the inability to maintain a control it is not possible to exclude environmental or other factors as a cause of the variation, and the result can be used as an indication only. The cost of feeding mineralized salt licks over this strategic period is examined.

Effect of strategic anthelmintic drenching, mineral supplementation and concentrate feeding on the performance of Nepalese hill goats (Khari)

Kadariya RK and Joshi BR (1994). Effect of strategic anthelmintic drenching, mineral supplementation and concentrate feeding on the performance of Nepalese hill goats (Khari) . *Working Paper 94/14,* Lumle Agricultural Research Centre (LARC), Kaski, Nepal

A study was carried out to assess the effects of strategic anthelmintic drenching, mineral and concentrate supplementation on the production potential of the hill Khari goat in four villages (900-1450 m asl) from August, 1991 to January, 1993. Forty young (3-4 months) female hogget's of similar body weight, sex and health condition were reared under the sedentary management system. The mean/day weight gain was found to be 25.8 ± 1.41 g in the control group (A), 29.7± .75 g in the anthelmintic group (B), 37.5±1.38 g in the anthelmintic plus mineral supplementation group (C) and 43.5±0.95 g in the anthelmintic plus mineral plus concentrate group (D). The difference was highly significant ($P<0.001$) between the treatment. The average birth weight of the kid was not significantly different ($P>0.05$) between group and sexes. Differences in the age of puberty between groups (200-276 days) were not significant ($P>0.05$). A significantly different ($P>0.05$) age of first kidding [426±4 (A), 350±7 (B), 330±1 (C) and 386±1 (D)], kidding conception interval [129±4 (A), 103±8 (B), 102±6 (C), and 90±7 (D), and kidding interval (281±4 (A),259±8 (B), 257±7 (C), and 244±7 (D)] in days were recorded. A significantly lower ($P<0.05$) kidding percentage were recorded in the A group (50%) compared to the group B (88%), the C group (87%) and the D group (100%) but not between any other groups. Twinning percentage was not significantly affected by treatments. The most prevalent helminth species found at the site was *Haemonchus spp* followed by *Ostertagia spp*. The gastrointestinal nematode burden was significantly lower from September to February ($P<0.000$) in anthelmintic treated groups as compared to control group. Strategic drenching with anthelmintic, mineral supplementation and concentrate feeding were found cost effective in improving the goat productivity of Khari goats.

Effect of mineral supplementation on the performance of crossbred lambs

Upreti CR and PS Mahato (1995). Effect of mineral supplementation on the performance of crossbred lambs. *Nepalese Journal of Animal Science (NASA),* **9**(9)**:**10-16

Sixteen 9 months old crossbred ram (PxB,MxB) of mean live weight of 21.81±2.5 kg were selected and divided into 4 groups (4 animals in each group) on the basis of live weight and age. Animals were allocated at random to each treatment. The different treatments were: Treatment A; 60 g common salt at 15 days interval, Treatment B: 30 g salt = Red soil mixed block,

Treatment C: major mineral 20g per animal, Treatment D: Major mineral 19.4 g + trace mineral 0.6 g per animal per day. Two hundred gram of barley, and hay adlib was offered to all treatments. Trial duration was of 150 days during the winter months. The average live weight gain was not significantly different (P>0.05) between the treatments. Also the different minerals offered did not affect the mean wool growth. The average daily growth rate was higher in treatment D although the differences were not significant. The reason of the low growth rate in treatment B and high in A was not known. The expected growth rate in treatment C and B was very low and it may be due to the unknown nutritional status of feedstuff used, as the diet as there is an interaction between the minerals in varying level. For the future research of this kind need to analyze the soil and plant herbage for the level of mineral concentrations.

Effect of mineral mixture on the performance of castrated male goats under controlled condition

Pandey SB and AP Sainju (1996). Effect of mineral mixture on the performance of castrated male goats under controlled condition. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal,* May 7-9, 1996*,* Khumaltar, Lalitpur, May 7-9, 1996, pp 37

An experiment at the Agricultural Research Station (Goat), Bandipur was conducted to study the effects of mineral mixture on the performance of the castrated male goats under controlled conditions. Fourteen castrated male goats of about 4-5 months old with initial average live weight of 19.1±0.76kg were blocked by weight into two treatment groups which was replicated 7 times. The treatment given to the animals were: A- fodder tree (Khanayo and Kutmiro mixed) leaves (3kg), concentrate mixture (0.1kg) and Iodised salt (0.01kg); B- fodder tree (Khanayo and Kutmiro mixed) leaves (3kg), concentrate mixture (0.1kg), Mineral mixture (0.01kg). Mineral mixture contained Nacl (35%), $CaCO_3$ (10%), $Ca_3 (PO4)_2$ (32.2%), KCl (14.3%), $MgCO_3$ (8%) and trace minerals (0.5%). Trace minerals contained Fe_2O_3 (32%), $CuCl_2 2H_2O$ (16%), $MnCl_2 4H_2O$ (0.8%) and KI (0.2%). The ratio of fodder tree and concentrate mixture was 8.7:1. There were no significant differences in daily dry matter intakes (836±15.2 vs 849±11.1g) or daily dry matter intakes per kg live weight (45±2.6 vs 45±1.0g) or apparent dry matter digestibility (62±1.6vs 63±0.9%) between the experimental diets. However, there was the significant difference (p<0.05) on the daily live weight gains (40±5.2 vs. 47±2.9g) of the animals between the treatments.

Effect of anthelmintic treatment and feeding regimes on goat

Shrestha NP, SP Neopane and HB Gurung (1990). Effect of anthelmintic treatment and feeding regimes on goat. *Technical Paper N. 90/127*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

Sixteen local goats aged approximately 6 months were divided into 4 equal groups (A, B, C and D) on the basis of body weight. They were stall fed with local grasses ad libitum and supplemented with maize grain @ of 10 g/body weight for groups C and D. group A and C were drenched against parasites whereas group B and D were not drenched. The highest mean growth arte of 66 g/day followed by 48 g/day was achieved by group C and A respectively. Analysis of variance showed that there were significant effects on growth rate due to anthelmintic treatment (P<0.01) and due to feeding regimes (P<0.05). Financial analysis showed that treatments A and C (i.e. those with parasite control) gave the highest net benefits. The highest marginal rate of return, observed for treatment A (parasite control and 10 g/kg maize), was 215%.

Effect of protein supplementation (mustard cake) and anthelmintic drenching on the growth and carcass yield in fattening goats

Gurung HB, NP Shrestha and SP Neopane (1994). Effect of protein supplementation (mustard cake) and anthelmintic drenching on the growth and carcass yield in fattening goats. *Technical Paper N. 94/157,* Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

Twenty castrated bucks six months of age with an average weight of 10.5 kg were divided into four equal groups (group A, B, C and D) on the basis of their body weight. The experimental animals in group A and C were given maize grain at the rate of 10g/kg body weight while 8g/kg body weight was given to groups B and D, Group B and D were supplemented with mustard cake (2 g/kg body weight) as a protein supplement whereas group A and C were kept as control. According to seasonal availability, other grasses were fed ad lib. Group A and B were drenched against internal parasites but group C and D were not drenched. Dry matter intake in term of metabolic body weight for groups A, B, C and D was 93.3, 91.0, 101.7 and 99.75g/kg, respectively. There was no significant difference ($P>0.5$) in dry matter intake between the groups. Concentrate to forage ratio (in percentage) was found to be 23:77 for group A and B and 20:80 in groups C and D respectively. Growth rate of animals under treatments A, B, C and D was 39, 37, 19.1 and 28.7 g/day, respectively. There was a significant difference (($P<0.01$) in the growth of goats between the groups. Supplementation of mustard cake as a protein supplement did not significantly effect ($P>0.05$) the growth of goats in the drenched group. In the non drenched group, the supplementation of mustard cake showed a significantly ($P<0.05$) higher effect on the growth of goats where it gave a 50.3% higher daily gain as compared to the non supplemented group. There was a significant effect of the anthelmentic treatment on the growth of goats ($P<0.01$), where it gave an average 58.9% higher daily growth over the non drenched group. There was no significant difference in the dressing percentage ($P>0.05$) and internal fat content ($P>0.05$) between groups. The financial analysis showed that group A had the highest financial return. Group C without anthelmentic and protein supplementation, gave the lowest return in terms of expenditure over the experimental period.

Effect of flushing in goat under forest based semi-scavenging system

Sharma M, M Kharel, MR Kolachhpati, DB Nepali and NR Devkota (1995). Effect of flushing in goat under forest based semi scavenging system. *Journal of Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan, Research Reports* (1993-94), pp 129-134

A field study was conducted to see the effect of flushing in goats under forest based semi scavenging system during 1994 in Gaurigung and Salyani villages of Chitawan. Using PRA, ten goat raisers were selected which were classified into flushing and non flushing groups. Feed concentrate along with mineral supplements were provided to the farmers @ 250g/day/doe and feeding was started 4 weeks before kidding. Uniform does were selected for age, breed and body weight. The birth weight of kids was higher (20.02kg) from flushed does as compared to non flushed does (1.53kg). Flushing of does exerted significant ($P<0.05$) influence on body weight of kids from birth until they reached 3 months of age. Average daily gain also was higher in kids borne by flushed does. About 1/3 (28.25) of the does came in heat in the month of January and more kidding (22.2%) was observed in the month of June.

Goat nutrition and management for meat production

Kolachhapati MR (2005). Goat nutrition and management for meat production. *Green Field Journal of Himalayan College of Agricultural Sciences and Technology (HICAST),* Gathaghar, Bhakktapur, Nepal, **5**(1):82-94

This paper addresses the problems of inadequate understanding of feeding and management practices of the farmers that lower productivity of the species. Lack of supplementing balanced nutrition (protein, minerals and energy requirement) will severely affects the growth and reproduction of goats although they could have a good potentiality. Balancing feeding of the locally available feed resources in terms of nutritional requirements can make a significant improvement and increment in the productivity of both male and female kids. It also improves the reproductive efficiency of female kids in terms of early conception and litter size, which ultimately increases their lifetime productivity.

Effect of concentrate feed supplementation on the growth performance of goats fed tree foliage as basal diet in the hills of Nepal

Panday SB, AD Degen, M Kam and CR Upreti (2007). Effect of concentrate feed supplementation on the growth performance of goats fed tree foliage as basal diet in the hills of Nepal. *Proceedings of the 8th National Outreach Research Workshop,* Khumaltar, Lalitpur, *19*-20 June, 2007, pp 374-377

The aim of this study was to investigate the effect of concentrate feed as supplementation on the growth performance of growing goats, which were fed fodder tree foliage as basal diet in the hills of Nepal. Stylo was included on the study. 12 castrated male goats of age 6-8 months were taken and grouped into 3 groups comprising 4 goats in each dietary treatment. Animal of 1st diet groups (D1) were fed with maize flour (150-200 gm) + fodder tree foliage ad lib, 2nd diet group (D2) with compound concentrate feed (150-200 gm) + fodder tree foliage ad lib and 3rd diet group (D3) with compound concentrate feed (150-200 gm) + fodder tree foliage + Stylo (200gm). These rations were fed to animals of individual diet group for 150 days. Daily feed offered, feed refused and intake, body weight change was recorded. Body weight was taken at the beginning, at the end of every 15 days interval. The average daily feed intake was higher in D3 (794±18 DM g/day) compared to D2 (685±53) and D3 (737±45). Average feed intake for (DM was 2.7% of body weight). There was significant difference ($P<0.05$) among dietary groups for total weight gain with respect to average daily gain (ADG). The highest ADG was observed in D3 (70 gm/day) followed by D1 (56.g/day) and D2 (50 g/day). The ADG in this experiment is higher compared to average herd of goats in Nepal which is normally 50g/day. The results revealed that diet 3 comprising fodder tree foliage + concentrate + Stylo have better response on the growth performance of growing goats. Therefore, supplementation of 150 g with Stylo@ 200 fresh matter in tree foliage feeding as basal diet is suitable to get more meat production under stall feed management system in the hills of Nepal

Effect of rice bran and Leucaena supplement on the growth performance of goats fed with urea treated rice straw (UTRS)

Upreti CR and Edgar A Orden (2008). Effect of rice bran and Leucaena supplement on the growth performance of goats fed with urea treated rice straw. *Journal of Nepal Academy of Science and Technology (NAST), Kathmandu, Nepal*, **9:**29-36

An experiment was conducted for 90 days to determine the effect of energy level using different level rice bran on the UTRS as a basal diet supplemented with fixed level of Leucaena on growing goats. Experimental diets included 4 levels of rice bran: 0, 10, 20 and 30% rice bran in basal diets. A total of 20 growing female goats of 5-6 months age were randomly allocated

into 4 different dietary groups. Findings showed that inclusion of 20% rice bran significantly (P<0.05) improved in total DMI than the other levels. A 30% rice bran inclusion was not able to improve further the total DMI, which might be due to the negative effect of higher level of anti nutritional factor in rice bran. In situ degradation of D3 and D4 recorded the higher estimated solid outflow rate indicating on the improvement on digestion of feedstuffs. The 20 and 30% rice bran inclusion resulted significantly (P<0.05) higher OM digestibility of UTRS based diet with Leucaena supplementation. ADG (41.1 g), FCE (10.96) and benefit over feed cost Pilipino Peso (238.2) was significantly higher in diet groups with 20% rice bran inclusion. Based on the results it can be concluded that supplementation of rice bran at 20% level is economic net income (US$ 2.040/goat) in feeding goats with UTRS based diet and supplemented with 20% of Leucaena.

Effect of feeding Banmara (*Eupatorium adenophorum*) on fattening goats

Arial IK, NP Shrestha, SP Neopane, HB Gurung and AR Gurung (1994). Effect of feeding Banmara *(Eupatorium adenophorum)* on fattening goats. *Technical Paper N. 94/158*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

Twelve castrated goats with an average age six months were divided into two equal groups based on their age and weight. These two groups were fed with two types of rations. Zero percent Banmara (100% other local fodder) – Control, 100 percent Banmara. Green fodder was provided adlib and all goats were supplemented with concentrate ration at one percent of their live weight. The goats were kept in the feeding trail for a period of one year and then slaughtered for carcass evaluation. The average dry matter (DM) intake of goats receiving 100 percent Banmara (460±108g/day) was significantly lower (P<0.01) than the 0 percent Banmara group (620±160g/d). Similarly, the live weight gain was also significantly lower (P<0.01) in the 100 percent Banmara group (28.3±5.9 g/d) than in 0 percent Banmara group (41.3± .1 g/d). However, the growth rate of 28.3±5.9 g/d in the 100 percent Banmara group is comparable with other reported results. No adverse effects on Haematological or biochemical values were found in the group, which was fed Banmara. Meat production was found significantly lower (P <0.05) in the Banmara fed group. However, no significant difference was found in the dressing percentage in terms of the live weights between the two groups (P >0.05). NO significant difference (P<0.05) was found in the composition of lean meat between the two groups. On the other hand, goats receiving 100 percent Banmara had significantly (P <0.05) heavier livers and kidneys. In the 100 percent Banmara group although there was low DM intake, growth rate and meat production compared to the 0 percent Banmara group indicates that Banmara can be used even unto 100 percent when there are shortages of other green fodders in the diet of fattening goats.

Effect of feeding Banmara (*Eupatorium adenophorum*) on reproductive performance of goats in the eastern hills of Nepal

Gurung HB, NP Shrestha, PB Chemjong, SP Neopane and IK Aryal (1996). Effect of feeding Banmara (*Eupatorium adenophorum*) on reproductive performance of goats in the eastern hills of Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **11**(2):48-50

A study on the effect of feeding Banmara on the reproductive performance of goats were carried out between 1992 and 1995 in 4 on farm sites of the eastern hills of Nepal. Twenty four local goats, 5-6 months of age were equally divided into 3 groups based on their live weights. These three groups of goats were fed 0, 25 and 50 % Banmara in their forage diets. The amount of DM intake of the goats in the 3 different groups was not significant. However, the DM intake

of the 50% Banmara fed group was significantly lower (P<0.05) in the monsoon season as compared to the 0 and 25% Banmara groups. There was no significant effect on daily weight gain, age at 1st service or kidding interval between the 3 groups. Similarly, the birth and weaning weight of the kids born from these 3 groups of goats was non significant. The results indicated that Banmara can be fed at levels up to 50% of the forage diet without any adverse effect on the growth and reproduction of goats.

Effect of non-conventional and conventional fodder on growth performance of goats in farmers' field condition

Tiwari MR, NL Tamrakar and HR Shrestha (2006). Effect of non conventional and conventional fodder on growth performance of goats in farmers' field condition. *Nepal Journal of Science and Technology,* Nepal Academy of Science and Technology (NAST*),* Khumaltar, Lalitpur, **7:**15-17

The present experiment was carried out on farmers' goats in their sheds in Rayale village of Kavre district for 150 days. Eighteen Khari goats (both male and female), 8-12 months old and having similar body weight were randomly divided into 3 groups comprising of 6 individuals in each group. Three types of rations were formulated for the experimental goats. Feed intake by experimental goats in terms of green and dry matter was significantly different (P<0.05) between the treatment groups. Growth rate of the goats fed with top dressed maize stover (Treatment 2) was higher than the Treatment 3 (seasonal fodder adlib+200 g concentrate mixture) and Treatment 1 (1/2 maize stover silage + seasonal fodder adlib+200 g concentrate mixture). The lowest average daily gain was found in treatment 3 where goats were fed conventional fodder and grasses supplemented with concentrate (18.4 g) followed by Treatment 1 (24.6 g).

Comparison between conventional and non-conventional feedstuffs for growth performances of growing goats

Tiwari MR, NL Tamrakar and HR Shrestha (2007). Comparison between conventional and non-conventional feedstuffs for growth performances of growing goats. *Green Field Journal of Himalayan College of Agricultural Science and Technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **5**(1):61-66

An experiment was carried out at Agriculture Research Station (Goat), Bandipur, Tanahun for 150 days with the aim of to check the effect of banana leaves on growth performance of growing goats during 2002 to 2003. Eighteen goats of Khari, Khari x Jamunapari and Khari x Barberi of 8-12 months of age having similar body weight were taken as an experimental unit and randomly divided into 3 groups comprising of 6 animals in each group by using CRD. Three types of experimental diet were prepared for testing. Dry matter intake ranged from 2.71 to 2.74 percent of body weight and was not significant among diet group (P>0.05). The total body weight gain of experimental animals in 150 days of feeding period was also found non-significant (P>0.05) among the tested treatments. The average daily gain due to describe the Treatment (1 and 2) was similar (60 g/d/ animal) fed with Raikhanayo and 75% Raikhanayo+ 25% banana leaves, respectively whereas the growth rate 46g/d/animal was recorded for Treatment 3 in which 50% of Raikhanayo was replaced with banana leaves.

Growth performance of goats fed with conventional and non-conventional fodder species

Tiwari MR and HR Shrestha (2007). Growth performance of goats fed with conventional and non-conventional fodder species. *Nepal Journal of Science and Technology*, Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur,Nepal, **8:**49-52

An experiment was carried out on goats at Goat Development Farm, Buditola, Kailali district for 150 days. 18 goats (Khari breed), 8-12 months old having similar body weight were taken and randomly divided into 3 groups comprising of 6 animals in each group. Three types of diets were developed for the experimental animals. There was significant difference ($P<0.05$) in total dry matter intake per animal per day. No significant difference ($P>0.05$) was observed between non-conventional and conventional fodders for body weight gain and average daily gain (ADG).

Study on the effect of rice straw, tree leaves and concentrate feeding on goats

Upreti CR and SB Pandey (2000). Study on the effect of rice straw, tree leaves and concentrate feeding on goats. *Proceedings of the 4th National Workshop on Livestock and Fisheries Research in Nepal*, Agricultural Research Station, Pakhribas, Dhakuta, April 24-26, 2000, pp 145-150

A biological trial was conducted at Agriculture Research Station (Goat) Bandipur to investigate the possible use of the different level of rice straw in the goat diet. There was a significant effect of treatment, including of rice straw on body weight gain in castrated male goat ($P<0.05$). The Duncan Multiple Range Test (DMRT) showed the treatment 4 (including of 30% rice straw) gave significantly the lowest weight (2.5±0.94kg). However, the effect of other three diets was similar. Both the fecal (288.7±149gm/day/goat) and urine output (312.0±160 ml/day/goat) was lower in T0 treatment group compared to other level of rice straw. Feed conversion efficiency was 13.0%, 12.4%, 8.83% and 4.79 % to T0, T1, T2 and T3, respectively. Twenty % of rice straw as feed supplement to the goat diet can be safely used without affecting the feed conversion efficiency maintaining the low cost.

Possible use of crop residues supplemented with urea and molasses in goat diets

Upreti CR, BS Kuwar and SB Panday (2006). Possible use of crop residues supplemented with urea and molasses in goat diets. *Nepal Journal of Science and Technology,* Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, **7:**59-64

In this experiment, 20 castrated male Khari and half-bred (Khari x Jamunapari) goats of 6-8 months of age were divided into 4 dietary groups comprising of 5 goats in each. The experiment was conducted for 150 days during the winter season. Animals of 1st diet group (D_1) were fed with fodder leaves (Khanyu) + concentrate @ 1% body weight, 2nd diet group (D_2) consisted fodder leaves (Khanyu) + chaffed rice straw and 2% molasses to dressed rice straw % 20% of dry matter requirement + concentrate @% body weight, 3rd diet group (D_3) had fodder (Khanyu) + chaffed rice straw and 2% urea molasses top dressed rice straw @ 20% of dry matter requirement + concentrate @ 1% body weight, and diet group 4 (D_4) consisted of fodder (Khanyu) + chaffed rice straw, 4% urea treated, ensiled and 2% molasses top dressed rice straw @ 20% of dry matter requirement + concentrate @ 1% body weight were fed to the animals. A digestibility trial for 7 days was carried out at the end of experiment. Daily feed intake and urine and faeces excreted by animals were recorded. Body weight change was recorded at 15 days interval. The average daily weight gain was not significantly different ($P>0.05$) between diet groups. However, animals under D_2 obtained highest growth rate (44.9g/d) followed byD_3 (44 g/d), and D1 (34.8 g/d) and the lowest average daily gain (ADG) was obtained in D_4 (28.9 g/d). Significantly higher ($P<0.05$) coefficient of digestibility for DM, CP, ADF, hemicellulose, and cellulose was found in D_3. Nitrogen, ca and P balance were high and

positive in all diets groups. From this evidence, it can be suggested that rice straw could be used for goat feeding without affecting the growth rate provided it was pretreated either with 2% molasses or 2% urea molasses solution.

Use of rice straw and black gram straw in fodder based goat's diets in the hills of Nepal

Upreti CR, BS Kunwar and SB Panday (2007). Use of rice straw and black gram straw in fodder based goat's diets in the hills of Nepal. *Nepal Agriculture Research Journal (SAS/N)*, **8**:94-99

The aim of this study was to investigate the possible use of crop residue such as rice straw and black gram straw (Kushauro) in the hill goat's diet. Twenty male and female goats of age 6-9 months were divided into 4 dietary groups. Animal of the 1st diet group (D1) were fed with fodder leaves (Khanyu) only, 2nd diet group (D2) with 20% rice straw + fodder tree foliage leaves, 3rd diet group (D3) with 20% rice straw + fodder tree foliage + concentrate @ 1% of body weight, and 4th diet group (D4) fodder tree foliage +15% rice straw + 5% black gram straw + concentrate @ 1% of body weight meet to the daily requirement. Thee rations were fed to animals of individual diet group for 150 days. Daily feed intake and daily weight changes was recorded. Body weight was taken at the beginning of the experiment, at the end of experiment and 15 days interval. The result showed that there was significant difference ($P<0.05$) between different dietary groups for average daily gain (ADG). The highest ADG was observed in D3 (19.6±4.33), followed by D2 (12.67±1.38 g/d) and D4 (11.73±1.78g/d). The lowest ADG was found in D1 (10.8±1.87 g/d). The result indicated that 20% rice straw could be used in goat feeding with supplementary diet of concentrate @ 1% body weight and foliage of Khanyu as a basal diet. Feeding only fodder tree foliage is not suitable to get higher ADG in stall feeding management.

Effect of intervention in feeding management on meat production of hill goats

Shrestha HR and AP Sainju (1996). Effect of intervention in feeding management on meat production of hill goats, Paper published in *The 8th AAAP (Austro Asia Animal Production) Animal Science Congress Proceedings*, 2:294-295

Forty-eight local hill goats were divided into three treatment groups. Treatment A – kept in traditional production management system, grazing 6-8 hours per day and supplemented with native fodder grass 1.5 kg/ animal during the nighttime. Treatment B- Treatment A + supplemented with improved fodder grass- Desmodium in summer, berseem + Oats + vetch grass 1.5 kg in winter. Treatment C–Treatment A+B+200 gm of concentrate feed. Produced kids were weaned at the age of 4 months in all treatment groups. Half of the animals in each group i.e. 4 animals were castrated just after weaning. The live weight gain in intact group was found to be 25.5±0.35, 31.75±2.85 and 22.16±0.36. Similarly, in castrate group 20.16±0.49, 20.85± 1.17, 29.25±.59 kg were found at three different treatment groups A, B and C, respectively. There were no significant in live weight gain in intact group between A, B, and C groups. Where as in castrate groups, there was significant in live weight gains between the groups. The growth rate of intact goats at the age of 18 months was found to be higher as compared to castrate group of treatment A, B and C. The meat production from intact bucks in live weight basis was found comparatively higher than in the castrate group. However, there was no significance difference on live weight gain, meat production and dressing percentage in castrate and intact hill goats by intervention the traditional goat production system, slaughtering at 18 months of age.

Optimizing growth potential of indigenous Khari and Sinhal breeds of Nepal with health and nutrition management

Joshi BR, BS Shrestha and K Mishra (2004). Optimizing growth potential of indigenous Khari and Sinhal breeds of Nepal with health and nutrition management. *Proceedings of the 2nd SAS/N Convention*, Kathmandu, 30 July – 1 Aug, 2003, pp 370-376

Goats are an important source of household income and means of livelihood for the rural farmers of Nepal. The productivity of indigenous goat breeds under traditional management and subsistence production system is low because of poor nutrition, health care and other management practices. However, the actual potential of these animals under optimal health and nutrient management have not been evaluated so far. Hence, studies were carried out to identify the growth potential of indigenous goat breeds under optimal health and feeding management, so that the production potential of these animals could be known and technologies could be developed for increased production and higher economic returns for the farmers. These experiments were carried out at ARS, Lumle during 2000-2001 to determine the voluntary feed intake, response of supplementation at early age and post weaning feed lot production potential of Khari and Sinhal goats under different feeding regimes. All animals used in studies were vaccinated against the epidemic disease PPR and Enterotoxaemia and treated against the parasites strategically. Evaluation of voluntary intake (daily dry matter intake) of goats ranged from 3.9-5.4% of their body weight. Daily intake was higher when offered with fodder tree leaves (5.4% of body weight) as compared to ground grass (3.9%). The average daily gain (ADG) of Khari kids (between 1 to 5 months of age) supplemented with creep feed adlib was 72g which was significantly higher ($P<0.01$) than those in the non-supplemented group (33 g). The final body weight of kids at the age of 5 months supplemented group was 13.8 kg as compared to 8.8 kg in non-supplemented group. The average daily concentrate intake during the period was 230 g/kid and the net benefit of supplementation was NRS 219/kid for the specified period under prevailing market price. In a feedlot study, ADG in Sinhal (59.5±5.87 g/day) and Khari (52.5±4.43 g/day) goats were not significantly different ($P>0.05$), whereas at different level of concentrate intake in proportion to daily dry matter (DM) requirements, the level of concentrate supplementation had significant effect on ADG ($P<0.05$). The ADG of goats offered 50% and 40% of their DM requirement through concentrates were significantly higher (65.7±6.43 and 60.71±4.54 g respectively) than those of goats supplemented with only 25% concentrate of their DM requirements (43.9±5.84g). Economically, concentrate supplementation at 40% DM intake was found to be profitable under intensive feedlot management.

Effect of feeding Stylo to pregnant goats and growth performance of kids from birth to 60 days of age under stall feeding system

Singh SB (2004). Effect of feeding Stylo to pregnant goats and growth performance of kids from birth to 60 days of age under stall feeding system. *Proceedings of the 5th National Animal Science Convention (NASA) in Nepal, pp125-130*

A collaborative study among DLS, NARC, multipurpose forage seed production cooperative and goat rearing farmers of Padampokhari, Makwanpur had been undertaken in Sep 2000, to examine the effect of Stylo on pregnant goats as well as growth performance of growing kids from birth to 60 days of age under stall feeding system. The study was facilitated by TA/HLFDO. There were 3 treatments: control group without Stylo (T0) and group fed Stylo at 1 kg/day (T1) and the group fed with 2 kg /day (T2). Animals were offered basal diets constituting of other forage and supplementary ground maize grain. There were 4 animals in T0, 8 in T1 and 5 in T2. In each treatment, there was one goat that was either crossbred or a local goat breed with Jamunapari buck. The trial started Sep 14, 2000 and ended on Feb 2001 due to wider

spread in kidding from Sep 17, 2000 to Dec 18, 2000. Animals were housed individually on the owner's responsibility in locally prepared slatted pens with individual feeding and watering troughs. During the night, they were housed together with their herd mates. At the end of the experiment, the empirical derivations were cross checked through performance assessment by farmers and government officials gathered in a workshop for that purpose. The Stylo intake of T1 group averaged 873±49 g/day and that of T2 averaged 1407±104 g/day for the 15 weeks feeding period. A strong correlation was observed between the quantity of fresh Stylo intake and the kid's growth rate. T2 kids grew by 140g/day, T1 by 125g/day and the T0 by 100 g/day. The plenary discussion during the workshop came to a general consensus that this effect could have been associated with increased milk production of mothers due to Stylo feeding and the kids had opportunity to nibble Stylo along with their mothers or the kids had enjoined both the opportunities. Abrupt Stylo feeding at large quantity caused mild to severe digestive upset. But the study had a number of limitations such as small replications, limited acclimatization period, lack of complete randomization, large variation in parity and stage of pregnancy among the experimental animals and lack of proper health care management.

Effect of Stylo supplementation at different level on growth performance of growing goats

CR Upreti, SB Panday, BK Shrestha and LN Panday (2007). Effect of Stylo supplementation at different level on growth performance of growing goats. *Proceedings of the 8th National Outreach Research Workshop in Nepal*, Khumaltar, Lalitpur, Nepal, 19-20 June, 2007, pp 378-382

Twenty growing castrate male goats, of age 6-7 months were divided into 4 dietary groups to evaluate the effect of different levels of fresh Stylo herbage on growth performance. Tree foliage was selected from cafeteria trial such as Khanayo (*Ficus semicordata*), Sal (*Shorea robusta*), Kavro (*Ficus lacor)*, Pakhuri (*Ficus globerima*), Katus (*Castanopsis triboloids*) and Mango (*Magnifera indica*) were used as basal diet. The dietary treatments were D1= season fodder ad lib + 75 g concentrate, D2= season fodder ad lib + 100 g Stylo + 75 g concentrate, D3 = seasonal fodder ad lib + 300 g Stylo + 75 g concentrate, D4 = season fodder ad lib + 500 g Stylo + 75 g concentrate/day. The duration of experiment was 150 days. The results indicated that the supplementation of 300 g fresh Stylo to the goats diet suitable to improve growth performance of goats. However, the increased growth rate was not significantly different. The highest average daily weight gain was obtained in D3 (66±4 g/day) followed by D2 (63±7 g/day), D4 (57±1g/day) and D1 (53±g/day). The feed conversation ratio (FCR) was significantly improved in D1 (7±1followed by D2 (10±1) and D4 (10±1). Lowest FCR was recorded with D1 (11±1) suggesting the need of Stylo supplementation to improve on the feed utilization. From this experiment, it can be concluded that supplementation of Stylo about 20% of total diet (i.e. 300 g fresh matter) is suitable to improve in feed utilization and growth performance of goats in the hills of Nepal.

Feeding system, feeds availability and nutrient content in the feed and forages given to goats in Tanahun, Gorkha and Syangja districts

Khanal RC, SB Panday and SK Khanal (1999). Feeding system, feeds availability and nutrient content in the feed and forages given to goats in Tanahun, Gorkha and Syangja districts. *Proceedings of the 3rd Nation Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, 26-28 June, 1999, pp 29-37

A study was conducted to investigate the feeding systems, feeds availability and nutrient content in the feeds and forages available in 3 major goat raising districts of Tanahun, Gorkha and Syangja. Feeds and feeding situation for goats in these 3 major goat keeping districts was

not encouraging. Mostly the animals were browsed in the forest and nearby areas. Situation was found to be poor from Falgun onwards when all green forages get exhausted and greenery in the forest also fades due to shedding of leaves from the browse plants and trees. There were some places where stall feeding was in practice, particularly when there were few heads of goats. This was mostly along the corridors of Prithvi highway. Concentrate was not usually given except for those lactating does having very young kids. Stall fed goats also depended on the forage collected from the forest and farm yard or Bari kanlas. Nutrient content in the tree fodders was good, roughages poor and some locally available concentrate feed ingredients normal. Some immediate measures needed to be implemented to improve the feeds and feeding situation in the districts.

Productivity, nutrient content and utilization of major fodder tree leaves (Badahar, Kutmiro, Dabdabe and Nimaro) by goats under stall fed conditions

Upreti CR, MP Sah and RR Khanal (2001). Productivity, nutrient content and utilization of major fodder tree leaves (Badahar, Kutmiro, Dabdabe and Nimaro) by goats under stall fed conditions. *Proceedings of the 1st SAS/N Convention*, *Kathmandu, Nepal, March 29-31, 1999, pp* 258-262

A trial was conducted to assess the productivity, palatability of major fodder tree and utilization of tree leaves by goats in stallfed management (I) four different fodder tree species were tagged and lopped to get the tree leaves production. Leaves were analyzed for proximate composition (II) sixteen growing goat hogget were assigned to four types of leaves, used to estimate the utilization of tree leaves, and feed conversion efficiency. Dry matter production was better to *Garuga pinnate* (54.9 Kg/tree/year) followed by *Ficus roxuburghii* (26.33 Kg), *Artocarpus lakoocha* ranked 1st in feed utilization (87.32 %), feed conversion efficiency (15.14±1.6 %), dry matter digestibility % (73.0±7.4) and crude protein digestibility % (86.2±5.4), and growth performance (70.0±7.74g /day), compare to other three tree leaves. Dry matter intake, growth performance and feed conversion efficiency of four different tree leaves in goat was significantly different. Looking at the response to the growth performance, *lakoocha* leaves were the best (FCE of 15.14±6.7 %) followed by *B .purpurea*, (10.64) *G. pinnate*, and *F. roxburghii*. With proper management, goat can be reared with different level of growth performance (30.0 to 70.0 g/d) in the tree leaves diet under stall fed condition.

Effect of grazing and feeding combinations on castrated goats

Barakoti TP and M Sapkota (2008). Effect of grazing and feeding combinations on castrated goats. *The 5th National Conference on Science and Technology*, Nepal Academy of Science and Technology (NAST), Kathmandu, Nepal, 10-12 *Nov,* pp 12-17

An experiment on feeding and grazing combinations on 24 castrated goats was conducted during summer of 1998 with an aim to quantify the effect of Ipil Ipil (*Leucaena leucocephala*), Para grass (*Brachiaria ruziziensis*) and Napier (*Pennnisetum pupureum*) on the live weight gain, dry matter intake and feed efficiency of the local goats at Rampur condition. The results revealed that Ipil ipil was found more nutritive for increasing live weight and feed efficiency of the goats. It enhanced 4.84 kg of average weight gain during the experimental period of 4 months. However, feeding Ipil Ipil ad lib only without grazing was harmful because it caused reduction of body weight. It was also found that grazing for 8 hrs without additional feed supplement was more effective for increasing body weight than Para and Napier feeding without grazing. Based on the thoroughly experimented results, grazing for 4 hr + Ipil Ipil ad lib feeding can be recommended to the goat keepers for higher production of meat.

Growth performance of hill and Terai goats of Udayapur and Siraha districts of Nepal

Kolachhapati MR and NR Devkota (2010). Growth performance of hill and Terai goats of Udayapur and Siraha districts of Nepal**.** *Nepalese Journal of Agricultural Sciences, Himalayan College of Agricultural Sciences and Technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **8:**173-188

The study was conducted in Udayapur and Siraha districts in 2006 to represent the hill and Terai goats of Nepal. A total of 50 goats 25 in each district were considered for the study. Complete randomized factorial design was used to set the experiment. The present study revealed that goats of 6 months aged had higher body weight (BW) at the end of 6 months experimental period. Similarly, goats fed with 14% crude protein (CP) in the diet had attained higher BW. The treatment combination of 6 months aged goats fed with 14% CP was found the best combination for fattening the male goats for Terai and hills as well. Likewise, 14% CP supplementation was found more appropriate to obtain the higher BW when the female goats were fattened in Terai. However, the CP level of 12 and 16% had shown similar body weight; whereas these two levels of CP were found better than other lower two levels in hills. Higher monthly body weight gain of male goats for every month was also obtained from the 6 months aged goats kept in the experiment in both locations. All the CP levels had yielded similar monthly BW gain during initial months of experiment. The different treatment combinations were also found similar for BW gain in both of the locations. Similarly, higher CP levels (16% in Siraha, and 12% and 16% in Udayapur) yielded higher monthly BW gain for female goats in every month. Average daily gain of male goats was also found higher for 6 months aged goats kept in the experiment, and also for 14% in the diet for later months of the experiment for both locations. The ADG of male goats were similar for different treatment combinations. The fattening of six months aged male goats with 14% CP ration seemed appropriate in terms of higher BW gain in Terai and lower hills.

Effect of combined implantation of trenbolone acetate and oestra- diol-17B on growth, carcase characteristics and certain blood metabolites in wether lambs

Singh SB and H Galbraith (1990). Effect of combined implantation of trenbolone acetate and oestra- diol-17B on growth, carcase characteristics and certain blood metabolites in wether lambs. *Journal of Institute of Agriculture and Animal Science (IAAS),* Rampur, Chitawan, **11**:31-39

Ten Greyface x Suffolk castrated male lambs weighing 25.0 kg on an average were randomly allocated to two groups and were either sham-implanted or implanted with two pellets of Revalor (35 mg trenbolone acetate + 5 mg oestradiol-17B). They were individually fed commercial diet containing an estimated 12.5 MJ metabolisable energy and 202 g crude protein (CP) per kg dry matter. Six days before to 7 days after implantation lambs were subjected to N-balance study. Four weeks after implantation they were injected intramuscularly with 10 I.U. of adrenocorticotrophic hormone (ACTH). The experiment lasted for 42 days. Steroid treated lambs gained more weight and had heavier empty body weight but lower feed conversion ratio than control. These observations were associated with increased N-retention due to treatment. Treated lambs had consistently heavier liver ($P<0.01$), adrenals ($P<0.05$), perirenal and channel fat ($P<0.01$) but significantly lighter thyroids ($P<0.01$) and thymus ($P<0.01$) than those of control. The trend of non-significantly lower concentration of plasma urea observed for the first 3 weeks after implantation in the treated lambs as compared to untreated/control was reversed in the subsequent weeks after ACTH injection. Although the plasma glucose concentration was lower in lambs treated with hormone, ACTH injection resulted in significantly greater concentration in control lambs at 15 min ($P<0.05$), 30 min ($P<0.01$), 60

min (P<0.05), 360 min (P<0.05) and 24 hr (P<0.05). Plasma cortisol concentration in the control lambs were significantly higher at 15 min (P<0.01), which peaked to 28.3 ng/ml at 120 min., while the peak of the treated lambs was 25.7 mg/ml only at 180 min.

Stress caused by a shortage of winter feed as a constraint upon the migratory system of sheep management in the western hills of Nepal

Dhaubhadel TS (2000). Stress caused by a shortage of winter feed as a constraint upon the migratory system of sheep management in the western hills of Nepal. *Proceedings of the 3rd National Animal Science Convention (NASA), Lalitpur, Khumaltar, Nepal, Aug 27-28, 2000,* pp 97-102

During the movement of Baruwal sheep in migratory system of management, the animals suffer from different types of stress including winter nutritional stress. This trial was carried out in Siklis area on Baruwal ewes in 1986 for 18 weeks. The objective was to combat weight loss from nutritional stress by supplementing concentrate feed in winter. Thirty-four Baruwal ewes were randomly divided into two groups. One group was offered 200 g of concentrate feed per animal as a treatment and the other 17 ewes were not supplemented. It was found that the treatment group gained body weight by 0.2 kg±0.49 over a period of 18 weeks. The control group of ewes lost the body weight by 1.5 kg±0.58. Over the same period the difference was significant (p<0.01). The concentrate feeding to Baruwal ewes improved their body weight and maintained condition. Though there are many constraints, such a little amount of concentrate feeding practice is recommended to be adopted in migratory system.

2.3 BREEDING

Study on the genetic and phenotypic characteristics of indigenous goat breed (Sinhal) at Karnali region

Upreti CR and PS Mahato (1995). Study on the genetic and phenotypic characteristics of indigenous goat breed (Sinhal) at Karnali Region. *Proceedings of the 2nd National Animal Science Convention (NASA)*, Lalitpur, Nepal, Aug 7-10, 1995, pp 82-84

Mature 150 female of indigenous Sinhal goats maintained at SGRP were used to record the phenotypic (physical) and functional (productive) characteristics. The data collected over the two year are complied and discussed. Sinhal goats in Western mountainous region are hairy and heavier (26.73±4.79kg) compared to the Khari (Sinhal type) goat breed (25.4±6.2 kg). However, the difference in live weight may be due to the different breed strain. Jumli Sinhal was higher in most of the body measurements compared to the eastern hilly goat breeds. Regarding the productive performance, the Sinhal goat grew faster at the rate of 76.9 gram per day than eastern hilly goats (54g/d). Sinhal produced 200 gram of long (9.25cm) coarse fiber of more than 60 micron. Sinhal were capable to carry more load (13kg of grain) (32.5% of live weight) than sheep (10.5kg). The milk produced by the Sinhal goat in Karnali region is adequate to rear the singleton as the production is around 200 ml per day during 2 to 3 weeks of kidding. The milk yield in eastern mountain region is higher (43±16 lit/lactation) compared to this area (26.13±1).

Effect of the size of does on their progenies

Lamichhane AR, M Kharel and U Pokharel (1995). Effect of the size of does on their progenies. *Journal of Institute of Agriculture and Animal Science (IAAS), Research Reports, Rampur, Chitawan,* (1993-94), pp 187-192

Two half sibs' families, one in Bhimnagar and other in Suryanagar were studied in order to find

out the significance of genetic contributions from dam line to her offspring's keeping the sire factor constant. It was found that the does sired by a buck in villages could be classified into 2 groups, larger and smaller. When the kids from the larger and smaller does (sired by the same buck) were compared, the kids from the larger does appeared to be higher in the measurements of all characteristics, even in bone measurements such as body length and height than that of the kids from smaller does. The validity of this result was confirmed by the studies conducted at two locations. The results indicated that dam had significant role in causing variation. Hence, consideration of dam aspect, especially in selection plan and mating design, would be of much scientific for the improvement and development of livestock species than just considering only sire effect.

Performance of Kiko crossbred goats in the mid hills of Nepal

Neopane SP and AP Sainju (1995). Performance of Kiko crossbred goats in the mid hills of Nepal. *Proceedings of the 2nd National Animal Science Convention (NASA),* Khumaltar, Lalitpur, Nepal, Aug 7-10, 1995, pp 100-104

Local goats in the mid hills (Pakhribas in east and Bandipur in west) were inseminated with frozen semen of Kiko goats in 1990 and 1991. The crossbreeds born were studied for their performance in terms of both weight and reproductive traits in comparison with local goats. Kiko crossbreed goats were found significantly heavier than local goats at birth ($P<0.001$) and at weaning weights ($P<0.05$). However, there were not significant differences between two genetic groups in terms of six month and one year weights. Kiko crossbreeds grew from birth to weaning age (4 months) at the rate of 62.7 g/day as compared to 57.0 g/day for local goats ($P<0.05$). The average litter size at birth was 1.27±0.06 in Kiko and 1.37±0.06 in local goats. Kiko cross goats had a longer kidding interval (322±14 days) than local goats (302±14 days). However, at both cases, the differences were not significant. The preliminary analysis revealed that Kiko crossbreeds were better than the local in some weight traits and in terms of reproductive characters. However, the records available are not adequate to confirm the results.

Goat (*Capra hircus*) genetic resources in Nepal

Kharel M (1997). Goat (*Capra hircus*) Genetic resources in Nepal. *Veterinary Review*, Animal Health Research Division, Tripureswor, Kathmandu, Nepal, **12**(1)**:**14-16

Due to the diverse topographical and climatic conditions of Nepal some distinct breed or strains of goats have evolved to each topographical and environmental condition some of which are typically different than that of the other parts of the world. These breeds have widely adapted from the tropical to the high Himalayan temperate zone. The present paper describes the possible origin, distribution and characteristics of the goat breeds of Nepal.

Karyotypes of indigenous Khari goats in the western hills of Nepal

Rasali DP, HD Joshi, RS Rana, N Amatya and PK Patel (1997). Karotype of indigenous Khari goats in the western hills of Nepal. *Bulletin of Veterinary Science and Animal Husbandry*, **25**:61-63

Lymphocytes were cultured from the blood samples of 1 male and 1 female jet black color Khari goats and 1 male and female white Khari goats kept at Agricultural research Station, Lumle, using RPMI-1640 media supplemented with foetal calf serum, antibiotics and amidogen. The cultures were harvested at 72 hrs of incubation. Prepared slides were then screened under microscope. Results showed that all the goats had normal Karyotype with 60 diploid chromosomes resembling Indian domestic goats.

Genetic and non genetic factors affecting post weaning survivability in indigenous goats in east Nepal

Neopane SP (1998). Genetic and non genetic factors affecting poet weaning survivability in indigenous goats in east Nepal. *Journal of Society of Agriculture Scientists, Nepal (SAS/N*), **2**(1)**:**8-12

The data on 627 hill goat kids born over 11 years were used to study the effects of sex, color type, season of birth, year of birth, birth weight and type of birth and parity of dams on survival rate during post weaning periods (16-36, 36-48 and 16-48 weeks). The overall survival rate of the kids was 80% from weaning to 48 weeks of age. Birth weight, sex, season of birth of the kids and parity of dams affected significantly on survival rate. Color type, year of birth and type of birth of kids did not affect on survival rate. Amongst all the factors studied, birth weight was the most important source of variation for survival rate. Estimates of heritability for survival rate at 16-36, 36-48 and 16-48 weeks were 0.22±0.108, 0.16±1.115 and 0.13±0.098, respectively. Low to moderate estimates of heritability and significant effect of environmental factors revealed that the presence of some additive genetic variance and high environmental variance for this trait. This indicates that both genetic and non genetic factors are important for improving the survival rate.

Genetic potential of hill goats: conservation through improvement

Neopane SP (1998). Genetic potential of hill goats: conservation through improvement. *The 4th Global Conference on Conservation of Domestic Animal genetic Resources*. Birendra International Convention Center, Baneswor, Kathmandu, Nepal, 17-21 Aug, 1998

Goats are an important livestock species in the hills of Nepal. They provide a major source of animal protein and household cash income. They also provide manure for maintaining or increasing soil fertility. Their meat is the most expensive and is preferred over other types of meat throughout the country. Chyangra, Sinhal and hill goats are three recognized populations of the goats in the hills and mountains of Nepal. Hill goats are found and reared in the lower and mid hills. They are prolific with an efficient reproductive rate (average litter size at birth is 1.61, kidding interval is 283 days, age at 1st service is 374 days). However, they have a lower finishing weight due to a slower growth arte compared to Indian and other exotic breeds introduced into the country. The average weight at 48 weeks of age is 12.6 kg. Data analyzed (including record between 1984 and 1997) revealed that all the weight traits have moderate to high heritability estimates and the weights at different ages are positively correlated to each other. This information indicates that the hill goats have genetic potential for improvement. The major constraints for conservation and improvement of hill goats are the scattered population and lack of selection plan for improvement. A suggested plan for conservation and improvement of hill goats is the improvement of productivity through farmer selection. This involves a nucleus flock at the centre and farmers at different places in the hills. Male and female kids will be selected based on the selection criteria (weaning weight and six months weights of kids born from multiple births). The best 15% of bucks and 20% of does will be kept in the nucleus and the next best 15 to 20% of bucks and does will be sent to the farmers' fields. These animals will be used for making improvement. It is expected that body weight will be uplifted by 1-2% in the nucleus flock and 1% in the farmers flocks annually using proposed open nucleus breeding scheme. This plan includes two major parts, the selection of better animals (firstly at the centre but later both at the centre and from the farmers flocks) and dissemination of improved genes/animals to the local population. This plan would help in making genetic improvement for hill goats in the eastern hills of Nepal. This would eventually

contribute to the conservation of hill goats, as the farmers themselves will be involved in managing genetic variability in living populations.

Role of women in genetic conservation of goat

Panday U and R Bhurtel (1998). Role of women in genetic conservation of goat. *The 4th Global Conference on Conservation of Domestic Animal genetic Resources*. Birendra International Convention Center, Baneswor, Kathmandu, Nepal, 17-21 Aug, 1998

This study was undertaken to find out the role of women in goat production in the farming system. Goat raising most common among the farmers of Nepal. This is because goat meat is accepted and consumed by all ethnic and caste groups. Two sites, one from the Terai (Nijgarh of Bara district) and other from the hills (Anbukhaireni, Ghansikuwa and Chokchisapani of Tanahun district) were selected. A survey was done by interviewing the respondents. The involvement of the farmers in goat raising was 91% in Bara and 93% in Tanahun district. The majority of them were raising indigenous goats. The average number of goats was 5 and 6 at the households of Bara and Tanahun district, respectively. Farmers of both sites kept goats for religious purpose, their own consumption and for sale. The total labour force contributed by females was found to be 82% in Bara and 84% in Tanahun for goat production. In both places, farmers sell their best goats for cash purposes. In Bara and Tanahun districts respondents made NRs 1830.0 and 1761.0 cash by the sale of their healthy goats, respectively. Women play a key role in raising goats and in the conservation of these important genetic resources.

Characteristics of some of goat populations in the western hills of Nepal

Shrestha HK, SC Ghimire, DP Rasali, HD Joshi and NPS Karki (1998). Characteristics of some of goat populations in the western hills of Nepal. *The 4th Global Conference on Conservation of Domestic Animal genetic Resources,* Birendra International Convention Center, Baneswor, Kathmandu, Nepal,17-21 Aug 1998

Of the various domestic animal species in Nepal, goats are important resources found from the agro-climatic conditions of the regions, and have developed into different populations with specific characteristics (Chyangra, Sinhal and Khari). The poster depicts some of the production and reproduction characteristics of these three goat populations managed under the traditional system. A total of 2362 Chyangra, 6749 Sinhal and 4766 Khari goats are found in Mustang, Kaski, Lamjung, Syangja and Tanahun districts. They were observed and recorded for various production and reproduction parameters. The Chyangra goat is a hardy population particularly acclimatized to the rain shadow areas of the Himalayas. The animals are famous for their cashmere and meat. The adult body weight of Chyangra is 36 kg in males and 32 kg in females. The Sinhal is another high mountain goat, which is hardy in nature and can withstand diverse climatic conditions. The adult live body weight of this goat is 39 kg in males and 37 kg in females. The Khari also known as the aule goat is found in the hilly region and is believed to be closely related to the Indian Black Bengal Goat. The animals are smaller in body size, attaining 33 kg in males and 29 kg in females as adult live weight. Khari goats are known for their high prolificacy and early sexual maturity. There is potential to improve these goats within the population through systematic selection and better management practices.

Improvement of hill goats through selection

Neopane SP (1999). Improvement of hill goats through selection. *Proceedings of 3rd National Workshop on Science and Technology*, Royal Nepal Academy of Science and Technology (RONAST), Kathmandu, Nepal, March 8-11, 1999, pp 1105-1110

Hill goat is recognized for its prolificacy and adaptability. However, their weaned weight and finish weights are lower than the exotic breeds. The lower finish weight has to be improved in order to make the goat production more profitable. Data collected over 13 years were analyzed for genetic parameter estimation. The results indicated that weight traits can be improved quickly as selection would be effective for bringing genetic improvement. Based on the available information a selection program on hill goats was proposed to increase the body weights. Selection criteria were weaning weight of kids born from multiple cases and final selection is made on the basis of 6 months weight. There are two tiers at this scheme, nucleus and farmers. Selection of better dams and bucks are being undertaken both at the nucleus and the farmers flock based on the criteria mentioned above. The proposed scheme is open nucleus breeding. It is expected that 1-2% genetic gain will be achieved at the farmers and the nucleus flock respectively per year from this program. This indicates that body weight at market age of hill goats can be increased at a substantial rate by applying strategic selection and dissemination plan.

A report on productive performances of hill goats in the eastern hill

Pokharel PK, SP Neopane and TP Paudel (1999). A report on productive performances of hill goats in the eastern hill. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal,* Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, pp 255-261

A semi structured questionnaire survey was under taken at 5 different sites (Muga, Belahara, Dandabazar, Fakchamara and Hasanpur) to collect the initial productive performance of local hill goats. The information will be used later to monitor the progress of local hill goat selection programme. 180 households were visited and more than1000 animals were weighed during the course of the interview period. The average body weight of the 4, 6 and 9 months old goats were found to be 8.6 ±1.44, 10.5±0.4 and 12.6±0.87 kg, respectively for male and 7.38±0.77, 8.75±0.24 and 11.7±0.72 kg, respectively for female. 1-2 year and above 2 years matured body weights of the animals ranged from 16.5 to 18.5 kg and 21 to 25 kg, respectively. Regarding the birth types 73% of the animals were born single and the rest (27%) was multiple (twining and triplet). Multiple born cases in mid hills were found better than low hills (36% vs 19%). The new born kids suckled the mothers as long as they allow. Weaning is not parasitized to shorten kidding interval and to improve the maternal health condition. Age at 1st mating of doe was 6-7 months, but in most of the cases it was prolonged up to 18 months. The normal castration age was at 1 year and above. No consciousness among the farmers regarding the weaning, castration, controlled breeding and overall recording system of the animals was evident.

Blood protein and Isoenzyme polymorphism in Nepalese hill goats

Kunwar BS (2000). Blood protein and Isoenzyme polymorphism in Nepalese hill goats. *Veterinary Review,* Animal Health Research Division, Tripureswor, Kathmandu, Nepal, **15:**13-21

Blood samples of 189 male and female adult hill goats (Khari) were taken from different locations in the hills of Nepal and analyzed electrophoretically for 7 blood proteins and Isoenzymes. Hemoglobin, Albumin, Transferin, Alkaline phosphatase and Esterases I and II were found polymorphic while α2 macroglobulin was found monomorphic in hill goats. Nei's genetic distances were estimated between the goats of different locations, which range from

0.0039 to 0.02462. The highest genetic distance was found between goats of Bandipur and Pakhribas. A phylogenetic tree was constructed based on these genetic distances, in which goats sampled from Pakhribas were farthest than the goats of other regions.

Characterization of local breed of goat in central Terai of Nepal

Neopane SP (2000). Characterization of local breed of goat in central Terai of Nepal. *Proceedings of the 4th National Workshop on Livestock and Fisheries Research in Nepal,* Agriculture Research Station Pakhribas, Dhankuta, April 24-26, 2000, pp 214-217

In 1997 a study was initiated with the objective of identifying and characterizing the breed for their further utilization. The parameter recorded was morphological body parts, production performance and system of goat production. Amongst the morphological characters, body length, height at withers, height at hipbone and heart girth of adult goats was 60.6±0.87, 60.3±0.82, 60.8±0.73 and 68.3±0.91, respectively. The adult weight (above 2 years) was 27.3±0.75kg and the litter size at birth was 1.6±0.064. These results indicated that the goats located in these 3 districts are bigger than Khari/Hill goat in size and are better than Terai for litter size. The information suggests that they may be different breed/strain from other Terai goats.

Hemoglobin and transferring polymorphism in Nepalese hill goats

Kunwar BS, M Kharel, and SP Neopane (2001). Hemoglobin and transferring polymorphism in Nepalese hill goats. *Proceedings of the 4th National Animal Science Convention*. Nepal Animal Science Association (NASA), Kathmandu, Nepal, Nov 29 – Dec, 2000, pp 141-151

Blood samples of 189 adult male and female hill goats maintained at ARS/Pakhribas, Dhankuta (eastern region), Sindhuli (central region), Agriculture Research Station, Lumle, Kaski (western region), Agriculture Research Station (Goat), Bandipur, Tanahun (western region), Salyan and Surkhet (mid-western region) were taken and analyzed in hydrolyzed potato starch gel electrophoretically. Hemoglobin was found polymorphic in Nepalese Hill goats. Two genotypes of hemoglobin, HbAA and HbAE were found in the sampled population. The gene frequency of HbA was higher than HbE, which was more in the goats sampled from East Nepal. Four genotypes of Transferrin, TIA, TIE, TIE and T.rc were found in the Hill goats with decreasing trend of genotypic frequencies. TI and TI highest followed the gene frequency of TI. The gene frequency of 1, and TI were higher in the goats of East Nepal than in the goats of West. Polymorphism of these two principal blood proteins including differences in gene frequencies between the populations of Hill goats found in different locations indicated the genetic variation in Hill goats.

Comparative performances of hill goat and its crossbred with Kiko goats

Neopane SP and CR Upreti (2001). Comparative performances of hill goat and its crossbred with Kiko goats. *Proceedings of the 1st SAS/N Convention*, Kathmandu, March 29-31, 1999, pp 213-216

Kiko goats developed in New Zealand suitable for harsh environmental conditions were imported for crossbreeding with Khari goats both in the western and eastern hills of Nepal in early 1990's. Frozen semen was used for inseminating the hill goats. Conception rate was very low and hence it was felt to have all the goats at one station. All the goats were, therefore, handed over to ARS, Bandipur in 1993 by PAC. Since then the study has been implementing at ARS, Bandipur. The monitoring on weight traits, litter size and dam traits was made. Data obtained from 1990-1997 were analyzed using the statistical package, Harvey (1990) based on least squares procedure. Amongst the weight traits, birth weight was only found significantly

heavier for Kiko (2.09±0.03 kg) than Khari goats (1.65 ± 0.57 kg) (P<0.001)> other weights (pre and post weaning) were similar for both breeds. Breed was a significant source of variation for litter weights. Kiko goats produced the heavier litter weights than Khari goats (P<0.001). Breed did not affect on litter size at birth and weaning. The heavier kidding interval was 312±11.4 days. Breed did not affect on the trait. To overall gestation length was found well within a range (146.5±0.35 days) reported in the literature. The results revealed that Kiko goat was similar with Khari goats, so far in weight traits and some of the reproductive traits (litter size) are concerned. They were better than the Khari goats in terms of litter weights. This indicated that Kiko dams have better maternal ability. Unlike the previous studies where Khari goats were crossed with Indian breeds (Jamunapari, Beetle and Barberi), the results of this study was encouraging as the productivity level of Kiko was similar or better than Khari goats in the hills of Nepal. However, its cost effectiveness over the local breed (as it requires a lot of investment in importing exotic breeds in the country) should not be ignored while recommending the breed for its suitability.

Selection impact on the productivity improvements of goat (*Capra hircus*) in the hills of Nepal

Pokhrel PK SP Neopane and MP Aryal (2001). Selection impact on the productivity improvements of goat (Capra hircus) in the hills of Nepal. *Proceedings of the 4th National Animal Science Convention.* Nepal Animal Science Association (NASA), Kathmandu, Nepal, Nov 29 – Dec, 2000, pp 152-160

In two years study the effectiveness of the program showed that there was a significant improvement (P<0.001) in four and six month weights of the first filial kids. Likewise, overall twinning percent of the goats elevated from 28 to 55 %. In both altitude levels multiple born cases were increased by 27 percent. Observed response of selection per generation for birth, and four and six- month weights were 0.62, 19.3 and 20.4 percent, respectively. The results indicated the usefulness of selection scheme for the enlistment of production and productivity of Hill goats emphasizing its broader application both in the low and mid hills of Nepal where goat keeping is a traditional practice.

The comparative performance of indigenous Khari goats and Khari x Sinhal crossbred at Lumle farm

Rasali DP and RC Khanal (2002). The comparative performance of indigenous Khari goats and Khari x Sinhal crossbred at Lumle farm. *Nepal Journal of Science and Technology,* Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, **4:**129-134

A study was undertaken to evaluate the performances of Khari goats and Khari x Sinhal crossbreds maintained at Lumle farm. Khari females and Sinhal bucks were collected from various parts of the western hills and Khari x Sinhal crossbreds were produced at Lumle farm to explore the possibility of improving genetic potential by utilizing the local genotypes. Birth weight was significantly influenced (P<0.01) by the sex, year and season of birth but not by the genotype (P>0.05). Average birth weight of Khari kids and Khari x Sinhal crossbreds were 2.03 and 2.14 kg respectively whereas that of male and female kids was 2.01 and 2.16 kg respectively. Kids born during monsoon were largest whereas those born during summer were smallest. Autumn and winter born kids were similar in body weights and were intermediate between monsoon and summer born kids. Body weights of kids in different ages were significantly influenced by genotype, sex and year of birth but not by the season of birth. Body weights of Khari x Sinhal crossbreds at 3 months (P<0.01) and 6 months (P<0.05) of age were significantly higher than that of Khari kids. When the kids were 9 months old body weight of both the genotypes was similar and not significantly different (P<0.05). However, it was

overtaken by Khari kids when they reached a year of age (P<0.01). Female kids were significantly larger (P<0.05) in size up to 6 months of age but there was no significant difference in weight after 9 months of age between the two sexes. There was no specific pattern with regards to the effect of year on body weight. Age at 1st service was significantly influenced by genotype (P<0.01), and was 229.2 and 367.6 days respectively for Khari x Sinhal crossbred goats, but not by any other factors considered. Autumn born kids had a tendency of coming into 1st service earlier that the kids born in other seasons. First kidding interval was not affected by genotype, year and season of birth. Like the case with age at 1st service, autumn born kids had a tendency of having shorter 1st kidding interval. Twining percentage in the 2nd kidding was not significantly influenced by the genotype. It was 27.07 and 19.05% for Khari and Khari x Sinhal respectively. In conclusion crossbreeding of Khari x Sinhal goats could not show much of comparative advantage between the two genotypes under on station management at Lumle Farm.

Post weaning growth of local hill goat at Agriculture Research Station (ARS), Pakhribas

Pokhrel PK, SP Neopane (2002). Post weaning growth of local hill goat at ARS, Pakhribas. *Proceedings of 5th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, July 10-11, 2002, pp 119-122

Selection index developed at the station are highly flourishing on overall productivity of the hill goat body weight gain of the first generation kids is significantly improved (p<0.05) than that of their parents. Genetic gain found in the first generation kids is arresting – up to 5.5 per cent per year accounting to the generation interval is 2.75 years. Breeding bucks selected on the birth type, weaning and six-month weight weighed up to 35 kg at the two years of breeding age at station management condition. Twinning up to the 8th parity seems progressive and remains requiring in 9th and 10th. Color dhobini of goat performed best both in terms of growth and reproduction. Rainy season is found to be more critical in the kids' mortality. Selective breeding has positive impact on the post weaning growth of the breed and proved as an effective tool for the hill goats.

Genetic evaluation of Nepalese hill goats

Kunwar BS, SP Neopane and M Kharel (2002). Genetic evaluation of Nepalese hill goats. *Proceedings of the International Seminar on Mountains,* Kathmandu, Nepal, March 6-8, pp 632-637

Hill goat is a principle breed of the goat in the country. Hill goats of western region of Nepal are bigger in size than the goats found in eastern region. To know whether this difference was due to environmental factors of due to genetic variations, 189 adult male and female hill goats from Pakhribas, Sindhuli, Bandipur, Lumle, Salyan and Surkhet were measured for 24 phenotypic characteristics and subjected to discriminate and cluster analysis. Similarly, 7 blood protein and isoenzyme systems were analyzed using electrophoretic techniques and Nel's genetic distance matrix was constructed. Discriminant analysis revealed higher probability of membership of goats in their own location of origin. Cluster analysis showed 3 different types of hill goats, above medium, medium and below medium types for western, central and eastern part of Nepal and which were significantly different (P<0.01) from each other in morphological characteristics> protein and isoenzyme analysis revealed that hemoglobin, albumin, transferring, alkaline phosphatase, eastearse -1 and easterase – II were polymorphic and μ2 macroglobulin was monomorphic in Nepal hill goats. The Nel's genetic distance among goats from different locations ranged from 0.0039-0.246. The combined information of morphological and genetic dendograms implied that the goat population from Salyan and

Surkhet and Pakhribas were distinctly different to each other, while goats from Bandipur and Lumle were intermediate between these 2 extremes.

Evaluation of native goats (Sinhal and Chyangra) for morphological characteristics and production performances

Tiwari MR, SP Neopane and NL Tamrakar (2002). Evaluation of native goats (Sinhal and chyangra) for morphological characteristics and production performances. *Proceedings of the 5th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 10-11 July, 2002, pp 7-102

Understanding the importance of goats for rural poor people in Nepal, a study was initiated with the objective of characterization and evaluation of productive and reproductive performances of Sinhal and Chyangra goat in western and mid western region. Using the structured questionnaire and format developed by FAO for goat breed characterization a survey was made in 1999. Parameters included were body parts measurements and production traits observation. Results showed that Sinhal and Chyangra goats are black in color but sometimes white and brown patches are frequent. The average mean of barrel girth, loin girth, body length, height at hipbone, height at wither and heart girth was found higher for female than male (55.09, 65.8, 55.5, 53.27, 52.24 and 63.13 cm, respectively). Mean of the age at puberty, age at 1st kidding and kidding interval of Sinhal goats in Mugu, Jumla and Dolpa districts were 12.01, 19.16 and 9.58 months respectively. The age at 1st work and last work of male Chyangra was observed almost same as Sinhal (24.04 and 72.33 months, respectively).mean slaughter age and slaughter weight for Sinhal was observed 27.65 months and 25.09g, respectively.

Identification of breeding strategies for goat improvement in high hills and mountain of Nepal

Tiwari MR (2003). Identification of breeding strategies for goat improvement in high hills and mountain of Nepal. *HARP Projects Completion Report*, Sheep and Goat Research Program, Guthichaur, Jumla

From the study, the investigator has submitted the following breeding strategy for the improvement of mountainous goat-Sinhal and transhimalayan goat. I. To avoid in breeding effect both in production and reproduction traits, select the best bucks out of 10-12 bucks. II The ratio of selected buck and dam for breeding should be 1:25 or less. III. The average age at puberty is around 13 months and gestation period of doe is 5 months. . It means the buck's offspring will be ready for first conception after 18 months. At this time, the buck is either sold or replaced by another unrelated buck after 18 months of its stay at goat flock to check the chances of inbreeding. Iv. Implementation of breeding plan based breeding strategy.

- Identify the districts of goats based on good population.
- Identify the pocket area of Sinhal and Chyangra based.
- Sensitize and Internalize farmers of the pocket area about the importance of breeding plan of their goats through social mobilization.
- Form a Goat Improvement Committee.
- Provide in site training technique of best buck selection for breeding.
- Adopt breeding strategy to improve the genetic potentiality of Sinhal and Chyangra.

Comparative study of two extenders used in preserving buck (*Capra hircus Linn*) semen

Manandhar PP, SS Capitan, NP Roxas and PL Alviola III (2004). Comparative study of two extenders used in preserving buck (*Capra hircus Linn*) semen. *Proceedings of the 5th National Animal Science Convention (NASA),* pp 205-212

Two standards skim milk glucose (SMG) and egg yolk Citrate (EYC) were used to preserve the semen of 7 Anglo Nubian (AN) breeds of buck. The mean neat semen motility (NSM) was recorded to be 58.02%. The seminal plasma, being considered to impart deleterious consequences to the spermatozoa, was discarded after washing and centrifugation. The motility after centrifugation (MAC) for the SMG was 69.76% and that for EYG 69.26% with the means of extender not significantly different (p>0.05). The higher MAC value indicated that the seminal plasma has detrimental effect on spermatozoa. The semen samples thereafter were diluted with extenders following a 2 step dilution (at body temperature and at room temperature) and stored at 40C. The motility after 1st dilution (MDL1) and 2nd dilution (MDL2) in case of SMG were 68.38 and 61.63%, and those for EYC, 64.51 and 57.59% respectively. The extender means in case of MDL1 was not significantly different (P>0.05) whereas, that in MDL2, it was significantly different (P<0.05). The semen mixture and remaining extender, fortified with 7% glycerol were stored at 40C. This was further extended following a 4 step dilution at 15 minutes interval to acquire the final volume which was further stored at 40C for glycerolization. After 1st (1 hrs MGL1), 2nd (3 hrs MGl2), 3rd (6hrs MGL3), and 4th (9 hrs (MGHL4) stage of glycerolization, the respective motilities were 56.43, 61.91, 61.36 an d61.24% for SMG and 51.49, 56.18, 55.38 and 55.31% for EYC, In all the stage of glycerolization, the extender means were significantly different 9P<0.05). The data indicated that the 1st stage of glycerolization is detrimental to the spermatozoa and that, at least 3 hrs equilibration time is necessary. After being packaged in 0.5 ml medium straws and sealed with the polyvinyl acetate powder (PVA) the semen straws were frozen and stored into liquid nitrogen (-1960C). The post thawing motility test was carried up to one month of storage .The respective post thawing motility after 30 minutes (MST 1), 24 hrs (MST 2), 1st week (MST3), 2 weeks (MST4), and one month (MST5) of storage period showed motility of 36.79, 36.49, 36.56, 36.26 and 36.64% for SMG and 30.02, 29.07, 28.91, 28.57 and 28.08% for EYC. The extender means were significantly different (P<0.05) in all the stage of storage. SMG extender had higher magnitude of motilities in all the ways from MDL2 up to storage, than those in case of EYC extender. It shows that SMG extender is better and superior as far as buck semen processing and cryopreservation is concerned.

Study on productivity improvement of hill goat through selective breeding programme

Pokharel PK and SP Neopane (2006). Study on productivity improvement of hill goat through selective breeding programme. *Nepal Journal of Science and Technology,* Nepal Academy of Science and Technology *(NAST*), Khumaltar, laitpur, Nepal, **7**:1-5

An attempt for the 1st time ever in the livestock species has been made to enrich the production potentiality of hill goat through selective breeding. Two tier open nucleus breeding scheme had been assiduously applied in order to enhance the genetic gain of hill goats. Breeding records of 221 does and 1462 kids in nucleus herd, and records of 968 does and 1622 kids born in on farm condition fathered selected bucks during 1998 to 2004 were considered for the study. Selection response of the breeding programme was calculated in terms of genetic gain. Response of selection for the 1st generation of kids in nucleus flock at station was found to be 2.77 and 9.6% per generation for 4 and 6 months weight respectively. Similarly, overall twining ability of hill goats for the period was increased by 0.73% reaching the level of 68.75. In on farm condition, response of selection for 1st generation kids per year were 0.22, 7.01 and 7.41% for birth, 4 and 6 months weights respectively. Likewise, twining frequency was improved by 27 % indicating the level of 55. In both low and mid altitudes (up to 1100 m asl) of eastern hills

the selection program was found effective for improving the overall productivity of local hill goats and could be equally effective for other parts of the country.

Reproductive efficiency of hill goats in eastern Nepal

Pokharel PK and DR Khanal (2006). Reproductive efficiency of hill goats in eastern Nepal. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, 1-2 July, 2004, pp29-32

Hill goats are well known for their prolificacy and reproductive traits. A flock of goat maintained at 1742 m asl in the eastern part of the Nepal in semi intensive management system is considered for this study. Age at first service (days), age at first parturition (days), weight at first service (kg) and weight at first parturition (kg) of first generation kids was found to be 342.44±94.21, 504.57±106.8, 13.97±2.3 and 17.47±2.32, respectively. Average parturition interval of does at station management condition was recorded 320.87±99.06. Reproductive and litter traits of kids were studied and compared with parental, generation and parity.

Productivity of Khari goat in outreach site of Dukuchap, Lalitpur

Pokharel PK, SP Neopane and CR Upreti (2007). Productivity of Khari goat in outreach site of Dikuchap, Lalitpur. *Proceeding of the 8th National Outreach Research Workshop*, Khumaltar, Lalitpur, Nepal, 19-20 June, 2007, pp 499-504

A selective breeding program to improve the productivity of local Khari goat was initiated in Dukuchap OR site. Semi structured questionnaire survey, weighing of live goats, and discussion with key informants was made in order to collect the basic information on goat husbandry and initial productivity which will be further used to monitor the progress of selective breeding program. A total of 152 goats from 37 households were included in the study. Weight traits, birth types, parity and color patterns of goats were studied. Parity of goat reared in the site ranged from 1 to 10 whereas 5 different body color pattern were observed. Twining of the goat was found to be 61.5%. Body weight and Standard deviation of 1st parity goat was found to be 19.2±4.265 kg whereas for the 10th parity it was 27.5±4.79 kg. Mean one and two year body of goat with standard deviation were 15.09±4.488 and 26.0±2.82 kg, respectively. Variation in weight traits was found remarkable. Among the available body color type Kali (Black) goat was found predominating with 36.2% population. The paper describes overall management situation of goat in the site and its improvement plan especially focusing on selective breeding.

Mean daily weight gain and correlation coefficients among weights of goat of Chitawan, Udayapur, Siraha and Tanahun districts

Sapkota S, MR Kolachhapati, NR Devkota and SP Neopane (2008). Mean daily weight gain and correlation coefficients among weights of goat of Chitawan, Udayapur, Siraha and Tanahun districts. *Green field journal of Himalayan College of Agricultural Science and Technology (HICAST),* Gathaghar, Bhaktapur, Nepal, **6**:46-51

A study was carried out to compare and estimate the effect of non genetic factor such as location on the productive (weight) performance of goat representing central, eastern and western regions of Nepal, based on farmers managed condition from May, 2006 to January, 2007. Altogether, 122 kids and 60 does from Chitawan, 93 kids and 67 does from Udayapur, 101 kids and 60 does from Siraha and 62 kids and 38 does from Tanahun districts were taken for the study purpose. Data on productive (weight) traits were collected through direct recording and periodic observations monthly from birth up to 8 months. The data for mean daily weight gain were analyzed using the method suggested by Harvey (1990) and that for correlation coefficients were analyzed using SPSS 10. Mean daily weight gain significantly

(P<0.001) differed with respect to location. The overall findings of this study firmly suggested that the goat flock of Chitawan district had comparatively better performance in terms of production traits. Positive and significant (P<0.01) correlation coefficients between birth and weaning as well as weaning post weaning weights suggest that selection of the best performing kids could be done on the basis of both birth and weaning weights to obtain higher weight at later stages.

Study on the effects of non genetic factors on the growth and reproductive traits of hill goat

Kolachhapati MR, M Sapkota, NR Devkota and M Kharel (2008). Study on the effects of non genetic factors on the growth and reproductive traits of hill goat. *Journal of Institute of Agriculture and animal Science (IAAS)*, Rampur, Chitawan, Nepal

A study was carried out at farmers' field to evaluate the productive and reproductive performances of Hill goats (Khari) across the three ecological belts of Nepal, viz; at Udaipur, Kavre, and Surkhet districts, and a second study was done at IAAS livestock farm, Rampur, by pooling F_1 population from all the sites of first study. This paper is summary, based on the pooled three years data of the goats of all the sites. Least Square Analysis (Harvey, 1990) was used to determine the effect of non-genetic factors on the specific traits. Experiments were based on 2×2×2 factorial combination of treatments with five replications. Findings revealed that Hill goats varied significantly in terms of body weight, reproduction traits, and morphological characteristics, whereas the goats in Surkhet and Kavre were relatively larger and heavier than those in Udaypur, indicating existence of geographical niche specific differences among the Hill goats. The findings also revealed that the non genetic factors such as sex of the kids, litter size at birth, type of birth, and season of birth had a significant (P<0.05) effect on the pre and post weaning weight of the kids. It can be suggested that weaning and post weaning weight (six months) could be a good selection criterion in improving the productivity in term of body weight gain of goats. Therefore, selection of goat (breeding flock) would be a key area of consideration to improve reproductive and productive performance of Hill goats in Nepal.

Morphometric variation and reproductive performance of local Terai gaot under farmers managed conditions in Siraha, Nepal

Bhattarai N, M Sharma, NR Devkota and MR Kolachhapati (2008). Morphometric variation and reproductive performance of local Terai gaot under farmers managed conditions in Siraha, Nepal. Journal of Institute of Agriculture and Animal Sciences (IAAS), Rampur, Chitawan, Nepal

A field study was carried out to evaluate the productive and reproductive performance of local Terai goats during March 2006 to February 2007 in Siraha district, Nepal. A total of 206 dams and 318 goat kids, having different age groups were identified and studied. Morphological attributes, productive, and reproductive performance were collected based on direct measurement and monitoring. Least square analysis was performed using Harvey (1990) computer software package. The mean body weight of goat kids at birth, pre-weaning, weaning, at 6 months and at 8 months of post weaning age was 2.23±0.04, 5.75±0.16, 10.18±0.23, 13.67±0.28, and 19.31±0.44 kg, respectively. The measurements of morphological traits were always higher in male as compared to female kids. The findings further revealed that mean age at first conception, age at first kidding, gestation length, kidding interval, post partum estrus, and kidding rate were, 283.87±3.07, 457.05±2.73, 150.79±0.98, 246.97±6.130, 80.05±2.33 days, and 1.45±0.04 per parity, respectively. Information revealed from this study thus provided some basic facts about productive and reproductive performance of local Terai goat

reared under farmers' management conditions. Further in depth scientific study is required aiming to improve productivity of Terai goats through appropriate breeding practices.

Effect of genetic group on weight traits of goat under the western hill condition of Nepal

Panday SR, MR Kolachhapati, NR Devkota and SP Neopane (2009). Effect of genetic group on weight traits of goat under the western hill condition of Nepal. *Nepalese Journal of Agricultural Sciences , Himalayan College of Agricultural Sciences and Technology (HICAST),* Gathaghar, Bhaktapur, Nepal, **7**:91-95

Several different genetic groups of goats are being reared by Nepalese farmers without adequate information about their productive and reproductive performance. Goats of exotic origin are still being introduced in the country aiming to increase the productivity of indigenous goat through cross breeding, but the effects of such cross breeding in relation to productive and reproductive performances of goats are not adequately studied under field condition. A study was carried out in Tanahun district of Nepal from March, 2006 to January, 2007 to evaluate the effect of genetic group on the weight trait of goat. Local hill goat and its crosses with Jamunapari and Barberi were used for the study. Altogether 96 Khari kids, 96 Khari x Jamunapari (50% crossbred) kids and 94 Khari x Barberi (50% crossbred) kids were taken for study. Data on weight traits were collected through direct observations on the farmers' field during the study period and analyzed using the statistical package Harvey (1990). Mean comparison was done by using DMRT. The mean birth, pre weaning (2 months), weaning and 6 months weight were 2.25, 6.08, 10.32 and 13.0 kg, respectively for Khari x Jamunapari (50% crossbred) kids which were comparatively higher than that of Khari kids (1.89, 5.17, 8.84 and 11.38 kg) and Khari x Barberi (50% crossbred) kids (2.21, 5.76, 9.96 and 12.48 kg). Thus, the study revealed that crossbreeding of Khari with Jamunapari or Barberi may improve the weight trait of Khari goat.

Study on production potentiality of Khari goat in on farm condition

Pokharel PK, NL Tamrakar and SP Neopane (2009). Study on production potentiality of Khari goat in on farm condition. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 288-292

A benchmark study on on-farm productivity of Khari goats was made at Abukhaireni VDC of Tanahun district of western Nepal. Semi structured questionnaire survey, weighing of live goats, and discussion with key informants was carried out in order to collect the status on weight, twining, goat market and husbandry conditions practiced in the site. Altogether 212 goats of varied color patterns and parity from 33 households were studied. Twining of the kids was found to be 72.6% in against of single 26.4%.Population of Kali (Black) and Khairi (brown) goats were found more of 32.1 and 27.8%, respectively than any other available color pattern. Mean live weight and standard deviation of the 1st parity goat was found to be 21.8±2.48 kg whereas for the 6th parity goat the value was 43.4±6.87 kg. The outcome of the study will serve the evaluation of selective breeding program that is being implemented in the site.

Productivity of western Khari in Bandipur farm

Pokharel PK and NL Tamrakar (2009). Productivity of western Khari in Bandipur farm. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal 25-27 June, 2007, pp 298-302

A study on productivity of Khari goat at Bandipur Goat Farm was made using records of 3 consecutive years from 2060/61 to 062/63 BS. 247 kids were born during these periods. Goats were husbanded under semi intensive management condition with 6 hrs grazing on farm

pasture. Overall birth, wean, 6, 9 and 12 month weights of the kids found to be 1.69±0.02, 7.80 ±0.17, 10.13±0.23, 12.63±0.35 and 15.38 ±0.58 kg, respectively. The ratio of single and multiple birth cases of the kids during period was 114:133. A wide variation on weight traits and comparatively lower twining frequency often uncommon to this breed was observed. Effect of year was found significant (P<0.05) on wean and 6 months weights of the kids. The paper attempts to describe the overall productivity of western Khari goats in relation with the Khari from other regions of the country, as well as suggests improvement plan of the breed focusing on selective breeding program.

Dimensional characteristics of buck spermatozoa in relation to fertility and repeatability estimates

Kolachhapati MR and AK Batabyal (1990). Dimensional characteristics of buck spermatozoa in relation to fertility and repeatability estimates. *Journal of the Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan*, **11:**99-103

Twenty bucks were randomly selected (10 Beetle and 10 black Bengal x Beetle F1 crosses) for this study. Five ejaculates were collected from each buck at an interval of 3 days. Ten live normal spermatozoa were drawn randomly from each ejaculates. Six dimensional attributes of spermatozoa were studied viz. head area, head length, head breadth, head base, head shape and mid piece length. Attempts were made to isolate the best set of varieties influencing fertility. The result showed significant positive association of spermatozoa head length (0.671 and 0.664), head area (0.687 and 0.809) and head width (0.788 and 0.704) with fertility in Beetle and Beetle x Black Bengal F1 crosses, respectively. The repeatability values of these attributes in both genetic groups indicated the close associations with reproductive fitness were head area 0.44±0.12, 043±0.12, head length 0.62±0.11 and head width 0.50±0.12, 0.43±0.12. Age and body weight of bucks were not significantly associated with the dimensional attributes of spermatozoa.

Study on productive and reproductive performances of different genotypes of goats maintained at Agriculture Research Station (Goat), Bandipur

Tamrakar NL and MP Sah (2009). Study on productive and reproductive performances of different genotypes of goats maintained at ARS (Goat), Bandipur. *Proceedings of the 7th National Workshop on Livestock and Fisheries in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 283-287

This study was carried out on the goats maintained at Agriculture Research Station (Goat), Bandipur. Kids born during fiscal year (2051/52 to 062/63) were subjected to study on productive and reproductive performances. Kids were kept with mother up to 4 months of age. At 4 months, kids were weaned and stall feeding fodder leaves, green grasses and concentrate mixture @ 1 percent of body weight per day. Recorded data were analyzed by using statistical version 1. The data analysis revealed that Sinhal was found to be heaviest in birth, 4, 6, 9, and 12 months weight (2.4, 10.97, 13.59, 15.77 and 18.34 kg, respectively) compared to other genotypes. Highest birth weight was found in the kid born as male and single birth. The effect of sex, season, birth type and year of the birth was significant (P<0.01). The lowest age at 1st kidding and kidding interval was found in Khari goats (533.4 and 298 days, respectively). The highest kidding percentage was found in Barberi (159.8) followed by 50% Barberi x Khari (156.4) and Khari (148.3). Likewise, weaning percentage was found highest in Barberi (117) followed by (Khari (113.9) and 50% Jamunapari x Khari (107.9). Significantly higher survivability (P<0.01) was found in 50% Kiko x Khari crosses followed by 50% Barberi x Khari and Sinhal goats. The lowest survivability was found in pure Barberi breed. There was

significant effect of age on survivability of goats. The survivability percentage male and female kid was non-significant.

Flock maintenance and performance study if native (Terai local) and exotic (Barberi) and their crosses (F1 generation) of goats at Region Agricultural Research Station (RARS), Nepalgung

Shrestha YK (2009). Flock maintenance and performance study if native (Terai local) and exotic (Barberi) and their crosses (F1 generation) of goats at RARS, Nepalgung. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, Pp 294-297

Three goat breeds namely Terai local, exotic (Barberi) and their F1 crosses were maintained at Regional Agricultural Research Station, Nepalgung adopting sedentary management system since 2054 BS. Animals were allowed to graze for 6-7 hrs daily, concentrate feed @ 100g/ animal and basic health service were provided. A sound breeding plan was made for breeding the animals from the beginning. Daily observation was taken, recorded and analyzed different parameters of economically importance traits viz., weight trait, litter traits and reproductive (dam) traits. 50% BL was found to be heavier (1.97±0.059 kg) followed by Barberi (1.92±0.064 kg) and Terai local (1.78±0.074 kg) but weight at slaughter age was performed better by Terai local (16.71±0.352 kg) followed by BL 50% crosses (15.22±0.3 kg) and pure Barberi (14.33±0.246 kg). Litter size at birth to one year and corresponding weight was found better in BL 50% (1.55±0.084 to 1.28±0.081 and 2.91±0.146 kg to 24.5±1.362 kg) than Terai local (1.58±0.097 to 1.16±0.063 and 2.86±0.165 kg to 17.97±1.05 kg) and Barberi (1.38±0.08 to 1.0±0 and 2.64±0.12 to 14.33±0.34 kg), respectively. Terai local goat has to be found more prolific in terms of kidding rate (1.58±0.09) and kidding interval (281.42±10.03 day) and age at 1st service (356.8±12.23 days) followed by BL 50% (1.55±0.08, 355.14±17.03, 421.0±16.59 days) and Barberi (1.38±0.08, 287.42±13.37, 454.0±17.1 days), respectively. The mean body weight at 1st service of goats was 19.0±1.52 kg and gestation length was 146.0±1.0 days.

Effect of genetic groups on litter and dam traits of goat under the western hill condition of Nepal

Pandey SR, MR Kolachhapati, NR Devkota and SP Neopane (2009). Effect of genetic groups on litter and dam traits of goat under the western hill condition of Nepal. *Journal of Institute of Agriculture and Animal Science (IAAS),* Rampur, Chitawan, **30**: 87-96

A study was carried out in Tanahu district, Nepal from March 2006 to January, 2007 to evaluate the effect of genetic group on litter and dam traits of goat. Local hill goat and its crosses with Jamunapari and Barbari were used. A total of 180 does including 60 from each genetic group were taken. Data on litter and dam traits were collected through direct observations on the farmers' field, and through household survey, by employing a semi-structured questionnaire. The data were analyzed using the statistical package, Harvey (1990). Mean comparison was done by using DMRT. The mean litter size at birth were 1.70, 1.31, and 1.44 with the corresponding litter weight of 3.19 kg, 2.88 kg, and 3.0 kg for Khari, 50% Khari x Jamunapari, and 50% Khari x Barbari, respectively. Likewise, the litter size at weaning was: 1.51, 1.06, and 1.20 with the corresponding litter weight of 12.90 kg, 11.03 kg, and 11.88 kg, respectively. The mean age at first conception, age at first kidding and kidding interval were 403.75 days, 549.50 days and 261.15 days, respectively for Khari doe which were comparatively lower than that of Khari x Jamunapari doe (554.40 days, 696.36 days, and 329.11 days) and Khari x Barbari doe (450.13 days, 588.05 days, and 299.0 days). Thus, the study revealed that Khari doe was

superior to its crosses with Jamunapari and Barbari for litter traits and major dam traits such as age at first conception, age at first kidding, and kidding interval.

Reproduction of sheep and goats in Koshi hills

Gatenby RM, PB Chemjong and BB Kshatri (1990). Reproduction of sheep and goats in Koshi hills. *Technical Paper N. 90/136*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

A survey of 178 farmers keeping sheep and goats was conducted in Bhojpur, Dhankuta, and Sankhuwasava and Terhathum districts in eastern Nepal. Mean litter size was 1.7±0.04 for goats and 1.2± 0.05 for sheep. These means are significantly different ($P<0.01$). The average litter size of Jamunapari crossbred does was significantly lowers (1.5) than the average for local does (1.8). The interval between successive kidding and lambing averaged 9.3±0.23 months for goats and 10.3±0.3 months for sheep. The average kidding interval of Jamunapari crossbred goats (10.3 months) is significantly longer than the interval for local goats (8.8 months). The age at 1st kidding averaged 13 months, and the age at 1st lambing was 18 months. Bucks were first used for mating at about 8 months of age, whereas rams were 1st used at about 11 months. The age of does at 1st kidding and the age of bucks at 1st service were both significantly older for Jamunapari crossbreds than for local goats. The most common season for kidding is between January and May, in the dry season. Very few kids were born in the monsoon months of July, August and September. For sheep there was less seasonal variation than for goats, although there were few births in the middle of monsoon (July-August). There appears to be no effect of photoperiod on the pattern of parturition in either species. For goats, the optimum season for kidding was October to February, i.e. in the early part of the dry season. For sheep, October and November were the preferred months. The average age at weaning for both species was 5.6±0.2 months. Several farmers commented that kids and lambs wean themselves when the dam's milk production becomes very low. The estimated pre-weaning mortality rates were 7% for goats and 5% for sheep. Feeding and digestive problems were the stated causes of death in kids and 1/3 in lambs. Inadequate milk and diarrhea were cited as the most common problems. The lifetime number of kidding or lambing totaled 13. It is estimated that goats remain in the herd for 11 years and ewes for 12 years. As Nepal is a Hindu country the slaughter of female animals is discouraged. In the majority of goat herds either the doe is taken to the buck when oestrus is observed or the buck is brought to the doe. For sheep, uncontrolled mating is the most common system. The majority of farmers with goats and sheep do not have own a mature male, but rely on service by a buck or ram belonging to another farmer. 89% of farmers with does and 82% with ewes do not pay a service fee, even when mating is controlled. The weaning rate of goats is estimated to be 2 kids/doe/year, and that of sheep 1.3 lamb/ewe/year. Assuming that all weaned male kids and lambs are fattened and sold, the annual income from one doe is NRs 1200-1500 and from one ewe is NRs 650-910. Jamunapari crossbred goats are not popular in villages. Their reproductive performance is lower than that of local goats. It is recommended that 3 messages are put forward to farmers by extension workers,

- Recognition of oestrus and, in flocks in which there is not an adult male, the importance of quickly finding a buck or ram for mating
- Appropriate methods of improving the feeding of does and ewes, and
- The importance of mating does and ewes with an unrelated male to avoid inbreeding.

Migratory Baruwal sheep and Sinhal goats in the Annapurna region of Nepal: is conservation required

Ghimire SC, DP Rasali, HK Shrestha, RS Rana and HD Joshi (1998). Migratory Baruwal sheep and Sinhal goats in the Annapurna region of Nepal: is conservation required. *The 4th Global Conference on Conservation of Domestic Animal genetic Resources*, Birendra International Convention Center, Baneswor, Kathmandu, Nepal,17-21 Aug 1998

Baruwal sheep and Sinhal goats are the major species of livestock raised in mixed flocks under the transhumance system in the Annapurna region of Nepal. The system was developed and practiced for centuries utilizing the natural resources in the region. The vast area of alpine pastures situated between the snowline (5000 m asl) and the tree line (3700 m asl), which is otherwise inaccessible for human settlements, offers excellent grazing area for more than 20000 sheep and goats. These animals are well adapted to the harsh conditions of migration and tolerate the heavy rainfall of the monsoon and the cold weather. Analysis of the trend in the small ruminant population over the past 18 years in this region shows a decline of 23% in the number of flocks, 19% in the sheep and 40% in goats. This situation is alarming. This is despite the fact that the demand for sheep and goat products like meat, wool/fibre and even manure (for maintaining soil fertility) is increasing, and the poor farmers in the high hill villages are desperately in need of cash. The hard life of the shepherds with limited financial incentives, attraction of the younger generation to off farm income generation, insufficient scientific interventions to improve the system and productivity, various diseases, limited grazing area during winter etc. are the major causes for their decline. If the trend continues, if the profession does not attract a new generation and if no measures are undertaken to improve the situation, the system itself may eventually collapse, making Baruwal sheep and Sinhal goats endangered. Systematic approaches are, therefore, required to maintain and improve these genetic resources in a sustainable manner. Combining eco-tourism in the alpine areas with the age old migratory system of raising sheep and goats is one such approach which seems to have a promising future, but is yet unexplored.

Indigenous sheep populations in Nepal, their scope and conservation

Upreti CR (1998). Indigenous sheep populations in Nepal, their scope and conservation. *The 4th Global Conference on Conservation of Domestic Animal genetic Resources.* Birendra International Convention Center, Baneswor, Kathmandu, Nepal, 17-21 Aug, 1998

Sheep are multipurpose domesticated small ruminants reared in all agro- ecological zones of Nepal. They provide wool for clothing and carpets (average 1 kg/sheep) fresh organic manure for crop farming (0.8 kg/sheep/day), draft power to carry the basic commodities (10 kg/sheep/trip, 33% of live weight) and meat as a source of protein (16kg dressed/meat/animal). The indigenous sheep population consists of Bhyanglung (4% of total 0.87 million) in the Trans Himalayan region, Baruwal (63%) in the hills and mountains, Kage (21%) in the hills and valleys, and Lampuchhre (long tail – 12%) in the southern plains (Terai) of Nepal. Sheep farming has been concentrated in the remote areas of the hills and mountains and is the main stay of rural people in this tract. Wool is the main source of raw material for Nepalese handmade carpets as it is possible to blend raw wool (25% Baruwal and 53% Bhyanglung) without affecting the quality of the carpet. The national annual raw wool requirement can be supplemented by 30% native raw wool. Bhyanglung sheep produced fine to medium (25-27μ) and Baruwal produced coarse type (38-50μ) with adequate staple length (12-16cm). Overall, the national sheep population growth rate is 2-5%, but the population of Bhyanglung and Baruwal is decreasing by 5-10% annually. The conservation and promotion of

these indigenous sheep populations means the retention of local people in their home tract and the production of raw wool for the wool industry, particularly the carpet industry.

Sheep genetic resources of Nepal

Shrestha BS, S Shrestha, SP Neopane and NP Shrestha (1998). Sheep genetic resources of Nepal. *The 4th Global Conference on Conservation of Domestic Animal genetic Resources*. Birendra International Convention Center, Baneswor, Kathmandu, Nepal, 1998,17-21 Aug, 1998.

The Central Bureau of Statistics estimated the sheep population to be 0.87 million in 1994/95. From north to south of the country, there exist 4 distinct populations of sheep. The fine wool Bhyanglung in the Trans-Himalayan region (>2500 m asl), a rough wool population, Baruwal (inclusive of Dhorel), in the high hills and mountains (1500-2500 m asl), Kage, in mid hills and valleys (300-1500 m asl) and Lampuchhre the west Terai (<300 m asl). Out of the total estimated sheep population, 4% are Bhyanglung, 63% Baruwal, 21% Kage and 12% Lampuchhre. About 84% of the sheep are concentrated in the hills and the remainder in the Terai. Bhyanglung sheep, raised under the Trans-Humance system of management, are predominately white in color, followed by black and white and black and have relatively small sized bodies (adult wt 27-30 kg). The average body length of Bhyanglung sheep was found to be 69 cm (60-79 cm). The average withers height, height at hipbone, and barrel height from ground were found to be 64 cm (55-75 cm), 66 cm (57-79 cm) and 33 cm (28-40 cm), respectively. The chest girth of Bhyanglung sheep was 77 cm (66-86 cm). The body size varied with location. The Bhyanglung sheep has mostly coiled horns with a horn length of 35-cm (13-54 cm), small dropping ears of 10.4-cm average length and a small hairy tail of 15.5-cm (6-20 cm). Bhyanglung sheep lamb for the first time at an age of 1.5 yr and generally have single births with a lambing interval of 7 months. The birth weight of lamb varied from 2.2 to 2.5 kg. Sheep are sheared once a year and wool yield varies from 0.8 to 1.1 kg with a fibre diameter of 26.65µ. Baruwal sheep raised under the migratory system of management are mostly white, black, black and white and brown in color. The adult body weight averaged 25-32 kg. The average body length, wither height, hip bone height, barrel height, and chest girth were 70 cm (64-77 cm), 66.3 cm (57-72 cm), 24.3 cm (29-39 cm) and 75.8 cm (68-83 cm), respectively. The Baruwal has upward and backward curved horns 20.7 cm (3.5-64 cm) in length. These sheep have a roman rose, small ear of 5.5-cm length (3.5-13.5 cm) and a tail length of 15.5-cm (6-19.5 cm). Baruwal sheep also lamb for the first time at an age of 1.5 year, produce single birth with lambs having a birth weight of 2.4 to 3 kg. The lambing interval is 6 to 12 months. Sheep are generally sheared twice a year, once in spring and once in autumn, with average wool yield of 800 g annually with 46.3µ fibre diameter. Dhorel (the strain within Baruwal) are slightly heavier (30-45 kg) with a curve on the lower part of Roman nose and give a slightly higher annual wool yield (0.9-1 kg) of a coarse type (54.9µ). Kage, relatively prolific sheep, are raised in the low hills and valleys of Nepal. The average body length, wither height, hipbone height, barrel height and chest girth were 60.6 cm, 53.9 cm, 55.1 cm, 21.2 cm, and 67.8 cm, respectively. Kage females are mostly polled, having an average ear length and tail length of 12.8 cm and 13.7 cm, respectively. The average birth weight of lambs was 1.5 kg. Sheep are generally sheared twice a year with an annual wool yield of 480 g and fibre diameter of 25- 50 µ.Lampuchhre (long tail) sheep are found in the western Terai of Nepal. The average body length, wither height, hip bone height, barrel height and chest girth of Lampuchhre sheep were 63.1 cm (55-75 cm), 50.9 cm (53-69 cm), 53.3 cm (54-73 cm), 33.1 cm (28-38 cm) and 71.3 cm (64.79 cm), respectively. Some of the sheep were polled white others had twisted curved horns. Ear length averaged 12 cm (3-18 cm) with slight drooping. However, the tail length of this sheep breed is relatively longer (32.7 cm). The average age at first lambing ranged from 17- 18 months and lambs with a birth weight of 1.8 kg. Three times a year shearing is carried out with an annual wool yield of 750 g and a fibre diameter of 25 to 50µ.

Selection for nematode resistance: An alternative approach for parasitic control in sheep

Shrestha BS (2004). Selection for nematode resistance: An alternative approach for parasitic control in sheep. *Proceedings of the 2nd SAS/N Convention*, Kathmandu, 30 July – 1 Aug, 2003, pp 353-361

Parasitism in sheep on is considered as one of the major problems. Control strategy based on anthelmentic treatment has come under threat due to emergence of anthelmentic resistance in wide range of nematode species. Breeding sheep for nematode resistance have emerged as one of the alternatives. Nematode resistance trait is under genetic control and it's mediated through immunological response. The common measure of resistance is fecal egg counts (FEC) and FEC is moderately heritable with typical heritability 0.2-0.4. The heritability estimate is lambs (1-2 months) are not significantly different from zero indicating that resistance is rather acquired than the innate trait. The genetic correlation between resistance and production traits (body weight and wool) is mostly favorable (r-0.02 to -0.8) though neutral to slightly unfavorable correlation has also been reported. The genetic parameters suggested that the resistance trait can be incorporated as one of the criteria in selection objective.

2.4 PRODUCTION AND MANAGEMENT

Comparative performance of Khari goats and its crossbred with Jamunapari goat at Central Goat Farm, Bandipur

Pradhan SL and NK Gurung (1985). Comparative performance of Khari goats and its crossbred with Jamunapari goat at central goat farm, Bandipur. *Nepalese Journal of Animal Science (NASA),* **1**(1): 35-45

Comparative performance Khari goat and its crossbred with Jamunapari studied at Central Goat Farm, Bandipur and of some important breeds for example Jamunapari, Beetle, Barberi, Black Bengal and Malabari of India, Matou of China and Kambing Katjang of Malaysia, were examined in terms of average litter size, weaning percentage, kidding/doe/annum, kids born alive/doe/annum, kids reared up to weaning/doe/annum and total live weight of weaned/doe/annum. Although Khari goat reared less number of kids /doe/annum than Black Bengal and Matou, It has produced more live weight weaned /doe/annum than Black Bengal, Beetle and Barberi. The 1st cross (50% crossbred) of Jamunapari and Khari produced more live weight of kids Raise/doe/annum, but it has less multiple birth percentage and number of kids reared up to weaning/doe/annum compare to Khari goat.

Skin and fibre production from goats

Pradhan SL. (1987). Skin and fibre production from goats. *Nepal Journal of Animal Science (NASA*), **3**:31-57

Prospects of skin fiber production from goats and its international market trend have been highlighted and the possibility of improving indigenous goats for skin and fiber production has been reviewed. It has described classification of skin, evaluation of breed for skin production, wool selection parameters and grading system of wool.

Goat breeds comparison study in Hattikharka Panchayat

Oli KP (1988). Goat breeds comparison study in Hattikharka Panchayat. *Nepalese Journal of Animal Science (NASA),* **4**(4)**:**1-11

The Performances of crossbreed goats raised under traditional husbandry system were compared with local goats at altitude between 2000-6500 ft. asl in the mid hills of Nepal. No

production performance differences were observed due to altitude within this altitude range. The birth weight of a kid represented 10 to13 percent (%) of the live weight of a one-year-old goat. No significant difference in the growth rates between the different breeds of goats was observed. In terms of mortality, Jamunapari ´Local (JP´LO) had the highest rate of 28% followed by Barberi ´Local (Ba ´ Lo 18% Beetal ´ Local (Be ´ LO) 15%, compared with Local of only 4% Comparison of the reproductive parameters showed that among the breed tested, the Local goats produced nearly 60% more meat per doe per year than the other crossbreed goats. The findings of this on farm study casts doubts on the benefits claimed by the use of exotic breeds of goats for upgrading the indigenous goat's population. It indicated the need to adopt a strategy of genetic improvement of Local goats through selection investigation of the exotic breeds for up grading purposes other than those used in these experiments should continue, but in the light of this study, not rate as a high priority.

Performance of Kiko crossbred goats at Pakhribas Agricultural Centre

Aryal IK, NP Shrestha and SP Neopane (1992). Performance of Kiko crossbred goats at Pakhribas Agricultural Centre. *Working Paper N. 92/33*, Pakhribas Agricultural centre (PAC), Pakribas, Dhankuta, Nepal

A performance study on Kiko crossbred goats is being carried out at Pakhribas Agricultural centre (PAC). Local goats were purchased from local farmers. Oestrus synchronization and super ovulation was done by using pregnant mare serum Gonadotrophin (PMSG) and vaginal sponges. The local goats were then artificially inseminated with Kiko frozen semen imported from New Zealand. The conception rate and average gestation period was found to be 31% and 143±4 days, respectively. The average litter size was 2.8±1.6 whereas the average birth weight of kids was 1.69±0.59 kg/head. Pre weaning mortality was found to be 32% mainly because of insufficient milk being available from the mothers to sustain the litter size. The average weaning weight and growth rate of the kids ($F_{1)}$ were 6.83±1.62 kg and 51±13 g/day, respectively. No significant differences were observed on weaning weight and growth rate between male and female ((P>0.05).

Performance of Chyangra (mountain goat) under sedentary system

Shrestha NP, SP Neopane, BB Kshetri and IK Aryal (1992). Performance of Chyangra (mountain goat) under sedentary system. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Paakhribas, Dhankuta, Nepal, **7**(2):53-54

Pakhribas Agricultural Centre (PAC) introduced Chyangra in 1987 at an altitude of 1750 m in order to see their productive performances under sedentary system. The mean birth weight recorded was 1.71±0.24 kg with a range of 1.5 to 2 kg with no significant difference between male and female (P>0.05). The average litter size recorded from 4 does with 2 kidding was one kid/birth. Pre-weaning mortality rate was 13% in kids which was mainly due to Coccidiosis and diarrhea. Among the parasites, Strongyle was quite frequently reported. The external traits of the animals were also monitored. The observations suggest that Chyangra can be reared under sedentary system in high altitude.

Effect of slaughter ages on meat production of fattening goats in the hills of east Nepal

Aryal IK, NP Shrestha and SP Neopane. (1995). Effect of slaughter ages on meat production of fattening goats in the hills of east Nepal. *Veterinary Review*, Nepal Agricultultural Research Council, Khumaltar, Lalitpur, **10**(2):15-18

A study was conducted to find out the economic age of fattening goats for slaughtering. A total 44 male goats were weaned and castrated at 4 months of age and reared under stall-feeding

condition. They were slaughtered at either 1, 1.5, 2 or 2.5 years of age. The results showed that the slaughter weight at above ages was found to be (mean ±SD) 12.37 ±1.34, 20.64 ± 3.65, 22.32 ±3.68and 32.06 ± 5.90 Kg, respectively. The total meat production, including edible offal (kg) was 7.75 ± 0.95, 12.85 ± 2.36, 13.93 ± 2.16, 22.06 ± 4.83, and the dressing % was 62.76 ± 5.09, 62.2 ± 2.01, 62.48 ± 2.37 and 68.43 ±4.14 %, respectively. The overall financial analysis of this study showed that 1.5 years of age is most appropriate for slaughtering for meat production.

Growth and carcass yield of intact male hill goats in east Nepal

Aryal IK and SP Neopane (1996). Growth and carcass yield of intact male hill goats in east Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **11**(1):11-13

A study was carried out to assess the growth and carcass yield of one year old intact male hill goats at Pakhribas Agricultural Center, Dhankuta, Nepal during 1994-95. The highest growth rate (51 g/day) of goats was obtained from birth to weaning and lowest (18g/day) from weaning (four months) to eight months of age. The average growth rate from birth to one year of age was 29g/day. The average slaughter weight of the goats was 14.3±0.03 kg (mean±SE) and the dressing percentage was 43 %. However, by including edible offal's it was found to be 62 %. This study has established baseline information for intact male hill goats.

Comparative performance of seven goat breeds at Agriculture Research Station (Goat) Bandipur

Upreti CR and RR Khanal (1997). Comparative performance of seven goat breeds at Agriculture Research Station (Goat), Bandipur. *Proceedings of 2nd National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Sept 24-25, 1997, pp 24-28

Goat breeds maintained at ARS (Goat) Bandipur were used to compile their morphological, reproductive and productive performances. Among the seven breeds studied Jamunapari was bigger and Barberi was smaller in body weight, wither height and body length. Barberi cross (Khari x Barberi) had big round neck showing good meat type and attractive physic. Comparatively Khari was superior in major reproductive traits such as age at first kidding, kidding interval, kidding rate, kid weaned per doe per parity, adult and kid mortality. Interesting results were observed regarding the meat production showing that the Khari had highest economic return (NRs 770) followed by Sinhal (NRs 665), Khari x Kiko (NRs 330, Khari x Barberi (NRs 31) Barberi (NRs 12), Jamunapari (NRs252), keeping Khari x Jamunapari (50%) earning as midpoint to economic return (NRs 1905.75/doe/parity).

Sannen goats as a possible income generator for small farmers in Nepal

Paudel D (1997). Sannen goats as a possible income generator for small farmers in Nepal. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 11-16 March, 1997, pp16-22

A comparative study of local hill, Sannen and local X Sannen goats was started in 1986 at the Rural Development Center Farm, Lamachaur, Pokhara. This paper summary the information collected so far on age at first kidding, kidding interval, litter size, survival rate of kids to weaning, birth weight and weaning weight. Crossbred does were superior to local does in terms of kid weight at birth and weaning, kid mortality and milk production. However, local does had lower ages at first kidding and kidding intervals. The crossbred does produced total kid weights of 5.3 and 30.4 kg/doe/year at birth and weaning at 15 weeks. The values for local does were 3.5 and 17.4 kg/does/year, and for Sannen does 4.9 and 24.5 kg/doe/year.

Growth performance of Israeli crossbred goats under farmers' field condition

Kolachhapati MR, M Kharel, M Sharma and DB Nepali (1998-99). Growth performance of Israeli crossbred goats under farmers' field condition. *Journal of Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan*, **19-20**:169-173

A study on performance of crossbred goats sired by Israeli bucks [Damascus (D) and Mamber (M)] with local (L) goats was conducted around the villages surrounding IAAS, Rampur to know their performance in field condition and to understand, and farmer's response towards these crossbred. In general, the average body weight at 1st old age stage of both 50% DxL (23.1±1.8 kg) and 50% M x L (20.8±2.1 kg) were superior to that of local . Between two genotypes 50% D x L crossbred did better than MxL. However, they were more responsive to quality of management. The average daily gain of both genotypes was almost double under good management condition (105.5 g/day) than that in poor management condition (57.7g/day). Besides, dam line also affected the performance of crossbred; the bigger (mainly Terai) does produced better offsprings than that from similar does. Sixty five percent respondents liked these genotypes in place of local Jamunapari crossbred and were interested in receiving the buck services of these breeds where as some farmers whose animals were inferior were not encouraged with these breeds.

Study on the existing goat production system with productive performance and associated constraints in farmers' condition

Upreti CR and GP Khakural (1999). Study on the existing goat production system with productive performance and associated constraints in farmers' condition. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, pp 190-196

A survey was conducted to find out the existing goat production system and associated constraints. A total of 15 breeding bucks of 3 breeds (5 bucks in each breed Barberi, Jamunapari and Khari) were distributed. Distributed bucks were monitored for their reproductive performance. Average herd size/household for goats, cattle and buffalo was 6.12, 3.36 and 1.72 heads respectively. Per capita goat population in survey area was 0.5 i.e. 0.5 goats/head human population which was higher to national average. Among the ruminant move male cattle (38%) and more buffalo were reared. Goats were taken to grazing by the children and women. The women and children grazed about 75 and 25% goats respectively. Grazing hours was reduced by average 5.5 (5-7 hrs) to average 3.5 hrs (2-6 hrs) which might be due to:

- Children were going to school
- Increases cultivation pressure.

Total 11 major fodder trees, ranging from 3-6 in numbers were used mainly during Feb-May. Feed wastage was recorded up to 50% around the traditionally made feeder rack. Only 5% household adopted the improved sheds. High incidence of respiratory diseases (28.8% goat affected) was caused by the unremoval of faces from the ground. All types of goats, irrespective of age and sex were panned together with uncontrolled breeding. Parasitic burden in farmers field was lower (30.43% infestation) than the research station (60.3%). At farmers condition Khabari (50%Barberi x 50% Khari) performed better (52g/d growth rate) than Khapari (50% Jamunapari x 50% Khari) (48g/d) and pure Khari (44g/d). The farmers' preferred Khabari to other 2 breeds. Main constraints faced by the farmers were lack of improved and hygienic housing, unplanned and uncontrolled breeding plan, use of unselected breeding buck, shortage of labor, lack of community grazing land and frequent occurrence of goat diseases and shortage of veterinary medicine and services.

Meat production performance of different color types of goat

Aryal IK (2001). Meat production performance of different color types of goat. *Proceedings of the 1st SAS/N Convention*, Kathmandu, March 29-31, 1999, pp 238-242

A study was conducted to investigate the meat production performance of different color types of goat (Ghorlie, Dhobini, kali, Seti and Sigari). A total of 42 local male goats aged between 22 and 24 months old were slaughtered by the local method. The slaughter weight of goats was 21.5±3.32 kg. Data on meat production performance were analyzed using the least square analysis. The live weight of different color goats during slaughter was no significant. The dressed carcass weight was significantly lower (P<0.05) in Seti (9.83±0.7 kg) and Singari (9.88±0.97 kg), compared to Ghorle (11.5±0.43 kg). However, this was not significant with Dhobini (10.5±75 kg) and Kali (10.4±0.34 kg). The total meat production, including all edible offal or byproducts was significantly lower (P<0.05) in Seti (13.5±1.05 kg) as compared to Ghorlie (16±0.7 kg). The carcass dressing percentage and the dressing percentage, including all edible offal or by products was significantly lower in Seti goats as compared to Ghorlie and Dhobini. However, the reasons for low dressing percentage in Seti are not known. The results of this study showed that the validity of the farmers perception that white goats have lower meat production potential, and that Ghorlie, Dhobini and Kali were better meat producers.

Exploration of constraints and opportunities of small ruminant production system in Karnali Zone

Tiwari MR (2002). Exploration of constraints and opportunities for ruminant production system in Karnali Zone. *HRP Project Completion Report*, Sheep and Goat Research Program, Guthichaur, Jumla

The aim of the study was to explore the constraints and opportunities of small ruminant's production system. The major constraints were predators (59.8%of respondents, herding problem, 20.6% of respondents) poisonous plants 10.9% of the respondents and limited feeding resources (8.7% of the respondents). Diseases and predators were the major cause for the population decline followed by lack of pasture and obstruction by community forestry on tree access to grazing and predators. An average of 12% lamb mortality and 5.9% adult mortality in sheep is being reported. Where as in case of goat it was found to be 10.9% kids and 5.7% adult mortality. Identified constraints and opportunities of small ruminants should be disseminated to the stakeholders at all level.

Performance study of native (Terai) and exotic (Barberi) goat at Regional Agricultural Research Station (RARS), Nepalgung

Chapagain PB, BP Kushuwa and RB Rana (2002). Performance study of native (Terai) and exotic (Barberi) goat at Regional Agricultural Research Station, Nepalgung. *Proceedings of 5th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, July 10-11, 2002, pp 115-118

A study was under taken to identify the suitable breed of goat for mid and far western Terai region of Nepal. Different parameters recorded were birth weight, pre weaning weight, weaning weight, post weaning weight, 9,12, and 24 months weight, litter size (N), litter weight (kg) age at first service, age at first kidding, kidding interval etc. Twenty-four months weight of Terai local and Barbari was 28.12±7.09 kg and 23.73±4.13 kg, respectively.

Meat production in Nepal: current status and future potential

Joshi BR and BKP Sah (2003). Meat production in Nepal**:** current status and future potential. *Proceedings of the 7th National Conference of Nepal Veterinary Association*, Tripureswor, Kathmandu, Nepal, 5-7 Nov, **24**:19-24

Traditionally, meat and meat products originating from all domestic farm animals except cattle are consumed in Nepal. Animal slaughter is a common practice not only for consumption but also for religious sacrifices and other traditional ceremonies. The available data indicate that buffalo meat contributes highest in the meat supply followed by goats, poultry, pigs, sheep and other species. However, except for poultry meat, there is a heavy dependency on the import of live animals and meat products from the neighboring countries especially from India for fulfilling the urban requirement of the country. The national population of 3.4 million buffaloes and 6.5 million goats has not contributed to their potential to the urban meat requirement of the nation basically due to lack of market oriented meat production enterprises in these species. On the other hand, the imported animals are mostly of old age in poor health and body condition. Similarly, the meat processing system is traditional and lacks proper veterinary inspection in most parts of the country. Although, legislation has been promulgated for hygienic meat production in the country, yet effective implementation of this act is difficult for most parts of the country inhabited by scattered settlements in rural settings. In this regard, it would be important to educate the people on the concept of healthy animal production, processing and supply of wholesome meat for safeguarding the health of the nation. Present paper discusses these issues and outlines some strategies for the promotion of meat industry in the country.

Study on goat production system in the Far Western hills of Nepal

Shrestha HR, HK Shrestha, BR Banstola, BS Kuwar and N Hamal (2004). Study on goat production system in the far western hills of Nepal. *Proceedings of the 5th National Animal Science Convention*, Nepal Animal Science Association (NASA), pp 237-240

Household survey and PRA were carried out to collect information on goat production system, its constraints and opportunity in the far western hills of Nepal. The study revealed that average land holding was 2.42 ha comprising of pastureland, Bari land and Khet land in proportion of 2.6:2.1. Each household had its own pastureland in which grazing was restricted during June to October. The grasses were harvested during early winter and piled up for bedding late winter and early dry season. The highest number of goats per household was found in Dadeldhura (13.18), followed by Darchula (9.63) and Baitadi (2.58). Out of the total household surveyed, 10 % households reared goats under stall-feeding and 21 % under sedentary system with limited grazing. About 69 % households rear goats under extensive systems in which goats were grazed over the larger area of forestry or pastureland. Khari goat was most common and was highly prolific producing about 1.5 kids per kidding. However, the mortality rate of kids and adult was high (15-25%) due to poor health management. Farmers were less aware about improved breeding practices and the chances of negative selection and inbreeding were high. The goat marketing system was poorly developed. Goat development in the far western hills can be enhanced through proper management of health, housing, feeding breeding and marketing.

Goat satasat karyakram (passing on) for poverty reduction: A case study of Dadeldhura district

Aryal IK (2004). Goat satasat karyakram (passing on) for poverty reduction: case study of Dadeldhura district. *Proceedings of the 4th National Conference on Science and Technology*, Nepal Academy of Science and Technology (NAST), Baneswor, Kathmandu, Nepal, March 23-26, 2004, pp 201-206

Goat has been recognized as one of the most important components for poverty alleviation in the rural communities from different agencies. Goat passing on is one of the major programs for income generation and poverty reduction in the rural community especially for women from the DLSO. Each farm family is provided with 5 goats with other supporting services. The program was implemented through group approach. The overall results of the program such as the approach used: women participation in income generation, support for poverty reduction and empowerment has been found successful. However, there are some areas where improvements are required. For example, during passing on from 1st group to the second they are reluctant to provide good young goats as per the agreement. As a result the farmers from 2nd group onwards are getting lesser benefits as compared to that of 1st group. Based on the analysis of the information and field experience, recommendations have been made for effective and demand driven program to resource poor communities, especially women for poverty reduction.

Development and evaluation of improved feeders for goats suitable to stall fed management system

Upreti CR, BS Kunwar and SB Panday (2005). Development and evaluation of improved feeders for goats suitable to stall fed management system. *Nepal Agriculture Research Journal (SAS/N*), **6**: 78-83

Five different feeders were designed and tested on goats to find out their effectiveness in reducing feed waste and cost fabrication. Experiment was conducted at ARS, Bandipur for 2 years. Tested feeders were hexagonal, hay rack, chain barrel, rectangular and conventional wooden tatnu. Feeders were fabricated using iron bars and woods. They were tested with the adult goats for feed wastage and feed contamination. Experimental feeds were fodder twigs (Tanki), forage (Stylo and Napier), crop residues (black bean straw) and commercial concentrate. Chain barrel type of feeder was also tested at farmer's field at Baradi. Rectangular feeders have significantly lower ($P<0.01$) feed wastage (6.61% for fodders) compared to other tested feeders. The fabrication cost was NRs 3200, 1700, 700, 900 and 150 for hexagonal, rectangular, hay rack, chain barrel and conventional wooden tatnu respectively. The rectangular feeder is suitable for goats feeding in Terai and in the hills of Nepal. It has provision for feeding fodders, grasses, crop residues and concentrates together at the same time. Chain barrel type had comparatively higher wastage (10.7% for fodder) than the rectangular but was preferred by the farmers due to its low fabricating cost, portable in size, small space required and easy to handle. Therefore, the rectangular feeder is recommended for middle level farmers and chain barrel for small farmers who rear few goats.

Production responses of migratory small ruminants in Nepal with integrated application of health, nutrition and flock management improvements

Joshi BR and BS Shrestha (2005). Production responses of migratory small ruminants in Nepal with integrated application of health, nutrition and flock management improvements. *Veterinary Journal*, **28**:15-24

Studies on various approaches and technologies on improvements in health, nutrition and flock management in the migratory flocks of Nepal showed that technologies on gastrointestinal

parasite control, poisoning treatment, nutritional supplementation and predation control reduced the flock mortality, increased body weight gain of young and yearling lambs and kids and advanced the mating and parturition by few months, which is better suited for survival and growth of young animals. Treatment of gastrointestinal nematodes with anthelmentics at monthly intervals during wet summer months improved the body weight gain of treated lambs and kids by 3.8 and 2.2 kg over the untreated controls. Similarly, oral drench of sodium thiosulphate solution @ 5-10 g/animal was effective to save the animals from natural poisoning with aconite plants. The solar lighting and nylon net enclosure was very effective to control predation during night. The anthelmintic treatment and nutritional supplementation during winter was highly effective to alleviate stunting syndrome of yearling lambs, as well as inducing earlier mating and lambing/kidding in the adult ewes and does. All these approaches when introduced in an integrated manner were highly effective to improve overall flock productivity and income from the flocks. Introduction of these technologies in the flocks in a package of practices could support the viability and sustainability of the system and increase flock productivity. It is thus important to develop the mechanism to transfer these technologies to the migratory management system to protect it from declining, and support its continuity and contribution to the local and national economy.

Identification of goat production system, its constraints and opportunities in mid western and Far Western hills of Nepal

Shrestha HR, BS Kuwar and SM Pradhan (2006). Identification of goat production system, its constraints and opportunities in mid western and Far Western hills of Nepal. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, 1-2 July, 2004, pp 37-49

It has been found from the study that the goat production systems in far- and mid-western hills are largely traditional and suffer basically from general lack of scientific approach to their improvement. The landholding size, percentage of households keeping goats, number of goats kept per household and quantity of DM available per household was higher in these hills compared to other regions. It is apparent that the local breed of goat is well adapted in the harsh environment of the hills and mountains of the far-and mid-western regions and productive efficiency is higher than the indigenous goats of other regions and is comparable to 50% crossbred goats. Even with available labor and feed resources, there is a high potential for goat development in the villages in terms of both quantity and quality of meat and number of animals. However, the existing system of goat management necessitates improvement in breeding management, health management, housing management and feeding management and production of feeding resources.

Migratory small ruminants: their potential and economic contribution in the high hills and mountain

Shrestha, BS BR Joshi and HD Joshi (2006). Migratory small ruminants: their potential and economic contribution in the high hills and mountain, *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, 1-2 July, 2004, pp 50-55

Migratory management of small ruminant is the tradition and an important means of livelihood in the high hills and mountains of Nepal. Sheep and goats under this system are reared for multiple functions. Meat, wool, manure and transportation are the important contribution made by these migratory small ruminants besides these animals being handy source of cash in the time of need to quench household requirements. Studies were carried out jointly by RARS, Lumle and LIBIRD, Pokhara in Sikles, Guthigaun and Pipalchauri VDCs of Kaski, Jumla and Darchula districts with the financial support of HARP from 2001 to 2004 with the objective of

identifying the existing constraints and opportunities of the system and introduce some interventions for improving the productivity of small ruminants and to sustain the system as a whole. The potential of the small ruminants under exiting and improved management system and the economic contribution made by small ruminants in the existing system have been described in this paper

Technical backstopping for increased food security through improved goat production

Kharel M, B Khadka, BR KC and MR Bhandari (2006). Technical backstopping for increased food security through improved goat production. *Green Field Journal of Himalayan College of Agricultural Sciences and Technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **4**(1):53-59

The districts of Rautahat and Bara located in mid Terai region of Nepal have significant proportion of landless and/or jobless people who have been neglected socially, culturally and religiously since centuries. MADE - Nepal, an NGO, in partnership with Plan – Bara and Rautahat came up to upgrade food security and income generation status of those families from 1996 to 2003. This project launched its program in 23 VDCs of Rautahat and 13 VDCs of Bara district. Because of the new awareness of farmers in health, nutrition and sanitation supported by the continuous assistance of the village vet workers, the mortality of goats was reduced down. With the effect of combination of all measures including breeding, the yearly body weight which used to be 13 kg at 12 months previously increased to 22.6 kg. The ten kg increment per animal per year with low mortality rate became a significant achievement of the project.

Chyangra production system and feeding resources: A case study of Mustang district

Tiwari MR and NLTamrakar (2006). Chyangra production system and feeding resources: A case study of Mustang district. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 1-2 July, 2004, pp 56-65

Goat is one of the most important livestock species reared in Mustang district. A survey study carried out in the district revealed that the highest number of goats/household was found in Kagbeni VDC (86.28%) followed by Marpha and Chhusang VDCs (60.1%). Most of the farmers followed migratory system (74.5%) and some adopted sedentary (25.55) system of goat management. Average of 2.39 ropani land of each household was found to be occupied by orchard. Due to the forage scarcity for livestock feeding during winter period, 99% farmers responded that they have keen interest to cultivate improved grass species under orchard rather than to leave it fallow. The average straw production/ropani was observed to be 1378.88, 649.33, 469.33, 405.33 and 408.9 kg for Uwa, Buckwheat, Barley, Maize stover and wheat straw respectively. Most of the farmers (40.4%) responded that they usually feed straw and stover to their animals from Mansir to Jestha. On an average, 13.8% of interviewed farmers responded that they provide concentrate n\mixture to all animals whereas 86.2 % responded that only weak animals and kids were provided with concentrate mixture. External parasites, mainly lice mange were the major health problem in goats.

An effective goat rearing model for poor farmers for poverty alleviation

Pariyar D (2006). An effective goat rearing model for poor farmers for poverty alleviation. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 1-2 July, 2004, pp 70-71

Goat is recognized as poor man's cow and is the major ruminant in the household of marginal farmers. All over the country, its meat is consumable by all ethnic groups. Different four models of goat rearing were tested in 24 farmers in four districts under two management system in

three belts e.g. low (400-1200 m asl); transitional (1201-1800 m asl) and high hills (1801-2200 m asl) for three years. Results indicate that goat rearing model =II with 5 goats, was the economical model for poor farmers which gave a net income of NRs 7000.0 per goat in three years whereas the model = IV with 9 goats gave a net income of only NRs 5000.0 per goat in three years, model=III with 6 and model=I with 4 goats had given a net income of NRs 6000.0 per goats in three years. On the other hand, stall feeding had better growth rate of kids than open grazing system of rearing. Under stall fed condition, average weight gain ranged from 260-340g/month, whereas in open grazing system weight gain was 176-250 g/month in different belts.

On farm production performance of different goat breeds and their constraints at Baradi, Tanahun

Tamrakar NL and MP Sah (2007). On farm production performance of different goat breeds and their constraints at Baradi, Tanahun*. Proceedings of the 8th National Outreach Research Workshop*, Khumaltar, Lalitpur, 19-20 June, 2007, pp 406-408

This study was carried out at outreach Baradi, Tanahun, Agricultural Research Station (Goat), Bandipur. The site was divided into 3 blocks (i) 5% Barbari x Khari (ii) 50 % Jamunapari x Khari and (iii) Khari blocks. The main objective of the study was to verify adaptability of 3 genotypes of goats and their constraints and parasitic infestation in goats under farmers' field condition. Kids born from 3 genotypes were subjected to their production performance study. The results revealed that birth weight of 50% Barberi x Khari and 50% Jamunapari x Khari was12 months were found heaviest in 50% Jamunapari x Khari (11.75, 14.74, 16.9 and 20.01 kg, respectively) in comparison to other breeds. The main constraints faced by the farmers in goat farming were lack of selected breeding bucks (25.7%) followed by lack of medicine and treatment (25%) and lack of technical advice (10%). Likewise, internal and external parasitic infestations were the major problems faced by the framers of Baradi. Fecal sample examination indicated that Strongyles and Coccidiosis account major parasitic infestation in goats at the outreach site Baradi.

Productive performance of Khari goats: A case study of eastern hills

Pokharel PK (2007). Productive performance of Khari goats: A case study of eastern hills. *Green Field Journal of Himalayan College of Agricultural Science and Technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **5**(1):41-48

A semi structured questionnaire survey was under taken at 5 sites of 3 districts in the eastern hills to collect productive performances and husbandry practices of Khari goats. One hundred eighty households were visited and 1228 goats were weighed during the study period. The mean body weight of the four, six and nine month's old male and female kids were found to be 8.6, 10.5 and 12.6 and 7.36, 8.74 and 11.7 kg, respectively. Average adult body weight 92 years old) of the she goat in farmers management condition was found to be 18.84 kg. During survey, maximum body weight of she goat was recorded 26.84 kg for three years age. Regarding the birth types, multiple born cases in the mid hills were found better than the low hills (36% vs. 19%). Castration age of male kids was varied from 6-9 months and above. Knowledge among the farmers on weaning, castration, controlled breeding and negative selection was greatly differ emphasizing due to consideration for betterment.

Goat marketing in the western hills of Nepal

Nepali MB and M Subedi (2007). Goat marketing in the western hills of Nepal. *Green Field Journal of Himalayan College of Agricultural Sciences and Technology (HICAST)*, Gathaghar, Bhgaktapur, Nepal, **5**(1):101-113

A study embracing to the marketing of goats were conducted in 11 districts of western hills with the objective of assessing marketing constraints and existing marketing channels using RMA along with survey. Most of goat raising farmers, middle man and wholesalers realized the lack of goat marketing centers either in the VDCs or in the district headquarters/ municipalities of western hills of Nepal. Some of the market channels are at the village level market, catchments markets, terminal markets and district headquarters. There are some marketing agents dealing with the goat marketing from village to the municipalities. Goat marketing agents are mainly farmers and middlemen at the village level. Similarly farmers and middlemen were dealing goat marketing in catchments. In terminal markets mainly wholesalers and middlemen were found dealing goat business. In district headquarters and municipalities middlemen, wholesalers and butchers were dealing the goat business. A total of 59% respondents' believed that middlemen visit in the village for goat marketing. Major constraints on goat marketing were lack of public goat marketing centers, lack of communications about goat marketing and lack of infrastructure etc either in village level markets or terminal markets or district headquarters/ municipalities markets. In the western hills of Nepal main goat marketing centre was found in Pokhara sub municipality where traders/ wholesalers bring the goats to sale from different catchments. Based on the survey in 11 districts the average share of goat in the total household income found to be 11%.

Goat production and marketing constraints in the western hills of Nepal

Nepali MB, S Gautam, HP Paudel and K Dhakal (2007). Goat production and marketing constraints in the western hills of Nepal. *Nepal Journal of Science and Technology,* Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, Nepal **8**:53-61

Goat production and marketing study was conducted in 11 districts with the objectives of exploration of the existing goat production and marketing system in western hills of Nepal. The methodology of the study was household survey, rapid marketing appraisal and use of secondary data. Most of the farmers raise goats in the villages. Major constraints in goat production were breeds, predators, infertility, parasites and feeding management. Some of the goat marketing centers are the village level, catchments, terminal level markets and district headquarters. There are some marketing agents dealing with goat marketing from village to the municipalities. Goat marketing agents mainly found farmers and middlemen at the village level and catchments markets. In terminal markets mainly wholesalers and middlemen were involved whereas the district headquarters and municipalities' middlemen, wholesalers and butchers were dealing goat business. Fifty-nine percent respondents believe that middlemen visit villages for goat marketing. Almost all farmers sell their goats on the basis of estimated price. Major constraints on goat marketing were lack of public goat marketing centers, lack of communications about goat marketing and lack of infrastructure, etc. in all the domestic markets. In the western hills of Nepal main goat marketing centre was found in Pokhara sub municipality where traders/whole sellers bring their goat to sale from different catchments. Based on the survey in 11 districts, the average share of goat in the total household income was found to be 11% Government should have the provision of establishing new goat marketing centers in each VDC and district headquarters.

Performance evaluation of Terai goat under farmers' management condition of Siraha, Nepal

Bhattrai N, MR Kolachhapati, M Sharma and NR Devkota (2009). Performance evaluation of Terai goat under farmers' management condition of Siraha, Nepal. *Nepalese Journal of Agricultural Sciences, Himalayan College of Agricultural Sciences and Technology (HICAST),* Gathaghar, Bhaktapur, Nepal, **7**: 70-75

Scientific information on morphological characteristics in relation to productive and reproductive performance of goat breeds is considered valuable in improving productivity. A field study was carried out to evaluate the productive and reproductive performance of local Terai goats during March 2006 to February 2007 in Siraha district of eastern Nepal. Altogether 206 dams and 318 goat kids of different age groups were identified for this study. Morphological attributes, productive and reproductive performance were collected based on field monitoring and measurements. Least square analysis was performed using Harvey (1990) computer software package. The mean body weight of goat kids at birth, pre-weaning, weaning, at 6 months and 8 months post weaning age was 2.23±0.04, 5.75±0.16, 10.18±0.023, 13.67±0.28 and 19.31±0.44 kg, respectively. Results revealed that the mean age at 1st conception, age at 1st kidding, gestation length, kidding interval, post partum estrus and kidding rate were 28387±3.07, 457.05±±2.73, 150.79±0.98, 246.97±6.13, 80.05±2.33 days and 1.45±0.44 per parity, respectively. This information revealed some basic facts about productive and reproductive performance of local Terai goat reared under farmers' management conditions and suggested that there is need of further scientific study aiming to improve productivity of these goats through breeding practices.

Understanding of potential and critical constraints to marketing of goats in the western hills of Nepal

Nepali MB, MR Tiwari, S Sapkota, HP Paudel, BR Acharya, KR Joshi and S Amatya (2009). Understanding of potential and critical constraints to marketing of goats in the western hills of Nepal. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 333-348

Goat production and marketing study was conducted in 11 hill districts of western Nepal. Most of the goat raising farmers, intermediary and wholesalers explained that there is lack of goat marketing centers either in the VDCs level or in district headquarters/municipalities of the western hills of Nepal. Some of the marketing channels are the village level markets, catchments markets, terminal markets and district headquarters/municipalities market. There are some marketing agents dealing with goat marketing from village to municipalities. Goat marketing agents mainly found farmers and intermediary at the village level catchments markets. In terminal markets, mainly wholesalers and intermediaries were involved whereas in district headquarters and municipalities the intermediaries, wholesalers and butchers were dealing the goat business. The results revealed that 59.3% respondents believe middlemen visit in the village for goat marketing. Almost all farmers sell their goats based on estimated price. Major constraints marketing were lack of public goat marketing centers, lack of communications about goat marketing and lack of infrastructure etc in all domestic markets. In the western hills of Nepal main goat marketing centre was found in Pokhara sub municipality where traders/wholesalers bring their goats to sale from different catchments. Based on the survey in 11 districts, the average share of goat in the total household income was found to be 11%.

Adoption of goat production technology at the farm level: a case study of Krishnagandaki VDC of Syangja district

Nepali MB, S Sapkota, S Upreti, BR Pokharel, B Sharma, HP Devkota and SM Amatya (2010). Adoption of goat production technology at the farm level: a case study of Krishnagandaki VDC of Syangja district. *Nepal Journal of Science and Technology,* Nepal Academy of Science and Technology (NAST*)*, Khumaltar, Lalitpur,**11:**79-82

Adoption of goat production technology consists of health, breeding, nutrition, pasture and fodder and management. The study was conducted in Krishnagandaki VDC of Syangja district with the objective of exploring the existing goat production technology adoption at the farm level. The methodology of the study included household survey, PRA and secondary data analysis. Most of the farmers raised goats in the villages. Overall farmers reported that the average adoption of goat production technology was (42.2%). The study revealed that farmers adopted breeding technology (53.5%), health technology (34.8%), nutrition technology (36.2%), management technology (53.9%) and pasture and fodder technology (32.4%).

Performance study of the Chitawan local goat and Kathmandu Kage sheep at livestock farm, Rampur, Chitawan

Dhakal IP, DB Nepali, M Kharel and KR Tiwari (1985). Performance study of the Chitawan local goat and Kathmandu Kage sheep at livestock farm, Rampur, Chitawan. *Journal of Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan*, **6**:161-172

A general performance study of the local goats of Chitawan and Nawalparasi districts and Kage sheep of Kathmandu valley was done at the livestock farm, Rampur for a period of 2 years. The total number of goats and sheep studied were 56 each. The findings indicated that the adult body weight and milk yield of the goat were 18.93 kg and 28.68 lit/lactation respectively. Similarly, the adult body weight, annual wool production and milk yield of Kage sheep were 16.05 kg, 250 g and 19.7 lit/lactation respectively. Significant performance of Kage sheep was observed with respect to its prolificacy. Its litter size in 2nd lambing was found 1.5 and lambing interval was 181 days.

Pure breed and crossbred sheep of Nepal – A Review

Kharel MK and SL Pradhan (1986). Pure breed and crossbred sheep of Nepal – A Review. *Nepalese Journal of Animal Science (NASA)*, **2**(2):13-25

A review of the general performances of pure and crossbred sheep reared in the various livestock farms of Nepal was made. Local breeds are well adapted to local management conditions but very poor in most economic characters. Some strains of Kage that are found in lower village of Kathmandu, Lalitpur and Makwanpur meet outstanding level of prolificacy of sheep. Baruwal and Kage, as principle breeds of Nepal, are most widely used breeds of local sheep for crossbreeding in Nepal. Crossbreds obtained after crossing local breed with any exotic breeds certainly did better in most of the characters considered especially in wool production. However, Polwarth which is most widely used in Nepal for crossing has not been appeared satisfactory to reach up to the desirable level. It seems that replacement of Polwarth by some other more suitable exotic breeds could be an appropriate attempt.

Production characteristics of Kage sheep of mid and Western Regions of Nepal

Pradhan SL. (1986). Production characteristics of Kage sheep of mid and Western Regions of Nepal. *Nepalese Journal of Animal Science (NASA)*, **2**:27-30

Kage sheep, one of the prominent of Nepal, adapted to subtropical condition, is extremely popular amongst the farmers' of inner valley of Nepal. Although, Kage population is not high, but it is noted for high prolificacy, hardiness, ease of raising, low maintenance cost and good meat flavor and tenderness. Some of physical and production characteristics of the Kage breed have been studied to substantiate its inherent qualities. Kage sheep of Pokhara valley was considerably bigger in size but same in appearance compare to the population of Lalitpur. Kage sheep of Lalitpur was more prolific 44.9% (multiple births) than that of Pokhara valley (3.7%, multiple births) but the mortality of the Lalitpur Kage lambs was slightly higher 20.4% compare to 15% of Pokhara lambs. The frequency of lambing/annum was slightly better for Lalitpur Kage population (1.3%) compare with figure 1.2% Pokhara Kage population. Although the number of lambs weaned/ewe/annum for Pokhara Kage was only 1.06 but the total live weight output of Kage lambs weaned /ewe/annum was higher, 14.14 kg compare to the Lalitpur Kage, 11 kg wool production of Pokhara Kage adult was about 0.345 g and of Lalitpur was 0.327g but the quality of wool from Lalitpur Kage sheep was better.

The effect of monsoon on lambs born at different times of year

Owen OD (1987). The effect of monsoon on lambs born at different times of year. *Technical Paper 87/8,* Lumle Agricultural Centre (LAC), Lumle, Kaski, Nepal

Little difference was found in the mortality rate over the monsoon of lambs born at different times of the year, but those born in late autumn on yearly winter were still significantly heavier (3-6 kg) at 1 year of age than those born after mid winter i.e. mid Dec onwards. An earlier investigation conducted at LAC by Odell in conjunction with HFRO was reviewed and recommendations made regarding the probable best season for lambing. The report concludes that on the evidence of these two investigations the most advantageous time for lambing is October/November and November/Dececember. Lambs born in these months tend to have a lower mortality and better weight gain up to 1 year of age, which may lead to earlier puberty. It also adds that this is the most convenient time for the shepherds, but that are the disadvantages in concentrating lambing into too short a period.

A comparative study on lamb mortality and lambing performance in Baruwal and Baruwal x Polworth (25-50%) crossbred sheep in the migratory flocks of Kaski district in Nepal

Karki NPS and TS Dhauwadel (1988). A comparative study on lamb mortality and lambing performance in Baruwal and Baruwal x Polworth (25-50) crossbred sheep in the migratory flocks of Kaski district in Nepal. *Technical Paper N. 88/17*, Lumle Agricultural Center (LAC), Lumle, Kaski, Nepal

Mortality in 200 crossbred (Polworth x Baruwal) and 277 Baruwal lambs were studied in 9 migratory flocks of Ghandruk, Kaski and lamb mortality of 29.58 and 39.78 % were found respectively within one year of recording. This does not prove high mortality in crossbred lambs as reported earlier in Nepal. Similarly, Lambing percentage in crossbred (Polworth x Baruwal) and native breed Baruwal ewes was studied in 7 migratory flocks of Ghandruk, Kaski and percentage of 90.76 and 94.14% was found, respectively in the ewes above 3 years of age. This was not significant difference statistically and hence it is concluded that there was no significant difference in lamb mortality and lambing performance in crossbred and local Baruwal breed of sheep in traditional migratory system of sheep keeping.

Performance of exotic breeds (French Merino and Polworth) native breeds (Baruwal) and their crosses in Pansayakhola Sheep Farm, Nuwakot, Nepal

Upreti CR (1990). Performance of exotic breeds (French Merino and Polworth) native breeds (Baruwal) and their crosses in Pansayakhola Sheep Farm, Nuwakot. *Nepalese Journal of Animal Science (NASA),* **6**(6):47-51

Fifty percent crosses of Baruwal with both Polworth and Merino performed better than the local Baruwal breed on the Government Sheep Farm, Nuwakot. Crossbreds grew faster than the pure breeds. Wool production from the crosses was more than twice that of the native Baruwal breed. French Merino had the lowest lambing interval of 281 days, Polworth of 321 days and Baruwal of 360 days, and crossbreds of 348-363 days. French Merino and Baruwal x Merino crossbreds had higher lambing percentages 92.9 and 89.8% respectively, than Polworth (79%) and Polwarth x Baruwal crossbreds (83%). Multiple births were found only in French Merino (11.1%) and Baruwal (2%). Lambs weaned/ewe/year ranged between 0.5 (French Merino) to 0.8 (French Merino x Baruwal crossbreds). Polworth and Polworth x Baruwal crossbreds (20, 4 and 23.7 kg) had lower yearling weights that those of Baruwal, Merino and French Merino x Baruwal crossbreds (26-28.5 kg).

Comparative study of various sheep breeds at Pansayakhola sheep farm, Nuwakot

Upreti CR (1991). Comparative study of various sheep breeds at Pansayakhola sheep farm, Nuwakot. *Proceedings of the 1st National Animal Science Convention (NASA)*, Lalitpur, Nepal, January 14-15, 1991, pp 82-85

Study indicated that the 50% crosses of Baruwal sheep with both Polworth and Merino performed better in many traits compared to local Baruwal breed at this farm and migratory flock. Crossbred grew faster (87 to 100g/d) than the pure exotic breeds 80.7 to 94.35 g/d). Wool production from the cross was more than one and half time (1.54 kg) that of the native Baruwal breeds (0.85kg). Crossbred had longer staple length (12 and 11.4 cm of M x BW and P x BW respectively) than pure exotic and native breed (7.8 to 9.9 cm), which has a significant effect on carpet making. Crossbred had better weaning ability (0.81 and 0.71 in M x BW and PX BW respectively) than pure exotic and native breeds (0.6 to 0.7 lambs per ewe). Merino and their crossbred had higher lambing percentages (95and 93%, respectively) compared to both Polworth and their cross and Baruwal (90, 84and 83.5, respectively). Only pure Merino and Baruwal showed twinning ability (5% and 2%, respectively (Pure exotic breeds were early lambers (568 and 617 days for Polworth and Merino) than their crosses (701 to 770 days). General comparison between stationary and migratory flocks revealed that sheep kept in migratory flock performed better especially in lambing percentage, lamb growth rate, survivability and birth weight.

Comparative study of load carrying ability of Jumli Baruwal and Polworth crossbred wethers

Gurung NK (1991). Comparative study of load carrying ability of Jumli Baruwal and Polworth crossbred wethers. *Proceedings of the 1st National Animal Science Convention (NASA*), Lalitpur, Nepal, January 14-15, 1991, pp 86-95

Twenty sheep withers (Ten Polworth cross and Ten Baruwal) were used to study the load carrying ability of crossbred and native sheep breed in Jumla, Nepal. The average age of the Polworth cross and Baruwal were 412.2 and 481.8 days, respectively. The average body weights were 28.59 kg for Polworth crosses and 23.0 kg for Baruwal. Both the breed of animal was divided into two groups containing 5 animals in each group assigning 15 and 20% load equivalent to their body weight. Barley grain was filled in the harness and animal were derived

pre-determined distance of 13.6 km, daily from 6.00 AM to 1.00 PM. The rectal temperature and the respiration rate were measured and statistically analyzed to compare the stress caused by the load. The result indicated that out of the two physiological reactions measured, respiration rate was the most sensitive to the load carried. Among the breed Polarity cross-had higher respiratory rate showing more stressed. The result indicated that with the percent of load carried (i.e. 15% and 20%) there was no significant different of the load carrying ability of both crosses and indigenous sheep breed.

A comparative study on lamb mortality between Polworth cross and Baruwal lambs

Karki NPS and TS Dhauwadel (1991). A comparative study on lamb mortality between Polworth cross and Baruwal lambs. *Proceedings of the 1st National Animal Science Convention (NASA)*, Lalitpur, Nepal, Jan 14-15, pp 101-103

Lamb mortality is major constraint of sheep farming in Nepal and causes economical losses to the sheep industry. This mortality is high in the migratory flocks and various factors are responsible. A lot of lambs are lost due to faulty management, go missing in the forest or taken by predators. These losses are an added burden to the sheep farmers. A comparative study was made between Polworth cross and Baruwal lambs in Ghandruk area of Kaski district. The result showed that 23.5% died, and 10.9% were lost from the crossbreed population, while 17.7% died due to various diseases, and 18.2% were lost in the Baruwal breed. Some reasons for these differences are suggested and discussed.

Trends in the sheep population in the hills of eastern Nepal

Kshetri BB (1992). Trends in the sheep population in the hills of eastern Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **7**(2)**:**58-61

A study of the transhumant system of sheep production was conducted in Okhaldunga district between 1979/89. During a 10 year period the number of shepherds fell from 69 to 31 (a fall of 55%) and the number of sheep fell by 38%. The reasons for the decline in the transhumant system are several. Potential shepherds prefer other work or an urban life rather than shepherding. Shepherding is a difficult life and now a day's generates little income as there is less pasture available due to weeds, forest and cultivation taking over traditional pastures lands. The growth rate of sheep flocks is limited by factors such as diseases and poisonous plants. Several recommendations are made. Insurance should be given to shepherds to minimize the effects of disasters. Shepherds should be given a pasture guarantee certificate which allows them to follow their normal routes of migration without paying excessive taxes to the government or to persons owning land illegally. There should be specialists within the national livestock system who concentrate on transhumant systems. A forestation and other forest development programmes must be carried out with the collaboration of the shepherds. Groups of shepherds can together identify their problems and purpose solutions.

Performance of Polworth sheep at Pakhribas Agricultural Centre

Gurung AR, IK Aryal, SP Neopane and BB Tamang (1993). Performance of Polworth sheep at Pakhribas Agricultural Centre. *Working Paper N. 66*, Pakhribas Agriculture Centre (PAC), Pakhribas, Dhankuta, Nepal

Polworth sheep were first introduced to Pakhribas Agricultural Centre in 1978n in order to assess their productive performance under a sedentary system. The sheep were housed in a shed made of mud with stonewalls and a thatched roof. They were grazed for five hours daily throughout the year. Concentrate feed (Commercial feed) containing 14 % crude protein was given at an average of 200 g/head/day. It was observed that Polworth sheep reared at PAC

were bred for the first time at the age of 448±131 days. Their lambing percentage was 86.3±11.9 with an average litter size of one. The mean birth weight of the lambs was 2.75±0.52 kg with a range of 1-4 Kg. No significant differences were found between males and females (P >0.05). The body weight increase in both male and female lambs was highly correlated with their age (r2 = 0.98). There was no significant difference between the growth rate of males (50.0 ± 1.6 g) and female (51.7±2.1 g/d) lambs. The pre weaning mortality rate (up to the age of 15 weeks was up to the age of 15 weeks was found to be 13 percent. Causes of mortality were mainly diarrhea, dysentery, cold and other unknown etiology. The average wool production obtained was 1.76 ± 0.57 kg/head/year.

A potential role for Australian carpet wool sheep in Nepal

Robards GE, SC Champion and SL Pradhan (1995). A potential role for Australian carpet wool sheep in Nepal. *Proceeding of the 2nd National Animal Science Convention (NASA)*, Khumaltar, Lalitpur, Nepal, Aug 7-10, pp 143-148

In recent years, there has been considerable expansion of the hand - woven carpet industry in Nepal. This growth has meant that by 1993 Nepal was the world's largest exporter of hand knot carpets, with large market in Germany and other European countries. However, the carpet industry in Nepal depends to large extent on a blend consisting of 25-30% Tibetan fibre, and majority of New Zealand Romney and Romcross fibre. In the interest of the long term economy of Nepal there is obvious value in considering ways in which larger quantities of fibre suitable for hand –knot could be grown in Nepal. Such fibre production must take into account the rigorous conditions under which the majority of the Nepalese sheep are grazed, and also the traditional uses of fibre which necessitate warMth and water shedding properties. In Nepal, breeds which produce fibre of Romcross quality in New Zealand and other countries may not produce the same fleece quality in Nepal, and these fleeces may not meet the local warMth and water whetting specifications as pure breeds, or even in crosses with local Nepalese sheep herds such as the Baruwal, Dhorel and Kage. The paper to be presented at the convention will examine the possible role that specialty carpet wool sheep which have evolved in New Zealand and Australia (Carpet master, Drysdale Ellittdale and Tukidale) may play in the Nepalese livestock and carpet industries. Data from these specialty breeds will be compared with data from Romney, Border Leicester and similar breeds wherever possible. Also, the results of crossbreeding with indigenous sheep breeds in India and other countries will be reviewed to guidelines for possible evaluations which might be conducted in Nepal. Whilst is not possible to predict the outcome of most livestock crosses with any accuracy, particularly difficult to predict the performance of crossbred progeny in an environment as diverse as Nepal, reasonable conclusion can be drawn for example, it will be argued that a breed such as the Ellittdale could be useful for crossing progarmmes on better country such as in the mid hills of Nepal. Alternatively, it will be suggested that the carpet mater may be a worthwhile consideration for use in hilly country. Finally, the Drysdale/Tukidale and Border Leicester breeds may have a role in Nepal through crossbreeding to produce sheep with improved fleece quality (especially optimum staple length, fibre fineness and handle), for the hand spun carpet industry.

Comparative performance of Baruwal and 25 % Border Leicester x 75% Baruwal yearlings lambs under a transhumance system in the high hills.

Rasali DP (1995). Comparative performance of Baruwal and 25 % Border Leicester x 75% Baruwal yearlings lambs under a transhumance system in the high hills. *Proceedings of the 2nd National Animal Science Convention (NASA)*, Lalitpur, Nepal, Aug 7-10, 1995, pp 85-91

In an on-farm study of crossbreeding Baruwal with border Leicester to improve the productive performance of sheep under a transhumance system in the high hills of Nepal. 362 lambs, comprising 173 Baruwal and 189 25% Border Leicester (BL) x 75% Baruwal crossbred lambs born from Baruwal ewes from the year 1991 to 1993 periods were considered. Baruwal and the BL crossbred lambs weighed 2.44±0.09 and 2.87±0.09 kg respectively at birth, whilst their body weights at 12 month age were 19.99±0.20 and 20.91±0.21 kg with an average daily weight gain of 47.6±0.6 and 49.2±0.6 g/day, respectively. The weight of lambs at birth was significantly influenced by genotype, sex and year of birth ($P<0.05$) but not by the season of birth, whilst their bodyweight at one year of age differed significantly with genotype, year and season of birth ($P<0.05$) but not with sex. Quadratic regression analysis of monthly bodyweights of lambs revealed significantly higher growth rate ($P<0.001$) in the BL crossbred than in the Baruwal, whilst the average daily gain in lamb weight over a period of one year age was likewise significant across the genotype ($P<0.01$), year and season of their births ($P<0.001$). The greasy fleece weight at one year of age of the crossbred lambs (550.3±25.4g) was significantly higher than that of the Baruwal lambs ($P<0.001$), which was 459.4±23.3g. The mortality rate was 11.6% in Baruwal and 17.5% in the crossbred lambs up to one year of their age. Logistic regression analysis showed that the effect of year of birth on lamb mortality was significant ($P<0.001$), but the effect of other factors was not significant.

A comparative study on lambing performance between Baruwal and Polworth x Baruwal ewes in the migratory flocks of Ghandruk area

Dhaubhdel TS and NPS Karki (1996). A comparative study on lambing performance between Baruwal and Polworth x Baruwal ewes in the migratory flocks of Ghandruk area. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal May 7-9, 1996, pp 138-142

A total of 615 ewes above 3 years old in Baruwal and 65 ewes in Polworth x Baruwal cross above 3 years old were recorded from different flocks. 94% lambing was found in Baruwal ewes and 91% lambing found in Polworth cross ewes.

Transhumant sheep and goats production systems and their productivity at Guphapokhari site

Shrestha NP (1997). Transhumant sheep and goats production systems and their productivity at Guphapokhari site. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, May 7-9, 1996, pp 272-282

Raising sheep and goats under a transhumant system in high altitude pasture areas is a common and efficient method for converting remote plant resources into meat and wool. However, very little detailed information on the productive performance of these animals is available. The present study was therefore carried out to quantify the information about sheep and goats production system and their productivity in high altitude pasture areas of Guphapokhari sites. Results showed that the mean annual herd offtake was 21.1 and 21.8% and mortality was 15.1 and 19.4% for sheep and goats respectively. Herd offtake and mortality between sheep and goats were not significantly different ($P>0.05$) but a highly significant

difference (P<0.001) was found between the herd. The growth rate of female Baruwal sheep was 66 g/day from birth to 1 year and 36g/day from 1 year to 2 years. The average live body weight for female Baruwal sheep at 2 years of age was 41.2 kg and the average wool yield was 885g/shearing averaged over 10 shearing; shearing is done twice a year. Similarly, the average growth rate of Sinhal crossbred goats was 45g/day from birth to 1 year age and 29g/day from 1 to 2 years of age. The average live body weight at 2 years of age was 33.85 kg for male and 22.94 kg for female adults' goats. Male goats were fattened after castration at 6-7 months of age. The average age at 1st service and lambing interval for Baruwal sheep were 536±71 and 371±63 days, respectively. Similarly, the average age at 1st service and kidding interval for Sinhal crossbred were 248±60 and 271±67 days respectively. Annual mortality for Baruwal sheep and Sinhal crossbred goat was found to be 15.1 and 19.4%, respectively. On the basis of the present findings it is apparent that the local breed of sheep and goats are well adapted to the harsh environment of the mid hills and mountains of Nepal. Their productive performances are satisfactory provided they are efficiently managed to reduce the current higher rates of mortality. Until management is improved there is no point in introducing highly productive breeds of sheep in the migratory systems.

Ruminant livestock production and their role in sustainable development in mountain regions of Nepal

Panday SB and MR Tiwari (2002). Ruminant livestock production and their role in sustainable development in mountain regions of Nepal. *Proceedings of the 5th meeting of the Temperate Asia Pasture and Fodder Network (TAPAFON)*, RNR Research Centre Bajo, Wangdue, Bhutan, 30th Apr – 4th May, pp 28-34

Livestock plays a major part in national agriculture. Livestock products like meat, milk, skins, draft power and manure from about 15% of GDP. The ruminant population of the country has been estimated at 17726214 heads. Generally, mountain households keep more livestock than hills and Terai households. Yak, Chauri and Lulu cattle are reared at high altitudes (3000-5000 m asl). Cattle, buffaloes and goats are the main livestock in the mid hills and Terai. Bhyanglung, Baruwal, Kage and Lampuchhre are main indigenous breeds of sheep, which are found in High Mountain, mid hills, lower mid hills and Terai, respectively. Similarly, Chyangra, Sinhal, Khari and Terai goats are main indigenous breeds of goats of Nepal. The Chyangra are popular in high mountain, Sinhal are in the mid hills and high mountain, Khari goats are in lower and mid hills and Terai goats are found in Terai (below 300 m asl). The Jamunapari, Beetle and Barberi breeds of goats have been used during the past 20-25 years to cross with the local Khari and Terai goats to improve the meat production.

Present status of migratory small ruminant management system in Karnali zone

Tiwari MR and YK Shrestha (2004). Present status of migratory small ruminant management system in Karnali zone. *Workshop Proceedings of the participatory program for improving productivity and income from small ruminants raised under migratory management system in the high hills and mountains of Nepal*, Khumaltar, Lalitpur, 9th March, 2004, pp 48-56

A field survey was conducted with structured questionnaires in Kalikot, Dolpa, Humla, Mugu and Jumla districts in order to identify the general overview of farmers on their major constraints and potential of livestock production. In each district, 40-50 farmers from different VDCs were chosen randomly and interviewed. The survey revealed that the population of small ruminants is decreasing by year, because of prevalence of different diseases, lack of pasture etc. 76.56% farmers of Karnali zone preferred migratory system of rearing than that of sedentary system (23.44%). 59.8 % farmers of Karnali zone expressed that predators are the main problem for migratory system of management followed by shelter/food problem for shepherds and poisoning plants (14.1 and 10.9%, respectively). Feed deficit is acute for small ruminants

especially in winter season. The average birth weight of sheep in Karnali zone was higher (2.28 kg) than that of goats (1.98 kg). The average wool production from sheep and goats in Karnali zone was recorded to be 750 and 390 g/year/animal, respectively. Average load carrying capacity of sheep and goats was recorded to be 12.6 and 10.2 kg, respectively. In Karnali zone, FMD was the most prevalent disease (615) followed my mange and internal/external parasites (42.2 and 33%, respectively).

Study on the performance of the Border Leicester X Baruwal crosses and Baruwal sheep in the migratory management system of western hills of Nepal

Amatya N, DP Rasali and RS Rana (2006). Study on the performance of the Border Leicester X Baruwal crosses and Baruwal sheep in the migratory management system of western hills of Nepal. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 1-2 July, 2004, pp 25-25

A preliminary study was conducted from August 1997 to December 1998 to study the performance of different blood levels of Border Leicester X Baruwal crossbred sheep under migratory management at Ghanapokhra village of Lamjung district. Baruwal, 50% and < 50% Border Leicester X Baruwal crossbreds were allowed to move together in a migratory flock. Live weight gain, lambing percentage and mortality data recorded showed that change in live weight gain in different season was similar in all genotypes, whereas, lambing percentage was significantly higher in Baruwal sheep. Similarly, mortality in adult animals was significantly higher in the crossbred animals than Baruwal sheep.

Productive and reproductive performance of different genotypes of sheep at Guthichaur

Shrestha YK (2006). Productive and reproductive performance of different genotypes of sheep at Guthichaur. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 1-2 July, 2004, pp 33-36

Different native and exotic sheep and their crosses were maintained on station at Guthichaur, Jumla. Daily observations and recording have been taken for different traits. Records were analyzed for means and standard deviations. The results showed that average birth weight of lamb was (2.26±0.25 kg). Pure Merino was the heaviest (2.78±0.21 kg) at birth and Baruwal lamb was the lightest (2.01±0.21 kg). The average six months weight and daily weight gain were 11.7±1.44 kg and 59 g,respectively. The average adult body weight of different breed was 32.23±3.22 kg. The overall wool production of sheep was 0.65±0.24 kg/year. The wool yield was found more during Autumn shearing (0.67±0.19 kg) followed by spring shearing (0.54±0.25 kg). The fibre diameter was higher in native sheep than exotic and crosses. Amongst reproductive traits, age at first lambing and lambing interval were 890±2.25 days and 577±2.69 days, respectively.

Bhyanglung sheep production system in Manang and Mustang districts of western Nepal

Tiwari MR, PB Chapagain, R Basnet and N Kusum (2009). Bhyanglung sheep production system in Manang and Mustang districts of western Nepal. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 157-164

Survey was carried out in different VDCs Manang and Mustang districts to identify the existing production system for Bhyanglung sheep. A total of 22 farmers in Mustang and 15 farmers in Manang districts who have been involving in Bhyanglung sheep rearing were interviewed on existing production and reproduction performances, feeding situation and marketing system of Bhyanglung sheep. Similarly, 45 and 40 (male and female) were measured for the morphological characteristics in Mustang and Manang districts, respectively. Survey revealed that average population of sheep per household was 84.5±21.45 and 8.0±1.47 for Mustang and

Manang district, respectively. In both district, sheep population was found in declining trend due to lack of pasture, market problem of wool, and restriction on movement of the flocks with the Chinese occupation of Tibet, sheepherding problem and internal, external parasitic burden and diseases. Average birth weight, 6th month weight, yearling weight and adult weight of male and female was recorded 1.71± 0.15, 0.98±0.02; 13.66±0.49, 11.83±0.60; 18.3±1.53, 15.4±1.05 and 27.9±2.23, 23.6±2.29 kg in Mustang district, respectively. Likewise, average birth weight, 6th month weight, yearling weight and adult weight of male and female was recorded 2.62±0.23, 2.25±0.023; 9.75±3.32, 8.75±3.03; 17.3±4.38, 16.0±4.83 and 25.5±3.32, 23.5±3.84 kg for Manang district, respectively. There was highly significant (P<0.001) difference in birth weight between sex and district. Average annual wool production of individuals (male and female) was noted to be 1.21±1.06, 0.7±0.8 kg and 1.1±1.25, 0.85±0.22 kg in Mustang and Manang district, respectively which was found significant difference (P=0.008) on sex. The average age at 1st service, weight at 1st service, lambing percentage and kidding interval was found to be 12.0±1.83 months, 10.0±2.65 months, 15.0±4.54 kg, 74.6±4.2%, 95.0±4.04% and 7.0±0.1 month, 6.5±0.1 month for Mustang and Manang districts, respectively.

Study on constraints and potential of Bhyanglung sheep production for carpet production

Upreti CR and BK Shrestha (2009). Study on constraints and potential of Bhyanglung sheep production for carpet production. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 165-171

In this study an attempt was made to study on the constraints and potential of Bhyanglung sheep production for carpet production. Study was during 2062/63 in Jumla district. Existing situation of livestock production, feed availability, and nutrient contents of feedstuffs available in Jumla was studied. Study indicated that adequate pasture land is available and about 36% of total land (66.225 ha) could be used for grazing and major parts of the forest land (37% i.e. 94369 ha) could also be used as a cheaper source of feedstuffs to the animals. A total of 30 pasturelands were available for free grazing to ruminant particularly for 52973 sheep, 69052 goats, 3407 buffaloes, 64284 cattle and 337 Yak. Fodder available in Jumla recorded high (>10%) in CP content. Apple by products were nutritionally moderate (5-9.99%) in CP Content. Available feed record showed that there is adequate feedstuff to raise the Bhyanglung sheep including the existing sheep population in the district.

Participatory program for improving productivity and income from sheep and goats in Karnali region

Shrestha YK (2010). Participatory program for improving productivity and income from sheep and goats in Karnali region. *Proceedings of the 9th National Outreach Workshop*, Khumaltar, Lalitpur, Nepal, 7-8 June, 2010, pp 340-342

The potential area of sheep and goat production as Patmara, Guthichaur and Dillichaur VDCs of Jumla district was selected to launch the productivity improvement program. A sheep and goat research farmers group was formed to implement the pocket package program. Technical knowledge regarding improved sheep and goat farming was provided by training. One superior ram was provided for breeding. A routine of dipping and drenching schedule was made in an interval of 6and 4 months, respectively to control the parasite. Sodium thiosulphate @ 5-10 g orally and physical control has been found effective corrective measures in plant poisoning cases. White clover, Ryegrass and Cocksfoot seeds were broadcasted in alpine pasture simultaneously at the of grazing and observed up to 70% germination. Technique to produce good quality hay its conservation for winter was demonstrated.

3. SWINE

3.1 HEALTH

Various gastrointestinal parasites of swine and their control with Fenbendazole at Rampur, Nepal

Dhakal IP and M Sapkota (1987). Various gastrointestinal parasites of swine and their control with Fenbendazole at Rampur, Nepal. *Journal of the Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan*, **8:**37-44

A total of 58 pigs (22 adult and 36 young pigs) were divided randomly into treatment and control groups. Prior to the treatments, 51.8% of the adult pigs were infested with *Oesophagostomum dentatum* (nodular worms) and *Trichuris suis* (whip worms) and 25% of the young pigs were infested with *Oesophagostomum dentatum* and *Ascaris suum* (round worms). Treatment with fenbendazole reduced the fecal egg counts of infested pigs to zero for the entire 60 days post treatment observation period, whereas in untreated control pigs egg counts were increased. Body weight gain was significantly improved by anthelmintic therapy ($P<0.05$).

Streptococcal arthritis of pigs at Pakhribas Agricultural Centre

Jha VC (1992). Streptococcal arthritis of pigs at Pakhribas Agricultural Centre. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **7**(2)**:**65-66

Thirty two 2-3 weeks old piglets at the PAC farm were found affected with a swelling of hock and shoulder joints. After surgically opening the joint of one of the affected piglets' creamy pus was found in the periarticular space. The pus sample from one piglet and joint fluid with pus particle from 4 other affected piglets was taken for bacteriological culture and antibiotic sensitivity test. *Streptococcus spp* was isolated from all the samples. Affected piglets were treated with penicillin for 7 -10 days and all piglets recovered after the treatment.

An outbreak of Pasteurellosis in pigs in Dhankuta district

Jha VC (1995). An outbreak of pasteurellosis in pigs in Dhankuta district. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **10**(2)**:**23-24

An outbreak of a disease in pigs was reported in Pelekpang village of Dhankuta district. A detailed investigation of the outbreak was carried out and pathological samples were collected for lab examination. The results of the staining, culture, biochemical tests and mice inoculation test suggested that the isolates were *Pasteurella multocida*. The findings of this investigation revealed that the pigs had suffered and died from an acute form of pasteurellosis.

Diseases of pig in the eastern hills of Nepal

Thakuri KC (1996). Diseases of pig in the eastern hills of Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **11**(2)**:**33-36

Records of the 10332 clinical cases treated at 7 districts of livestock offices (including PAC vet clinic) of the eastern hills over a period of 8 years were analyzed to assess and document the importance of existing pig diseases on the basis of their occurrence. Parasitic diseases (57.2%), general debility (10.7%) and digestive disorders (8.7%) were main health problems responsible for degrading the pig production. the occurrence of febrile conditions with lung involvement was also of significance. The control measures need to be taken and the additional information required managing pig diseases are discussed in this paper.

Control of endoparasitic diseases of pig in the eastern hills of Nepal

Thakur RP (2003). Control of endoparasitic diseases of pig in the eastern hills of Nepal. *Proceedings of the 7th National Conference of Nepal Veterinary Association*, Tripureswor, Kathmandu, Nepal, 5-7 Nov, **24:**83-90

Endoparasites have been considered as an important factor limiting pig production. There is considerable loss in pig productivity in terms of growth rate and mortality due to endoparasites. A study on epidemiology and control of endoparasites in pigs of different altitude of eastern hills were carried out. The major internal parasites, (*Trichostrongylus axei, Hyostrongylus rubidis, Oesophagostomum dentatum, Ascaris suum* and *Trichuris*) and coccidia of pigs were identified. The parasites identified are considered to be highly pathogenic species for pigs. The overall annual prevalence was recorded to be very high (90%). The level of infection also varied in different altitudes and in different months of the year. There was significant effect of humidity in both prevalence and extent of infection in all altitudes and in different months of the year. Little effect could be seen of temperature on these parasites. Age of piglets have also significant effect on the level of infection of Ascaris, although other parasites were affected by age. The eggs per gram of fecal (EPG) counts were greatly reduced in pigs receiving treatment compared to untreated control groups. At high altitude, the mean body weight after one year was 59, 95, 121.7 and 124 kg in control group, single, double and multiple drenching groups, respectively. Whilst in mid altitude, the comparable figure was 54.9, 113, 125.5 and 122 kg for the same treatment. Treatments have highly significant ($P<0.001$) effect on the body weight of pigs in both altitudes. The body weight of single drenching group was significantly higher than control groups. Body weight of double drenching group pigs was significantly higher than single drenching group but there was no difference between double and multiple drenching. Hence, double drenching is preferred, as this would be the most cost effective treatment for controlling endoparasites in pigs. Double drenching (June and August) with anthelmentics (Albendazole) @ 15 mg/kg body weight proved to be highly effective against endoparasitic diseases of pigs.

Impact of climate change on livestock and vice versa

Khanal DR, SP Sharma and A Prdhan (2010). Impact of climate change on livestock and vice versa. *Proceedings of the 9th Conference of Nepal Veterinary Association,* Veterinary Complex, Tripureswor, Kathmandu, Nepal, 22-24 April, 2010, pp 19-24

Of late, impact of global warming on animal agriculture has been a subject of greater concern. Rise in average temperature has profound effect not only on the life cycle of parasites but also on the sifting location of the migratory birds carrying influenza viruses. Very important trend that has been observed in migratory birds is that they need not go such during chilly winter and instead they are seen even in northern Nepal, Tibet and Japan which were otherwise cold places previously. This sifting distribution of carrier birds has lead to outbreaks of avian influenza in previously unknown areas of the world. How progressively tick population in domestic animals is being substituted is discussed. Besides, the dynamics of emerging diseases in new geographic locations will be highlighted in this paper. An attempt will also be made on discussing how livestock and poultry industries are contributing to raise in the production of green house gases that ultimately contributes to global warming and climate change.

People, Pigs and Parasites: Relational contexts and epidemiological possibilities in Nepal

Joshi, BR (2006). People, Pigs and Parasites: Relational contexts and epidemiological possibilities in Nepal. *Proceedings on Seminar on control of Cysticercosis in Nepal,* National Zoonotic and Food Hygiene Research Centre, (eds. D.D. Joshi), pp.137-142

Among the population of nearly one million pigs in Nepal, indigenous pig population comprises of about 58 percent raised under scavenging management and poor sanitary environment. Though, traditionally the indigenous pigs are raised by some ethnic communities only, their population is distributed in almost all districts of the country indicating their wider distribution. With the introduction of exotic pigs, more and diverse groups of people are being involved in pig production and the national pig population has nearly doubled during the last decade. The traditional pig husbandry is mainly adopted by poor and marginal communities, and animals are managed under poor hygienic and sanitary environment. This practice, though have provided some livelihood support to these communities has also become a cause of concern for the control of parasitic zoonotic diseases especially of cestode tapeworms. Awareness and significance of cysticercosis especially of neurocysticercosis and its epidemiological relationship with pig husbandry practices highlighted the importance of this parasite and necessitated to study the subject in greater depth and diverse climatic and socioeconomic conditions of the country so that the control strategies could be developed for effective management of these serious disease conditions of human health. This paper deals with the relationship between these interlinked issues and suggests the possible strategies for minimizing the incidences of parasitic zoonosis in human population. The practical difficulties associated with the introduction of corrective approaches, the risk of their failure, and possible approaches are also discussed within the context of prevailing environment and socioeconomic condition of the country.

Zoonoses and human health

Joshi DD (2010). Zoonoses and human health. *Proceedings of the 9th Conference of Nepal Veterinary Association,* Veterinary Complex, Tripureswor, Kathmandu, Nepal, *22*-24 April, 2010*, p*p 25-31

Zoonotic diseases are those in which human beings are infected with pathogens carried by animals. They can be transmitted directly through animal to person contact, or indirectly through consumption of contamination food. Livestock carry potential health hazards, so food animals are an integral part of public health protocols. Hence, the myriad of food safety policy legislation found globally. Regarding pigs, classical swine influenza is documented as having been transmitted to people on occasions, as has *Streptococcus spp*, which could be considered an occupational health hazard for those working in the pork industry. The domestic pig is known to be Tuberculosis and Japanese B encephalitis (JE), etc. Pig meat from infected pigs, when consumed raw or inadequately cooked, can transmit a number of pathogens, such as *Trichinella spp, Cysticercus spp, Salmonella spp* and *Listeria spp*; for Taeniasis/cysticercosis inadequate hygiene during meat processing or at home can also be a source of contamination to human beings. In many circumstances, particularly for livestock production diseases, the environment in which livestock are kept determines the course and severity of disease expression; a highly contaminated environment for livestock with a weakened immune system often tips the balance and makes a disease clinical epidemiologically. In Nepal, so far mostly

diagnosed zoonotic diseases are Brucellosis, Cysticercosis, Trichinellois, Tuberculosis, Salmonellosis, Echinococcosis/hydatidosis, Japanese encephlatis, Rabbies, Streptococsis suis and Listeriasis.

Prevalence of *Taenia solium* Cysticercosis in swine in Kathmandu valley and its impact on public health

Karna AK and DD Joshi (2010). Prevalence of *Taenia solium* Cysticercosis in swine in Kathmandu valley and its impact on public health. *Proceedings of the 9th Conference of Nepal Veterinary Association,* Veterinary Complex, Tripureswor, Kathmandu, Nepal, 22-24 April, 2010, pp 100-104

Pig production and pork consumption has increased in Nepal during the last decade. With an increase in pigs and consumption by small holder, there have been problems with zoonotic parasitic diseases especially porcine cysticercosis. It has remained a major health and socioeconomic problem in Nepal and mainly low income countries and is the one of the main causes of epileptic seizures in many less developed countries and is also increasingly seen in more developed countries because of immigration from endemic areas. A study was conducted among 200 pigs from nine different slaughter slabs from Kathmandu valley during June to August 2009. The objectives of the study were to determine prevalence of *Taenia solium* cysticercosis in swine by carcass, lingual and ELISA examination, to collect data retrospectively on episode of Taeniosis and epilepsy/ Neurocysticercosis (NCC) in humans in major hospitals of Kathmandu valley, and to analyze the questionnaires for the possible risk factors and public health impact. The prevalence rate of cysticercosis by lingual examination, carcass examination and ELISA was found to be 0.0%, 0.005% and 35.5%, respectively. The collected cysts were confirmed as *Taenia solium* cyst by the histopathology and microscopic examination. NCC patients were found at an overall rate of 9.8% (179) out of 1839 epilepsy patients from the survey of five hospitals of Kathmandu valley viz. TUTH, Bir, Patan, Norvic and NMC. The age wise distributions of NCC patients were 55.63%, 24.02% and 22.35% for 15-35 yrs, 0-14 yrs and above 35 yrs, respectively. The distribution of NCC in male and female were 66.5 and 33.5%, respectively. This study has indicated for strong enforcement of the meat inspection Act for the prevention of meat borne zoonoses and lessens the economic burden in the people of Nepal and other developing countries.

Prevalence of Helminth parasites of piglet in peri urban areas of Kathmandu valley

Baskota N and RP Thakur (2010). Prevalence of Helminth parasites of piglet in peri urban areas of Kathmandu valley. *Proceedings of the 9th Conference of Nepal Veterinary Association,* Veterinary Complex, Tripureswor, Kathmandu, Nepal, 22-24 April, 2010, pp 154-57

A study was conducted to find out the prevalence of Helminth parasites of piglet in peri urban areas of Kathmandu valley. Altogether 148 faecal samples were brought from different areas of Kathmandu and were examined for Helminth parasites in the Pathology Laboratory of Animal Health Research Division, NARC. Results of faecal examination in different areas Kathmandu showed mainly two helminthes parasites: Ascaris (29) and Strongyloides (14) in piglets below three months of age. The overall prevalence as detected by faecal egg output in swine was (29%). Piglets from Jadibuti area showed the highest prevalence (44.44%) while Nayapati area showed a lowest (27.27%) prevalence. Similarly, piglets below 60 days showed highest prevalence of Ascaris while animals between 60-90 days showed higher prevalence of Strongyloides. The prevalence of Ascaris below 60 days age group was highest. From the questionnaire survey, it was known that most of the farmers were familiar about the helminthes parasite of swine. It was reported that their pig were treated with Ivermectin in

every 3-5 months interval and Ivermectin was the drug of choice. Albendazole, Ivermectin, Fenbendazole and Levamisole were most commonly used anthelmentic drug.

3.2 NUTRITION

Replacement of animal protein with oil seed cakes in swine diet

Singh SB (1990). Replacement of animal protein with oil seed cakes in swine diet. *Journal of Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan*, **11**:77-81

Two experiments were conducted to examine the growth performance of Yorkshire X Hampshire young male piglets fed on diets supplemented with either fish meal as one of the protein supplements or oilseed cakes as the only source of dietary protein. In experiment 1, fishmeal was replaced with Soya bean cake and mustard cake. In Expt. II fishmeal was completely replaced with either sesame cake or sesame cake and mustard cake at 5:4 ratios. Piglets were fed to appetite. The diet contained on estimated 2800 K cal metabolizable energy and 180 g crude protein per Kg dry matter. No significance difference in Dry matter intake feed conversion ratio and dressing percentage were observed between treatments in either experiments. In experiment II, total live weight gain for the experiment period of 78 days in piglets receiving diets supplemented with fish meal or soybean meal were similar and significantly greater than in groups receiving sesame cake or sesame cake and mustard cake in different proportions as the only source of dietary protein. Live weight gain for group receiving fish meal, fish meal replaced with Soya bean meal or sesame cake and both fish meal and soybean meal replaced with sesame and mustard cake at 5:4 proportion were 37.8 kg. 37.9 kg, 31.0 kg and 32.6 kg, respectively.

Study on the effects of different concentrate mixtures on the voluntary feed intake and daily weight gain of weaned piglets

Pandey SB, N Ranjit and SM Pradhan (1991). Study on the effects of different concentrate mixtures on the voluntary feed intake and daily weight gain of weaned piglets. *Proceedings of the 1st National Animal Science Convention (NASA)*, Lalitpur, Nepal, Jan14-15, 1991, pp 62-69

The effects of feeding different concentrate mixtures on VFI and daily LW gain of 48 cross-bred piglets (24 M and 24 F) which were of about 8 weeks of age were investigated in this experiment. The groups of animals given Khumal feed (KF) had significantly ($P<0.05$) lower Average daily food intake (ADFI) and Average daily live weight gain (ADLWG) than the groups of animals given either Ratna Feed (RF) or Hetauda feed(HF). However, ADFI and ADLWG between RF and HF were not found significantly different. Feed conversion ratios and apparent digestibility were not significantly different between the treatment groups.

The effect of dietary Crude protein on the performance of entire male pigs fed ad libitum

Panday SB, AP Sainju, SM Pradhan and N Panday (1994). The effect of dietary Crude protein on the performance of entire male pigs fed ad libitum. *Nepalese Journal of Animal Science (NASA*), **8**(8): 49-57

Nine crossbred entire male pigs which were about 6-8 months old and 41.1 kg average live weight were put in a simple experiment consisting 3 dietary treatments and 3 replications. Experimental diets A, B and C contained 181, 175 and 134 g CP/kg DM. The experimental period was of 63 days. The average daily feed intakes, average daily gains, average feed efficiencies and apparent digestibility's were the main parameter measured in the experiment. Groups of animals given diet A (181 CP g /kg DM) had significantly higher ($P<0.05$) feed intakes than groups of animals given either diet B (175 g CP/kg DM) or diet C (134 g CP/kg DM) during

40-70 and 40-80 kg stages of growth. Apparent digestibility of the feeds offered were not significantly affected by the dietary CP. Significantly higher (P<0.05) CP balance was found in the groups of animals given diet A than the groups of animals given either diet B or C. Except during 40-70 kg stage of growth (P<0/05) in other stage of growth dietary CP had no significant effect on the average daily gain. Feed efficiencies were found significantly lower (P<0.05) in the groups of animals given diet C than the groups of animals given either diet A or B during 40-90 kg and 40-100 kg stages of growth.

The effect of feeding different levels of Iodine supplemented diets during pregnancy and nursing period on the production performance of sows

Pradhan SM (1996). The effect of feeding different levels of Iodine supplemented diets during pregnancy and nursing period on the production performance of sows. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, 7-9 May, 1996, pp 31-32

An experiment was designed to test the required level of iodine in sows' diet during pregnancy and nursing period. The 4 treatments imposed were (A) control) –concentrate mixture, (Io) (B), same control diet in which 0.25 mg iodine/kg feed were added (I1), (C) same control diet in which 0.35 mg iodine/kg feed were added and (I2), (D) same control diet in which 0.45 mg of iodine / kg feed were added (I3). All the sows were given 2.5 kg concentrate mixture daily and were provided additional concentrate mixture according to their litter size at the rate of 0.25 kg concentrate mixture/piglet during nursing period. Significant difference of birth weight and weaning weight at 4th week were observed. Piglets born from sows fed I1 diet were significantly (P<0.05) heavier at birth (1.33±0.07 kg) than from Io group (1.21±0.05 kg) and I3 group (1.21±0.06 kg). Similarly piglets feed I1 diet were observed significantly heavier (P<0.05) at weaning then from Io group (4.88±0.19 kg), I2 group (5.45±0.16 kg) and I3 group (5±0.18 kg). Inclusion of 0.25 mg iodine/kg diet of sows ration deficient in iodine content have shown encouraging, result in the piglets birth weight and growth performance before weaning.

Economic Use of Brewer's Dried Grain (BDG) in the Diet of Swine

Rijal TB, DB Nepali, RA Sah and MP Sharma (2009). Economic Use of Brewer's Dried Grain (BDG) in the Diet of Swine. *Nepal Journal of Science and Technology,* Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, **10:**29-35

An experiment was conducted from 18th October, 2006 to 18th January, 2007 at IAAS Livestock Farm, Rampur, Chitawan to determine the substitution effects of soybean meal with brewer's dried grain (BDG) on the performance, economics and meat traits of swine production. Starter, grower and finisher diets were formulated containing 18, 16, and 14% CP respectively with 3000 Kcal/kg ME and adequately supplemented with required vitamins, minerals and amino acids. The treatments were: diet without brewer's dried grain -T1 (control diet), diet substituted with 10% brewer's driedgrain-T2, diet substituted with 20% brewer's dried grain-T3, diet substituted with 30% brewer's dried grain-T4 and diet substituted with 35% brewer's dried grain-T5. Twenty weaned piglets having 7.37 to 7.94 kg live weight were housed in individual pens. Five piglets were randomly assigned to the five treatments following a randomized complete block design (RCBD) considering each individual as a replication. Fortnightly live weight, daily feed consumption, income over feed and pig cost, and different meat traits of pigs were recorded. The effect of replacing formulated diets with various level of brewer's dried grains on body weight gain was significant (p<0.01) with higher level of substitution resulting lower live-weight at the end of each of starter, grower and finisher diet period. The average body weight of piglets substituted with 35%BDG (27.00kg) and 30%BDG

(39.75kg) were significantly lower (p<0.01) compared to the weight of piglets receiving 0% (65.75kg), 10% (64.25kg) and 20% (60.25kg) BDG replaced diets at the end of 3 months experimental period. A significant reduction (P<0.01) in average daily feed consumption were also recorded with increasing level of BDG in the diet. Better feed conversion ratio (FCR) was observed in T2 at early period which at finisher stage T3 diet resulted significantly better FCR which was at par with T1 and T2 diet fed group. However, T5 diet resulted the poorest feed conversion ratio of 5.26, 4.92 and 5.87 for starter, grower and finisher respectively. There was reduction in feed cost with different levels of BDG substitution in diet of pig. Highest income (in per cent) over expenditure (109.01%) was found in T2 followed by T1, T3, and T4. Lowest income over expenditure (-8.2%) was found in T5. Highest dressing percent (71.87%) was recorded in T1 and lowest (70%) in T5 diet fed group. Inclusion of 10-20% BDG seems most acceptable level of substitution of SBM. However, this result needs to be verified under farmer's management condition before recommendation.

Effect of supplementation of green forage (Oat+Barseem) to breeding sows during late pregnancy and nursing period at Regional Agricultural Research station (RARS), Tarahara

Sah RB (1996). Effect of supplementation of green forage (Oat+ Barseem) to breeding sows during late pregnancy and nursing period at RARS, Tarahara. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal, Khumaltar, Lalitpur, 7-9 May, 1996,* pp 48-49

An experiment was carried out on pregnant sows in RARS, Tarahara by providing to T1 2.5 kg concentrate feed, T2- 2 kg concentrate feed + 2 kg green forage and T3- 1.5 kg concentrate feed + 4 kg green forage. The supplementation of green forage was carried out in 3 groups starting 1 month prior farrowing to first month past farrowing. The effect of different combinations of feed was significant, however, the highest weight gain was recorded from T2 (154 g/day), T3 (151g/day) and lowest by T1 (141.33 g/day). The live litter size was significantly higher for sows fed with 1.5 kg feed plus 4 kg green forage (T3 (10.33) followed and lowest in T1 (6.30). The average mortality percent of piglets was highest in T1 (33.33%) followed by T3 (19.35%) and lowest in T2 (10.71%).

Traditional feeding practices for pigs in the Koshi hills

Shrestha NP, IK Aryal and HB Gurung (1997). Traditional feeding practices for pigs in the Koshi hills. *Nepal Agriculture Research Journal (SAS/N*), **1**(1):71-76

A study was conducted to understand the traditional feeding practices of pigs in the 4 Koshi hill districts (Dhankuta, Tehrathum, Sankhuwasava and Bhojpur) of Nepal. A total of 44 pig keeping farmers were randomly selected and interviewed. A structured questionnaire was prepared to find out feeding management practices, type of feed and estimated quantity of feed provided to the pigs. Fifty nine percent respondent farmers stall fed their pigs throughout the year, whereas 41% scavenge the pigs during dry winter (January- April). Average daily dry matter supplied to pigs was 2.21 kg, ranging from 1.29 to 5.08 kg. However, 52% of the respondent farmers fed below this average value. Crop byproducts, green vegetables, and weeds, and brewery residues were the major portion of the pig diet contributing 72, 17.5 and 20.5% of the daily ration of pigs respectively. Shortage of green vegetables and weeds during the dry season may cause poor growth and maintenance of pigs, as vegetables and weeds supply are an important contribution of the pig diet. Surplus production of local vegetable including Pumpkin, Eskush, Colocasis are important for feeding pig during the dry season.

3.3 BREEDING

Establishment of nucleus breeding units: A sustainable way for disseminating technology

Aryal IK, NP Shrestha, PB Chemjong and HB Gurung (1994). Establishment of nucleus breeding units: a sustainable way for disseminating technology. *Proceedings of the 2nd National Conference on Science and Technology,*Nepal Academy of Science and Technology (NAST), Kathmandu, Nepal, June 8-11, 1994, pp 222-229

Pigs are one of the domestic animals in the eastern hills of Nepal. Pakhribas pig is black in color, high productive performance and had got very high demand by the farmers in the eastern hills. To meet the local demand of Pakhribas pig 26 nucleus breeding units were established in the 4 Koshi hill districts to produce Pakhribas piglets in the village to make the local area self sufficient. Each breeding unit was supplies with 2 months old 1 male and 1 female Pakhribas piglets and they were managed by the farmers. Feed intake and live weight were recorded fortnightly and reproductive performances were also maintained. The average age and weight at 1st service was 8.7±2.7 months and 44±12 kg. It was observed that 25% gills did not conceive in the 1st time of mating and had to be rebreeding. It has been seen that gilts receiving less amount of feed had repeat breeding problem. The average feed intake was 3.83±1.82 kg/day and quantity of food provided varied highly from farmer to farmer. This has resulted reproductive problems where low amounts of feed were offered. The average birth weight of the piglets produced from the breeding units was 0.78±0.12 kg. The average litter size and weaning size was 8.9±2.12 and 8±2.45 piglets/farrowing, respectively. The average weaning weight of the piglet was 4±0.89 kg. The litter size, weaning size and weaning of the piglets indicates the nucleus breeding units can produce healthy piglets in the village under farmer's management conditions and can fulfill the local demand for Pakhribas piglets if dietary levels are properly managed.

Swine genetic resources of Nepal with special reference to a case study of native black pigs in the western mid hills

Rasali DP, SM Pradhan and TS Dhauwadel (1994). Swine genetic resources of Nepal with special reference to a case study of native black pigs in the western mid hills. *Seminar Paper N. 94/1*, Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

The native domestic pigs in Nepal have a common feature with the native pigs in the neighboring region in their genetic constitution, and are genetically closest to the Indian wild pigs that are considered to their ancestors. The native pigs are of diminutive size and are characterized by very slow growth arte, and low productive and reproductive efficiencies. They are generally neglected as “unclean” animals and are raised by restricted ethnic groups of peoples. Very little information is available about native pigs, both domesticated as well as wild, whereas the performance characteristics of exotic pigs are relatively well documented. A case study on the native black pigs carried out in 3 selected locations in the mid hills of the western region provides information on their production systems, growth and reproductive performances. The deleterious effects on the native pig genetic resources resulting from constant genetic deterioration due to close inbreeding in small populations, recent competition from more productive exotic pigs and constantly diminishing feed resources have brought them to a “vulnerable” status breed, warranting an appropriate conservation programme. Suggestions and recommendations for such conservation programme are made.

Conservation of pig genetic resources and role of women farmers in Nepal

Kshetri BB and D Neupane (1998). Conservation of pig genetic resources and role of women farmers in Nepal. *The 4th Global Conference on Conservation of Domestic Animal genetic Resources*, Birendra International Convention Center, Baneswor, Kathmandu, Nepal, 17-21 Aug 1998

This study highlights the importance of pig genetic resources in Nepal and the role played by women farmers in their conservation. It identifies the limitations on conservation of pig genetic wealth and examines relationship between domesticated pigs and their ancestors. It also reviews trends in the pig population and suggests modifications for the conservation of pig genetic resources in Nepal. Methodology includes the survey of farmers keeping a pig nucleus breeding unit in Koshi hills established by Pakhribas Agricultural Centre, Dhankuta. Visits were made to hat bazaar in Terhathum, Jhapa and Damak to find out the number of pigs sold each week and the number of women involved in pig enterprise. To find out the number of breeds and strength of pig breeds within Nepal, all pig farms belonging to the government of Nepal and Nepal Agricultural research Council were visited and private pig farms owned by women farmers in Kathmandu, Pokhara, Jiri and Tarahara were also examined. In addition, we visited Sukla Phant Wildlife Conservation area to determine the situation of the pygmy hog. The study found that women are the major care takers of indigenous Nepali pigs which are miniature in size. 86% of native pigs are being kept mainly by poor women farmers belonging to lower Hindu casts. Since the taboo of un-touchability has been partially lifted, there has been an increase of 16% in new pig farmers belonging to the upper Hindu casts. A total of 12 breeds of pigs and their crosses exist in Nepal. The average herd size in only 2.1 pigs. Nepal has 724000 domesticated pigs of which 586440 are of the indigenous type kept by 344761 farm families. Each year 12374 Mt of pig meat are produced, the 3rd largest source of meat after buffalo and goats. The pig population grew @ 7.95% during the years between1996 to 1997 which was much higher that the average for the past 10 years (3.87%).The number of pygmy hogs is estimated to be less than 100 globally of which about 50 are located in and around Sukla Phat Wildlife Conservation Area. About 2000 wild pigs are being killed each year as a delicacy during Dashain and other festivals. Scientific pig conservation involving identification, quantification, characterization, development and promotion of indigenous pigs is urgently needed. Formation of pig producers group involving interested women, a participatory approach and institutionalization of pig associations representing all sectors of pig producers will help sustain and explore rare breeds of pigs.

Characterization of a pig developed at Pakhribas Agricultural Centre: the Pakhribas pig

Shrestha NP (1998). Characterization of a pig developed at Pakhribas Agricultural Centre: the Pakhribas pig**.** *The 4th Global Conference on Conservation of Domestic Animal genetic Resources*, Birendra International Convention Center, Baneswor, Kathmandu, Nepal, 17-21 Aug, 1998

In the mid 1970's, Pakhribas Agricultural Centre (PAC) introduced exotic pigs (Yorkshire, Saddle black, Fa Yuen, Hampshire and Tamworth) in its command areas. These breeds were not black, like the local breeds; therefore they were not accepted by the pig keeping community in the eastern hills due to socio-cultural reasons. These exotic breeds were also highly susceptible to photosensitization (sun burn disease) and not very hardy and so did not fit well under the poor management conditions existing in the eastern hills. This contributed to farmers not accepting them. Large white, saddle Black and Hampshire breeds are known to be superior for larger body size, Tamworth are hardy and Fa Yuen highly prolific. It was agreed an improved black pig based on a three ay cross between Saddle Black, Tamworth and Fa Yuen should be developed. The morphological and biological characteristics of the Pakhribas pig are as following: the shoulder height is 76.8 cm, body length 134.5 cm, heart girth 126.7cm, ear length

15.7 cm and hair length 7.5 cm. The age at 1st service is 251 days, age at 1st farrowing 368 days, gestation period 113 days, litter size at birth 9.5 days, litter size at weaning 8.45, farrowing interval 178 days, birth weight 1.05 kg, weaning weight at six weeks 6.6 kg, pre weaning mortality 9.6 and number of pig produced/sow/year 17.5, respectively. The mean back fat thickness for different stages of sows ranged from 14 to 40 mm. 95% of the sows had a P2 measurement ranging between 19 and 23 mm. This shows that this population has slightly higher levels of back fat thickness than other breeds of European origin which typically have 13 and 18 mm. It can be concluded that while the performance of Pakhribas pig of the exotic breeds (Yorkshire, Landrace, Duroc and Hampshire). It is highly adapted by the pig keeping community of the eastern hills. The population therefore should be maintained for improving the productivity of pigs in the hills and mountains of Nepal.

Characterization of pigmy pigs (Pudke Banel), Nagpuri and Hurrah pig in the eastern region of Nepal

Chaudhary SR, RD Pandit, NP Shrestha and L Sherchand (1998). Characterization of pigmy pigs (Pudke banel), Nagpuri and hurrah pig in the eastern region of Nepal. *The 4th Global Conference on Conservation of Domestic Animal genetic Resources*, Birendra International Convention Center, Baneswor, Kathmandu, Nepal, 17-21 Aug 1998

This study involved a survey of 3 indigenous pig populations from the eastern region of Nepal, Nagpuri, Hurrah and Pudke Banel. Data were collected for the characterization of their morphological traits. In all, 11 external traits of each breed were analyzed and compared. The body weights of pudke banel and nagpuri were 65 kg and 80 kg respectively. Wither height, total body length, chest girth, hip bone height, hip width, neck length, neck circumference, fore leg length, fore feet below knee and tail length of nagpuri, hurrah and wild pig were 57, 63, 36, 99, 97, 52, 95, 95, 46, 62, 67, 40, 20, 23, 10, 17, 15, 8, 72, 64, 32, 32, 43, 23, 15, 10, 27, 28, 26 and 10 cm, respectively.

Study of morphological characters of native pigs from Salyan and Pyuthan districts of mid western development region of Nepal

Pradhan SM (1999). Study of morphological characters of native pigs from Salyan and Pyuthan districts of mid western development region of Nepal. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, Pp 241-248

The study result showed that the mean body length from occiput to tail head was 86 cm. The body length of the male pigs were not found significantly different ($P>0.05$) than that of female pigs but the heart girth of female pigs were observed significantly greater than ($P<0.05$) that of males. Similarly the least square means (LSM) of the barrel height of female pigs (14.4 ± 1.09 cm.) was significantly ($P<0.01$) lower than that of male pigs (18.0 ± 1.28 cm). The average age of first farrowing was 11.3 ± 0.46 months. The average litter size at birth and weaning were 8.74 ± 0.7 and 7.16 ± 0.70, respectively.

Phenotypic relationship among litter traits in the swine herd at Lampatan Livestock Farm, Pokhara, Nepal

Rasali DP and MN Lohani (1995). Phenotypic relationship among litter traits in the swine herd at Lampatan Livestock Farm, Pokhara, Nepal. *Proceeding of the 4th National Veterinary Conference of Nepal Veterinary Association*, 17-19 Nov, 1992, **21-23**:56-63

The records of the 161 swine litters comprising of 1499 piglets farrowed by 62 sows of Landrace, Yorkshire and their crosses at Lampatan Livestock Farm, Pokhara from 1983 to 1988

were analyzed. Means and SE of 5 litter traits relating to litter size at birth, six traits relating to litter size at weaning and 5 traits relating to pre-weaning weights were estimated. These values particularly for the total number of Pigs born, number of live pigs born, total number of pigs weaned, weaning percentage of total pigs born, litter birth weight, litter weaning weight and pre-weaning average daily gain were 9.311±0.192, 8.994±0.186, 7.087±0.188, 77.211±1.539%, 10.453±0.24 kg, 59.48±1.934 kg and 0.127±0.003 kg, respectively. Phenotypic correlations among most of the traits were in general agreement with the results reports reported in the literature. Five principle components accounting for 91.92% of the total variation were extracted from the correlation matrix. The factor analysis of these components revealed five common factors representing characteristics measures of the overall litter performance, the efficiency of weaning, the efficiency of pre-weaning growth, the litter partitioning according to piglet sex and the losses at farrowing.

Phenotypic and genetic study of Nepalese dwarf hill pig breeds

Rana RB, PK Pokhrel and NP Shrestha (1997). Phenotypic and genetic study of Nepalese dwarf hill pig breeds. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Sep 24-25, 1997, pp 36-39

Dwarf native pig breeds from Debchuli, Arkhala VDCs of Nawalparasi district were studied. These pigs are smaller in size than others Hurrah native pig breed of Western Terai region. The adult body weight of dwarf native pig were found to be 58.72±4.56 kg, adult body length 79.93± 2.1cm, heart girth 82.26±3.37, height at wither 55.96±1.84cm. The pig matures at an age of 5.25±0.25 months with an age of farrowing 8.16±0.38 months. Control mating and checking inbreeding followed by selective breeding may help to conserve the valuable native pig breed.

Genetic and non genetic factors affecting on litter traits of Pakhribas black pigs in Nepal

Neopane SP (2005). Genetic and non genetic factors affecting on litter traits of Pakhribas Black pigs in Nepal. *Veterinary Journal*, **28**:51-57

Pakhribas black pig is a black color pig and is highly preferred by the people in the eastern hills of Nepal. This breed has been developed in Nepal by three ways crossing of exotic breeds (Saddle black, Fayuen and Tamworth) at ARS, Pakhribas, and then PAC. The data on 317 pigs born over a period of 14 years (1989-2002) were used to study the effect of non genetic factors on litter traits and estimate their genetic parameters. The overall litter size at birth, litter size at weaning, litter weight at birth and litter weight at weaning was 9.4 ±0.19, 8.3±0.18, and 9.32±0.25 and 50.6±1.45 kg, respectively. Parity of birth affected the litter traits. Heritability estimates of litter size at birth were low but the estimates for litter weight at weaning was high (0.68±0.314) suggesting selection based on litter weight at weaning would bring the improvement.

Genetic and non genetic factors affecting reproductive traits of Pakhribas pig in Nepal

Neopane SP (2007). Genetic and non genetic factors affecting reproductive traits of Pakhribas pig in Nepal. *Nepal Agriculture Research Journal (SAS/N*), **8:**89-93

Pakhribas back pig is a black color pig and highly preferred by the people in the eastern hills of Nepal. This breed was developed in Nepal by three ways crossing of exotic breeds (Saddle black, Fayuen and Tamworth) at Agricultural Research Station (ARS), Pakhribas, the then Pakhribas Agricultural Centre (PAC). The data of 348 pigs, born over a period of 15 years (1990 to 2004) were used to study the effect of non genetic factors on reproductive traits and estimate their genetic parameters. The findings revealed that the overall gestation length and farrowing intervals were 113.7±0.12 days and 182.5±2.2 days, respectively. Season of birth and parity of

dams were not important source of variation for reproductive traits, whereas year affected these traits significantly. Heritability estimates of gestation length was low (0.02±0.094), but heritability for farrowing interval was moderate (0.14±0.147) suggesting selection based on farrowing interval would bring the improvement in the trait.

Reproduction of pigs in the Koshi hills

Gatenby RM, PB Chemjong, B Pakhrin and SK Chimariya (1990). Reproduction of pigs in the Koshi hills. *Technical Paper N. 90/125*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

A survey of 101 farmers with sows was conducted in the Koshi hills. Estimates of the reproductive traits of both local and Pakhribas crossbred sows are farrowing interval 7.4 months, litter size at birth 8.3, age of piglets at weaning 2.2 months and total number of farrowing 13.2. Local pigs reach sexual maturity sooner than crossbred pigs, age at 1st farrowing for the 2 genotypes is 10.7 and 12 months, and age at 1st mating of boars is 6.5 and 7.4 months. Sows farrow throughout the year, and there is no clearly defined best season of farrowing. Pre – weaning mortality rates are estimated to be 22% for local piglets and 15% for crossbreds. The main causes of mortality are lack of milk and concentrate food, and overlying by the sow Almost all farmers practice controlled mating in which either the sow is taken to the boar, or the boar is brought to the sow. The production of farmers (with sows) who own a boar is only about 5%. Most farmers without a boar pay for service by a neighbor's boar. It is recommended that programmes to introduce Pakhribas pigs into villages should continue because their growth and reproductive performance is better than that of local pigs. The extension services should give advice to farmers regarding,

- Oestrus detection in sows
- The benefits of breeding at the 1st oestrus, about 5 days after weaning
- The possibility of reducing the weaning age to 1.5 months, and
- The importance of a good diet if sows are to have short farrowing intervals
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Reproductive problems in pigs in the eastern hills of Nepal

Jha R, B Pakhrin and RP Thakur (1997). Reproductive problems in pigs in the eastern hills of Nepal. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 24-25 Sep, 1997, pp 11-17

A survey on reproductive problems in pigs was carried out in 6 districts (Bhojpur, Taplejung, Terhathum, Sankhuwasava, Dhankuta and Ilam) of the astern hills of Nepal. The objective of the survey was to know the extent of reproductive problems in different breeds of pigs and to identify the causes of reproductive problems with special reference to infectious and parasitological aspects. A total of 316 pig rearing households were surveyed through pre designed questionnaire format and the required samples (blood, serum faeces, prepucial wash and vaginal swab) were collected and analyzed in the Vet Lab of Pakhribas Agricultural centre (PAC). The survey results showed that 53% of the pigs irrespective of breed had delayed sexual maturity (> 9 months). Pakhribas pig had the highest percentage of delayed sexual maturity (77%) followed by local (55%) and Pakhribas pig x local crossbred (42%). Regarding the age at 1st farrowing, Pakhribas black pig and crossbred had more problems than in local pigs. A total of 20% pigs were reported having problems during pregnancy and farrowing. Among these problems, still birth (425) was the highest followed by abortion (30%) and weak litter (22%). None of bacteriological samples were found positive for either of Leptospria and Brucella antibody which are responsible for infectious causes of reproductive problem. Similarly the vaginal swabs and prepucial wash samples were examined for Ttrichomoniasis, but all the

samples were found negative. Although 5 genera of gastrointestinal parasites namely Ascaris, Strogyles, Strongyloides, Trichuris and Coccidia were identified, the level of infection was not high enough to be a prime cause of reproductive problems in pigs. The findings from the lab tests confirmed that diseases (infectious agents (Brucella, Leptospria and Trichomonas) and gastrointestinal parasites) are not important causes of reproductive problems in pigs in the eastern hills of Nepal. Thus, it has been recommended that the other causes (breeding, management, hormonal imbalance, housing, nutrition and others) responsible for reproductive problems in pigs should be investigated.

Survey on infertility of pigs in eastern hills of Nepal

Thakur RP (2006). Survey on infertility of pigs in eastern hills of Nepal. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, 1-2 July, 2004, pp 102-107

Pig rearing is an important enterprise, which generates good source of income especially for poor ethnic group of farmers "Matuwali" in the eastern hills of Nepal. There are about 0.17 million pigs in the Koshi and Mechi hills and 45% farmers keep pigs in the Koshi hills. Infertility of pigs is considered to be an important problem and cause big income loss. About 30% sows suffer from infertility problems in nucleus breeding unit (NBU). The study was carried out to identify the extent and probable causes of infertility in pigs. A household survey was conducted in 5 districts (Terathum, Dhankuta, Taplejung, Panchthar and Ilam) of Koshi and Mechi hills. A total of 316 pig rearing households were surveyed and information on age of puberty, farrowing interval, number of piglets farrowed, dead/weak piglet born, history of repeat breeding, anoestrus, abortion problems during pregnancy and problems during farrowing collected. Meantime samples were also collected from the pigs having history of reproductive problems. Of the 329 pigs, 53% have delayed sexual maturity (>9 months) irrespective of breed. The average age at first farrowing is 10.7 months for local sows and 12 months for Pakhribas cross (PAC X Local) herds. In this survey 38% pigs farrowed at age of 10-12 months, 42% at 13-16 months while 13% after 16 months of age. Local pig (40%) and Pakhribas crossbred pig (38%) farrowed at 10-12 months of age while 18% of pure PAC breeds also farrowed in 10-12 months. Pakhribas crossbred pig first gave birth at a larger age than local pigs. PAC breed of pig highest percentage of repeat breeding problems (27%) than other breeds. Many farmers (>25%) do not mate their sows in time (within 48 hrs heat) or they take their sows to the boar when sows laps heat period. On an average 7% pigs have anoestrous problem while abortion problem is highest (37%) in PAC breed. A total of 74 samples from the sows having history of infertility were analyzed for bacteriological/serological tests for Trichomohas, Leptospria and Brucella antibody. None of the samples was found positive for the above diseases. The major parasites identified were Stongyles, Strongyloides, Ascaris and Trichuris. About 30% of sows show deficiency of Ca in blood while P and FE level was normal in all the samples.

A case study on native black pigs in the western mid hills of Nepal

Rasali DP, SM Pradhan, TS Dhauwadel, NP Shrestha and JB Abington (1994). A case study on native black pigs in the western mid hills of Nepal. *Seminar Paper N.94/17*, Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

A total of 105 native black pig raising household (HHS) were surveyed in the western mid hills. On average each HH raised 0.6 sows. 0.3 mature males and 3.2 piglets. 70.5% were keeping native pigs under confinement; whilst 29.5% allowed them scavenge during the day. The native pigs were raised mainly to produce meat for household consumption, and to provide piglets for religious sacrifices. The native black pigs in the western hills have small body size with a characteristically long, slender and conical head, short ears and neck, narrow shoulders, a

straight back and deep belly. They have moderately long bristles growing into a mane from the occiput to the shoulders. The mean piglet weights at birth and weaning were 0.8±0.06 kg and 6.8±0.64 kg, respectively. The mean weights of mature sows and barrows at slaughter were 17.3±0.78 kg and 24±1.15 kg, respectively. Age of piglets at weaning averaged 96 days. Post weaning daily weight gain of barrows, after 148 days post weaning fattening period was 126±15 g/day. The mean litter size at birth and weaning were 8.66±0.45 and 6.06±0.43, respectively. The hill black pigs are a valuable genetic resource, but have been reduced to a vulnerable breed, warranting their conservation following a strategic plan.

Effect of early weaning of piglets on the productivity of sows

Aryal IK, NP Shrestha, SP Neopane and HB Gurung (1995). Effect of early weaning of piglets on the productivity of sows. *Proceedings of the 2nd National Animal Science Convention (NASA*), Khumaltar, Lalitpur, Nepal, Aug 7-10, 1995, pp 108-112

A total of 19 Pakhribas sows were used in this study. They were randomly divided into two groups (10 sows for six-week weaning and 9 sows for eight week weaning. The piglets produced from these two groups of sows were weaned at six and at eight weeks of age. This study was carried out between l99l and 1994 at Pakhribas Agricultural Center. The results showed that the farrowing interval of sows decreased significantly (P=0.002) when the piglets were weaned at six weeks (162±4.38 days) of age compared to eight weeks (179±13.2 days). The lower farrowing interval in six weeks group has significantly increased the number of litters per sow per year (2.26 vs. 2.05, p=0.001). The number of piglets weaned per sow per year was 19.4 and 16.4 for six and eight week weaning groups respectively. No significant differences for litter traits (litter weight at birth, litter size at birth, litter size at weaning) were found. The results obtained from this study suggest that weaning of piglets at six weeks of age increases the productivity of sows.

Production performance of Pakhribas black colored pig

Ghimire RP and MP Aryal (1999). Production performance of Pakhribas black colored pig. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal,* Agriculture Research Station, Lumle, Kaski, Nepal, 26-28 June, 1999, pp 267-275

Eastern hill is the most potential area for pig raising. The ethnic groups inhabiting this region have tremendous affinity towards the black colored pig due to the socio-cultural reasons. In early 80's the then Pakhribas Agricultural centre (PAC) has developed Pakhribas black pig by crossing between Fayeun, saddleback and Tomworth which became very popular because of its black color and high productivity. From its very beginning PAC has maintained this breed so as to provide piglets for research purpose, support programe of the regional Directorate of Livestock in the eastern hills and other income generation activities of NGOs/INGOs through out the nation. A total of 33 breeding stock comprising of 28 sows and 5 boars of different age groups were maintained at station. This report describes the production performance of the breeding stock over 10 years together with production and distribution pattern of Pakhribas black pig in this region. The mean age at 1st service of the sows, age at 1st farrowing, farrowing interval and gestation period were found 249.5±19.4, 364.2±7.4, 172.8±12.1 and 113.5±1.84 days, respectively. Similarly mean litter size at birth and weaning size were 9.24±2.87 and 8.43±2.7 piglets/litter, whereas still birth and pre-weaning mortality were 4.86 and 10.4% respectively. The average weaning weight of piglets was 6.19±1.77 kg and average lifetime productivity of sows was found 170 piglets in 18 farrowing. A total of 2407 piglets were produced from 28 sows in last 10 years out of which 34.6% piglets were provided for research purpose, 48.8% to the government line agencies and remaining 16.6% to NGOs and INGOs.

A comparative performance study of Hampshire, Yorkshire and their crossbred pigs at Tarahara

Sah RB, RD Pandit and P Mandal (2000). A comparative performance study of Hampshire, Yorkshire and their crossbred pigs at Tarahara. *Proceedings of the 4th National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Pakhribas, Dhankuta, Nepal, April 24-26, 2000, pp 197-199

In a Trail, twenty-four piglets (8 Hampshire, 8 Yorkshire and crossbred) were used for comparative study of productive and reproductive performance. It was observed that the growth rate was significant at the age of 9 and 12 months ($P<0.01$). The highest live weight gain was obtained by Yorkshire (164.9 kg). The highest litter size was obtained by Yorkshire (9.46). The highest weaned litter size was obtained by Yorkshire (7.4) followed by Hampshire (6.4) and the crossbred (3.1), respectively. The highest mortality percent was significant ($P<0.01$). It was observed that the highest mortality percent was in crossbred (30.7%) followed by Hampshire (23.7%) and Yorkshire (21.2%), respectively.

Studies on the performance of F1 cross (Hampshire x Local) over local pig

Pandit RD, P Mandal and RB Sah (2001). Studies on the performance of F1 cross (Hampshire x Local). *Proceedings of the 1st SAS/N Convention*, Kathmandu, Nepal, March 29-31, 1999, Pp 271-275

This study was conducted at Banigama and Dhangadhi VDCs of Morang and Siraha districts respectively. There were two treatments with 10 replications. Treatment 1 was crossbred of pig (Hampshire x Local) and treatment 2 was local. Litter size, daily weight gain from birth to weaning and age at 1st maturity of the crossbred were found significantly different from the local one ($P<0.05$). Litter weight at birth, weaning weight, litter size at weaning, mortality percentage, age at 1st farrowing and farrowing interval were not significantly different.

On station performance of different pig breeds at Regional Agricultural Research Station (RARS), Tarahara

Pandit RD, RB Sah, P Mandal and BP Budhanagaria (2004). On station performance of different pig breeds at RARS, Tarahara. *Proceedings of the 5th National Animal Science Convention (NASA*), Katmandu, Oct 15-16, 2003, pp 193-196

Regional Agriculture Research Station, Tarahara has maintained different exotic pig breeds like Hampshire, Yorkshire and their crossbred for many years. On station their production and reproduction performance were analyzed for the period of 1993/94 (2050/51) to 1999/2000 (2056/057). All together 95 sows comprising of Hampshire (n= 62), Yorkshire (n= 27) and crossbred (n= 6) with 2. Nine parity were used in this study. The body weight of gilt at mating were 100.67±7.09 kg, 101.83±6.55 kg and 109.66±5.96 kg, litter size at weaning 8.58±1.08, 9.25±0.97 and 6.33±1.15 numbers, litter weight at weaning 8.20±0.59, 8.02±0.37 and 9.0± 0.24 kg, and litter index/sow/year 1.75±0.08, 1.75±0.06 and 1.63±0.11 times for Hampshire, Yorkshire and their crossbred, respectively. Similarly, the litter size at birth 11.16±2.47, 12.33± 2.78 and 9.0±1.21 number and furrowing interval 205.83±47.98, 213.85±63.89 and 231.80± 71.20 days for Hampshire, Yorkshire and their crossbred and were found significant ($p<0.05$). The 1st conception age was 293.83±26.41, 294.75±26.52 and 314.16±45.12 days, 1st furrowing age was 409.75±25.99, 412.66±24.37 and 428.57±44.38 days. Litter weight at birth was 1.35±0.12, 1.35±0.10 and 1.43±0.12 kg, mortality of piglets before weaning was 20.89±9.83, 22.16±13.52 and 27.19±9.72% and gestation length 114.58±1.68, 114.41±1.38 and 114.66±1.56 days among the breeds were found non significant ($p>0.05$).

Performance of improved pig breeds at Khumaltar

Dhauwadel TS and TP Paudel (2009). Performance of improved pig breeds at Khumaltar. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 278-282

Production and management of pigs of superior breeds in terms of their productive and reproductive parameters are of paramount importance. Similarly, variation in the breeds of pigs has differing suitability in different agro-ecological zones in the country. Keeping these facts in mind Swine and Avian Research Programme (SARP) is committed to maintain and distribute pigs of superior qualities and better production potentials. Landrace and Yorkshire are the major breeds being maintained at the farm. However, efforts were made to improve the production and suitability in different areas by crossbreeding these breeds either by natural or by artificial insemination. This way, 56% of Landrace piglets were produced while the proportion of Yorkshire and crosses of the both are 27 and 17%, respectively. A decade long monitoring of piglets in the farms showed that the mean birth weight of pigs was 1.18 kg with a standard deviation (SD) of 0.29 kg. Production of male piglets was 50% while that of female piglets were 49.5%. After 4 months of nurturing, the piglets were weaned from their mothers and were either distributed or maintained as replacement stock. The mean weaning weight was 6 kg with SD of 2 kg. An overall average of 12% mortality was recorded over 10 years and there was a considerably high percentage (9%) of stillbirth added to that mortality has a staggering effect on production and has a unanimous need of investigation and improvement in this area. Looking at the distribution pattern of the piglets, it is clearly understood that the breeds are very popular in and around the valley. However, there is a need for a wider dissemination of the breeds being produced as well as a study to produce the piglets in an economic pattern especially in terms of their feeding and nutrition.

3.4 PRODUCTION AND MANAGEMENT

Trials to compare the fattening abilities and production costs of local and improved pigs at Pakhribas Agricultural Centre and in the field

Merritt S AM Morel and NP Shrestha (1983). Trials to compare the fattening abilities and production costs of local and improved pigs at Pakhribas Agricultural Centre and in the field. *Technical Paper N. 83/67*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

One improved (Fayun x Tamworth x Saddleback x Large white) and one local litter of piglets were recorded at Pakhribas Agricultural Centre (PAC) for 9 months. Both were housed and fed under local conditions. Piglets were weighed weekly and the food intake measured. The improved piglets showed a significantly higher live weight gain and cost benefit ratio ($P<0.01$) over the trial period. Thirteen litters of improved piglets and 9 litters of local piglets were weighed in the field at 3 and 6 weeks. The improved piglets weighed significantly more than the local piglets at both ages ($P<0.01$).

Comparative study of carcass yields of different breeds of pigs in the eastern hills of Nepal

Oli KP (1987). Comparative study of carcass yields of different breeds of pigs in the eastern hills of Nepal. *Nepalese Journal of Animal Science (NASA),* **3**(3):21-26

Comparative studies were made of the Carcass yields of 37 Native, 34 Native x exotic and 40 exotic fattener pigs raised under the traditional husbandry system. Results indicated that there was a significant ($P<0.01$) difference in carcass yields between native and crossbreds, Exotics

and Crossbred with Exotics. The killing out percentage was in the order of 68, 76 and 78%, respectively. Gut content in the relation to live weight was similar in the entire introduction of improved pig breeds in the hilly areas of Nepal appears a viable economic proposition.

A study on the growth rate of local, crossbred and exotic breeds of pigs and carcass evaluation of local pigs

Gurung HB (1989). A study on the growth rate of local, crossbred and exotic breeds of pigs and carcass evaluation of local pigs. *Technical Paper N. 89/116*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

To compare the growth rate of pigs, nine castrated local male piglets were used. Their feeding management and weight gain measurements were studied under farmers' management conditions for a period of 48 weeks and finally their carcasses were evaluated. Growth rates along with the carcass yield of local black piglets were found insignificant when compared with the improved (saddle back x Tamworth x Fayen) and its crossbreds as measured by Oli (1986). The observation of feed supplementation to the local pigs throughout the experiment revealed that the pig feed was extremely low win dry matter and other valuable nutrients such as crude protein, in consideration of their body requirements. This has also greatly affected the growth rate and carcass yield of local pigs.

Effect of castration at two different ages on the growth and carcass yields of fattening pigs

Gurung HB, NP Shrestha, IK Aryal and PP Rai (1994). Effect of castration at two different ages on the growth and carcass yields of fattening pigs. *Technical Paper N. 94/156*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

Twelve Pakhribas Agriculture Centre crossbred piglets of 6 weeks age were studied to see the effect of castration. They were grouped into 2 groups (A and B) according to their body weight. Group A and B piglets were castrated at 6 and 8 weeks of age respectively. Their growth was measured up to a period of 40 weeks. They were fed commercial ration. There was no significant ($P>0.05$) effect of castration at 2 different ages on the growth and carcass yield and composition of fattening pigs. Group B piglets when castrated at 8 weeks (330g/day) age however, gave slightly higher daily growth compared to group A piglets when castrated at 6 weeks age (312 g/day) but there was no significant different.

A review of pig production in Nepal and approaches to improve climatic environment and efficiency of pig meat production from local resources

Kshetri BB, PR English, JF Robertson and G Burnett (1995). A review of pig production in Nepal and approaches to improve climatic environment and efficiency of pig meat production from local resources. *Proceeding of the 2nd National Animal Science Convention*, Khumaltar, Lalitpur, Nepal, Aug 7-10, pp 113-118

The climatic environment provided for pigs in many small holding situations is a primary factor which contributes to efficiency in terms of high piglet mortality, slow piglet growth and inefficient use of food and other resources. Climatic penalties have been quantified associated with damp floors/ resting areas, draughty conditions, low temperature, and housing of pig singly and low intakes of digestible/ metabolizable energy. There is an urgent need to improve housing in terms of rain proofing of roof and walls, improved insulation value of floor, roof and walls, reduction of draughts, housing pigs in groups rather than singly and increasing digestible energy intake. On the basis of the climatic penalties identified and the practical approaches for minimizing these penalties, the concept of an improved building / management system for

smallholders is proposed. This is designed to improve the efficiency of utilization of basis resources such as feed, labor and housing materials using appropriate technologies and locally available materials.

Comparative performance of improved pigs under improved and traditional management systems in a village of western mid hills of Nepal

Rasali DP, HB Gurung, DB Gurung and RK Amatya (1995). Comparative performance of improved pigs under improved and traditional management systems in a village of western mid hills of Nepal. *Working Paper No. 95/69*, Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

An on farm trial involving fattening test of 7 landrace and 3 landrace x Yorkshire cross pigs fed with household cereal based feed stuffs and green leaves and kept in traditional sties under traditional input management, and 8 landrace and 2 landrace x Yorkshire cross pigs fed with standard amounts of commercial concentrate feed and kept in concrete floor housing under improved input management was conducted in 10 households of disadvantaged farmers in a village of western mid hills. Each household was given one pig from each of two input management groups in order to examine the two management systems for pig production as an income generation activity. The results showed that the productive performance of the experimental pigs measured in terms of three traits viz. average daily gain, back fat thickness and final weight, averaging 399.4±26.4 g/day, 0.87±0.05 inch and 77.7±3.06 kg, respectively in the overall, did not differ significantly across management systems, breed and sex. The economic analysis of pig fattening test showed that the exotic pig raising under the traditional input management had an economic advantage over the improved input management not only due to high cost and lack of cash availability for concentrate feeding under the improved input management, but also due to the availability of adequate household feed stuffs to feed one or two pigs in the homesteads of disadvantaged farmers under traditional input management. The average net returns from fattening a pig under traditional and improved management systems were NRs 2100 and NRs 2216 with a benefit-cost ratio of 2.38 and 1.01, respectively. The farmers were found to prefer exotic breed to native, improved concrete housing to traditional sty, fattening to breeding pigs, raising one pig to two pigs at any one time, and traditional feeding to concentrate feeding regime for pig production. Traditionally, religious and cultural taboos are a social constraint to pig rising in a mixed community. However, raising them in a closed pen system is found to be socially acceptable. The other constraints perceived by the farmers in pig rising are lack of cash to buy piglets and construction of concrete housing, and marketing of finished pigs.

A comparative study on growth performance of different pig breeds up to the age of 12 months

Sah RB (1996). A comparative study on growth performance of different pig breeds up to the age of 12 months. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research* in Nepal, Khumaltar, Lalitpur, Nepal, May 7-9, 1996, pp 136-137

Twenty-four female piglet withers were used to study the growth rate of different pig breeds at RARS, Tarahara. It was observed that the average body weight gain was found highly significant at the age of 9 and 12 months ($P< 0.01$). The highest live weight was obtained by Yorkshire (115.55 kg), followed by crossbred (104.04 kg) and lowest by Hampshire (93.42 kg) at the age of 9 months. The highest live weight was obtained by Yorkshire (164.97 kg) followed by crossbred (16I.45 kg) and lowest by Hampshire (137.43 kg), respectively at the age of 12 months.

Effect of weaning age of piglets on the productivity of sows

Aryal IK, NP Shrestha, SP Neopane and HB Gurung (1996). Effect of weaning age of piglets on the productivity of sows. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **11** (2):45-47

A study was carried out to see the effect of weaning age of piglets on the productivity of sows at PAC. A total of 19 Pakhribas sows were used in this study. They were randomly divided into 2 groups (10 sows for six weeks weaning and 9 sows for 8 weeks weaning). The piglets produced from these 2 groups of sows were weaned at 6 and at 8 weeks of age. The sows were always bred after weaning their piglets when they came in heat. This study was carried out between 1991 and 1994 at PAC. The results showed that farrowing interval of sows decreased significantly ($P<0.01$) when the piglets were waned at 6 weeks (162±4.38 days) of age compared to 8 weeks (179±13.2 days). The lower farrowing interval in 6 weeks group has significantly increased the number of litters /sow/year (2.26 vs 2.05, $P<0.001$). The number of piglets' weaned/sow/year was 19.4 and 16.4 for 6 and 8 weeks weaning groups, respectively. No significant differences for litter traits (litter eight at birth, litter size at birth, litter size at weaning) were found. The results obtained from this study suggest that weaning of piglets at 6 weeks of age increases the productivity of sows.

Color preference for pig production in the hills of eastern Nepal

Aryal IK (1998). Color preference for pig production in the hills of eastern Nepal. *The 4th Global Conference on Conservation of Domestic Animal genetic Resources*. Birendra International Convention Center, Baneswor, Kathmandu, Nepal, 17-21 Aug, 1998

A survey of color preference among farmers for pigs in the hills of eastern Nepal was conducted at 12 sites (6 with access to road and 6 without access to road) using structured questionnaires. A total of 240 households (20 households from each site) were interviewed in the pig keeping community. Data were analyzed and compared between access and no access to roads and by ethnic groups (Rai, Limbu and others) on their color preference for pigs. Results showed that more than 97% of the existing pigs in the survey areas were black in color. Very few pigs were mixed color type (black with white markings and spotted). Regarding choice of the color of pigs 100% of farmers preferred a black pig. If black pigs are not available then 71% preferred Pangre (saddle at the back: resembles Hampshire or Saddle Black breed) followed by 54% for Thople (spotted), 53% Khairo (brown) and 59% Seto (white). White pigs were least preferred by majority of the farmers. The choice between access and no access to roads and by different ethnicity was similar. The reasons for preferring black pigs were because black piglets can be sold easily in the market at a higher price compared to other colors, they are used for religious as sacrificial animals for God, have tasty meat, bristle value and are compatible with conditions in the hills. About 97% of the farm households preferred medium sized pigs (60-120 kg live weight). During purchase of piglets, the selection criteria applied by the farmers were based on thin hairs, long body size, similar size of both testicles, short and bold snout, large ears, more than 12 teats, thick and long tail and black in color. The results confirm that pig-farming households prefer black pigs in the eastern hills.

Study on production of improved pigs under low input management of traditional pig farmers in the western mid hill

Rasali DP and R Pandit (1998). Study on production of improved pigs under low input management of traditional pig farmers in the western mid hills. *Working Paper N. 98/29*, Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

One group of 6 occupational caste farmers, and another group of 10 Magar community farmers in Kewarebhanjyang (Syangja district) and one group of 12 occupational caste farmers in Lumle village (Kaski district) were organized. In each group, one or two farmers were given a pair of improved weaned piglets of Landrace and Yorkshire blood for breeding purpose, and the rest of the farmers were given a male or female piglet for fattening under low input management. A slightly improved pig pen, household wastes and byproducts for pig feed with some supplementation of grain flour, mineral mixture, and occasional deworming and health care were provided to each of the animals. Pigs production performance analysis showed that their average daily gain in weight and carcass weight were significantly higher ($P<0.05$) in Keware site (0.35±0.03 g/day and 73.03±5.28 kg, respectively) than in Lumle site (0.17±0.03 g/day and 37.44±6.57 kg, respectively). However, both these performance traits were not significantly across caste groups or across pig sex. The final weight and back fat thickness were not significantly different across the sites, caste groups and the pig's sex. Farmers' discussions in all the three groups revealed that the traditional pig raising farmers could raise one or two improved pigs under low input management with the feed stuffs available at their homesteads as their food wastes or by products. They preferred to manage the improved pigs under closed system improving the sanitation, and resulting the alleviation of social problems arising from rising. The activity could prove to be a potential source of income generation for resource poor socially disadvantages and traditionally pig raising farmers in the mid hills provided that the technical and financial supports made available to them for few initial years.

A socio economic analysis on improved pig raising under farmers low input management system in the western hill of Nepal

Nepali MB, DP Rasali and RB Prasad (`1998). A socio economic analysis on improved pig raising under farmers low input management system in the western hill of Nepal. *Proceedings of the 4th National Outreach Research Workshop*, Khumaltar, Lalitpur, 27-29 April, 1998, pp100-105

An on farm trail of improved pig raising as an option of income generation for socio economically disadvantage traditional pig farmers under the low feed management system in the improved sty was conducted in 3 groups of western hill farmers at Bhumlingchock and Taranagar (Chhepetar) of Gorkha district in 1977. Thirty four households were given an improved pig (Landrace or Yorkshire cross). The pigs were fed under the local low input management system (household cereal based feedstuffs and green leaves). Productive performance (weight) of the pig at slaughter was measured. Cost benefit analysis revealed that this system is only profitable for households that have food sufficiency. Therefore, improved pigs in improved sites can be a source of income generation for these farmers.

Importance of pig production and strategy for sustainable development in the eastern hills of Nepal

Aryal IK (1999). Importance of pig production and strategy for sustainable development in the eastern hills of Nepal. *Proceedings of 3rd National Workshop on Science and Technology*, Royal Nepal Academy of Science and Technology (RONAST), Kathmandu, Nepal, March 8-11, 1999, Pp 880-889

A study was conducted to understand the pig production situation in the Mechi and Koshi hills of Nepal. A survey covered 240 household of different pig keeping ethnic groups with and without road access. 60% of the total households were involved in rearing pig, with the average herd size 1.58 pigs/household. There was no difference in the herd size of pigs between different ethnic groups. 76% of the total pigs were of an improved type (Pakhribas and Pakhribas x local). Most pigs (72%) were kept for fattening, and the rest for breeding, with breeders concentrated in Limbu (61%) and Rai (31%) communities. More than 97% of the pigs were black. All households preferred black, medium size pigs (<120 kg adult live weight) for socio cultural and scientific reasons too. No market problems for piglets or for meat were reported. A strategy for sustainable pig production in the hills has been formulated based on the data obtained.

Poverty alleviation of resource poor farmers through improved pig raising in the western hills of Nepal

Joshi KR, MB Nepali and SM Pradhan (2002). Poverty alleviation of resource poor farmers through improved pig raising in the western hills of Nepal. *Seminar Paper N. 02/10*, Agricultural Research Station, Lumle, Kaski, Nepal

Improved pig raising as an option of income generation for socio economically disadvantaged farmers under low input management system was tested at OR sites Taranagar and Bamgha in Gorkha and Gulmi districts respectively. Pig sites for each participatory farmer were constructed and piglets were distributed to the farmers in 2 lots during 1999 and 2000 in each site. Out of 50 piglets distributed, 24 were female and 26 were male of Landrace and Yorkshire breed. Among them, 4 pairs of piglets were given for the breeding and others for the fattening purpose. The growth of pigs was found to be better at Bamgha (118±17.1 kg) than in Taranagar (104±16.8 kg). The average daily gains were 370 g and 322 g in the respective sites. The final body weight of Landrace (105±18.96 kg) was found higher than that of Yorkshire (100±16.63 kg), however, the significant were none difference (P>0.05). The economic analysis revealed that the average benefit cost ratio was 1.55:1 for both sites during 1999 to 2001 with gross income of NRs 9615.0 and net income of NRs 3423.5/pig.

On station performance of different pig breeds at Regional Agricultural Research Station (RARS), Tarahara

Pandit RD, RB Sah, P Mandal and BP Budhanagaria (2004). On station performance of different pig breeds at RARS, Tarahara. *Proceedings of 5th National Animal Science Convention (NASA),* Oct 15-16, 2003, pp 193-195

Regional Agricultural Research Station, Tarahara has maintained different exotic pig breeds like Hampshire, Yorkshire and their crossbred for many years. Their on station production and reproduction performance were analyzed for the period of 1993/94 to 1999/2000. All together 95 sows comprising of Hampshire (62), Yorkshire (27) and crossbred (6) with 2 -9 parity were used in this study. The body weight of gilt at mating were 100.67±7.09, 101.83±6.55 and 109.66±5.96 kg litter size at weaning 8.58±1.08, 9.25±0.97 and 6.33±1.15 numbers, litter weight at weaning 8.2±0.59, 8.02±0.37 and 9±0.24 kg, and litter index/sow/year 1.75±0.08, 1.75±0.06

and 1.63±0.11 times for Hampshire, Yorkshire and their crossbred respectively. Similarly, the litter size at birth 11.16±2.47, 13.32±2.78 and 9±1.21 number and farrowing interval 205.83±47.98, 213.85±63.89 and 231.8±71.2 days for Hampshire, Yorkshire and their crossbred and were found significant (P<0.05). The 1st conception age was 293.83±26.41, 294.75±26.52 and 314.16±45.12 days, 1st farrowing age was 409.75±25.99, 412.66±24.37 and 428.57±44.38 days, litter weight at birth was 1.35±0.12, 1.35±0.10 and 1.43±0.12 kg, mortality of piglets before weaning was 20.89±9.83, 22.16±13.52 and 27.19±9.72% and gestation length 114.58±1.68, 114.41±1.38 and 114.66±1.56 days among the breeds were found no significant (P>0.05).

A small scale pig Farming for rural household

Dhauwadel TS and RP Ghimire (2006). A small scale pig Farming for rural household. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, 1-2 July, 1994, pp 72-75

Pig farming contributes to generate income to improve the livelihood of the poor farmers in rural area where unemployment and poverty is largely existed. The pig population and pig meat production is increasing in the country by about 5% and 4.5%/year, respectively. A study was made at the Outreach sites of Palanse and Kirtipur. Farmers were given piglets and allowed to rear them in their local management practices. Due to the religious detachment towards the meat of this animal, the society higher class groups of people are doing pig farming in commercial scale to earn higher level of income. The piglet mortality of around 34% is one of the important causes, which has reduced the income of the pig rearing farmers in the community. The existing pig production system in the villages is largely a small scale. The farmers earn a profit of NRs 9360.0 from the sale of piglets and meat from one sow in 60 weeks. The present piggery management systems in the country need to be strengthen and, farmers should adopt simple and cheap available technology in pig farming with expansion of farm size to draw a larger income.

Pig mortality: A big economic penalty to the pig farmers

Dhauwadel TS and PK Pokharel (1997). Pig mortality: A big penalty to pig farmers. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 24-25 Sep, pp 175-178

Pig has been economically valued animal to generate cash to the certain caste group of people in Nepal. The contribution of pork meat in the national GDP is 7%. The pork meat is gaining popularity in the diet of Nepalese people and has contributed to the rearing of improved pigs in both small and medium scale in other communities. Improved breed of pigs demand high level of management to increase the production and survival both during infancy and at later stage when they are matured. Mortality of piglets is one of the economic penalties which considerably reduced the economic of the farmers in the pig rearing communities. This report analyzed the neonatal and post natal mortality with the weaning rate from the data obtained in the Khumaltar pig farm where Landrace, Yorkshire and their crosses were reared for breeding and distribution purposes. The result showed that the parental mortality was 10% as against 18% post natal mortality with 28% over all mortality in the farm. The mean litter size was 8.9±2.7 with 6.44±2.59 at weaning among all kinds of breed reared in the farm.

A study on the basic cases of the pig mortality

Pradhan SM and PR English (1999). A study of the basic causes of the piglet mortality at Khumaltar pig farm. *Proceedings of 3rd National Conference on Science and Technology,* Royal Nepal Academy of Science and Technology (RONAST), Kathmandu, Nepal, March 8-11, 1999, pp 1087-1096

Three years data from 1993/94 to1995/96 comprising of 142 farrowing at Khumaltar Pigs Farm were analyzed to find out the basic causes of piglet mortality at pre-weaning stage. From the analysis of data, it was revealed that the major causes of losses were: Starvation 56.1 %, agalactia 16.1 % and infection (Mainly scour) 11.1 %. Mortality of live birth in pure breed (18.9%) was higher than in crossbred litters (15 .2 %). Mortality was lowest (11.2 %) during March to May which is dry and warmer season and it was highest (22.7%) in the autumn (Sept-Nov) because of large diurnal temperature variation in September and October, witty September months as well as other management factors associated with holidays around the main festivals in September and October. Mortality of live born piglets was highest in live born litter size groups of 1-3 (41.9 %) and 16 (16.5 %). Mortality rate of female piglets was higher than that of male piglets.

Some characteristics of the Pakhribas pig

Aryal IK, NP Shrestha, BB Kshatri, PP Rai and MP Shrestha (1992). Some characteristics of the Pakhribas pig. *Veterinary Review*, Pakhribas Agriculture Centre, Pakhribas, Dhankuta, Nepal, **7**(1)**:**21-23

Pakhribas Agriculture Centre has developed a black, high yielding pig; from a tree way cross of the Fyuen, Tamworth and Saddleback exotic breeds, known locally as the Pakhribas pig. Its performance was evaluated between 1983 and 1991 with on station data. The average at 1st service, 1st farrowing and farrowing interval were 241±26, 374±29 and 183±20 days, respectively. Average litter size was 9.92±2.7 piglets /farrowing, i.e. 19.8±3.02/year. The average birth weight, weaning weight and weaning piglet size were 1.04±0.19, 9.43±1.81 kg and 8.9±2.58 piglets respectively. The pre weaning mortality rate was 10.28% and no major health problems were encountered. This breed has been widely adopted by farmers in the eastern hills of Nepal.

A case study on native black pigs in the western mid hills of Nepal

Rasali DP, SM Pradhan, TS Dhaubhdel, NP Shrestha and JB Abington (1994). A case study on native black pigs in the western mid hills of Nepal. *Seminar Paper No 94/17*, Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

A total of 105 native pig-raising households (HHs) were surveyed in the western Mid-hills. On an average each HH raised 0.6 sows, 0.3 mature males and 3.2 piglets. 70.5 % were keeping native pigs under confinement, whilst 29.5% were allowed them to scavenge during the day. The native pigs were raised mainly to produce meat for household consumption, and to provide piglets for religious sacrifices. The native black pigs in the western mid-hills have small body size with a characteristically long. Slender and conical head, short ear and neck, narrow shoulders, a straight back and deep belly. They have moderately long bristles growing into a mane from the occiput to the shoulders. The mean piglets weight at birth and weaning were 0.8±0.06 (SE) kg and 6.8±barrows at slaughter were 17.3±0.78 kg and 24.0±1.5 kg, respectively. Age of piglets at weaning averaged 96 days. Post weaning average daily weight gain of barrows after 148 days post –weaning fattening period was 126± 15g/day. The mean liter sizes at birth and weaning period were 8.66±0.45 and 6.06±0.43, respectively. The hill black pigs are a valuable genetic resource but have been reduced to a vulnerable breed, warranting their observation following a strategic plan.

4. AVIAN

4.1 HEALTH

Studies on *Acuararia spiralis*, the proventricular worm in poultry

Agrawal PK (1982). Studies on *Acuaria spiralis*, the proventricular worm in poultry. *Bulletin of Veterinary Science and Animal Husbandry*, **10-11**:19-23

Infestation of chicks with *Acuaria spiralis* was studied. Numerous nematodes seen with their hand buried deep into the wall of the proventriculus causing an extensive damage to the host. Out of 74 birds, 24 died due to heavy infestation with *A. spiralis*. The morphology of the worm, gross and microscopic changes has been described. Total numbers of worms found in each proventriculus varied between 20 to 60 (average 35).

Three new species of poultry (*Gallus gallus domesticus*) cestodes from Nepal

Gupta R and J Rai (1990). Three new species of poultry (*Gallus gallus* domesticus) cestodes from Nepal. *Bulletin of Veterinary Science and Animal Husbandry*, Special issue published on the 3rd National Veterinary Conference, **17-18:**9-13

Three new species of tapeworms (cestodes, helminth parasites) of G*allus gallus domesticus* (domestic fowl) not previously recorded from Nepal are reported. The cestode parasites are *Amoebotarnia cuneata, Cotugnia digonopora* and *Raillietina echinobothrida*. The genus Amoebotaenia and its family dilepididae are reported for the first time in Nepal

Studies on Helminth parasites of duck and fowl from Institute of Agriculture and Animal Science (IAAS), Rampur

Rana HB, IP Dhakal, BA Ansari and CNR Yadav (1993). Studies on helminth parasites of duck and fowl from IAAS, Rampur, *Journal of Intitute of Agriculture and Animal Science (IAAS), Research Reports (1985-91), Rampur, Chitawan*, pp 395-417

An experiment was conducted at IAAS, during 1989/90 to investigate the helminth parasites harboring the ducks and poultry. Out of three ducks examined, only one was infested and only one species of trematode, *Prosthogonimus ovatus*, was observed. The parasitic infestation was very high (91%) in case of domestick fowl. Female birds (64%) were more susceptible than the males. Six species of helminth parasites, *Davainea proglottina, Raillietina bakeri, Raillietina cesticellus, Raillietina tetragona* and *Heterakis gallinae*, were recovered. *Prosthogonimus ovatus* was recovered from peaking duck. The internal organs of different species of each parasite were studied and variations between them were also noted.

Histopathological studies of Helminthic infestation in domestic fowl (*Gallus gallus domesticus*) in Chitawan

Gupta MP, R Gupta and RB Rana (1993). Histopathological studies of Helminthic infestation in domestic fowl (*Gallus gallus domesticus*) in Chitawan. *Journal of Institute of Agriculture and Animal Science (IAAS), Research Reports (1985-1991), Rampur, Chitawan*, pp 539-559

Five species of helminth parasites were collected after an examination of 105 specimens of domestic fowls in Chitawan during the period of Dec 1990 to April 1991. All the fowl were local breeds. Out of 105 fowls examined, 98 were found to be infected. These parasites included one species of trematoda (*Catatropic verrucos*), one species of nematode (*Heteralis gallinae*) and 3 species of cestoda (*Amoebotaenia cuneata*, *Hymenolepis carioca* and *Rallietina tetragona*). Most

of the intestines were infected by the presence of multiple groups of parasites. The percentage of infection varied with different types of helminth association. Among these, the association of nematodes and cestodes found high infection. All the 3 cestodes were common. *A. cuneata* and *H. carioca* when present were very commonly found in hundreds attached to the wall of duodenum. *R. tetragona* were found in small intestine and mostly their number was within one hundred. *H. gallinae* and *C. verrucosa* were found in the caeca and the number of these parasites was more common between 6-50 and 20-50 respectively.

Effect of *Emeria necatrix* infection on shank pigmentation inoculated with different dosages of oocysts

Bhurtel R (1994). Effect of *Emeria necatrix* infection on shank pigmentation inoculated with different dosages of oocysts. *Nepalese Journal of Animal Science (NASA)*, **8**(8)**:**69-73

This study was undertaken to observe the effect of *Emeria necatrix* on sank pigmentation when chicken were inoculated with dosages of oocysts. The isolate use in this study was obtained from Sterwin lab, Opelika Alabama USA chickens were given different dosages of oocysts (25000, 50000or 100000/bird) and their skin pigmentation during infection was compared with that of uninfected control chickens. A "Roche, yellow color hen" was used to measure sank pigmentation. Comparisons were made on D, D+4, D+7, D+14 and D+17. De-pigmentation of shank skin was first on the 5th day post inoculation. Pigmentation of infected chickens was significantly less ($P<0.05$) than that of uninfected controls and continued to 17 days post inoculation. During the length of the experimental period skin failed to regain its original color.

Pathogenecity of *E. necatrix* infection in broiler

Bhurtel R (1995). Pathogenecity of *E. necatrix* infection in broiler. *Nepalese Journal of Animal Science (NASA)*, **9:**41-51

This study was undertaken to find out the Pathogenecity of *E. necatrix* in broiler strain of chickens. Four experiments were done with different age of broiler inoculated with 25000 and 100000 oocysts and compare with uninfected control groups. The first sign of infection was evident at the end of the 4th days post inoculation. On the 5th days signs were more prominent and suppression of growth was more pronounced with severe infection (100000/bird) then with mild ones. Sudden death occurred from 5th through the 8th days post inoculation with severe infections. Chickens that recovered from severe infection given 100000 oocysts appeared to be weak, pale and more emaciated then those given 25000 oocysts. Chickens that survive the 7-8 days usually recovered slower than those with milder infection. There was 6% mortality among 8 weeks old chickens, 25% deaths among 4-week-old chickens when given 100000 sporulated oocysts to each. Thus mortality rate was greater among younger than older chickens

Preliminary evaluation of a commercial coccidiosis vaccine in broiler parental flocks

Singh UM (1996). Preliminary evaluation of a commercial coccidiosis vaccine in broiler parental flocks. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **11**(2)**:**61-62

Coccidiosis is the biggest problem in the broiler industry from an economic view of point especially when poultry are raised under a litter system. The results of a preliminary observation, which is reported here, showed that the disease can be controlled effectively by using a commercially available vaccine manufactured in the People's Republic of China.

Identification of *Eimeria species* in chickens in the eastern hills of Nepal

Thakuri KC and K Rai (1996). Identification of *Eimeria species* in chickens in the eastern hills of Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **11**(1)**:**5-7

A study to identify the species of *Eimeria* infecting village chickens in the eastern hills was conducted at PAC, Dhankuta. Four species of *Eimeria* namely *E. acervulina, E. brunetti, E. tenella* and *E maxima* were identified on the basis of oocyst morphology (dimensions and shape) and postmortem lesions seen in the experimentally infected chicks. Further steps which nee to be taken to overcome coccidiosis are discussed

Lesion scores of chickens given different number of *Eimeria necatrix* oocysts

Bhurtel R and SA Edger (1997). Lesion scores of chickens given different number of *Eimeria necatrix* oocysts. Nepal *Agriculture Research Journal (SAS/N)*, **1**(1)**:**52-56

The study was under taken to observe the lesion scores of chickens were given different number of oocysts of *Eimeria necatrix*. Maximum severity in chickens was observed with *Eimeria necatrix* at 120 to 144 hrs, with 100,000 or 2000,000 oocysts /bird at a68 hrs when chickens had 20,000 oocysts/bird. Severe infection caused acute hemorrhage enteritis. Lesions were uniformly distributed throughout the length of the small intestines, but the middle portion showed that greater involvement. At 144 hrs post inoculation, the intestine became"ballooned" and was congested and edematous in appearance. The thickness of the intestinal walls increased to more than double the normal size. A few *trophozoites* and *schizonts* were found in proventiculum and gizzard probably due to reverse peristalsis. The swelling and excessive thickness disappeared by 192 hrs. The intestinal tract looked dehydrated but no scars were seen in emaciated survivors. In case of mild infection, the petechiae and white spots accompanied by hemorrhages were most pronounced at 168 hrs post inoculation. The serosa of intestines had a spotted appearance. White spots were intermingled with bright or dull red petechiae of various sizes and mostly present in the middle portion of the small intestine which was swollen like a balloon, swelling decreased as petechiae disappeared. The intestinal wall became thicker than normal. Yellow tinged exudates were present in the intestinal contents, which was streaked with small hemorrhages. At 192 hrs the intestine looked almost normal. The changes seen in infected chickens were very constant and striking.

Incidence of coccidiosis in Chicken

Singh UM, SP Shrestha and K Sharma (2001). Incidence of coccidiosis in Chicken. *Proceedings of the 1st SAS/N Convention*, *March 29-31, 1999, Kathmandu, Nepal*, pp 276-280

Occurrence of coccidiosis was monitored in 3 commercial broiler poultry farms in Lalitpur for one year. Clinical symptoms were droopiness, soiled vent, diarrhea, some times blood tinged, chocolate color or bloody droppings. Post-mortem lesions were intestine ballooning, pinpoint hemorrhage, haemorrhagic enteritis, clinical distention and bloody ingesta and some times cheesy materials. There were altogether 123 cases of coccidiosis, of which 51 (41.5%) were caecal coccidiosis, 45 (36.6%) intestinal coccidiosis and 27 (21.9%) mixed coccidiosis. Seventy-two cases (58.6%) occurred in 0-4 weeks age group, 49 (39.8%) in 4-8weeks age group and 2 (1.6%) in > 8 week age group of chickens. In the same way incidence of coccidiosis recorded at the Central veterinary Laboratory was analyzed, Total cases of coccidiosis were 133, of which 71 (53.4%) were intestinal and 62 (46.6%) caecal coccidiosis. Mortality and morbidity were 5.53% and 6.29%, respectively. The highest incidence of coccidiosis was 61 (45.8%) recorded in 4-8 weeks age group followed by 52 (39.1%) in 0-4 week age group.

Prevalence of Salmonella infection among chickens in Pakhribas Agricultural Centre, its extension areas and two Government farms

Mahato SN, KC Thakuri, PB Thapa and JN Yadav (1990). Prevalence of Salmonella infection among chickens in Pakhribas Agricultural Centre, its extension areas and two Government farms. *Special issue published on the occasion of the 3rd National Veterinary Conference,* Aug 10-12, 1990, **17&18:**1-8

A total of 406 serum samples from breeding poultry birds of Pakhribas Agricultural centre (PAC), Dhankuta, its extension areas, Tarahara Livestock Research Farm (TLRF), Sunsari and Lampatan Animal Husbandry Research Centre (LAHRC), Kaski were examined for the presence of Salmonella antibodies. The plate agglutination test using stained *Salmonella pullorum* antigen detected percentages of reactors ranging from 52 at PAC to 67 at TLRF. The organisms isolated from the reactors of the PAC flock were identified biochemically as *S. pullorum*. Various aspects of *S. pullorum* infection including measures are also discussed.

Prevalence of Salmonella infection in chickens in Nepal

Mahato SN, KC Thakuri, PB Thapa and JN Yadav (1990). Prevalence of Salmonella infection in chickens in Nepal. *Special issue published on the occasion of the 3rd National Veterinary Conference, 10-12 Aug, 1990*, **17-18:**1-8

A total of 406 serum samples from breeding layers of Pakhribas Agricultural Centre (PAC), Dhankuta, Tarahara Livestock Research Farm (TLRF), Sunsari and Lampatan Animal Husbandry Research centre, Kaski were examined for the presence of *Salmonella* antibodies. The plate agglutination test using stained *Salmonella pullorum* antigen detected percentage of reactors ranging from 52 at PAC to 67 at TLRF. The organisms isolated from the reactors of the PAC flock were identified biochemically and serologically as *S. pullorum*. Various aspects of S*. pullorum* infection including control measures are discussed

Prevalence of Salmonellosis in chickens in the eastern Nepal

Jha VC, RP Thakur, K Chand Thakuri and JN Yadav (1994). Prevalence of Salmonellosis in chickens in the eastern Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **9** (1)**:**4-6

A study on Salmonellosis was conducted in village chickens and at the livestock farms in the eastern Nepal. Of 1409 blood samples examined serologically, the prevalence of Salmonellosis in chickens at the Tarahara Livestock Farm was 25.6%; 21.8% at the PAC livestock farm, 21.3% in the village flocks of Bhojpur and 12% in the village flocks of Dhankuta. Breed-wise the prevalence was highest (29.8%) in Giriraja chicken. Age-wise the highest prevalence was (40.2%) in 51-60 weeks old chickens. On bacteriological examination of samples from sacrificed reactor and on sero-typing of isolates the identified bacteria was confirmed to be *Salmonella pullorum*. The antibiotic sensitivity of isolates revealed that ampicillin, Nalidixic acid, Nitrofurantion, Gentamycin and Ciprofloxacillin highly effective in controlling the bacteria.

Study on *Salmonella gallinarum* isolates from liver of chicken

Pradhan A (1997). Study on *Salmonella gallinarum* isolates from livers of chicken, *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 24-25 Sep, 1997, Nepal, pp 105-108

Two hundred serum samples were collected from apparently healthy and sick birds. Out of 100 healthy birds only 2 were seropositive for salmonella infection. Two isolates of *S. pullorum* were found in the culture of livers collected from both seropositive cases. On the other hand,

out of 100 sick birds 10 were positive for *Salmonella gallinarum*. All the isolates of *Salmonella gallinarum* were highly sensitive to Choramphenicol and Cephalaxin, moderate sensitive to Erythromycin and Nitrofurazone and resistant to Penicillin, Ampicillin and Tetracycline.

Study on pathogenecity of *Salmonella gallinarium* isolates

Pradhan A and UM Singh (1999). Study on pathogenecity of *Salmonella gallinarium* isolates, *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research station, Lumle, Kaski, Nepal, 26-28 June, 1999, pp130-132

An experiment was conducted to study the pathogenecity of *Salmonella gallinarum* isolates 17, 18 and 10B in 8 weeks old chicks. In all the cases of infection clinical observation revealed that listlessness, droopiness, ruffled feather and somnolence and inappetence. Some chicks even survived after infection and were positive for Salmonella Plate Agglutination Test. Chicks inoculated with isolates 17, 18 and 10B resulted in 5 (83%), 6 (100%) and 4 (67%) dead chicks respectively within 14 days of infection. Histopathological examination in all cases showed necrotic foci in liver and pneumonia of lungs. This study suggested that all the 3 isolates of *S. gallinarium* were pathogenic to chicken with some variation in virulence.

Prevalence of multi drug resistant Salmonella in poultry meat in Kathmandu valley

Shrestha K, N Pokharel and P Manandhar (2008). Prevalence of multi drug resistant Salmonella in poultry meat in Kathmandu valley. *The 5th National Conference on Science and Technology,* Nepal Academy of Science and Technology (NAST), Kathmandu, Nepal, 10-12 Nov, 2008

The present study was conducted at Central Veterinary Lab, Tripureswor, Kathmandu from Shrawan to Kartik, 2064 with the aim of determination of prevalence of multi drug resistant *Salmonella* spp in poultry. Altogether 200 poultry meat samples were collected from different retail shops of Kathmandu valley. All these samples were processed for the detection of *Salmonella spp*. All Salmonella isolates were tested to different antibiotics for the determination of antibiotic susceptibility profile. The prevalence of *Salmonella spp* in meat in Kathmandu valley was found to be 13%. The prevalence of Salmonella detected cases was almost similar in Kathmandu and Bhaktapur (14.45 and 14.03%, respectively) which were slightly higher than that in Lalitpur (10%). Among 26 isolates of Salmonella, 50% belonged to Serogroups B, D and E. They were found resistant to antibiotics Tetracycline and Nalidixic acid. In this research, multi drug resistance was observed in only 3.84% of Salmonella isolates.

Isolation and identification of Salmonella species from the postmortem samples of poultry at Regional Veterinary Laboratory, Pokhara

Shrestha K, PR Shrestha and SP Devkota (2010). Isolation and identification of Salmonella species from the postmortem samples of poultry at Regional Veterinary Laboratory, Pokhara. *Proceedings of the 9th National Conference of National Veterinary Association,* Veterinary Complex, Tripureswor, Kathmandu, Nepal, 22-24 April, 2010, pp 76-80

This study was conducted from March to July 2009 at Regional Veterinary Laboratory (RVL), Pokhara with attempts to find out the prevalence of Salmonellosis in poultry. Isolate and identify Salmonella species in post mortem (PM) samples and perform the antimicrobial sensivity tests of the Salmonella isolates. One hundred eighty one (181) live birds brought at RVL were tested by rapid plate agglutination test using *S. pullorum* color antigen, out of which 61 (33.7%) showed positive reaction. A total of 64 samples (liver, spleen, heart, lungs, gallbladder and intestine) were collected from the postmortem cases of the positive reactors and from other cases with lesions suspected to be positive for Salmonella infection for the isolation of bacteria in different media, and identification was performed based on the staining,

culture and biochemical properties of Salmonella species. Out of 64 samples, 17 (26.56%) isolates of Salmonella species were isolated. The isolates were subjected to antimicrobial sensivity test for different antimicrobial using disc diffusion method which revealed Enrofloxacin (100%) to be most sensitive antimicrobials followed by Gentamycin (94.11%), Contrimoxazole (94.11%), Chloramphenicol (88.23%) and Doxycyclin (76.47%). Tetracyclin (58.22%) was moderately sensitive, Cefotaxime (29.41%) was least sensitive and Ampicillin was found insensitive. The result showed that the poultry farms at Kaski were in treats of Salmonella infections and necessary measures needs to be taken for its control and prevention.

Report on outbreak of fowl cholera in Dhankuta district

Thakur RP and JN Yadav (1990). Report on outbreak of fowl cholera in Dhankuta district, *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakribas, Dhankuta, Nepal, **5:**3-4

An out break of fowl cholera was investigated in Pakhribas village, Dhankuta district during Dec and Jan 1990. In a population of 620 local birds, 598 were affected, 411 died and 187 chickens recovered from the disease attack. This is the first report of lab confirmed outbreak of fowl cholera in Dhankuta district.

Antibiotic sensitivity pattern of *Mycoplasma gallinarum* isolates from the chicken

Pradhan A and UM Singh (1997). Antibiotic sensitivity pattern of *Mycoplasma gallinarum* isolates from the chicken. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 24-25 Sep, 1997, pp 109-111

Six isolates of *Mycoplasma gallinarum* isolated from lungs were used in the study. The antibiotic sensitivity of the isolates against antibiotics was interpreted according to the width of zone of inhibition of the growth of the isolates by different antibiotics in sensitivity test media. All the isolates were highly sensitive to Tylosin, Chloramphenicol and Erythromycin and moderate sensitive to Doxycycline and Gentamycine and resistant to Ampicillin, Tetracycline and Cloxacillin.

Study on chronic respiratory disease in chicken

Pradhan A, VC Jha and S Hokonohora (1999). Study on chronic respiratory disease in chicken, *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal,* Agriculture Research Station, Lumle, Kaski, Nepal, 26-28 June, 1999, pp 26-129

Preliminary survey of chronic respiratory disease in chicken was done in Chitawan, Kathmandu, Pokhara and Gorkha. A total of 184 serum samples were collected for the study. Plate agglutination test was employed for the Mycoplasma agglutinins in the blood sera. Prevalence of CRD in Chitawan, Kathmandu, Pokhara and Gorkha were 75, 29, 63 and 66% respectively. Mycoplasms infection in 2 to 5 months age, 6 to 8 months age and > 9 months age group were 76, 56 and 45 % respectively.

Occurrence of Mycoplasma infection in crossbred chicken at Pakhribas farm

Khanal DR, S Shrestha, Prenil KC and PK Pokharel (2006). Occurrence of Mycoplasma infection in crossbred chicken at Pakhribas farm. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, 1-2 July, 2004, pp 108-110

Following the sudden death of an adult, sow belonging to the farm, four weeks old Giriraja crossbred and New Hampshire crossbred chicken exhibited the symptoms of typical of Mycoplasmosis and died. This has lead to suspect that the same person who did postmortem of

a dead pig and locked after chicken might have carried Mycoplasma from swine to birds. Possible involvement of personnel in carrying out interspecies infection could not be ruled out. The daily mortality rate was around 2-10% in Giriraja strain and persisted for a week even after Tylosin therapy whereas mortality was checked in New Hampshire breed with Tylosin. Respiratory manifestation and join involvement were quite distinct for presumptive diagnosis of Mycoplasma infection that was later confirmed by agar gel immuno diffusion (AGID) test.

Enterococcus: the major cause of weakness and mortality of day old chick

Basnet HB, HJ Kwon, SH Cho and SJ Kim (2010). Enterococcus: the major cause of weakness and mortality of day old chick*. Proceedings of the 9th National Conference of National Veterinary Association,* Veterinary Complex, Tripureswor, Kathmandu, Nepal*,* 22-24 April, 2010, pp 81-85

A total of 96 liver and 75 yolk sacs samples from 118 day old dead chicks were examined for the presence of bacterial and mycotic infection. Enterococci were positive in 30.4% liver samples and 27.1% of yolk sac samples. In the same way 145 unpiped embryos were tested and 20% of embryos were found to be infected with Enterococci. Mixed infections were not found in both dead day old chicks and dead embryos. Only 2 species of Enterococci were detected from liver and yolk sac samples representing 86.9% *E. faecalis* and only 13.1% *E. faecium*. Prevalence of *E. faecalis* was found to be 89.6% in dead chick's embryos and remaining 10.4% were other species of Enterococci. During the pathogenicity test with *E. faecalis*, a maximum of 45% of embryos found to be un hatched and un piped and almost 42% of the hatched chicks were weak and 78.6% of weak chicks died within 48 hrs of chick's life and *E. faecalis* were re isolated from 90.9% of dead chicks. This study showed Enterococci was one of the major causes of weak chicks, early chick mortality and *E. faecalis* was the major cause of embryonic death of chicken embryo.

An outbreak of Avian Encephalomyelitis in chicks at Kavrepalanchok district in Nepal

Jha VC, UM Joshi and S Hokonohora (1999). An outbreak of Avian Encephalomyelitis in chicks at Kavrepalanchok district in Nepal. *Veterinary Review*, Animal Health Research Division, Tripureswor, Kathmandu, Nepal, **14:**23-25

An out of a disease in day old chicks in a hatchery and after a week also in broiler farms of the Kavrepalanchok district was reported. The findings of this investigation suggested that the chicks at the hatchery and at broiler farms had suffered from avian encephalomyelitis disease outbreak. The disease was confirmed by serological and histopathological examinations of the collected samples. The parent flock had not been vaccinated. The affected chicks had clinical signs of dulless, depression, ataxia, tremors of head and neck and inclination to sit on their hocks. At the broiler farms the overall morbidity rate due to AE was 30.6% and mortality rate was 22.6%.

Inclusion body hepatitis- hydropericardimum syndrome: Emergence of a new disease problem in Nepalese poultry industry

Karna VK (2003). Inclusion body hepatitis- hydropericardimum syndrome: Emergence of a new disease problem in Nepalese poultry industry. *Proceedings of the 7th National Conference of Nepal Veterinary Association,* Tripureswor, Kathmandu, Nepal, 5-7 Nov*,* **24:**78-82

Nepalese poultry industry has experienced inclusion body hepatitis hydropericardium syndrome, a new emerging disease of economic importance during the year 2003. Officially, 1st hand notification was recorded when postmortem of 4 broiler birds was conducted in the Central Veterinary Laboratory (CVL) on 4 July 2003. The provisional diagnosis was made at CVL as Leechi Disease and was confirmed as inclusion body hepatitis hydropericardium

syndrome at Indian Veterinary Research Institute (IVRI), India. The prevalence study conducted in the Kathmandu valley and Kavre district showed that the disease has achieved the enzootic status. Since its appearance, it has caused on estimated financial loss of NRs 1.5 million. Outbreaks have also been recorded in parent stocks and commercial layers as well. Occurrence of the disease has also been confirmed in the Kailali district.

Outbreak of New castle disease in commercial chicken in Nepal

Bohora KB, IP Dhakal, TC Bhattrai and DR Adikari (1996). Outbreak of New castle disease in commercial chicken in Nepal. *Proceedings of the 5th National Veterinary Conference*, 11-13 Sept, **24:**100-104

An out break of New Castle Disease in commercial poultry farms in Chitawan valley was investigated. The outbreak affected an estimated population of 0.4 to 0.5 millions of commercial chickens. The morbidity and mortality were estimated to be more than 75 and 5%, respectively. Chickens of all breeds were found to be affected but mortality was seen only in younger birds. Broiler chickens were found to be most affected. Based on haemagglutination inhibition (HI) test and challenge trail, the isolate was confirmed to be velogenic viscerotropic strain of New castle disease virus (VVNDV). This was the 1st isolate for the year 1996 but 2nd isolate of Nepal. The isolate was designated as NDV-NP1/96 for identification.

Efficacy study of New Castle disease virus V_4 strain vaccine in chicken in Nepal

Bohora KB and UM Singh (1996). Efficacy study of New Castle disease virus V_4 strain vaccine in chicken in Nepal. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, 7-9 May, 1996, pp 189-196

Efficacy of the oral NDVR4HR strain vaccine against Nepalese velogenic field strain of NDV (ND-NP1/95) was investigated in experiment I. Oral vaccination with drinking water provided 80% protection against the challenge with ND–NP1/95, a very virulent local strain of NDV. The result of feed based vaccination was rather inconclusive. Experiment II was carried out to simulate the natural field storage conditions and their impact upon protection offered by V4HR strain vaccine. The vaccine held at 20^0 C and 37^0 C for an extended period of 6 days did not offered protection against challenge with velogenic ND-NP1/95 whereas vaccine held at 4^0 C offered protection against same challenge.

Comparative study on the efficacy of heat resistant V_4 vaccine given in feed and water against the challenge infection of New Castle disease of chicken in Nepal

Bohora KB (1997). Comparative study on the efficacy of heat resistant V_4 vaccine given in feed and water against the challenge infection of New Castle disease of chicken in Nepal. *Veterinary Review*, Animal Health Research Division, Tripureswor, Kathmandu, Nepal, **12**(1)**:**7-9

Twenty chickens of 2 weeks of age in 2 different groups were vaccinated orally with NDV4HR strain vaccine, one in water and another in cocked rice. The efficacy of the oral NDV4HR strain vaccine against Nepalese Velogenic field strain of NDV was evaluated through post vaccine challenge method. Oral vaccination with drinking water provided 80% protection against the challenge while the results of feed based vaccination were rather inconclusive.

A review of literature on thermostability of infectivity and haemagglutinin of New Castle disease virus

Pradhan SMS and GR Scott (1993-95). A review of literature on thermostability of infectivity and haemagglutinin of New Castle disease virus. *Proceedings of the 4th National Veterinary Conference*, **21-23:**8-21

The thermostability of haemagglutinin and infectivity could be used for characterizing the different strains of NDV to segregate a mutant population or heterogeneous population of virus but great variations were found. Usually the thermo stability of haemagglutinin was found to be more that stable then infectivity. However, lentogenic strains have almost equal or more thermoresistance of infectivity. Virus remained infective for long period under freeze dried conditions with negligible decrease in titre. Virulence is not related to the heat sensitivity of the virus.

Evaluation of commercial vaccine against IBD in Nepal

Bohora KB (1996). Evaluation of commercial vaccine against IBD in Nepal. *Proceedings of the 1st National Workshop on Livestock and Fisheries Researchin Nepal,* Khumaltar, Lalitpur, 7-9 May, 1996, pp 202-211

This study was conducted to evaluate the pathogenicity and immunosuppressive effects of 3 intermediate and 1 hot strain of infections bursal disease (IBD) vaccine. 16 days old broiler chickens were vaccinated with this vaccine. 3 weeks post IBD vaccination; they were also vaccinated orally in water with NDV4HR vaccine. The pathogenicity was evaluated by observing clinically visible signs and lesions on body surfaces and bursa, typical for IBD infection. Immunosuppressive effects were evaluated by determining the response of IBD vaccinated birds to NDV vaccine. Bursal lesions and mild muscular lesions were noticed in all 4-vaccine groups but no externally visible clinical symptoms with mortality are recorded for none of the vaccine group. All groups respond to NDV4HR vaccine with variable results.

Surveillacne and sampling strategy for detection of highly pathogenic Avian influenza in Nepal

Ghimire NP (2008). Surveillacne and sampling strategy for detection of highly pathogenic Avian influenza in Nepal. *Green Field Journal of Himalayan College of Agricultural Science and Technology (HICAST)*, Gathghar, Bhaktpaur, Nepal, **6**: 124-134

An overview of the national surveillance and sampling dtrategy designed for the detection of highly pathogenic Avian influenza (HPAI) infection has been dixcussed with respect to the risk assessment of various physiographic situations and avian population. Even though the country is free from infection but there is a greater risk of possible entrance of the disease. Among the 75 districts were classified as high risk (26), medium risk (18) and low risk (31) districts in relation with the outbreak of HPAI. Out of 26 high risk districts, the Ilam, Jhapa, Morang, Sunsari, Saptari and Siraha were categorized as most vulnerable owing to the afct the frequent outbreak of disease in adjacent west Bengal state of India. The total population of avian of the country was classified as backyard, commercial and wild birds where the risk was assessed to be moderate to high. A higher risk of outbreak was realized in the population of birds in the live market. The sample collection strategy was targeted to obtain 12540 samples annualy from backyard poultry (5700), commercial poultry (5900) and wild birds (940). The procedure for cliniical surveillance, recording of reportable symptoms and detailed procedure for sample collection in case of backyard and commercial poultyr has been outlined. The arragement made for prompt reporting of information was also discussed in relation with the risk of Avian influenza.

Experience sharing and lessons learned from the outbreak of highly pathogenic Avian influenza in Pokhara

Nirmal BK, AB Shah, SP Devkota and RN Tiwari (2010). Experience sharing and lessons learned from the outbreak of highly pathogenic Avian influenza in Pokhara. *Proceedings of the 9th National Conference of National Veterinary Association,* Veterinary Complex, Tripureswor, Kathmandu, Nepal, 22-24 April, 2010, pp 140-145

Following the history of mass mortality and morbidity in ducks, six samples of dead birds submitted to the Regional Veterinary Laboratory (RVL), Pokhara showed positive for rapid flu a test on 26 January, 2010 which was later confirmed as H5N1 at Central Veterinary Laboratory and Veterinary Analytical Laboratory, UK on 3 Feb, 2010. Government of Nepal declared Gharipatan of Pokhara as bird flu infected zone and bird flu control room was established for the stamping out operation, followed by cleaning, mopping and disinfection in the same fixed boundaries of infected zone. In 1287 households, total of 11129 birds, 144.5 kg poultry meat, 1902 eggs and 1516 kg of feed were destroyed. Due to delay in declaration of bird flu infected zone, the disease was spread in other parts of city as well as in neighboring district Tanahun. Ten places were declared as hot spots in which 1276 birds, 107.5 kg meat, 669 eggs and 385 kg feeds were destroyed in 246 households. The probable hypothesis for the spread of disease was thought to be through wild migratory birds. Total number of rapid response team (RRT)/prompt response team (PRT) employed were 5 and total numbers of resources were 165 in which 47 were labors. Total of 478 personal protective equipment (PPE) and 24300 kg lime, 98450 g virkon were used for complete operation. Total number of backyard birds/farm observed by surveillance team was 2269 and 455 samples were collected from 157 farms. Major strengths, constraints, post operative activities and lessons learned were discussed in this article for further facilitation of operation for future control strategy of bird flu control in Nepal. Late declaration of infected zone, unpractical specification of procedure, budgetary constraints and monetary compensation were found to be main constraints where multidisciplinary coordination and responsible media were major strengths of Pokhara operation.

Diagnosis of infectious bursal disease by agar gel precipitation test

Joshi HD, HK Shrestha and BR Joshi (1996). Diagnosis of infectious bursal disease by agar gel precipitation test. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **11**(1)**:** 27-29

Suspected outbreak of infectious bursal disease (IBD) in a small scale broiler farm at Patichaur, Parbat district was confirmed by using Agar Gel Precipitation Test (AGPT). IBD virus antigen was prepared from the affected cloacal burse and AGPT was performed with the standard antisera obtained from Central Veterinary Laboratory, Weybridge, UK. The disease was confirmed by the formation of distinct precipitation line in agar gel following 48 hrs incubation at 20^0 C. The typical postmortem lesions recorded in the slaughtered sick birds also supported the laboratory findings.

Sero-prevalence of some viral infections in chickens in Koshi Zone.

Mahato SN and PB Thapa (1992). Ser-prevalence of some viral infections in chickens in Koshi Zone.*Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **7**(1)**:**26-28

A study was conducted to determine the seroprevalence of infectious bursal disease (IBD), Marek's disease (MD) and chicken embryo lethal orphan (CELO) in the breeding layers at the 3

main hatcheries located in the Koshi zone of Nepal. The results indicated that IBD, MD and CELO viruses exist in the Koshi zone; the overall prevalence being 4.1, 6.0 and 5.3%, respectively. It is recommended that the chickens produced at these hatcheries must be vaccinated against IBD and MD before being distributed to farmers.

A study on the immunological aspect of fowl pox vaccine in Nepal

Baidya TN (1985). A study on the immunological aspect of fowl pox vaccine in Nepal. *Bulletin of Veterinary Science and animal Husbandry*, **13:**25-30

Some level of immunity to fowl pox was detected in chicks vaccinated with pigeon pox virus vaccine. The vaccine from IVRI and BPD had identical immunogenic properties. Revaccination of the chicks was found to be more effective in maintaining high level of immune response.

An Outbreak investigation of pigeon pox

Manandhar P and M Dhakal (2003). An Outbreak investigation of pigeon pox. *Proceedings of the 7th National Conference of Nepal Veterinary Association,* Tripureswor, Kathmandu, Nepal, 5-7 Nov, **24:**104-106

An outbreak investigation of pigeon pox was carried out in CVL from 4 dead pigeon brought from 2 outbreak areas of Pokhara and Kathmandu valley. On examination, cutaneous lesions were observed in one dead pigeon from Kathmandu where as all three dead pigeon from RVL Pokhara were having diphtheritic lesions only. On suspicion of pigeon pox samples from these lesions were collected separately, an attempt to culture the virus was done the control. After 5 days of incubation at 37^0C the CAM were harvested and observed for pock lesions on them. The percentage of pock lesions on all CAM from the test samples and absence of these on CAM of control samples suggested the pigeon pox on them.

Natural occurrence of Aflatoxin in various feed commodities of Nepal

Karmacharya S (1994). Natural occurrence of Aflatoxin in various feed commodities of Nepal. *Nepalese Journal of Animal Science (NASA)*. **8:**43-48

Aflatoxin, a clinical carcinogenic compound, is produced by the mold *Aspergillus flavus* and *Aspergillus parasiticus*. These may pose threat to animals and human health when present in feed and food source. Various type of feed and feed ingredients collect from different industries of the country was checked for the detection of aflatoxin contamination. About 62% of poultry feed, 55.2 % of cattle feed, and 53.3 % of the pig feed out of 426, 90, and 45 samples respectively were found contaminated with aflatoxin B. few of these contaminated samples were also loaded with aflatoxin B2. Maize and peanut cake used as feed ingredients were traced to be the main source of aflatoxin contamination in various types of feed. Percentage and level of aflatoxin contamination were high in poultry feed in comparison to others. Contamination problems were seen in the hills as well as in Terai region throughout the year. But the cases were more pronounced rainy and post rainy season.

Aflatoxin contamination in Livestock feeds and feed ingredients of Nepal

Khadka BB, BK Dinha, KCP Singh, LN Prasad and SB Verma (2000). Aflatoxin contamination in Livestock feeds and feed ingredients of Nepal. *Nepal Journal of Science and Technology,* Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, **2:** 45-49

Aflatoxins are secondary metabolites produced by moulds *Aspergillus flavus* and *A. parasiticus*, which are ubiquitous and frequently contaminate most of the agricultural and livestock food products. These toxins are potent hepatotoxins and carcinogens, and mainly cause liver cancer.

With limited information available on the level of aflatoxin contamination in Nepalese livestock feeds and feed ingredients, its risk to human health is not extensively investigated. In this study, aflatoxin contamination in various feed ingredients/processed livestock and poultry feeds collected from different parts of Nepal was measured. Altogether, 100 samples comprising of 25 livestock feeds, 50 poultry feeds and 25 feed ingredients were collected and processed for aflatoxin assay. The % of samples with aflatoxin contamination was 80, 74 and 72%, respectively for livestock feeds, poultry feeds and feed ingredients, giving an overall contamination of 75%. Aflatoxin B1 was detected in all aflatoxin positive samples either alone or in combination with aflatoxin B2. The concentration of aflatoxin in positive samples ranged from trace to 300 µg/kg in livestock feeds, trace to 500 µg/kg in poultry feeds and trace to 300 mg/kg of feed ingredients. There was non significant difference ($P>0.05$) in contamination of aflatoxin between various feeds/ingredients examination. Such a high level of aflatoxin is of great concern to livestock, poultry and human health. The need for regular and frequent checking of these commodities before consumption is emphasiz

4.2 NUTRITION

Experiments with high levels of soybean meal in chicks' diet

Shrestha TP (1981). Experiments with high levels of soybean meal in chicks' diet. *Bulletin of Veterinary Science and Animal Husbandry, Nepal* **8-9**: pp 25-36

Two experiments were conducted to study the effect on chicken growth of two major protein source, soybean meal and herring meal, combined with different cereal bases with and without supplementary DL methionine. It was confirmed that soybean meal is 1st limiting in sulphur containing amino acids as the addition of DL methionine to soybean meal – maize diets always resulted in an improvement in growth. Soybean meal-maize diets without methionine supplementation did not support maximum growth rate even at high levels of proteins, indicating that merely increasing protein is not an effective way of supplying the extra methionine needed for maximum growth. Hence it is necessary to supply the 1st limiting sulphur containing amino acids in such a diets if maximum growth rate is required. All vegetable diets gave better growth that diets using herring meal combined with different cereals, showing that soybean can displace herring without affecting the necessary amino acids except sulphur amino acids. Soybean and maize represent a good combination.

Effect of heat treatment of mustard oil meal on chick growth

Joshi NP, RJ Deans and DE Ullrey (1987). Effect of heat treatment of mustard oil meal on chick growth. *Journal of Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan*, **8**:121-130

To examine the effect of heat treatment of mustard oil meal (MOM) on chick growth, 3 experiments were conducted at Michigan State University, East Lansing MI, USA. The effects of the levels (10, 20 and 30%) and the effect of defatting of MOM on chick growth were also studied. Autoclaved (15 psi for 30 min) MOM when fed to chick improved their growth over dry oven heating or hot water treatment ($P<0.05$). Defatting also improved chick growth and there was further improvement in chick growth upon autoclaving of defatted MOM. It was indicated that the growth depression of chicks fed diets containing MOM was not due to erucic acid alone. There was decrease in weight gain of chicks fed higher levels of MOM ($P<0.05$) irrespective of the treatments.

Chemical Characterization of mustard oil seed cake from Nepal

Joshi NP and RJ Deans (1988). Chemical Characterization of mustard oil seed cake from Nepal. *Journal of Institute of Agriculture and Animal Science (IAAS*), Rampur, Chitawan, **9**:57-61

Samples of mustard oil seed cake were subjected to proximate analysis. Crude protein content was 38.5%, Ether extract 11.6%, dry fibre 6.9% and ash content was 9.4% on dray matter basis. Amino acid content of the crude protein was 52mg/100 gm and 54 mg/100 gm for lysine and arginine, respectively. Gross energy and metabolizable energy were 4653 and 3295 Kcal/ kg respectively. The glucosinolate content was 4.7% on dry matter basis, erucic acid in residual oil was 37.1% and tannin (as Quercitannic acid) was 2.9% on fat free dry matter basis.

Utilization of damaged soybean grain in broiler rations

Gupta JJ, A Verma and BPS Yadav (1997). Utilization of damaged soybean grain in broiler rations. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 11-16 March 1997, pp 115

In the current study the utility of damaged soybean grain (DSG) in broiler mash was studied in a series of experiments on commercial chickens. The DSG was severely damaged in that 40-50% of grains were infested by insects or fungi. In the 1st experiment, the efficacy of DSG was tested as a protein component of broiler mash. The results indicated that compared with a diet containing un-roasted DSG, the growth performance of chickens was superior on the roasted DSG diet. For the diet containing roasted DSG, weight gain was 1297 g and feed to gain ration was 2.93. In the 2nd experiment, the performance of broiler chickens was tested at different metabolizable energy (ME) levels with DSG. It was found that 12.1 MJ/kg ME is the optimum for production, and gave protein retention levels significantly ($P<0.05$) higher than other DSG diets having 11.3 and 13.8 MJ/kg ME values. In the 3rd experiment, the potential level of inclusion of DSG with a minimum number of feed ingredients was assessed. Roasted DSG to the level of 36% was used. At this level there were no adverse effects in diets with maize only or with rice polish and maize. Thus, it can be concluded that roasted DSG can be used in poultry broiler mash as source of both protein and energy.

Effect of forage peanut meal on the production performance of Lohmann layers

Adhikary BN, IP Dhakal, NR Devkota and M Sapkota (2010). Effect of forage peanut meal on the production performance of Lohmann layers. *Proceedings of the 9th National Conference of Nepal Veterinary Association*, Kathmandu, Nepal, 22-24 April, pp 70-75

A study based on the field situation analysis by employing system-learning approach (SLA) was conducted during Aug 2008. Experimental learning system analysis and participatory rural appraisal (PRA) tools were used to explore and identify the key researchable issues related to poultry production focusing on feeding component and the nutrition of laying hens. Need of exploration of alternative protein source through possible legume forages was the key researchable issue identified through the SLA works. Incorporation of forage peanut (*Arachis pintoi*) meal at different proportions to study its effects on the performance of egg quality characteristics in the layers diet for a period of two months (25 to 33 weeks age) were investigated. It was concluded that system approach was a valid tool to explore and analyze key researchable issues pertinent to poultry production. Incorporation of forage peanut meal at 2-5% level in the diet of layers resulted optimum production with no observable side effects. However, use of forage peanut meal in the layers ration needs further research to cover the entire laying cycle before recommending its incorporation in poultry feed.

Effects of feeding Ipil Ipil dry leaf meal to chicks

Parajuli DP (1997). Effects of feeding Ipil Ipil dry leaf meal to chicks. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Ressarch in Nepal,* Khumaltar, Lalitpur, Nepal, 11-16 March 1997, pp 115

An experiment was conducted to study the effects of feeding dry Ipil Ipil leaf meal at a level of 5% in diets of chicks. 40 day old New Hampshire chicks were given a diet containing 5% Ipil Ipil, and 40 similar chicks were given a control diet. All chicks were weighed at weekly intervals for 8 weeks. The initial mean body weight of chicks was 34 g. Growth rates to 8 weeks were 5.9g/d for the treatment group and 6.3 g/d for the control group. The food composition to 8 weeks was 1.58 and 1.89 kg for the treatment and control groups respectively. The food conversation ratio of the 2 groups was 4.89 and 4.47 and mortality rate was 15 and 12%, respectively. It was concluded that the performance of chicks was not seriously affected by the inclusion of 5% Ipil Ipil meal. This level of inclusion is therefore recommended because it reduces the cost of the diet.

Effect of Ipil Ipil (Leucaena leucocephala) leaf meal on growth of Vencobb broiler

Singh MK and SD Sah (2007). Effect of Ipil Ipil (Leucaena leucocephala) leaf meal on growth of Vencobb broiler. *Proceedings of the 8th National Outreach Research Workshop*, Khumaltar, Lalitpur, 19-20 June, 2007, pp 399-405

A study was conducted to determine the effect of feeding different level of dried and ground Ipil Ipil leaf meal (LLM) on growth, feed consumption, feed efficiency, and cost of different rations of Vencobb broiler at livestock farm IAAS, from 5th April to 165t May, 2005. Two hundred day old straight run chicks from same hatched were brooded for a period of 7 days, where pre experimental diet was offered. On 85t day, chicks having uniform body weight were weighed and leg banded was randomly allocated into 5 dietary treatments with 4 replications (10 chicks in each). The isoproteneous and isocaloric formulated standard starter (CP 22.3%; ME 3036 K cal/kg) and finisher (CP 20%; ME 3204.7 K cal/kg) diets were supplemented with LLM in order to T1 0%, T2 2.5%, T3 5%, T4 7.5% and T5 10%, respectively. The chicks were offered ad lib broiler starter and finisher diets from 8-21 and 22-49 days respectively with clean drinking water. The uniform management practices were performed throughout the investigation period. The data were subjected to statistical analysis under CRD as per the methods of MSTAT. The results revealed that effect of feeding different levels of inclusion of LLM on average live body weight (g) of different dietary groups differed significantly ($P<0.05$); the highest average live body weight (2091.3±16.3) was in the group on diet supplemented with 5% LLM and the lowest (1961±16.3) in the group on diet having 10% LLM, the diets having 5% LLM was significantly higher than that of groups on diet having 5% and 7.5% LLM respectively. Effect of LLM on average live weight gain (g) did not differ significantly ($P<0.05$); the highest weight gain (493.6±17.6) and lowest (385±17.6) in the group on diet having 5 and 7.5% LLM respectively. Similarly, effect of LLM on average fee consumption (g) of different dietary groups differed significantly; the highest feed consumption (1136.4±21.17) was in the group on diet having 10% LLM and lowest (978.621.17) in the group on diet having 0% LLM, the groups on diets having 5 and 10% LLM had resulted significantly higher than that of 0% LLM. Effect of LLM inclusion on the average feed efficiency of different groups of birds did not differ significantly; the highest feed efficiency (3.6±0.27) was recorded in the group on diet containing 7.5% LLM and lowest (2.14±0.27) in the groups on 0% LLM. The price of rations per kg in NRs was the lowest (17.2) in the groups on diet having 10% LLM. As the inclusion rate of LLM was increased the price of feeds was decreased. By selling overall performances, it can be concluded that broiler chicks can be raised safely up to 5% inclusion of LLM in diets.

Growth performance of duck breeds in Chitawan

Jha DK and S Tiwari (1993). Growth performance of duck breeds in Chitawan. *Journal of Institute of Agriculture and Animal Science (IAAS), Research Reports (1985-1991), Rampur, Chitawan*, pp 418-426

A study was conducted to examine the growth performance of 3 breeds of ducks (*Anas sp*) at IAAS, Rampur, Chitawan during Jan to April 1991 for a period of 105 days. The ducks were fed on a balanced poultry feed for the 1st 3 weeks and after that they were fed on the same diet and also were allowed to feed on natural food available in the nearby marshy land. The average weight gains of ducks at the end of the experiment period were 1750±23.0, 1662±0.25 and 1202±0.21g for Peking (n=39), Hongkong (n=29) and Khaki Cambell (n=26) breeds, respectively. Peking and Hongkong breeds showed almost equal body weight gain which were significantly ($P<0.01$) higher than the weight gains by the Khaki Cambell breed.

A method of preparing bovine lung protein concentrates of high nutritive value

Subba D (2000). A method of preparing bovine lung protein concentrates of high nutritive value. *Nepal Journal of Science and Technology,* Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur**, 2:59**-62

A method of preparing protein concentrate of high nutritive value from bovine lung has been described. The lung protein was extracted with an aqueous and a 9% salt (NaCl). The extracted protein was precipitated at P^H 4.5-4.6 and dried. The lung protein concentrate (LPC) was devoid of connective tissue protein (0.16% on dry weight basis). Significant difference was found when the values of protein quality evaluation parameters of LPC were compared with that of dries lung ($P<0.05$). The LPC contained 42.7% essential amino acids in total amino acids. The content of individual essential amino acid was higher in LPC. It showed in vitro digestibility of 83%.

Animal feed industry in Nepal: A review of pertinent issues

Lohani MN (2000). Animal feed industry in Nepal: A review of pertinent issues. *Proceedings of the 4th National Animal Science Convention (NASA)*, pp 6-10

The feed industries of Nepal produced a total of 260.628 Mt of a concentrate feed for livestock and poultry in 1999/2000, and are self sufficient in this product at present. The industry, however, has a dependency of 46% on the imported raw materials. Various pertinent issues related to this industry are discussed. The constraints limiting the future expansion, growth and sustainability of this industry are; lack of a favorable long term policy, paucity of nutritious and economical feed ingredients and inadequate technical support services. Correction of these problems requires a strong determination and seriousness in all the parties concerned. Failure to do so leaves this sector at high vulnerability.

Effect on performance of layer type chickens on pellet vs mash feed of same feed composition

Osti NP, Dhaubhdel T, Bhurtel R. and Koirala PK (2000). Effect on performance of layer type chickens on pellet vs mash feed of same feed composition. *Proceedings of the 3rd National Animal Science Convention (NASA)*. Lalitpur, Khumaltar, Nepal, Aug 27-28, 2000, pp 103 –107

The effect on production performance of layer type chickens on pellet vs. mash feed of same feed composition was observed. The New Hampshire chickens were involved in the experiment for the period of 12 months. Five months of aged pullets consisting of 209 pullets and 109 cockerels were fed pellet feed and housed in hall1 and same number of pullets and cockerels

fed on commercial mixture (mash feed) and housed in hall 2. The differences were not significant between performances of two feeding systems, in the percentage of laying (33 and 29 eggs/days/100 hens), in the feed intake of hens (81.18 and 83.69 g/d/h) and in the feed efficiency. The minimum feed required per dozen-egg production was found in pellet feeding group (1.8 kg/dozen eggs), where as mash feeding group consumed 2.8 kg feed for same number of eggs.

Effect of temperature, moisture and duration of heat treatment on Lysine availability in mustard seed meal for chicks

Joshi NP, RJ Deans and DE Ullrey (1992). Effect of temperature, moisture and duration of heat treatment on Lysine availability in mustard seed meal for chicks. Journal of Institute of Agricultura and Animal Science (IAAS), Rampur, Chitawan, **13:**65-70

The feeding value of plant proteins has been improved by certain forms of processing. This study was conducted to determine the effect in processing conditions on lysine availability of mustard seed meal (MSM) for chick growth. MSM was heat treated at 85 ^{0}C or 100 ^{0}C with 12.5 or 25% moisture for 15 or 60 min in a rotating drum. A standard lysine response curve (Y = 0.53 +23.81X where Y=daily gain in g above basal and X=% lysine from L-Lysine.HCL) was developed by adding graded levels of lysine (0.1%, 0.2%, 0.3% or 0.6%) to a basal diet containing .5% lysine. Daily gain above the basal was used to determine lysine availability at two levels of lysine intake (0.1% or 0.25%) from raw or heat-treated MSM. Lysine concentration of the MSM was decreased 3 to 21% by heat treatment. However, heating improved the availability of lysine. Thus, the proportion and amount of total lysine that was available in heat-treated MSM was greater (P<.05) than in raw MSM. This study indicated that of the heat treatments studied, a temperature of 100^{o}C at a meal moisture level of 25.0% for 15 min was most satisfactory for enhancing

Reducing crude protein by supplementing 1-lysine and dl- methionine in Broiler

Khanal RC, NP Osthi, R Bhurtel and SK Khanal (2000). Reducing crude protein by supplementing 1-lysine and dl- methionine in Broiler. *Veterinary Review*, Animal Health Research Division, Tripureswor, Kathmandu, Nepal, **15**:1-6

An experiment was conducted to study the effect of reducing dietary crude protein while balancing critical amino acids by supplemental synthetic l –lysine and dl- methionine, in broilers raised in cages made of mesh wire and kept in deep litter system. Broilers were provided feed with 23% (starter) and 20% (finisher) CP (T1), 21 % and 18% CP (T2), 19% and 16% CP (T3), 17% and 14% CP (T4) and 15% and a2% CP (T5), in iso-calorie diets containing calculated ME of 3200 Kcal/kg ration was formulated to meet NRC requirement for ME, Ca, P, L-lysine, and dl-methionine, synthetic l-lysine and dl- methionine were supplemented to meet the NRC requirement of broilers in T2-T5. No synthetic amino acid was supplemented in T1 but its amino acids were balanced through feed ingredients. Each treatment was replicated 4 times with 10 birds in each replicate. Reducing dietary CP did not have any negative effect on live weight gain and feed conversation ratio up to T3. Slaughter weight, daily weight gain, feed consumption and feed conversion ratio was highest in T3 followed by T1 and T2.Reducing dietary CP below 19% (starter) and 16% (finisher) had significantly impaired the broiler performance ($p<0.05$). Under the conditions of this experiment, it could be concluded that dietary CP could be reduced by 4 percentage units while balancing with supplemental synthetic l-lysine and dl-methionine in broilers. This would increase profit through reduced feed cost and increased slaughter weight at 19% (starter) and 16% (finisher) dietary CP level keeping ME, Ca, P, l-lysine and dl-methionine constant.

Layers starter ration with methionine and lysine supplements: an ideal approach of raising quails

Osti NP, NR Devkota, M Sharma and M Sapkota (2003). Layers starter ration with methionine and lysine supplements: an ideal approach of raising quails. *Journal of Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan*, **24**:75-80

Two consecutive experiments were conducted at Regional Agricultural Research Station, Parwanipur, Nepal during September-October (2001) to know the effect of supplemental methionine and Lysine with ordinary layer starter ration to the meat production from quail. In the first experiment, birds raised in deep litter system were fed with ordinary layer starter ration supplemented with 5 percent fishmeal, 125 g methionine and 250 g Lysine per 100 kg of feed and ordinary layer starter ration without additional fishmeal, methionine and lysine. In experiment II, birds were fed with layer starter ration (L1) + no methionine and lysine (T1), L1 +0.00625 g methionine and 0.0125 g lysine (T2), L1+0.0125 g methionine and 0.025 g lysine (T3) and L1+0.025 g methionine and 0.05 g lysine (T4) respectively. It was concluded that in experiment 1, birds fed ration supplemented with methionine and lysine had higher body weight gain and likewise in experiment II higher body weight gain, better feed efficiency and higher gross income were recorded in bird fed ration supplemented with L1+0.0125 methionine and 0.025 lysine.

Methionine and lysine supplementation in low quality feed ingredient: an ideal approach of raising broiler chicken

Osti NP, SB Panday, SK Khanal and BK Shrestha (2004). Methionine and lysine supplementation in low quality feed ingredient: an ideal approach of raising broiler chicken. *Proceedings of the 4th National Conference on Science and Technology,* Nepal Academy of Science and Technology (NAST*),* Khumaltar, Lalitpur, March 23-26, 2004, pp184-191

Two hundred Vencob broiler chicks were randomly assigned to 4 dietary treatments and replicated five times. Treatmeent compositions were: 23% crude protein (CP) in starter and 29% CP in finisher (T1), 19% CP + lysine (0.04%) in starter and 16% CP + lysine (0.165) in finisher (T2), 19% CP + methionine (0.09%) in starter and 16 % CP + methionine (0.03%) in finisher (T3) and 19% CP + lysine 0.04%) + methionine (0.09%) in starter and 16% CP + lysine (0.16%) + methionine (0.03%) in finisher (T4). Starter diets were fed from the 3rd day after hatching to 28 days of feeding period and finisher diets were fed from 29th day to 49th day of feeding period. Significant differences were found in feed consumption and body weight gains. However, similar feed efficiency was recorded among the treatments. The highest feed consumption and body weight gains were from methionine and lysine supplemented groups of the broiler chickens.

Replacement of maize by wheat with supplemented methionine and lysine for broiler production in low protein diets

Osti NP, SK Khanal and MR Tiwari (2004). Replacement of maize by wheat with supplemented methionine and lysine for broiler production in low protein diets. *Proceedings of the 2nd SAS/N Convention,* Kathmandu, 30 July – 1Aug, 2003, pp 377-380

192-day-old broiler chicks were procured from ordinary market of Kathmandu. Chicks were randomly assigned into 4 dietary treatments with 6 replications. A ration consisting 19% crude protein (CP) in starter diets and 16% CP in finisher diets with supplemental methionine and lysine without wheat grain incorporation was formulated for control (T_0) group[in T_1, T_2 and T_3 treatments groups' proportion of maize was replaced by wheat with 10, 20 and 30%,

respectively. Results showed that there were no significant differences in feed consumption. However, body weight gain and feed efficiency differed from control. It is concluded that in the period of maize scarcity wheat grain can replace maize with however some compromise in body weight gain. It is also suggested that further research should be directed towards the nutrient utilization of wheat-based diets in poultry production.

Economics and meat production performances of broiler chicken with methionine and lysine supplementation in low protein indigenous diet

Osti NP, SB Panday (2005). Economics and meat production performances of broiler chicken with methionine and lysine supplementation in low protein indigenous diet. *Proceeding of Technical Seminar and Workshop, National Poultry Expo -2005*, Narayangadh, Nepal, pp 17-22

An experiment was conducted on broiler chicken to know the meat production potentiality and economy of supplementing methionine and lysine in low protein diet for 8 weeks feeding period. Two hundred day old Vencob broiler chicks were assigned to 5 dietary treatments. The treatment composition were; T1=19% CP+methionine and lysine, T2=18.5% CP+methionine and lysine, T3=18%CP+methionine and lysine, T4=17.5% CP+methionine and lysine, and T5=17% CP+methionine and lysine in 1-4 weeks starter phase. Similarly, in 5-8 weeks finisher phase:T1=16%CP+methionine and lysine, T2=15.5% CP+methionine and lysine, T3=15% CP+methionine and lysine, T4=14.5% CP+methionine and lysine, and T5=14% CP+methionine and lysine. No significant differences were observed up to 18%CP in starter and 15% CP in finisher with supplemental methionine and lysine in diets feed intake, body weight gain and income over feed and chick cost. It is also recommended that broiler chicken should be harvested in between 6 and 7 weeks of age for maximum income, after 7 week there will decline income.

Response of Japanese quail layers to different diets containing different levels of rice bran formulated based on total amino acids and digestible amino acids

Pradhan SM and WA Martin (2008). Response of Japanese quail layers to different diets containing different levels of rice bran formulated based on total amino acids and digestible amino acids. *The 5th National Conference on Science and Technology*, Nepal Academy of Science and Technology (NAST), Kathmandu, Nepal, 10-12 Nov

The study was assessing the utilization of rice bran in quail layer diets through formulation methods based on (TAA) total amino acids and (DAA) digestible amino acids. The experiment was conducted to evaluate the egg production and efficiency of diet in Japanese quail layers with different levels (0, 20 and 40%) of rice bran formulated based on TAA and DAA. Feed intake of the quail layers was significantly ($P<0.01$) affected by level of rice bran in diet. The birds consumed least amount of feed having high level of rice bran. However, the diet formulation method did not affect the intake level. The laying performance of Japanese quail was also significantly ($P<0.01$) affected by RB level in the diet but the difference was significant only 4) % level. The birds in dietary group with 20% RB level showed better FCR (feed consumption/dozen eggs, feed consumption /kg egg) than the dietary groups with 0 and 20% RB level. The daily egg mass production of birds from dietary groups with 0 and 20% RB level was significantly higher ($P<0.01$) than the dietary group 40% RB. Rice bran in quail layer diet can be included at 20% level with minimum level of fish meal (2.5%) without any detrimental effects on production performance irrespective of diet formulation methods based on TAA and DAA.

Effect of herbal and chemical toxin binders on the performance of commercial broilers

Neopane D, SD Sharma and RK Sharma (2005). Effect of herbal and chemical toxin binders on the performance of commercial broilers. *Proceeding of Technical Seminar and Workshop, National Poultry Expo -2005,* Narayangadh, Nepal, pp 23-30

The present experiment was undertaken on 630-day-old broiler chicks that were randomized into 7 groups (D1 to D7) with 3 replicates each. All the groups along with their replicates were randomly housed in a poultry house with standard and identical management, nutritional and environmental conditions. All chicks were vaccinated as per the routine practice of the farm. Group D1 was kept as control and was offered basal diet of broiler starter and finisher rations whereas group D2 and D5 and their replicates received basal diet supplemented with aflatoxin (AFB1) @ 100 and 200 ppb in the feed, respectively, from day 1 to 6 weeks of age. Diet for other groups were mixed with AFB1 (100 or 200 ppb) along with either organic acid and aluminium silicate combination (HSCAS) or herbal toxin binder and detoxicant (Toxi check) in different combinations. No other growth promoter was added in the feed or drinking water. It was observed that feeding of aflatoxins significantly suppressed the growth of broilers along with increase in their FCR in diet groups D2 and D5 as compared to the control group D1 but when birds were fed Toxi check along with aflatoxins, there was no adverse effect on the growth and FCR of broilers. Similar favorable effect of Toxi check was observed on protein and energy utilization and mortality. Toxi check could efficiently bind the aflatoxins present in the diet and facilitate their excretion through faeces. Further, the detoxifying actions of Toxi check helped in maintaining health and optimum growth of birds. The results of present study indicated better efficacy of Toxi check over HSCASP for binding and excretion of aflatoxins from intestinal tract, improving growth, FCR, nutrient digestibility and reducing severity of liver lesions and incidence of FLS. It may be concluded that supplementation of Toxi check is beneficial as it improved growth, weight gain, feed efficiency, nutrient digestibility and reduced mortality in broiler chickens kept on feed containing mycotoxins.

Vitamin E, C and antioxidants in poultry

Reddy VR (2005). Vitamin E, C and antioxidants in poultry. *Proceeding of Technical Seminar and Workshop, National Poultry Expo -2005*, Narayangadh, Nepal, pp 1-12

Vitamin E and C reduce antioxidant activity in biological system and improve performance of broilers and layers. Vitamin E + selenium (inorganic or organic) we re beneficial in improving the cellular and humoral immunity. Vitamin E, selenium and ocimum improved cell mediated and humoral immune response and increased the resistance to E coli infection. Vitamin E from herbals has higher antioxidant activity than synthetic vitamin E. Vitamin C from herbal products is heat resistant and of higher antioxidant activity than synthetic vitamin C. Vitamin C, synthetic and herbal improved broiler weight and FCR, reduced mortality, reduced erythrocytic lipid peroxidation and improved plasma ascorbic acid and antibody titres to NCD. The effect with herbal C was better than with synthetic vitamin C. Herbal C in diet improved FCR, egg weight and shell thickness than reference diet in layers. The effect with herbal C was better than or equal to synthetic C. Herbal C at 200 g/ton was better than at 100 g/ton in improving shell strength.

Comparative performance of Turkey on broiler ration versus formulated ration

Karki M (2006). Comparative performance of Turkey on broiler rations versus formulated ration. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, 1-2, July 2004, pp 127-132

The present work was designed to study the comparative performance of Turkey poults fed on common broiler ration versus formulated ration. Commercially available Ratna feed was used as broiler ration and another feed having 28% protein with 2800 Kcal ME as starter and 24% protein with 2900 Kcal ME were prepared as formulated ration. Daily feed intake and weekly weight gain were recorded from one week to 10 weeks of age. A significantly higher ($P<0.01$) body weight was observed for turkey birds fed with formulated feed compared to broilers feed. Similarly, feed exerted a highly significant ($P<0.01$) influence on feed consumption with formulated ration exhibiting its superiority over broiler ration. The effect of feed on FCR was found significant ($P<0.05$) from 2nd to 5th week as well as cumulative basis but non-significant effect was observed 6 weeks onwards. Furthermore, the formulated ration was found to be more economical in terms of income over chicks and feed cost per bird (Rest 68.02 Vs Rest 35.14) up to 10 weeks of age. However, further research activities towards generating low cost feed management technologies with advancement of age are necessary.

Nutritional variation of feed ingredients found in different parts of Nepal

Tiwari MR, SK Khanal, B Shrestha and RK Jha (2006). Nutritional variation of feed ingredients found in different parts of Nepal. *Green Field Journal of Himalayan College of Agricultural Sciences and Technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **4**(2):65-73

Many feed industries in various parts of the country have been producing and marketing different types of concentrate feeds. The source of feed ingredients also varies greatly which will ultimately lead to the variation in the quality of finished products. Altogether 493 samples of 50 different feed ingredients were collected from Baglung, Baitadi, Banke, Chitawan, Darchula, Dolakha, Dolpa, Gorkha, Ilam, Jhapa, Kathmandu, Kaski, Lalitpur, Lamjung, Morang, Mahottary, Makwanpur, Myagdi, Nawalparasi, Saptari, Sarlahi, Sindhupalchock, Siraha, Syangja and Tanahun districts from 1990-2001 A.D. These samples were analyzed in animal nutrition division in Khumaltar, Lalitpur. The results showed that the highest content of dry matter (99.51%) and crude protein (57.85%) was recorded for oyster cell and meat meal, respectively. Similarly, the rice husk was found to be superior in crude fibre content (35.46%). In terms of minerals, oyster cell was found superior in calcium content (35.94%) and bone meal for phosphorous content (1.59%) as compared to other feed ingredients. The findings of the research will help to manufacturers for improving the feed quality by utilizing the locally available feed ingredients. Subsequently, farmers will get quality feed which will help to enhance productivity of different livestock species.

Effect of herbal liver stimulant on the performance of commercial broilers

Neopane D, M Karki and TS Dhauwadel (2009). Effect of herbal liver stimulant on the performance of commercial broilers. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 141-145

The present investigation was undertaken on 240 days old broiler chicks (Vencob 100) in Swine and Avian Research Program, Khumaltar which were randomized into 4 dietary groups (D1 to D4) with 3 replicates of each. All the groups along with their replicates were separately housed in a poultry house with standard and identical management and environmental conditions. A commercial broiler feed (Ratna Feed) was used as basal diet (D1). Other diets were prepared by mixing different herbal stimulants in different dose levels in the basal diet.

Bird fed with Livoliv 250@ 250 g/ton (D2) attained higher body weight (1903± 72 g) followed by D4 i.e. Superliv @ 500 g/ton (1711±16g) and basal diet (1675±78 g) with FCR of 2.70±0.09, 2.84±0.04 and 2.83±0.06, respectively. Whereas birds under D3 (Livoliv 250@ 500 g/ton) gained significantly (P<0.05) lower body weight (1582±23 g) with FCR of 2.81±0.01. The results clearly indicated a negative impact of higher concentration of Livoliv 250 in feed consumption and weight gain. Similarly, percentage of mortality was recorded 1.59% and 1.64% under the diet D3 and D4, respectively. Profit per bird over chick and feed cost was obtained higher with Livoliv 250@ 250 g/ton (NRs 73.69±6.1) followed by Superliv @500 g/ton (NRs 59.55±1.9) and it was lowest under Livoliv 250@g500g /ton (NRs 53.99± 1.4). It may concluded that supplementation of liver stimulant (Livoliv 250@ 250g/ton) is beneficial for improving growth, FCR, nutrient digestibility, reducing severity of liver lesions and higher profit in broilers.

Assessment of feed industries and economics of maize as major feed ingredients in poultry diets

Sapkota S (2009). Assessment of feed industries and economics of maize as major feed ingredients in poultry diets. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 349-356

A study was conducted involving different feed mills of Chitawan district to assess the status of feed industries and economics of maize as a major feed ingredient in poultry feeds. Sample survey, personal contact and literature were reviewed to collect the data. There were altogether 70 feed industries in Nepal in the year of 2005/06 and among them Pashu Ahara Utpadan Bikas Samiti, is the registered government owned feed industry. Collect information from Chitawan showed that the feed mills in Chitawan, which are not working industries were Triveni Feed, Bhandari Feed, Narayani Feed industries reason behind, were the imperfect market information, limitation for owner about the availability for marketing rational decisions and higher price fluctuation of feed ingredients. Yellow maize, rice polish, deoiled rice polish, wheat bran, molasses, oil meal, sunflower cake, mustard cake, fish meal, bone meal, oyster shells, limestone feed supplement were the ingredients used to formulate the feed. The annual production of poultry feeds fluctuates, showed increased trend in the year of 2000 up to 2003, and decreased from the year of 20003 to 2005. In addition to this trend of export of feed were also showed a fluctuating trend with decreased from 1999 to 2001 and increased up to year of 2004 and again decreased in 2005. 108579MT yellow maize was used a year as the feed ingredients , of total amount of yellow maize used as the feed 60% was imported from different countries. By analyzing the data of over 8 years of area and the production of maize the trend showed that the area occupied by maize is almost stagnant but the production per ha was increased. By comparing the number of feed industries of the year 2003 to 2006, the number of feed industries was reducing with increased number of poultry production. Unavailability of quality control of prepared poultry feed, deteriorating in purity of high yielding variety of maize, imperfect market information, fluctuating price and the problem of dumping were the problem faced by the farmers and the feed industries.

4.3 BREEDING

Some genetic factors responsible for body growth in Muscovy duck

Kharel M and CR Arboleda (1986). Some genetic factors responsible for body growth in Muscovy duck. *Journal of Institute of Agriculture and Animal Science (IAAS)*, Rampur, Chitawan, **7:**101-110

Three hundred one (301) female and three hundred five (305) male Muscovy ducklings were produced from pure Black pure White reciprocal crosses, back crosses and F_1 *inter se* matings and raised for up to 8-weeks. Heterosis detected in F_1 hybrids of both sexes was not significant. Individual Scaling Test revealed that the variations in body growth of Muscovy ducks were mainly due to additive and dominance effect among the gene actions. For the variation of body weight of female to the male in different progeny types some sex linked genes in addition to autosomal genes may be responsible.

Morphological traits of native chickens in mid hills and plain of Nepal

Bhurtel R (1996). Morphological traits of native chickens in mid hills and plain of Nepal. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal,* Khumalltar, Lalitpur, May 7- 9, 1996, pp 89 – 97

A study was undertaken in Mid-hill (Naldhung) and plains (Ratna Nagar) to investigate the morphological characters of the native chicken. Different plumage color was found (Brown to reddish brown color) were the most prominent plumage color. Three different types of combs were single, rose and pea. But single comb with red or pink and white earlobes was highest in was most common. The average egg weight of the Full Feather (FF) was 47.03 g and the average weight of Naked Neck (NN) was 46.25 g. No significant difference was found between egg weight of FF and NN chicken. Similarly no significant between average body weight of FF and NN chicken were found in mid hill and plains.

Role of women in the conservation of chickens, goats and pigs in Nawalparasi, Nepa

Bhurtel R (1998). Role of women in the conservation of chickens, goats and pigs in Nawalparasi, Nepal. *The 4th Global Conference on Conservation of Domestic Animal genetic Resources*. Birendra International Convention Center, Baneswor, Kathmandu, Nepal, 17-21 Aug, 1998

A baseline survey was conducted in two development regions, four districts and 10 sites of these districts, to determine the existing situation of the short life cycle (Pigs, chicken and goat) animal raising system. It was found that 99% of the farmers were raising indigenous animals by the traditional methods. They were keeping animals according to their ethnicity, social structure and economic condition. They were spending 0.5-2 hrs for raising poultry and swine and 5-7 hrs for raising goats. They preferred local animals for various purposes such as (a) religious ritual (b) family consumption and (c) for sale. Women shouldered 90% of the responsibility for rearing animals in their backyard. They did not raise exotic animals because (a) they are not suitable for religious rituals, (b) need extra skill, space, capital, and (c) are poor disease resistance. The "Pewa system" was found common in Nawalparasi district. None of the women had animal husbandry training. Women sell their best animals during times of emergency and kept the rest for further propagation. Indiscriminate breeding systems were found at all of the sites. Proper education on production, management and health aspects is needed to conserve the local domestic animals. Sustainable technologies should be introduced in the rural livestock raising systems with a participatory approach.

Red jungle fowl: strategy for conservation

Parajuli DP (2003). Red jungle fowl: strategy for conservation. *Proceedings of the 7th National Conference of Nepal Veterinary Association*, Tripureswor, Kathmandu, Nepal,5-7 Nov,**24**:126-129

Red jungle fowl (*Gallus gallus*) is a jungle fowl and is a progenitor of domestic poultry. Red jungle fowl could be a contributor to the traits of disease resistance, capacity to withstand stress and incorporation of new genetic diversity to the modern poultry. This is a selected ford desirable trait for high production. The population of red jungle fowl is declining due to gradual reduction of their habitat. There is also a possibility of crossing red jungle fowl with the local chicken. The loss of wild fowl may seriously hamper the future of poultry industry. Proper conservation methods need to be adopted for their characterization. Ecological and morphological study together with molecular characterization would assure the genetic purity of red jungle fowl

Characterization of indigenous chicken: a case study in tharu ethnic community of Chitawan

Thapa Magar DB and MR Kolachhpati (2008). Characterization of indigenous chicken: A case study in tharu ethnic community of Chitawan. *Green field Journal of Himalayan College of Agricultural Science and technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **8**:111-117

A survey was conducted during the period of May to June, 2008 in the tharu community of Chitawan district of Nepal to determine the characteristics of native chicken. Information were collected for morphological and productive characters which included age at sexual maturity, productive lifespan, feeding system, housing system and age to attain marketable size. The results of the survey provided evidence that: local chickens exhibit large variations in body shape, plumage color and comb type and shank color. Local chickens were small in size. The housing system was found to be semi intensive and feed them locally available grains and byproducts like broken rice, maize etc. Different plumage color were found, among them brown to reddish brown color was the most predominant plumage color. All the chickens observed have single comb with red or pink and white earlobes. Four different color of shank were observed i.e. yellow, black, gray and white, among them yellow shank color was most common. No specific relationship of shank was found with plumage color because even black plumage colored chickens has yellow shank. The average sexual maturity was found to be 5.6 months and age at 1st laying was observed to be 6.7 months. The matured body weight of male and female was recorded as 2.73 and 1.88 kg, respectively. The average number of eggs per clutch was 16.8 nos. The average egg weight, hatchability percentage and productive lifespan were 38.6 g, 87% and 4.3 years age, respectively. Two different types of chicken were predominantly observed were Full Feathered (FF) and Naked Neck (NN).

Conservation and improvement of different poultry breeds at Regional Agricultural Research station (RARS), Tarahara

Sah RB, RD Pandit, RS Mandal and UN Yadav (2009). Conservation and improvement of different poultry breeds at RARS, Tarahara. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 272-275

The experiment was conducted to study the performance of different line of Giriraja, Cornish and Plymouth Rock chicken in similar management condition at the Poultry Research Centre of RARS, Tarahara. At two month of age, the highest body weight were recorded in PR (1313 g)

followed by GRI (1242 g) GR3 (1241 g), GR4 (1230 g), GR5 (1215 g), CR (1213 g) and GR2 (1176 g). The differences in the mean body weight of different poultry breeds due to treatments and age were non-significant. The highest egg production was recorded in GR4 (48%) followed by GR3 (44%), GR1 (43%), GR2 (40%), PR (36%) and lowest by CR (21%). The differences in egg production were highly significant among breeds. The highest fertility was recorded in GR2 (95.92%) followed by GR1 (95.76%), GR4 (95.35%), PR (93.94%), GR3 (91.82%) and lowest by CR (89.76%). However, the average fertility of the farm birds was 93.75%. The highest hatchability was recorded in GR4 (90.25%) followed by GR2 (90.22%), GR3 (88.86%), GR1 (88.62%), CR (88.59%) and PR (78.22%).

4.4 PRODUCTION AND MANAGEMENT

The effect of fumigation and holding time on embryonic mortality in chicken eggs of high or low shell quality as measured by specific gravity

Bhurtel R (1982). The effect of fumigation and holding time on embryonic mortality in chicken eggs of high or low shell quality as measured by specific gravity. *Bulletin of Veterinary Science and Animal Husbandry*, **10-11**:33-35

Three experiments were conducted to study the effects of fumigation on embryonic mortality in poor and high shell quality eggs stored for different lengths of time. The results indicated that fumigated eggs of poor sheep quality had higher early mortality than controls. Egg held 15 days had higher embryonic mortality in both poor and high shell quality groups compared to fresh fumigated eggs.

Egg laying performance of local hen

Shrestha TP (1982). Egg laying performance of local hen. *Bulletin of Veterinary Science and Animal Husbandry*, **10-11**:36-40

The experiment which was conducted for knowing the actual egg laying potentiality of indigenous birds indicated that the potentiality of egg lying was observed due to insufficient feed, energy loss during scavenging and stress factors in the environment. Egg production could be raised up by confining the birds in a small room and feeding concentrates. Selection of good layers among local birds for more egg production would be a possibility to add more eggs.

Production performance of local chickens in mid hill and plain of Nepal

Bhurtel R (1995). Production performance of local chickens in mid hill and plain of Nepal. *Proceedings of the 2nd National Animal Science Convention (NASA),* Lalitpur, Nepal, Aug 7- 10, pp 119-123

A study was undertaken in the Anadem and Ratnanager to investigate the productive performance of local chickens. Both survey areas were purposely selected. Anadem represented the mid-hill and Ratnanagar represented the plain and tropical climate. The number of eggs laid by a hen before getting broody was about 2 % in both cases. Hatchability of eggs was higher in the plains of Ratnanagar with 70 – 80 % and was significantly higher than was observed in Naaldum with only about 60 %. Percent hatchability was higher during the winter season than in the hot summer season. There were 2-3 laying cycles from each hen observed in one year in both the sites. Brooding mortality of chicks were as high as 40 % in both the mid-hills and the plains. Chicks were weaned from 5-9 months in both areas. . Chicken resumed egg lying between 11-15 days after weaning the chicks.

Production performance of local Sakhini and their 50% crossbred (Black Austrolop (BA) x Local) chicken

Sah RB (1998). Production performance of local Sakhini and their 50% crossbred (BA x local) chicken. *Proceedings of the 4th National Outreach Research Workshop*, Khumaltar, Lalitpur, 27-29 April, 1998, pp 132-134

A study involving 96 birds for body weight gain and egg production performance under farmers' management condition at Dhangadhi, Siraha and Banigama, Morang during 1996-1998. The production performance of local and 50% crossbred (BA x Local) chicken was evaluated in the study for 500 days in each site. During this period 50% crossbred and local chicken produces 156 and 90 eggs/hen/annum, respectively. The body weight of 50% crossbred birds and local at the age of 32 weeks was recorded as 1.8 and 1.5 kg, respectively in the sites. The result indicated that 50% crossbred birds can perform better in both of egg and meat production, respectively than local birds.

Study of early and mid embryonic mortality and fumigation effects during late hatching period in two different breeds of chicken

Basnet TB and R Bhurtel (1985). Study of early and mid embryonic mortality and fumigation effects during late hatching period in two different breeds of chicken. *Nepalese Journal of Animal Science (NASA)*, **1**(1):7-11

In this study eggs were collected from New Hampshire and Austrolop breeds, which were cleaned and fumigated prior to incubation. The comparison of New Hampshire and Austrolop breeds showed significant difference between early and mid mortality but no significant effect on late mortality was found in both of the breeds after 18th day candling and during hatching period in visually selected clean normal eggs.

Evaluation of egg laying performances of crossbred chickens under semi intensive conditions

Oli KP (1986). Evaluation of egg laying performances of crossbred chickens under semi intensive conditions. *Special issue Published on the Occasion of 2nd National Veterinary Conference*, **14**:42-48

A comparative study was made on the age at 1st lay, egg production and egg weight of Light Sussex x local (LS x Lo), Black Austrolop cross local (BA x Lo), New Hampshire x local (NH x Lo) and local chickens under semi intensive condition. Result showed that LS x Lo chicken take significantly longer time to reach the point of lay than the locals and other breeds ($P<0.01$). All the crossbred exotic chickens showed significantly higher egg production that the locals ($P<0.01$). The average egg weight of all the crossbred chickens was significantly higher than the locals ($P<0.01$). There was no significant difference in egg production between NH x Lo- BA x Lo, BA x Lo – LS x Lo chickens. Between NH x Lo and LS x Lo there was significant difference at the 10% level ($P<0.01$). Study indicated that New Hampshire is the best breed for upgrading and crossbreeding purpose in villages as compared to the other two breeds.

Evaluation of three breeds of poultry brought from Australia

Shrestha NP, PP Gautam and DP Parajuli (1988). Evaluation of three breeds of poultry brought from Australia. *Nepalese Journal of Animal Science (NASA*), **4**:31-52

Lifelong productive performances of 3 poultry breeds imported from Australia were evaluated for brooding rearing, laying and hatching performances. Higher mortality was observed in the New Hampshire (NH) (6.35%) compared to Austrolop (4.9%) and White Legorn (WL) (2.15%) during brooding, rearing and laying stages. Feed conversion efficiency of WL was found to be

better during brooding period while NH was better during rearing period. Percentage of healthy chicks produced with respect to eggs set to incubator was better for Austrolop than the other twobreeds. The highest hen day egg production was found in WL (55%) followed by Austrolop (51%) and NH (46%). Time of egg production per bird was 250, 299 and 192 for WL, Austrolop and NH, respectively. When one egg produced was compared against the amount of feed consumed by the breeds, WL was found to be more efficient (217 g feed/egg) than NH (295 g feed/ egg) and Austrolop (326 g feed/egg).

Effect of pre incubation storage period and storage position on hatchability of New Hampshire eggs during winter season

Shrestha SB (1995). Effect of pre incubation storage period and storage position on hatchability of New Hampshire eggs during winter season. *Nepalese Journal of Animal Science (NASA*), **9**:54-61

A study was undertaken to find out the effect of pre incubation storage duration (1, 3, 5 and 7 days) and storage position (small end up vs large end up) on hatchability at central hatchery, Parwanipur. Hatchability of fertile eggs set were 92.32% from of one day and 89.88% from 7 days of pre-incubation period of storage. Similarly, hatchability of eggs storage with small end up was 92.14% and that of large end up was 89.88%.

Productivity study of Canadian chicks (New Hampshire)

Shrestha SB (1997). Productivity study of Canadian chicks (New Hampshire). *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 24-25 Sep, 1997, pp 22-23

This study was undertaken to find out the productive performance of the Canadian New Hampshire hens, which were handed over to Avian Research program from rural Poultry Development of HMG. Twelve New Hampshire Canadian chicks were brooded in Khumaltar; they were given concentrate feed and water adlibitum. Breed consumed 0.19 kg feed to reach 0.37 kg live weight at 8 weeks of age. The average feed intake was 34 g/day in 8 weeks. The mortality rate was 33% at brooding period. They started laying eggs at 23 weeks of age and average egg production 102/bird in 130 days lying cycle. This study showed that 9 kg of feed was needed to produce 102/bird. It cost about 99 total return by egg sale were NRs 280.0. The net profit/bird was NRs 181 in 130 days. Therefore, it was recommended that this line of breed was economical for small scale poultry entrepreneurs.

Dressing percentage and cut parts of spent hen

Shrestha SB and R Bhurtel (1999). Dressing percentage and cut parts of spent hen. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal,* Agriculture Research Station, Lumle, Kaski, 26-28 June, 1999, pp 205-207

This study was conducted at Poultry Farm of Swine and Avian Research Program, Khumaltar to find out the dressing percentage of old hens of three pure breeds. New Hampshire (NH), Canadian New Hampshire (CNH) and Austrolorp (AU). Significant difference ($P<0.05$) was found in the body weight of breeds. Canadian New Hampshire was significant heavier than the rest. No significant differences were found among the dressing percentage of the breeds. The comparison of the different cut parts was done. Significant differences ($P<0.05$) were found in the weight of the backbone and leg. Again Canadian New Hampshire had heavier weight than other two breeds.

Effects of breeds and diet on growth rate, food consumption and abdominal fat accumulation by two breeds of broiler chicken

Raut Y (2000). Effects of breeds and diet on growth rate, food consumption and abdominal fat accumulation by two breeds of broiler chicken. *Proceedings of the 3rd National Animal Science Convention (NASA)*, pp 121-126

The experiment was primary designed to examine the effect of genotype, protein energy ratio and their interaction on growth and body composition in broilers. One hundred and twenty eight birds were assigned in the experiment. Experiment was arranged with 2 x 2 factorial designs. Two birds were examined in the experiment, i.e. Biadia (B) and Australian poultry (A) with 2 levels of energy and protein diets (12.52 MJ ME /kg, CP=252 g/kg) and LP (13.8 MJ ME/kg, CP=220 g/kg). The experiment was conducted up to 35 days from hatching (i.e. with day old chicks). For the first 7 days, all the chicks were fed with normal starter standard feed. Experimental diets were given from the 7th day onward. Biadia chicks were found to be superior in growth rate ($P<0.05$) and weight gain irrespective of diets. There was no any significant difference observed in feed efficiency among breeds and diets. However, the diets with high protein content was found to be significant in reducing abdominal fat accumulation ($P<0.05$). No interactions were found between breeds and diets on growth and fat pad reduction.

Intensive management of dual purpose chicken as potential income generating option for medium farmers

Dhauwadel TS, M Karki and SB Shrestha (2009). Intensive management of dual purpose chicken as potential income generating option for medium farmers. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 135-140

Comparative performance of New Hampshire, Black Austrolop and Giriraja was studied at Swine and Avian Research Program, Khumaltar during February to July of 2005. The observation of feed intake, weight gain and mortality was taken from day old chicks to 12 weeks of age. All experimental birds were fed with commercial broilers feed (Ratna Feed) and were reared under similar management. Highly significant ($P<0.001$) effect of the breed on body weight was observed with Giriraja above others. Effect of sex and season on body weight was also found highly significant ($P< 0.001$). Irrespective of breed, higher weight was obtained with birds reared in February – May compared to May-July. At 12 weeks of age, higher body weight was observed for Giriraja male (1.82 kg), followed by Giriraja female (1.46 kg) and New Hampshire male (1.23 kg) with cumulative FCR of 3.25, 3.65 and 3.83, respectively. Irrespective of sex and season, Giriraja exhibited better FCR than other in all weeks of rearing. The better FCR was observed for bird reared in February - May season. The cumulative mortality was found as 6.44, 9.95 and 16.29% for New Hampshire, Black Austrolop and Giriraja, respectively. Up to 12 weeks of rearing, higher saving per bird was observed for Giriraja (NRs 50.63) followed by New Hampshire (NRs (18.4) and Black Austrolop (NRs 12.74). The finding of the present study revealed that these dual purpose breeds have potentiality to be competitive meat producer in intensive management. February -May season is favorable for duel purpose chicken rearing than May-July in terms of higher growth, better feed efficiency and saving per bird but need for proper health management in future. Heaviest body weight with having better feed efficiency and higher saving per bird of 12 weeks rearing of Giriraja suggesting that it may be the choice of economically viable intensive farming for medium farmers whereas New Hampshire and Black Australop are appeared to suitable for semi intensive and scavenging management.

Study on the production performance of Cornish, Plymouth Rock, native and their crossbred chicken fed broiler ration

Sah RB, RD Pandit, RS Mandal and UN Yadav (2009). Study on the production performance of Cornish, Plymouth Rock, native and their crossbred chicken fed broiler ration. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 268-271

An experiment was conducted to study the effect of pure and crossbred progeny. Cornish, Plymouth Rock, Native and their crossbred birds were taken to evaluate the performance parameters (feed intake, weight gain, mortality percent, carcass yield and economic validity), which were fed with broiler ration and were reared in the tropical climates at the Poultry Research Farm of Regional Agricultural Research Station, Tarahara. The experiment was replicated three times with CRD. Seven pure and crossbred genotypes (C x C, P x P, N x N, C x P, P x P, C x N and P x N) were used in this study. Highly significant incidence of painting was high on crossbred (C x P) progeny as it was significantly heavier than the rest. Economic return over different treatment ranged from NRs 27 – 37.5/birds at the age of 8th weeks. Highest return was found in the crossbred (C x P) progeny.

On station performance of Giriraja chicken at Pakhribas Agriculture Centre

Shrestha NP and IK Aryal (1994). On station performance of Giriraja chicken at Pakhribas Agriculture Centre. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **9**(1): 29-30

Giriraja, a dual purpose breed of chicken was introduced at Pakhribas Agricultural Centre from the University of Agricultural Sciences, Bangalore, India in 1991. They were raised at the center under a deep litter system. Their productive performances were monitored. The result showed that they attained 1.0 kg body weight at 8 weeks of age. Body weight was significantly higher in males than females at 42 days ($P<0.01$). The age at first lay (10%) was recorded at 142 days. Egg production was 160/hen/year

Performance of Giriraja x Local chicken at Pakhribas Agriculture Centre

Aryal IK, SP Neopane and NP Shrestha (1995). Performance of Giriraja x local chicken at Pakhribas Agricultural Centre. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **10** (2):30-31

An observation study on the possibility of using Giriraja chicken for upgrading local stock was carried out at Pakhribas Agricultural Centre in 1993-94. Fifty percent Giriraja birds were produced by introducing Giriraja cockerels in local hen. The performance of 50% Giriraja birds was studied for a period of 500 days. During this period, they produced 165 eggs for hen and the dispersal body weight was 2.54 kg/bird. The result indicated that 50% Giriraja birds had similar performance in egg production to the reputed results of Giriraja and New Hampshire birds. However, meat production in 50% Giriraja was lower as compared to Giriraja but similar to New Hampshire birds. Similarly, the hatchability was 84±0.123 and 88±0.131% for Giriraja and New Hampshire, respectively.

Performance of Giriraja chicken in the eastern hills of Nepal

Aryal IK and SP Neopane (1997). Performance of Giriraja chicken in the eastern hills of Nepal. *Technical Paper N.97/179*, Pakhribas Agricultural Center (PAC), Pakhribas, Dhankuta, Nepal

A study was conducted to evaluate the performance of Giriraja chicken on station (Deep litter system) and on- farms (scavenging system) between 1992 and 1996 in the eastern hills of

Nepal. These birds were imported from the University of Agricultural Sciences Bangalore, India. A contemporary group of New Hampshire and local chicken on-farm were also kept as a check to compare their performances under the same management. On-station results showed that the eight-week body weight of Giriraja (1050 g) was significantly higher ($P< 0.001$) as compared to New Hampshire (338 g). A similar weight trend was obtained in twelve week old Giriraja (1098 g) and New Hampshire (746 g) on–farm ($P<0.001$). The eight-week body weight was higher on station than on-farm, which could be due to different management systems. The mortality rate of chicks unto eight weeks of age on –farm was higher in Giriraja (49%) than in New Hampshire (38%) ($P< 0.05$). In adult birds, Giriraja had a lower predation rate (9.2%) than in the local (13.1%) The average egg production per bird of Giriraja and local chicken on –farm was 113 and 100 eggs at 500 days of age. The expectation of less mortality of Giriraja was not found to be true under eastern hill conditions. However, most of the farmers preferred Giriraja chicken due to their higher body weights, attractive colors and were considered as a quick cash-generating breed as compared to New Hampshire under the same feeding management.

Studies on production traits of Giriraja chickens

Shrestha SB, P Mandal and RB Sah (2006). Studies on production traits of Giriraja chickens. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 1-2 July, 2004, pp 21-24

The present study was under taken in Giriraja chicken maintained at Poultry Research Program, Regional Agricultural Research Station, Tarahara. Observation was taken on 500 chicks of Giriraja. The Averages weight at day old 4th, 8th, 12th, 16th and 20th week body weight were 38±0.132 455.26±0.252, 720.76±0.762, 1471.04±0.981, 2552.10±1.189, 3012.50±1.456 and 3290.50±1.386 g, respectively. The average egg production in 90, 180, 270 and 365 days were 31, 85, 127 and 161 numbers, respectively. The overall average egg weight was 55gm. Final body weight obtained by Giriraja 4kg. The average egg laying performance was obtained 160-180 eggs per year. The fertility of eggs was 86±0.123% for Giriraja and 88±0.131% for New Hampshire birds.

Evaluation of production performance of different colours of Giriraja chicken

Shreatha SB and RB Sah (2009). Evaluation of production performance of different colours of Giriraja chicken. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 259-263

A study was conducted to know the effect of colour on growth rate and egg production of Giriraja chicken, maintained at Poultry Research Program of Regional Agricultural Research Station, Tarahara. Observation was taken on 211 chicks of Giriraja chicken. The average body weight at day old 2nd, 4th, 6th, 8th, 10th and 12th weeks was measured. The birds were divided into 4 colour group viz, red, black, dark black with white spot (Koude) and ash colour. The average body weight at day old were 0.35±0.05, 043±0.026, 042±0.01, 0.48±0.03 kg in red, black, dark black with spot and ash colour, respectively which was significantly different between the groups. The average weight of chicks at 4th, 8th and 12th week were 0.82±0.049, 0.79±0.051 and 0.86±0.052; 1.07±0.08, 1.81±0.04 and 1.88±0.09; 2.29±0.03, 2.04±0.15 and 2.0±0.07 kg, respectively in red, black, dark black with white spot and ash colour, respectively. The statistical analysis revealed that from 2nd to 12th week there were not significantly different between the colour groups in body weight. At 13 weeks of age, chicks were divided in 4 groups according to their colour. The hen day production performance was recorded. The overall hen day production performance was 45%. In four different colour groups' hen day production percentage were 48, 41, 43 and 55 for the colour group koude, black, ash and red, respectively. The analysis on egg production showed that non-significant between the colors

groups. As the variation in growth and egg production between the groups was non-significant, the choice of colour might be merely the farmer's preference in colour.

Evaluation of production performance of Giriraja chicken in Dolakha

Shrestha SB, JN Pradhan, RK Karki, TP Paudel and TS Dhaubhadel (2010). Evaluation of production performance of Giriraja chicken in Dolakha. *Proceedings of the 9th National Outreach Workshop*, Khumaltar, Lalitpur, Nepal, 7-8 June, 2010, pp 134-138

On farm study was conducted in Bhimeswor municipality, Dolakha. Observations were taken on 626 numbers of birds up to 70 days. These birds were randomly given to 12 farmers. The treatments groups were as: 1 group. Commercial feed 130 g, 2 groups: feed 120 g + brewers grain 40 g +, 3 groups: feed 117 g + gandhe grass 17 g + pote grass 33 g, 4 groups: feed 120 g + grazing at least 2 hrs /day. The average body weight in male was 4, 5, 4, 4 with the mean value 4±1.9 kg in treatment 1, 2, 3 and 4, respectively. The average body weight of female was 3, 2.3, 2.3 and 2.6 with mean value 2.6±0.1 kg. The average egg production per bird was 163, 152, 164 and 80 (mean value 140) in treatment 1, 2, 3 and 4, respectively. The analysis showed no significant difference between the groups. The average fertility was 85 and hatchability was 80%. Economic analysis showed that all the treatment groups had got profit i.e NRs 20101, 22780, 27585 and 15868 with mean value of NRs 21583 and the average profit/bird was NRs 415.

Growth, efficiency of feed utilization and economics of different periods of Turkeys

Karki M (2005). Growth, efficiency of feed utilization and economics of different periods of Turkeys. *Nepal Agriculture Research Journal (SAS/N*), **6**:84-88

The present study on body weight and feed efficiency for growth was carried out on 112 Turkey poults from day of hatch to 28 weeks of age during May to Nov 2002 at Poultry Research Unit of RARS, Parwanipur. Layer starter ration supplemented with 6% fish meal + 0.3% lysine + 0.125% methionine was fed up to 8 weeks of age, then after layer finisher diet was fed. The body weight, feed consumption was observed at 4 weekly interval and feed efficiency and economics of rearing period in terms of income over feed and poults cost was calculated. Significant increment in body weight was recorded up to 28 weeks in male and 20 weeks in female. Male Turkey had significantly higher body weight than that of female in all ages. Feed efficiency is best at earlier age but up to 16 weeks it is 3.77 for male after that it diorites progressively. Male Turkey exhibited better feed efficiency that that of female for all weeks. Significantly higher return/bird for both male and female in all age. The profit /bird for both male and female was found maximum in 16 weeks of rearing , followed by 20 and 24 weeks. Therefore, instead of waiting for highest body weight, it is better to sell Turkey at 16 to 20 weeks of age to take maximum advantage of higher weight gain, higher efficiency of feed utilization and higher profit.

Influence of age and sex on carcass traits of Turkey

Karki M and D Sah (2006). Influence of age and sex on carcass traits of Turkey. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, 1-2 July, 2004, pp 17-20

Twenty four numbers of Turkeys, six each of male and female at 16 week and 24 week of age were taken to study carcass traits. Consumer's responses were also collected regarding the test of meat. A significantly higher ($P<0.05$) percent eviscerated yield, percent of breast yield and a significantly ($P<0.01$) lower percent yield of wings were observed at 24 week of age as compared to 16 week. Similarly, dressing percentage and percent of breast yield were found higher in male compared to female. Turkey meat was found preferred by most of the

consumers for its less fat content, high meaty parts and good test, particularly at 24 weeks of age. This study indicates that in addition to increasing dressing percent and breast yield percent; test of meat seems to be improved with advancement in age.

Production performance and economics of Turkey reared under scavenging condition

Paudel S, BP Kuswaha, M Karki and JP Yadav (2009). Production performance and economics of turkey reared under scavenging condition. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 154-156

A study was carried out to evaluate production performances and economics of Turkey (*Meleagris gallopava)* under scavenging condition at outreach sites of Regional Agricultural Research Station, Parwanipur. Three sites; Fattepur (Bara), Bindhyawasini (Parsa) and Saruhatha (Rautahat) were taken for the study. Three farmers were selected from each site. One farmer was provided with one male and 4 female chicks to rear under scavenging condition. Results indicated that male attained 12.89 kg (SD=0.98 kg) and female attained 5.83 kg (SD=0.24 kg) of average body weight after one year. Average egg lying was 66 (SD=9.07) in 500 days. Economic analysis of turkey rearing suggests that an average net profit of NRs 775.6 can be made under scavenging conditions.

Study on egg laying performance of Turkeys in the central Terai of Nepal

Karki M and S Paudel (2009). Study on egg laying performance of Turkeys in the central Terai of Nepal. *Proceedings of the 7th National Workshop on Livestock and Fisheries Researchin Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 264-267

The observation was carried out at poultry research unit of Regional Agricultural Research Station, Parwanipur during Feb to Dec 24, 2003 using 48 matured female turkeys. The experimental birds were randomly divided into 4 groups and were housed in separate compartment in deep litter housing. Daily egg production, weekly feed intake and mortality were recorded from on set of lay o 44 weeks duration. First lay was observed at 45 weeks of age. However, the peak egg production was found at 49-56 weeks with average hen day egg production and hen housed egg production was found at 14.9 egg/hen/28 days, there after found to be declined with age. The average feed intake, mortality and egg production of female was found to be 204 g/day, 4.17% and 67 egg/hen, respectively. Similarly, average egg weight was recorded 76.07 and hatchability was found 58%. The observation clearly indicated the higher cost of production so that comprehensive research needs to be carried out in the future towards minimizing the cost of poultry production.

Production performance of three lines of Japanese Quail

Karki M (2002). Production performance of three lines of Japanese Quail. *Proceedings of the 5th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, July 10-11, 2002, pp 106-110

The study was conducted on 360 Quail (120 each of three line Heavy line, White feathered and white breasted). Chicken starter ration supplementing with 5% fish meal was fed to all Quails ad libitum. At 2, 3 and 4 weeks of age, heavy weight showed significantly higher body weight than white feather but non-significant difference were observed at maturity (145.68 g, 144.8 g, 142.04 g, respectively). Significantly better feed efficiency was observed in heavy weight at 2 and 3 weeks of age followed by white breasted and white feather, although no significant differences were observed at maturity, nevertheless better efficiency was observed in white feather than other (4.19 vs. 4.23). Over all mortality was observed 4.16% at 2 weeks and 4.83%

up to 6 weeks. It was found that growth rate of Quail is in increasing trends up to five weeks of age and is the best marketable age of Japanese Quail (meat type) for fetching higher profit.

Carcass quality traits of broiler Quail

Parajuli DP, SM Singh, R Narain and D Singh (2003). Carcass quality traits of broiler Quail. *Proceedings on 7th National Conference of Nepal Veterinary Association*, Tripureswor, Kathmandu, Nepal, 5-7 Nov, **24:**99-103

A complete 4 x 4 diallel experiment involving 4 broiler Quail lines was performed to evaluate the carcass quality traits (dressing %, evisceration yield and giblet content) in 16 genetic groups at 5th weeks of age. Each genetic group consists of 30 sire and 30 dams. Analysis of variance was carried out for the statistical analysis and DMR test was used to compare the mean values (significant at P<0.01). The results indicated that the mean values for dressing and giblet percentage were not significantly different in pure breed and crossbreeds in both sexes but mean value for evisceration percentage was significantly different (P<0.01) in female. There was significant difference (P<0.01) between the genetic groups for dressing, evisceration and giblet percentage in both the sexes. The result showed that the effect of mating system was highly significant 9P<0.01) for dressing percentage and significant (P<0.05) for evisceration yield in female and non significant in male. The effect of mating system for giblet content was non significant in both sexes. The findings indicate that most of the pure breed female progenies had better evisceration percentage than crossbreds.

Effect of space density on egg quality traits

Shrestha SB (2005). Effect of space density on egg quality traits. *Proceedings of the National Poultry Expo – 2005,* Narayangarh, Chitawan, Nepal, pp 109-115

At 20 weeks of age 256 birds were randomly transferred in 3 different space density groups as 0.20, 0.25 and 0.30 m^2 /bird. The traits measured in each space density were egg production was 0.15±0.21 with a CV of 6.79%. The mortality under 3 different floor space density were 0.21±0.03, 0.13±0.03 and 0.12±0.03 (12, 13 and 12 %), respectively. Results showed that the space density had no significant influence on mortality. The overall average number of egg laid by bird up to 100 days was 20.62±0.36 with CV of 31.34%. In 3 different floor spaces density group's number of eggs laid were 27.0±0.64, 19.0±0.64 and 15.0±0.64, respectively. The statistical analysis revealed highly significant effect of floor space on egg production. Based on observation on egg quality traits in White Leghorn birds, it may be concluded that albumen index, yolk index, yolk weight, shell thickness, shell weight, albumin weight and egg weight had significant differences in these space density groups i.e. 0.20, 0.25 and 0.30 m^2 /bird floor space.

Evaluation and maintenance of different strains of Quail and their genetic improvement

Sah RB, RD Pandit, RS Mandal and UN Yadav (2009). Evaluation and maintenance of different strains of Quail and their genetic improvement. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 276-277

The experiment was conducted to study the performance of different strains of Quail in a similar management condition at the Poultry Research Centre of Regional Agricultural Research Station, Tarahara. The result indicated that the similar result from each strains of Quail and non-significant effect from each other and at 6 week of age body weight was found higher in Foroh (157 g) followed by EW (155.16 g) and Toxido (151.27 g). The differences in the body mean weight of different strains of Quail were not significant. The differences in egg production were not significant. The Quails were promising in out condition in Eastern Terai

Region. Demand of Quail is high by the farmers due to high protein content, fast growth, and hardy in nature and high in egg production.

Assessment of production cost of Ducks

Bista JD, SK Wagle, RK Shrestha and AK Rai (1999). Assessment of production cost of Ducks. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal,* Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, pp 78-84

One week old ducklings were raised for 17 weeks for the assessment of cost of production. One hundred and twenty ducklings divided into three equal lot, receiving 23 and 18% crude protein content diet, were raised in confinement. The highest growth rate (39.52 g/day) was obtained during 4th week with an average feed conversion ratio of 1.5. The maximum average weight of duck was 2.02 kg during 12th week. The survival rate was about 92%. The overall net returns were positive for duck growing period of 8 and 12 week, while net returns were negative for the ducks raised for 17 weeks. The total disposable income from the duck production operation was NRs 5880.5, 6666.4 and1239.6 for a period of 8, 12 and 17 weeks, respectively. Of the total cost 55.3, 59.2 and 63.1% was for feed, respectively, for ducks raised for 8, 12 and 17 weeks. Possibilities to reduce the feed cost for ducks have been discussed.

Commercial poultry production in Nepal: A critical review

Lohani MN, TC Bhattrai and JL Amatya (1996). Commercial poultry production in Nepal: A critical review. *Proceedings of the 5th National Veterinary Conference*, 11-13 Sept, **24**:10-18

The commercial poultry industry of Nepal produced 9.8 million day old chicks, 351 million table eggs and 17-29 thousand metric ton of chicken meat in 1995/96. The per capita availability of commercial hen egg and chicken meat were 17.47 and 0.86 kg, respectively. The value of commercial poultry products and by products including poultry feed was NRs 4.354 million in current market price. The contribution of this sector to country's total and agricultural GDP were 2 and 3%, respectively. Additionally, this sector generated a total of 29.165 direct employments mostly in the rural areas. The constraints limiting the further expansion growth and sustainability of commercial poultry sector are lack of a systematic and organized marketing infrastructure, paucity of nutritious and economical foodstuffs for poultry, inadequate technical support services, failure to provide agriculture status to this sector, and failure to provide for market competition environment. These problems can only be corrected by the government determination and seriousness through related policy reforms and program implementation. Failure to do so makes this sector highly vulnerable with a danger of complete ruin in future.

Economics of poultry production in Chitawan district of Nepal

Shrestha SS, PB Bhandari and GR Bhattarai (1998-99). Economics of poultry production in Chitawan district of Nepal. *Journal of Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan*, **19-20:**125-132

Based on the stratified random sample of 26 broiler, 27 layer farms in the western Chitawan valley of Nepal, This paper examines the profitability of broiler and layer production, and effect of the scale of production, and distance of farms location from the core market on the costs, revenue and net returns of broiler and layer production. The findings revealed that, at industry level, there was a net return NRs 15/broiler and about NRs 217/layer, for a period of one production cycle. Nevertheless, 30% of broiler and 37% of layer producers were found at loss, which could be attributed to differences in individual management practice, the situation that make them dependent on input suppliers and buyers of their produce , and poor use of

technical knowledge. The average costs, revenues, and net returns realized by farms with respect to the scale of production and distance from the market center, for both broiler and layer industries, were statistically insignificant. This indicates that there may be other stronger factors that outweigh the scale of production in influencing the profitability of production. This provides lost of avenue for further investigation, in particular to production management and the institutional issues.

Production and marketing system of poultry in Kavre district

Nepal S (2005). Production and marketing system of poultry in Kavre district. *Green Field Journal of Himalayan College of Agricultural Sciences and Technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **5**(1)**:**100

In recent years, poultry industry, in its position as a branch of entrepreneurs, has emerged as an encouraging enterprise for many farmers and entrepreneurs in urban and sub urban areas of the Kavre district. It has witnessed considerable investments, which is reflected by the growing members of poultry farmers. Along with the increment in poultry production, infrastructure development has gained momentum during the last few years in Nepal however, production situation has meagerly assessed. Thus present study regarding scale of production, management practices and marketing systems of poultry business was carried out in Kavre district. To render the study, the households were divided into 3 strata viz farmers growing less than 500 birds (small scale), 500-1000 birds (medium scale) and greater than 1000 birds (large scale). A total of 90 poultry growing households were selected randomly from each stratum with 30 samples representing each stratum. Cost per unit of bird and Internal Rate of Return (IRR) has been used in this study as an indicator to examine the economic situation of a poultry business. The average variable cost and average fixed cost per bird small, medium and large categories of flock sizes of broilers were NRs 146.68, 140.61, 143.83 and 4.18, 3.38, 3.94, respectively. Similarly, the IRR for 3 different categories were 1.01, 1.14 and 0.99, respectively. A similar was the case of layers with IRR for 3 different flock sizes which equaled to 1.08, 1.15 and 1.05, respectively. This situation may be aggravated to the poor marginal skills of farmers on record keeping of cost items, heavy investment in feed and medicines, poor housing systems leading to parasitic diseases and high mortality of chicks. Similarly, even the management systems of the large scale farmers was not satisfactory as majority of them were not fully adopting scientific management practices and making unnecessary high investments of feeds, housing and equipments. As a result of this, farmers are not been able to derive anticipated benefits from the poultry business. The study shows that majority of the poultry farmers in three sites of Kavre have not been receiving any significant supports from the concerned public extension agencies and lack basic technical knowhow on improved poultry keeping.

Prospect and potential of poultry sector

Bhurtel R (2009). Prospect and potential of poultry sector. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 146-153

This study was undertaken to know the prospect and potential of poultry sector. The secondary data, literature and information obtained from other related sources were reviewed. The findings showed that poultry industry became the 3rd largest livestock commodity in Nepal and contribute 2.7% to total GDP and 6.4% on agriculture GDP. The rapid development of commercial poultry in and around urban areas has primarily been in response to the growing consumer demand for poultry meat and egg. At present there are 51 hatcheries with production potential of approximately 25 million chicks per year, 147 feed mills with a capacity of approximately 600,000 MT feed a year. At present the total poultry population is 22790224

chickens. Out of that 6643350 are laying hens which produce 756.5 thousand MT egg and 15.7 thousand MT meats. More than 32928 persons have directly employment in commercial poultry production and marketing alone. Beside direct employment poultry provide employment opportunities at different levels to approximately to 66000 people. The chemical composition of edible parts of hen's egg has high nutritive and low caloric value, so it is easy to digest. Even poultry manure has high fertilizer value and provides healthy organic fertilizer to the soil and replaces the chemical fertilizer to some extend. Manure also used as animal feed by recycling because it has undigested feed components. Poultry sector therefore has great potential but the growth of this sector has been unplanned and without direction. The risk and constraints remain paramount due to absence of clarity in government approach toward poultry production. Government should provide adequate support to poultry sector and needs to develop its long term policy and strategy. Research, extension and clinical services should be strengthen and need to collaborate together.

5. RABBIT

5.1 HEALTH

Salmonellosis in rabbits

Pradhan A (1985). Salmonellosis in rabbits. *Bulletin of veterinary Science and Animal Husbandry*, **13**:22-24

In the present study, potential pathogenic strain of *Salmonella typhimurium* was recovered from clinically sick rabbits. Some of the rabbits on postmortem were found infected with coccidiosis. The gross lesions observed were moderate congestion of liver and lungs. The isolates were highly pathogenic to laboratory mice. The organism was identified on the basis of morpholog cal, biochemical properties, pathogenecity and serological characters. The isolates were highly sensitive to Chloramphenicol.

Identification of *Eimeria species* of rabbits in Nepal

Shrestha SP and UM Singh (1997). Identification of *Eimeria species* of rabbits in Nepal. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 24-25 Sep, Pp 86-99

A study was undertaken in the year 1995/96 with the objective of identifying the prevalence of the pathogenic species of Eimeria in rabbits in Kathmandu valley, Kaski and Kavre districts. Five species of Eimeria has been identified. Those identified were *E. steidae, E. intestinalis, E. piriformis, E. magna* and *E. perforans*.

Efficacy of Ivermectin against Ear mite in rabbits

Thakuri KC, RP Thakur and K Rai (1993). Efficacy of Ivermectin against Ear mite in rabbits. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **8**(1)**:**1-3

A study on the efficacy of Ivermectin against Ear mite infection in rabbits was conducted at PAC, Dhankuta, Nepal. The efficacy was measured on the basis of absence of mite and the disappearance of lesions. The finding showed 100% efficacy of Ivermectin when applied topically at a concentration of 10 mg/ml or injected sub cutaneously at the recommended dose rate (0.02 ml/kg body weight). No evidence of drug associated toxicity or side effect were noticed the study period.

Local treatment of Ear mite infestation in a colony of rabbits in the mid hills of western Nepal

Daldell JK (1996). Local treatment of Ear mite infestation in a colony of rabbits in the mid hills of western Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **11** (1): 30

An out break of Ear mite infestation in a small colony of New Zealand white rabbits was treated with Either Benzyl BenzOate or with mixture of mustard seed oil and kerosene. The results of both treatments were the successful in eliminating of the problem.

A report on hepatic coccidiosis in rabbits in Kathmandu valley

Singh UM (1993-95). A report on hepatic coccidiosis in rabbits in Kathmandu valley. *Proceedings of the 4th National Veterinary Conference,* **19-23**:82-87

The records of 23 cases of coccidiosis in rabbits autopsied between 1986/87 and 1991/92 at Animal Health Research Division, Tripureswor were analyzed. Out of 23 cases, 13 cases (56%) were hepatic and the remaining 9 cases (39.1%) were intestinal coccidiosis. Pathological lesions included enlarged and dark colored liver with different sizes of necrotic white nodules and microscopic examination showed numerous developing stages of coccidia in bile duct epithelium and areas of necrosis. Impression smear of necrotic foci and microscopic examination of bile revealed numerous coccidial oocysts.

Report on some causes of death in rabbits at the Pakhribas Agricultural Centre

Jha VC and KC Thakuri (1996). Report on some causes of death in rabbits at the PAC, Dhankuta. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **11**(2): 42-44

The postmortem (PM) records from 1988 to 1995 maintained at the PAC Veterinary Investigation and Analytical Services Section (VIASS) were analyzed to identify the causes of death in rabbits. Of 201 rabbits autopsied the major causes of death recorded were intestinal coccidiosis (42.8%), pneumonia (10.9%), hepatic coccidiosis (8.4%), enteritis (7%) and retention of urine (5.5%). Both forms of coccidiosis were seen as the major threat to the rabbit industry in Nepal.

5.2 NUTRITION

Trial of pelleted feed on Angora rabbit

Neopane D (2000). Trial of pelleted feed on Angora rabbit. *Proceedings of the 3rd National Animal Science Convention (NASA)*, Aug 27-28, 2000, Lalitpur, Nepal, Pp 90-96

This trial was conducted on 18 German Angora rabbit at Dhulikhel of Kavre District for six months period. The rabbits were divided into three equal groups and given three different types of feed in equal quantity. The feeds used in the trial were pelleted feed containing 18% CP and 2500 Kcal ME, pelleted feed containing 16% CP and 2600 Kcal ME and mash feed containing about 15% CP. This trial was conducted to observe the performance of three different types of rabbit feed in body weight gain, wool production and wool quality. The overall mean body weight gain during the trial period was 2.61, 2.44 and 1.77 kg. The overall mean production of wool during the trial period were 255, 242 and 192.50 g, mean length of wool during the trial period were 2.75, 2.54 and 2.38 inch in feeding pelleted feed containing 18% CP, Pelleted feed containing 16% CP and mash feed containing about 15% CP, respectively. From the study, it was concluded that the pelleted feed containing 18% CP and 2500 Kcal ME gave better result in body weight gain and wool production and quality of wool than other feeds used in the trial.

Replacement of maize with local agro byproducts in rabbit feeding

Ghimire RP and MR Tiwari (2004). Replacement of maize with local agro byproducts in rabbit feeding. *Proceedings of the 5th National Animal Science Convention (NASA*), Oct 15-16, 2003, Kathmandu, pp 33-40

Two separate Feeding trails were carried out at Sheep and Goat Research program, Jumla during 1999 and 2000. Ten pairs of Chinese Angora rabbit kits of an average two months of age were brought from Agricultural Research Center, Lumle. They were divided into five groups on

the basis of their body weight. Concentrate mixture was prepared by replacing 0, 8, 16, 24, 32 parts of maize by Dried Brewer's Grain (DBG) and 0, 5, 10, 15 and 20 part of maize by Dry Apple Pulp (DAP) where 0 parts of DBG and DAP were control groups. Intake of concentrate was found to be higher in control groups in both trials (with no replacement of maize). Eight percent replacement of maize by DBG and 15% replacement of maize by DAP have increased body weight 1.73 and 0.39 kg, respectively. Similarly, in terms of wool production 8% replacement of maize by DBG and 10% replacement of maize by DAP have contributed to higher wool production (247 and 260g, respectively). Digestibility of DM, OM, CP, Hemicellulose and Cellulose found to be higher where 8% maize was replaced by DBG and 15% by DAP. Inclusion of DBG 8-16 % and DAP 10-15 % in concentrate mixture instead of maize have shown that can increase meat and wool productivity of rabbit.

Effect of replacing maize with dried brewer's grain on production performances of Angora rabbit

Tiwari MR, D Neopane and SK Khanal (2006). Effect of replacing maize with dried brewer's grain on production performances of Angora rabbit. *Proceedings of the 6th National workshop on Livestock Fisheries Research in Nepal,* Khumaltar, Lalitpur, 1-2 July, 2004, pp122-126

Twelve pairs of Angora rabbits of age 50–60 days were taken from Swine and Avian Research Program, Khumaltar. Completely Randomized Design (CRD) divided them into six treatments with assignment of four animals in each treatment. Replacing maize with dried brewer's grain in the ratios of 0; 8; 10; 12; 14 and 16 prepared six types of concentrate mixtures. The intake of concentrate mixture and green grass was not significant among the groups (P>0.05); however, the highest concentrate mixture intake was found for T2 group (76.49 1.22) and for grass in T4 group (286.5 1.01). The body weight gain of control group (T0) and T4 group (where DBG was included 14 percent in concentrate mixture) was similar (1.66 Vs 1.64 kg). The highest wool production was recorded in T2 group (183.33 g) followed byT4 group (177.5 g) where dried brewer's grain (DBG) was incorporated 8 and 14%, respectively. But the total body weight gain and wool production traits were not significant (P>0.05) among the groups.

Effect of different concentrates and forage feeding on growth and fibre production performance of rabbit

Shrestha BK, PR Regmi, CR Upreti, D Neopane and TS Dhauwadel (2009). Effect of different concentrates and forage feeding on growth and fibre production performance of rabbit. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 241-246

In this experiment, 15 German mixed bunnies (male and female)) of 7-9 months of age were divided into 5 dietary groups comprising of 3 rabbits in each. The experiment was conducted for 157 days during thee winter spring season in 2005. Animals of 1st diet group (D1) were fed with Hetauda cattle feed + adlib green grasses, 2nd diet group (D2) received of wheat bran + adlib green grass, 3rd diet group (D3) was given rice bran + adlib green grass, 4th diet group (D4) was provided maize + adlib green grass, and 5th diet group (D5) mixed concentrate + adlib green grass. A digestibility trial for 7 days was carried out at the end of experiment. Daily feed intake, and urine and faeces excreted by the animals were recorded. Body weight change was recorded at 15 days interval. Feed intake in all dietary groups was not significantly different. The average daily gain (ADG) was not significantly different as well. However, the ADG was the highest with D3 (6.58 g/day) numerically. The lowest ADG was recorded with D1 (2.97 g/day) with lower digestibility co efficient (58.11%). Higher CP, ADF and NDF digestibility was recorded in D2 group. Feed conversion ratio (FCR) was the best in diet (16.29). Fibre production was significantly higher (P<0.05) in D5 (385±84). Fibre production was higher in D5. From this evidence, it can be suggested that D3 that included rice bran in the

diet as concentrate feed could be used for rabbit feeding as this diet group had highest ADG, FCR, lowest DMI and better digestibility of CP, NDF and ADF.

Effect of level of roughage and rice bran on the growth performance of rabbit

Upreti CR, TS Dhauwadel, D Neopane and BK Shrestha (2009). Effect of level of roughage and rice bran on the growth performance of rabbit. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 247-254

In this experiment, 16 Germany mixed bunnies (male and female) of about 2 months of age were divided into 4 dietary groups comprising of 4 bunnies in each. The experiment was divided into 2 phases and conducted for 91 days. First phase was for 42 days and the 2nd phase for 49 days. In first phase, animals of 1st diet group (D1) were fed with 40% concentrate HCF +60% roughage (80%) Oat/ Rye grass or Kikyu and 20% Clover), 2nd diet group (D2) consisted of 40% concentrate (20% RB in concentrate mixture) + 60% roughage (80% Oat /Rye grass or Kikyu and 20% Clover) of total dry matter required, 3rd diet group (D3) had 40% concentrate (40% RB in concentrate mixture) + 60% roughage (80% Oat / Rye grass or Kikyu and 20% Clover), diet group (D4) consisted 40% concentrate mixture (60% RB in concentrate mixture) + 60% green roughages (80% Oat/Rye grass or Kikyu and 20% Clover) of total dry matter required. In 2nd phase, same bunnies from 1st phase were used for 49 days of experimental period. Animals 1st diet group (D1) was fed with 40% HCF + 60% roughage (80% Oat /Rye grass or Kikyu and 20% White clover) of total dry matter required. Second diet group (D2) consisted of 40% concentrate mixture containing 40% RB + 60% roughage (80% Oat/Rye grass or Kikyu and 20% White clover of total DM required, 3rd diet group (D3) had 50% concentrate mixture containing 40% RB + 50% roughage (80 % Oat/Rye grass/Kikyu and 20% White clover, and diet 4 (D4) consisted of 60% roughage (80% Oat/Rye grass/Kikyu and 20% White clover. A digestibility trial for 7 days was carried out at the end of the experiment. Daily feed intake, and urine and faeces excreted by the animals were recorded. Body weight gain was recorded at 7 days interval. In 1st phase, the average daily weight gain was not significantly different between diet groups. Growth performance of D1 and D4 was almost similar which indicated that inclusion of RB @ 60% in concentrate mixture is possible. Economically, D4 had highest economic return and net income was in increasing order, as the level of RB in concentrate was increased (20, 40 and 60%). In 2nd phase, the average daily weight gain was highest in D4, which contained 60% concentrate (of 40% RB) that was superior to produce meat than other dietary group. Feed conversion ratio (FCR) was better for D4 and was in decreasing order to D3 and D1 of 7.87, 8.49 and 9.14, respectively. Economically, among the tested feed, D4 recorded significantly highest net income of NRs 73.99 and lowest with D1 (55.37) during the experiment period of 49 days.

5.3 PRODUCTION AND MANAGEMENT

Angora Rabbit production at Pakhribas Agricultural Centre

Neopane SP, NP Shrestha, IK Aryal and AR Gurung (1992). Angora rabbit production at Pakhribas Agricultural Centre. *Working Paper N. 92/34*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

Angora rabbits (British, Russian and German) were introduced at Pakhribas Agricultural centre (PAC) from Himanchal Pradesh, India in 1989. Their productive performances such as birth weight, weaned weight, wool yield and reproductive parameters were being monitored. The resulted that there was no significant differences on birth weight, weaned weight, concentrate

feed intake, wool yield and reproductive parameters between the 2 breeds (British and Russian) at P>0.05. Wool yield from the British and Russian Angora was significantly lower than the German Angora (P<0.05). However, pre- weaning mortality was found significantly higher in German than the British and Russian Angoras (P<0.05).

Angora rabbits: A good source of income generation for small farmers in the hills of Nepal

Shrestha NP and SP Neopane (1994). Angora rabbits: A good source of income generation for small farmers in the hills of Nepal. *Proceedings of the 2nd National Conference on Science and Technology, Royal Nepal Academy of Science and Technology (RONAST),* Kathmandu, June 8-11, 1994, pp 221

Angora rabbit were 1st introduced in Nepal through the Pakhribas Agriculture Centre from Himanchal Pradesh, India in 1989. Rabbits provide good quality meat and wool by utilizing even low quality feeds (Reddy, 1987). Angora rabbit wool, one of the finest animal fibres, is considered to be a luxury fibre which can utilized as a pure fibre or as blends with sheep wool, silk and synthetics to manufacture quality woolen apparels for home consumption and export (Mahajan, 1989). Angora farming does not require sophisticated management or high inputs. Oli and Morel (1985) reported that Angora rabbit farming has greater potential in the hills and mountains due to their high prolificacy and low cost involvement. A temperate type of climate is more suitable for angora farming. PAC has already demonstrated that angora rabbits can be successfully reared in the hills and mountains between altitudes from 1300 to 1900 m asl. Angora rabbit farming had considerable potential for small subsistence farmers as an income generation activity in the hills of Nepal. Technology requires for farming angora rabbits and the experience gained by PAC in the eastern hills of Nepal should be fully capitalized.

On farm performances of Angora rabbits in the eastern hills of Nepal

Neopane SP, NP Shrestha and AR Gurung (1994). On farm performances of Angora rabbits in the eastern hills of Nepal. *Working Paper N. 94/97*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

Angora rabbits (British, German and Russian) were introduced to on farm sites (Ilam, Mamling, Nigale and Sukrabare) in the eastern hills to study their adaptability and monitor their productive performances in the farmers' condition. The results showed no significant differences on reproductive parameters except, age at 1st service amongst the 3 strains. Age at 1st service was the lowest (149 days) in German Angora (P<0.05). The overall pre-weaning mortality was 17%; the lowest being 8% in German Angora. The overall wool production in the 1st year (1st to 4th shearing) was 266 g/annum. As in on station, the German strain produced more wool (288g) than British (265 g) and Russian strains (246g) in the 1st year.

Factors affecting on wool production of Angora rabbits in the eastern hills of Nepal

Neopane SP (1997). Factors affecting on wool production of Angora rabbits in the eastern hills of Nepal. *Proceedings of the 2ndNational Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, Sep 24-25, 1997, pp 143-147

The overall wool production in the first (first to fourth shearing) and second year (fifth to eight shearing) were found 265 g and 291 g, respectively. The German strain produced more wool than British and Russian strains at the first and second year. Wool yield at the first year was 249, 292 and 253 g for British, German and Russian Angora, respectively. Similarly wool yield at the second year was 289g, 331 g and 254 g for the above strains, respectively. Strain, Sex and experimental site significantly affected wool production in both the first and second year.

Altitude and year of birth of kits affected wool production significantly in both the first and second year.

Comparative study on production and reproduction performances of different strains of Angora rabbits in Khumaltar

Neopane D, SM Pradhan and D Ghale (1997). Comparative study on production and reproduction performances of different strains of Angora rabbits in Khumaltar. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, Sep 18-21, 1997, pp 18-21

The result have shown significant higher wool yield and larger litter size in German Angora (423,125g and 7,4) than British and Russian angora (305,344 g and 5.77), but, the pre-weaning mortality in British and Russian strain (18,18% and 23,69%) were lower than in German Angora (32%).The maximum wool yield of German rabbit (612g/head/year) in Khumaltar station was higher than reported previously at Pakhribas Agriculture Center (PAC) and similarly the litter size of German Angora (16.2) was also larger than that reported in PAC.

Production performance of three strains of Angora rabbits in the eastern hills of Nepal

Neopane SP (1998). Production performance of three strains of Angora rabbits in the eastern hills of Nepal. *Technical Paper N.98/184*, Pakhribas Agricultural Center (PAC), Pakhribas, Dhankuta, Nepal

Angora rabbits of three strains (British, Russian and German) were introduced to on-farm sites (Barbate, Mailing, Nigale and Sukrabare) in the eastern hills to study their adaptability and monitor their productive performance in farmer's conditions. The results of two year's showed significant strains differences on some reproductive parameters such as litter size at birth, litter weight at weaning and number of kits born per doe per year. Litter size at birth was the lowest in British (4.89) while Russian and German Angora rabbits were similar ($P<0.001$). German Angora Rabbits had higher litter weight at weaning (1984 g) and British Angora Rabbits had the lowest (1478g) ($P<0.05$). German Angora also produced the highest number of kits born from a doe in a year ($P<0.05$). These indicated that German Angora Rabbits had better mothering ability. The overall pre weaning mortality was 39.9%. The overall wool production in the first (first to fourth shearing) and second year (fifth to eight shearing) was 265 and 291 g per annum, respectively. The German strain produced more wool than British and Russian strains at the first and second year. Sex (male and Female), strain (British, Russian and German) and experimental site significantly affected wool production for both the first and second year. Altitude (1150–1450, 1451-1700 and 1701–1950 m asl) and year of birth (1991, 1992 and 1993) of kits affected wool production significantly at the first and second year, respectively.

Angora wool: A synopsis of the problems of the eastern hills of Nepal

Paudel TP, DB Subba, RP Ghimire and RC Khanal (1999). Angora wool: A synopsis of the problems of the easter hills of Nepal. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, pp 229-236

Pakhribas Agricultural Centre introduced rabbit in Nepal in 1989. Then the proliferation started in the eastern hills rapidly. Consequently, the eastern hill farmers started facing problem with marketing and producing the angora wool. To mitigate the need a survey was carried out across four locations of Dhankuta, Terhathum and Ilam districts through a semi structured questionnaire that encompassed principally the production and marketing parameters. Now a day, only 36% of the total respondents were continuing the enterprise with

very little size where 77% of the total used to rear more than 5 pairs. On an average rabbit mortality was 31% however, farmers indicated that kit mortality forms large part of this. Breeding was affected more in winter and the mortality of kits was found more because of early weaning of kits. All of them were found feeding the rabbits with both grains and grasses. Two out of 84 were found plucking once as a method of wool harvesting but had left now and follow the general shearing method in spite of being known about quality and quantity of wool was being superior. The wool yield was more in males. The yield was more in winter as reported by 50% of the respondents. Marketing of the wool was found affected by the poor grading practice; lack of authorized depots and lack of know how about the market and market price. Farmers of Fikal and Nigale were organized into groups to improve the marketing system.

Bunnies' production and kindling mortality of different strains of Angora rabbit

Dhaubhdel TS and D Neopane (1999). Bunny's production and kindling mortality of different strains of Angora rabbit. *Proceedings of the 1st Society of Agricultural Scientists (SAS*), pp 217-218

A study was conducted on British, German, Chinese and Russian rabbits to study on kindling mortality at Swine and Avian Research Program, Khumaltar. The results showed that British, Chinese, German and Russian Angora rabbit weaned 4.85±1.35, 4.77±1.31, 3.61±1.96 and 3.25± 2.5, respectively. Similarly, the mortality rates of the bunnies were found 24.4%, 23.2%, 29% and 35% for British, Chinese, German and Russian Angora rabbit, respectively. The overall mortality in the flock was 27%.

Evaluation of wool production performance on different lines and strains of Angora rabbit in Khumaltar, Lalitpur

Neopane D (1999). Evaluation of wool production performance on different lines and strains of Angora rabbit in Khumaltar, Lalitpur. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Researchin Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, pp 277-280

Based upon the first year data available at Rabbit Research Program of Swine and Avian Research Program, Khumaltar concluded that the G1 line of German Angora produced significantly higher wool yield (average of 949.2g/rabbit/year) than other line and strains of Angora rabbit. The average annual wood production in Chinese Angora, G2 line of German Angora, Russian Angora and British Angora was 656.2g. 511.9g. 349.5g and 355g, respectively. The wood production performances of existing lines and strains have also been slightly increased than previous year.

Quality of Angora wool versus altered management

Paudel TP and M Karki (2000). Quality of Angora wool versus altered management. *Proceedings of the 4th National Workshop on Livestock and Fisheries Research in Nepal,* Agriculture Research Station, Pakhribas, Dhankuta, Nepal, April 24-26, 2000, pp 72-76

Considering the problem of wool quality and management practices a research trial was initiated in 1998 at Agricultural Research Station (ARS), Pakhribas. Housing system, wool harvesting method and feed resources were the parameters across which the quality of wool was considered to be dependent. The results revealed that the existing system of housing, which was made by using indigenous bamboo, was at par with the cage system made up of galvanized iron netting. Plucking was a better wool harvesting method than the current method of shearing. While considering the effect of sex on the wool production, females showed the better performance than males but the difference of sex on wool production was not significant. Castration resulted negatively in wool production.

Evaluation of cost benefit ratio on G1 line of German Angora rabbit in Khumaltar, Lalitpur

Neopane D and TS Dhaubhdel (2006). Evaluation of cost benefit ratio on G1 line of German Angora rabbit in Khumaltar, Lalitpur. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, 1-2 July, 2004, pp 76-78

Ten weaned rabbit from G1 line of German Angora were selected to evaluate the cost benefit ratio in Khumaltar, Lalitpur. They were kept in the individual cages (3' length 2.5' width and 2' in height).They were given 60g of pelleted feed containing 18% CP and 300 g of green grasses. The rabbits were sheared manually with the help of scissors in 2.5 months interval. The rabbits in the trial were allowed for breeding purpose. The records of wool production, bunnies' production, feed cost, other expenses and revenue received were recorded. The total wool and bunnies' production from 10 German Angora rabbit in two years period were 17.43 kg and 25, respectively. The return from wool was NRs. 17427.0 and from bunnies NRs. 8150.0. The total expense to keep 10 rabbits for two years period was NRs 12966.0. In this study the net income only from wool was NRs. 4461.0 and from both bunnies and wool was NRs. 11961.0.

Evaluation of wool production performance on different lines and strains of Angora rabbit at Khumaltar, Lalitpur

Neopane D, TS Dhauwadel and SP Nepane (2010). Evaluation of wool production performance on different lines and strains of Angora rabbit at Khumaltar, Lalitpur. *Nepal Journal of Science and Technology,* Nepal Academy of Science and technology (NAST*)*, Khumaltar, Lalitpur, **11**:83-86

Research on wool production performance between different lines and strains of Angora rabbit was started at Swine and Avian Research Program (SARP), Khumaltar, Lalitpur since 1994. The high yielding lines of German (G1) and Chinese angora were introduced at SARP in 1998 from Chitlang Goat Farm of Department of Livestock Service (DLS) and Lumle Agricultural Research Centre. Research on wool production performance of German, Chinese, Russian and British strains of Angora rabbit at Khumaltar, Lalitpur was conducted. One year data of G1 line of German Angora rabbit showed significantly ($P<0.05$) higher wool production (949.2±101g/ rabbit/year) than other lines and strains of Angora rabbit. The average wool production of Chinese angora, G2 line of German angora, Russian and British angora were 652.2, 511, 349.5 and 335g, respectively. Similarly, additional improvement on management for existing lines and strains also showed significant ($P<0.05$) increase on wool production performance as compared with the results of previous year (G2 line of German 423.125 to 511 g and British 305 to 349g)

Economics of meat rabbit production under farmers management in the hills of Nepal

Amatya LK and DB Gurung (1997). Economics of meat rabbit production under farmers' management in the hills of Nepal. *Working Paper N. 97/1,* Lumle Agricultural Research Centre, Lumle, Kaski, Nepal

A productivity and profitability study of a meat breed of rabbit, Hyaline Californian under farmers' management in five VDCs had shown this enterprise to be economically profitable with an overall rate of return of 135%. Mortality due to disease was found to be major factor responsible for reducing the profitability. The acceptance of the enterprise by the farmers was indicated by an increase in the total number of animals kept and high proportion of the meat consumed at home. A recommendation to study different aspects of investment evaluation in dynamic market situation was made.

Evaluation of production performance of Soviet Chinchilla and Hyaline California meat rabbits under farmers' management conditions

Gautam DC, DP Rasali and DB Gurung (1998). Evaluation of production performance of Soviet Chinchilla and Hyaline California meat rabbits under farmers' management conditions. *Working Paper N. 98/7,* Lumle Agricultural Research Centre (LARC), Kaski, Nepal

Rabbit is a small animal that mostly survives on green grasses and will not compete with human food, and could be an alternate source of animal protein in human diet. This study was conducted in low and mid hills of the western hills of Nepal under farmers' management condition with two different breeds of meat rabbits namely Soviet Chinchilla and Hyaline California with the objective of evaluating their performance and verifying their husbandry practices under farmers' management. Farmers were divided into 2 groups each breed of rabbit one female of each breed was provided to then on cost free basis, and one male of each breed was rotated between two farmers of the same group. Hutch of the rabbit was constructed by the farmers and participation by using locally available materials. Fourteen rabbits were available for feeding and management recording, 14 does for number of weaned kit were sold, 10 for utilization of labour time, 47 rabbits for productive performances and 43 rabbits for reproductive performances. Daily feeding intake was significantly different ($P<.05$) across the sites where farmers of the low hills fed considerably higher quantity of feed (4.5-5 kg/rabbit) than those of mid hills (2.4±0.38 kg/rabbit). Similarly, utilization of labour was higher in Jhobang, in low hills (643.2±100 days) than Kewarebhanjyang in mid hills (430±46.8 days). The body weight, final and average daily weight gain were not affected by sex ($P>0.05$), whereas these traits were significantly different ($P<0.05$) across sites and breeds, with an average daily weight gain of 4.404±0.409 g/day in mid hills and 2.25 to 2.54 g/day in the low hills. Soviet Chinchilla attained their puberty at the age of nine months compared t with that of 10 months for Hyaline California. Litter size at weaning was slightly greater in case of Soviet Chinchilla (1.18±0.518) than Hyaline California (0.975±0.437). Higher numbers of kits were sold from the does of Hyaline California. During this study the major feedback from the farmers were problems of technical know how of rabbitary, poor hutch management, high mortality at the age of weaning and poor sanitation.

6. FISHERY

6.1 Health

Relationship of bacterial flora of Grass carp (*Ctenopharyngodon idella*) and its environment

Shrestha PM, RP Adhikary and AK Rai (2000). Relationship of bacterial flora of Grass carp (*Ctenopharyngodon idella*) and its environment. *Proceedings of the 3rd National Animal Science Convention (NASA)*, Kathmandu, Aug 27-28, 1997, pp 134-144

Enumeration and isolation of aerobic bacteria especially from the fresh water Grass carp were done. The average total viable numbers of bacteria in slime/skin, gills, intestine of fishes, fish diet, aquatic insect and pond water were found 6.7×10^3 -1.2×10^5, 4.2×10^4 -1.6×10^5, 1.6×10^4 -1.7×10^5, 3.8×10^2 – 5.4×10^3, 1.8×10^2 – 4.1×10^3, 1.2×10^2 – 4.4×10^2 – 4.4×10^3 and 5.2×10^2 – 4.4×10^4 CFU/ml, respectively. Gram positive bacteria were the dominant micro flora in all samples. The predominant aerobic bacteria flora isolated from these samples were *Pseudomonas, Aeromonas, Staphylococcus, Micrococcus, Enterobacteriaceae* (different numbers), *Bacillus, Streptococcus, Vibrio and Salmonella*. The enzymatic activities of fish isolates were also studied and were found 87% lipase producer, 57% protease producer and 29% amylase producer. The maximum amylase and protease activities were shown by *Bacillus licheniformis* and *Bacillus cereus* and the maximum lipase activity was shown by Aeromonas hydrophila on basal medium.

Occurrence of fish parasites in Pokhara valley

Bista JD, S Prasad, SK Wagle and RK Shrestha (2001). Occurrence of fish parasites in Pokhara valley. *Proceedings of the 4th National Animal Science Convention*, Kathmandu, Nov 29 to Dec 1, 2000, pp 179-183

Observation on the occurrence of fish parasites were made in various fish culture facilities in Pokhara valley. No evidence of occurrence of fish parasites were observed in cultured fish in natural water. The four species of parasites: *Trichodina spp*, *Dactylogyrus spp, Gyrodactylus spp* and *Argulus spp* were recorded from the fry and adult fish in ponds at Lake Begnas. High diurnal fluctuation of dissolved oxygen (0.6 mg. l^1 in the morning and >20 mg. l^1 in the evening) might have stressed fish and encouraged parasites infestation. Fish fry mortality was estimated between 1.8 % and 15% caused by *Trichodina spp* but insignificant losses due to other parasites. Trichlorofon at 0.25 mg. l^1 and formalin at 15-20 mg. l^1 as therapeutic control measures were found effective to control *Trichodina spp* in fry and *Argulus spp* in brood fish.

An Outbreak of *Aeromonas Caviae* infection in Rainbow Trout fish at Godavari

Rayamajhi A (2003). An Outbreak of *Aeromonas caviae* infection in Rainbow Trout fish at Godavari. *Proceedings of 2nd SAS/ N Convention*, Kathmandu, 30 July - 1 Aug 2003, Pp

The rainbow trout (*Oncorhynchus mykiss*) has been cultured in raceways of Fisheries Research Division, Godavari since 1988. An unknown disease, which caused about 32% mortalities. Bacterial fish isolate was cultured on Tryptic Soy Agar (TSA) and was incubated for 24 hours at 31ºC. The bacterial isolate cultured from lesion of trout skin was identified as *Aeromonas caviae* by applying standard biochemical test and API 20E Strip system. The *A. caviae* reported from Godavari has not previously been recorded. The results of sensitivity test revealed that applied antibacterial agents namely Oxolinic acid, Streptomycin, Tetracyclin, Norfloxacin, Nitrofurantoin and Sulfamethoxazole were all effective against *A. caviae*. External and internal

organs of trout fish were stained in haematoxylin and eosin (HE) examined histologically by contained shrunken glomeruli in Bowman's capsule of kidney. Some pyknotic nuclei were observed in the regenerating epithelial cells and also debris in the lumen of renal tubules. Haemopoitic tissues congestion in sinosoids of liver were recorded. Hypertrophy, hyperplasia and some pyknotic nuclei were observed in epithelium cells of secondary gill lamellae and odema was seen in the epithelium of primary and secondary gill lamellaes of trout.

Seasonal prevalence of monogenean parasite in Common Carp (*Cyprinus carpio*) in mid hill fish farm

Rayamajhi A (2007). Seasonal prevalence of monogenean parasite in Common Carp (*Cyprinus carpio*) in mid hill fish farm. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, 25-27 June, 2007, pp 65-70

Dactylogyrid parasites in Common Carp (*Cyprinus carpio*) were studied collected from Godavari and Trishuli fish farms. Two Monogeneon parasites *Dactylogyrus extensus* (Mueller and Van Cleave, 1932), and *D. vastator* Nybelin, 1924 were isolated from the gills of Common carp juveniles. On the basis of earlier history on *Dactylogyrus*, it was proposed that *D. extensus* and *D. vastator* were new occurrence in Nepal. The proportion of mean prevalence of *Dactylogyrus* infection was significantly different ($P<0.05$) in winter (32%), summer (66.7%) and rainy seasons (100%), whereas mean intensity rate of parasitic trend per infected juveniles were not significantly different ($P>0.05$) in winter, summer and rainy season. These two species, *D. extensus and D. vastator* were observed as sympatric on the gills of common carp in rainy season at both station Godavari and Trishuli, while *D. Extensus* occurred in all season in Godavari. To control these parasites indefinite use of formalin @ 15 ppm was found to be effective.

An evaluation on rainbow trout (*Oncorhynchus mykiss*) diseases and their control measures in Nepal

Raymajhi A and RR Dhital (2008). An evaluation on rainbow trout (*Oncorhynchus mykiss*) diseases and their control measures in Nepal. *Proceedings of 1st National Workshop on Scaling-up of rainbow trout (Oncorhynchus mykiss) Farming Strategies in Nepal*", Organizers: NARC, JICA, Department of Agriculture (DOA), NEFIS, pp 52-56

History of trout cultivation is relatively new intervention. As trout were introduced only about two decades before, since then knowledge on rainbow trout diseases and their control measures have accumulated in Nepal. In this review work, we found that trout are susceptible to diseases mainly originated from feed and water contamination. Unclean water may predispose bacterial, protozoan and cytozoic parasitic for infection, while unhygienic feed may trigger hepatoma and several other diseases. These harmful diseases may cause severe economic losses to trout farmers. It was concluded that at present no urgent disease problems have been found in rainbow trout which could causes mass mortality. This might be due to trout farming relatively in low intensity

Identification of disease problems in fish farming pocket areas of Chitawan and Banke, Nepal

Rayamajhi A, SP Dahal, S Rai, N Pradhan, DK Jha (2010). Identification of disease problems in fish farming pocket areas of Chitawan and Banke, Nepal. *Proceedings of the 8th National Workshop on Livestock and Fisheries Researchin Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

Framework survey on carp fish diseases and related consequences was carried out in fish farming pocket areas of Kathar and Madi Village Development Committee (VDC) of Chitawan and, Nobasta and Bankatti VDC of Banke District. The major fish diseases identified were ectoparasitic (Trichodinasis, Dactylogyrosis, Argulosis), endoparasitic (Intestinal worm), nutritional deficiency (lordosis), fungal (Saprolegniasis) and bacterial disease (Dropsy, gill rot and ulcers). Overloading of fish stock, frequent oxygen depletion, malpractice of production management and substandard pond engineering were the major cause for the outbreak of diseases. Fish health management capacity of farmers was enhanced through interactive dialogue, field demonstration and awareness program on code of conduct for responsible aquaculture.

Diagnosis and innovative treatments of Coccidia (Apicomplexa) infection in Rainbow trout (*Oncorhynchus mykiss*) in Nepal

Rayamajhi A, N Pradhan and NK Roy (2010). Diagnosis and innovative treatments of Coccidian (Apicomplexa) infection in Rainbow trout (*Oncorhynchus mykiss*) in Nepal. *Proceedings of the 8th National Workshop on Livestock and Fisheries Research in Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

Coccidiosis, is an economically important fish disease, has significant effect on grow out performance of Rainbow trout under semi-intensive production systems in Nepal. The treatment measures of the disease were meager in the country, hence, a study was carried out in farmer's field at Rasuwa, Nuwakot and Sindhupalchowk districts to evaluate efficacy of a drug (Amprolium) to control coccidiosis in trout. Therapeutic doses of Amprolium was established at two levels viz. 30 $mg.kg^{-1}$ and 60 $mg.kg^{-1}$ body weights and administered according to the selected regimen. Pre-treatment observation revealed that severe occurrence of oocysts (6.7 µm±1.2), as potential sign of coccidiosis, was evident from the gut of fingerlings (1.9±0.7 g) to large size trout (73.3±33.8 g). The prevalence rate of coccidiosis was significantly higher (50.1 to 70.1%) in large size trout than the prevalence rate (26.7%) estimated for small size trout. Raceways fed with run-off water containing humus and silt during monsoon, uneaten feed waste sediment and fecal deposition in rearing system were found to stimulate the outbreak of coccidiosis in trout. Coccidiosis prevalence rate was significantly reduced (8.9 - 18.5%) in trout population treated with Amprolium at the dose 60 $mg.kg^{-1}$ body weight $.day^{-1}$ for two week. Mortality rate for Amprolium treated fish population was significantly reduced ($P<0.05$) to a range between 0.85±0.1% to 7.0±0.5% compared to the untreated population (0.7 - 22.6%).

6.2 Nutrition

Culture evaluation of Sahar (*Tor puttitora*) larval feed on initial diet contained different level of fish meal

Bista JD and OJamada (1996). Culture evaluation of Sahar (*Tor puttitora*) larval feed on initial diet contained different level of fish meal. *Proceedings of the first National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, 7-9 May, 1996, pp 39-44

Early fry Sahar reared in 75 lit capacity plastic tanks filled with 50 lit water and 80 larvae stocked in each tank fed on 8 different initial diets. The net weight gain (83.8 g) of fish was the best among the diets when live zooplankton during 30 days of culture. The growth of fry showed better weight gain (45.5 g) when fed with low level of fish meal (15-20%) in which 80-90% of fish meal replaced by soybean cake compared to high contained of fish meal (45-55%). The recovery rate was also showed higher (90-92%) when fed with live zooplankton and soybean meal. The net weight gain (34.35 g) as well as the recovery rate (33%) showed poor when feed with high contained fish meal.

Comparative growth study of indigenous fish species Mahseer, Kattle and Asla fed with local feed ingredients

Rai AK and AK Rana (1997). Comparative growth study of indigenous fish species Mahseer, Kattle and Asla fed with local feed ingredients. *Nepal Agriculture Research Journal (SAS/N*), **1**(1): 57 – 61

Three indigenous local fish species Mahseer, Katle and Asala (Chuche and Buche) were studied for about 10 months by feeding local feed ingredients and compared their growths. Among the three species Mahseer and Asala (Buche) showed better growth (0.05 g/day) and followed by Katle (0.03g/day) and Asala (Chuche) (0.02 g/day), respectively.

Effect of satiation feeding in pond on the growth, recovery and uniformity of carp fry

Wagle, SK (1998). Effect of satiation feeding in pond on the growth, recovery and uniformity of carp fry. *Proceedings of the Present Status of Fisheries Research, Development and Education in Nepal*, NARC-JICA, pp 1-6

Feeding experiment was conducted in four rearing ponds for four carp species. The fry of Common carp, Grass carp, Silver carp and Bighead carp were stocked in their respective pond at a density of 80 tail.m^{-2} and reared for 45 days. A dry ration crumble (33.5% crude protein) was provided continuously by watching as the fish fry eat. The net production of 5.3, 3.6, 2.8 and 1.9 g.$tail^{-1}$ was obtained, respectively, for Common, Grass, Silver and Bighead carp. In contrary of absolute growth, the fry of Bighead carp showed higher relative growth of 18.1%.day^{-1}. The fry of all species exceeded 87% survival rate at harvest. A steady feed conversion rate (FCR) of 2.5 and 2.2 was found, respectively, for the fry of silver and Grass carp between sub periods. The mean FCR of 2.1 and 1.9 was calculated, respectively, for Common and Bighead carp fry. From the satiation feeding, the predicted daily feeding rate was 14-18% and 4-6% of total live weight, respectively, for 0.1-0.3 g and 5.0-6.0 g size group irrespective of species at mean water temperature ranging from 25.2 to 31.3 ^{0}c. A more uniform size of fry of all species was observed at harvest.

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Development of starter feed for trout larvae under local management

Pradhan N and RM Mulmi (1999). Development of starter feed for trout larvae under local management. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, June 26-28, 1999, pp 38-41

A study on the growth performance of Rainbow trout fry with three different types of feeds was carried out in cemented circular tanks for 2 months. The dry starter feed was considered as a control diet. Survival was excellent, over 99%. The fish fed with dry starter feed gave the best result (0.096 g/day) followed by the fish fed with buffalo liver (0.066 g/day) and then the boiled egg yolk (0.06 g/day). The treatments were not significantly different.

The effect of Methonine supplemented feed on the growth of Sahar (*Tor putitora*)

Bista JD, S Prasad and RK Shrestha (1999). The effect of Methonine supplemented feed on the growth of Sahar (*Tor putitora*). *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, June 26-28, 1999, pp 42-46

An experiment was carried out in flOating net cage in Lake Phewa to develop appropriate diet for Sahar. The yearling of Sahar with an average weight of 40.4 g was stocked at a density of 295 individuals 8 m^3 of net cages. Fish diets, with and without Methionine supplementation were provided to the experimental fish. Body weight gain of Sahar in each growth period was not significantly different between the groups fed with and without Methionine supplemented Soya based diet. However, total weight at the end of the experiment was observed to be higher in Methionine supplemented diet (94 g). Both food intake and growth of Sahar were influenced by water temperature.

Variation in the growth of Rainbow trout fed upon pellet feed with different proportions of shrimp meal

Roy NK, AP Nepal and SR Basnet (1999). Variation in the growth of Rainbow trout fed upon pellet feed with different proportions of shrimp meal. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, pp 47-52

Animal protein is the most essential part of trout feed. Shrimp is a good source of animal protein to improve the quality of Rainbow trout. However, shrimp is very expensive in the local market. An alternative way to reduce the cost of Trout feed is to use the shrimp meal as low as possible. Feeding trail was carried out with four group of diet with 70, 50, 30 and 10% shrimp powder with and without incorporating 10% soybean oil in each diet. Rainbow trout fed up on the diets containing more than 50% shrimp powder resulted in highest specific growth rate (2%/day), feed efficiency more than 57% and survival rate more than 98%. The 10% soybean oil mixed in diet with 30% shrimp powder produced similar growth results of trout as contrived in 50% inclusion of shrimp powder. The production cost of trout with 30% shrimp powder added with 10% soybean oil was estimated to be 15% less than the feed prepared with 50% inclusion level of shrimp powder.

Nutritional value and digestibility of fish feed stuff of Nepal

Bista JD and RK Shrestha (2000). Nutritional value and digestibility of fish feed stuff of Nepal. *Proceedings of the 4th National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Pakhribas, Dhankuta, 24-26 April, 2000, pp 30-38

Samples of feed stuffs were collected from five developemnt regions of the country and were analyzed for nutritional values. Nutrient digestibility of different ingredients by Rohu (*Labeo rohita*) was carried out to develop low cost fish feed. Rohu with an average weight of 10.5g raised in plastic tanks were fed at 3% of the body weight. Their faeces were collected for a week to determine of apparent digestibility of dry matter and nutrient (protein and fat) in the diet. Feed stuff of a particular kind showed wide variation in their nutrient content (protein, fat, ash and moisture) due to variation in variety, cultrue practices, geography and so on. Soybean was most digestible (84%) with apparent protein digestibilty (APD) value. Rice bran resulted in the highest APD (71%) and followed by wheat bran (62.6%) among the test ingredients but low protein. Rohu was able to utilize the soybean and mustard cake efficiently as dietary protein sources. Similarly, *Labeo rohita* efficietly utilized rice and wheat bran at less than 30% inclusion level.

Effect of different feed ingredients on the growth of caged Common carp

Rai AK and JD Bista (2000). Effect of different feed ingredients on the growth of caged Common carp. *Nepal Agriculture Research Journal (SAS/N)*, **4**:60-63

To know the effect of four different fish feeds, nine months old Common carp about 47g size were stocked at the stocking density 12 fish m^3 in the cages and cultured in Lake Phewa for 175 days. Four different feed ingredients used were fish meal + oil cake + rice bran + wheat flour, fish meal + oil cake + rice bran + wheat flour, soybean + oil cake + rice bran + wheat flour and commercial cattle feed. The crude protein content of feed ranged from 23 to 32.2%. The crude protein content feed containing ingredients of fish meal + soybean + oil cake + rice bran + wheat flour was better for the fish growth ($0.30g/day^{-1}$) but was the lowest survival rate (65.4%) followed by 27.1% crude protein content feed containing fish meal +oil cake + rice bran + wheat flour ($0.23\ g/day^{-1}$). 26.2% crude protein content feed containing soybean + oil cake + rice bran + wheat flour without animal protein was the poorest growth rate ($0.17\ g/day^{-1}$) with highest survival rate (95.7%) among the tested feed. It was observed that feed with higher crude protein level was better for the fish growth and the growth of the fish was different significantly among the treatments except the treatment fish meal + oil cake + rice bran + wheat flour and commercial cattle feed. The Common carp fish cultured in cages through artificial feed was not satisfactory. It digs the burrows the pond embankments and sides in search of organic matter that makes pond turbid.

Use of chopped leaves of three fodder and terrestrial grass as a feed for Grass Carp (Ctenopharyngodon idella) and their subsequent use in Carp polyculture

Jha DC and M Sapkota (2001). Use of chopped leaves of three fodder and terrestrial grass as a feed for Grass Carp (Ctenopharyngodon idella) and their subsequent use in Carp polyculture. *Proceedings of the 4th National Animal Science Convention*, Kathmandu Nepal, Nov 29 to Dec 1, 2000, pp 184-188

An experiment was conducted in outdoor cemented ponds with static water system at the Institute of Agriculture and Animal Science, Rampur, Chitawan to evaluate the growth and production performance of Grass Carp and subsequent production of other polycultured species feeding with fresh chopped leaves of Badahar (*Artocarpus lakoocha*, T1), Koiralo (*Bauhinia purpurea*, T2) and Napier grass (*Pennisetum purpureum*, T3). Each treatment was

tested at stocking density of one fish/m^2 using polyculture of Grass Carp, Silver Carp (*Hypophthalmichthys molitrix*), Common Carp (*Cyprinus carpio*) and Bighead Carp (*Aristichthys nobilis*) with a stocking combination of 38, 33, 21 and 8% ,respectively. Mean net fish yield (NFY) obtained from Grass Carp were 0.56±0.09, 031±0.01 and 2.36±0.12 kg /ha /day from T1, T2 and T3, respectively. The NFY from T3 was significantly ($p<0.05$) higher than obtained from T1 and T2. The mean total NFY obtained were 1.93±0.16, 1.17±0.06 kg /ha/ day from T1 and T2 respectively while 4.12±0.06 kg/ha/day fish yield was obtained from T3. The results indicated that Grass Carp performs better when fed with Napier than fed with Badahar and Koiralo. It also supports the production of planktivorous fish species in Carp polyculture.

Growth performance of Sahar (*Tor putitora*) fed on diet with different protein level

Bista JD and RK Shrestha (2001). Growth performance of Sahar (*Tor putitora*) fed on diet with different protein level. *Proceedings of the 4th National Animal Science Convention*, Kathmandu, Nepal Nov 29 to Dec 1, 2000, pp 189-191

A preliminary study was conducted to examine the growth performance of Sahar on two levels of dietary protein (30% and 40%) in the cage culture environment. Fingerlings weighing 0.6g, on an average were the diets for 210 days during 1998/99. The net weight gain of fingerlings fed on 30% protein diet increased significantly ($p<0.05$) for the first 90 days, while the growth of those fed with 40% protein diet was non significant. The growth of fingerlings fed with 40% protein diet was significant ($p<0.05$) only after 90 days. The mean values of body weight of Sahar obtained at harvest were 19.5 g and 22.5 g fed on 30% and 40% protein diets, respectively.

Study on growth performance and quality of meat in relation to nutrient level of Rainbow Trout fed on different protein level diets

Nepal AP, GP Lamsal, N Pradhan and SK Shrestha (2003). Study on growth performance and quality of meat in relation to nutrient level of Rainbow Trout fed on different protein level diets. *Proceedings of 2nd SAS-N Convention*, Kathmandu, 30 July - 1 Aug, 2003

A feeding trial was conducted to observe the growth performance and the meat quality of Rainbow trout using fry of initial average body weight of 3.9±0.5 to 4.3±0.6 g in first experiment and 9.4±0.6 and 9.6±0.5 g in second experiment. Fish were fed with 5 different types of diet containing 30%, 35%, 40%, 45% crude protein (CP) and control diet was existing feed (35% CP content) practiced in the Centre. All treatments were supplied with 10% soybean oil as the energy source. The feed efficiency remained 44.8% to 53.5% in first experiment and 31.5% to 50.6% in second experiment showing highest efficiency, 53.5% in 30%CP containing diet in first experiment and 50.6% in 45% CP containing diet in second experiment, The highest specific growth rate was observed (2.2%/day) in fish fed with 45%CP containing diet in first experiment and lowest (1.3%) in fish fed with control diet and 30% CP containing diet in second experiment. Survival rate were >87.7% and >91.3% in all treatments in first and second experiments, respectively. The feed conversion ratio (FCR) remained 1.9 to 2.2 in first experiments and 2.0 to 3.2 in second experiment. The average body weight gain was the highest in 45% CP containing diet, but there was no significant difference ($p>0.05$) on the growth of fish among the treatments in both experiments. Highest protein level (22.8%) in meat was found in treatment B (35% CP) in second experiment. But there was no significant difference ($p>0.05$) in protein level of fish meat among treatments in both experiments.

Effect of different starter feed on the survival rate and growth of African catfish (*Clarias gariepinus*) fry

Shrestha RK, MA Husen, B Shrestha and SK Wagle (2007). Effect of different starter feed on the survival rate and growth of African catfish (*Clarias gariepinus*) fry. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, June 25-27, 2007, pp 86-90

Formulation of the most desirable feeds which satisfy the nutritional requirement of catfish (*Clarias gariepinus*) larvae is one of major task in development of aquaculture packages of practices of the catfish. To evaluate the effect of live food organisms and several feed formulation on the survival and growth of catfish larvae experiments were carried out. Treatments for starter feed includes zooplankton and artemia naupli as live food organisms and carp micro-feed (formulated ration) were fed to the experimental catfish larvae. The growth of catfish larvae was significantly ($P<0.05$) higher in zooplankton fed condition. The mean final weight attained by catfish larvae was 197.3mg and 126.7mg, respectively, feeding with zooplankton and *Artemia naupli*. The mean survival rate for *C. gariepinus* fry fed on zooplankton and *Artemia naupli* at the end of 4 weeks experiment was 53.3% and 56.8%, respectively. Absolute mortality was evidenced for larvae fed under carp micro-feed. An increased zooplankton density in nursing water (423 to 1268/L) did not influence ($P>0.05$) the growth of larvae. Larval growth was significantly ($P<0.05$) increased at increasing density (604 to 1813/L of *Artemia naupli* in nursing water. Survival rate of larvae was found to decrease as the feeding rate of *Artemia naupli* increased while zooplankton fed larvae showed increased survival rate (77.0 to 82.0%) in response to increase in feeding rate.

Rainbow trout (*Oncorhynchus mykiss*) nutrition and feed formulation in Nepal

Bista JD, SK Wagle, N Pradhan and NK Roy (2008). Rainbow trout (*Oncorhynchus mykiss*) nutrition and feed formulation in Nepal, *Proceedings of 1st National Workshop on Scaling-up of rainbow trout (Oncorhynchus mykiss) Farming Strategies in Nepal*", Organizers: NARC, JICA, Department of Agriculture (DOA), NEFIS, pp 23-40

Rainbow trout (*Oncorhynchus mykiss*) was introduced in Nepal to meet many needs including use of vast cold-water resources for aquaculture in mountain region of the country and import substitution of high valued fish. Technological packages of trout farming in prevailing ecological condition have been developed and efforts are being made for up scaling of the technology among farming communities. Despite of huge potential exist for the development of trout farming in cold-water region of the country, feed supply could be major constraints hindering rapid expansion. Supply of nutritionally rich feed could play central and essential role in the sustained development of trout aquaculture and, therefore, feed resources continue to dominate its aquaculture needs. This paper reviewed a number of specific issues in the fields of trout nutrition and feed formulation which were critical for sustainable trout production in Nepal. For example, nutrient requirements of trout and their supply under practical farming conditions, availability and supply of feed resources and their implication on development of trout feeds, and maintenance of environmental quality and sustainability of trout aquaculture systems. Fishmeal and shrimp meal are an essential component in the diet of trout. In view of the increasing cost and relative scarcity of these feed stuffs, a considerable research effort has been expanded in the country on evaluating the suitability of plant ingredients as complete or partial replacement of the fishmeal components in trout diet. A review of selected research literatures on investigations into the use of plant feedstuffs in trout feed indicated that it is possible to utilize processed soybean meal at high level (up to 60%) in trout diet without impairing growth and environment. Dietary formulations, based on the use of high inclusion levels of locally available and known quality ingredients were recommended for use within two

distinct feed lines, namely starter, and fingerling and production diets. Emphasis has been placed on larval nutrition and need for refinement and improvement of buff liver to increase feed efficiency. Production and nutritional data of most of the locally available feed stuffs, which could be utilized in the formulation of trout feeds were updated and methods of enhancing the nutritive value of these feed stuffs were also presented. Practical suggestions were given for the use of grain and other by-products in the formulation and processing of trout feeds for small fish farms. Feedstuffs may show wide fluctuations in their composition due to seasonal and geographic variations, and formulations should be modified accordingly.

Recovery of Gardi (*Labeo dero*) fry in Hapa nursing with and without supplementary feeding

Prasad S, JD Bista, RP Dhakal, DR Acharya, A Hussain and AP Nepal (2010). Recovery of Gardi (*Labeo dero*) fry in Hapa nursing with and without supplementary feeding. *Proceedings of the 8th National Workshop on Livestock and Fisheries Research in Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

Gardi (*Labeo dero*) is one of the important indigenous fish species found in several river systems of Nepal. Recent success of mass scale seed production technology of this species has shown it's potentially to be included as aquaculture species. However, low recovery during nursing in ponds from hatchling to fry stage constrains adoption for its commercial scale farming. Therefore, a new technology was required to reduce the mortality and increase the recovery rate of gardi hatchlings. To find out the possibility if the recovery rate of hatchlings could be enhanced or not the present study with supplementary feed versus natural food developed into pond by fertilization was tested from July to September 2009 at Fisheries Research Center, Pokhara. Gardi hatchlings were stocked at density 100 larvae m^{-2} in six experimental hapa (2.0 m^3) fixed in pond. To develop natural foods, ponds were fortnightly fertilized with 12.8 kg $N.ha^{-1}$ and 9.2 kg $P.ha^{-1}$ by urea and Di-ammonium phosphate, respectively. Micro feed was provided 3 times a day. Weekly water quality parameters showed that water temperature ranged from 27.4-29.0 ^{0}C, pH from 7.0-9.1, dissolve oxygen level from 6.0-9.1 and chlorophyll-$_a$ concentration from 1.0-8.0 mg/m^3. The phytoplankton abundance ranged from 5200-12103 cells/ml and zooplankton density ranged from 2-1728 no/L. The results revealed that fry under continuous feeding with supplementary feed demonstrated significantly ($P<0.05$) higher recovery (92.03%) and net weight gain (0.78g) compared to recovery (69.33 %) and growth (0.47 g) of fish raised on natural food in 70 days nursing period. This successful nursing technology would help availability of increasing number of fry in future for its commercialization.

Raw material, storage, equipment and accessories for trout (*Oncorhynchus mykiss*) feed preparation in private sector in Nepal

Dhital RR and NK Roy (2008). Raw material, storage, equipment and accessories for trout (*Oncorhynchus mykiss*) feed preparation in private sector in Nepal. *Proceedings of 1st National Workshop on Scaling-up of rainbow trout (Oncorhynchus mykiss) Farming Strategies in Nepal*", Organizers: NARC, JICA, Department of Agriculture (DOA), NEFIS, Pp 41-45

Small scale aquaculture of Rainbow trout (*Oncorhynchus mykiss*) has been initiated by farmers in close collaboration with researchers in hills and mountains of Nepal. As a part of trout farming packages, formulation, preparation, and storage of feeds for trout have been disseminated among the farmers. The management of trout feed became one of the important steps for maintaining consistent feed quality and trout production. Therefore, to evaluate the status of raw feed quality, preparation, formulation, equipment and accessories used in private sector a survey was conducted. The survey result showed that the raw materials used were almost common among the farmers. The level of crude protein in dry feed using the local pellet

machine was about 33%, almost equals to the feed required to trout for table purpose. The calculated production cost of one kilogram feed was about 40.24 Nepalese Rupees. Though, farmers do not store ready pellet feed more than 2-3 days, however, storage facilities for raw material and pellet feed needs further improvement. The feed management by trout growers was an innovative achievement in Nepal, implying positive achievement for scaling up of trout farming in hills and mountains. We recommend for maintaining consistency in quality of feed ingredients, formulation, quality storage facilities for sustainability of trout farming. Furthermore, the farmers should be trained to enhance their skill in feed preparation time to time on management and quality of feed for high quality trout production.

6.3 Breeding

Influence of breeding periods on hatchability of Asla

Joshi Pl, M Igarashi and AP Nepal (1996). Influence of breeding periods on hatchability of Asala. *Proceedings of the first National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, 7-9 May, 1996, pp98-103

During 1992/93 and 1993/94 Asala (*Schizothorax plagiostomus*) were manually striped in two consecutive breeding periods: October/November and February/March at Fisheries Research Centre, Trishuli, Nuwakot. The females were checked for rapines once a week in the first fiscal year and after every 3-4 days in the second fiscal year. Female broods spawned in October/November and in February/March. No spawning occurred in December and January. The survival rate from egg to hatching was higher (>50%) in October/November and lower (<25%) in February/March. Hatching time ranged from 10-12 days based on temperature variation which varied from 11-16^{0}C. Mean fecundity/kg body weight of fish was about 12000 eggs.

Spawning behavior of Sahar *Tor putitora*

Basnyat SR, GP Lamsal and AP Nepal (1999). Spawning behavior of Sahar *Tor putitora. Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, pp 85-89

Sahar is well known as a game fish and an indigenous fish species. Its population is declining in natural water bodies of the country year by year because of overfishing, electrocuting, poisoning and degradation of aquatic environment. Development of seed production technology of this species is essential to restore its population abundance in natural water resources and to explore the possibility of high value commercial fish farming. With this in view, Broods of Sahar from the wild stock have been reared in the earthen ponds at Agricultue Research Station (Fish), Trishuli, Nuwakot since 1989 to study their spawning behavior. Spawner had spawned off and on in the past. However, they did not spawn every year. As usual spawners were checked weekly from March to May, the first spawning period of Sahar. Altogether 11 spawners out of 20 with an average weight of 4.0-6.0 kg were subjected to hand stripping. Collectively 189610 eggs were released by the spawners. The average fecundity per kg body weight of the female was nearly 3100 eggs. Fertility was excellent over 90% and hatchability remained 81 percent. Eggs, ranging from 2.25 to 2.80 mm in diameter, hatched out 60-80 hours after being incubated at temperature ranged from 19.5 to 20.4 ^{0}c.

Hatchary breeding of Sighi (*Heteropneustes fossilis*) in Neapl

Yadav CNR and AN Bart (2001). Hatchary breeding of Sighi (*Heteropneustes fossilis*) in Neapl. *Proceedings of the 4th National Animal Science Convention*, Kathmandu, Nov 29 to Dec 1, 2000, pp 167-178

Singhi was spawned successfully at the first time using artificial and semi artificial breeding method in Nepal. Artificial method was involved hormonal inducement, stripping of eggs from females and fertilized with milt from sacrificed males. Semi artificial method involved by inducing single dose of pituitary gland, HCG and GnRHA hormones for female only. Pituitary gland resulted the highest number of fry production (mean 671) ($p<0.05$) in semi artificial breeding method among the three hormonal treatments followed by GnRHA implant producing fry with the mean value of 419. These fish seemed to be seasonal breeders and the latency period was 14 hrs at 27-29^{0}C in pituirary gland and HCG hormones treated females, and 21 hrs in GnRHA treated females. The incubation period was about 26 hrs in 27-29^{0}C for the eggs obtained from pituirary gland and HCG treated females, and 20-24 hrs for the eggs obtained from GnRHA treated females. Semi artificial breeding using pituirary gland or GnRHA was expected to be more reliable and successful propagation in hatchery condition for commercial seed production of Singhi in the Nepalese context.

Breeding observation of Gold fish (*Carassius auratus)*

Bajracharya K, PL Joshi, A Rayamajhi and D KC (2002). Breeding observation of Gold fish (*Carassius auratus). Proceedings of the 5th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 10-11 July, 2002, pp51-55

The spawning behavior of gold fish (*Carassius auratus*) was studied from February to July 2000 in natural condition. Gold fish produced their young ones from 29 February to 16 May 2000. Egg fertility was observed from 76% to 87.5% and the hatchibility was observed from 71% to 80%. A total of 499 offspring were resulted at seven batches. About 91% small size fries were lost out of 499 individuals.

Breeding behavior of Sahar (*Tor putitora)*

Nepal AP, SR Basnyat and GP Lamsal (2002). Breeding behavior of sahar, *Tor putitora. Proceedings of the 5th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 10-11 July, 2002, pp69-75

Broods of Sahar from the wild stock have been rearing in the earthen ponds at Fisheries Research Station (FRS), Trishuli, Nuwakot since 1989 to domesticate and study their spawning behaviour. Spawner had spawned off and on in the past. However, they have spawned every year for these 3-4 years period. Some F_1 brood of Sahar produced at Station, which were the offspring of wild collection brood also started to spawn since 2000. As usual spawner was checked weekly from March to May, the early spawning period and from October to November as the late spawning period of Sahar. Altogether 11 spawner with an average weight of 4.5-6.0 kg in 1998/99, 5 spawner with an average weight of 6.6-7.5 kg in 1999/2000 and 6 spawner in 2000/01 with an average weight of 2.2-4.3 kg was subjected to hand stripping. The spawner released collectively 189610, 138950 and 92945 eggs in 1998/99, 1999/2000 and 2000/01, respectively. The average fecundity (eggs per kg of body weight) of the female was nearly 1000 to 6000 eggs. Fertility was good over 80% and hatchibility remained more than 66%. Eggs, with average diameter 2.0 to 2.9 mm hatched out after 84 - 125 hours of total incubation period at temperature ranged from 19 to 22ºC.

Study on survival and growth of hatchling to fry of carps

Srivastav KK (2002). Study on survival and growth of hatchling to fry of carps. *Proceedings of the 5th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 10-11 July, 2002, pp76-78

The experiment was carried out with 3 to 5 days old hatchlings of carps Silver carp (*Hypopthalmichthys molitrix*), Big head carp (*Aristichthys nobilis*) and Rohu (*Labeo rohita*) at Parwaipur fish farm in 2000. The stocking density of hatchlings ranged 2-3 millions/ha. For the experiment nursery ponds were well dried, and malalthion was used to eradicate large zooplankton as these could caused higher mortality of fragile larvae. The mean recovery was 42.27 and 49.9%, respectively for the fish fry fed on 20 and 25 crude protein content feed. The variation appeared in the percent recovery among different species of fish was higher than the effect of different level of crude protein content feed and stocking density on the survival of fish fry. The similar pattern of growth of fish fry was found in the both 20 and 25% crude protein content.

Brood fish management status and suggestions to control inbreeding in carp hatcheries

Wagle SK and N Pradhan (2003). Broodfish management status and suggestions to control inbreeding inCarp hatcheries. *Proceedings of 2nd SAS-N Convention*, Kathmandu, 30 July - 1 Aug 2003

Carp polyculture in Nepal is entirely dependent on the seeds produced from fish hatcheries scattered throughout the Terai region of the country. Over sixty hatcheries established in the private and public sector has been breeding four exotic and three native fish species. Induced spawning of both the exotic and native carp by hypophysation has been practiced extensively since early 1980's. At present, all hatcheries function as isolated genetically closed units raising their own stock of breeders and producing fish seed for distribution to grow-out areas. There was growing concern that hatch stock may be deteriorated due to poor broodstock management and inbreeding depression. Poor reproductive performance, retarted growth and morphological deformaties of hatchery produced seeds have been unsubstantially claimed. In this paper, effective population size (Ne) and the rate of inbreeding (ΔF) have been estimated on the basis of numbers of new individual recruited as broodstock each year and the variance of their reproductive success. The study was based on the data collected for 1999 to 2001 from 3 hatcheries representing broodstock management in Terai and mid hill region of the country. Effective population size ranges from as low as 2 to a maximum of 31, and the rate of inbreeding from 1.6% to 27.6% per year. Rapid inbreeding of hatchery stocks of the carp was apparent. Possible ways to control accumulation of further inbreeding in hatchery stock has been suggested.

Cryopreservation and its implication for fish seed production

Basnet SR, G P Lamsal and AP Nepal (2003). Cryopreservation and its implication for fish seed production. *Proceedings of 2nd SAS-N Convention*, Kathmandu, 30 July - 1 Aug 2003, pp 198-204

The present study describes a method for cryopreservation of milt of carps, indigenous Sahar (*Tor putitora*) and Rainbow trout (*Onchorynchus mykiss*) for a period of 2-4 days. For collection of milt healthy and robust male with best characteristic were selected, wiped with clean and soft cloth. The milt was collected by stripping the belly. The milt was diluted in the cold extender in a ratio of 1:4 (milt: extender) then transferred into 0.5 ml straws (French straw) in a beaker and kept into refrigerator. The preserved cryomilt was thawed after 2nd, 3rd and 4th day in warm water bath at a different temperature ranging from 15±1ºC to 38±1ºC. The sperm motility ranged 35-60%. There was no significant ($p<0.05$) difference among the media and

sperm motility till 4 days. However, among the media ''A'' and ''B'' showed slightly better result than media ''C'' in the experiment. The main objective of cryopreservation was to develop the storage technique that could help the fish breeding by which selective breedingcan be under taken for improvement of the indigenous stock.

Response to selection for body weight of walking catfish *(Clarias macrocephalus Günther)* after two generations of bidirectional mass selection

Wagle, SK and U Na-Nakorn (2003). Response to selection for body weight of walking catfish, *Clarias macrocephalus* (Gunther) after two generations of bidirectional mass selection. *Journal of Institute of Agriculture and Animal Science (IAAS),* Rampur, Chitawan*,* **24**: 67-74

A study was conducted on divergent lines of walking catfish (*Clarias macrocephalus*) to assess the response to mass selection for body weight at Kasetsart University, Thailand. Brood *C. macrocephalus* used in this experiment were seventh generation progeny of a base population originating from random mating of six natural populations. Mass selection for body weight was performed at 10 month of age in the high and low line directions. Fifty pairs of F_2 selected brooders from the two divergent lines were individual-mated to produce second generation offspring. Fish were reared in indoor tanks for 7 weeks and in cages for 26 weeks thereafter to determine response to bidirectional selection for body weight. Significant divergence in body weight and length of the low and high line occurred at 29 and 33 weeks of age. Response to selection for body weight, measured as the half of the divergence between low and high line, after two generations was 4.16g (4.16%) and 3.19g (3.4%) at 29 and 33 weeks of age, respectively. Total length difference between the high and a low line was 0.35 cm (1.64%) at 33 weeks of age. Differences in selection differential between divergent lines could have underestimated response in one direction and generated asymmetry in response between selected lines.

Broodfish management status and suggestions to control inbreeding in carp hatcheries in Nepal

Wagle, SK and N Pradhan (2004). Brood fish management status and suggestions to control inbreeding in carp hatcheries in Nepal. *Proceedings of 2nd SAS Convension on Agricultural Research for Enhancing Livelihood of Nepalese People*. Society of Agricultural Scientists-Nepal (SAS-N), pp 398-411

Carp polyculture in Nepal is entirely dependent on the seeds produced from fish hatcheries scattered throughout the Terai region of the country. Over sixty hatcheries established in the private and public sector has been breeding four exotic and three native fish species. Induced spawning of both the exotic and native carp by hypophysation has been practiced extensively since early 1980's. At present, all hatcheries function as isolated genetically closed units raising their own stock of breeders and producing fish seed for distribution to grow-out areas. There is growing concern that hatch stock may be deteriorated due to poor broodstock management and inbreeding depression. Poor reproductive performance, retarted growth and morphological deformaties of hatchery produced seeds have been unsubstantially claimed. In this paper, effective population size (N_e) and the rate of inbreeding (ΔF) have been estimated on the basis of numbers of new individual recruited as broodstock each year and the variance of their reproductive success. The study was based on the data collected for 1999 to 2001 from 3 hatcheries representing broodstock management in Terai and mid hill region of the country. Effective population size ranged from as low as 2 to a maximum of 31, and the rate of inbreeding from 1.6% to 27.6% per year. Rapid inbreeding of hatchery stocks of the carp was apparent. Possible ways to control accumulation of further inbreeding in hatchery stock has been suggested.

Semi-natural breeding of Asian catfish, *Clarias batrachus* (Magur) without sacrificing male

Gurung TB, JD Bista and B Shrestha (2004). Semi-natural breeding of Asian catfish, *Clarias batrachus* (Magur) without sacrificing male. *Proceedings of the 5th National Animal Science Convention (NASA),* Kathmandu, Nepal, Oct 15-16, 2003, pp 99-104

Collection of adult *Clarias batrachus*, Asian catfish from wild and reared in small experimental ponds for breeding in June 2002 and July 2003 when water temperature was about 28-30^{0}C. Healthy, gravid and ripe female with protruded bellies of about 120 to 200g were selected for breeding. Males of almost similar size were also selected from the rearing ponds. The female and male were injected with 0.5 ml per kg body weight of "Ovaprim" hormone. These treated broods were released into a small cement tank of approximately 1m^2 sizes, where water depth was maintained 30-40 cm along with "spawning bed" made up of coconut coir at the bottom surface. On these spawning beds the treated brood spawned after 10-15 hours. Since the breeding was semi-natural, therefore, males were not sacrificed to obtain their milt. The eggs attached in corners of the choirs hatch out within 24 hours. The fertility rate, hatching rate ranged from 50-70%, and 70-80%, respectively. This method was successful to breed the same brood continuously for 2-years at Fisheries Research Station ,Pokhara.

Induced spawning and fry rearing of African catfish (*Clarias gariepinus)*

Basnet SR, GP Lamsal, AP Nepal and SK Shrestha (2004). Induced spawning and fry rearing of African catfish (*Clarias gariepinus). Proceedings of the 5th National Animal Science Convention (NASA*), Kathmandu, Nepal, Oct 15-16, 2003, pp 75-80

Induced breeding and fry rearing of *Clarias gariepinus* were carried out in Fisheries Research Centre, Trishuli, Nuwakot. Matured brood of 3-5 years old of 0.6–3.9 kg size were used for spawning. Total 344250 matured green eggs were collected from 14 females and fertilized eggs with milt from 27 males. Rate of fertilization was 95% and hatchability was 59%. Hatched out fry became into swimming stage by 46%. The swimming stage fries fed with three different diets. The fries fed with zooplankton had the highest survival rate (61%) followed by fries fed with zooplankton plus 35% CP containing diet (57%) and fries fed with 35% CP diet (1.7%), respectively. The result showed that the fry survival rate of *Clarias gariepinus* fed with 35% CP containing diet was significantly lower ($P<0.05$) than fries fed with zooplankton and zooplankton plus 35% CP containing diet, but no significant difference ($P>0.05$) between the fries fed with zooplankton and zooplankton plus 35% CP containing diet.

Artificail breeding, hatchability, alevin rearing of cold water fish Rainbow Trout in Nepal

Basnet SR, GP Lamsal and AP Nepal (2006). Artificail breeding, hatchability, alevin rearing of cold water fish Rainbow Trout in Nepal. *Proceedings of the 6th National Workshop on Livesticok and Fisheries Research in Nepal*, Khumaltar, Laitpur, 1-2 July, 2004, pp 203-211

The breeding of Rainbow trout at Fisheries Research Sation, Trishuli, Nuwakot was carried out from November to January. The brood fish used for spawning were about 1^+ to 2^+ years old. Brood fish were fed with 35% crude protein pellet feed. Number of female used were 341, 231 and 374 of 1^+ year old and 96, 114 and 81 of 2^+ years in 1997/98, 1998/99 and 1999/00, respectively. The average hatchability was recorded from 13.9% to 36.8% from 1^+ and froom 9.9% to 29.5% in 2^+ years old. The better hatchability ocuured from 1^+ group than 2^+ groups. Out of total hatched alevins, abnormally remained almost same from both groups. Mortality of alevin was slightly higher in 2^+ groups than 1^+ age group before swimming stage. Poor

hatchability may be due to the poor brood fish management and or the presence of silt in the water used for egg incubation.

Current breeding status of giant fresh water Prawn (*Macrobrachium rosenbergii*) De man in Nepal

Thapa AB, KP Gautam and PK Sah (2006). Current breeding status of giant fresh water Prawn (*Macrobrachium rosenbergii*) De man in Nepal. *Proceedings of the 6th National Workshop on Livesticok and Fisheries Research in Nepal*, Khumaltar, Laitpur, 1-2 July, 2004, pp 212-215

Breeding of fresh water Prawn succeeded in Regional Agricultural Research Station, Tarahara. Fresh water Prawn needs brackish water to complete their ecdysis but juveniles can be cultures in fresh water. For brackish water supply, aqua salt with dissolving fresh water at 10 ppt was used. When Prawn larvae were reared in this salt by feeding on brine shrimp nuapli, an average 75% survivability of Prawn larvae could be obtained. The post larvae were distributed for rearing in polyculture fish farming. Efforts are needed for large number of post larvae production and management.

Potential of genetics for aquaculture development in Nepal

Wagle, SK and N Pradhan (2006). Potential of genetics for aquaculture development in Nepal. *Proceedings of 4th National Conference on Science and Technology,* Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, Nepal, pp 266-280

Aquaculture in Nepal is fairly insignificant by world standard. Higher mortality, poor growth of cultured carps led to the conclusion that the deterioration of hatchery stocks through inbreeding, negative selection and unplanned breeding scheme may have contributed to this problem. The application of genetics can play an important role in efforts to increase aquaculture production in Nepal through methods such as selective breeding, hybridization and polyploidy. Aquaculture in Nepal revolves the cultivation of native and exotic carps. Exotic carps have been introduced successfully into the country mainly for increasing aquaculture production. Although records on the real impacts to the natural ecosystem from the introduced species are scarce, some of the introduction may have detrimental effects on the native species, particularly catfish flock. Issues pertaining to possible future introductions are discussed. Development of domestication program for indigenous species to relieve pressure on wild stock and to commercial production through selective and crossbreeding will also require the inclusion of appropriate genetic variation in the broodstock population. The need for the characterization of genetic structure of stock for the conservation of biological diversity in aquaculture and in the wild is suggested. Use of genetically improved fish from indigenous species is recommended, since this is probably an environmentally safer means of addressing the aquaculture productivity shortcomings and is less likely to impact biodiversity or genetic diversity compared to exotic species. Other issues that need to be addressed are limited genetic research facilities, funding, human capacity and suitable indigenous species for aquaculture.

Preliminary results on the hybridization between African catfish (*Clarias gariepinus*) and Asian catfish (*Clarias batrachus*)

Wagle, SK, AP Baidya, B Shrestha and MA Husen (2007). Preliminary results on the hybridization between African catfish (*Clarias gariepinus*) and Asian catfish (*Clarias batrachus*). *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*. Khumaltar, Lalitpur, Nepal, pp 27-35

Fish species diversity seems to be one of the most important constituent to intensify the current aquaculture production system in Nepal, since the productivity of ponds with

planktivorous carp species reached a plateau. Catfish are more productive in the tropics because of their ability to withstand and grow continuously in adverse environment and intensive system. Asian catfish (*Clarias batrachus*) is native to Nepal and posses high economic value. Improvement in *C. batrachus* was essential before its introduction in aquaculture system, because slow growth, low production and diseases susceptibility associated with this species. The present study was undertaken for stock improvement of Asian catfish (*C. batrachus*) through hybridization with informally introduced African catfish (*C. gariepinus*). Hybrid was produced through cross breeding between *C. gariepinus*♀ and *C. batrachus* ♂. Heterosis could not be compared between F1 hybrids because of poor gamatic viability of the cross between *C. batrachus*♀ and *C. gariepinus* ♂. Hybrid was compared at different stages from larval to market size with its respective control sibs. The average performance traits (viz. fertility, hatching rate, growth and survival) of individuals derived from cross between *C. gariepinus*♀ and *C. batrachus* ♂ was significantly better than its one of the control sib (*C. batrachus*). Hybrid showed high rate (31.5%) of deformity and abnormality in larval stage before the start of exogenous feeding and deformity extend until maturity. Significant divergence in morph type resembling to both of their parents and corresponding growth was found in hybrid population. As the hybrid showed heterotic in growth performance trait, it might have important implication for the aquaculture industry.

Nursery practices of hatchery bred riverine Gardi (*Labeo dero*) in captive environment in mid hill valley and river basin

Prasad S (2007). Nursery practices of hatchery bred riverine Gardi (*Labeo dero*) in captive environment in mid hill valley and river basin. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, June 25-27, 2007, pp 45-48

Gardi (*Labeo dero*) is one of the economically important indigenous fish. Recently, mass seed production hatchery technology of this species has been developed. However, their nursing technology for fry production has yet to be established. Therefore, to develop appropriate nursing methodology for Gardi experiment were performed in cemented ponds in 2003 to 2004, respectively. For the experiments, 3-4 days old larvae were obtained from captive breeding. The cement cisterns were prepared as per methods applied for commercial carps with fertilization in Pokhara and Kali Gandaki. The larval density in both places was maintained at the rate of 3.0 million/ha. The larvae were fed with sieved pellet feed containing approximately 30 % of crude protein. Water temperature ranged in ponds ranged from 24.0 to 27.8^{o}C during study period. The fry from were harvested after 90 days with a survival rate of 24.1% and 10.3%, respectively in Kali Gandaki and Pokhara, respectively. Mean final weight (4.05±0.25 g) of fry in Pokhara was significantly higher ($P<0.05$) than the final weight (2.50±0.19g) of fry measured in Kali Gandaki. This difference was probably associated with natural food availability to larvae because survival rate of fry in Pokhara was higher in Kali Gandaki than in Pokhara. This study suggests that nursing practices of Gardi could possibly be achieved through adopting the methods implied for commercial carp species.

Domestication and breeding status of some native fishes in Nepal

Baidya AP, JD Bista and TB Gurung (2008). Domestication and breeding status of some native fishes in Nepal. *Proceedings of the Workshop Indigenous Fish Stock and Livelihood in Nepal*, 5 June, 2008

The growth, reproduction, cares and feeding of domesticated organisms are more or less controlled by man. At sex maturation, some fish can spawn spontaneously in captivity, but

some fish will spawn if properly induced under controlled conditions. A total of 187 native fish species are reported in different rivers and other water bodies of Nepal. Among these species, the economically important native fish species are Sahar, *Tor* spp.; Katle, *Neolissocheilus hexagonolepis*; Asala, *Schizothorax* spp.; *Schizothoraichthys* spp.; Gardi, *Labeo dero*; Hade, *L. pangusia*; Thend *L. angra*; Jalkapur, *Clupisoma garua*; *Pseudeotropius murius*; etc. The population of native fishes is declining in their natural habitat due to over fishing, damming, degradation of the aquatic environment and biological changes in the ecosystem. Developments of captive breeding and culture techniques are the means for conservation and promotion of a sustainable population of native fishes. Breeding technology of some native fishes such as Sahar, *T. putitora*; Katle, Asala, *S. plagiostomus* and Gardi have been developed in Nepal after many years of study. Preliminary observation on induced breeding of some native fish species resulted in successful breeding of Hade, Thend, Lahare, *Garra annandelai*; Buduna, *G. gotyla* and Baghi, *Botia lohachata* last year in Kali Gandaki Fish Hatchery after few years of domestication of these species. The objective of this paper was to evaluate the present status of domestication and breeding of some native fish species. The paper is documented based on the compilation of the past works and experiences gained and from the information cited in literatures.

Indigenous fishes and their contribution in rural livelihoods in Nepal

Wagle SK and TB Gurung (2008). Indigenous fishes and their contribution in rural livelihoods in Nepal. *Proceedings of the Workshop Indigenous Fish Stock and Livelihood in Nepal*, 5 June, 2008

Inland water resources of Nepal harbor 187 indigenous fish species of food, sport and ornamental value. Capture fisheries comprised mostly of indigenous fish contributes approximately 43% of the national fish production. Twenty of the 103 ethnic/caste community of Nepal are largely depends on aquatic and fisheries resources for sustaining livelihoods. As common property resources, to which access is open to all, fisheries provide households a means for diversifying their subsistence and income-generating activities, optimizing their labor resources during different seasons, and "insuring" against the risks of agricultural failures. Moreover, people with no land, little money for capital investments, and few alternative livelihood opportunities can still often fish for subsistence. Nepal's aquatic and fisheries resources not only provide a foundation for food security, income, and employment for most of the wetland dependent population, but also an essential "safety net" for the rural poor. Illegal and unsustainable harvests of indigenous fish and a growing rural population have resulted in a reduction in the productive value of fisheries. Information is provided on fish production, the importance of indigenous fish to rural livelihoods, the status and challenges of fisheries management and cross-sector impacts to fisheries. A number of potential areas for future research and development are suggested based on assessment of the needs.

A morphometric study on Mahseer (*Tor putitora*) from a mid-hill lake and rivers of Nepal

Wagle, SK, N Pradhan and AK Rai (2008). A morphometric study on mahseer (*Tor putitora*) from a mid-hill lake and rivers of Nepal. *Asian Fisheries Science* **21**:113-125

Mahseer or Sahar (*Tor putitora*, Cyprinidae), one of highly valued, mighty and giant freshwater fish of Transhimalayan regions, is distributed in all major river systems and mid hill lakes of Nepal. It has been hypothesized that differences between habitats (e.g. flow regime, foraging opportunities) might create selective pressures resulting in morphological divergence between intraspecific populations. Morphometric diversifica-tion between three river populations (Koshi, Trishuli, Kali Gandaki) and one Lake population (Phewa Lake) of mahseer was examined to identify intraspecific unit for enabling better management and perpetuation of the resources. Morphometric analysis showed that most of the shape variation among these populations occurs in the head region, body depth and fin length. Lake population of mahseer

was found to diverge most from river populations. The characters that best discriminated the river and Lake population of mahseer were associated with locomotion patterns and foraging behavior of fish. The mahseer may be phenotypically plastic in response to the environmental conditions of the habitat of each population.

Allozyme marker based genetic variation assessment of mahseer (*Tor putitora*) from riverine and lacustrine environment

Pradhan N, SK Wagle and TB Gurung (2009). Allozyme marker based genetic variation assessment of mahseer (*Tor putitora*) from riverine and lacustrine environment. *The 10th International SAymphosium on Genetic in Acquaculture, "Roles of Acquaculture Genetics in Addressing Global Food Crisis*, Bangkok, Thailand, 22-26 June, 2009

This study was conducted to quantify genetic variation within and between natural populations of mahseer, *Tor putitora*, an economically important fish for food and sport value. Altogether, 152 samples were collected from glacial fed three rivers: Kali Gandaki, Trishuli and Koshi; and Lake: Phewa. Seven enzyme systems were analyzed and resulted in 11 loci being resolved that include five polymorphic loci. Most riverine populations confirmed to Hardy-Weinberg equilibrium (P>0.01) after Bonferroni correction, except population from Trishuli. Our study showed that the natural population of mahseer had relatively low average number of alleles per locus which were between 1.54-2.27 (averaged 1.79), percentage of polymorphic loci (45.45%). Observed and expected heterozygosity were relatively high (H_o= 0.179-0.323, averaged 0.239; H_e = 0.204-0.372, averaged 0.247). The mean F_{ST} value was 0.0465 indicating little genetic differentiation among 4 population of mahseer and 5% of total genetic variation was distributed between populations, whereas 95% of the variation within populations. The Nei's genetic distance, ranged from 0.0083 to 0.0379 falls within the range of conspecific. Low genetic variation between populations of mahseer observed in this study suggests that translocation and restocking of mahseer between these water bodies and their tributaries for rehabilitation purpose seems possible. Deviation from Hardy-Weinberg equilibrium warrants that some regulatory mechanisms need to be imposed to improve the effective population size (N_e) of mahseer in Trishuli River.

Participatory hapa spaning of indigenous *Labeo spp* in stagnant water of Rupa Lake, Pokhara

Prasad S, JD Bista, AP Nepal, BK Shrestha and TB Gurung (2010). Participatory hapa spaning of indigenous *Labeo spp* in stagnant water of Rupa Lake, Pokhara. *Proceedings of the 9th National Outreach Workshop*, Khumaltar, Lalitpur, 7-8 June, 2010pp 366-371

Rupa is the biggest Lake of Pokhara valley. Open water fishery under cooperative management through stock enhancement is a major source of biodiversity conservation, Lake restoration and livelihood enhancement of local community. However, the major impediment to trap the potential productivity from these resources is the inadequate supply of fish seed as major production input. Therefore, this study was conducted for capacity building of cooperatives members in fish seed production technology suited to farmer's local condition. Reproduction of indigenous species Rohu (*Labeo rohita*) and Gardi (*Labeo dero*) was performed in hapa fixed in marginal area of stagnant water into lake after hormonal injection for spawning. Rohu spawned naturally while Gardi were stripped. Results showed that average fecundity, fertilization rate and hatching percentage in Rohu was 121.404±19.779 eggs/kg female, 59.75±4.6% and 69.5%, respectively whereas it was 167.117±85.883 eggs/kg female, 58.8±4.9% and 40.4% in Gardi at water temperature range of 27-31^{0}C. The survival percentage after 30 days from hatching to fry was 58.1% in Rohu and 15.8% in Gardi. The successful breeding would help cooperative for self sustainability in seed supply for stock enhancement.

Genetic variation of Mahseer (*Tor putitora*) populations from hatchery, lake and rivers of Nepal

Pradan N, SK Waggle and TB Gurung (2010). Genetic variation of Mahseer (*Tor putitora*) populations from hatchery, lake and rivers of Nepal. *Proceedings of the 8th National Workshop on Livestock and Fisheries Research in Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

This study was carried out to quantify genetic variation within and among natural and hatchery populations of mahseer, *Tor putitora,* which are an economically important food as well as game fish of Trans-Himalayan Region. Four natural populations from Kali Gandaki river, Koshi river, Trishuli river and Phewa Lake of Nepal and two hatchery populations of mahseer derived from wild population of Phewa Lake were collected for genetic variation study. Analyses of five polymorphic allozyme loci in populations of mahseer, *T. putitora* from a mid hill lake, three glacial fed rivers and two consecutive generations in a hatchery showed that all populations conformed to Hardy-Weinberg equilibrium (P>0.01), except the Trishuli River population. Observed heterozygosity (average H_o=0.119±0.143) and the average number of alleles per locus (average A=1.45±0.181) in the hatchery populations was less than that in lake and river populations (H_o=0.239±0.063; A=1.79±0.90). The alleles *EST-2*74*, *IDH*70* and *GDH*33,* present in the wild populations, were absent from both hatchery generations suggesting the founders (20-30 individuals) of the hatchery populations represented bottlenecks of very small N_e. These results indicated that larger numbers of breeders and controlled mating are needed to ensure retaining large genetic variation.

Induced spawning of Catfish (*Clarias batrachus, Linn)* and *Glarias gariepinus:* effect of various latency periods on spawning performance and egg quality

Wagle SK, AP Baidya, A Husen, B Shrestha (2010). Induced spawning of catfish (*Clarias batrachus, Linn)* and *Glarias gariepinus:* effect of various latency periods on spawning performance and egg quality. *Proceedings of the 8th National Workshop on Livestock and Fisheries Research in Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

This study observed the total output of strippable eggs and fertilization rates of eggs of Asian catfish (*Clarias batrachus*) and African catfish (*Clarias gariepinus*) stripped at 8 to 16 h and 7 to 11 h latency periods and corresponding 27 to 30 ^oC latency temperatures. Ovulation was induced by Ovaprim (SGnRHa in combination with domperidone) with a single dose of 0.5 ml/kg. The number of strippable eggs and fertilization percent of eggs in *C. batrachus* had significantly increased (P<0.05) with increase in latency period to 8-16 h at increasing temperature to 27-30 ^oC. The highest (P<0.05) number of eggs were stripped at 14-16 hrs of post injection of ovaprim at temperature between 28-30^{0}C. The highest (P<0.05) fertilization rate (80.2%) was observed when the females were stripped at 16 hrs latency followed by 28-30^{o}C temperature. The eggs of *C. batrachus* stripped at 8 hrs at 28-29^{o}C latency did not fertilize, and hence did not hatch. *C. gariepinus* significantly exhibit (P<0.05) the highest number of strippable eggs and fertilization percent of eggs in low latency period of 7-8 hrs at temperature 27-29 ^oC. The highest (P<0.05) number of eggs were stripped at 7 h of post injection of ovaprim at temperature between 27-29^{0}C. The highest (P<0.05) fertilization rate (94%) was observed when the females were stripped at 7 hrs latency period. Both egg numbers and fertilization rate of eggs of *C. gariepinus* significantly (P<0.05) decreased when stripped at 11 hrs latency corresponded by 28-30^{o}C. The latency period of 16 hrs at 28-30 ^oC and 7-8 hrs at 27-29^{o}C was found to be suitable to obtain good-quality eggs with high fertilization rate in *C. batrachus* and *C. griepinus*, respectively.

Breeding and production performance of genetically improved farmed Tilapia (GIFT, *Oreochromis niloticus*) in eastern Nepal

Thapa AB, KP Gautam, SK Shrestha, PK Sah and SN Mehta (2010). Breeding and production performance of genetically improved farmed Tilapia (GIFT, *Oreochromis niloticus*) in eastern Nepal**.** *Proceedings of the 8th National Workshop on Livestock and Fisheries Research in Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

Genetically improved farmed tilapia (GIFT, *Oreochromis niloticus*) is often promoted as alternative to carps aquaculture due to its wide range of aquatic environment, biological characteristics to adopt climate change and high productivity relative to normal Tilapia. Its aquaculture practices in wide scale require mass-scale seed production with all male population and assessment of productivity in local environment. With respect to these requirements, seed production study conducted at Tarahara during March to November (18-37ºC) revealed that GIFT Tilapia could produce 1500±300 eggs.kg/ha^{-1} female.month^{-1}. Day old fish larvae fed for 35 days with a starter ration treated with 17α-Methyl testosterone (MT) hormone resulted in about 95% masculized male fry. Masculized and normal mixed sex GIFT Tilapia were compared for their grow out performance in pond environment by stocking fingerling (10.0g) at density 2 fish.m^{-2} and following conventional pond management. The productivity obtained after 270 days of rearing was 6.5 Mt.ha^{-1} for masculized population followed by 3.0 Mt.ha^{-1} for normal mixed population of GIFT Tilapia. The Survival rate (75 to 80%) of fish at harvest was not significantly different (P>0.05) between masculized and mix sex population in grow out ponds.

Reproductive performance of domesticate Asala (*Schizothorax richardsonii)* in captive environment at Godavari, Lalitpur

Roy NK, ARaymajhi, N Pradhan and SK Wagle (2010). Reproductive performance of domesticate Asala (*Schizothorax richizothorax)* in captive environment at Godavari, Lalitpur**.** *Proceedings of the 8th National Workshop on Livestock and Fisheries Research in Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

Asala (*Schizothorax richardsonii*) is a locally preferred, economically important cold water indigenous fish which has aquaculture potential in cold water region of the country. The information on reproductive performance of Asala in controlled environment is scanty, which is essential to develop mass-scale seed production technology. Therefore, studies have been carried out to develop seed production technology of Asala in controlled environment. Wild stocks of Asala fry were collected from Nallu Stream (Lalitpur) and domesticated for two years in circular tanks at Fisheries Research Division, Godavari, Lalitpur. Asala matured sexually at two years of age at temperature between 10.0°C to 18.0°C. Monthly estimation of Gonado Somatic Index (GSI) revealed that the suitable breeding season for Asala lies between October to November with highest GSI of 32.9 to 37.9%. The mean fecundity estimated from hand stripped eggs was 2463 ±1192 eggs.kg^{-1} body weight of female. Average fertility, estimated after 12 hrs of incubation, was 52.8±17.9% for artificially inseminated eggs. Hatching took place after 165 hrs of incubation at 19^{o}C water temperature and the hatchability estimated was 5.2%.

Successful breeding of Goldfish (*Caratius auratius*) in Pokhara, Nepal

Shrestha RK, JD Bista and BK Shrestha (2010). Successful breeding of Goldfish (*Caratius auratius*) in Pokhara, Nepal. *Proceedings of the 8th National Workshop on Livestock and Fisheries Research in Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

Aquaria decoration has been gaining popularity in urban and per urban areas of Nepal. Most of the ornamental fish seed and related accessories including feed, drugs etc were imported from

aboard with expense of estimated about 25 million Nepalese Rupees per annum. Concerted efforts have been initiated to establish and develop seed production technology of exotic and native fish species with ornamental characteristics. Goldfish (*Caratius auratus*) is an exotic high value ornamental fish species, having high demand in Nepalese market in recent years. Attempts were made to reproduce this species in Fisheries Research Center, Pokhara with the purpose to substitute the import and promote the ornamental fisheries business in the country. Broods of Goldfish were reared in plastic tanks with supplying 35% crude protein content feed. First age of sexual maturity was obtained in 18 months of age. Ovaprim (gonadotropin hormone) at 0.5 $ml.kg^{-1}$ was found effective to ovulate the ripen eggs from the female. Fertility and hatchability of incubated eggs at 21ºC water temperature was 90% and 75%, respectively. Fry survival (30%) considered a low.

Spawning response of Sahar (*Tor putitora*) in different seasons under pond condition in Pokhara, Nepal

Bista JD, BK Shrestha, AP Nepal, S Prasad, AP Baidya, SK Wagle and TB Gerung (2010). Spawning response of Sahar (*Tor putitora*) in different seasons under pond condition in Pokhara, Nepal. *Proceedings of the 8th National Workshop on Livestock and Fisheries Research in Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

Studies on spawning response of Sahar (*Tor putitora*) in captive condition were conducted at Fisheries Research Centre, Pokhara from July 2009 to April 2010 to assess the appropriate breeding season and corresponding spawning success rate. Fifty male and 50 female brood fish were reared in 500 m^2 sized earthen ponds. Sixty percent female responded to spawning and only 10% female released viable eggs during autumn season (mid September to late October) at water temperature ranges from 27.5 to 29.0^{0}C. Most of the female (88%) responded to spawning and 46% female produced viable eggs during spring season (late February to late March) at 19.0-25.0^{0}C water temperature. Twelve percent female were found over matured during the maturity examination in spring season. The fertilization and hatching rates of Sahar eggs range between 50-95%. These results indicated that breeding attempts of Sahar during spring season could trigger mass-scale seed production. For higher spawning rate and eggs viability, determination of optimum stripping time by frequent checking of brood fish in every 1-2 days interval is essential.

Spawning performance and post spawning mortality of Chinese carp broods reared in pond condition of mid-hill region

Bista JD, BK Shrestha, AP Baidya, S Prasad, AP Nepal and SK Wagle (2010). Spawning performance and post spawning mortality of Chinese carp broods reared in pond condition of mid-hill region. *Proceedings of the 8th National Workshop on Livestock and Fisheries Research in Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

High mortality of post spawned Chinese carp brood fish after the propagation, is the major constraints in brood stocks management for public and private hatcheries. Replenishment of brood stock with genetic quality and high cost associated are the consequences of frequent loss of broods after spawning. This study was carried out to improve spawning performance of Chinese carp for minimizing brood mortality by improving pre and post spawning brood management practices. The supplementary feed with 25% crude protein was supplied to broods in the ponds. Sprouted beans and wheat grain were also supplied to Grass carp. Frequent water exchange in brood ponds, modification of seining, care in fish handling and indoor care of post spawners were the management variables to improve performance of brood stocks. The spawning performance was higher in the fishes fed with 25% crude protein level feed in all three species of the Chinese carps. All the brood fish of Silver carp, Bighead carp

and Grass carp reared in ponds were matured in their corresponding spawning season. Spawning success rate varied among species with the highest spawning rate of 96.4%; in Grass carp, 83.8% in Bighead carp and the lowest (52.6%) in Silver carp. The mortality of post-spawned and hormone treated unspawned brood was higher in Silver carp (39.0%) compared to Bighead carp (24.3%) and Grass carp (7.0%). Brood mortality was highly skewed to female in all species of Chinese carps. The major causes of brood mortality were frequent handling in hatchery, stress, unsuccessful spawning, over striping after hormonal treatment and problems in egg release.

6.4 Production and Management

Fish Culture: Protection of fingerlings against predators

Augusthy KT (1981). Fish Culture: Protection of fingerlings against predators. *Journal of Institute of Agriculture and Animal Science (IAAS),* Rampur, Chitawan, **2(2)**:67-70

Fingerlings were grown in a frog proof nylon net cage fixed in water in the corner of a stock pond at IAAS for one month when they surpassed the attack of frogs. Then, they were tested for their fitness against the attack of frogs. Frogs could not eat them. Another alternative was to cover the sides and top of the nursery pond with nylon net. Methods of feeding and precautions to be taken against mass mortality that could result from water pollution due to food decaying in both the cases are also discussed.

Growth performance of Rainbow trout in different culture system

Joshi PL (1999). Growth performance of Rainbow trout in different culture system**.** *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, Pp 90-93

Rainbow trout was raised in three different culture systems-race way ponds, earthen pond and net cages to study their comparative growth. The experiment was carried out from 14th January to 11th April 1998 for a period of 90 days. Fish were provided pellet feed containing 35% crude protein four times a day at an interval of every 2 hrs. Feeding rate varied from 2 to 4% of their body weight depending on temperature variation in the culture system. Growth rate was highest (1.5 g/day) in race way ponds followed by net cages (0.7 g/day) and earthen pond (0.69 g/day), respectively. Survival was excellent (98.7%) in raceway ponds and fish in cages exhibited the least survival, less than 90%.

Cold water mountain aquaculture: technology adoption and livelihood in Nepal

Basnet SR, GP Lamsal, PL Joshi, AK Rai and TB Gurung (2003). Cold water mountain aquaculture: technology adoption and livelihood in Nepal. *Proceedings of 2nd SAS-N Convention*, 30 July - 1 Aug 2003, Kathmandu, Pp

This paper briefly describes cold-water aquaculture in the mountains of Nepal. Here, the cold water aquaculture is fish husbandry carried one in small scale utilizing the near by rural water resources having water temperature <20^{0}C. One of the most suitable fish species to rear in cold waters is Rainbow trout (*Onchorynchus mykiss*) in Nepal. This popular cold-water species was introduced in Nepal from Japan in 1989's. At present the total production of the country including that of private sector has reached about 19 Mt, of which the contribution of private sector is about 66% to total production in 2002. At present there are 5 private cold water fish farms located in Nuwakot, a hill district of Nepal. The cold-water fish farming technology is expected to adopt with the infrastructure development in rural hills of the country. At present the trout productivity in private sector ranges from 12-18 kg/m^2. This productivity needs to be enhanced gaining practical knowledge and technical skills on trout farming. This paper

highlights the status and prospects of cold-water fish farming as one of the potential livelihood means for people living in the hills.

Cage culture of Rainbow trout (*Oncorhynchus mykiss*) in stagnant water of Lake and Reservoir

Bista JD, TB Gurung, SK Wagle, GB Karki and RP Dhakal (2003). Cage culture of Rainbow trout (*Oncorhynchus mykiss*) in stagnant water of Lake and Reservoir. *Proceedings of 2nd SAS-N Convention,* Kathmandu, 30 July - 1 Aug 2003, pp

The present study was conducted as a means to utilize the empty carp harvested cages during winter in mid hill lakes. In summer, production cages were used to grow plankton feeder carps, however, in winter since carp did not show satisfactory growth due to low water temperature and low productivity of plankton. Thus, mostly carp were harvested in winter and remain empty for 3-4 months until the next generation of carp seed were not supplied to farmers. The present experiment showed that in a cage of 5 m x 5 m x 2 m dimension about a stocking rate of 5 trout per cubic meter, a total of 25 kg trout could be produced with a per day growth rate of trout in Lakes and reservoir was up to 0.88 g. We showed that in trout farming during the winter from November to March when water temperature remained within 13-22^{o}C, trout could be grown satisfactorily in mid hill stagnant lakes and reservoirs. The present work revealed that marginal farmer can achieve a benefit of about 2735 Nepalese Rupees per cage in a period of 100 days. Mechanism for trout seed supply to enhance the further adoption of the technology is recommended.

A study on economic benefit of trout farmers of Nuwakot district

Paudyal S (2003). A study on economic benefit of trout farmers of Nuwakot district. *Journal of Himalayan College of Agricultural Science and Technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **3**(1)**:** 98

Fisheries sector is becoming one of the potential activities in Nuwakot district. Some of the farmers of Nuwakot district have initiated this business, however, their economic enhancement has yet to be traced. The study to find out the economic enhancement of the farmers involved in exotic cold water fish (*Onchorthynchus mykiss*) was conducted at potential areas of Nuwakot district where only four farmers were found to be involved in this areas. The B/c ratio of those farm business was ranged from 1.024 to 1.66. It might be due to high cost for the feed which made production cost high. The cost of production of government farm was about NRs 170/kg but at farmer level it was about NRs 250/kg. The selling price of the trout was about NRs 300-600/kg depending on the time and consumer type. Trout cultivation has wide scope within as well as outside the country. Neighboring countries like India, Pakistan, Bangladesh, Thailand and China has wide demand of it. Though the main market of the trout is not well specified, big hotels and restaurants and some of the diplomatic groups with high income level preferit. Marketing cjannel of this fish business was found very simple, that is, producer to consumer without any intermediaries. Transportation system is so simple since fresh meat is consumed and it is tranported through local vehicles by packing in the plastic crate with ice. Through the study it can be said that there is immense scope of enhancing economic level of the farmers throught trout business if the farmers are provided with loan facility, technical backstopping and related inputs.

Trout culture in Nepal: Gender issues and future investment opportunities for sustainable development

Sapkota S and KR Joshi (2007). Trout culture in Nepal: Gender issues and future investment opportunities for sustainable development. *First National Workshop on Rainbow Trout Farming Scaling- up Strategies in Nepal*, Hotel Himalaya, Pulchowk, Lalitpur, Nepal, January 18-19, 2007

Study on behalf of gender issues and to detect the potentialities for the sustainable development of the hilly areas due to introduction of Rainbow trout (*Oncorhynchus mykiss*) was done in the year of 2006. Madanpur and the Kakani VDC were the sites selected purposively on the basis of trout producing area. A questionnaire was developed; direct interview and telephone interview technique was followed to collect the data. A large portion of rural women performed unpaid work in agriculture especially in providing for household needs. In hilly area when they are paid women received lower pay than men for the same or equivalent work. After the introduction of trout in hilly area unemployed women are getting opportunity to share their leisure time on trout production and the income generation. During their participation to disseminate the technology and the trend of work done during the brood selection and breeding of trout was more appropriate than that of men. Therefore, women participation in trout production increased success possibility for hatchability due to their delicate handling. The cost and return structure in trout production showed about 1.9 output input ratio and the net profit per Kg of trout was NRs.261.76. Although a less productive land for other crops were used to produce trout, calculated impressive net profit and output input ratio could have to be a good lesson for the increased involvement in trout production and sustainable development of the hilly area. A project to promote the transfer of trout production technology to peasant communities in the mountain as well as hilly areas has to promote in the participation of women in extension, and carried out sensitization workshops for trout production programme and project designers could be a good opportunity for the increased participation on trout production.

Recommendations for wider scaling up of Rainbow trout (*Oncorhynchus mykiss*) farming in Nepal

Gurung TB (2007). Recommendations for wider scaling up of Rainbow trout (*Oncorhynchus mykiss*) farming in Nepal. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, June 25-27, 2007, pp 23-26

Recently, Nepal Agricultural Research Council has developed a technological package of Rainbow trout farming suitable to hill and mountain regions. Aiming for wider dissemination of this technology through strategic planning, a 2 days workshop was held, where about 150 farmers, technicians, scientists, NGOs, policy makers, entrepreneurs, traders, consumers, media and agricultural administrators actively participated. In the workshop 20 papers were presented including 15 oral and 5 posters. Later a trip to farmer field was organized for enabling direct interaction among various stakeholders of the value chain and to review analytically on the status of trout farming around Kathmandu- Rasuwa highway corridor. For further scaling up of trout farming, the workshop recommended on strengthening and improvement in institutional status, human resources for research and extension, facilities, linkage among stakeholders. The workshop also recommended subsidy to farmers, code of conduct on aquaculture practices, credit schemes, better communication mechanisms, land valuation on the basis of investment and research and development on consistent trout seed production and supply mechanism within the country. Several other recommendations were also suggested for further scaling up of trout farming in Nepal.

Trout in media and its implication in scaling

Singh Basnet BM (2008). Trout in media and its implication in scaling. *Proceedings of the workshop on scaling-up of Rainbow trout (Oncorhynchus mykiss) farming strategies in Nepal*, Kathmandu, Nepal, pp 125-13

Trout are native to cold waters of the Northern Hemisphere and have been introduced to cold waters throughout the world. Trout are prized both as food as well as sport fish. Trout is considered as high value low volume commodity for food security, nutritional security, profitability. Nepal has already developed full package of practices for Rainbow trout farming. Media have played a greater role for bringing Rainbow trout as "One village one Product" commodity in the government policy. As its farming have been advocating since many years through print, electronic media (radio, FM, TVs) and exhibitions etc. Therefore, journalist as one of the developments partners in the budget and programme for communications and promotions for any agriculture-related projects is highly recommended. Media is needed for wider scaling-up too. Press release and conferences can be organised for creating awareness. Media can sensitise, not only the farmers but donors, planners, financial agencies, policy makers, social scientists, politicians, extension, I/NGOs, CBOs, development workers, entrepreneurs, producers and consumers, marketing agencies etc. It is said "Not published means not done". Donors in the past always forgot these vital parts of communications. The persuasion of this author also helped for bringing out publication entitled "Rainbow Trout Culture in the Himalayan Kingdom of Nepal: A Success Story" by Asia-Pacific Association for Agricultural Research Institutions (APAARI). We should not forget to make any program successful, there should be "research push and market pull". Researcher should not lack in salesmanship or pro-activeness. They should be a good communicator for scaling-up of successful technologies.

Extention strategies for trout aquaculture in Nepal

Singh DM, BC Shrestha, RN Mishra and SP Dahal (2008). Extention strategies for trout aquaculture in Nepal. *Proceedings of the workshop on scaling-up of Rainbow trout (Oncorhynchus mykiss) farming strategies in Nepal*, Kathmandu, Nepal, pp 116-119

Rainbow trout (*Oncorhynchus mykiss*) has a high economic value as food fish and provides ample of opportunities for commercial production in mid and high-hill areas of Nepal. Visualizing its high potentiality, Fisheries Research Division Godavari, Lalitpur and Fisheries Research Centre Trishuli, Nuwakot under Nepal Agriculture Research Council (NARC) have been conducting researches in several aspects of Rainbow trout culture since 1988's. Recently, a suitable technology for trout has been developed and recommended for wider adoption and commercialization in feasible sites of Nepal. Fisheries extension program was implemented along with the agricultural development activities in the year 2006 B.S. (1950). Since that time, fisheries activities come under one umbrella and Department of Agriculture is determining the public sector agricultural extension services through District Agriculture Development Offices and Fisheries Development Centers at grass-root level. Despite several attempts made by the government to reform agriculture extension, the present extension service could not be effective in fisheries sub-sector due to poor coordination and linkages, domination of input supply approach, subsistence level farming, insufficient human resources, inadequate fund for activities, etc. It is a widespread realization to have a specific strategic plan for scaling-up, expansion and boosting of trout farming for income generating and improving the socio-economic conditions of mountain people. Therefore, the government of Nepal has recently initiated "One Village One Product (OVOP)" program for Rainbow trout promotion in collaboration with FNCCI in Rasuwa and Nuwakot districts. In view of the changed context, the strategic framework of trout extension strategy needs to include participatory approach,

decentralized service delivery, institutional pluralism, modifying public sector's roles, group co-operatization, optimization of local resources, use of pocket/cluster approach, farmers to farmer extension, use of information technology, targeting and coordination with all stakeholders including INGOs, NGOs, CBOs. Therefore, to achieve the stable and sustained growth in aquaculture, particularly cold-water aquaculture, the major elements such as research, extension, support system and farmers should work harmonically.

Prospects of trout (*Oncorhynchus mykiss*) farming commercialization in relation to global context in Nepal

Thapa TB, N Pradhan, DMan Singh and TB Gurung (2008). Prospects of trout (*Oncorhynchus mykiss*) farming commercialization in relation to global context in Nepal. *Proceedings of the workshop on scaling-up of Rainbow trout (Oncorhynchus mykiss) farming strategies in Nepal*, Kathmandu, Nepal, pp 71-79

The total trout production in Nepal is meager totaling about 18 Mt in 2005 from m^2 area. However, recent achievements in private sectors in Nuwakot and Rasuwa districts, Nepal have demonstrated encouraging results for trout farming in hills. Farmers have also been successful to produce trout seed in their own farms as a part of participatory research. The present scenario of trout cultivation in hills showed that trout farming has successful despite of various management shortcomings. These successes of trout cultivation in Nepal Himalaya might be taken as one of strength for future scaling-up. Considering the remarkable progress achieved by farmers and private entrepreneurs around the world in diverse socio-economic perspectives, potentiality and future of trout commercialization is hopeful in Nepal. However, to establish trout commercial aquaculture in Nepal hills and mountains, a "paradigm shift" would be necessary in extension, research, social mobilization, financing and policy strategies of agriculture sector for soliciting theoretical potentiality of commercial trout production into the practical reality in the country.

Socio-economic study of Rainbow trout fish farming in Nepal: A case study of Kathmandu - Trishuli - Rasuwa Road Corridor

Thakur NS, D Gauchan, A Raymaghi and GP Lamsal (2008). Socio-economic study of Rainbow trout fish farming in Nepal: A case study of Kathmandu - Trishuli - Rasuwa Road Corridor. Proceedings of 1st National Workshop on Scaling-up of rainbow trout (*Oncorhynchus mykiss*) Farming Strategies in Nepal", Organizers: NARC, JICA, DOA, NFS, pp 63-70

Farming of Rainbow trout is gradually adopting by farmers in hill and mountains near by the capital, Kathmandu in Nepal. The adoptability could be enhanced if socio-economic set up of potential farmers could be understood. Therefore, we focused our objective to explore the emerging trend of effectiveness of trout fish farming which ultimately contribute to the farmers' income in Kathmandu -Trishuli - Rasuwa highway corridor. The study used purposive selection of samples since number of trout producing farmers was very much limited. The study was conducted by a group of multidisciplinary team that consisted of socio-economists and trout fish researchers. Collection of data was done through personal interviews as well as direct field observation and informal discussion with trout producers and other key informants. The study revealed that the average family and farm size of the trout producer was 11 persons and 10 ropani, respectively. These farmers had a total number of 80 fish ponds with the water surface area of 2.35 ropani. Lama, Brahmin and Ghale were the major ethnic groups in trout fish farming. The production of trout fish has increased from 8323.40 kg to 16069.36 kg during the 1998-2006. The time series data indicated that the annual growth rate analyses have a significant growth for FRC, FRD, private farmers and overall production which is 17.39%, 12.66%, 35.11% and 32.32%, respectively. The share of private producers increased

from 10% in the 1998 to 75% in 2006. This indicated that there was a high annual growth rate in the private level because the farmers were adopting the technology and marketing it successfully. The study also indicated that about 68% (4385 kg) of the production was sold directly to consumers and 3% (1900 kg) sold to traders/ middlemen. The gender analysis revealed that participation of men members is relatively higher than their counterpart female members, though women also contributed significantly in many trout production activities. Currently, Trishuli (75%) and Godavari (25%) farms are the major source of fingerlings supply to the farmers. However, this current fingerling production is not adequate to meet the increasing demand of trout fish farmers for scaling up the production and marketing activities. The main problem identified by the study was limited availability of fingerlings stock, low quality feeds, inadequate credit facilities, high mortality rate of fingerlings and high risks of production at the farm level. However, there was still ample scope for enhancing trout production in the study area as well as in other suitable hill and mountain areas of Nepal. But this will require strong technological, policy, institutional and integrated approach of Rainbow trout farming linking with eco-trout tourism development in the country.

Marketing channel of Rainbow trout (*Oncorhynchus mykiss*) in Nepal

Gauchan D, NThakur, B Shrestha, A Rayamajh, SGautam and GP Lamsal (2008). Marketing channel of Rainbow trout (*Oncorhynchus mykiss*) in Nepal. *Proceedings of 1st National Workshop on Scaling-up of rainbow trout (Oncorhynchus mykiss) Farming Strategies in Nepal*", Organizers: NARC, JICA, DOA, Nepal Fisheries Society (NFS), 57-62

Production and marketing of Rainbow trout fish is a recent phenomenon in Nepal. It is currently emerging as a 'niche' product for hills and mountain region. This paper is the output of an on-going marketing study of trout fish in Kathmandu-Trishuli-Rasuwa road corridor. It aimed to provide an assessment of marketing system, market demand and supply as well as market and production potentiality of Rainbow trout culture in Nepal. The study employed literature review, key informant interviews and market survey of trout producers, traders, and specific consumers of Rainbow trout in Trishuli and around Kathmandu valley. The market survey employed two sets of questionnaires. The first set was used to interview sample respondents (N=22) participating in marketing of Rainbow trout fish (e.g. farmers and market agents from department stores, restaurants, hotels, fresh house etc.) and the second set was used to interview random sample of trout fish consumers (>N=30). Specific marketing channels, marketing practices, market demand, supply, market prices and margins as well as production and marketing potentials were assessed and projected. Similarly consumers' demand, utility and the preferences for the size and types of Rainbow trout products were identified and suggested. The finding showed that currently trout marketing is in very small scale and it is in trial stage of commercialization. The farm households that are closer to road head and markets in Trishuli-Kathmandu highway have adopted trout farming and reaping fairly high benefits from this activity. The traders and hotel owners are also currently receiving good profit margin from the sale of Rainbow trout fish. However, the current production and market supply of rainbow trout fish is not meeting increasing demands of consumers in local market as well as the demands of many tourist hotels, restaurants and supermarkets in Kathmandu valley. Furthermore, this demand is increasing rapidly due to increasing tourist flow, urbanization, and increased consumer awareness about fresh organic trout fish products. The study therefore confirmed that market for Rainbow trout in Nepal is unexploited and large because of its increasing unfulfilled demands of high-income local consumers as well as demands of tourist hotels, restaurants and super markets. A high prospect for commercialization of this Rainbow trout fish exists as a 'niche' or 'specialty' product. Finally, the paper suggests that special policy consideration is required to enhance production and

supply of fingerlings as well as technical know-how and enabling investment environments for future growth in production and marketing.

Present status and prospects of Rainbow trout (*Oncorhynchus mykiss*) farming in Nepal

Rai AK, TB Gurung, SR Basnet, N Pradhan and RM Mulmi (2008). Present status and prospects of Rainbow trout (*Oncorhynchus mykiss*) farming in Nepal. *Proceedings of the workshop on scaling-up of Rainbow trout (Oncorhynchus mykiss) farming strategies in Nepal*, Kathmandu, Nepal, p 5-11

Rainbow trout (*Oncorhynchus mykiss*) is one suitable fish for intensive aquaculture and sport purpose in cold waters. Trout can survive in water temperature from 0 to 25^0C. The optimum water temperature for growth is 16-18 ^{0}C, however, for spawning and hatching temperature range of 9-14^0C is considered suitable. The present stock of trout was brought from Japan, now complete technological package for cultivation; breeding, nursing and rearing including feed production is available in Nepal. As a result 10 farmers had initiated trout cultivation in Ranipauwa, Jitpur, Okharpauwa, Dhunche, Naubishe, and Birethanti. Out of these, 8 farmers have continued, however, two have dropped the farming in Naubishe and Birethanti. The production of rainbow trout was initiated by single farmer in 1998/'99. Initially the trout production was about 0.8 Mt/year. Presently, trout production has been increased to about 12 Mt from 1270 m^2 area by 8 farmers in 2006. The current production rate was ~10 kg/m^2/year but it was expected to reach 15-20 kg/m^2/year. Trout was fed with 35% crude protein content pellet diet prepared locally by farmers. Feed conversion ration (FCR) was little higher in private sector about 3:1 than 2:1 in government sector. To grow the table size (about 200-300 g) of trout generally took 13-17 months from alevin stage in Trishuli while in Godavari it took 12-15 months. The trout demand was high and mostly sold on farm. Farmers selling price ranged from 500-700/kg, whereas government price was Rs. 300/kg. There are cold storage in Kathmandu where from frozen trout can be purchased. Trout meat has high quality containing different amino acids, which is considered beneficial for human health. Fingerlings availability was the bottle neck for commercial production. Therefore, fingerling production in mass scale is urgently needed for enhancing production nationwide. To solve the problems of trout seed participatory breeding in collaboration with Nepal Agricultural Research Council and private sectors has been initiated since 2005. In 2006 this collaboration produced about 44,000 fingerlings in Dhunche and Ranipauwa. It is expected that from both government and private sectors there would be nearly 300,000 fingerlings production in 2007. Nepal is the second richest country in fresh water resources in the world. If vast cold water resource could be utilized then trout farming would be highly potential in Nepal particularly in hilly region. If trout farming could be commercialized then this could support in livelihood of people living in the regions. It can also support for eco-tourism providing recreation by fishing. Trout farming has a bright prospect for expansion commercially as cold water resources from east to west in the hilly region are abundantly available.

Trout production potential sites identification using GIS in Nuwakot district, Nepal

Rai SK, TB Gurung and GP Lamsal (2008). Trout Production Potential sites Identification using GIS in Nuwakot district, Nepal. *Proceedings of the workshop on scaling-up of Rainbow trout (Oncorhynchus mykiss) farming strategies in Nepal*, Kathmandu, Nepal, pp 63-88

Nepal is a hilly country where majority of its area is covered by hills and mountains. This region is rich in water resources having higher potentiality of cold-water fish production. The physiographic and climatic condition of these area are suitable for cold-water fish production especially rainbow trout (*Oncorhynchus mykiss*). Making use of available information of Nuwakot district, which are related with trout fish production, an attempt has been initiated to

identify the locations that could be potential for Rainbow trout production with the help Geographic Information System (GIS). Depending upon the availability of the information mainly road, existing rivers and streams and land use required for the assessment, the potential sites in the Nuwakot district were identified with the help of GIS. Water information, one of the important aspects of trout farming however could not be included in the study due to its unavailability. The study was carried out in two scenarios; one with the cultivated area included and other one without cultivated area. Potential sites with areas of 4985.4 ha and 1183.3 ha were identified in two scenarios, respectively. This was not complete within itself however, information generated though this study gives an idea about the potential sites within the district where efforts can be focused directly making much easier in selection sites elsewhere. In future with the availability of other information, the study could further be made effective and efficient making use of the technology of GIS.

GIS based potentiality for Rainbow trout (*Oncorhynchus mykiss*) farming in Rasuwa district, Nepal

Arial SP, TB Gurung and MN Podia (2008). GIS based potentiality for Rainbow trout (*Oncorhynchus mykiss*) farming in Rasuwa district, Nepal. *Proceedings of the workshop on scaling-up of Rainbow trout (Oncorhynchus mykiss) farming strategies in Nepal*, Kathmandu, Nepal, pp 89-94

Nepal is one of the major countries for having vast fresh water resources in the world. These resources could also be used for aquaculture development with a view to support rural livelihood besides hydropower generation and other uses. Rasuwa district is located at 27° 2" – 27° 10"north latitude and 85° 45 "– 85° 88 " east longitude with an area of 1544 Sq. Km. The district lies between the altitude of 600 meters to 7246 meters and Dhunche is the capital of the district has an altitude of 1950 meters above from the sea level. The overall objective of the study was to identify GIS based potential pocket areas of Rainbow trout farming and thereby generating incomes of the needy people and to support their livelihood as well as poverty and unemployment reduction by optimizing available resources. Taking several assumptions we concluded that from water resources availability perspective the lower reaches of the district might be suitable for trout table fish production and the middle and higher water resources should be able to produce quality seed production activities.

A case study on integrated Trout (*Oncorhynchus mykiss*) farm in terrace land with other developmental activities in Betini, Nuwakot: A perspective of scaling-up in hill and mountains of Nepal

Lamsal GP, PB Rumba and SR Basnet (2008). A case study on integrated Trout (*Oncorhynchus mykiss*) farm in terrace land with other developmental activities in Betini, Nuwakot: A perspective of scaling-up in hill and mountains of Nepal. *Proceedings of the workshop on scaling-up of Rainbow trout (Oncorhynchus mykiss) farming strategies in Nepal*, Kathmandu, Nepal, pp 95-99

A case study on integrated trout production, pellet production, trout hatchery along with horticulture, livestock, floriculture, bee keeping, water mill and hydro-power in sloppy terrace land is presented. Mr. Padham Bahadur Lama Rumba's integrated trout farm located 50 Km far from the Kathmandu and 25 Km far from the Bidur Municipality. The most interesting part is the 7.5 KW hydropower generation could be possible with water discharge from the farm about 50 m down. With the help of electricity, grinding and pelleting machine were operated for trout feed. Mr. Rumba, a traditional terrace farmer had an estimated annual income 147,000 and expenses of 150,000 NRs per year before adopting trout integration. Since, the initial expense in trout farming is high construction of trout raceways was cost him nearly 450,000

NRs. In first year he could sell only 750 Kg trout but it has been increased up to 3600 Kg in 2005. The economic analysis showed after starting new intervention with trout integration his income reached approximately 1.66 million Rupees in recent year. The rate of return calculated on initial cost is 39.29% and rate of return on operating cost stands about 67.33%. Trout production contributes about 92% of the total income of the farm. The electricity contributes about 5.7%; remaining 2.3% of the farm income is contributed through livestock, floriculture, horticulture, water mill etc. The production cost of trout is 276 Rupees/Kg in his farm.

Rainbow trout (*Oncorhynchus mykiss*) larval rearing methodologies in Nepal

Pradhan N, A Raymajhi and SK Shrestha (2008). Rainbow trout (*Oncorhynchus mykiss*) larval rearing methodologies in Nepal. *Proceedings of 1st National Workshop on Scaling-up of rainbow trout (Oncorhynchus mykiss) Farming Strategies in Nepal*", Organizers: NARC, JICA, DOA, NFS, pp 7-22

Sustainability of aquaculture highly depends on the availability of high quality; robust and healthy seed. The larvae of trout accept feed from early stages after yolk sac are absorbed. Preparation of composite feed for early fry is complex process. In earlier years in absence of appropriate modern technologies for the preparation of dried crumble feeds, several local methods were attempted in Nepal. Previous works suggested that in absence of well balanced appropriate dry starter pellet, boiled egg yolk and liver could be the best feed for larval rearing as starter feed. The growth pattern and survival of fry fed with egg yolk and liver were same as it was with dry pellet. These methods could be useful in remote trout hatcheries where transportation of dry pellet will be impractical.

Water quality parameters for trout (*Oncorhynchus mykiss*) farming in hills of Nepal

Pradhan N, RM Mulmi and RP Dhakal (2008). Water quality parameters for trout (*Oncorhynchus mykiss*) farming in hills of Nepal. *Proceedings of the workshop on scaling-up of Rainbow trout (Oncorhynchus mykiss) farming strategies in Nepal*, Kathmandu, Nepal, pp 46-51

Trout is a clean, cold and high dissolved oxygen requiring fish. Water quality is one of the basic prerequisite to begin the cultivation of trout (*Oncorhynchis mykiss*). As fish completely depend and perform all functions in water as their living medium, it is essential not to impair their environment. Farmers living in hills may require information on water quality to begin and sustain their farming practices. The present study aimed to provide basic information on desirable water quality and quantity for trout culture. Moreover, in this paper result of water quality test of Godavari Fish Farm before entering after passing through raceway ponds have also been presented. The result showed that in Godavari Fish Farm the water quality such as dissolved oxygen, temperature, CO_2, pH, total phosphorus, and nitrate nitrogen did not vary substantially into the inlet and outlet stream.

One Village One Product program with special reference to trout farming, marketing in Nepal

Pandey KR (2008). One Village One Product program with special reference to trout farming, marketing in Nepal. *Proceedings of the workshop on scaling-up of Rainbow trout (Oncorhynchus mykiss) farming strategies in Nepal*, Kathmandu, Nepal, pp 132-136

The success of "One Village One Product" program in many countries involving local community and utilizing local resources towards attaining a prosperous economic development has inspired the Federation of Nepalese Chambers of Commerce Industry (FNCCI), an umbrella organization of the Nepalese private sector, to initiate “One Village One Product” in a form of a national prioritized program jointly with the Government of Nepal. The

program encouraged local people to become more motivated, to feel greater pride in their communities, and to become more involved in the activation of their local community through their own efforts to produce local specialties. It strongly believes that economic development programs linked with rural communities particularly focusing on the agriculture and potential employment generating economic activities have got to be the major program thrust areas for Nepal. Currently FNCCI and the Government of Nepal, especially the Ministry of Agriculture and Cooperatives, are working together in a public private partnership approach in carrying out OVOP program in Nepal. The Government of Nepal has formally incorporated OVOP concept in the National Program and Budget for the fiscal year 2006/07 and has approved the Working Procedures for the implementation of OVOP program in Nepal. Pilot programs in about six districts for four agricultural products have been approved in a public private partnership modality. Himalayan Rainbow trout fish is one of the sub-sectors that will be promoted as OVOP program in Nuwakot and Rasuwa districts. The program focused on the existing rich experience of the government sector and that of some of the private sector entrepreneurs and enhanced production and marketing capabilities based on the total value chain approach (from farmers' groups, to processors (handling and packaging), marketers and consumers) to cater the increasing demand of local market. Besides, the program also facilitated the government in the expansion of seedling hatchery in Rasuwa district. The program was envisaging of increasing production of trout up to 400 Mt by the end of 2009, thereby involving local farmers.

Linkage among research organization, development agencies, private farms and institutions: Potential vistas for commercial Rainbow trout farming in Nepal

Joshi KR, S Sapkota, GP Lamsal and SGautam (2008). Linkage among research organization, development agencies, private farms and institutions: Potential vistas for commercial Rainbow trout farming in Nepal. *Proceedings of the workshop on scaling-up of Rainbow trout (Oncorhynchus mykiss) farming strategies in Nepal*, Kathmandu, Nepal, pp 80-82

The success of Rainbow trout breeding, rearing and production had been over more than one decade. This paper reviews research findings on Rainbow trout from and Socio-economic impact of the people. The research data of Fisheries Research Division, Godavari, Lalitpur have shown that Rainbow trout production has increased by 1657.0 kg (255.6%) from 188.0 ha and the data of Fisheries Research Station, Trishuli, Nuwakot showed decreased production by 1096.0 (26.7%) from 1991.0 m2 during the year 2005/06 as compared to 2001/02. Similarly, private farmers from Nuwakot, Kakani and Rasuwa districts were also producing Rainbow trout of 12000.0 kg from 1250.1m^2 .Total Rainbow trout production was about 80207.0 kg and income from Rainbow trout was NRs 35682.8 thousand from 2001/02 to 2005/06. In 2005/06, eight private farm owners produced Rainbow trout total of 12.6 Mt which generated income of NRs 7500.0 thousand. The cost of production of Rainbow trout was found NRs 285.0 in research farm and 288.2/kg in private farm. Farm's price of Rainbow trout was 300.0 to 625.0/kg in 2005/06. During the socio-economic survey, Rainbow trout producers said that there was no problem of market but farmers were demanding further technical support regarding brooding and hatching for increasing their trout production. The study had given more emphasis on linkage development model for promoting Rainbow trout commercialization among NARC and various institutions, which are Ministry of Agriculture and Cooperative, Department of Agricultural/Directorate of Fisheries Development, Agricultural Development Bank, Department of road, Agro-enterprises, Private enterprises, I/NGOs, Farmers/Producers, Insurance Private Company Ltd, Marketing and Consumer. Major linkage should be considered for producing Rainbow trout for commercialization with Local, National, Regional and International Markets. Lessons were learned from Rainbow trout produced by private farm. Private entrepreneurs were much more conscious on Rainbow trout breeding in their race way ponds because technical support was provided from Fisheries Research Division, Godavari,

Lalitpur and Fisheries Research Station, Trishuli, Nuwakot. Rainbow trout farming should extensively be expanded in hills and mountains area for commercialization through private entrepreneurs. It has become a source of income generation and creating employment. It is expected that socio-economic status of the Nepalese people will be improved through commercial Rainbow trout farming.

Effect of stocking density of Rainbow trout (*Onchorhynchus mykiss*) on mortality and growth of fish and ammonia level in raceway grow out system at Tatopani, Sindhupalckowk

Mulmi RM, SK Wagle, N Pradhan and KM KC (2010). Effect of stocking density of Rainbow trout (*Onchorhynchus mykiss*) on mortality and growth of fish and ammonia level in raceway grow out system at Tatopani, Sindhupalckowk**.** *Proceedings of the 8th National Workshop on Livestock and Fisheries Research in Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

Overstocking trout production units (raceway) can result in poor water quality which consequently reduce growth rates and stress fish. Low productivity and poor economic efficiency of the production units were the consequences of under stocking. Appropriate stocking density is essential for optimal use of space and water flow to achieve carrying capacity, the balance between biotic factor (fish) and abiotic factor (water and raceway). Therefore, preliminary study was carried out to determine the stocking density of trout in private trout farms at Tatopani, Sindhupalckowk during 2008/09. The stocking treatments employed were 75, 100, 125 and 150 fish with an average individual weight of 47.0 g per m^2 of raceway area. Results revealed that survival (94.6%), growth rate (1.37 $g.day^{-1}$) and final weight (263.8 g) of fish were significantly high ($P<0.05$) for lowest stocking density (75 $fish.m^2$). Fish stocked at 150 $fish/.m^2$ exhibited highest gross yield (25.1 kg/m^2) but net yields were not significantly different ($P>0.05$) among treatments. Lowest feed conversion rate (2.28 kg) was also in favor of density 75 $fish.m^2$. Ammonia level (0.5 mg/L) significantly high ($P<0.05$) at later stage of growing period at density 150 $fish/m^2$ and the lowest value (0.35) of ammonia was for density 75 $fish/m^2$. With respect to farmer's present capacity on feeding and water quality management, the stocking density of 75 $fish/m^2$ of raceway may be appropriate for trout grow out.

Scaling up of Rainbow trout farming in farmers field

Basnet SR, KP Gautam and GP Lamsal (2010). Scaling up of Rainbow trout farming in farmers field. *Proceedings of the 8th National Workshop on Livestock and Fisheries Research in Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

Participatory Rainbow trout (*Oncorhynchus mykiss*) breeding program was conducted in farmer's field at Nuwakot and Rasuwa districts (1100-1950 m asl) during 2008/09. Capacity of involved nine farmers was enhanced through training on Rainbow trout seed production processes, on-the-spot demonstration and supply of hatchery accessories. Collectively 294000 trout fry was produced by the private trout hatcheries in the breeding season. Consequently, with the more seed available for grow out, the number of trout growers increased from merely eight farmers to 31 farmers during 2009. Raceway area increased to 3966.4 m^2 and the fish harvest reached to about 40 metric tons in 2009/10. Implication of emergence of private trout hatchery in mountain area would be utilization of enormous cold water resources of the country to enhance the rural livelihoods through trout farming.

Prospects of cold water fisheries in high altitude wetlands

Gurung tB (2010). Prospects of cold water fisheries in high altitude wetlands. *Proceedings of the 8th National Workshop on Livestock and Fisheries Research in Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

Cold water high altitude wetland fisheries is one of common activities in Himalaya countries. Commercial as well as artisanal fisheries in lakes, reservoirs, rivers and streams or water from these sources for fish producton is the mainstay of high altitude wetland fisheries. The intention in this paper is to highlight status of high altitude fisheries and provide future perspectives which can be of substantial value to wetland managers and policy makers dealing with poverty alleviation, sustainable development and climate change. The results presented here have been collected from different published articles on high land wetlands and fisheries there in. the Himalaya is fascinating tallest mountains of the world, implying that wetland fisheries in these highest areas would be pioneering and inventive. Cold water fisheries technologies suitable to high altitude mountains are coming up gradually, which need to be scaled up through appropriate policy support. the fisheries in higher altitude wetlands should be prioritised synergestically along with innovative technologies and infrastructure development. Fisheries in high altitude moutains have several comparative advantages, as fish products from Himalaya could be easily branded for marketing. On addition, fishing-tourism in high altitude wetlands, the finest destination of the world for tourists is recommended. the fishing-tourism could be the boon for increasing productivity of high altitude wetlands fisheries.

Performance of Giant fresh water Prawn (*Macrobrachium rosenbergii*) with carp polyculture fish farming in eastern Terai of Nepal

Thapa AB, SK Shrestha, PK Sah and SN Mehta (2010). Performance of giant fresh water Prawn (*Macrobrachium rosenbergii*) with carp polyculture fish farming in eastern Terai of Nepal. *Proceedings of the 8th National Workshop on Livestock and Fisheries Research in Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

The productivity of pond fish farming can be enhanced with the inclusion of prawn (*Macrobrachium rosenbergii*) in carp aquaculture as an additional species. There is a consensus that the inclusion of a higher value species even though this may not necessarily result in an increase in productivity can yield a significantly higher income for the farmer because the increased production of the species most in demand from the market-generally the freshwater prawn itself. A study was conducted on the performance giant freshwater prawn in polyculture carp fish farming in farmers' pond in Sunsari district during 2008/09. Hatchery produced post larvae (PL, 0.2g) of prawn were additionally stocked at a density of 20000.ha^{-1} in ponds already stocked with six carp species at density 8000.ha-1. Stocked prawns were completely reliant on feed inputs supplied to carps. Body weight gain of prawn varied widely (30 to 80g) among farmer's ponds at harvest after 270 days of rearing period. Survival of prawn at harvest ranged between 40-60% and mean yield was 400 ± 40 kg/ha. Interaction on survival, total yield and economics between prawn and carps in mix farming suggests that inclusion of prawn in carp polyculture could improve pond productivity and profitability from the system.

Rice fish culture in Kaski district, Pokhara

Rai AK, BR Pradhan and M Wada (1996). Rice fish culture in Kaski district, Pokhara**.** *Proceedings of the first National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, 7-9 May, 1996, pp292-297

Two trials of rice fish culture were carried out during April to June and June to September in private sector in Budi Bajar, Kaski, district, Pokhara valley. The studies were carried out 50 days with CH-45 (Chaitedhan) from Apr to June (Trial -1) and 93 days with Mansuli from June to September (Trial – 2). The stocking density of fish was higher (9000 fish/ha) in trial -2 and also obtained higher production (756 kg/ha) but smaller size of fish (118 g/fish) harvested, whereas the stocking density of fish was lower (4000 fish/ha) in trial -1 and obtained lower production (329 kg/ha) but larger size of fish (163 g/fish) than in trial -2. The survival rate remained from 69-92%. The total income increased by 26% from rice fish culture than without fish culture in the rice field and increased by 6% only in rice production

Ecological principle of rice fish farming and research experiences: an aimplication for wider adoption

Gurung TB, JD Bista and HP Dhakal (2002). Ecological principle of rice fish farming and research experiences: an aimplication for wider adoption. *Proceedings of the Workshop on rice fish farming for productivity enhancement: a scientific basis for wider adoption in Nepal*, Pokhara, 19 July, 2002, pp 11-22

Field experiment demonstrate that rice fish farming can indeed increase the productivity of rice field and help to acieve ecological, economical and social benefits. In present paper, the ecological interaction among the different components of rice field ecosystem in ansence and presence of fish has been presented. Rice fish farming in Nepal was introduced four decades ago. However, the rate of adoption has been poor due to inadequate methodological package of rice fish farming. For wider scale adoption decentralization of fingerlings supply at village level have been recommended for successful and sustainable rice fish farming. In this paper, role of fish for increased production including that rice and strategy for wider adoption of rice fish farming have been discussed.

Status and potentiality of rice fish farming and implication approach of developed technology

Pradhan GB, SP Dahal and DM Singh (2002). Status and potentiality of rice fish farming and implication approach of developed technology. *Proceedings of the Workshop on rice fish farming for productivity enhancement: a scientific basis for wider adoption in Nepal*, Pokhara, 19 July, 2002, pp 23-26

This paper briefly describes the status, potentiality, strength and weakness of rice fish farming in Nepal. Rice fish farming was started in mid 1960's; however, despite of its higher potentiliaties and scope, farmers could not be encouraged to participate in rice fish farming practices due to several constraints. The present technologies packages of rice fish farming have shown encouraging results for its adoption. However, materilization of the recommendation of the described in this paper would certainly help for wider adoption of the developed technology.

Experience of rice fish farming at Syangja and Kaski districts

Mishra M and CN Adhikari (2002). Experience of rice fish farming at Syangja and Kaski districts. *Proceedings of the Workshop on rice fish farming for productivity enhancement: a scientific basis for wider adoption in Nepal*, Pokhara, 19 July, 2002, pp 34-36

Most farmers are skilled in rice cultivation, however, apart of fish management was a new approach, therefore to work with such farmers for expansion of rice fish farming few packages of incentive to farmers is recommended. Farmers have complained fish poaching, poisoning and insecticides problem in rice field. To control these problems involvement of community based organizations and rice fish farming commints in groups were proposed.

Expewrience of rice fish farming in Syangja, Kaksi and Tanahun districts and its economic analysis: farmer's perspective

Kunwar DN, IB Gurung and M KC (2002). Expewrience of rice fish farming in Syangja, Kaksi and Tanahun districts and its economic analysis: farmer's perspective. *Proceedings of the Workshop on rice fish farming for productivity enhancement: a scientific basis for wider adoption in Nepal*, Pokhara, 19 July, 2002, pp 37-47

Rice fish farming is one of the beneficial farming systems, which can increase rice farmer's income substantially by fish as well as increased rice harvest. In this paper, presented the result of rice fish farming economic analysis conducted in three mid hill districts: Syangja, Kaski and Tanahu. The data was collected from the farmers engaged in rice fish farming since last two years or more. All the farmers involved had the trench as "a survival fish refuse" in the rice field to protect the fish in emergencies such as during occassional drought, predation and other problems. The trench occupied from 3-5% of total rice cultivating area of the rice field. The findings showed that in rice fish integration rice production did not decline but increases and the total net benefit could be double due to harvesting of rice as well as fish from the same rice field.

Benefit and constraints of rice fish farming and their policy implication: an extension view point

Aryal BP (2002). Benefit and constraints of rice fish farming and their policy implication: an extension view point. *Proceedings of the Workshop on rice fish farming for productivity enhancement: a scientific basis for wider adoption in Nepal*, Pokhara, 19 July, 2002, pp 31-33

Benefit and constraints of integrated rice fish farming as perceived by farmers have been evaluated. Rice fish farming is one of effective farming methods for increasing productivity of rice field. Recent collaborative studies in Syangja, Kaski, Tanahu and Nuwakot districts have revealed that in rice fish integration, fish production could reach from 163 to 529 kg/ha and rice production increased from 10 to 15% even when about 3-5% rice field was used to dig drench as hiding place for fish in emergencies. Common carp (*Cyprinus carpio*) was successfully cultured with rice varieties such as Chaite -4, Radha -4, Janaki, Mansuli and Sabitri. If this technology is largely adopted, it could contribute substantially to total fish and rice production promoting nutritional status and income of the rural people in eco friendly environment.

Factors influencing farmer's decision and key issues for implication to enhance rice fish integrated farming for the people and nation

Gautam R, P Chaudhary and A Subedi (2002). Factors influencing farmer's decision and key issues for implication to enhance rice fish integrated farming for the people and nation. *Proceedings of the Workshop on rice fish farming for productivity enhancement: a scientific basis for wider adoption in Nepal*, Pokhara, 19 July, 2002, pp 27-30

Rice and fish farming provides rice as well as fish from the same place of land and also increases rice production. Despite all ecological, economical and social benefits, the coverage area under rice fish farming in Nepal is very small and the rate of increase is very low. To evaluate the reasons behind low adoption, farmer's perception on the rice fish farming were collected from individual farmer and group discussion through rapid survey method from both the technology practicing and the non participating farmers of Tanahu and Kaski districts. Lack of awareness, both at farmers and extension workers levels was attributed as the major factor for the slow adoption of the technology. Increased awareness among farmers through community and group mobilization and successful demonstration of the technology in the farmer's field in a participatory way would certainly help it out for the scaling up and wider adoption of the technology. Identification of the nodal farmers through farmer network analysis and mobilization of those farmers in the community speed up the farmer dissemination of the technology. Similarly, inclusion of rice fish farming coverage area in the regular program of district agriculture development office with high priority would certainly enhance the wider adoption of the technology.

Effect of Common carp (*Cyprinus carpio*) stocking size and density on production of rice and fish under rice-fish farming

Gurung TB, HP Dhakal and SK Wagle (2002). Effect of Common carp (*Cyprinus carpio*) stocking size and density on production of rice and fish under rice-fish farming**.** *Proceedings of the 5th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 10-11 July, 2002, pp 56-64

Evaluation of rice and fish yield at three stocking density of Common carp *Cyprinus carpio* (4000, 5000 and 6000 Nos/ha) in combination of two stocking size (5-10 g and 10-20 g) along with Sabitri rice was tested in farmer's field at Syanja and Tanahun. In general, 4-5% of rice field was occupied to dug "trench" as refuse for fish during emergencies. During this study, water temperature ranged from 27±2 to 39±2^{o}C. In general, fish showed rapid growth until first month after stocking then did not changed substantially till harvest in most treatments. Tiller number in control was less than treatments regardless of stocking number and size of fish. Rice yield was slightly higher in treatments than in control ranging from 4.7-5.8 Mt /ha, though rice was not planted in trench dug only in treatments. Indeed, rice yield seemed to be compensated due to increased number of tillers in treatments. This might also due to pest and weed control and rapid nutrient recycling by fish stocked in treatments. This study demonstrate that production of rice did not decrease with use of rice field as fish trench. However, rice-fish integration could optimize additional income to farmers through fish production which ranged from 180-395 kg/ha depending upon stocking density and size of fingerlings. In treatments fish yield increased with stocking density. Highest fish yield occurred in treatment with combination of large size (LS: 20g) and highest stocking (HS: 6000 Nos) density.

Fertility and productivity of dry season ricefield for integrated rice-fish farming in terraces of hid hills

Wagle, SK, TB Gurung, GP Lamsal and RM Mulmi (2004). Fertility and productivity of dry season ricefield for integrated rice-fish farming in tarraces of mid hills. *Proceedings of the 5th National Animal Science Convention* (NASA), pp 63-73

Agriculture practices alter the equilibrium of soil, water, biological and physico-chemical subsystem in ricefield ecosystem. Fish in ricefields feed extensively on the aquatic invertebrates and detrital aggregate. The effect of fertilization practices on physico-chemical properties and abundance of such aquatic fauna in rice-field is largely undocumented. Water quality parameters affecting fertility and productivity of rice-fish farming were studied for dry season rice in Tupche, Nuwakot during March 2000 to June 2001. Parameters were obtained for irrigated rice-fish fields to assess the effect of organic and inorganic fertilizer on water quality and population dynamics of aquatic invertebrates. Water temperature (27.1±5.5^{0}c), dissolve oxygen (7.2±2.9 mg/L) and pH (7.4±1.0) in rice-fish fields with inorganic fertilizer were not significantly different (P>0.05) to that of rice-fish fields with organic fertilizer. Relatively High concentrations of ammonium-N were measured in rice-fish fields corresponding to 0.99 mg/L and 1.08 mg/L, respectively, for organic and inorganic fertilizer treatments. Nitrite+nitrate-N (0.06±0.04 and 0.07±0.03 mg/L) and phosphate phosphorous (0.09±0.06 and (0.14±0.05 mg/L, respectively) were rather low, in spite of frequent fertilization at 7 Mt. /ha organic manure and 100-30-30 kg/ha NPK, respectively, in ricefields treated with organic and inorganic fertilizer. Mean value of chlorophyll$_a$ concentration (42.1 µg/L) was significantly higher (P<0.01) in rice-fish field with inorganic fertilizer.Thirteen species of phytoplankton belonging to 5 families were observed. Among them Cynophyceae, Bacillariophyceae and Chlorophyceae were dominant throughout the rice-fish growing period. Zooplankton densities were 78±23 and 144±28 ind/L, respectively, for rice-fish fields treated with organic and inorganic fertilizer. Zooplankton density increased to maximum of 167 ind/L by 45 days after transplanting (DAT) and then declined continuously until fish harvest in rice-fish fields treated with inorganic fertilizer. Differences were observed amongst populations of rotifer, copepoda and cladocerons in fertilizer treatments but the trends were inconsistent. The mean fish yield was 364±77.2 kg/ha and 294±60.4 kg/ha, respectively, for organic and inorganic fertilizer treatments. Low water level, declining water pH and temperature at later stage of rice growing period did affect (P<0.05) the growth and survivability of fish in rice field. Although not significant, rice yield increased by 10.5% in rice-fish fields over rice monoculture. Presence of fish through its role on biopurturbation and grazing on photosynthetic aquatic organisms could have played greater role to influence rice yield.

Fertility and productivity of ricefield for integrated rice-fish farming in mid hills of Nepal

Wagle, SK, RM Mulmi, TB Gurung and GP Lamsal (2005). Fertility and productivity of ricefield for integrated rice-fish farming in mid hills of Nepal. *Journal of Natural History Museum* **22:** 1-21

Physical and chemical parameters of water will determine species that can survive in ricefields. Fertility and primary productivity are important in rice-fish farming because they affect food availability for fish. Fish in ricefields feed extensively on the aquatic invertebrates and detrital aggregate. The effect of fertilization practices on physico-chemical properties and abundance of such aquatic fauna in rice-field is largely undocumented. Water quality parameters affecting fertility and productivity of rice-fish farming were studied for dry and wet season rice in Tupche, Nuwakot and Khudi of Kaski during March 2000 to November 2001. Parameters were obtained for irrigated rice-fish fields to assess the effect of organic and inorganic fertilizer on water quality, population dynamics of aquatic invertebrates and, rice and fish yield. Water

temperature (26.8±5.5 ^{0}c and 30.1±3.7 ^{0}c), dissolve oxygen (7.2±2.9 and 5.2±1.5 mg/L) and pH (7.4±1.0 and 6.5±0.8) observed, respectively, in dry and wet season rice-fish fields with inorganic fertilizer were not significantly different (P>0.05) to that of rice-fish fields with organic fertilizer. Ammonium-nitrogen concentrations were (1.08 mg/L) were significantly higher (P<0.05) in dry season rice-fish fields treated with inorganic fertilizer to that of wet season rice-fish fields. Nitrite+nitrate-N (0.06±0.04 to 0.115±0.04 mg/L) and phosphate phosphorous (0.0.074±0.03 to 0.14±0.47 mg/L) were rather low, in spite of frequent fertilization at 7 Mt. /ha organic manure and 100-30-30 kg/ha NPK, respectively, in ricefields treated with organic and inorganic fertilizer. Mean value of chlorophyll$_a$ concentration (42.1 µg/L) was significantly higher (P<0.01) in dry season rice-fish field with inorganic fertilizer than the rest of the treatments. Fourteen species of phytoplankton belonging to 5 family and seventeen species of zooplankton were observed in ricefields. Zooplankton densities were 76±16 and 145±19 ind. /L, respectively, for rice-fish fields treated with organic and inorganic fertilizer. Differences were observed amongst populations of rotifer, copepoda and cladocerons in fertilizer treatments but the trends were inconsistent. The mean fish yield, at density 5000/ha with *Cyprinus carpio*, was 364±77.2 kg/ha and 294±60.4 kg/ha, respectively, for organic and inorganic fertilizer treatments. Low water level, declining water pH and temperature at later stage of rice growing period did affect (P<0.05) the growth and survivability of fish in rice field. The mean yield of dry season rice (IR 9729 or Chaite 4) was 3.8 Mt/ha and 4.2-4.3 Mt/ha, respectively, for fields with rice monoculture and rice-fish integration. For wet season rice Savitri, the mean yield was 3.6 Mt/ha irrespective of treatments. Although not significant, rice yield during dry season increased by 11.8% in rice-fish fields over rice monoculture. Presence of fish through its role on biopurturbation and grazing on photosynthetic aquatic organisms could have played greater role to influence rice yield.

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Ecological and economical complementary between integrated pest management and rice-fish farming

Wagle, SK, TB Gurung and JD Bista (2006). Ecological and economical complementary between integrated pest management and rice-fish farming. *Proceedings of the National Seminar on Natural Resource Management,* February 13-14, 2004, Biratnagar, Nepal. 164-174

Rice-fish farming as an ecological farming practice started around 1960 but could not be adopted well in Nepal until 2000. One of the reasons of poor adoption is thought to be the indiscriminate use of pesticide in rice field. In last several decades use of pesticide for pest and disease eradication was seemed to be indispensable for increasing rice production. However, the use of insecticides has imposed several threats for long-term environment sustainability. For increasing rice field productivity, integrated pest management has been advocated as one of the safest option. In this juncture, here, we provide theoretical and practical evidences that rice-fish farming has the ecological and economical complementary with Integrated Pest Management (IPM). Fish as a biological control of insects, snails and certain diseases of rice, offer an attractive and safe alternative to chemical methods of control. Several studies have demonstrated that incidence of pest and disease in rice-fish systems decreased by 12-75% compared to rice in monoculture. Field experiments demonstrated that rice-fish farming could increase up to 12% of rice production and substantial income by fish production of about 529 kg/ha in the rice fields.In the perspective of increased economic benefits based on improved ecological management; rice-fish farming provides an interesting opportunity for encouraging the adoption of IPM. There are several evidences showing that the adoption of IPM reduces the pesticide use in rice fields. Decreased pesticide use enhances fish farming practices and the fish, in turn can act as a natural control agent of pest organism. These complementary effects are economic in nature: the income by the harvesting of fish in rice fields shift the economic threshold of applying pesticide (main decision-criteria in IPM) to a level which is very rarely reached by pests. Rice-fish farmers, therefore, tend to use less pesticide and may increase their income not only from decreased cost of pesticide, but also increased yield of fish. Matualism between IPM and Rice-fish culture is that the fish, as a part of ricefield ecosystem, creates a strong incentive to apply ecologically sound pest control methods. This way of integration of IPM and rice-fish culture can speed up the diffusion of IPM as well as rice-fish culture technology. Wider adoption of IPM and rice-fish culture could provide long-term sustainability for an efficient and environmentally sound production of food.

Effect of fertilizer on water quality and, rice and fish production in dry season rice-fish farming

Wagle SK, TB Gerung and GP Lamsal (2006). Effect of fertilizer on water quality and, rice and fish production in dry season rice-fish farming. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Neapl*, Khumaltar, Khumaltar, Lalitpur, 1-2 July, 2004, pp 195-202

Physical and chemical parameters of water will determine species that can survive in rice fields. Fertility and primary productivity are important in rice-fish farming because they affect food availability for fish. The effect of fertilization practices on physico-chemical properties of water in rice-field is largely undocumented. Water quality parameters affecting fertility and productivity of rice-fish farming were studied for dry season rice in Tupche, Nuwakot and Khudi of Kaski during March to July 2000. Parameters were obtained for irrigated rice-fish fields to assess the effect of organic and inorganic fertilizer on water quality. Water temperature (26.8±5.5 ^{0}c), dissolve oxygen (7.2±2.9 mg/L) and pH (7.4±1.0) observed in dry season rice-fish fields with inorganic fertilizer were not significantly different (P>0.05) to that of rice-fish fields with organic fertilizer. Nitrite+nitrate-N (0.064±0.04 to 0.071±0.03 mg/L) and phosphate phosphorous (0.096±0.06 to 0.14±0.047 mg/L) were rather low, in spite of frequent fertilization at 7 Mt. /ha organic manure and 100-30-30 kg/ha NPK, respectively, in rice fields treated with organic and inorganic fertilizer. Mean value of chlorophyll $_a$ concentration (42.1 µg/L) was significantly higher (P<0.01) in rice-fish field with inorganic fertilizer than the rest of the treatments. The mean fish yield was 364±77.2 kg/ha and 294±60.4 kg/ha, respectively, for organic and inorganic fertilizer treatments. Low water level, declining water pH and temperature at later stage of rice growing period did affect (P<0.05) the growth and survivability of fish in rice field. Although not significant, rice yield increased by 11.8% in rice-fish fields over rice monoculture. Presence of fish through its role on biopurturbation and grazing on photosynthetic aquatic organisms could have played greater role to influence rice yield.

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Polyculture potential of Nile Tilapia with fresh water snail and their competition for attached micro-organisms

Shrestha MK and CF Knud-Hansen (1990). Polyculture potential of Nile Tilapia with fresh water snail and their competition for attached micro-organisms. *Journal of Institute of Agriculture and Animal Science (IAAS),* Rampur, Chitawan, **11:15**-25

An experiment was conducted in outdoor tanks for 8 weeks with additional plastic baffles and bamboo poles to increase the surface area for the attachment of micro-organisms. Feeding of attached micro-organisms by Nile tilapia (*Oreochromis niloticus*) and feeding competition with substrate grazer fresh water snail (*Viviparus* spp.) were studied. Assessment of attached micro-

organism biomass showed significantly higher ($P<0.05$) dry weight (DW) and ash free dry weight (AFDW) in "no fish" system compared to mono and polyculture "fish" system. Nile Tilapia polycultured with fresh water snail resulted the competition index of 22.9% for Nile tilapia.

Production potential of fish fingerlings in nursery cages in the Lakes of Pokhara valley

Wagle SK, S Prasad, RM Mulmi and M Wada (1996). Production potential of fish fingerlings in nursery cages in the Lakes of Pokhara valley. *Proceedings of the first National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, 7-9 May, 1996, pp283-291

Fish fry nursing studies were carried out in nursery cages in the three Lakes of Pokhara valley. These studies focused on growth potential of Lakes based on natural production, season and fry density on the production of Silver Carp (H. molitrix) and Bighead Carp (A. nobilis) fingerlings. The results showed that the lake Phewa had positive response on fingerlings production in wet season (July to Oct). Lake Phewa showed the highest weight gain of 55.9 g in Silver Carp and 19.1 g in Bighead Carp. Lake Begnas was the poorest among three lakes while Rupa Lake stands in intermediate in accelerating the growth of Silver and Bighead Carp fry. Fry growth of Silver Carp was significantly differed between the Lakes. Abundance of zooplankton in these lakes affected the growth of Silver and Bighead Carp fry. Water temperature was the most critical element in determining the growth of fry during winter season (Oct – Jan) in both Phewa and Begnas Lake. The treatments mean yield from density trial was 0.5, 1.0 and 1.5 kg /m^3 in Lake Phewa, respectively for density 100, 300 and 500 tails / m^3. All the density treatment in Begnas resulted in loss of gross stocking weight at harvest.

Growth performance of carp fry in different density and feeding management in lakes of Pokhara valley

Wagle SK and S Prasad (1999). Growth performance of carp fry in different density and feeding management in lakes of Pokhara valley. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research*, Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, pp 70-77

Improvement of nursery technology in flOating net cages has become the primary concern to sustain availability of suitable fingerlings in time for fishery in the Lakes of Pokhara valley. In line with this, several experiments on growth and yield of carp fry in flOating nursery cages with the effect of different density and feeding management were carried out. These studies focused on growth potential of Lakes, season and fry density on the production of Silver carp (*Hypophthalmict molitrix*) and Bighead carp (*Aristichthys nobilis*) fingerlings. Water temperature was the most critical element in determining the growth of fry during winter season (October –January) in both Phewa and Begnas Lakes. The treatment's mean yield from density trial was 0.5, 1.0, and 1.5 kg/m^3 for Silver carp in Phewa, respectively for density 100, 300 and 500 tails /m^3. All the density treatment in Begnas resulted in loss of gross stocking weight at harvest. Fish fry of Bighead carp were stocked at densities of 250, 500 and 1000 fry /m^3 of water volume. Fish fry fed ad libitum for 120 days with a ration containing 19% crude protein. The absolute growth rate of fry was increased significantly ($p<0.01$) within and among densities between each sub period. The fry of Bighead carp showed highest net weight gain of 6.2 g/fry for density 250 fry/m^3 followed by 5.2 g/fry for density 500 fry/m^3. A high feed conversion ratio associated with high density was observed.

Effect of stocking size, breeding and rearing management on the growth and production performance of Common carp (*Cyprinus carpio L.*) in cage culture

Wagle SK, JD Bista and S Prasad (2000). Effect of stocking size, breeding and rearing management on the growth and production performance of Common carp (*Cyprinus carpio L.*) in cage culture. *Proceedings of the 4th National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Pakhribas, Dhankuta, 24-26 April, 2000, pp 15-23

In order to explore the potential of cage culture of Common carp, a series of experiments on size, feeding and rearing management of Common carp in cages were carried out since 1997 for three years in the lakes Phewa nd Begnas of Pokhara valley. The highest mean absolute daily weight gain (2.36g/day^{-1}) was large size fish stocked (122.6 g) and the small size fish stocked (27.8 g) gain weight at the rate of 1.63g/day $^{-1}$. The mean yields were 2.1 and 4 kg m^3, respectively, for small and large size fish stocked. Cage covered from all sides improved recovery rate by 16.8 and feed utilization by 20%, 30% and 40% crude protein contained diet yielded 4.1, 4.9 and 5.1 kg m^3, respectively. Net weight gain of fish fed on 20% protein contained diet was significantly poor ($p<0.01$) compared to fish fed on 30 and 40% protein contained diets. The highest growth rate (0.37 g/day $^{-1}$) was in lowest stocking density (0.25 kg m^3 – LD1) and the growth rate was decreased with an incresing density of large size fingering (LD group). Similar trend of density related growth rate demonstrated by the small size fingerling 9SD group) with highest growth rate (0.09 g/day^{-1}) for 0.2 kg m^3 (SD1). The highest yield was 0.46 kg m^3 for loading rate of 0.75 m^3 (LD 3) and the net yield decreased proportionally with decreased loading rate. The net yield ranged was between 0.22-0.23 kg m^3 for SD group.

Productivity assessment of polyculture fish farming using different stocking densities of fingerlings

Thapa AB and PK Sah (2000). Productivity assessment of polyculture fish farming using different stocking densities of fingerlings. *Proceedings of the 4th National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Pakhribas, Dhankuta, 24-26 April, 2000, pp 39-44

Polyculture using two major carp species of indigenous carp (Rhu, Bhakur and Naini) and exotic carp (Silver carp, Bighead carp and Grass carp) stocked in two stocking ratios (80:20) was carried out for 240 days from February 1988 to October 1999 in two different densities (5000 fingerlings /ha and 7000 fingerlings/ha). Average weight of fist 40-60 g size was stocked in earthen ponds (40 x 10 m). The common carp growth was highest (4.5 g/day and 4.1 g/day when stocked exotic carps as major species (80%) in both stocking densities (7000 fingerlings /ha and 5000 fingerlings /ha, respectively) followed by silver carp (3.4 -3.6 g/fay) and Bighead carp (2.5-3.5 g/day) when stocked exotic carps as major species (80%). The growth rates of carp, Rohu and Naini were low (1.3 -1.7 g/day) with slightly higher growth rate of Bhakur (1.8-2 g/day) showing no differences either in stocking ratios or stocking densities. The productivity obtained highest 4.2 Mt/ha when stocked 5000 fingerlings/ha using exotic carp as major species (80%) followed by 3.5 Mt /ha when stocked 7000 fingerlings/ha also using exotic carp as major carp. The lowest productivity was 2.0 Mt/ha when stocked 5000 fingerlings/ ha using indigenous carp as major species (80%). The survival rates did not show much difference in all treatments and remained between 75-84%.

Effect of different organic manures on fish production

Sah PK and PL Joshi (2002). Effect of different organic manures on fish production. *Proceedings of the 5th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 10-11 July, 2002, pp 65-68

A composite fish species including Silver carp, Bighead carp, Common carp, Grass carp, Rohu and Mrigal were stocked in twelve small earthen ponds, each of 500 m2 in the ratio of 40: 20: 20: 10: 5: 5 to select the most effective type of manure for the production of fish yield. Each pond was stocked with fishes at the rate of 8000/ha. The experiment consisting of four treatments was started on 2057-6-1 and terminated on 2058-2-1, a period of 270 days. Each treatment had three replicates. The first, second, and third treatment ponds were manured by chicken droppings, pig manure and cattle manure @ 500 kg/ha/month on dry matter basis, respectively. The control pond was not provided with any manure. No feeding at all in any pond. Chicken manured ponds exhibited the highest production (3.78 Mt/ha) and this was followed by pig-manured ponds (2.49 Mt/ha) and cattle manured ponds (2.14 Mt/ha), respectively. The control pond had minimum production of 1.2 Mt/ha. However, the experiment gave non-significant result. . Fish survival in the treatment ponds remained nearly 80 % and it was 75 % in the control pond. No outbreak of disease occurred during the experimental period.

Qualitative analysis of post harvested fish

Bajracharya K and NK Roy (2003). Qualitative analysis of post harvested fish. *Proceedings of 2nd SAS-N Convention*, Kathmandu, 30 July - 1 Aug 2003, pp 427-431

A study was carried out to determine the quality of cultured fish species namely Rohu (*Labeo rohita*), Naini (*Cirrhina mrigal*) and Silver carp (*Hypophthalmichthys molitrix*) which were transported from Fisheries Research Centre, Pokhara to Fisheries Research Division, Godawari in frozen and chilled (with ice) conditions as well as brought from Kathmandu market to Fisheries Research Division, Godawari. Fishes from Fisheries Research Centre (FRC), Pokhara were found good quality compared to Kathmandu market fishes in terms of bacterial load and by observing organoleptic test (appearance, colour of gills, texture of flesh and smell). But crude fat and crude protein level of fish species from Kathmandu market and FRC, Pokhara were not significantly different (P>0.05). The bacterial load of FRC's fish was found lower and ranged from $103x10^3$-$36x10^3$ CFU/g in comparison to the market fish, which was, found $132x10^4$- $265x10^4$ CFU/g in chilled condition in Rohu, Naini and Silver carp. But the total number of bacteria was increased after transportation of fresh fish in chilled condition. There were no significan differences in the content of crude fat and crude protein in sun dried fish and smoked fish (P>0.05) but smoked fish was better than sun dryied fish due to the presence of low number of bacteria. The bacterial numbers were found higher in sun-dried fish than in the smoked fish and ranged from $123x10^3$ - $43x10^4$ CFU/g than in the smoked fish and ranged from $99x10^2$ - $84x10^3$ CFU/gin the sun dried fish. The results showed that smoked fish can keep better quality than sun dried fish due to presence of low number of bacteria.

Cage cum pond fish productionusing mixed sex Nile tilapia

Rai AK and MB Shrestha (2004). Cage cum pond fish productionusing mixed sex Nile tilapia. *Proceedings of the 5th National Animal Science Convention (NASA),* Kathmandu, Oct 15-16, 2004, pp 55-62

A model on "cage cum pond fish culture for mixed sex Nile tilapia production" for subtropical Nepal developed by IAAS-NARC and studied at IAAS station. Model proposes two-production cycle from 16 July to 15 December 2000 as the first cycle (cycle- 1) and from 16 February to 15

July as the second cycle (cycle- 2). December 16 to February 15 is proposed as non-productive months as temperature drops below 20°C. Production potential of proposed model was evaluated. System produced net output yield of 25.5±0.9 kg and 31.4±2.5 kg in cycle- 1 and cycle- 2, respectively, with a total annual yield of 56.9±1.7 kg/72 m^2 ponds equivalent to net yield 7.9±0.4 t/ha/yr. System supplied fish to restock in cage as well as in pond. Excess new recruit produced, after restocking in ponds, were 15.3±2.6 kg and 9.4±1.2 kg in cycle- 1 and cycle- 2, respectively, with total of 24.7±1.7 kg/year from each pond. Feed conversion ratio (FCR) was 1.5 and 1.2 in cycle- 1 and cycle- 2, respectively, with mean ratio 1.3. The developed technology was verified for 4-month from 21 August to 21 December 2001 in cycle-1 and for 5-month from 12 February to 19 July 2002 in cycle-2 in farmers' ponds at Kathar Village Development Committee–1, Kusahana, Chitawan. Three farmers owned 100-110 m^2 size ponds involved in Cycle–1 and four farmers owned same size ponds involved in cycle-2. System produced mean net output yield of 17.7±2.2 kg and 24.7±1.3 kg in cycle-1 and cycle-2, respectively, with a total annual output yield of 42.4 kg/100 m^2 ponds equivalent to net yield 4.41 t/ha/yr. Excess new recruits produced, after restocking in the ponds, were 2.5 kg and 7.9 kg in cycle-1 and cycle-2, respectively, with total of 10.4 kg/year from each pond. Feed conversion ratio (FCR) was 1.4 and 1.5 in cycle-1 and cycle-2, respectively, which was about similar to the station. Net output yield in farmer's pond condition was lower compared to previous on station yield, which might be due to one month less culture period in cycle-1 as well as week management, which should be improved. However, the model seems viable to produce marketable size Tilapia of 250-300g and is applicable to other farmers particularly small farmer will be more benefited.

Grass carp – Nile tilapia polyculture: a low cost fish culture practice for small farmers

Pandit NP and MK Shrestha (2004). Grass carp – Nile tilapia polyculture: a low cost fish culture practice for small farmers. *Proceedings of the 5th National Animal Science Convention (NASA)*, Kathmandu, Nepal, Oct 15-16, 2003, pp 91-98

An experiment was conducted in outdoor concrete tanks (4.9 m x 4.8 m x 1.75 m) at the Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan, Nepal to assess the growth of grass carp and Nile Tilapia with Napier feeding in polyculture system. The experiment was laid out in a completely randomized design with five treatments replicated thrice. Five stocking ratios of grass carp to Nile Tilapia were tested: (1) grass carp only at 0.5 fish/m^2 (control); (2) grass carp at 0.5 fish/m^2 plus Nile tilapia at 0.25 fish/m^2; (3) grass carp at 0.5 fish/m^2 plus Nile tilapia at 0.5 fish/m^2; (4) grass carp at 0.5 fish/m^2 plus Nile Tilapia at 1 fish/m^2; (5) grass carp at 0.5 fish/m^2 plus Nile Tilapia at 2 fish/m^2. Grass carp fingerlings (39.3±2.3– 6.6±0.2 g, mean±SE) were stocked on 26 May 2002, while mixed-sex Nile Tilapia fingerlings (9.0±0.1– 0.0±0.2 g, mean±SE) were stocked 6 days later. Chopped fresh Napier grass leaf was the sole nutrient input and provided ad libitum daily. Mass mortality of Grass carp (100%) occurred in all three replications of the monoculture (Treatment 1) during the 12 weeks of the experimental period due to low dissolved oxygen. Survival of Grass carp was not significantly different among the polyculture treatments (Treatment 2 through 5) ($P>0.05$). At harvest, the mean weights (634.90±28.4 g/fish) and daily weight gains (3.14±0.2 g/fish/d) of Grass carp in Treatment 3 were significantly greater than those in other polyculture Treatment ($P<0.05$). Net fish yields were highest in treatment 3 (12.60±1.0 kg/ha/d), intermediate in Teatments 4 (9.78±1.0 kg/ha/d) and 5 (9.99±1.0 kg/ha/d), and lowest in Treatment 2 (9.00±0.6 kg/ha/d) ($P < 0.05$). Survival of Nile tilapia was 100% in all polyculture treatments. Mean weights of Nile tilapia at harvest decreased linearly with increased stocking densities, while mean net fish yields of Nile tilapia increased linearly ($P<0.05$). There were no significant differences in all measured water quality parameters. Optimal ratio of Grass carp to Nile Tilapia

in polyculture fed Napier grass is 1:1 in the present study, i.e., Grass carp at 0.5 fish/m^2 plus Nile Tilapia at 0.5 fish/m^2. Addition of Nile Tilapia to the grass carp tanks fed Napier grass as the sole nutrient input can efficiently utilize available resources, reuse wastes derived from Grass carp, increase total fish production. The present study has also demonstrated that the Grass carp – Nile Tilapia polyculture fed Napier grass is a low-cost alternative aquaculture system for small-scale poor farmers.

Stocking effectiveness and interannual yield variation of fishery in Begnas Lake, Nepal with reference to stock and recapture, and self-recruiting populations

Wagle, SK, TB Gurung, JD Bista and I Hussain (2007). Stocking effectiveness and interannual yield variation in Begnas Lake fishery in reference to stock, recapture and self recruiting populations. *Journal of Institute of Agriculture and Animal Science (IAAS),* Rampur, Chitawan, **28**: 105-114.

Stocking effectiveness, interannual variation and growth rate in yield per species from Begnas Lake, Pokhara valley, Nepal was analyzed by using historical long-term (1994 to 2005) landing data. The potential relationship of the numbers of stocked fish to yields was evaluated using time-lapse analysis. Species-wise interannual variations were defined in terms of absolute and relative variation around the mean yield and long term trends in catch levels. The most important fishing gear used in Begnas Lake is the gill net by which about 95% of the total fish landing is caught. The capture fishery of lake Begnas based on the annual stocking of advanced fry/fingerlings of 0.5 to 5.0-g Bighead carp (*Aristichthys nobilis*), Silver carp (*Hypophthalmichthys molitrix*), Rohu (*Labeo rohita*) and Bhakur (*Catla catla*), as well as self-recruiting indigenous species Bhitte (*Puntius spp.*), Rewa (*Cirrhinus rewa*) and several minor species. On average, the regularly stocked species contribute 74% of the total production, which has been around 33.2-44.1 kg/ha^{-1} in the last few years. A monthly peak catches of stocked species occured between November to January. Based on landing size, a significant relationship ($P<0.05$) between stocking density (SD, n kg^{-1}) and the yield of all stocked species in combination in year n+2, 3 (Y, $kg.ha^{-1}$) exist was:

$$Y\ (n+2,3..) = -0.001\ SD^2 + 0.276\ SD + 37.54\ (r^2 = 0.62,\ P = 0.049)$$

Annual variation of stocked fish species was directly related to yield indicated by higher absolute variation (37%) than the relative variation (19.7%). Self-recruiting species Rewa (*Cirrhinus rewa*) showed large variation in annual yield. This might have occurred because of variation in annual recruitment. Trends in yield rate of major fish species for 12-year periods revealed a sharp decline in the catch of self-recruiting species. The conclusion is that the fishery of native species of Begnas Lake is an overexploited fish stock. To stabilize the fishery, the existing stocking structure needs to be reoriented and strengthened, and more effectively implemented. An effective stock protection policy is also suggested.

Growth performance of Sahar (*Tor putitora*) in earthen pond in Pokhara Valley

Bista JD and SK Wagle (2004). Growth performance of Sahar (*Tor putitora*) in earthen pond in Pokhara Valley. *6th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur 1-2 July, 2004, pp 189-194

Indigenous species are often promoted as alternatives to introduction of exotic species for aquaculture development. They may be preferred locally, may contribute to preservation of biodiversity, and help maintain integrity of aquatic communities and ecosystems by appropriate management. Being indigenous, Sahar, *Tor putitora,* seemed good candidates for aquaculture. Growth potential of Sahar in captivity needs to be exploited for its commercial culture. Growth experiment of Sahar was conducted in earthen ponds at Pokhara valley during April 2002 to March 2003. The experimental fish used were of third generation of captive

breeding from the natural parental stock. The two Treatments of stocking size of Sahar viz. 4 g (3 months old) and 100 g (1 year old) were established at a density of 4000 individuals/ha. A ration containing 35% crude protein was fed to the fish at an average rate of 7.3% of total live weight. There was a marked difference ($p<0.05$) in weight gain between Treatments during May to August. Total weight gain of 256.0±8.48 g for one year old Sahar (100 g group) was significantly ($p<0.01$) higher than the total weight gain of 139.0±7.07 g for three months old Sahar (4 g group). One-year-old Sahar grew at the rate of 0.7 g/fish/day while the growth rate of three months old Sahar was 0.38 g/fish/day.

Evaluating growth performance of Himalayan Sahar (*Tor putitora*) for aquaculture development in mid hills and southern plain Nepal

Bista JD, SK Wagle, MK Shrestha and AB Thapa (2007). Evaluating growth performance of Himalayan Sahar (*Tor putitora*) for aquaculture development in mid hills and southern plain Nepal. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, June 25-27, 2007, pp 49-53

Promotion of indigenous species in aquaculture is imperative for sustainable aquaculture production and conservation of aquatic biodiversity. Indigenous Sahar (*Tor putitora*) constituted substantial natural fishery in major riverine and lacustrine ecosystem of Nepal in past. Presently their diversity has been threatened by various anthropogenic activities, presently considerable development has been achieved on artificial propagation of this species. Performance of *T. putitora* on its growth and yield in different eco-region are under evaluation. Growth experiment of Sahar with different age cohort was conducted in ponds at Pokhara valley and Tarahara, representing northern mid hill and southern plain, respectively during February 2005 to July 2005. The growth of Sahar was faster in warmer environment as evidenced by significant different ($P<0.05$) in body weight gain was found between Tarahara (66.5g) and Pokhara (52.8g) after 120 days of rearing of small size (3.5-4.0g) Sahar at mean water temperature of 26.3 and 29.1 ^{o}C, respectively. Differences in initial stocking size were also found to affect growth rate of Sahar. Sahar stocked with initial average weight of 4.0 g grew at the rate of 0.40 g.day^{-1} while the growth rate of large size (24.9g) Sahar was 0.49 g.day^{-1} during February to June in Pokhara and the differences were significant ($P<0.05$). One-year old fingerling of Sahar (50.9g) grew much faster (1.12 g.day^{-1}) and attained final weight of 219.4 g within 150 days in Tarahara. These results indicate that Sahar has a growth potential comparable to that of slow growing aquaculture species (viz. Rohu), but comparatively fetch a very high market price and is of high cultural value.

Fish production system in Sunsari and Morang district

Bhujel RB, KP Gautam and AB Thapa (2007). Fish production system in Sunsari and Morang district. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, June 25-27, 2007, pp 36-44

A survey on fish production system in Sunsari and Morang districts was carried out during 2060/61. Farmers were interviewed through a semi structured questionnaire which was modified after pre testing. Among the sample farmers, the average family size was 6.9 with an average operational holding of 2.7 ha and 188.24% cropping intensity. Among them 73% had a single pond and 93% had permanent one with average water surface area of 0.28 and 0.13 ha, respectively. Average number of fries and fingerlings supplied was 17950 and 3681/ha, respectively. Average fish production was calculated as 1282.4 kg/ha. The total variable cost incurred in fish production was found to be NRs 28106.14/ha giving a gross return of NRs 78111.75/ha. Thus the net profit was obtained as NRs 50005.61/ha with a benefit cost ratio of 2.78. Fish seed shared maximum cost of 35% followed by pond maintenance of 27% of

the sample farmers. Only 11% of the cost was shared by ration. If quality fish seeds are made available at time, train the farmers to control diseases and upgrade technical knowhow, then 69% of the problems seemed to be solved in fish farming. Farmers seemed taking fish as additional production irrespective to their investment and did not pay more attention to harvest more yield. There is a scope of increasing fish yield simply by providing technical services and make them aware of shortcomings in pond culture. Although the production is comparatively lower than national average, the scope of increasing production is very high through applying improved technology in pond culture. It is however, profitable to farmers and the benefit cost ratio can still be increased by applying inputs efficiently.

Dry fish market channel in Nepal

Pradhan N, TB Gurung, A Raymajhi and NK Roy (2007). Dry fish market channel in Nepal. *Proceedings of the 7th National Workshop on Livestock and Fisheries in Nepal*, Khumaltar, Lalitpur, Nepal, June 25-27, 2007, pp 79-85

Nepal is one of the market destinations of dry fish products. To understand the status of dry fish products, market structure, stakeholders and value chain a simple study was conducted focusing some parts of eastern-central regions of Nepal. The places include Kathmandu, Lalitpur, Bhaktapur, Dolaghat, Pokhara, Malekhu, Trishuli, Betrawati foot hills, considering that dry fish should be a main protein sources for people in high hill and mountains. In our sampling a total of 25 fish marine and freshwater and 5 shrimp species were identified. Among total fish species 14 were exotic and 11 belonging to indigenous group. In general, we collected sun and smoking dried products from the local market. This study showed India and Thailand are the main exporting countries of dry fish and shrimp in Nepal. Later more studies will require figuring out the total consumption and status of dry fish market in Nepal. The main consumers of dry fish are mostly Newar and Tamang and all hill communities. Dry fish are consumed for the household's purpose, animal and poultry feed, instant noodle industry and flower nurseries.

Nutritional and hygienic condition of smoked fish in Chisapani (Karnali River basin), Kailali, Nepal

Prada N, SK Waggle and A Rayamajhi (2010). Nutritional and hygienic condition of smoked fish in Chisapani (Karnali River basin), Kailali, Nepal. *Proceedings of the 8th National Workshop on Livestock and Fisheries Research in Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

Locally processed indigenous fish are delivered to the consumers by fisher and other communities settled near by wetland (river, Lakes, etc). From the consumers prospective, the information on quality and hygienic condition of such preserved fish is meager. Therefore, a survey on local fish processing was carried out at Chisapani (Karnali River basin), Kailali, a well known spot for availability of dry fish, in 2009 to explore the fish drying methods, quality and market of dried fish. The survey included on-the-spot observation, interview with fish venders and, nutritional and microbial assessment of collected samples of most commonly dried fish, Sahar (*Tor putitora*) and Kalanch (*Labeo* sp.). Fish caught from Karnali river were smoked and preserved by hoteliers in highway corridor of Chisapani for marketing. Proximate analysis of smoked fish revealed that the nutritive value of collected samples ranged between 43.4-59.3% of crude protein, 10-19.4% fat and 12.32-18.4 % of ash. High moisture content (23.7%) was evident for Kalanch; however, all samples exceed 10% of the permissible moisture content. Microbial examination of dried fish exposed the presence of mold was between 37 x 10^2 to too numerous to count (TNTC); yeast between 77 x 101 to 16 x10^2. *E. coli*, and coli form were evident in some of the fish samples while *Staphylococcus* sp. was enormous in all samples.

Survey and analysis suggest that locally processed fish at Chispani were not hygienic at current state of drying. The need of training and capacity building program for fish processing to the fish vending communities have been suggested.

Fish Fauna of the Narayani and Rapti River systems in Chitawan, Nepal

Jha DK, MK Shrestha and SC Rai (1989). Fish Fauna of the Narayani and Rapti River systems in Chitawan, Nepal. *Journal of Institute of Agriculture and Animal Science (IAAS),* Rampur, Chitawan, **10**:97-107

Fishery inventory of the rivers Narayani and Rapti along with their feeder streams, namely Trisuli, Marsyangdi, Khageri, Budhi Rapti and Lother River in Chitawan district was made to record existing fish fauna in these rivers. Sixty-eight species of fishes belonging to 9 orders and 19 families were recorded. List concerning kind, occurrence and distribution of the fishes in the various sections of these rivers are discussed.

Fish and benthic fauna in Kulekhani reservoir, Makwanpur

Saud TB and J Shrestha (2007). Fish and benthic fauna in Kulekhani reservoir, Makwanpur. *Nepal Journal of Science and Technology,* Nepal Academy of Science and Technology (NAST*),* Khumaltar, Lalitpur, **8:** 63-68

Physico chemical parameters of Kulakhani reservoir at surce were in satisfactory level for cage fish culture. This paper has reported only two indigenous fish species in the reservoir namely Katle (*Neolissocheilus hexagonolepis*) and Karange (*Nazirator chelyonides*) comprising only 2.4% and 1.36%, respectively whereas other exotic fish species mainy carps i.e. Bighead carp (*Aristichthys nobilis*) and Silver carp (*Hypophthalmichthys molitrix*) were dominant group of fish fauna in the reservoir comprising 96.24% at study sites. Average fish production of cage culture in Kulekhani reservoir was 3.8 kg/m^3/year. This study also reported only two groups of benthic fauna at the study sites namely Oligochaeta and Chironomidae comprising 95.52% and 4.417%, respectively in their abudance.

Survey of fish species and environmental variables in Kali Gandaki River near dam of Kali Gandaki "A" Hydroelectricity Project

Wagle, SK, JD Bista, AP Baidya and RM Mulmi (2000). Survey of fish species and environmental variables in Kali Gandaki River near Dam of Kali Gandaki "A" Hydroelectric Project. *Proceedings of the Fourth National Workshop on Livestock and Fisheries Research in Nepal*. Agriculture Research Station, Pakhribas, Dhankuta, Nepal, pp 24-30

The construction of Hydroelectricity dam was in underway in Kali Gandaki and richness of its ichthyofauna make the Gandaki River an excellent case study in fish biodiversity changes in pre and post impoundment conditions. Seasonal variation in fish diversity and water quality was captured by sampling in July, November and March in order to represent the pre-impoundment condition of Kali Gandaki River in term of fish species and water quality. Twenty-four fish species under 7 families was collected from Kali Gandaki and Aandhi Khola near Kali Gandaki hydroelectricity dam. Kali Gandaki and Aandhi Khola represented 23 species of 7 family and 17 species of 3 families, respectively, during the sampling period. Of the 24 species, 10 species were commonly occurring and 12 species were fairly common, while 2 species were scare as reported by fisher. The Cyprinids *Barilius bendelisis* and *B. vagra* were most common fish species in pools and runs of these areas occurring in every season. The loach species *Noemacheilus shebbearei, N. Rupicola* were also the most common fish species. Water temperature of Kali Gandaki (in Project site) ranged 15.5-23.1^{0}c. Other water quality were between dissolved oxygen 8.9 to 13.1 mg/l, pH 7.4 to 8.1, total dissolve solids 94.3 to 176.0 mg

/l , ammonium –N 0.0– 0.084 mg /l , NO_2 + NO_3 0.01 to 0.19 mg/l , PO_4–P 0.007 to 0.017 mg/l and chlorophyll$_a$ 1.0 to 1.6 μg/l.

Fish catch data and estimation of maximum sustained yield in a part of Trishuli River

Joshi PL and AP Nepal (2004). Fish catch data and estimation of maximum sustained yield in a part of Trishuli River. *Proceedings of the 5th National Animal Science Convention (NASA),* Kathmandu, Nepal, Oct 15-16, 2003, pp 81-84

Daily fish catch data was collected from the territory of Rijalghat (a part of Trishuli river) extended to 5.69 ha during the experimental period from July 1995 to June 1996 to estimate the fish yield per unit area and maximum sustained yield (MSY). The fish yield computed from morphoedaphic model remained 61 kg/ha/yr and it was very close to the actual fish yield 53 kg/ha/yr. Maximum sustained yield (MSY) depicted from catch effort curve was 93kg/ha/yr and it was exactly same to the value computed by regressing the catch per unit effort. The instantaneous mortality (Z) equaled to 0.36 and the fishing mortality (F) remained 0.34 because the natural mortality (M) 0.02 was almost negligible. Based on collective catch data fish density seemed to be 2502/ha. Higher exploitation rate (E =29 %), an indication of over fishing raised the fishing mortality (F=0.34). Restriction of exploitation rate to nearly 20% and fishing mortality (F) equaling 0.22 seemed to limit the fishing efforts from 290-300 and fish population in a steady state.

Livelihood assessment of capture fisheries of Koshi River in Nepal

Bhujel RB, AB Thapa and KP Gautam (2007). Livelihood assessment of capture fisheries of Koshi River in Nepal. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Kathmandu, June 25-27, 2007, pp 71-78

Fish capturing has been found as a basis of livelihoods of people whose main occupation is fishing and capture fishes to meet their daily needs. People capture fishes generally in public sources like river, Lakes and ponds. Koshi river is one of the most important river systems in Nepal and many capture fishers depend on it. A study in 2062/63 was carried out with the capture fishers of Koshi river from Hanuman Nagar, Koshi barrage to Chatar side. Most of the capture fishers were Mallah/ Bin, Mohamdan, Mandal, Mushar, Majhi, Khate, Chamar, Bantar, Mahato and Magar ethnic groups. Among 39 samples capture fishers the average family size was 7.56 with 3.97 male and 3.59 female members. Average school year of male was 7 with 1.48 members and that of female was 1.79 school years with 0.53 female members literate in a family. Average operational land holding was 0.21 ha with 60.19% cropping intensity and 28% did not have any holding. None of them has fish pond. Capture fishery contributed to 64% of their total income and average income was found to be NRs 34259.62/year. On an average they captured 3.96 kg of fish per day after 4.82 hrs fishing and consumed 7.8 kg of fish/month. They were found suffered from paying certain unofficial tips to local authority. None of them were acquainted with "Aquatic Act, 2055" and 61% insisted in community fish farming. They had realized the decreasing trend of high value local species and expect the prohibition on use of gill net especially with small mesh size.

Fishes of Kaligandaki hydro-dam and surrounding tributaries

Rayamajhi A, AP Nepal, SK Wagle and AP Baidhya (2010). Fishes of Kaligandaki hydro-dam and surrounding tributaries. *Sustainable use of Biological Resources in Nepal*. Publisher: Ecological Society (ECOS), P.O. 6132, Kathmandu, Nepal, pp152-160

Survey on fish diversity in Kali Gandaki reservoir and surrounding tributaries was carried out in 2005-06 for a year after the construction of the dam. Altogether 22 fish species have been

characterized and identified belonging to 3 Order, 7 Families, and 14 Genera. The Order Cypriniformes (Cyprinidae, Cobitinae and Balitoridae) constituted the highest number of fish species 16 (72.73 %) followed by Siluriformes (Siluridae, Sisoridae, Schilbeidae) 5 (22.7 %), whereas Anguilliformes (Anguillidae) constitute lowest number 1 (4.5 %). In general the species compositions have been fairly varied in upper and downstream of Kali Gandaki reservoir. Existing dam has negative effect in diversity of Gonch (*Bagarius bagarius*), Bage (*Botia lohachata*) and Thend (*Labeo angra*), were found completely disappeared from the upstream (Mirmy). Although it represented less than 2% habitat in downstream (Beltari). Likewise Khurpe (*Cyprinion semiplotum*) and Hade (*Labeo pangusia*) were not observed in Beltari but found 0.6% and 2.5% in Mirmi, respectively.

Actual fish yield and estimation of maximum sustainable yield (MSY) in up and downstream of Kali Gandaki Hydro-dam

Baidya AP, PL Joshi and AP Nepal (2010). Actual fish yield and estimation of maximum sustainable yield (MSY) in up and downstream of Kali Gandaki Hydro-dam. *Proceedings of the 8th National Workshop on Livestock and Fisheries Research in Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

Daily fish catch data was collected from upstream (Mirmi reservoir with tributaries, 80 ha) and downstream (Thulobagar to Tipuwa, 50.16 ha) of Kali Gandaki hydro-dam from May 2005 to April 2006 to determine actual fish yield and compare with estimated fish yield per unit area and assess maximum sustained yield (MSY). The actual fish yield resulted from daily fish catch data was 20 kg/ha/yr in upstream reservoir. Estimated fish yield based on Wellcomme's and Ryder's model of Morphoedaphic index (MEI) was 40 kg/ha/yr and 6 kg/ha/yr, respectively. Katle was the dominant fish (31.98%) in catch and followed by Sahar (24.37%), gardi (16.55%), Lahare (10.67%), Buduna (7.76%) and others (6.86) in upstream reservoir. MSY computed by regressing the catch per unit effort was 191 kg/ha/yr. The fish yield in downstream computed from Wellcomme's and Ryder's MEI model was 78 and 11 kg/ha/yr, respectively. The actual fish yield was 12 kg/ha/yr, very close to later model. Gardi was the dominant fish (43.84%) in catch and followed by Jalkapoor (22.04%), Katle (9.88%), Buduna (6.45%), Lahare (3.10%) and others (14.69). MSY computed by regressing the catch per unit effort was 272 kg/ha/yr. The wide variation between actual fish yield and MSY implied that major improvement required in the effort efficiency.

Temporal change in phytoplankton abundance in Lake Phewa, Pokhara

Dhakal RP, Md A Husen, SK Wagle and JD Bista (2007). Temporal change in phytoplankton abundance in Lake Phewa, Pokhara, *Proceedings of the 7th National Workshop on Livestock and Fisheries in Nepal*, Khumaltar, Lalitpur, Nepal, June 25-27, 2007, pp 59-64

Phytoplankton is one of the key suppliers of energy in aquatic ecosystem. Phytoplankton abundance, composition and activity affect dynamics of other organisms. Since, phytoplankton abundance and growth condition is important to elucidate fisheries; therefore their abundance was examined from January to December 2006. A total of twenty-three phytoplankton species were collected, where the mean monthly abundance was 2.0 $x10^3$ cells.mL^{-1}, with relatively higher values during June, August and November (3.1-4.09 $x10^3$ cells.mL^{-1}). The predominant phytoplankton was *Microcystis aeruginosa, Merismopedia tennuissima* and *Peridinium sp*. Among all Dinophyceae and Cyanophyceae increased significantly ($P<0.05$) with increasing total phosphorous. The current trend of phytoplankton abundance has been discussed in relation to fisheries management in Lake Phewa.

Changes in zooplanktons community and density with reference to nutrients in a subtropical Lake Begnas, Pokhara valley

Husen MA, RP Dhakal, SK Wagle and JD Bista (2007). Changes in zooplanktons community and density with reference to nutrients in a subtropical Lake Begnas, Pokhara valley. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, June 25-27, 2007, pp 54-58

Several species of zooplankton are used as indicators to identify different physico-chemical advection or eutrophic changes in lake. Seasonal variation of zooplanktons and nutrients plays an important role in ecosystem alteration of aquatic environment. Knowledge on nutrients and plankton dynamic of the lake provide basis for modality and extent of exploitation of fishery resources of the lakes. Therefore, monthly zooplankton and nutrients data collected from five different depth gradients of Lake Begnas for year 1995 and 2005 were analyzed and compared to investigate changes in zooplankton community and density.

Seasonal variations of phytoplankton population a natural shallow lake Rupa, Pokhara valley, Nepal

Dhakal RP, MAl Husen and JD Bista (2010). Seasonal variations of phytoplankton population a natural shallow lake Rupa, Pokhara valley, Nepal. *Proceedings of the 8th National Workshop on Livestock and Fisheries Research in Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

Presence of phytoplankton plays a vital role in aquatic environment for productivity of a Lake. Phytoplankton abundance and composition was investigated for 12 months in Rupa Lake from January to December 2007. All together seven phylla with 25 phytoplankton species were recorded in Rupa Lake during the study period. Chlorophyceae (10 species) was dominant phyla followed by Bacillariophyceae (6 species) in terms of species richness. In Rupa Lake, Bacillariophyceae (57.7%) was dominant followed by Chlorophyceae (16.5%) and Cyanophyceae (12.3%) in terms of annual mean density (cells.ml^{-1}). The predominant phytoplanktons were *Tabellaria fenestrate*, *Microcystis aeruginosa, Sphaerocystis schroeteri*, Melosira *garnulata* and *Synedra ulna*. The annual mean abundance of phytoplankton's was 2.0 x 10^3 cells mL^{-1} with highest density in May (3.6 x 10^3 cells.mL^{-1}) and lowest density in March (0.19 x10^3 cells.mL^{-1}). The abundance and compositions of phytoplankton indicates the improvement of the lake environment in terms of productivity varies in different season in the Lake Rupa.

Species composition and seasonal variation of zooplanktons in natural shallow Lake Rupa, Pokhara valley, Nepal

Husen MdA, RP Dhakal and JD Bista (2010). Species composition and seasonal variation of zooplanktons in natural shallow Lake Rupa, Pokhara valley, Nepal. *Proceedings of the 8th National Workshop on Livestock and Fisheries Research in Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

The zooplankton density and composition in lake water effect on changes of the Lake environment. Compositions and seasonal abundance of zooplanktons were investigated for 12 months from January to December 2007 in about 135 ha sized shallow Lake Rupa of Pokhara valley. A sum of 17 species of zooplanktons, among which eight species of rotifer, five of cladocera and four of copepods were recorded during the study period. Rotifers (64%) were dominants in abundance followed by Copepods (33%) then Cladocera (3%). Predominated species belongs to class rotifer were *Kerratella cochelearis*, *Polyyarthra trigala*, and *Trichocerca cylindrica* and class Copepods were *Nauplius sp and Cyclops vicinus*. The mean annual total

density was 85 individuals L^{-1} in the lake with highest, 185 individuals L^{-1} and lowest, 5 individuals L^{-1} in January and July, respectively. The total zooplanktons density fluctuated seasonally with highest abundance during winter months followed by summer and wet seasons.

Catch efforts and capture fishery in lakes of Pokhara valley: status and management perspective

Wagle SK and JD Bista (1999). Catch efforts and capture fishery in lakes of Pokhara valley: status and management perspective**.** *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Neapl*, Agriculture Research Station, Lumle, Kaski, Nepal, June 26-28, 1999, pp 53-69

Fish catch data were collected for a period of 5 years (1994 to 1998) from three major Lakes of Pokhara valley, Phewa, Begnas and Rupa. Catch statistics were analyzed to depict the fisheries management issues in future. Fishing gear survey interviews were conducted in 1998 to assess the degree of fishing efforts and pressure on the fish resources in the Lakes of Pokhara valley. Twenty four species of fish, of which 17 native were found in catch from the Lakes Pokhara valley. The total catch of fish was higher in Lake Phewa (50.7 t) followed by Lake Begnas (42.3 t) and the lowest were for Lake Rupa (8 t) during 1998. Species contribution to the total catch of individual lakes was varied greatly. Rohu dominated in catch for the recorded Lakes. Seasonal pattern of fish catch was almost similar for these Lakes. About 65-70% of the total catches occurred during the year 1994-1998. Growth rate of catch yield increased 4.3 and 6.6 % every year for Lakes Phewa and Begnas, respectively for a period of 1994 to 1998 whilst the catch decreased by 10.3% every year during the same period in Lake Rupa. Contribution of native fish in total catch was decreased by 12.7% every year during 1994-1998. Possible reasons for decline native fish in catch have been discussed. Three major types of fishing gear, gillnets, cast nets and fishing hooks were found in the Lakes of Pokhara valley. The gillnet was the most common fishing gear operated by fisher men with an average holding area of 5494, 5797 and 949 m^2, respectively for Lakes Phewa, Begnas and Rupa. The most common size of gillnet operated in these Lakes was between 350-450 m^2. Likewise the mesh opening (stretched) of gillnets varied greatly from 15 to 400 mm, irrespective of water bodies. The effectiveness of gillnet in catch was only 0.36 kg/m^2/year for the lakes of Pokhara valley. The pressure of fishing gear on the Lake fisheries resources has been analyzed and improvement measures have been suggested.

Limnological studies of wetland of Rampur Campus, Chitawan, Nepal

Jha DK and MK Shrestha (2004). Limnological studies of wetland of Rampur Campus, Chitawan, Nepal. *Proceedings of the 5th National Animal Science Convention (NASA),* Kathmandu, Nepal, Oct 15-16, 2003, pp 85-90

Rampur Wetland, located inside the Rampur Campus and Maize and Legume Research Program in Chitawan, is unique for its climatic physiographic and aquatic resources. A study was made to assess the physico-chemical and biological conditions of water which include air, water temperature, relative humidity, rainfall, pH, dissolved oxygen, alkalinity, conductivity and total ammonium nitrogen including fish fauna. Presence of 40 species belonging to 28 genera, 15 families and 6 orders have indicated that the resource supported rich and varied indigenous stock of carps, loaches, catfish, snakehead, feather back, gobies, perch, mud eel, spiny eel. Some species of fish have declined. The catch composition has changed towards abundance of species of lesser economic importance. The significance of wetland for conservation and management of fish genetic resources is highlighted. Approach for utilization of existing resource is needed.

A case study on participatory approach of Phewa lake fisheries, management, research and conservation for livelihood improvement of fishers in Pokhara, Nepal

Gurung TB, SK Wagle, JD Bista, RP Dhakal, PL Joshi, R Batajoo1, P Adhikari[1] and AK Rai (2003). A case study on participatory approach of Phewa lake fisheries, management, research and conservation for livelihood improvement of fishers in Pokhara, Nepal. *Proceedings of 2nd SAS-N Convention*, Kathmandu, 30 July - 1 Aug 2003, pp

This case study is focused on a participatory fisheries management of Lake Phewa by incorporating a fragile fisher community known as "Pode" or "Jalari" living around lakes of Pokhara Valley. The community was deprived of traditional agricultural land, skill, job and income in early 1960's. Thus, most of them had a nomadic life traveling from lakes, rivers and wetlands carrying a cast net for fishing to feed their family till 15-20 years back. In early 1960-70's when fish catch declined in lakes due to over fishing, the only one source of their livelihood was threatened. Meanwhile, Pokhara Fisheries Station was established in 1962 at the bank of Lake Phewa with a mandate to support for rehabilitation with job and income through subsistence cage aquaculture. At the beginning only a single $50m^3$ cage was given to a family. The technical guarantee of fish production by fisheries station was considered as collateral for repayment. At present, fish production in Lake Phewa is estimated to be 150 kg. Ha-1, producing about 75 Mt fish from cage fish culture and open water recapture fisheries in 2002. The income from fish production was shared among the local fisher families, which has brought substantial changes in livelihood of the fisher community. Cage aquaculture was one of such a farming system by which the deprived community has been able to alleviate poverty. Indeed, the present achievement was attributable to the fact that the community could access communal waters despite of the fact they were landless and lacked traditional agriculture skills. This strength of the community associated could be taken as an attractive entry point to improve the livelihoods of other deprived communities for bringing them in mainstream of other parts of the country. Presently, children of the community attend schools, and have achieving college level degree in the universities, however, few years before a single literate member in the community was difficult to find. Recently, the community has realized importance of resources for sustainability. They are self-motivated for removing water hyacinth, weed and devised the rules and regulation for conservation of native fisheries and other lake resources.

Participatory fisheries management for livelihood improvement of fishers in Phewa Lake, Pokhara, Nepal

Gurung, TB, SK Wagle, JD Bista, RP Dhakal, PL Joshi, R Batajoo, P Adhikari and AK Rai (2005). Participatory fisheries management for livelihood improvement of fishers in Phewa Lake, Pokhara, Nepal. *Himalayan Journal of Sciences* **3(5)**: 47-52

This paper deals with the participatory fisheries management program, aimed at and successful in livelihood improvement of fisher community known as 'Pode' or 'Jalari' living near Phewa Lake, Pokhara, Nepal. The community, traditionally depending on fishing activities for their livelihood, led a nomadic life along the rivers and lakes, carrying cast nets to feed their families. In the early 1960s, when the fish catch declined due to over fishing, the Pode's only source of livelihood was threatened. Meanwhile, the Fisheries Development Center, now Agriculture Research Station (Fisheries), was established in Pokhara in 1962 with the objective of assisting the poorest fishing communities through cage fish culture and open water fisheries. To begin with, each family was enabled to buy a single 50 m3 cage in order to start farming fish; the loans were underwritten by the local Agriculture Development Bank. The total fish production from Phewa Lake in 2001 was estimated at 98 Mt (224 kg/ha^{-1}: 52 Mt from cage culture and 46

Mt from open water recapture fisheries). The income from fish production is shared among local fisher families; it had brought substantial changes in the livelihood of the fisher community. A few years ago, it was difficult to find a literate member of the Pode community, but these days. Many children attend school and some even college. The community had realized the importance of Lake resources and devised a code of conduct for sustainable fishery. The improvement on livelihood of fisher community was attributable to the combination of participatory fisheries management with their traditional skill on fish handling as well as their easy access. Apart from supporting in livelihood of poor communities, participatory fisheries management also contributes in maintaining ecological balance of aquatic ecosystems.

Women's involvement in fisheries and aquaculture in Sarlahi district

Karna RR and J Shrestha (2007). Women's involvement in fisheries and aquaculture in Sarlahi district**.** *Nepal Journal of Science and Technology,* Nepal Academy of Science and Technology (NAST*),* Khumaltar, Lalitpur, **8:** 69-73

Study on women involvement in fisheries and aquacultur was carried out from May 10 to December 10, 2007 in Sarlahi district. The district has very high potential for the development of fisheries and aquaculture because of the availability of greater water surface area of 1161 ha. Women were highly involved in explorinf both fish and non fish commodities like Ghonghi (*Bellamya bengalensis*), Sippy (*Lamellidens marginalis*), Doka (*Pila globasa*), Prawans (*Macrobrachium spp*), Carbs (*Cancer spp*) and plant species like Makhana (*Euryale ferox*). They were also involved in different pond fish culture management programs like pond preparation, seed transportation, feeding and fertilization, fish marketing, fisheries tools and equipment and decision making programs. The study revealed that 48.35% of women were involved in fisheries and aquaculture, which was 5.06% of total population. They also generated a considerable income to assist the livelihod of their children and family but that has not been counted yet. They get the least productive share from income generated by their own effort. This was the reason that substantiated to conduct the study to present the real scenario of women in fisheries and aquaculture in the above district.

Resources management and implication of fisher women groups in lakes, Phewa and Begnas of Pokhara valley

Nepal AP, JD Bista, S Prasad, TB Gurung and DP Sharma (2010). Resources management and implication of fisher women groups in lakes, Phewa and Begnas of Pokhara valley. *Proceedings of the 9th National Outreach Workshop*, Khumaltar, Lalitpur, 7-8 June, 2010, pp 366-371

The effective conservation measures of the lakes for sustainable management are a great concern of fisher community. That introduced more effectively with an effort since the establishment of Jalari women groups recognized by "Machhapuchhre Women Group (MWG)" in 2000 and "Piple Women Group (PWG)" in 2004 at Phewa and Begnas, respectively. The primary objective of this study was to give an overview of the women's intervention into the resources management. A survey was made of 26 households in Phewa and 12 in Begnas, the members associated with the groups. Almost all respondents (94% in Phewa and 92% in Begnas) agreed with severe environmental problems mainly caused by wee infestation, pollution, silt deposition and encroachment of original husbandry. Women had a good understanding and interest on conservation of resources, biodiversity and maintaining beauty of the lakes. Most importantly, their attention had been focused on the conservation of high value indigenous Sahar (*Tor putitora*) fish. In case of their capability, women were highly capable ($p<0.05$) to perform the works if they are given such opportunity. The study showed that these women groups had been contributing relief of the problem and some form of the

intervention in the system is to perform their operations efficiently. As the consequence of the development of a participatory approach, this has been seemed as an effective mechanism of natural lake resource management.

Present status of enclosure fish farming in the lakes of Pokhara valley

Husen MA, AP Nepal and JD Bista (2010). Present status of enclosure fish farming in the lakes of Pokhara valley. *Proceedings of the 9th National Outreach Workshop*, 7-8 June, 2010, Khumaltar, Lalitpur, pp 358-365

Culture of fish in enclosure is an ecologically sound method of fish farming that is suitable for the fishers living around the natural water bodies. At present enclosure fish farming has been practiced in Begnas and Rupa Lakes in Pokhara valley. The main objectives of this study were to assess the production and productivity of enclosure fish farming with economic returns from this enterprise. Total fish production from enclosure was 34.44 Mt in Lakes of Pokhara valley. Altogether 10 enclosures with estimated area of 6.6 ha in Begnas Lake and four enclosures with estimated area of 14.5 ha in Rupa Lake are situated under enclosure fish farming activities. The fingerlings stocking has been managed the mean size of 15-20 g with stocking density 9215 and 9865/ha in Begnas and Rupa, respectively. Total fish production was 10.4 Mt with productivity 1.58 Mt/ha from enclosure fish farming in Begnas while total production and productivity was 24.04 Mt and 1.67 Mt/ha, respectively in Rupa Lake. The present status of net profit estimated from enclosure fish farming was NRs 152894 /ha from Rupa and NRs 138704 /ha enclosure of Begnas.

Mid hill river fish and fisheries: resilience to food and nutritional security among hill communities in upper Trishuli, Nepal

Gurung TB, A Raymajhi, G Lamasl, RPDhakal and SRBasnet (2010). Mid hill river fish and fisheries: resilience to food and nutritional security among hill communities in upper *Trishuli, Nepal. Proceedings of the 8th National Workshop on Livestock and Fisheries Research in Nepal*. June 7-8, 2010, National Animal Science Research Institute (NASRI), Khumaltar, Lalitpur

A mid hill river Trishuli River between Mailung and Thulo Gaun, Nuwakot situated at an elevation from 740 to 860 m was intensively sampled in three stations in approximately 6.5 Km length for aquatic invertebrates, water quality, and fish species, fishing devices and interacted on the occurrence of fish species and fisheries in May 2009. Among the fish species most abundantly collected fish was Asala (*Shizothorax richardsoni* Gray) representing more than 80% of the total catch in all sampling period. Other important fish were *Barilius bendelisis* (Hamilton-Buchanan), *Barilius vagra* (Hamilton-Buchanan), *Garra rupecula* (McClelland), *Nemacheilus multifaciatus* Day, *Nemacheilus* (Schistura) *rupecola* (McClelland); *Glyptosternum maculates* (Regan) and *Pseudecheneis sulcatus* (McClelland). During the study period local fishers reported occurrence of 13 fish species in different seasons. However, with the help of local fishers and biologist only 9 fish species were collected in during our sampling. Among phytoplankton *Synedra ulna, Navicula, Fragilaria,* Epithemia *Melosira, Nitzschia,* Scenedesmus *sp, Closeterium sp* were identified. The zooplankton recorded were *Conochilus spp*., *Trichocerca spp.*, *Calanoida*, *Daphnia, Bosmina sp.* The seasonal trend of fishing methods showed that loop-line trap was used in winter months. From October to February river water become free of turbidity then, loop-line trap (*Lahare-paso*) are used for fishing. Since *Asala* move downwards (*Udhouli*) in winter, this might be the reason that loop line trap becomes efficient fishing method. The seasonal trend of fishing gear operation and fish harvest seems related with the color pattern of water in River Trishuli. During pre to monsoon period, the melted water brings sediments, twigs and dirt, which easily strangled with net or *Lahare-paso* (loop-line fishing). Probably, this was the main reason that rod and line were preferred in these months, while

loop-line fishing becomes efficient in cool, calm, and clean river after monsoon. With the variation in fishing methods the seasonal occurrence of fish harvest also varies. The present survey showed that fishing in the river is one of the means of livelihood and food security among Tamang, Gurung, Sherpa communities providing resilience to hilly communities especially in dry periods of the year, when food grains becomes deficient in the region. Our analysis showed that the capture fisheries yield vary from 2.78±0.496, 2.32±0.58 and 3.34± 0.174 kg/day/individual, respectively in rainy, winter and summer seasons. Since several hill communities depend on fishing in hilly rivers for resilience to their livelihood especially during food deficient period, therefore careful consideration need to be taken to mobilize stream and riverine resources for future development works.

Control prospective of water hyacinth (*Eichhornia crassipes*) a most troublesome aquatic weed of Lake Phewa

Bista JD, SK Wagle, S Prasad, RK Shrestha, AP Nepal and DR Acharya (2010). Control prospective of water hyacinth (*Eichhornia crassipes*) a most troublesome aquatic weed of Lake Phewa. *Proceedings of the 9th National Outreach Workshop*, Khumaltar, Lalitpur, 7-8 June, 2010, pp 385-391

Pokhara valley posse's eight natural Lakes. Among these Phewa Lake is the biggest one (523 ha). The catchments area of the Lake is 110 Km^2. Lake Phewa used for various purposes including fisheries activities. However, the importance of the Lake for internal and external tourism is highly substantial. Many recent studies showed rapid europhication which accelerate infestation of aquatic weeds recently. The proliferation of a most troublesome aquatic weed, water hyacinth during a period of about 10 yrs has imposed a variety of socio economic impacts in the Lake which were not known in the past. Specially, the mobile water hyacinth affected various sectors including fisheries, water transportation, irrigation and tourism activities. An attempt was made for possibility of water hyacinth utilization as fish feed. Grass carp fed on weed in fresh condition and mixing with feed did not show promising results on growth of fish. In another experiment, water hyacinth was grown in earthen pond with and without Grass crap. Root length and plant growth were observed. Result showed that Grass carp may not eradicate but can only inhibit the further growth by consuming soft parts of root of the plants. These suggested that utilization of plants as fish feed has little importance. Therefore, present efforts to uproot the plants involving several governmental and non governmental agencies for eradicating plants manually would be the appropriate choice to control this weed in long run.

7. FODDER AND PASTURE

7.1 FORAGE

Preliminary screening of fodder production at livestock farm, Lampatan, Pokhara

Shrestha NP and S Paudel (1985). Preliminary screening of fodder production at livestock farm, Lampatan, Pokhara. *Nepalese Journal of Animal Science (NASA*), **1**(1):1-5

Five different types of grasses and 10 legume mixtures were planted, to study the productivity of those forages. A significant variation in green matter production among grass species and grass legume mixtures were observed. Teosinte and grass mixture produced the highest amount of green matter whereas Teosinte produced highest of TDN/unit land.

Production of crop residues in corn and corn legume inter cropping system

Pradhan DR (1988). Production of crop residues in corn and corn legume inter cropping system. *Nepalese Journal of Animal Science (NASA),* **4**:61-65

Common food legumes like Cowpea *(Vigna sinensis L.*) and Soybean (*Glycine max L.*) was intercropped with Corn (*Zea maize L*). Yield of corn with and without inter cropping of these legumes were compared and found that such inter cropping of legumes with corn do not affect the corn yield significantly, but make additional production of 5.86 tons of green cowpea pods and 1.94 tons of soybean grain/ha. Such inter cropping also increased the production of edible crop residues over straight corn growing, but however, this increase was not statistically significant (P>0.05). But such inter cropping also produces legume crops residues with better feeding value, brings extra income from green legume pods and legume grains and, helps to build up soil nitrogen. So this practice should be made wide spread among the farmers in Nepal.

Comparative study of forage yield of Ryegrass and White Clover and their composition

KC RB and BS Shakya (1988). Comparative study of forage yield of Ryegrass and White Clover and their composition. *Nepalese Journal of Animal Science* (NASA), **4:**13-18

This trial was conducted at Livestock Development farm, Jiri to study the forage yield from ryegrass (*Lolium perenne*) and white clover (*Trifolium repens*) as well as their combination. Two replications for each group and their combination were made in the plot size of 10 sqm each. Only FYM was applied @ of 20 T/ha during field preparation. Three cuttings in succession were taken and weighed from each treatment to compare the green forage yield. Forage yield from ryegrass plus clover combination was higher by 30.25% and 9.56 % than the sole cultivation of white clover and rye grass respectively.

Nutritive value of *Brachiaria ramosa* and *Imporata cylindrica* for adult sheep

Devkota NR and SB Singh (1988). Nutritive value of *Brachiaria ramosa* and *Imporata cylindrica* for adult sheep. *Journal of Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan*, **9:**63-67

Six mature non pregnant Kage ewes, each weighing about 18 kg were randomly allocated into 2 groups, and penned individually in the metallic crates. They were fed ad libitum with freshly harvested and chaffed fodder of *Brachiaria ramosa* (group A) or *Imporata cylindrica* (group B). Although the ether extracts (EE) and NFE values were similar in both the forages, *Brachiaria ramosa* contained significantly (P<0.001) higher values for CP and TA and lower values for DM and CF than in *Imporata cylindrica.* DM intakes were 605g/kg 0.5 for group A and 60.7 g/kg 0.75 for group B. Examination of the values for percentage digestibility indicated that the

digestibility of the CP in group A was significantly (P<0.001) higher as compared to that in group B. Trends towards greater values of digestibility of the remaining constituents under study were also observed in group A when compared with group B. In the N balance study, group A had consistently positive balance while it was negative in group B from day 1 to 7. However, the loss of weights of 185 g/day in group A and 300 g/day in group B suggests that *Brachiaria ramosa* forage by itself may not be complete diet where as *Imporata cylindrica* has a sub maintenance nutritional value for sheep

Fodder production in Nepal- A review

Giri MK (1990). Fodder production in Nepal- a review. *Proceedings of the 2nd Livestock Workshop* on *Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, 11-16 March, 1990, pp 42-52

Livestock production is a very important primary industry in Nepal, both on a national scale and for farm families. However, animal productivity is constrained by lack of adequate fodder. The estimated total production in Nepal is about 15 million tones of dry matter, 6.5 million tones of TDN and 0.68 million tons of Crude protein. Nationally, only meet about 70% of the fodder required by the livestock produced. Of the total land area in Nepal, 20% is crop land, 12% is grassland, 30% is forest, 5% is shrubland and 25% has other uses. Almost half the fodder for livestock comes from forest and the second major source is crop residues. Other sources of fodder are shrubland, terrace riser, fallow land and fodder trees on farmland. By appropriate development and proper management of traditional sources of fodder as well as cultivation of forage crops for strategic use in the feed supplement of improved livestock, a progressive increase in the fodder production can be achieved.

Comparative growth performances of different cultivars of Cocksfoot and Ryegrass with or without farm yard manure under Jiri conditions

Panday SB, A Grela, Y Raut and ND Joshi (1990), Comparative growth performances of different cultivars of Cocksfoot and Ryegrass with or without farm yard manure under Jiri conditions. *Nepal Journal of Animal Science (NASA)*, **7**(7)**:**43-52

The effect of 2 FYM treatments (with or without FYM) upon the performance of 2 cultivars of ryegrass and 2 cultivars of cocksfoot were investigated. The farm yard manure applied as basal dose at the rate of 8 T/ha (122 kg N/ha) was not found to bring changes in the chemical composition of the cultivars under study. Some differences in the chemical composition were detected between ryegrass and cocksfoot cultivars. Annual DM yields significantly increased by the application of FYM. When annual DM yields between different cultivars were compared, they were found significantly different. Amongst 4 cultivars investigated, *Lolium perenne* (Ranui) had the highest DM yield 11.3 T/ha, *Lolium perenne* (Khumal) 6.9 T/ha, *D. glomerata* Wana 6.2 T/ha and Currie 3.1 T/ha. Tiller density was significantly higher at the 1st cut when FYM was applied but FYM had no effect on it at the 6th cut. Cultivar Ruanui had the highest tiller density in the spring (4352 /m^2 vs 2304 /m^2 Wana, 1504/m^2 Khumal and 1344/m^2 Currie). FYM increased the plant height significantly only before the 1st cut. There were significant differences in plant height between cultivars. Cultivar Khumal had the tallest plant height (28.4 vs 24.2 cm Khumal, 13.8 Wana and 12.3 cm Currie).

Effects of cutting heights on the green matter production of Oats

Pariyar D, P Mandal and MK Shrestha (1991). Effects of cutting heights on the green matter production of Oats. *Proceedings of the 1st National Animal Science Convention (NASA*), Jan 14-15, 1991, Khumaltar, Lalitpur, Nepal, pp 52-55

An experiment comprising four cutting heights 3, 5, 7 or 9 cm of six cultivars (Kent, Swan, Amuri, Caraville, JH 810 and JH822) of Oat with three replications was conducted at Khumaltar (NPFRP) in FY 2046/47 under rain fed condition to asses forage production. Three cutting were taken 57, 45 or 37 days after sowing. FYM @ 5 T/ha. and urea @ 100kg/ha were applied as basal dose. The maximum production was harvested 39.0 T/ha fresh weight from JH 810 when cut at 7 cm. above ground level followed by Kent; 36.3 T/ha at 5cm., JH822; 33.8 T/ha at 7cm. Caraville; 33.3 T/ha at 9 cm., Swan; 32.9 T/ha at 5cm and Amory; 33.2 T/ha at 9 cm .There was no significant effect of cutting heights on green matter production.

Identification of appropriate leguminous fodders intercropped with different varieties of Oats under rainfed and irrigated conditions

Pariyar D, S Shah, P Mandal and MK Shrestha (1991). Identification of appropriate leguminous fodders intercropped with different varieties of Oats under rainfed and irrigated conditions. *Proceedings of the 1st National Animal Science Convention (NASA*), Khumaltar, Lalitpur, Nepal, Jan 14-15, 1991, pp, 34-37

Four cultivars of native legume were intercropped with four cultivars of Oat in order to assess the response of individual legume to the types of Oat both under rain fed (Khumaltar) and irrigated condition (Tarahara). The response of individual native legume to the individual cultivar of Oat was found to be different. Under rain fed condition, *Pisum lecherous* with Kent (16 Mt/ha), with Swan (18.7Mt/ha), with Amuri (15.7 Mt/ha) and *Pisum lethirus* with caraville (13.3Mt/ha) produced relative/y more forage. In the irrigated condition *Pisum lethirus*_with Kent (36.4 Mt/ha), and with caravels (32.2 Mt/ha) produced relative/y more forage. However, differences between the treatments were not significant in both the environmental conditions.

Green matter production of Oats and legume combinations at four levels of nitrogen under rainfed conditions

Shrestha RP (1991). Green matter production of Oats and legume combinations at four levels of nitrogen under rainfed conditions. *Proceedings of the 1st National Animal Science Convention (NASA)*, Khumaltar, Lalitpur, Nepal, Jan 14-15, 1991, pp 27-30

This experiment aimed to investigate the green matter production of three different combinations of Oat and legumes at four levels of Nitrogen (N_O N_{40} N_{70} and N_{100}). The levels of nitrogen significantly influenced ($P<0.01$) on the green matter production of all the combinations of Oat and legumes. The effects due to the inclusion of three different legumes and Nitrogen x Legumes interaction were not significant. The average GM yields at N_{70} (70 kg N/ha) was 20.9 T/ha i.e. 34 percent higher compared to that of N_0 level (control). An additional amount of N above N_{70} level had no significant effect on the GM production. Oat + c. vetch combination produced highest GM yield of 19.0 Mt ha^{-1} compared to that of other combinations, however, differences were not significant.

Oat cultivation as a winter fodder in Ilam district

Shrestha SR and RC Mahato (1992). Oat cultivation as a winter fodder in Ilam district. *Veterinary Review*, Pakhribas Agriculture Centra, Pakhribas, Dhankuta, Nepal, **7**(2):70-71

An experiment was conducted on 2 varieties of Oats (Swan and Kent) in a low altitude area of Ilam district so as to select a suitable variety of Oats which could give more green matter yield. The trial also demonstrated Oat cultivation to the farmers of Mechi hills. No significant difference was observed in green matter yield between the two varieties.

Oat forage production in the eastern hills of Nepal

Kshetri BB, PB Chemjong and KP Dewan (1993). Oat forage production in the eastern hills of Nepal. *Working Paper N. 93/42*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

In the hills of Nepal, lack of ruminant feed during dry winter season affects the health and productivity of animals. Oat is important forage for the winter season, particularly suited to those regions where wheat or barley is grown as a winter crop. A study was conducted in 1990/91 to investigate the productivity of Oat at different altitudes and at different times of sowing. Swan and Kent the 2 most promising varieties of Oat screened from on station trials, were further tested in 4 eastern hill districts. Trials were set out at high, mid and low altitudes, i.e. 1700-1900, 1100-1700 and 800-1100 m respectively. Two ploughing were undertaken and 3 irrigations were applied; no fertilizer was applied. Winter forage production of both varieties were found to be satisfactory, although yield was significantly higher at low altitude compared to mid and high altitude ($P<0.01$)). Fresh forage yields ranged between 7-9 t/ha (high), 11-18 t/ha (mid) and 19-22 t/ha (low). No significant differences in production were observed between the 2 varieties and different times of sowing within an altitude. However, in the case mid hills the P value for date of sowing was 3.96 compared to a tabulated value of 4.001 ($P=0.05$). It is suggested, therefore that both varieties can be grown for winter forage purposes in the hills of eastern Nepal.

Study on the effect of additional harvest of wheat as a green fodder during the dry season

Tiwari TP, YB Thapa, SP Chand and BD Gurung (1993). Study on the effect of additional harvest of wheat as a green fodder during the dry season. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **8**(1):20-22

A field experiment was conducted at PAC for two consecutive years (1990/91 and 1991/92) to determine the effect of taking a green fodder harvest from wheat on wheat grain yield. Three varieties in 1990/91 and five in 1991/92 were evaluated in a split plot design. Total biomass production (green and dry fodder) increased considerably from the double harvest treatment in both years. However, the double harvest resulted in reduced effective tillers/unit area accompanied with fewer seeds/head and smaller grains which consequently resulted in reduced grain and straw production. There was little effect on maturity period.

Preliminary results of a study of winter forage (Oat and combination of Oat and Vetch) production in the Koshi hills of Nepal

Kshetri BB, PB Chemjong and PP Rai (1993). Preliminary results of a study of winter forage (Oat and combination of Oat and Vetch) production in the Koshi hills of Nepal. *Working Paper N. 93/62*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

During the dry winter, lack of green fodder is the major limiting animal productivity in the hills. Oat and vetch are important grass and legume fodder crops of the dry winter in the Terai.

However, fodder cultivation and its production in the hills not yet been tested. Therefore, this study aims to assess the possibility of producing Oat and vetch as a fodder crop so as to fulfill green fodder requirements during winter. The importance of mixed cropping is to improve the nutritive quality of the fodder produced. Eleven sites at altitude 1020 m and 1650 m in 4 Koshi hill districts were selected. Two varieties of Oat (Kent and Swan) and one variety of Vetch were selected. Vetch was planted in combination with Kent and Swan. No compost or chemical fertilizer was applied as basal dose but 20 kg N/ha was top dressed between 20-50 days after emergence of the crop. The 1st cut was taken 75 days after sowing and 2 subsequent cuttings were taken at 45 days interval after 1st cut. The results showed that highest green forage was obtained from a mixture of Swan + vetch followed by mono-cropped Swan, mixed cropped Kent + Vetch and Kent alone. However, no significance difference between treatments was observed. The results suggested that Oat with vetch mixture is a promising means of increasing winter forage for dry winter season in the eastern hills.

Identification of suitable forage grasses and legumes for supplying fodder throughout the year at Institute of Agriculture and Animal Science (IAAS), Livestock farm

Devkota NR, SB Singh, KB Basnet and S Tiwari (1993). Identification of suitable forage grasses and legumes for supplying fodder throughout the year at IAAS, Livestock farm. *Journal of Institute of Agriculture and Animal Science (IAAS)*, Research Reports (1985-1991), Rampur, Chitawan, pp 467-480

Twelve experiments were conducted in RCBD with 3 replications in the year of 1990/91 at the livestock farm, IAAS, Rampur, for one year period to identify suitable fodder grasses and legumes for various seasons to support sustainable fodder production scheme suitable for crop livestock integrated farming system of Chitawan. Available species of legumes (6) and cereals (6) were used in experiments. They were arranged and grouped for 3 seasons on the basis of their possibilities. Seeds were sown on the 1st week of every month of the season. Soil having sandy loam in texture and P^H 6.5-7 was used in rainfed conditions with normal fertilization and intercultural operations. Two factors, fodder crops and sowing dates were taken into consideration. Out of the different species grown, Dinanath (*Pennisetum pedicellatum*) resulted best (46.8 Mt green yield/ha in Asar planting) for summer season, Lab lab (*Lab lab purpurious*) yielded significantly more (8.03 Mt green yield /ha) than Soybean (5.83 Mt/ha in Bhadra planting) to be suited for summer as a legume. Likewise, Oat (*Avena sativa*) with maximum green yield (15.83 Mt green yield /ha) and Pea (*Pisum arvens*) (7.5 Mt/ha) were best crops for winter season. Jowar (*Sorghum bicolar* (Linn) (75.4 Mt/ha) or Teosinte (*Euchlaena mexicana* (Schrad) (67.2 Mt/ha) and Cowpea (*Vigna unguculata* (L) Walp) (16.17 Mt/ha) produced maximum green fodder in Jesth planting and were considered as most suitable crops for spring season. A tentative scheme for sustainable fodder production throughout the year could be made, however, further work to see the intercropping effects of these selected species are highly recommended.

The quality ensiled Napier (*Pennisetum purpueesum*) and Gliricidia (*Gliricidia sapium*) with or without molasses

Aryal IK (1994). The quality ensiled Napier (*Pennisetum purpueesum*) and Gliricidia (*Gliricidia sapium*) with or without molasses. *Nepalese Journal of Animal Science (NASA)*, **8**(8):23-30

The composition, nutritive value and quality of ensiled Napier, Gliricidia and their combination (50:50 ratio) prepared with or without molasses were evaluated to test the effectively of ensiling as a conservation method and to determine spoilage in the silage making process, highly significant difference ($P<0.01$) obtained for DM, CP and TA content; in vitro DM digestibility (IVDMD), in vitro OM digestibility (IVOMD) and other physical and chemical

characteristics such as Ph, VFA and percent spoilage. The addition of molasses significantly ($P<0.01$) improved the Iv DMD and IVOMD and lowered the P^H and VFA level of the silage. Different color, texture and smells were also observed in the forage silage supplemented with or without molasses

Screening of Cocksfoot and Raigrass cultivars in Jiri

Raut Y, NP Joshi, AA Grela, RS Panday and SB Panday (1994). Screening of Cocksfoot and Raigrass cultivars in Jiri. *Nepal Journal of Animal Science (NASA*), **8**(8):5-14

Screening of 35 different varieties of Ryegrass and Cocksfoot were done at Jiri, Nepal. The plant characteristics such as height, tiller density, DM yield were recorded in 3 cuts. The highest cumulative yields (Mt of DM/ha) were obtained from *L. Perenne* CV Bastion (13.67). *L perenne* cv Kangaroo valley (13,.19), *L perenne* cv Peramo (13.03), *L maitiflorum* cv Lipo (12.67), *L perenne* cv Lamora (12.0), *L. multiflorum* cv Ellire (12.69), *L multiforum* cv Cervus (11.42), *L perenne* cv limes (10.9), *L multiflorum* cv fedo (10.85) and L. perenne cv Citadel (10.72). The average cumulative yield of L. perenne was 9.92 Mt DM /ha. Similarly, for *Lolium multiflorum, L. perenne x L. multiflorum* and *Dactalys glomerata* yields were found 9.4; 8.5 and 3.17 Mt DM /ha, respectively

Study of Oat production at farm condition

Shrestha SR, P Sapkota and RC Mahato (1994), Study of Oat production at farm condition. *Nepalese Journal of Animal Science (NASA)*, **8**(8):1-4

Fodder scarcity during the dry period (Nov-May) is one of the major problems in animal husbandry in Nepal. Oat cultivation could help to some extent in supplying green fodder, especially to milch animals. Therefore, an outreach experiment was conducted so as to select suitable variety which could give more yield (biomass) and exhibit demonstration effect to the farmers of Mechi hills. Two varieties of Oat vis. Swan and Kent were demonstrated at low altitude (950 m asl) at Santidada an out reach of Ilam district, in order to verify the green matter yield of on farm result on the farm condition. No significant differences were observed in biomass yield between the two varieties.

Dry matter yield and nutrient composition of *Setaria sphacelata* under row intercropping with different legumes

Pande KR and KR Tiwari (1994). Dry matter yield and nutrient composition of *Setaria sphacelata* under row intercropping with different legumes. *Journal of Institute of Agriculture and Animal Science (IAAS)*, Research Reports (1992-93), Rampur, Chitawan, pp 151-155

A study was conducted at IAAS livestock farm, Rampur, Chitawan, in 1993 with the objectives of evaluating the performance of *Setaria sphacelata* monoculture as well as in association with five legumes viz *Lablab purpureus, Pueraria spp, Pisum sativum, Stylosanthes guyanensis* and *Lathyrus sativus*. All the treatments were arranged in a randomized complete block design with 4 replications. Results indicated that *Setaria sphacelata* in combination with *Lablab purpureus* yielded highest amount of dry matter (5.55 t/ha) which was not only significantly ($P>0.01$) higher than *Setaria sphacelata* monoculture (3.83t/ha) but also to other treatments. The lowest amount of dry matter production was found in combination with *Pisum sativum* (2.9 t/ha). On the other hand, the crude protein yield/ha was highest in *Setaria sphacelata* while combination with *Lablab purpureus* produced only 9 t/ha. It was also found that the crude protein (CP) yields of *Setaria sphacelata* and *Pisum sativum* were more or less similar to *Setaria sphacelata* monoculture (0.18 t/ha). Likewise, tiller number was lowest (21/hill) in the treatment combination with *Lablab purpureus* which may be due to the competition of legume with

Setaria sphacelata for nutrient and other requirements. From this study it is concluded that *Setaria sphacelata* can be grown successfully in combination with promising legumes such as *Lablab purpureus, Lathyrus sativus, Pueraria spp* and *Stylosanthes guyanensis*. However, long term trails need to be carried out to assess the intercropping effects with respect to dry matter and nutrient yields.

An examination of the effects of differing row to row spacing on the growth characteristics of Deenanath grass

Ferris CP and Poudal GR (1994). An examination of the effects of differing row to row spacing on the growth characteristics of Deenanath grass. *Veterinary Review*, Pakhribas Agricultural Centre, Pakhribas, Dhankuta, Nepal, **9** (2) **10**(1):31-32

A trial was undertaken to examine the effects of row to row spacing on the growth characteristics of transplanted Deenanath grass. Using a Latin square design, four different row to row spacing was examined namely 30, 23, 15 and 37.5 cm. A constant plant to plant spacing of 15 cm was used in all treatments. Herbage was harvested twice during the trial row to row spacing was found to have no significant effect on plant height, tiller number/m^2 and yield of dry matter/ha ($p>0.05$). Tiller number/plant increased with increasing row to row spacing, with this effect being significant ($p<0.05$). Highest yield were recorded at the row to row spacing of 15 cm, and these were 1475 and 4637 kg DM/ha, for the 1st and 2nd harvest, respectively. It was concluded that Deenanath may be a useful fodder grass for the Dhankuta area, but that a simple method of establishment would probably be required.

Study of different cultivars of Oat for green forage production under rainfed condition

Shrestha NP and BB Kshatri (1995). Study of different cultivars of Oat for green forage production under rainfed condition. *Proceedings of the 2nd National Animal Science Convention (NASA*), Khumaltar, Lalitpur, Nepal, Aug 7-10, 1995, pp 27-29

A study was carried out in order to see the green forage production of eight most promising cultivars of Oats under rain fed conditions in two subsequent years. The result showed that there was no significant difference on the green forage yield between cultivars at (P>O. 05) for both years but significant difference was observed between years at (P<O. 01). The result pooled for two years showed that Swan produced highest green forage yield (24.14 t/ha), followed by Awapuni (23.94 t/ha), Amouri (23.31 t/ha), JHO810 (22.30 t/ha) and Kent (20.61 t/ha). From this study, it is indicated that Swan Awapuni, Amouri, JHO810 and Kent could be cultivated under rain fed conditions for green forage production during dry winter period.

An experiment of the effects of different row to row spacing on the growth characteristics of Deenanath grass

Paudel GR and CP Ferris (1995). An experiment of the effects of different row to row spacing on the growth characteristics of Deenanath grass. *Proceedings of 2ndNational animal Science Convention (NASA)*, Khumaltar, Lalitpur, Nepal, Aug 7-10, 1995, pp 46-48

A trail on Deenanath grass was conducted at an altitude of 1700 meter to examine the total DM yield and tillering effect of different R-R spacing. Though highest plant height (average 58.3 cm) and tiller number (16.95per plant, significant at 0.05 %) was observed in T-3 (25 % increased R-R spacing); maximum DM yield (average 3556kg/ha) and highest tiller number (average 433.7 per m2) was found in reduced R-R spacing by 50 %. From this study it would appear that Deenanath grass has potential as a fodder grass in a mid hill location as well.

Status and scope of forage seed production in Nepal

Panday RS (1995). Status and scope of forage seed production in Nepal. *Proceedings of the 2nd National Animal Science Convention (NASA)*, 7-10 Aug, pp 20-26

Forage seed are the basic requisites to carry out forage development activities. Since 1980, Nepal has received over 12Mt of forage seeds from overseas throughout the various agencies. Forage cultivation and rangelands improvement are new practice among the farmers. Traditional knowledge on forage production is lacking in Nepal. After the intervention of DLS, Livestock Development Project from 1980's forage cultivation and seed production activities had been popularly accepted by the farmers. At present, 4 government farms are involved in various kind of forage seed production. Over 20 different of forage crops are grown for seed production. The estimated production of forage seeds is about 55Mt in which 71% is contributed by farmers is Oat, Vetch, Berseem, Stylo, Molasses etc. There is a lack of proper marketing and distribution program and quality control measures for forage seeds. DLS has been promoting forage seed production through extension and development activities. DLS has been launching rural and bank program to promote seed production at farmers' level. It is estimated that about 1450 ha lands is brought under fodder and pasture crops each year. The domestic production of forage seeds meets only 66% of the total requirements. Due to the diversified climate Nepal has potential to grow wide range of forage seeds. Proper attention is needed to promote forage seed production, distribution and quality control to meet the domestic requirements as well as to promote export orient market of forage seeds.

Evaluation of New Zealand and other pasture species and herbs at Jiri KhiMti Farm

Shrestha KK (1995). Evaluation of New Zealand and other pasture species and herbs at Jiri KhiMti Farm. *Proceedings of the 2nd national Animal Science Convention (NASA)*, 7-10 Aug, Khumaltar, Lalitpur, Nepal, pp 17-19

Altogether 26 pasture species and herbs i.e 10 graminae, 12 leguminous and 4 herb forage species were sown at Livestock Farm Jiri, KhiMti. The germination, establishment, growth, flowering and seeding characters were studied under local condition of Jiri. The objective of this study was to find out the performance and adaptability of species of New Zealand and other exotic pasture species and herbs at local environment condition of Jiri. As a whole, graminae species performed better than leguminous species on germination, establishment, growth and other reproductive parameters. Among grass species, tall Oat grass (*Arenantherium elatius*) performed the best with the highest green matter (45T/ha). Three out of 4 herb species did well at local condition. One herb species sheep buret (*Sanguisor baminor*) performed the best. It produced 18.5 T GM/ha. Lotus "Maku" (*Lotus pedunculatus*) found to be best among leguminous species. It produced 45 T GM/ha.

Biomass and seed production study of forage Oats

Paudel KC and MRS Suwal (1996). Biomass and seed production study of forage Oats. *Working Paper N 96/23*, Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

Eleven cultivars of forage Oats, which were sown on 1st November 1994 in unirrigated bariland condition at Lumle farm (1675 masl) to evaluate their productive potential, have shown significant difference in green matter (GM) production between the cultivars tested (Jho-814, Jho-813, LV1, Kent , Awapuri, 346/2, Caraville, V-V3, Charisma, 83 inc 1167 and Taiko). Total Gm production varied from 5.7 T/ha (Taiko) to 11.7 T/ha (Awapuri) and the length of time taken to produce this biomass also varied greatly, from 135 days from sowing (Jho-814, Jho-813, LV1 and Kent) up to 149 days (Taiko and 346/2). All the cultivars were cut twice during this period. The cultivar Awapuri and Kent were most suitable for this agro-ecological zone as

they produced a significantly higher amount of biomass (11.7 T/ha and 8.9 T/ha) in 141 and 135 days, respectively. Cultivar Taiko was an unsuitable cultivar at this altitude. Kent variety of forage Oat cultivated from middle of October to 1st week of Nov in 1993 at Lumle Centre, ORS site Risig Patan (450 masl) and ORS site Lopre (2200 m asl) to evaluate their GM and seed production has shown large variations across sites. The Oat crop was subjected to one, two, tree cuts and no cut for green matter production so as to compare its effect on seed production. The trend of GM production was increased with increase in number of intermediate crop cuts, whereas the seed and straw yield was in reverse order. Total GM production was highest from 3 cuts at all the sites. It was 14, 7.4 and 4.6 T/ha at Lumle, Rising Patan and Lopre, respectively. Seed production from the no cut treatment was highest in all the sites and yielded 1.3, 2 and 2.6 T/ha in lumle, Lopre and Rising Patan, respectively, and was lowest from the treatments after 3 cuts (0.6 and 1.2 T/ha in Rising Patan and Lopre, respectively). Seed production was not possible after 3 intermediate cuts at Lumle. The number of days required to produce seed from no cut treatment was less in all 3 sites and lowest in low hill site (146 days in Rising Patan) followed by mid hill (194 days at Lumle) and high hill (177 days at Lopre). Seed production at the low hill site was also possible after taking one green matter harvesting without much delay in total number of days required between no cut and one cut treatment, whereas seed production after one green cut was delayed by about a month in mid and high hills that may adversely affect cultivation of following crop.

Effect of sowing date and cutting frequency on green matter and seed yield of eight cultivars of forage Oats

Paudel KC and R Pandit (1996). Effect of sowing date and cutting frequency on green matter and seed yield of eight cultivars of forage Oats. *Working Paper N. 96/55*, Lumle Agricultural Research Centre, Lumle, Kaski, Nepal

Eight cultivars of forage Oats, which were shown on 4 cutting frequencies of 1 week interval starting on 1st Nov 1995 in an unirrigated bariland condition of Lumle farm (1675 masl), to evaluate the effect of sowing date on green matter and seed yield have shown significant effect of sowing date on green matter (GM) and dry matter (DM) production and number of days required for seed maturity. The November 1st sown plots have produced highest amount GM of 12.6 t/ha and November 22nd sown plots produced least GM (10.7 T/ha) (P=0.025). Similarly, Dm production was highest (2.5 T/ha) in 1st of November sown plots compared to 22nd November sown plots (1.9 T/ha) (P=0.030). Sowing date had no significant effect on seed production (P=0.167). The average production was 2.9 T/ha. Less number of days required for seed ripening in late sowing. The November 22nd sown plots took 181 days for seed ripening followed by November 15th (186 days), 8th (191 days) and 1st (192 days). Cultivars did not differed much (P=0.629) for GM production (9.7-11.3 t/ha) but significant difference was found in terms of DM production (P=0.003). Cultivar Swan produced the highest DM (2.5 T/ha) followed by Taiko (2.4 T/ha) and 346/2 (2.3 T/ha). 83 Inc, 19 G3 and 346/2 were better for early harvest; swan, 346/2 and Taiko for higher DM; and Swan, Kent and 346/2 for earlier seed production. The same 8 cultivars of Oat were sown on 23rd November 1995 in unirrigated khet land condition at Rising patan (450 m asl), to evaluate their GM and seed yield potential under 4 cuttings frequencies (1st cutting on 60, 80, 100 and 120 days after sowing). Highest amount of GM (26.2 T/ha) was obtained from Swan when cut at 100 days after sowing and repeated at 120 days (P=0.000). This cutting frequency had overall higher GM production of 21 T/ha compared to other cutting frequencies. Minimum GM was produced (12 T/ha) from cutting starting at 60 days after sowing and Awapuri produced higher GM (16.4-18 T/ha) whereas Kent, did not produced GM at 120 days as they were already at flowering stage. Effect of cutting frequency was significant for seed production (P=0.000). Maximum amount of seed was produced (1 t/ha) from uncut plots in a minimum number of days (167) with higher straw

yield (9 T/ha) compared to cutting at 100 days after sowing which produced least amount of poor quality seed (85 kg/ha) with least straw (4.6 T/ha) yield and took maximum number of days (176) for ripening. Among the cultivars, Swan produced significantly higher seed yield (1.16 t/ha), especially from uncut treatment (2.5 T/ha). Cutting at 60 days after sowing and repeated after 20 days is the best timing for higher GM production at lo hills. For seed production, an uncut option is better than intermediate cuttings.

Study the effect of fertilizer application (N) on green matter production and seed production of Cocksfoot (*Dactylis glomerata*)

Bastola BR (1996). Study the effect of fertilizer application (N) on green matter production and seed production of Cocksfoot (*Dactylis glomerata*). *Proceedings of the 1st National Worksho on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, 7-9 May*, 1996,* pp 33-36

Six different level of fertilizer (N) 100:60:30, 80:60:30, 60:60:30, 40:60:30, 20:60:30 and 0:0:0NPK respectively were applied in cocksfoot trial plot. The highest green matter was obtained from 80:60:30 treatments 21.81Mt/ha and seed yield 0.28 Mt/ha from the same treatment. For green matter production it was cut 4 times in 1st year of sowing and 7 times in 2nd year.

On station and on farm study of monoculture and mixed cropping of Oat and Berseem on green matter production in eastern Terai

Shiwakoti KP (1996). On station and on farm study of monoculture and mixed cropping of Oat and Berseem on green matter production in eastern Terai. *Proceedings of the 1st National Worksho on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur*,* 7-9 May*, 1996,* pp 50-53

Experiments were conducted at Tarahara as on station and on farm at Banigama, Morang with objectives of evaluating the green yield performance of monoculture as well as the combination of Oat and berseem. All the treatments were arranged in a RCBD with 5 replications. The highest amount of green matter from Oat+berseem and berseem (47.42 t/ha and 47.24 t/ha respectively) was observed from on station a experiment, which was highly significant ($P<0.01$) whereas on farm condition Oat + berseem mixture yielded highest amount of green matter (33.2 t/ha) and similar yield was observed from monoculture Oat (28.8 t/ha). Mono crop berseem produced the least yield (10.5 t/ha) which was highly significant ($P<0.01$). The production of monoculture berseem was observed very poor due to unavailability of irrigation facilities in on farm experiment. Mixture of grass and legumes was better to feed livestock. When the production of berseem and Oat (monoculture) calculated separately production from on station experiment was found 47.24 and 30.47 t/ha, respectively, and the mean calculated (38.85 t/ha) was highly significant and similar results were found in on farm experiment too. From this study it is concluded that combination of Oat and berseem is better to grow than monoculture for green matter production.

Study on production performance of Oat cultivars under rainfed condition at Parwanipur

Osti NP, RS Manual, D Pariyar and PB Munakarmi (1997). Study on production performance of Oat cultivars under rainfed condition at Parwanipur. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 24-25 Sep, pp 69-71

An initial trial was conducted to know the production performance of 10 cultivars of Oat (*Avena sativa*) under rainfed condition at Parwanipur. The cultivars tested were 3412, Canadian, Kent, 323/02, Pakistani PDLV, Omihi, Bundel 1551, Swan (PAK) and Charisma. The mean plant height 29.64 cm, number of leaves/plant were 6, leaf length 23.47 cm, the leaf breath 1.44 cm, tiller

density/hill 8, days to 50% flowering days and the mean seed yield 3.08 t/ha was found. All the varieties tested were promising, however, Canadian variety performed better in this trial.

Performance study of Oat cultivars for green forage production in Terai under rainfed condition

Osti NP, AC Shrivastava and D Pariyar (1998). Performance study of Oat cultivars for green forage production in Terai under rainfed condition. *Proceedings of the 4th National Outreach Research Workshop*, Khumaltar, Lalitpur, 27-29 April, 1998, pp 146-148

A farmer's field trial was conducted to determine the green forage production capacity of different 4 cultivars of Oats (*Avena sativa*) under rain fed conditions at Santapur outreach research site of Regional Agricultural Research station, Parwanipur in 1997/98. The cultivar under test was Kent, Canadian, Swan and Cravilie. The mean green forage yield was 20.9, 20.9, 19.92 and 15.35 t/ha from Kent, Canadian, Swan and Caravilie respectively, in 3 subsequent cuttings; the 1st cut was harvested at 45 days after sowing, then 30 days interval for 2 subsequent cuttings. The tested cultivars did not differ significantly for green forage production and the mean green forage production among the cultivars was 19.26±1.65 t/ha. The green forage production from different cutting were highly significantly (P>0.01), forage production from 2nd cutting (8.18 t/ha) was found highly significant (P>0.01) than 1st (5.98 ton/ha and 3rd (5.11 ton/ha) cuttings.

Performance study of Oat cultivars for green forage production in Terai under irrigated conditions

Osti NP and D Pariyar (1999). Performance study of Oat cultivars for green forage production in Terai under irrigated condition. *Proceedings of 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Statation, Lumle, Kaski, Nepal, 26-28 June, 1999, pp 158-162

A varietals trial of different cultivars of Oat was conducted to determine the total dry matter (DM) production capability and to estimate the net area required for Oat cultivation during winter season for each milch animal under irrigated condition in Terai. The mean DM production of 3.96, 3.79, 3.79, 3.76, 3.65, 3.60, 3.49, 3.36, 3.35 and 3.15 ton per ha was obtained from 346.2 Bandel 851,32302, Caraville, Kent, PDLV (PAK), Charisma, Omihi, NARC-1 (PAK), and Canadian respectively in three subsequent cuttings. DM production within cultivars was found non-significant, but from each cutting was found highly significant. The net area estimated under irrigated condition in Terai was 500 square meters or one ropani for each normal milch animal weighing 300 kg body weight and giving 4 liter of 4.5 percent fat corrected milk.

Performance of fodder species and their mixtures in dairy pocket areas of Ilam, Kaski and Rupandehi

Pariyar D, PB Munakarmi, KK Shreshta and CK Mishra (1999). Performance of fodder species and their mixtures in dairy pocket areas of Ilam, Kaski and Rupandehi. *Proceedings of 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, 26-28 June, 1999, pp 172-178

The long-term perception was gradually recognized with the creation of dairy pocket areas and expansion of milk producer's association co-operatives by HMG agencies. The same time hay was given priority to the fodder improvement for increased profitability of dairy entrepreneurs through increased livestock productivity. The pertinent problems of fodder for winter period and less amount of fodder obtained through out the year were major concern of dairy

entrepreneur's farmers. Among the three-cultivation practices Berseem under two fertilizers treatment and zero tillage cum fertilizer application produced better results (40.2 t /ha). Within eight cultivars Oats tested in three important dairy pocket areas for consecutive three years fewer than two-fertilizer treatment. In Rupandehi under fertilizer, the highest green matter was produced by multi cultivar 83 INC-19 G3 (45.5 t /ha). In Kaski, where cultivar Tailo produced the highest (26.5 t/ ha) yield. In case of Ilam the old cultivar Kent produced good result (26.7/ t ha) and Canadian produced 26.2 t/ ha. Under three combinations of Oats and legumes, Oats-vetch was found better combination for higher green matter production and soil fertility maintained although non-significance difference was found among three combinations.

Effect of time of planting on fodder production of Oats under rainfed condition

Aryal IK and HB Gurung (2000). Effect of time of planting on fodder production of Oats under rainfed condition. *Proceedings of the 3rd National Animal Science Convention (NASA*), Aug 27-28, 1997, Lalitpur, Nepal, Pp 56-64

A study was conducted to find out the appropriate time of planting on fodder production of different cultivars of Oat. A significant difference in fodder yield was obtained among the genotypes tested (P<0.01). Highest green fodder yield was obtained from Amouri (17.0 t/ha) and lowest from Awapuni (11.34 t/ha).There was no significant effect on fodder yield due to time of sowing. Similarly highest green fodder yield was obtained from second cutting in Amouri (7.19 t /ha) followed by Swan (7.06 t/ha) and decreased thereafter. Fodder yield from other cultivars decreased after first cutting. From this study, Amouri and Swan have been found to be the most potential Oat cultivar for higher fodder production under rainfed conditions.

Assessment of winter fodder and their mixture in dairy pockets

Pradhan SM, D Pariyar, PB Munakarmi, RN Kandel and KK Shrestha (2001). Assessment of winter fodder and their mixture in dairy pockets. *Proceedings of the 4th National Animal Science Convention (NASA)*, Kathmandu, Nepal, Nov 29–Dec1, 2000, pp127-131

In this study, no significant difference was observed between different crops for plant height, tiller numbers, number of leaves and green matter production. However, the difference in plant height, number of leaves, and green matter production per hectare was significant (P<O.O5). Oat +Pea mixed crops yielded (on average from three districts) the highest green matter of 42.8$\pm$ 11.3 Mt/ha unfertilized condition and 31.0$\pm$11.3 Mt/ha in controlled condition. The average green matter production from Oat + Vetch in fertilizer application and zero fertilizer application was 41.4$\pm$9.51 Mt/ha and 27.7$\pm$6.4 Mt/ha respectively. The corresponding values for Oat solo crop was 39.6$\pm$ .41 and 25.0$\pm$ .2 Mt/ha.

Effect of sowing time on production performance of Oat cultivars under irrigated condition in Terai

Osti NP, B Rajbhandary, KK Shrestha and SM Pradhan (2001). Effect of sowing time on production performance of Oat cultivars under irrigated condition in Terai. *Proceedings of the 4th National Animal Science Convention. (NASA)*, Kathmandu, Nepal, Nov 29–Dec1, 2000, pp 132-136

A study was carried out to investigate the effect of sowing time on green forage production from four cultivars of Oat under irrigated condition. Significant differences were observed in plant height, number of tillers per hill, leaf numbers per plant, leaf length, leaf breadth and green forage production due to differences in sowing time. Plant height, tillers per hill, leaf length and leaf breadth were positively correlated with green forage yield; while the leaf number per plant and the green forage yield were not correlated. An increasing trend in green

forage production was observed in Oats that were sown up to December 1 but a reverse trend was observed for Oats that were sown after December 15. Therefore, it is suggested that Oat should be sown within first week of December for greater green forage yield in the central Terai.

Study on production performance of winter forage crops on farmers filed of Dhaibung and Laharepauwa VDC of Rasuwa

Shrestha KK, NP Shrestha and NP Bhattrai (2002). Study on production performance of winter forage crops on farmers filed of Dhaibung and Laharepauwa VDC of Rasuwa. *Proceedings of 5th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, July 10 - 11, 2002, Pp 183-186

The result revealed that no significant difference was found on plant height, leaf length, leaf breadth, leaf number, tiller number, green matter and dry matter production among treatments and replications but significant difference was found among the years. The performance of first year is better than second and third year. The fodder production under rainfed versus irrigated conditions was also found non significant different. The maximum forage production was found from Oat intercropped with pea 13.74 Mt/ha GM and 2.23 Mt/ha DM in rainfed condition while the fodder production was maximum 16.17 Mt/ha GM and 2.6 Mt/ha DM from sole Oat in irrigated condition. The result revealed that forage production increased by 18% under irrigated vs. rainfed condition

Fodder Oats in Nepal

Pariyar D (2002). Fodder Oats in Nepal. *Proceedings of the 5th Meeting of the Temperate Asia Pasture and Fodder Network (TAPAFON)*, RNR Research Centre Bajo, Wangdue, Bhutan, 30 Apr – 4 May, 2002, pp 167-180

Inadequate feed supply and poor nutrition during the dry winter months (Dec to April) is one of the biggest constraints to the promotion of livestock development in Nepal. Malnutrition over a significant part of the year reduces the condition of the animals and adversely affects production levels. Cultivation of Oats (*Avena sativa* L.) in Nepal was started about 100 yrs ago by landlords in the Terai region in order to provide green fodder during the dry winter months for their elephants. However, testing of Oat cultivars started on government farms and stations only in the 1970 s. Cultivation of Oats on larger areas became more popular during the 1980-1994 livestock development projects, when the main objective was to increase livestock productivity through better feeding and poorer healthcare and management. At present Oat cultivation is concentrated mainly in Khetland of the Terai and low hills and in the Bariland both in the low and mid hills regions. With the introduction of new management systems (proper amounts of manure and fertilizer, multi cut cultivars, better combinations such as Oats + Vetch and Oats + Peas) both commercial dairy farmers and resource poor farmers have greatly reduced the feed shortage problem for their animals during the dry winter months as well as achieving a 30% reduction in the cost of feed. The result has been that under forage based milk production systems in the periurban areas of Ilam, the production cost of one liter of milk around NRs 10.0 (US$ 0.13), whereas in urban areas of the country under the concentrate+ paddy straw feeding milk production system the cost of one liter milk about NRs 18 (US$ 0.23). Also, for resource poor farmer's Oat cultivation has resulted in a net profit of NRs 1538 /animal/month/ arable land area of 0.075 ha. With the introduction of multi cut cultivars and new management technologies, the yield of fodder Oats gone up from 15-20 t/ha to 50-93 t/ha. For commercial dairy pocket areas, the Oat cultivars Awapuni, Swan, Caraville, Charisma, Canadian and Kent are recommended up to an elevation of 1600 m asl. Oats+Vetch is the best mixture for high yields and improved soil fertility. For resource poor farmers, Oat

cultivars Canadian and Kent are recommended and a combination of Oats+Vetch. Oat seed production is a viable source of income generation in many areas of Nepal and under optimum management practices Oats can produce on average 2 tons of seed/ha after taking one cut for fodder. The total area under Oats is 2,172 ha and 43,440 households are now cultivating Oats.

A Case study: Oat + Vetch utilization for milk production

D Pariyar (2002). Case study: Oat + Vetch utilization for milk production. *Proceedings of the 3rd National Animal Science Convention (NASA)*, Lalitpur, Nepal, Aug 27-28, 2000, pp 73-77

This study aims to find out the role of Oat in milk production and its contribution to total earning as compared to cereal production from the more land. This case study was carried in a very poor farm where the only source of income was milk selling from a milking buffalo. It indicated that a net income of NRs 1, 538/- per month can be obtained by feeding 8-16kg Oat + vetch per day. If this level of green fodder can be made available per day during winter, over 33% reduction in the cost of concentrate can be achieved. At the same time relief on fodder scarcity during winter can also be achieved. This case study has also indicated that winter fodder in association with high yielding livestock and available market facility could help alleviation poverty at marginal farm level.

Effect of sowing dates on biomass and seed production of Oat cultivars under rainfed condition at Regional Agricultural Research Station (RARS), Nepalgung

Tiwari DN (2002). Effect of sowing dates on bio mass and seed production of Oat cultivars under rainfed condition at RARS, Nepalgung. *Proceedings of the 4th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, April 24-26, 2000, pp 77-83

The result showed the significant differences on the biomass and seed yields between the cultivars and sowing dates ($P<0.05$). The Oat cultivars Canadian and Omihi were observed less sensitive to late sowing for the bio-mass production because of the similar dry matter (4158 to 4193 Kg/ha and 3955 to 3882 Kg/ha respectively) yields on 20th November to 5th December sowings. But the seed grain production was the lower (Canadian-1223 to 426 Kg/ha and Omihi-2000 to 1773 Kg/ha) at the same sowing times. The cultivars Bundel-851 produced the highest biomass (4559 to 3932 Kg DM/ha) and seed grain (2540 to 2000 Kg/ha) at 20th November to 5th December sowing period.

Study on establishment and production performance of temperate pasture species (Cocksfoot and native grasses) in White Clover saturated rangeland of Rasuwa district

Shrestha KK, Shrestha NP and Bhatia NP (2004). Study on establishment and production performance of temperate pasture species (Cocksfoot and native grasses) in White Clover saturated rangeland of Rasuwa district. *Proceedings of 5th National Animal Science Convention (NASA),* Oct 14-16, 2003, pp 131-134

A field experiment was conducted in white clover saturated rangeland at an elevation of 2,900 masl using RCB design with 4 replications. The temperate exotic grass species, such as cocksfoot and two native grasses, pang and bulky were used for this study. Rooted slips of each grass species were planted at 20 cm (P x P) and 50 cm (R x R) spacing using $90m^2$ plot size in 1999. The data on survivability percentage of plant species, growth performance, and forage bio-mass was taken on second year onwards from each treatment. The proximate analysis of pasture species was carried out to determine their chemical constituents. The results showed that maximum percentage of survivability was found in cocksfoot (82%) followed by mixed species (75%), and pang (36%), respectively. The combination of grass species such as cocksfoot + bulky + pang (33% of each grass) produced maximum bio-mass (7.5 t/ha) followed

by cocksfoot (6.6 t/ha), bulky (4.5 t/ha) and pang (4.1 t/ha). Likewise, the performance of cocksfoot was better than that of pang and bulky in terms of plant height (47.80 cm) and numbers of tiller per plant (12). The lower biomass production of bulky and pang was possibly due to poor establishment and stress due to frequent cutting. The chemical constituent analysis revealed that crude protein (19.94%), organic matter (91.29%) and phosphorous (0.22) content of mixed grasses (cocksfoot + bulky + pang) were higher than that of other grass, but was significant only for phosphorous content.

Exploration and evaluation of fodder Oat (*Avena sativa*) cultivars to sustain livestock production in winter

Pariyar D (2004). Exploration and evaluation of fodder Oat (*Avena sativa*) cultivars to sustain livestock production in winter. *Proceedings of the 4th National Conference on Science and Technology,* Royal Nepal Academy of Science and Technology (RONAST), Baneswor, Kathmandu, Nepal, 23-26 March 2004, pp 216-221

The inadequate feed supply and poor nutrition during the dry winter season (December-April) is one of the biggest constraints to the promotion of livestock development in Nepal. Exploration and evaluation of fodder Oat cultivars were initiated since 1970 focused mainly in Terai and lower parts of mid hills under different domains. In over 3 decades a total of 30 fodder Oat cultivars have been evaluated in relation to their adaptation, fodder yield and quality for on farm livestock population in various socio-economic conditions. With various efforts finally some good fodder Oat cultivars have been identified and recommended for different domains and its capability of fodder production have helped in alleviating fodder problem of dry winter sustaining animal production. Impact of this work has resulted in more area coverage by Oats (2000-3500 ha/annum) in Nepal.

Oats cultivation in the mid hills of Nepal: Adaptation and profitability

Shrestha BC (2004). Oats cultivation in the mid hills of Nepal: Adaptation and profitability. *Proceedings of the 5th National Animal Science Convention (NASA*), pp 115-124

The study was done in Ugrachandi nala VDC of Kavrepalanchok interviewing randomly selected 35 farmers with Oats cultivation (adopters) and the same number of farmers without Oats cultivation (non-adopters) using pre-tested semi-structured questionnaires. To assess the profitability of Oats against other competing winter crops partial analysis was done. In spite of the highest return to labor and land, Oats does not seem to be a priority crop for farmers against other winter crops due to lack of a ready market for Oats forage and grain. The result of logistic regression analysis showed significant influences of sex of the household head, number of the extension contacts and credit use on adoption decision of Oats cultivation. A female household head seems to be less likely to adopt than a male household head. Increase in extension contact and credit use may boost the adoption of Oats cultivation. In the context of the small sample size and the coverage of limited geographical area for this study, the findings of the study should not be generalized, but could be taken as a reference for similar situations.

Fodder and pasture seed production for household income generation

Tara PC (2005). Fodder and pasture seed production for household income generation. *Proceedings of the Workshop on Fodder Oats, Fodder Technology Packages and Small Farm Income Generation*, Kathmandu, Nepal, 8-11 March, pp 175-178

Current production of forage seed in Nepal is only 73 tons whereas there is a vast need to increase fodder production to increase livestock production at a low cost to meet the government targets. Forage seed production seems more profitable that contemporary grain

crops. This huge amount of forage seed demand and profit from seed production indicates that there is a great opportunity of income generation for small holder farmers in the country.

Livestock feeding systems and the place of fodder Oats in Nepalese systems

Upreti CR (2005). Livestock feeding systems and the place of fodder Oats in Nepalese systems. *Proceedings of the Workshop on Fodder Oats, Fodder Technology Packages and Small Farm Income Generation*, Kathmandu, Nepal, 8-11 March, pp 77-82

This paper analyses the prevailing livestock feeding system and place of fodder Oat in mixed crop livestock farming system. Nepal's economy is strongly influenced by the livestock rearing activities adopted in different typological zones of the country. Nepal can be divided broadly into 3 geographic ecozones: Terai, hills and mountains with 6 crop- livestock typological zones. Terai is grouped into 4 zones 1a, 1b, 2a, 2b (covering 20 districts) hills with 5 zones (covering 39 districts) and mountain zone with 16 districts. Terai regions have a lower share of geographical area (22%) but a larger share of the cropped land (50%). In contrast, for grazing land, the mountain region accounts for the bulk of the grazing land. Rice and wheat (75 and 57% of total production, respectively) are the main crops in the Terai which are the major sources of crop residues for winter feeding. Zone 6 and 3 in the hill districts account for the bulk of the coarse cereal that includes millets and maize. Crop residues are major feed resources for all zones contributing 40-50% of the total feed but are less palatable and low in nutrient content and hence need supplementation by palatable green forage. Among the cultivated forage crops, Oat is the main fodder crop that can fit with the existing mixed crop-livestock farming systems in Terai and hill zones. A suitable proportion of green Oat supplementation to the crop residue based diet for ruminant feeding still needs to be identified. Nepal's economy is strongly influenced by livestock; their contribution to agricultural GDP varies from 48% in the mountain region to 20% in the Terai (Devendra, 2002). Mixed crop livestock farming is the dominant form of production system in Nepal, based on growing both annual and perennial crops and grazing. Grazing includes the use of plants growing on cultivated, uncultivated and forestland.

Evaluation of Oat germplasm in Nepal

Pariyar D (2005). Evaluation of Oat germplasm in Nepal. *Proceedings of the Workshop on Fodder Oats, Fodder Technology Packages and Small Farm Income Generation*, Kathmandu, Nepal, 8-11 March, pp 8-14

Oats provide good fodder during the dry winter in Nepal when other forage is very scarce. Their popularity has increased since the introduction of improved, multi-cut cultivars which coincided with an upsurge in smallholder dairying. The range of genetic material available in country had been very narrow. Many cultivars have been introduced, screened and field tested in recent years over a wide range of altitudes and agro-ecological conditions, especially since 2002. Testing has been done in farmers' field after on station screening. Testing methodology and the results of work to date are described. Oat is an allogamous fodder crop, which can be grown in all kinds of agro-ecological zones irrespective of land type. It is the only fodder crop which most of the dairy farmers can except to grow on their farms under Bari land condition in the mid hills of Nepal right from the eastern hills to the far western hills. However, it is also widely grown in the plains of Terai regions of Nepal. Its multicut ability, acceptability to all categories of livestock, utilization in different feeding forms (green, hay, straw and grain) and its availability during dry winter (December- April) has helped in the development of a commercial livestock industry. The area under Oats in Nepal has been estimated to be 10000 ha and the productivity of green fodder 12 t/ha in two cuts.

Research activities on fodder Oat cultivation for household income generation in the eastern Terai region of Nepal

Mandal P and KP Premy (2005). Research activities on fodder Oat cultivation for household income generation in the eastern Terai region of Nepal. *Proceedings of the Workshop on Fodder Oats, Fodder Technology Packages and Small Farm Income Generation*, Kathmandu, Nepal, 8-11 March, pp 51-56

This paper reviews the research on winter forage production and assesses the role of fodder Oat in household income generation, comparing the economics of fodder Oat and wheat grain. The study found that Oat is a very useful winter fodder and could help farmers to alleviate winter fodder scarcity. Among cultivars, Kent proved to be the best producer of green forage (35.55-40.72 t/ha). Feeding green Oat in winter increased the milk production (1.03-1.13 lit/animals/day). When net return was compared growing fodder Oat was found comparatively more beneficial than growing wheat grain (NRs 11762 over 3406.0/ha) Oat seed could be a very promising crop for household income generation in eastern Terai region.

Technology package for Oat cultivation in Nepal

Sharma LP and SM Pradhan (2005). Technology package for Oat cultivation in Nepal. *Proceedings of the Workshop on Fodder Oats, Fodder Technology Packages and Small Farm Income Generation*, Kathmandu, Nepal, 8-11 March, pp 105-110

Oats are major winter fodder of Nepal and can be grown after summer crops, rice and maize, then harvested before the next cereal sowing season. The cool, dry winter is a major season of feed scarcity in Nepal. Only at very high altitudes about 300 m asl they are sown in spring. The paper describes the introduction of Oats to farm use since the 1970, research on their agronomy and use and utilization in farming systems. Oats are mainly a crop for commercial dairy farmers, both small and medium scale. Recommendations for Oat growing in both rainfed and irrigated situations are given.

Testing of Oat cultivars for seed production in the high hills

Shrestha KK (2005). Testing of Oat cultivars for seed production in the high hills. *Proceedings of the Workshop on Fodder Oats, Fodder Technology Packages and Small Farm Income Generation*, Kathmandu, Nepal, 8-11 March, pp 146-149

Twenty one cultivars of Oat were evaluated at two high altitudes sites, Dhunche 1950 masl, and Chandanbari 3250 masl for winter sowing in 2002. Seed did not ripen properly at Chandanbari. In a summer sowing trial (2003) at Dhunche grain yields were very low although there were significant differences between cultivars. Grain production after one fodder cut was found to be of poor quality due to uneven flowering and maturity in the summer trial. Cultivars 932902, CDA 2801/G302, 9217603, Drummond, 9425641, Hokonui and 9216901 were found good for grain production in winter sowing at Dhunche. In Chandanbari, 9217302, 9113061, 9217608, 9217408, 9217603 and 9425654 were better for fodder.

Oat production for winter forage in Sunsari and Morang districts of the eastern Terai

Premy KP and P Mandal (2005). Oat production for winter forage in Sunsari and Morang districts of the eastern Terai. *Proceedings of the Workshop on Fodder Oats, Fodder Technology Packages and Small Farm Income Generation*, Kathmandu, Nepal, 8-11 March, pp 169-174

In Morang and Sunsari districts in the eastern Terai of Nepal most families are small landholders where livestock are a major cash source. There is serious winter fodder scarcity. The status of fodder Oat production, status of seed supply, role of private sectors in seed supply

and its production at farmers' level were studied in dairy pockets of these districts. Oat is the favorite winter forage among dairy farmers and their area is increasing. Farmers with provisions for milk marketing use arable land for growing Oats for their dairy animals in spite of small holdings. Due to demand for Oat seed by dairy farmers' private sector were also engaged in forage seed selling. Unfortunately neither the private seed supplies nor farmers were aware about varieties of fodder Oat. The share of private sector has now surpassed the government sector in seed distribution. Fodder yield in farmers filed was far below than standard production level, thus introduction of new high yielding Oat cultivars with technology backup is needed to alleviate fodder scarcity and boost the production of dairy animals in winter.

Production performance of different Oat cultivars on existing framing systems of different high altitude locations in Rasuwa district

Shrestha KK, NP Bhattrai and AK Rajbhandary (2007). Production performance of different Oat cultivars on existing framing systems of different high altitude locations in Rasuwa district. *Proceedings of the 8th National Outreach Research Workshop*, Khumaltar, Lalitpur, 19-20 June, 2007, pp 383-387

Sixteen cultivars of Oat were tested at 4 high altitude locations ranged from 2000 to 3500 m asl on existing farming system in Rasuwa district. Some of the testing sites were located at Lantang VDC in altitude range of 3400-3500 m asl. In this site, single crop is grown once a year. Barley, potato and buckwheat are major cereal crops and seed sowing is done in spring. Fodder Oats were sown in spring season after snow melting at Langtang. Three other sites were located at Bridhim (2050 m asl), Brable (2250 m asl) and Chandanbari (3250 m asl). Oats were sown in winter in these locations. Crops at Chandanbari were covered under snow for 3-4 months every year and growth of crop takes place after snow melt. There was sometimes snow fall in another two sites as well. Three cuttings were taken at Bridhim and Brable while 2 cuttings were taken at Chandanbari and Langtang. The productions of introduced Oat fodders were studied at different 4 locations and compared their performance. A significant difference was found on plant height among different Oat cultivars and across locations. Oat cultivar NARC -1 (Pak) was found tallest (50.7 cm) and shortest was found from Omihi (36.4 cm). Fodder production was not significantly different among Oat cultivars at each location but it was highly significant ($P<0.000$) on production performance across locations. Maximum fodder (20.8 t/ha) was produced from Bridhim followed by Langtang (18.5 t/ha), Brable (16.5 t/ha) and Chandanbari (14.4 t/ha). At Lang tang cultivar CDA 1001, Netra and 32302 were found having higher fodder production and similar NARC-1 (Pak) 82INC 19G3, and Kmdhenu were found promising Oat cultivars at Chandanbari. At Bridhim and Brable, Awapuri, 346/2, Swan (NEP), NARC-1 (Pak) and Craville were observed promising Oat cultivars for winter fodder production.

Study on effect of cuttings on seed production of five promising Oat cultivars at Agriculture Research Station (ARS), Rasuwa

Shrestha KK, NP Bhattarai and AK Rajbhandari (2009). Study on effect of cuttings on seed production of five promising Oat cultivars at ARS, Rasuwa. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 104-114

Kamdhenu, Omihi, CDA 1001, Awapuni and 831 NC 19 G3 are promising cultivars for more fodder and seed production at station. Three cuttings management practices (0, 1 and 2 cut) were studied for their potential performance on seed production during 2060 to 2063 in this study. Significant difference was not found among 5 Oat cultivars but highly significant difference ($P<0.001$) was found among cutting management practices and years for seed

production. More seed production (3.5 Mt/ha) was found on zero cut management followed by one cut (2.7 Mt/ha) 2 cut (2.2 Mt/ha) management practices, respectively. Irrespective of cutting management Awapuri produced the maximum seed (3.4 Mt/ha) and the lowest seed was produced from Omihi (2.5 Mt/ha). The differences on plant height was found highly significant (P<0.001) among different 5 Oat cultivars, cutting management and years. Awapuri was found the taller in plant height (71.5 cm) and shorter was 831 NC19G3 (52.8cm). Irrespective of Oat cultivars zero cut plants attained maximum plant height (71.97 cm) followed by one cut 959.52 cm) and 2 cut management practices (48.21 cm). The crop maturity days was also found highly significant different (P<0.001) among different Oat cultivars, cutting management and years for harvesting the seeds. The mean days of harvesting (DOH) of Awapuri was the earliest (220 days) followed by Kamdhenu (226 days), CDA1001 (230 days), Omihi (232. days) and 831 NC 19 G3 (234 days) irrespective on cutting management practice. An overall zero cut plants matured early (221 days) which was 7 and 15 days earlier than I and II cut management practices. The performance of most agronomic characters on 3rd year was better compare to 1st and 2nd year.

Evaluation of Oat germplasms for hay production under rainfed condition in Khumaltar

Pariyar D and L Sherchand (2009). Evaluation of Oat germplasms for hay production under rainfed condition in Khumaltar. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 93-96

A study was conducted to find out the suitable cultivars of Oats for hay production in Khumaltar condition. Twenty one cultivars of Oat were obtained from the crop and food research, New Zealand and 2 native cultivars of Nepal were selected for the study. The experiment was designed on RCBD in 3 replications. The plot size was measured 5 m^2. The fertilizer was applied @ 80: 60:40 NPK kg/ha + FYM 5 Mt/ha as basal dose. The seed rate was used 100 kg/ha and sowing was done on July 6, 2003. The 1st cutting was done for green matter production 60 days after sowing and then it was left for hay production. Data were recoded for Oat cultivars separately on parameters (a) plant height, (b) tiller number per plant (c) leaf number per plant (d) green matter yield/ha and (e) hay yield/ha. Green Matter (GM) yield of cultivar Stempede (23.7 kg/plot of 5 m^2 i.e 47.4 Mt /ha was significantly (P<0.05) greater than that of the cultivar NZ 92169, 01 (14 kg/plot of 5 m^2 i.e. 28 Mt/ha) and 4 cultivars found significant with the 1st 17 cultivars. The hay yield of cultivar Stempede (10.3 kg/plot of 5 m^2 i.e. 20.6 Mt/ha) was significantly (P<0.05) higher than that of NZ 64256.67 cultivar (7.2 kg /plot of 5 m^2 i.e. 14.4 Mt/ha) and following cultivars down the column. Non significant hay production was found among 1st 3 cultivars whose value ranged from 7.5 to 10.3 kg/plot of 5 m^2 i.e. 15-20.6 Mt/ha.

Evaluation of exotic temperate pasture species at Agriculture Research Station, Rasuwa and substation Chandanbari in Rasuwa district

Shrestha KK and NP Bhattarai (2009). Evaluation of exotic temperate pasture species at ARS, Rasuwa and substation Chandanbari in Rasuwa district. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 97-103

Twenty different exotic temperate pasture species and cultivars were tested at ARS Dhunche 1950 m asl and substation Chandanbari 3250 masl during 2001-2004. Highly significant different (P<0.001) was found in dry matter production among different forage pasture species and locations. Among 20, 17 pasture species and cultivars established better and produced fodders at Dhunche. Highland bent grass produced maximum fodder 43.2 Mt GM/ha and 13.9 Mt DM/ha followed by Chewing fescue tiffany (39.6 Mt GM/ha and 12.1 Mt DM/ha) and Tall

fescue Demeter (35.0 Mt GM/ha and 10.7 Mt DM/ha). Birdsfoot trefoil Leo produced maximum fodder (40.8 Mt/ha GM and 8.6 Mt DM/ha) in case of pasture legume species. At Chandanbari maximum fodder production was found from orchard grass Potomac 39.5 Mt GM/ha and 8.6 Mt DM/ha followed by Cocksfoot porto (28.3 Mt GM/ha and 4.1 Mt DM/ha), highland bent grass (26.7 Mt GM/ha and 6.9 Mt DM/ha) and Ryegrass kangaroo gold (22.6 Mt GM/ha and 4.1 Mt DM/ha. Fourteen species and cultivars established better and produced fodder at Chandanbari. The germination performance of introduced forage species and cultivars was better at Chandanbari compare to Dhunche. Although, more number of pasture species and cultivars found very good germination the performance of establishment and persistent fodder production at Dhunche was found better than Chandanbari. Four cuttings were taken at Dhunche and 2 cuttings were taken at Chandanbari. The seed production was found significant different among pasture species ($P<0.05$) and locations ($P<0.006$). Seeds were collected from 14 species ar Dhunche and Chandanbari. Chewing Fescue tiffany produced maximum seeds (780 kg/ha)) at Dhunche and Tall Fescue cultivars were also found good seed producers average (447 kg/ha). The average seed production of Tall Fescue cultivars and chewing fescue was 160 kg/ha at Chandanbari.

Evaluation of temperate pasture species for high altitude regions of Nepal

Pariyar D (2009). Evaluation of temperate pasture species for high altitude regions of Nepal. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 125-127

A study was conducted to find out promising pasture species for high altitude regions. Native as well as exotic species were compared for their productive parameters. The experiment was conducted for 2 years in Simibhanjyang Pakha (1950 masl) in Rayale, of Kavre district. A significant difference ($P<0.05$) was found among different pasture species although the highest plant height was recorded in *Setaria anceps* (131.13 cm). A significant difference ($P<0.054$) was found also in their tiller number, leaf number and dry matter yield. The highest dry matter yield was found in *Setaria anceps* which indicated that the taller the plant the more dry matter yield.

Comparative growth performances of different cultivars of Red and White clovers under three fertilizer treatments

Panday SB, A Grela, Y Raut and ND Joshi (1990). Comparative growth performances of different cultivars of Red and White Clovers under three fertilizer treatments. *Nepalese Journal of Animal Science (NASA),* **7**(7)**:**53-60

Six cultivars of clovers, broad leaf and Florie from red clover, and Huia, Khumal and Ladino from white clover were sown to investigate the effects 3 fertilizations at Jiri. The fertilizers given in the treatment were namely: (A) - inoculated legumes with P_2O_5 (100 kg/ha) + K_2O (50 kg/ha), (B) – inoculated legumes with FYM (8 t/ha), and (C) – non inoculated legumes with no fertilizer. Except Ladino in white clover chemical composition between cultivars in each legume (red and white clovers) was similar. However, some differences in the chemical compositions were found between red and white clovers. Production of total herbage DM was significantly ($P<0.05$) increased due to the application of FYM. Among 6 legume cultivars Florie had the highest amount of DM production (1.3 t/ha) vs 0.9 t/ha: Huia, 0.9 t/ha: Ladino 0.7 T/ha: Khumal).5 T/ha: Pawera, 0.2 T/ha: broad leaf). Legume plots with chemical fertilizers and FYM had similar tiller densities (18Vs19), but they had significantly ($P<0.01$) higher densities than the legume plots with no fertilization. Cultivar Hua had the highest tiller density (27) followed by Florie (24), Khumal (17), Ladino (14), Broad leaf (10) and Pawera (5).

Observation on the adaptability and seed production of forage legumes at Pakhribas Agricultural Centre

Shrestha NP, SP Neopane, HB Gurung, B Pakhrin and P Shrestha (1990). Observation on the adaptability and seed production of forage legumes at Pakhribas Agricultural Centre. *Technical Paper N. 90/126,* Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

Thirty two forage legume species were received from Australia and sown at Pakhribas Agricultural Center's south farm (1520 m). Their adaptability and seed production performance were monitored. *Cassia rotundifolia, Desmodium intortum, D. uncinatum, Neonotonia wightii, Stylosanthes guianensis* and *Vicia dasycarpa* were observed as a potential source of forages throughout the year as these species were found to remain green even during winter. Some species were observed to be better for the rainy season as they were found to be green only during this season. These are *Aeschynomene Americana, A. villosa, Alysicarpus monilifer, A. rugosus, Desmanthus virgatus, desmodium discolor, D. distiortum, D. heterocarpon, Stylosanthes hamata* and *Vigna parkeri.*

Observations on the adaptability of Berseem as winter fodder in Koshi hill areas

Shrestha NP, SR Shrestha, PB Chemjong, BB Kshatri, SP Neopane and PP Rai (1991). Observations on the adaptability of Berseem as winter fodder in Koshi hill areas. *Working Paper N. 91/16*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

Inoculated berseem seeds were broadcast in the standing paddy crop 3 weeks before paddy harvest in 11 sites of 4 Koshi hill districts between 1010 and 1650 m altitude range. The 1st cutting was taken after 75 days of sowing and 3 subsequent cuttings was taken at 15 days intervals. The 4th cutting could be taken only in 3 sites. The average green fodder yield of those 3 sites was 25.7 t/ha with a range of 11.7 to 38.4 t/ha. The results showed that this crop is suitable for areas below 1400 m altitude.

Study on the mixed cropping of legumes with maize

Pariyar D, MK Shrestha and P Mandal (1991). Study on the mixed cropping of legumes with maize. *Proceedings of the 1st National Animal Science Convention (NASA),* Khumaltar, Lalitpur, Nepal, Jan 14-15, 1991, pp 31-33

Maize (*Zea Mays*) is the major cereal crop in Nepal. Inter-cropping of legume for forage with maize is not common practice of the farmers. Four types of legumes (i.e. *Phaseolus radials, Dolichus biflorus, Passels vulgaris and Glycine max*) were inter-cropped with maize to asses the total bio-mass productivity. A basal dose of FYM-10 Mt/ha., N-60, P2O5-40, and K2O-40 kg/ha was applied at the time of sowing. The total biomass production was recorded highest in the combination of *Zea mays* with *Glycine max* (64.1Mt/ha.) where as *Zea mays* in combination with *Phaseolus radialus* and *Glycine max* produced more qualitative feed (21Mt/ha.) for livestock. Maize residue edible to animals was obtained in more quantity (22.5Mt/ha.) from purely grown maize. Similarly, purely grown maize was also the major source of fuel (28.3Mt/ha.). However, there was a statistically significant difference observed among the treatments for the grain as well as legume forage production.

Preliminary study of different forage legume species at Pakhribas Agricultural Centre

Neopane SP and NP Shrestha (1991). Preliminary study of different forage legume species at Pakhribas Agricultural Centre. *Proceedings of the 1st National Animal Science Convention (NASA),* Khumaltar, Lalitpur, Nepal, Jan14-15, 1991, pp 38-42

The experiment was conducted under local farmer's condition (No chemical fertilizers and irrigation were applied). The main objective was to find out if any of the forage species could remain green and produce green fodder during the dry season (November to May).The highest green matter yield during dry season was obtained from *Desmodium intortum* 4.7 t/ha. A total of eight cuttings were taken from all the species except *Vicia dasycarpa*, from which only two cuttings were obtained. Total annual green matter yield of *Desmodium intortum*, Stylosanthes quianensis, Desmodium intortum, Stylosanthes quianensis, Desmodium *uncinatum, Neonotonia wightii, Vicia dasycarpa* and *Cassia rotundifolia* was 24.6$_t$, 16.9$_t$, 9.9$_t$, 7.9, 4.5$_t$ and 3.8$_t$ per hectare respectively. The preliminary results of this study reveal that the above-mentioned species can be a potential source of forage during the dry season in the Eastern Hills of Nepal.

Availability of protein from high altitude tree study of the biomass production of Berseem at two different time of sowing under rice relay cropping system

Shrestha NP, BB Kshetri and IK Aryal (1993). Availability of protein from high altitude tree study of the biomass production of Berseem at two different time of sowing under rice relay cropping system. *Working Paper N. 93/37*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

A study of the biomass production of Berseem at 2 different time of sowing was conducted at 3 on farm sites, each below 1400 m in the eastern hills. Inoculated Berseem seeds were broadcasted at 3 weeks (29th October 1990) and 2 weeks (5th November, 1990) before paddy harvest (under relay cropping). The 1st cutting of berseem was taken 85 days after sowing and subsequent cuttings were taken at intervals of 35, 30 and 25 days. For the 1st time of sowing, the highest green matter yield obtained (26 t/ha) was from Dingla while lowest yield (7.1 t/ha) came from Sukrabare; the average yield of 14.9 t/ha. For the 2nd time of sowing, the highest green matter yield obtained (10.3 t/ha) was at Sukrabare and the lowest yield (3.9 t/ha) at Dingla; the average yield was 8.9 t/ha. The wide variation in yields at the 3 sites occurred as a result of differences in irrigation regimes altitude, the incidence of uncontrolled grazing and inoculation methods. No significant difference in biomass production level observed to arise from different times of sowing ($P>0.05$).

Performance of White Clover (*Trifolium repense L.*) in Nepal: A Review

Panday RS (1995). Performance of White Clover (*Trifolium repense L.*) in Nepal: A Review. *Proceedings of the 2nd National Animal Science Convention (NASA*), Lalitpur, Nepal, August 7-10, 1995, pp 35-38

White clover is believed to be introduced in around 1940 in Nepal. Since then over 23 cultivars from 8 different countries were introduced and tested. Different INGOs /NGOs are involving in introduction and the promotion of white clover in Nepal. Between the FY 1980 to 1990, over 1600 kg of white clover seeds were imported from overseas country under DOAD programme. White clover is widely used for over sowing into native pasture lands to improve the productivity as well as maintain soil fertility status. White clover is growing between the altitudes from 700 m to 4000 m altitude and is quite popular as a pasture as well as lawn grass. The DM production of white clover has been found up to 9.5 Mt/ha under multicut regime in experimental conditions with fertilization and irrigation. Similarly, the seed production has

been recorded up to 375 kg/ha from cultivar Laden at Marpha. Out of the total varieties the local Khumal was found successful in humid areas whereas Aberyswuth cultivars like S-128 was found good in transhimalayan region such as Marpha.

Performance of some forage Legumes at Pakhribas in the eastern hills of Nepal

Chemjong PB (1995). Performance of some forage Legumes at Pakhribas in the eastern hills of Nepal, Promotion of Animal Production through Research and Development. *Proceedings of the 2nd National Animal Science Convention (NASA)*, Khumaltar, Lalitpur, Nepal, Aug 7-10, 1995, pp 39-45

At Pakhribas Agricultural Center (PAC), South Farm, Dhankuta, at an elevation of 1520 masl with an average rainfall of 1500 mm/year, a study was carried out of six forage legumes, *Desmodium intottum cv. Greenleaf*, *Desmodium uncinatum cv. Silverleaf*, *Neonotonia wightii cv. Clarence*, *Styloanthes guianensis cv. Graham, Cassia rotundifolia cv. Wynn* and *Vicia dasycarpa cv. Nomoi*, to assess their performance under both irrigated and rainfed conditions for two years. During the years 189/90 and 1990/91, observation on survivability and establishment of forage legume blocks through vegetative propagation was also recorded. The biomass yields from six species were obtained with and without irrigation. The average yield increase due to irrigation was 0.51DM t/ha, a non-statistically significant effect. However, there were statistically significant differences in yield between species ($P<0.001$) and between years ($p<0.002$). The highest average annual dry matter (DM) yield was obtained from desmodium intotum (4.25 DM t/ha), followed by *stvlosanthes guianensis* (3.84 DM t/ha). *Demodium uncinatum* (3.11 DM t/ha), *Neonotonia wightii* (3.08 DM t/ha) *Cassia rotundifolia* (1.00 DM t/ha) and *Vicia dasycarpa* (0.48 DM t/ha).

Productivity of Berseem (*Trifolium alexandrinum*) fodder crop under rice relay cropping system in the eastern hills of Nepal

Chemjong PB and IK Aryal (1996). Productivity of Berseem (*Trifolium alexandrinum*) fodder crop under rice relay cropping system in the eastern hills of Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **11**(2):63-64

A study was conducted to see the productivity of Berseem fodder crop at two different time of sowing (6th and 13th of Oct, 1994) in three on farm sites under rice relay cropping system in the eastern hills of Nepal. There was no significant effect of the time of sowing on green fodder production of Berseem, with average yield being 15.1 t/ha

Screening of different grass and legumes for forage production at Goat Research Centre, Bandipur

Munakarmi PB and YK Shrestha (1996). Screening of different grass and legumes for forage production at Goat Research Centre, Bandipur. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, 7-9 May, 1996, pp 26-30

Eight different grasses and legumes species were sown to find out the comparative biomass production and adoptability at goat research centre, Bandipur. Such as Setaria ancepa, Rhodes (*Chloris gayana*), Napier (*Pennisisetum purporeum*), Molasses (*Melinis minulifora*), Stylo (*Stylosanthes quianonsis*), Siratro (*Macroplilium apropurpureum*), Centro (*Centrosema pubescents*) and Kudzu (*Pueraria thumbergiana*). Among them Napier produced the highest forage 177.5 Mt/ha followed by Molasses 46.7 Mt/ha in *graminecia* species likewise in leguminous species Siratro produced the highest35.83 Mt/ ha followed by Kudzu 31.41 Mt/ ha green forage production.

Study on the productivity of temperate grass species in combination with White Clover

Bastola BR, NP Shrestha and NP Bhattarai (1997). Study on the productivity of temperate grass species in combination with White Clover. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 24-25 Sep, 1997, pp 72-75

A trial was conducted at ARS (Rasuwa) to study the comparative productivity of different temperate grass species in combination with white clover for a period of 3 years (1993/94-1995/96). During the entire trial period data were recorded for dry matter production, seed yield, plant height, leaf length and tiller number. After analyzing the data for 3 years it was found that maximum dry matter production (6 Mt/ha) was obtained in cocks foot combination and maximum seed yield (0.62 Mt/ha) was obtained in Rye grass combination. Similarly, plant height, leaf length and number of tiller were 25.43, 22 cm and 30 for cocks foot combination and 32.3, 16.6 cm and 20.5 respectively for Rye grass combination. Moreover it was found that cocks foot (*Dactylis glometra*) combination is suitable for long period maintenance of rangeland whereas rye grass combination is suitable for short period.

Study on effect of cutting on economical seed production of Stylo

Shrestha KK (1997). Study on effect of cutting on economical seed production of Stylo. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Sep 24-25, 1997, pp 66-68

A fodder cutting trial of Stylo on its seed production was studied on exiting Stylo swards in Palpa district. The seed production pattern and seed quality of style with no forage cutting prior to seed harvest was compared to single cut and double cuts taken in 1st week of August and subsequent cutting of double cut was in 2nd week of October. The fodder yield, Plant height, number of branches per plant, branch height, number of nodules per plant, bush yield seed yield and germination performance of seed the time taken from cutting and seed preparation were recorded separately from each treatment. The average seed production was 76.0 kg/ha in No cut (TI) 53.0 Kg/ha. in Single cut (T2) and 11.0 Kg/ha in Double cuts (T3) respectively. The fodder production prior to seed harvest was 13.0 Ton/ha in T2 and 18.0 Ton/ha in T3 treatments respectively. The weight of bus after seed cleaning was 90.0 kg/ha. in T1, 75.0 Kg/ha in T2 and 58.0 Kg/ha in T3.The fodder production prior to seed harvesting has more economic benefit than other treatments. Style is not only economically high value pasture species also provide notorious fodder for livestock to increase their production.

Performance of different cultivars of Stylo for green matter and seed production under leasehold condition

Pariyar D, JR Adhikary, RN Kandel, RC Ghimire and RR Shrestha (1999). Performance of different cultivars of Stylo for green matter and seed production under leasehold condition. *Proceedings of 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, 26-28 June, 1999, pp 179-184

The annual demand of Stylo seed is estimated at 34 t annually where as 25% of the required amount is produced in the country. This experiment was conducted in the leasehold sites with leasehold farmers groups in order to find out the varietals capability for seed production and cost-benefit condition. Experiment on fodder cum seed production was conducted in two leasehold groups in Makwanpur and in Kavre and Ramechhap districts under complete randomized design. The pasture species *Stylosanthes gainensis cv. cook* was sown under minimum tillage. A comparison was done for green matter and seed production among three cultivars of style. On an average green matter production from Stylo*santhes gainensis cv. Cook* was 20 t ha. As for seed production potential is concerned the highest quality seed was

produced from *Stylosanthes gainensis CV Graham* 56.3 kg ha followed by *Stylosanthes gainensis cv CIAT-184* 52.7 kg ha and *Stylosanthes gainensis cv. cook* 22.5 ha. Cost benefit condition indicated that the net income from seed and green fodder production per ha basis was the highest from cv. CIAT-184 (NRs 57344:00) followed by cv. Graham (NRs 54044:00) and cv. Cook (NRs 30194:0) in three year period.

Performance of Stylo under different types of lime application and inoculation

Pradhan SM, D Pariyar, JR Adhikari, PB Munakarmi and RN Kandel (2000). Performance of Stylo under different types of lime application and inoculation. *Proceedings of the 4th National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Pakhribas, Dhankuta, 24-26 April, 2000, pp 91-94

A study was done to know the effect of inoculation and treatment with lime in production yield of Stylo (*Stylosanthes guianesis* cv. Cook). On an average 34.8 and 37.5 t/ha of green forage was produced from inoculated Stylo in the years 1997 and 1998 respectively. This production was significantly higher ($P<0.05$) than control (without inoculation and lime application). Compared among the districts, significant difference ($P<0.05$) was observed with Ramechhap district producing lowest 17.0 and 18.0 t/ha in control group against the highest yield of 48 and 49.2 t/ha in Makwanpur district. The green forage yield was recorded comparatively higher in second year than in the first year in almost all the treatments and districts.

Effect of cutting on seed production of winter legumes

Munakarmi PB, SM Pradhan, KK. Shrestha and D Pariyar (2000). Effect of cutting on seed production of winter legumes. *Proceedings of the 4th National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Pakhribas, Dhankuta, pp 88 - 90

On an average of three years, Common vetch (*Vicia sativa*) produced the maximum forage yield (5.4t/ha) among four winter forage legumes from two cutting management practices which is highly significant to one cutting management practices. Similarly, within three *Pisum spps*, Whiro pea produced more green matter (4.1t/ha) from two cutting management practices. The maximum seed yield from Vetch (2.5 t/ha) was obtained from zero cutting management practices. Whiro pea produced more seed (2.2 t/ha) among three *Pisum spps* in zero cutting. *Vicia sativa* produced the maximum (2.5 t/ha) seed. A significant difference of treatments was found on green matter ($P<0.001$) and seed production ($P<0.001$) among four winter forage legumes on cultivation practices.

Evaluation of different legumes species for high altitude areas

Pradhan SM, D Pariyar, RN Kandel, JR Adhikari, PB Munakarmi and KK Shrestha (2000). Evaluation of different legumes species for high altitude areas. *Proceedings of the 4th National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Pakhribas, Dhankuta, April 24-26, 2000, pp 95-99

Four different legume species via, Trefoil ripens cv. Cook, *Trifolium repens* CV Tahoka, *Lotus pendunculatus* cv. Maku were tested in fertilizer applied condition (250 kg DAP/ha) and control (without fertilizer) at Hills Leasehold Forestry areas Makwanpur, Kavre and Ramechap. From the data of two years production yield, *Lotus pendunculatus* cv. Maku produced 10-t/ha bio-mass which was significantly higher ($P<0.05$) than *Trifolium repens* cv. Khumal (5t/ha) and *Trifolium repens* cv. Tahora (4.5t/ha) in average production yield. An increase in biomass production yield under application of fertilizer over the control was 36% and 46% and 52.3% for *Trifolium repens* cv. Khumal, *Trifolium repens* cv. Tahora and *Lotus pendunculatus* cv. Maku respectively.

Evaluation of production performance of different cultivars of *Stylosanthes spp* on degraded lands

Shrestha KK, MP Sharma, D Pariya, M Sapkota, JL Yadav and SM Pradhan (2001). Evaluation of production performance of different cultivars of *Stylosanthes spp* on degraded lands. *Proceedings of the 4th National Animal Science Convention (NASA)*, Nov 29 – Dec1, 2000, pp 120-126

In this study, the results showed that there was significant difference ($P<0.001$) on growth among different cultivars in each district. Similarly the production potential differed significantly in each district except Ramechhap. Among six cultivars of Stylosanthes spp, CIAT 184, Graham and Cook established well than others in Makwanpur district producing 7.4, 5.3 and 3.4 Mt green matter (GM) corresponding to 2.5, 1.8 and 1.1 Mt dry matter (DM)/ha/cutting respectively. Seca and Cook performed better than others in Kavre district producing 4.3 and 2.5 Mt GM and 0.9 and 0.85 Mt DM/ha/cutting. Cook, CIAT 184 and Graham produced more GM (6.9, 5.5 and 3.4 Mt) and DM (2.1, 1.7 and 1.1 Mt) per ha/cutting in Sindupalchok district. In case of growth performance CIAT 184 attained the maximum plant height (98.7$\pm$9.8cm) in Makwanpur and Sindupalchok (117.7$\pm$19.17 cm), Seca in Kavre (94.80$\pm$21.5 cm) and Cook in Ramechhap district (82.4$\pm$7.28 cm).

Study on economic benefit and marketing situation of major forage cultivars in different eco zones of Nepal

Bastola BR, HK Shrestha, SB Singh, GK Sedain and BB Kshatri (2004). Study on economic benefit and marketing situation of major forage cultivars in different eco zones of Nepal. *Proceedings of the 5th National Animal Science Convention (NASA),* pp 163-171

A study was carried out in different eco zones of Nepal to assess the economic benefit and marketing situation of major forage cultivars. The highest green matter yields of Oat and Berseem were recorded in Mahottari (36 Mt/ha and 65.26 Mt/ha, respectively). Green matter yield from Stylo was recorded highest in Jhapa (43.74 Mt/ha). The highest seed yields for Oats were reported in Rupandehi (2.3 Mt/ha), for Berseem in Banke (510 kg/ha) and for Stylo in Jhapa (123 kg/ha). Stylo seed producers in Banke and been earning a net income up to NRs 52.761/ha in Ilam. Stylo seed producers earned up to NRs 43.216/ha in Makwanpur. The average net income obtained by framers from Berseem, Oat, Stylo and winter Vetch were NRs 40.303; 18.932, 29.102 and 22.864/ha, respectively, whereas the net income from Maize, Wheat and lentil averaged NRs 8.301, 5.896 and 5.499/ha, respectively. Despite rudimentary forage seed marketing network in the country 24 of 38 seed suppliers interviewed reported that forage seed demand had been increasing, five respondents reported that no change in seed demand, while 2 reported that there was declining demand in the recent years. Seven respondents did not know the trend of forage seed demand in the district. Majority pf seed suppliers had been selling seeds of annual forage mainly Oats and berseem. Other species included Stylo, Molasses and Teosinte.

Study on production performance of different temperate pasture species under hortipasture system of Rasuwa district

Shrestha NP, KK Shrestha and NP Bhattrai (2004). Study on production performance of different temperate pasture species under hortipasture system of Rasuwa district. *Proceedings of the 5th National Animal Science Convention (NASA)*, pp 141-143

A study was carried out to test the performance of pasture legume (white clover) and grass (Cocksfoot, Ryegrass and local grass) combinations under hortipasture system at 2 different locations of Rasuwa district. The growth pattern and productive performance were taken

separately from each site and analyzed for their nutritive value from each treatment. The highly significant differences were found on plant height among treatments and locations. The difference on forage production was only significant between locations. The maximum forage production was obtained from the combination of Ryegrass, Cocksfoot and White clover (7.53 Mt/ha) followed by Ryegrass + White clover (6.91 Mt/ha), White clover + Cocksfoot (5.76 Mt/ha) and White clover + local grass (5.28 Mt/ha). The productive performance of forage at Brable found better than at Bridim. The proximate analysis revealed that the combination of White clover and local grass contained the maximum CP (12%) and Ca (1.3%) than other combination, mainly attributed White clover.

Economical cultivation practices of Berseem in dairy pocket areas

Kandel RN (2006). Economical cultivation practices of Berseem in dairy pocket areas. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research* in Nepal, Khumaltar, Lalitpur, 1-2 July, 2004, pp 175-176

After Oat, Berseem is the most promising fodder species which provides green fodder during Nov-March. It is a traditional cultivated fodder legume which is in cultivation practices on farm since over last 40 years in the sub tropical region of the country. This fodder legume is relished by all kinds of livestock and has over 18% crude protein content. To reduce the cost of fodder production surface seeding, line sowing and broadcasting methods were studied in dairy pocket areas of Rupandehi, Kaski and Ilam districts. Surface seeding of Berseem in standing paddy crop, 10-15 days before paddy harvesting was found to be economical in terms of fodder production. A comparative study on yield under three different methods of sowings indicated that surface seeding has produced 21% and 32% more fodder yield than line sowing and broadcasting methods respectively.

Production potential of Stylo and Joint Vetch under community forestland

Mandal P, RD Pandit, BP Budhanagaria and MD Jha (2006). Production potential of Stylo and Joint Vetch under community forestland. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, 1-2 July, 2004, pp 180-182

Five farmers of Bakdhuwa VDC of Saptari district were selected for this study. They were provided seeds and fertilizers. Plot size was 10 m^2 in community forest land. Seed rate of Stylo and Joint Vetch were @ 3.0 and 15.0 kg/ha respectively. Methods used were line sowing with NPK application @ 40:30:20 kg/ha and FYM 10 Mt/ha, respectively. The highest green matter recorded (22.2 Mt/ha) was from Joint vetch of 3 cuts while lower yield 18.44 Mt/ha was found from 3 cuts of Stylo. First cutting was taken after 90 days of sowing and 2nd and 3rd were at 60 days intervals. Plant height recorded was 104 and 70 cm for Joint vetch and Stylo, respectively.

Study on the intercropping of forage legumes along with cereal crops at Agriculture Research Station (ARS) Rasuwa, Dhunche

Shrestha KK, NP Bhattarai and NP Shrestha (2006). Study on the intercropping of forage legumes along with cereal crops at ARS Rasuwa, Dhunche. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, 1-2 July, 2004, pp 169-174

Maize, finger millet and wheat are major food crops of Rasuwa district. Small landholders can not afford land for forage cultivation and need to intercrop forage with main crops without negative effect on cereal production. Thus, a comparative study of forage legumes grown mixed with wheat, maize and millet on station was carried out. Two winter forage legume species, common vetch and pea were intercropped with local wheat. Similarly soybean and local beans

were grown with maize and finger millet at station during 2000-2002. A significant difference ($P<0.05$) on grain production was found in the yield of wheat and maize crops but there was non significant difference on finger millet grain production. Sole cropping of wheat produced more grain 2.4 Mt/ha followed by vetch and pea inter cropped. 1.6 Mt/ha and 1.5 Mt/ha respectively. In case of maize, intercropping with soybean produced maximum grain 3.6 Mt/ha followed by sole crop maize and bean inter cropped as 3.0 and 2.4 Mt. /ha respectively. Sole crop of finger millet produced more grain 0.47 Mt/ha than other forage legume intercropping, however, the differences were not significant when intercropped with forage legumes. Fodder production was found maximum from maize inter cropped with soybean 17.6 Mt/ha followed by sole maize 15.4 Mt/ha and maize + bean 12.9 Mt/ha. Small land holding farmers could inter crop forage legumes along with cereal crops for both grain and quality fodder production from same piece of land.

Technologies generated in Pasture, Fodder and Agro-forestry for increasing livestock feed situation

Pariyar D (2006). Technologies generated in Pasture, Fodder and Agro-forestry for increasing livestock feed situation. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, 1-2 July, 2004, Khumaltar, pp 153-158

A total of 40% landmass of the country contributing to feed 8.68 million livestock units. Even though a feed deficit 37% is prevailing. The major source of feed are cultivated land, forest and rangelands. Some important and valuable research work has been accomplished to alleviate fodder deficit situation in the country. With the available technologies at hand, rangeland, degraded open and shrub land, fallow land has potential to provide 34 times more forage yield. Better germplasms, combination of grasses and legumes and appropriate management practices have been found to be essential to boost forage production in different agro-ecological zones.

To study the productivity of pastureland under natural condition

Shakya BS (1988). To study the productivity of pastureland under natural condition. *Nepalese Journal of Animal Science (NASA)*, **4**:53-59

This trial was conducted at Livestock Development Farm, Jiri. The main objective of this trial was to assess the productivity of pastureland. In Nepal, most of the pasturelands are commonly owned. But it is irony that these pasturelands are very poorly managed. Neither cultivation is not done nor is any fertilizer added. Grasses grow on these lands under completely natural condition. Realizing the fact, this trial was conducted to picture out the general idea about the productivity of natural pastureland of this region. For this purpose, 6 plots having 6 sqm/plot were selected randomly from the pastureland. These plots were fenced to protect from grazing animals. Harvesting of forage was done on every 1st day of the month. We were able to take 5 cuttings in a year. The green forage yield on an average was 11.19 t/ha/annum.

Study of high altitude pastures in east Nepal

Shrestha NP, P Shrestha and RM Gatenby (1990). Study of high altitude pastures in east Nepal. *Working Paper N. 90/7*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal

Pastures were studied near Gupha pokhari and Khamlalung at altitudes between 1500 and 2900 m in the hills of eastern Nepal. The duration the herds' spent on the pastures averaged 9.5 h/day in July, and fell to 6.7 h/day in December. The average bite rates of adult animals were 59 /min for chauries, 56 /min for buffaloes and cattle, 54 /min for sheep and 51/min for goats. For all species bite rate was lower for young animals, and was higher during the summer than

the winter. Adult buffaloes, cattle and chauries have bite areas of 8-13 sq cm, whereas sheep and goats have bite areas of about a.6 sq cm. For all species, bite area increases with age, and there was little seasonal effect. The quantity of forage ingested was about 1.1g/bite for adult buffaloes and cattle, it was lower in the winter (0.9 g) than in the summer (1.4 g), but the dry matter content of the herbage was much higher in the winter (80%) than in the summer (24%). It was estimated that the annual production of herbage was about 13000 kg/ha (fresh weight) or 3600 kg DM/ha. Herbage intake was about 22 kg/day for adult buffaloes and 24 kg/day for adult cattle. Levels of crude protein indicated that the nutritive value of herbage was very high at the beginning of the monsoon and felled during winter. The carrying capacity of the pasture was estimated to be about 1.7 adult buffaloes or cattle/ha.

Evaluation of native and exotic pasture species at Guthichaur sheep farm, Jumla

Singh SB, NP Joshi, KR Tiwari, NK Gurung and DR Dongol (1990). Evaluation of native and exotic pasture species at Guthichaur sheep farm, Jumla. *Proceedings of the 2nd Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalipur, Nepal, 11-16 March, 1990, pp 74-100

Two experiments were conducted at Guthichaur sheep farm, Jumla in June 1989. In one experiment, 29 grasses and 14 legumes were tested for DM production. The highest DM yield of 13.4 Mt/ ha was recorded in *L. multiflorum* cv. Barmultra followed by *L. multiflorum*, *L. prenne* cv. Sabrina (11.1 Mt/ha), *L. perenne* cv Baranna (7.1 Mt/ha) among grasses and 10.5 Mt/ha from *T. Subterraneum* cv Seaton Park followed by *T. pretense* cv Karim and *T. resupinatum* cv. Kyambro (each 6.4 Mt/ha) and *T. subterraneum* cv. Dalkeith (5.8 Mt/ha) among legumes. The yield performance of *Medicago spp* and *T. repens* CV Khumal was almost 1/3 the yield of *T. subterraneum* CV Seaton Park. In another experiment, botanical composition and carrying capacity were determined in south facing sloppy pasture where 10 cages (1x1 m) were positioned at equal intervals during 3 months. The observation revealed that the experimental pasture block does not comprise any naturally growing legume species. *Themeda hookerii, Arundinella hookerii, Chrysopogon grrllus* and *Thymus linearis* were the most abundantly available species in the caged area contributing 85.9% of plant population and 84.6% of the total biomass production. In the un-caged area *Andropogon tristis* was also among the predominant species. These species in the un-caged area occupied 81.7% of the total population contributing 28.5% of the total biomass. The biomass production were 1.46 t DM/ha of the caged area and 1.11 t DM/ha for un-caged area. The carrying capacity of natural pasture is estimated at 4.4 adult sheep/ha/annum

Species composition of the natural pasturelands at Guthichaur, Jumla

Joshi NP, DR Dongol, SB Singh, KR Tiwari and NK Gurung (1990). Species composition of the natural pasturelands at Guthichaur, Jumla. *Proceedings of the 2nd Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, 11-16 March, 1990, pp 159-177

Two surveys were conducted to monitor species composition and plant density in the Guthichaur natural pasturelands during June and Sep 1989. A total of 191 species of vascular plants belonging to 145 genera and 52 families were identified. The species rich families were Poaceae (29 spp), Asteraceae (25 spp), Rosaceae (14 spp), lemiaceae (13 spp), Fabaceae (9 spp), Polygonaceae (9 spp), Ranunculaceae (7 spp) and Scrophulariceae (5 Spp). Out of 52 families recorded, 25 were represented by one species each. One poisonous plant species, *Aconitum spicatum*, a parasitic plant, *Cuscuta spp*, and an insectivorous plant, *Drosera peltata* were recoded. Based on plant density (n/m^2) estimated in June 1989, *Trisetum apicatum* (211), *Arundinella hookerii* (88), *Artemisia spp* (37), *Anomone obtusiloba* (24) and *Anaphalis contora* (12) were dominant species in the pastureland (2800 masl)flat area, close to the airstrip;

Arundinella hookerii (175), *Thymus linearis* (25), *Anaphalis nepalensis* (20), *Traxacum officinal* (16) and *Potentilla filgans* (15) were the dominant species in the sloppy pasture blocks (3030 masl); where as Poa attennuata (157), *Potentilla microphylla* (74), *Leontopodium nanum* (61), *Potentilla argyrophylla* (39.2) and *Campanula pallida* (23) were important species in the alpine pastureland (3940 masl).

Study of high altitude pasture in east Nepal

Shrestha NP and P Shrestha (1991). Study of high altitude pasture in east Nepal. *Proceedings of the 1st National Animal Science Convention (NASA)*, Khumaltar, Lalitpur, Nepal, Jan 14-15, 1991, pp 43-51

A study was undertaken at altitude between 1500 and 2900m asl in the hills of eastern Nepal. It is estimated that annual production of herbage is about 13000 kg/ha fresh weight) or 3600 kg/ha dry matter. Herbage intake is about 22 kg/d for adult buffalo and cattle. Levels of crude protein indicate that the nutritive values of herbage are very high at the beginning of the monsoon but falls during the winter. The carrying capacity of the pasture is estimated to be 1.3 livestock unit LSU) per hectare whereas, stocking area is 6.7 LSU/ha.

Mineral status of highland pasture during the dry season in the eastern hills of Nepal

Subba DB and BB Tamang (1992). Mineral status of highland pasture during the dry season in the eastern hills of Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **7**(1): 32-33

Forage samples collected during the dry season from two highland pastures were analyzed for major and minor mineral contents. The minerals found to be deficient were P and Na. The levels of Ca, Mg, Cu and ZN in the forage samples were sufficient to meet the requirements for ruminants. However, to fully understand the availability of the minerals identified in the forage samples, detailed studies of the blood biochemistry of the animals grazing in these areas are envisaged.

Botanical composition of high Himalayan pasture and the evaluation of its nutritive value at Rohun alpine pasture of Kaski

Dahaubhdel TS and BN Tiwari (1995). Botanical composition of high Himalayan pasture and the evaluation of its nutritive value at Rohun alpine pasture of Kaski. *Proceedings of the 2nd National Animal Science Convention (NASA)*, 7-10, Aug, 1995, pp 30-34

An observation trail was conducted at Rohun alpine pasture at 3800m altitude. This pasture land is grazed for 2-3 months in the summer by sheep, goats, buffalo and cattle. The purpose of the trail was to identify the botanical composition, the biomass production and the proximate analysis of the forage. Ten species of grass were identified but no legumes were found. Biomass production was found to be 2.4 Mt DM/ha in August, and 2.1 Mt DM /ha in September. Protein content of the pasture was higher when harvested in August (10.89) as compared to that harvested in September (9.52%).

Rumen degradability (dry matter and crude protein) of some rainy season terrace raiser grasses in the eastern hills of Nepal

Gurung HB, NP Shrestha, PB Chemjong and DB Subba (1996). Rumen degradability (dry matter and crude protein) of some rainy season terrace raiser grasses in the eastern hills of Nepal.*Veterinary Review,* Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **11**(1): 18-20

The rumen degradability of eight terrace riser grasses was determined. Dry matter (DM), crude protein (CP) and modified acid detergent fiber (MADF content of the grasses ranged from 7.7-

39%, 6.4-21.5%and 22.6-44% respectively. Dry matter degradability (DMD) and crude protein degradability (CPD) of these grasses ranged from 44-79.8% and 22.9-91.9% respectively. The DMD and CPD values were highly significantly different (p<. 01) between the species. MADF content of these grasses were negatively correlated (r^2=0.73, p<. 01) with DMD. Also, the tannin level was negatively correlated (r^2=0.65, P<.001) with the CPD. Considering DMD, CPD and CP values, Ilame Ratneulo, Rimai and Banso are good quality whereas, Salimbo and Siru are of poor quality grasses for ruminants. However farmer's rankings of the eight grasses do not coincide with the scientific findings.

Establishment of grasses on debris slopes report

Paudel KC, JH Howell and BP Tripathi (1998). Establishment of grasses on debris slopes report. *Working Paper N. 98/5,* Lumle Agricultural Research Centre, Lumle, Kaski, Nepal

A factorial experiment was conducted to evaluate the effect of fertilizers and slopes on the establishment of indigenous grass species on roadside debris materials. Performance of grass establishment was compared among 3 grass species – Furke (*Arunduella nepalensis*), Kans (*Saccharum spontaneum*) and Babiyo (*Eulaliopsis binata*); and 4 level of inorganic fertilizers – control, minimum (NPK 80:40:40), medium (NPK 150:80:80) and maximum (NPK 240:120:120). Soil analysis report showed poor nutrient content at both sites with high amount of stones (50%). The overall survival grass in fill slope was 99% and at out slope was around 90%. Effect of inorganic fertilizer on survival, plant height, ground coverage, and grass production was not evident. However, species Kans was excellent in term of plan height (126 cm), grass production (264 gm DM/plot) and root development compared to Babiyo and Furke. Furke had poor plant height (39 cm), grass production (19 gm DM/plot) and root development. Grass growth was better at fill slope near Lumle Centre compared to cut slope near Baglung. Grass species Kans and Babiyo could be established successfully at roadside debris materials even without additional of inorganic fertilizers.

Morphological aspects of pasture species in the shade in relation to various management practices under silvi-pastoral systems

Devkota NR and PD Kemp (1998-1999). Morphological aspects of pasture species in the shade in relation to various management practices under silvo-pastoral systems. *Journal of Institute of Agriculture and Animal Science (IAAS),* Rampur, Chitawan, **19-20**:1-6

Understanding competitive interactions between tree species and understory pasture is required to help for the development of silvi-pastoral systems. Existing knowledge on tree pasture interactions helps to guide planning research activities in line with determination of growth of pasture species under tree shade. In this paper, a definition of agro forestry in the broader sense and silvo-pastoral systems in the practice are reviewed. The review mainly focuses on current trends in agro forestry systems, with an emphasis on the role of broad leaf trees in the silvo-pastoral system, together with the interrelationships between trees, pasture and animal components. Similarly, the current knowledge on production and persistence of understorey pasture is reviewed in relation to morphological adaptations and effects of light, fertilizer and defoliation. Since tree pasture interactions are a complex phenomenon to understand, it is important to get guidelines in order to identify shade tolerant pasture species so that management practices of pasture species could be ensured for a productive and persistence of introduced pasture species under a given silvo-pastoral systems.

Feeding system, feeds availability and nutrient content in the feed and forages found in the high mountain areas of Solukhumbu and Sankhuwasava districts

Khanal RC, SB Panday and SK Khanal (1999). Feeding system, feeds availability and nutrient content in the feed and forages found in the high mountain areas of Solukhumbu and Sankhuwasava districts. *Proceedings of the 3rd Nation Workshop on Livestock and Fisheries Research in Nepal,* Agriculture Research Station, Lumle, Kaski, Nepal, 26-28 June, 1999, pp 15-24

Two separate studies were conducted in 1997 and 1998 to investigate the feeding systems, feeds availability and nutrient content in the available feeds and forages in 2 districts using formal in informal survey, discussion and observation of the study areas. Nutritional analysis was carried out for the feed and forages most commonly available in the study areas and collected during the time of visit. Major findings have been discussed under the headings:

- Major feeds and forages
- Feedings systems
- Availability of feeds and forages
- Situation of pastures and grazing land
- Nutritive value of the feeds and forages
- Major poisons plants found in the study areas
- Major problems associated with feeds and feeding, and
- Strategies for improvement

Study on the productivity of Brassica (Chota and Koira)

Shrestha BS (1999). Study on the productivity of Brassica (Chota and Koira). *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research* in Nepal, Agriculture Research Station, Lumle, Kaski, Nepal, 26-28 June, 1999, pp 186-189

An experiment was conducted to study the productivity of Chota and Koira at different spacing (20, 30, 40 and 50 cm) in a 2x 4 factorial design. The yield difference between species ie Chota and Koira was not significant while the yield difference at different spacing was highly significant ($P<0.01$). The yield was highest at plant to plant distance of 20 cm of for Chota (10.5= 1.14 t/ha) and 30 cm for Koira (14.7= 0.34 t/ha). A spacing of 20-30 cm between the plants for both of these species would be more productive.

Rangeland productivity and its management in high altitude rangelands of Rasuwa, Nepal

Bastola BR, M Sapkota, NR Devkota and M Sharma (2002). Rangeland productivity and its management in high altitude rangelands of Rasuwa, Nepal. *Proceedings of 5th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, July 10-11, 2002, pp 168-182

In order to study on vegetation composition and productivity of rangeland 17 rangelands were purposely selected in Rasuwa for the study. The major species found at 2520-3200 m asl were *Pennisetum flaccidum*, *Poa annua*, and *Trifolium repens*. The species found at 3200-3900 m asl was *Danthonia sp., Poa annua* and *Trifolium repens*. Similarly, the species found at 3950-4380 m asl were *Danthonia sp., Trifolium repens, Poa annua, Potentilla flugens* and *Bistorta sp*. The second cutting had higher yield than the first one in all the rangelands. *Potentilla fulgens* had the highest DM content (27.67%) where as *Corydalis meifolia* had the lowest DM (14.89%). The different species had significantly different DM content ($P<0.001$). The biomass production and

chemical constituents of high land range species were found increased with altitude up to the altitude of 4400 m asl.

Nutritional values of grasses found in Nepal

Tiwari MR, SK Khanal, BK Shrestha and RK Jha (2005). Nutritional values of grasses found in Nepal. *Nepalese Veterinary Journal*, **28**:78-94

The nutritional values of grasses in Nepal have not been evaluated comprehensively. In this study, altogether 686 samples of different grass species were collected from 28 districts (comprising of 9 mountains, 11 hills and 8 Terai districts) of Nepal during past 12 years were evaluated for their nutrient content. Average dry matter, organic matter, total ash and crude protein content different grass species were found to be 21.96, 87.87, 12.13 and 12.0 percent respectively. Similarly, average NDF, ADF, Lignin, hemicellulose and cellulose content of different grass species were recorded to be 62.53, 46.49, 13.55 15.76 and 32.85 percent respectively. Likewise, average calcium and phosphorous content of different grass species were recorded to be 0.78 and 0.32 percent respectively. Highest content of dry matter (36.67%), organic matter (97.97%), total ash (30.2%) and crude protein (26.91%) was recorded for Dush, Myang Myang, Karimari and Sunhemp species whereas, highest NDF, ADF, lignin, hemicellulose and cellulose content of different grass species were recorded for Daha, Chirabhuje, Marbindo, Bichro and Chirabhuje which was 81.86, 71.96, 39.32, 51.42 and 60.03 percent respectively. Similarly, grasses like Myang Myang and Kikyu were superior in phosphorous content (0.65% and Bethe for calcium content (2.8%).

Preliminary evaluation of promising native forage species in Dhading and Kavre districts

Prenil KC, D Pariyar, KK Shrestha and PB Munakarmi (2009). Preliminary evaluation of promising native forage species in Dhading and Kavre districts. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 115-124

Feeding of locally available forage species is crucial in the hills of Nepal in terms of livestock production. The forages, however, vary greatly in terms of its availability, morphological traits, nutrient content according to the season of their availability and the sites of their growth. Different forage species were, therefore evaluated in Dhading and Kavre for their seasonality and morphological traits as well as their ability to produce the biomass. The tradition practice of feeding native grasses to the livestock by the farmers in their homestead, terrace raisers, marginal lands, forestlands, swampy lands, barren lands and buds are very much common and they usually grow naturally without much care. A survey was conducted to assess 5 most popular forages in each site. In Dhading, Sama (*Echinochloa glabrescens*) and Banspate (*Setaria palmifolia*) performed better than Phool khari (*Celtis spp*), Chitre banso (*Digitari caliaris*) and Kode ghans (*Eleusine indica*) ($P<0.001$) in terms of plant height. Similarly, Sama and Phool khari were significantly better than other in tillering ability ($P<0.001$). More importantly, Sama outplayed others in terms of their biomass yield/ha ($P<0.001$). In contrary, Tharkhari and Phool khari were taller than Phurke khar (Arundinella *nepalensis*), Rato khar (*Adenostemma lavenia*) and Banspate ($P<0.001$) in Kavre, while Phurke khar and Banspate had least number of leaves per plant among the tested ($P<0.001$). Similarly, Rato khar demonstrated the best tillering ability among all ($P<0.001$). Above all, Phool khari pproduced the highest biomass in Kavre ($P<0.001$). In general, amny types of forages are managed for their rootstock during April to May and they start flower from August till October. Seeding occurs during December to January while they are harvested starting from June to October. Sama in Dhading and Phool khari in Kavre exhibited the best overall performances for their morphological and production traits. However, there is a need to verify these statistics with their ability to perform better in

terms of livestock production. Therefore, these forages will be tested for their nutritive quality and their ability to provide efficient nutrition in animal production especially in the hills of Nepal.

Nutritive value of different non - conventional feeding resources found in Nepal

Tiwari MR, NL Tamrakar, HR Shrestha, BK Shrestha and RK Jha (2006). Nutritive value of different non- conventional feeding resources found in Nepal. *Green Field Journal of Himalayan College of Agricultural Sciences and Technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **4**(1):33-45

The non conventional feed resource (NCFR) refers to all those feeds and forages that have not been traditionally used for animal feeding. Field survey of different sites was done to identify the non conventional feed resources. Highest content of dry matter was found in sunflower seed (93.68%). Chutro (97.91%) was found superior in organic matter content. Similarly, highest crude protein content was noted in Pumpkin lahara (35.15%). Likewise, highest content of total ash and ether extract was recorded for Jalkumvi and Banana's cover (bokra) (49.94 and 8.62% respectively). In case of detergent fibre content, highest content of NDF, ADF, Lignin, hemicellulose and cellulose was recorded for maize khosta, sadhan, maize stalk, maize stover, sugar beet stem with 81.36, 74.05, 58.96, 27.77 and 63.12% respectively. Similarly, highest content of calcium was recorded for Pumpkin lahara (4.68%) whereas phosphorous was found highest in sugarcane bark (chhokra) (1.77%).

Nutritive value of common forages under Melia tree based silvipastoral system

Barsila SR and NR Devkota (2008). Nutritive value of common forages under Melia tree based silvipastoral system. *The 5th National Conference on Science and Technology, Nepal Academy of Science and Technology (NAST)*, Khumaltar, Lalitpur, Nepal, 10-12 Nov
An experiment was conducted in SPD at IAAS livestock farm to measure the chemical composition

Of mixed grasses grown under 14 year old Melia tree shade maintained at 1200 stems/ha with 3 shade levels as main factor and forages in mixture as sub factor. Shade level was standardized and maintained throught the forage growth period by pruning the lowermost branches and reading the light intensity by digital lux meter. The forages, sampled from each subplots at 60 and 40 days after planting was considered for the dry matter estimation and proximate analysis. Shade effect remained significant ($P<0.05$) at 1st harvest and remained similar ($P>0.05$) to the species of grasses. However, in case of leguminous forages, crude protein content was varied according to the shade level in the 1st year ($P<0.05$) and significant ($P<0.001$) in 2nd year. Accordingly, shade effect was significant to the crude fibre content ($P<0.05$) and to forage species ($P<0.001$) too. The effect of shade to the under storey herbage production in relation to the nutritive value has been confirmed. Still, forage quality under particular silvipastoral system is yet to be determined in line to the digestibility results.

Herbage mass productivity and carrying capacity estimation of some of the selected rangelands of Taplejung district

Devkota NR and MR Kolachhapati (2010). Herbage mass productivity and carrying capacity estimation of some of the selected rangelands of Taplejung district. *Nepal Journal of Science and Technology (NAST)*, **11:** 63-70

A study of the representing rangelands of Taplejung district was carried out during summer of 2009 to estimate the herbage mass yield of different slope categories, and to calculate the carrying capacity (CC) of the representing rangelands based on 60 days re growth period so

that optimum number of livestock unit (LU) per unit area would be possible to allow for grazing. The findings revealed that plain slope had higher herbage mass produced, but was comparatively over grazed as revealed by higher stocking rate. Existing carrying capacity reasonably supports the grazers, but irrespective of the quality herbage. In deed there was a lower CC for higher slope area with higher CC for plain slope. Nevertheless, the CC values for different slope categories indicated that rangelands in Taplejung district was wider scope of improvement, both for herbage mass productivity, and grazing management through precise stocking rates to match with the prevailing carrying capacity. A major challenge, however, lies to convince herders about the benefits of reducing stocking rates and improving production efficiencies, with the increased income and less degradation of the present available rangelands. Detail study on herbage mass production based on total herbage mass harvest days of a year along with stocking rate for the respective period would be important to consider in generating concrete and site specific information.

Nutritional evaluation of different varieties of rice straws grown under different conditions of Nepal

Panday SB, SK Khanal and NP Osti (1995). Nutritional evaluation of different varieties of rice straws grown under different conditions of Nepal. *Proceedings of the 2nd National Animal Science Convention (NASA),* Lalitpur, Nepal, 7-10 Aug, pp 57-60

Twenty two varieties of rice straws from different locations of Nepal were analyzed for dry matter (DM), organic matter (OM), crude protein (CP) and total ash contents. DM, OM, CP and total ash contents were found to significantly different between different varieties of rice straws ($P<0.001$). Dm content ranged between 85 (birangful) and 90.5% (Jirasari). OM content ranged between 84.7 (Philis) and 89.9% (Chinapati), CP content ranged between 3.6 (Tilki) and 6% (Philis). Total ash content ranged between 10.1 (Chinapati) and 15.3% (Philis). The present paper indicated that 6 rice varieties (Philis, Satha, Yekahattar, Sabitri, Chirage and Mansuli) which contained CP between 5 to 6 percentages. It may be considered as some of the superior quality rice straws for feeding the ruminants in Nepal.

Hay yield of natural Pasture in response to manure application at KhiMti, Jiri

Shrestha KK (1996). Hay yield of natural Pasture in response to manure application at KhiMti, Jiri. *Proceedings of the 1st National Workshop on Livestock and Fisheries Research in Nepal,* Khumaltar, Lalitpur, 7-9 May, 1996, pp 44-47

The present hay meadow at Khimti has low productivity status due to annual cutting and removal of hay without return of nutrients. The objective of this study was to find out the response to farm yard manure application of natural pastures in terns of hay yields. Five levels of FYM Mo (no manure), M1- 10 kg, M2- 20 kg, M3- 30 kg and M4 -40 kg were applied randomly in 4 replicate plots measuring 5x4m areas to find out the differences of hay yields. The grass was cut at the normal time hay is made on farm. The cut grass was dried for a day in hay making process. The mean fresh and hay yield of natural pasture were not found significant response as an increase level of FYM application. The highest and lowest herbage production was obtained from the M3–9.0 Mt/ha which was 25% more yields and M1 -7 Mt/ha which was 2.8% less yield compare to M0 respectively. Similarly, the highest hay yield was recorded from M4-3.8Mt/ha which was 5.6% more yields and lowest hay yield was from the M1-3.2 Mt/ha which was 11.1% less yield compare to M0, respectively.

Study on forage conservation for winter feeding in Langtang VDC of Rasuwa district

Banstola BR and NP Shrestha (2001). Study on forage conservation for winter feeding in Langtang VDC of Rasuwa district. *Proceedings of the 4th National Animal Science Convention (NASA*), Kathmandu, Nepal, Nov 29 – Dec1, 2000, pp 137-140

The present study revealed that a farmer in the Lang tang VDC make about 556 kg of hay per year to keep up the livestock. The study also evidenced that herbage production decreased with increasing altitude ranging from 3000 to 3500 m asl. The herbage dry matter production in the study VDC varied from 2.82 to 3.87 Mt/ha/yr. The dry matter production of herbage increased but the crude protein content decreased with increasing stage of growth (9.12% during late Bhadra (Mid- September) to 6.28% during late Kartik (Mid-November).

Assessment on quality hay production through farmers' participation in Dhunche and Syaphru VDCs of Rasuwa district

Shrestha KK and NP Bhattarai (2004). Assessment on quality hay production through farmers' participation in Dhunche and Syaphru VDCs of Rasuwa district. *Proceedings of the 7th National Workshop on Outreach Research,* Khumaltar, Lalitpur, June 24-25, pp154-156

The forage preservation as hay is traditional practice of most hill farmers of Rasuwa district to feed their animals in lean periods of winter and summer dry months. The native forage species that are grown on terrace raiser; bunds and forest are cut during first and second week of Kartik with little understanding on forage quality. A study was done for development of forage preservation technique to support the livestock management system through farmers' participation during 1999-2000. Twelve farmers six each from Dhuncha and Syafru VDCs were involved for this study. Two methods of hay preparation 1) forage drying on fields, and 2) forage dried on ropes under shade were practiced at both locations. The available native forages were cut at two different stages of plants 1) initiation flowering, and 2) on 50% flowering on both locations. The hay yield after drying the cut grass was weighed. The 200 g sample of hay was sent to Animal Nutrition Division for their proximate analysis. Good quality of hay was produced when the grasses was cut at initiation of flowering stage. However, there was no significant variation on quality hay production between two methods and cutting stage of plants at both locations. The crude protein (CP) content of hay was about 13% that is double than the CP content at their normal time of hay preparation. The average hay yield was 16% of total green weight.

Socio economics study on forage production on and preservation system in Rasuwa

Shrestha HK, BR Bastola and NP Shrestha (2004). Socio economic study on forage production on and preservation in Rasuwa district. *Proceedings of the 5th National Animal Science Convention (NASA), p*p 153-162

A survey was carried out in Rasuwa district to collect information on socio economic status of livestock farmers, existing practices of forage production and constraints in livestock production system. The study revealed that average livestock unit/household was 13.5, 27, 4.9 in high altitude (> 2200 m asl), mid altitude (1600-2200 m asl) and low altitude (<1600 m asl), respectively. Out of the total cash income of farm household, the livestock component contributed about 53% in high hills, 61% in mid hills and 18% in lower hills as compared to other components like crop, horticulture and of farm activities. Yak, Chauri, sheep and goats in high hills, cattle and goats in mid hills and cattle and buffalo, pig and poultry in lower hills were the important source of cash income. In high hills, farmers used to grow traditional radish called huma or chota (*Brassica tora*) in addition to preserving green grass as hay for winter feeding to livestock. Other native herbs locally known as Champalhamu and Tigiri were also fed

to livestock in winter after chopping, mixing and boiling with huma. High hill was most feed deficit zone where farmers with mean livestock holding of 22.44 units had only 37 kg hay/livestock unit for whole winter season (December-April). The large livestock holding the lower was the hay production/unit livestock in upper belt of Rasuwa. Most of the respondents ranked the problem of forage scarcity as the most serious one for livestock production. Among other problems, outbreak of animal disease and lack of market facility were the important ones.

Oat hay production in Nepalese farming system

Shrestha KK (2005). Oat hay production in Nepalese farming system. *Proceedings of the Workshop on Fodder Oats, Fodder Technology Packages and Small Farm Income Generation*, Kathmandu, Nepal, 8-11 March, pp 68-72

A study on Oat cultivars for hay production was conducted at Dhunche (1950 masl) and Langtang (3300-3500 masl). Twenty two cultivars were sown on July 2003 at Dhunche; weeds were a great problem, particularly in summer and frequent weeding was needed. A cut taken after 2 months for green fodder averaged 10.3 tons/ha. The second cut was harvested for hay, but its yield was very low (2.4 t/ha); weather hampered drying and spoiled the hay. In Langtang, 12 Oat cultivars were sown on May 13, 2003 which was quite late in the cropping season. The 1st cut after 2 months gave an average yield of 5 tons/ha of fodder; no 2nd cutting was taken since the plots had been grazed. Next spring sowing was on Apr4, 2004. A total of 22 cultivars of Oat were tested. First cutting was after 2 months for fodder, the average yield was 6 tons/ha. The 2nd cut was on September 17, 2004 for hay; the average green yield production was 8.11 t/ha. Awapuni, Charisma, Canadian, Kent, Hokonui, Bundel 851, NARC – 1(Pak), Omihi, 9217603 and 83INC19G3 were found good for hay making. The average made hay yield was 2 tons/ha, about 24% of green fodder weight.

Reducing methane emissions by improving ruminant production in Nepal

Joshi DD, C Stem, T Worth and M Orlic (1997). Reducing methane emissions by improving ruminant production in Nepal. *Bulletin of Veterinary Science and Animal Husbandry*, **25**:14-21

Methane is a very important greenhouse gas and a major environmental pollutant. Its contribution to global warming represents about 20% of the greenhouse gases. Among the major sources of anthropogenic methane, ruminants produce around 22% of the total. So livestock ruminants offer a large opportunity for methane reductions. Methane is produced by normal ruminant digestion. The amount of methane produced, however, depends on the quantity and quality of feed, being more with roughages with poor digestibility such as crop residues. Provision of additional nitrogen supplement to ruminant for example through molasses urea multi nutrient block (MUB) can help ruminal micro flora to better breakdown cellulose in roughages into starch and sugars. This could help to increase the digestibility and animal intake of the feed, and reduce methane gas emission. Furthermore, this will also ensure better availability of nutrients to the animals and will help to improve livestock production. MUB is simple, applicable, available and low cost to produce in Nepal at community level, which could also reduce amount of methane production per unit of product.

Nutritional variation of different varieties of rice straw found in different parts of Nepal

Tiwari MR, SK Khanal, B Shrestha and RK Jha (2009). Nutritional variation of different varieties of rice straw found in different parts of Nepal. *Nepalese Journal of Agricultural Science, published by Himalayan College of Agricultural Sciences and Technology (HICAST)*, Gathaghar, Bhaktapur, Nepal, **7:**153-163

In Nepal, fibrous crop residues (straw) are the backbone of ruminant production system, particularly for cattle and buffaloes. Approximately 3 million tons of crop residues (straw) are being produced every year in Nepal (LMP, 1993) and its major portion is use for feeding ruminant animals. The nutritive values of straw are not evaluated well, even if evaluated, the results are not consistent. Altogether, 755 samples of different rice straw were collected from Baglung, Baitadi, Bara, Bhaktapur, Dang, Darchula, Dhankuta, Dhanusa, Illam, Kailali, Kanchanpur, Kaski, Kathmandu, Kavre, Lalitpur, Mahottary, Myagdi, Panchthar, Parbat, Parsa, Ramechhap, Sankhuwasava, Saptari, Sindhupalchok, Siraha, Solukhumbu, Surkhet, Syangja, Taplejung, Terhathum and Udayapur districts of Nepal during past 12 years and were evaluated for their nutrient content. Average dry matter, organic matter, total ash and crude protein content of different rice straw were found to be 87.31, 87.54, 12.46 and 4.77 %, respectively. Similarly, average neutral detergent fibre (NDF), acid detergent fibre (ADF), lignin, hemi cellulose and cellulose content of different rice straw were recorded 73.63, 51.62, 10.07, 21.95 and 41.20 %, respectively. Highest content of dry matter (93.51%), organic matter (97.19%), total ash (19.46%) and crude protein (7.22%) was recorded for Gunde, Takmara, Jhali and NR 15015 rice straw, respectively. Likewise, straw of Harda, Meranga and Himali, had higher NDF, lignin and hemicecellulose content (83.32, 15.08 and 29.95 %, respectively).

7.2 FODDER TREE

Effect of Tannin on the rumen degradability of the fodder tree leaves

Gurung HB, T Acamovic and C Stewart (1983). Effect of Tannin on the rumen degradability of the fodder tree leaves. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, 8(1)**:** 14-16

Thirteen important fodder tree leaves found in the eastern hills of Nepal were studied for tannin content and their associative effect on the dry matter and crude protein degradability. The tannin content of the fodder tree leaves ranged from 0.57 to 47.5 g/kg DM. The dry matter degradability (DMD) and crude protein degradability (CPD) of the tree leaves ranged from 32.3% to 76.9% and 26.7% to 91.5 % respectively. Tannin content of fodder tree leaves was negatively correlated but not statistically significant with DMD (r2=0.073, P>0.05) and CPD) r2=0.08, P> 0.05). However, the majority of fodder leaves contained relatively lower tannin except Bauhinia variegates which contained the highest tannin among the fodder tree leaves studied. Fodder tree leaves also contained higher fiber (26163-569.3g/kg DM), which also may have major influence on DMD because fiber content and DMD (5) of fodder leaves were negatively correlated or 2=0.607, P<0.01).

Study on productivity of fodder tree

Sharma LP (1985). Study on productivity of fodder tree. *Nepalese Journal of Animal Science (NASA)*, 1(1):19-24

Artocarpus lakoocha, Litsea pohyantha and *Premna integrafolia* are nutritious and palatable compared to others when fed to milking buffaloes. *Garuga pinnata* is palatable but nutritive value is poor but the farmers prefer to have some trees because it can be lopped even thrice in case of urgency and fed to all kinds of animal

Pretreatment of Bhimal (*Grewia optiva*) seed

Shrestha RK and MK Gautam (1989). Pretreatment of Bhimal (*Grewia optiva*) seed. *Technical Paper No. 89/2,* Lumle Agricultural Center (LAC), Lumle, Kaski, Nepal

Bhimal is considered to be one of the best fodder trees with a high nutritional value. The physical dormancy problem in Bhimal seed can be overcome by soaking 50^0C hot water, as well as in running water for 48 hrs. Although hot water treatment has advantage in germination starting and completion days, the germination percentage in two treatments were not much different. Hence soaking in 48 hrs running water is good to have fairly good germination.

Vegetative propagation of Nimaro (*Ficus auriculata*) and Raikhanayo (*Ficus semicordata*)

Suwal MRS, RK Shrestha and MK Gautam (1989). Vegetative propagation of Nimaro (*Ficus auriculata*) and Raikhanayo (*Ficus semicordata*). *Working Paper No. 89/18,* Lumle Agricultural Center (LAC), Lumle, Kaski, Nepal

The important fodder trees of the mid hills, Nimaro and Raikhanayo are lopped completely for fodder, generally during Dec until mid April. Except foliage and some soft twigs, other branches are left for nothing. The propagation of these species is very laborious from seed, and the high porter age of costs for carrying tube seedlings have necessitated the use of cut branches for vegetative propagation, which grow faster than seedlings. With the objective to select the best period of vegetative propagation, a study was conducted at two different elevations in different periods of time with different cuttings types. At the higher elevation, the best times for the vegetative propagation of Nimaro hardwood and softwood cuttings are between Feb to mid March and March to mid April respectively. But for Raikhanayo cuttings of both types strike better between mid Marchs to mid April although, its establishment is very poor as compared to Nimaro.

Chemical composition of the leaves of some common Ficus species

Mahato SN, DB Subba and PB Tamang (1989). Chemical composition of the leaves of some common Ficus species. *Veterinary Review*, Pakhribas Agriculture Centre, Pakhraibas, Dhankuta, Nepal, **2**:1-3

Leaves of six species Ficus growing at Pakhribas Agricultural Centre were collected each month. The species were *F. roxburghii, F. nemoralis, F. cunia, F. semicordata, F. locar* and *F bengalensis.* The monthly samples were pooled and analyzed in the laboratory. The results of the analysis showed that the DM content of leaves ranged from 29 to 39%. The CP content ranged from 8.5% in *F bengalensis* to 13.5% in *F. roxburghii*. Levels of indigestible components such as cutin and lignin were recorded. The digestibility of the species and farmers preferences for them had no obvious relation with the level of indigestible components or with tannin levels.

Seasonal variation in the chemical composition of the leaves of Ficus species fodder trees

Subba DB and PM Tamang (1990). Seasonal variation in the chemical composition of the leaves of ficus species fodder trees. *Proceedings of the 3rd meeting of the working group of fodder trees, forest fodder and leaf litter*, *Occasional Paper 2/90,* Kathmandu, Nepal, Dec 18-20, pp 20-24

Leaves of the 5 common Ficus species fodder trees *F. neriifolia (Dudhilo), F*. auriculate (Nimaro), *F semicordata* (Raikhanayo), *F semicordata* (Khasrokhanayo) and *F lacor* (Kavro) were analyzed every months for a period of one year for Dry matter (DM) crude protein (CP), ether extract (EE) total ash (TA) hemicellulose (HC) and modified acid detergent fibre (MADF). Analysis of variance showed that both months and species significantly affected ($P<0.001$)

constituents. The coefficient of variation (%) within each species were of the ranges 9-22, 7-24, 11-22, 4-8, 11-30 for DM, CP, EE, TA, MADF and HC, respectively. DM, CP and EE were highly variable in Nimaro. In general, CP content was negatively correlated with fibrous fractions and mineral matters indicating that CP levels are high when MADF, HC and TA levels are low.

Results of a fodder species elimination trial at Lumle Agricultural Center (LAC)

Harrison A (1989). Results of a fodder species elimination trial at Lumle Agricultural Center. *Technical Paper No. 89/13*, Lumle Agricultural Center (LAC), Lumle, Kaski, Nepal

Results from a fodder species elimination trial planted on a typically poor site at LAC are presented. The species planted were Kalo chuletro (*Brassiopsis glomerulata*), Seto chuletro (*Brassiopsis hainla)*, Dudhilo (*Ficus neriifolia*), Nimaro (*Ficus auriculata*), Kutmiro (*Litsea monopetala*) and Painyu (*Prunus cerasoides*). Over the 1st four years after plantation Painyu, Dudhilo and Kutmiro showed good survival (100%) while Kalo chuletro showed poor survival (33.3%). Painyu and Kutmiro showed the best mean height growth (192.4 and 117.1 cm respectively) over the same period. Whereas Kalo chuletro actually lost height on average (-3 cm). However, it was noted that height alone is not a good index of the performance of fodder trees. In terms of fodder volume Kutmiro and Painyu performed consistently well, however, both Nimaro and Seto chuletro well in better areas of the site. However, these observations are only qualitative at present. Even with good establishment practices (addition of compost to the pit, weeding and protection from grazing) it was clear that only the hardier species, Painyu and Kutmiro, performed well on this dry, stony, south facing slope, and only Painyu on the poorest parts of the site.

Proximate constituents of tree fodder from Institute of Agriculture and Animal Science (IAAS) Livestock Farm, Rampur

Jha US, SB Singh and R Pandey (1989). Proximate constituents of tree fodder from IAAS Livestock Farm, Rampur. *Journal of Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan*, **10**: 119-121

Ten tree fodder namely Painyu (*Prunus cerosoides*), Ginderi (*Premma integrifolia*) Ipil-ipil (*Leucaena leucocephala*), Koiralo (*Bauhinia variegata*), Panchpate (Unidentified), Khasreto (*Ficus hispida*), Badahar (*Artocarpus lakoocha*), Nimaro (*Ficus roxburghii*), Khanayo (*Ficus cunia*) and Kavro (*Ficus lacor*) were analyzed for crude protein (CP), ether extract (EE), crude fibre (CF), ash and nitrogen free extract (NFE) on dry matter basis (DMB) during February to April 1988. The chemical composition between species varied within the following limits; Dry Matter (DM), 31.3 to 49.2%; CP, 9.06 to 26.6%, EE, 2.5 to 5.9%; CF, 12.5 to 31.3%; ash 8.6 to 14.6% and NFE, 33.4 to 58.7%.

Nutritive value and Tannin content of some common tree fodder species of western hills of Nepal

Shrestha RK and BN Tiwari (1991). Nutritive value and Tannin content of some common tree fodder species of western hills of Nepal. *Working Paper N 31/91,* Lumle Agricultural Centre, Lumle, Kaski, Nepal

This paper gives some preliminary data on nutritive value of 13 common fodder tree species and compares previous data, with the new information obtained from analysis done in cooperation with the Natural Resources Institute, UK. This paper emphasizes the importance of anti nutrient factors which are also investigated, and gives recommendations for future study in the topic of fodder tree development. Tannin content of leaves varies with the time of harvest, and age of the leaves. It will be necessary to find out the permissible tannin content for

feeding animals without decreasing the available nutrient from the fodder trees. The tannin content of *A. lakoocha, Brassaiopsis hainla, Litsea polyantha, Dendrocalamus spp, Ficus glaberrima, Ficus semicordata, Ficus roxburghii, Ficus nerifolia, Quercus semicarpifolia, Q. lamellose, Prunus cerasodes, Castanopsis tribuloides* and *C. indica* were noted, 74-296, 72-708, 120-276, 0, 127-334, 72-369, 32-249, 57-205, 308-442, 200-280, 83-265, 164-298 and 164-208 PP unit/g, respectively.

Survival and growth of seedlings of some fodder species under different protection regimes

Suwal MRS and KC Paudel (1993). Survival and growth of seedlings of some fodder species under different protection regimes. *Working Paper N. 93/16*, Lumle Agricultural Research Center (LARC), Lumle, Kaski, Nepal

Raikhanayo (*F. semicordata*) was very susceptible to cold during its infant stage, whereas Seto chuletro (*B. hainla*) was cold resistant. Even without any shade over the entire trial period, Seto chuletro showed negligible mortality. In the case of Badahar (A*. lakoocha*), proper shading had reduced the mortality rate a great deal. No significant differences for mortality of seedling between plastic shading and the traditional practice of using local Bhakari were noted. There were no significant differences in growth between no shade and the Bhakari treatments. Growth was, however, significantly higher, at least twice, with the use of the plastic tunnel. The research results showed that the use of plastic tunnel can be used to reduce mortality and increase growth in forest nurseries during winter period. The cost involved in using plastic sheet for the trial was lower at NRs 300.0 compared to local Bhakari at NRs 360.o for the initial costs. These were also the possibility of reusing plastic sheets for more than one season.

Effect of application of compost, fertilizer and plastic mulching on the establishment and growth of Painyu, Nimaro, Raikhanim and Dudhilo

Suwal MRS, RK Shrestha and HB Thapa (1994). Effect of application of compost, fertilizer and plastic mulching on the establishment and growth of Painyu, Nimaro, Raikhanim and Dudhilo. *Working Paper N. 94/30*, Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

Plantation in poor and degraded sites has shown poor result in terms of seedling survival and growth rate due to the low soil fertility condition. The reported experiment was established in July 1988 at Chanaute of Parbat district to test the effect of site amelioration treatments on establishment and subsequent growth of seedlings for five years. A RB design in 4 replications compared the amelioration treatments of the application of 2 kg of compost or 20g of complexol in plantation pits and use of black plastic milch (60 cm radius) around the plant with control. Four fodder species, viz. Painyu, Nimaro, Raikhanim and Dudhilo were tested. Each plot consisted of 15 plants spaced at 1.5 m apart and arranged in a line. The application of 2 kg of compost in pits at planting had significantly better survival (91%), height growth (217 cm) and diameter (D_{30}) growth (3.4 cm) than rest of the treatments. Among the species, Painyu survived significantly better (93%) than the other species. But in terms of height and D_{30} growth, Raikhanim was significantly better (269 and 4.6 cm respectively) than other species. Thus, for the initial period, use of compost in planting pits enhances survival and growth rate of saplings in low soil fertility conditions.

Plantation establishment techniques of fodder tree species under stress conditions of soil fertility and exposure

Suwal MRS and A Harrison (1994). Plantation establishment techniques of fodder tree species under stress conditions of soil fertility and exposure. *Working Paper N. 94/53*, Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

Two experiments were conducted to examine techniques to improve plantation establishment under soil fertility and exposure stress conditions. In the 1st experiment , carried out at Puranogaon (1550 m asl) in July 1989 under low soil fertility conditions, seedlings of Raikhanim (*Ficus semicordata*) and Nimaro (*Ficus auriculata*) were planted in separate but contiguous areas and each area was sub divided into 3 square plots to plan 25 seedlings in each. Each plot was treated separately with one of these site amelioration treatments, viz plantings in standard pit size (30 x30 x 30 cm), larger pit (60 x 60 x 60 cm) and FYM applied to standard pit standard plus FYM. No marked difference in the mortality rate of saplings was found between the amelioration treatments. Survival rate was 100% for Raikhanim and 97% for Nimaro. The rate of increase in height and D_{30} growths of Raikhanim saplings between 1989 and 1994 was significantly greater for larger pit and FYM added standard pit than for the standard pit treatment (P=0.000), whereas in Nimaro the effect was not significant (P=0.093). In an observational study carried out at Lopre (2200m asl) in July 1989 under the exposed conditions, fodder tree species, Painyu (*Prunus ceracoides*) and Dudhilo (*Ficus nerrifolia*) were introduced by planting immediately leeward of small pines; midway between small pines; and under larger pine for shelter purposes. The study found that, in Aug 1994, seedlings planted immediately leeward of pines and under larger pines had performed comparatively better than those planted midway between small pines. In Painyu, the survival rates under each of these treatments were 100, 90 and 88% whereas the heights were 365, 390, 359 cm respectively. This was also true in Dudhilo that the survival rates were 72, 80 and 20%, and the heights 123, 87 and 57 cm respectively. Between species, Painyu showed better performance both in survival and growth rates as compared to Dudhilo.

Establishment of tree species by means of site ameltoration and bareroot planting

Suwal MRS (1995). Establishment of tree species by means of site ameltoration and bareroot planting*. Working Paper N. 95/27*, Lumle Agricultural Research Centre, Lumle, Kaski, Nepal

An experiment was conducted at Puranogaon (1500 masl) from July 1991 to Oct 1994 to determine the effect of planting pit amelioration treatments (2 kg FYM, 25 and 50 g complexol and control) on the establishment and growth of three fodder species, Raikhanim (*Ficus semicordata*), Nimaro (*Ficus auriculata*) and Dudhilo (*Ficus nerrifolaia*), on a poor fertility site (0.14% N, 240 ppm P, 0.06 md/100g K and 1.71 % K). Survival rate in Raikhanim (95%), height growth (204 cm) and D30 (2.1 cm) were significantly greater than for Nimaro (86%, 108 cm and 1.6 cm respectively) and Dudhilo (87%, 111 cm and 1.0 cm respectively). There was no significant difference between the planting pit amelioration treatments for these parameters. In a 2nd experiment was conducted at Puraogaon and Mohariya from June 1991 to Nov 1994 to observe the effectiveness of barerrot plantings of 7 broad species, Uttis (*Alnus nepalensis*), Camp (*Michelia champaca*), Pakhuri (*Ficus glaberrima*), Nimaro (*Ficus auriculata*), Raikhanim (*Ficus semicordata*), Dudhilo (*Ficus nerrifolia*) and Painyu (*Prunus cerasoide*s), and compared to the polypot raised seedlings of the same species. Due to the damage of seedlings by goats, the data statistically not analyzed, but the observations obtained at the end of the study showed that although polypot raised seedlings were comparatively better in survival rate than bareroot plantings, the later planting technique had shown equal potentiality in case of plant establishment. However, the differences were confounding and need further more investigation.

Learning indigenous knowledge from farmers about fodder trees

Panday T and DS Neopane (1995). Learning indigenous knowledge from farmers about fodder trees. *Journal of Institute of Agriculture and Animal Science (IAAS), Rampur, Chitawan, Research Reports (193-94*), pp 117-127

A study was carried out in Laxmipur-5 under Bharatpur municipality, Chitawan district; from March through August 1994 to investigate the indigenous knowledge system on fodder trees where integrated livestock based farming system was adopted. Thirteen species of fodder trees were planted by the farmers mostly on the sides and bonds of plots and around the homestead. The number of fodder trees was positively correlated to the size of the farm and size of animal herd. Generally, the fodder trees were lopped between Nov and April when the forage grasses were unavailable. Based on the quality and effect on animal health, farmers' catagorised the fodder trees into the following three classes: Class I: *Artocarpus lakoocha, Leucaena leucocephala*, and *Bauhinia perpuria*; class II: *Morus alba, Garuga pinnata, Melia azedarach, Premna integrifolia* and *Ficus cunia*; and class III: *Ficus roxburghii, Ficus lacor* and *Ficus glomerrata.*

Chemical composition of different varieties of fodder tree species

Panday SB and NP Osti (1995). Chemical composition of different varieties of fodder tree species. *Nepalese Journal of Animal Science (NASA),* **9**:17-25

Six different location of Gorkha district were selected for the evaluation of the nutrient contents of the fodder tree species. Fodder tree species *under investigation were Khasreto (Ficus hispida), Dumri (Ficus glomerata), Koiralo (Bauhinia* variegate), Tanki (*Bauhinia purpurea*), Gindari (*Premna integrefolia*), Kutmiro (*Litsea polyantha*). Fodder tree leaf samples were analyzed for DM, OM, NDF, ADF, lignin, Total Ash and CP contents. Nutrient such as OM, Cellulose, hemicellulose, cell soluble contents, lignin, Total Ash and CP differed significantly ($P<0.01$) between the fodder tree species.

Results of a fodder tree elimination trial at community managed kharbari land in the low hills of western Nepal

Paudel KC, MRS Suwal and B Adhikari (1997). Results of a fodder tree elimination trial at community managed kharbari land in the low hills of western Nepal. *Working Paper N. 97/64*, Lumle Agricultural Research Centre, Lumle, Kaski, Nepal

Six tree species of fodder value (*Ficus semicirdata, F. auriculata, F. neriifolia, Artocarpus lakoocha, Michelia Champasa* and *Brassiopsis hainla*) were planted to select the better species for fodder production at community managed kharbari land at Sigana (1000 masl), one of the off station research sites of Lumle Agricultural Research Centre at August 1992. At the end of the 4th year, the survival percentage and height growth of species were significantly different ($P<0.005$ in both) but not the diameter growth ($P=0.006$). The survival percentage of the species *F. neriifolia, F. semicordata* and *A. Lakoocha* was 96%, and that of *M. champaca* and *F. auriculata* was 92 and 80% respectively, whereas *B. hainla* had poorest survival (27%). Height growth of *F. semicordata* (147 cm), *F. neriifolia* (132 cm) and *M. champaca* (106 cm) was significantly greater than those of *A. lakoocha* (75 cm), *F. auriculata* (45 cm) and *B. hainla* (28 cm). The trend of height growth and their respective regression equations for all the 6 species are presented in the report. Preliminary reports from this experiment suggests the species *F. semicordata*, *F. neriifolia* and *M. champaca* can be satisfactorily established and *B. hainla* may be eliminated from future planting at such sites where thatch grass is grown and trees are planted in a conventional forestry practices. As the sites like kharbari are commonly available for fodder

tree plantation in the low and middle hills, results of this experiment has relatively high relevance to such sites. It is suggested that such trials need to be continued for few more years to get conclusive results.

Fodder trees as the potential resources for livestock feed in the western hills of Nepal

Rana RS and N Amatya (2000). Fodder trees as the potential resources for livestock feed in the western hills of Nepal. *Seminar Paper N. 2000/29*, Agriculture Research Station, Lumle, Kaski, Nepal

A Samuhik Braman was conducted in 1999 by the multi disciplinary group of livestock scientists, socio economist and livestock extension officers with special focus on feed and feeding of livestock. The team was assigned to visit 4 AER (Bhakimli, Maduwa, Chhahara and Chambans) and 4 OR sites (Rising Patan, Ghalegaun, Barhabise and Argali) of ARS, Lumle representing River basin, low hill, mid hill and high hill. A group discussion with the local farmers was organized through rapid rural appraisal (RRA) with the help of structured questionnaire. The survey showed that the livestock were mainly fed with crop residues, grasses, fodder, and grain depending up on the availability. Seventeen tree fodder species were identified as common fodder tree lopped between Oct to April especially during mid March to mid May, when livestock face the most critical feed scarcity. Fodder species such as *Artocarpus lakoocha, Bambusa balcooa, Bridelia retusa, Premna barbata, Terminalia chebula, Litsea monopolata, Ficus lacor, Ficus semocordata, Machilus odoratissima, Morus alba* and *Ficus globerrima* are the potential resources to support livestock during the lean period.

Site and seasonal variation on the nutrient content of twenty important fodder trees in the western hills of Nepal

Rana RS (2001). Site and seasonal variation on the nutrient content of twenty important fodder trees in the western hills of Nepal. *Proceedings of the 1st Society of Agricultural Scientists Convention (SAS/N)*, Kathmandu, Nepal, March 29-31, 1999, pp 265–270

The nutrient content of twenty important fodder trees, namely Bains (*Salix sp*.). Banjh (*Quercus incana*), Bedulo (Ficus *clavata*), Dhursul, Dudhilo (Ficus *nemoralis*), Gaya (*Ardelia retusa*), Harro (*Viscum album*), Khari (*Seltis australis*), Kimbu (*Morus alba*), Pakhuri (*Ficus glaberrima*), Thotne (*Ficus hispida*), Kavro (*Ficus lacor*), Nimaro (*Ficus auriculata*), Chuletro (*Brassaiopsis hainla*), Dabdabe (*Garuga pinnata*), Raikhanim (*Ficus semicordata*) Kutmiro (*Litsea polyantha*) , of 4 different agro-ecological research(AER) sites were analyzed during three different seasons (monsoon, autumn, late winter). The results showed that these species contain the nutrient in the range of 13.4-56.1% dry matter, 21-31.14 % total ash, 6.1 –30.4 % crude protein, 5.5-58.7% acid detergent lignin, 0.86-13.0 % hemicellulose, 8.6 – 34 .9% cellulose, 0.54 –11 .0% calcium, and 0.11-0.66% phosphorus on a dry matter basis. The fluctuation on nutrient content was mainly due to difference in sites, seasons and fodder trees species.

Digestibility of *Ficus roxburghii, Castanopsis indica* and *Ficus cunia* on growing buffalo from western hills of Nepal

Osti NP, PB Chapagain and MR Tiwari (2009). Digestibility of F*icus roxburghii, Castanopsis indica* and *Ficus cunia* on growing buffalo from western hills of Nepal. *Proceedings of the 7th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Nepal, 25-27 June, 2007, pp 233-237

Nine buffalo calves were subjected to three fodder tree species namely; Nimaro (*Ficus roxburghii*), Dhalne katus (*Castanopsis indica*) and Raikhanayo (*Ficus cunia*) for digestibility trial during Nov 27 to Dec 3, 2005 in regional Agricultural Research Station (RARS), Lumle,

Kaski, Nepal. Animals were kept 7 days prior to adaptation for these fodders. Weighed amount of fodder tree leaves including twigs and small branches were fed 2 times a day and observation on fodder offered, refused and fecal voided were recorded daily. Chemical composition of fresh matter and fecal voided were carried out for dry matter (DM), crude protein (CP), neutral detergent fibre (NDF), acid detergent fibre (ADF), lignin, calcium (Ca) and phosphorous (P). The mean dry matter content and their dry matter digestibility (DMD) of these three-fodder tree species was found 27.86, 46.02, 34.72, 73.21, 65.93 and 71.28%, respectively. There were strong negative correlations observed between Ca and CP with fibre fraction (NDF and ADF). The weak correlation was also observed between P and other constituents with respect to digestibility of constituents. From the results, if there could be provision of low fibre content in dry season, the three main nutrients (Ca, P and CP) may easily be absorbed by the animals.

Non conventional feed source for livestock in Nepal – *Energy source*

Singh SB and NP Joshi (1990). Non conventional feed source for livestock in Nepal – Energy source. *Nepalese Journal of Animal Science (NASA),* **6**(6):1-18

Non conventional feeding materials such as bagasse, banana leaves and stems, Sal seed meal, Cassava tubers, sawdust, water hyacinth and animal manure are plentiful in this country but have been given little attention due scattered availability, presence of toxic principles, lack of processing technology or lack of appropriate feeding technology. This paper attempt to describe the available non-conventional energy rich feeding materials and discuss their use. The factors limiting their use and the approach needed to overcome problems are also discussed.

Non- conventional feed resource for livestock in Nepal – *Protein sources*

Singh SB and NP Joshi (1990). Non conventional feed resource for livestock in Nepal – Protein sources. *Nepalese Journal of Animal Science (NASA*), **7**(7)**:**1-18

Non conventional feeding materials can broadly be grouped into energy rich or protein rich sources. In this paper the use of proteinous materials in animal feeds are discussed. Many of these materials contain toxic principles (eg sapoglucosides in *Madhuca indica*) while others are under explored for their production potential (insects and leaf protein concentrate) or feeding values. The constraints and the means of alleviate these problems are also discussed.

Tannin in tree fodders in Dhankuta district of east Nepal

Subba DB and PM Tamang (1990). Tannin in tree fodders in Dhankuta district of east Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **5**:5-6

Tannin (Gallotannic acid) contents in tree leaves and young branches (twigs) were at the range of 1-9% dry matter. Most tree twigs contained relatively higher amounts of tannin as compared to mature or young leaves. At the same time, most tree leaves contained the same amount of tannin concentration irrespective of their maturity. *Bredelia retusa* (Gayo) however, was found to have similar tannin levels in both mature and young leaves, and young branches (twigs).

Chemical composition and nutritive value of Amliso

Subba DB and CN Kanel (1990). Chemical composition and nutritive value of Amliso. *Veterinary Review,* Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **5**:9-10

This paper records the results of analysis of the proximate principles, polyphenolics, major mineral elements, calculated digestibility's and energy values of young leaves, mature leaves and tender stems of Amliso (*Thysandaena maxima*) growing at PAC, Dhankuta. The chemical

composition and nutritive values vary within plant parts. Young leaves were nutritionally better fodder as compared to mature leaves or young stems. The chemical constituent's compares well with tree fodders particularly Koiralo (*Bauhinia variegata).*

Role of browse shrubs/trees as animal feed in Nepal

Pande RS (1991). Role of browse shrubs/trees as animal feed in Nepal. *Proceedings of the first National Animal Science Convention (NASA)*, Khumaltar, Lalitpur, Nepal, Jan 14-15, pp 20-26

Browse shrubs /trees serve as a supplementary diet as well as sole diet for ruminant, especially in hill areas of Nepal/ Over 137 different species of browse have been used as a source of animal feed. Most of the leaves of browse are of low palatability and low digestibility. Many contain secondary compounds. Leguminous species are relatively high in nutritive value compared to non- legumes. Browse provides approximately 41% of the total DM in annual feed supply and 12% in the diet of dairy stocks. Use of fodder in hilly areas was estimated 655 kg/caput and for bedding materials 459 kg/caput. There is no attempt to assess animal preference for different browse species. Goats have been found to prefer for browse than cattle and sheep whenever available. Browse species may not be an efficient diet for livestock, but as a supplement with poor quality roughage such as straw, browse can serve as an excellent feed especially, in dry season when herbaceous species fail to meet the optimum level of production. More research work is needed for the better of browse.

Nutritional value and Tannin content of some common fodder species of the western hills of Nepal

Shrestha RK and BN Tiwari (1992). Nutritional value and Tannin content of some common fodder species of the western hills of Nepal. *Proceedings of the 4th meeting of the working group on fodder trees, forest fodder and leaf litter, Occasional Paper N. 1/92*, pp 1-5

Following on farm work carried out by Lumle Agricultural Centre in 1974, a detailed analysis of 13 commonly used fodder tree species was made between Nov 1990 and Feb 1991. Samples were analyzed for crude protein ash content and tannin content. The results revealed that in most species tannin levels vary throughout the period of growth. By managing the lopping cycles of a variety of species, it could be possible to limit tannin intake by animals. The bamboo, *Dendrocalamus sp*. produces no tannins.

Seasonal variation in nutritive fodder availability

Dutt P (1992). Seasonal variation in nutritive fodder availability. *Proceedings of the 4th meeting of the working group on fodder trees, forest fodder and leaf litter, Occasional Paper N. 1/92*, pp 13-20

Ruminant livestock productivity is dependent on maintaining a constant plane of nutrition throughout the year. However, nutritive fodder is seasonal. Availability is determined by on farm and off farm fodder resources. The period of critical fodder shortage may vary from one month to as many as 4 months. During this period livestock are generally fed crop residues sometimes supplemented by tree fodder. Individual fodder tree species come into production at various times during the year; therefore it is essential to provide a species mix for feeding to ruminant livestock. Farmers have evolved a number of practices to cover the critical period including the selection of certain winter fodder species. Some practices are localized, some are more extensive. Only one or two species are used over wide area. This paper attempts to highlight some species presently localized and explore the possibility of their wider adoption.

An assessment of farmers' knowledge of fodder in Jumla

Yadav BD (1992). An assessment of farmers' knowledge of fodder in Jumla. *Proceedings of the 4th meeting of the working group on fodder trees, forest fodder and leaf litter, Occasional Paper N. 1/92,* pp 26-30

A representative sample of 10%, made on the basis of status, sex and caste, was interviewed in Lamra, Mahat and Chandannath Village Development Committees in Jumla district. *Celtris australis* was found *to be the most used species, Salix sp. second and Pyrus pashia third. In the forest Quercus* semecapifolia *was first, Arundinaria intermedia second and Q. floribunda third. While only Desmodium* tillaefolium was used on farmland. Normal seasons for lopping are pre-monsoon, monsoon, post-monsoon and winter. It winter *Quercus semecarpifolia* is the only species to be lopped as most other species are deciduous. The survey was highlighted the importance of finding winter fodder species when there is not sufficient grass for grazing. The planting of grasses should be encouraged on grazing land, especially for the winter season.

Availability of protein from high altitude tree fodders during the dry season in the eastern hills of Nepal

Subba DB, BB, Tamang and PM, Tamang (1992). Availability of protein from high altitude tree fodders during the dry season in the eastern hills of Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **7**(2):55-57

Thirty-one high altitude (above 1700 m) tree fodders including a shrub, a creeper and a grass species were analyzed for crude protein (CP). The CP was fractionated *in-vitro* into soluble protein, insoluble but available protein and insoluble and unavailable protein. More than 80% of the total tree fodders contained more than 15% of CP. However, actual protein availability varied from 30% to 80%. The protein fractionates and their availability to the ruminants has been discussed.

Mineral status and their seasonality at three different stages of *Bauhinia purpurea*, *B. variegate, Artocarpus lakoocha* and *Litsea monopotela* in the eastern hills of Nepal

Subba DB, PM Tamang and BB Tamang (1993). Mineral status and their seasonality at three different stages of *Bauhinia purpurea, B. variegate, Artocarpus lakoocha* and *Litsea monopotela* in the eastern hills of Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **8**(2): 53-56

Three different stages (young leaves, mature leaves and twigs) of Tanki (*Bauhinia purpurea)*, Koiralo (B*. variegate),* Badahar (*Artocarpus lakoocha)* and Kutmiro (*Litsea monopotela) were* analyzed seasonwise for major and micro mineral elements. The general trend of distribution of minerals was higher in twigs than in young or mature leaves. All the species showed significantly higher levels of iron, manganese, calcium, magnesium, zinc and copper but lower levels of sodium and phosphorous as compared to the recommended dietary levels for maintenance and production of ruminants.

Reports on the results of a biomass study for Badahar (*Artocarpus lacoocha*)

Shrestha RK and KC Paudel (1993). Reports on the results of a biomass study for Badahar (*Artocarpus lacoocha*). *Working Paper N. 93/42*, Lumle Regional Agricultural Center (LARC), Lumle, Kaski, Nepal

Badahar is highly demanded fodder tree in the hills of Nepal and is commonly planted in an around cultivated land. Lack of information about fodder production per tree according to the size of tree, has constrained farmers in allocating their limited land resources properly. The

study was shown that there is strong correlation between the square of diameter at breast height and the fodder biomass production, which will be a reliable basis to estimate biomass for trees according to their size. Although the form of the relationship was the same in both 1991 and 1992, biomass production was lower during 1991. The same trend of production for 2 years data suggests that the study should continue for another 3-4 years to determine variation between seasons. The study has also shown that lopped Badahar contains an average of 72% leaf, 28.7% twigs, and that 90 % of lopped branches are palatable.

Effect of Tannin on the rumen degradability of the fodder tree leaves

Gurung HB, J Acamovic and C Stewart (1993). Effect of Tannin on the rumen degradability of the fodder tree leaves. *Veterinary Review*, 1993, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **8** (1):14-16

Thirteen important fodder tree leaves found in the eastern hills of Nepal were studied for tannin content and their associative effect on the dry matter and crude protein degradability. The tannin content of the fodder tree leaves ranged from 0.57-47.5g/kg DM. The dry matter degradability (DMD) and crude protein degradability (CPD) of the tree leaves ranged from 32.3-76.9% and 26.7-91.5% respectively. Tannin content of the fodder tree leaves was negatively correlated but not statistically significant with DMD (r2 = 0.073, P>0.05) and CPD (r^2= 0.089, P>0.05). However, the majority of the fodder leaves contained relatively lower tannin except *Bauhinia variegata* which contained the highest tannin among the fodder tree leaves studied. Fodder tree leaves also contained higher fibre (261.63-569.3g/kg DM), which also may have major influence on DMD because the fibre content and DMD percentage of fodder leaves were negatively correlated (r^2 =0.607, P<0.01).

Notes on farmers' knowledge and perception about tree fodder in the eastern hills of Nepal

Subba DB, PM Tamang, LB Rai and BB Tamang (1994). Notes on farmers' knowledge and perception about tree fodder in the eastern hills of Nepal. *Veterinary Review*, 1994, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **9**(1):24-27

A questionnaire survey was conducted in the six hill districts of Koshi and Mechi zones of eastern Nepal to identify farmer's perception on tree fodder in terms of nutritious and palatable fodder. The score given by farmers were ranked using a matrix survey technique. The district wise rankings of 15 different tree fodders were tested. The 10 most preferred tree species in the eastern hills were Kutmiro, Tanki, Dudhilo, Nimaro, Gogan, Badahar, Ghotli, Bans, KhasreKhanayo and Raikhanayo.

Seasonal variation in the proximate principle of some common tree fodder in the eastern hills of Nepal

Subba DB, PM Tamang and BB Tamang (1994). Seasonal variation in the proximate principle of some common tree fodder in the eastern hills of Nepal. *Veterinary Review,* Pakhribas Agricultural Centre, Pakhribas, Dhankuta, Nepal, **9**(2) **&10**(1):23-26

The proximate principles of the seven important tree fodders Tanki (*Bauhinia purpurea*), Koiralo (*Bauhinia variegate*), Badahar (*Artocarpus lacoocha*), Kutmiro (*Litsea monopotela*), Gogan (*Saurauia nepaulensis*), Khari (*Celtis australis*) and Ghotli (*Grewia oppositifolia*) were measured at three different stages (young, leaves, mature leaves and twigs) during the spring, summer, monsoon and winter season. The results showed that these species could supply on an average 21-39% DM, 10-16% CP, 1.4-2.8% EE, 19-35% CF, 7-14% TA and 38-55% NFE on a dry matter basis.

Livestock farming and fodder trees situation in Chitawan: A case study

Shrestha GM, IP Dhakal and TN Baral (1994). Livestock farming and fodder trees situation in Chitawan: A case study. *Journal of Institute of Agriculture and Animal Science (IAAS), Research Reports, (1992-93), Rampur, Chitawan*, pp 2134-239

A survey was conducted at Sharadanagar and Mangalpur VDCs in Chitawan during 1993 to study the ethnicity in the sample population, average livestock number/household, types of diseases affecting the livestock, livestock management practices, types of fodder trees preferred by the farmers and the important problems for cultivation of fodder trees. Brahmans were the dominating groups in both the VDCs. In Sharadanagar, average of ruminant holding was highest by Gurung and in Mangalpur it was highest by Brahamins. Livesrfluke was the most prevalent disease (85%) in both the VDCs which was followed by *Haemorrhagic septicaemia*. Stall feeding was the most common livestock management practices in both the VDCs followed by stall feeding + grazing systems. In Sharadanagar, average number of ipil ipil/household was highest (39.68%) which was followed by Bakaino (28.68%). However, in Mangalpur the average number of Bakaino/household was highest (7.92%) followed by Dabdabe (4.15). The main problems for cultivating fodder trees were lack of seeds and seedlings in both VDCs

Use of plastic tunnel enhances seedlings height growth in forest nurseries during winter

Suwal MRS (1995). Use of plastic tunnel enhances seedlings height growth in forest nurseries during winter.*Working Paper N. 95/2*, Lumle Agricultural Research Centre, Lumle, Kaski, Nepal

A study conducted at Khibang (1960 m asl) of Myagdi district during 1990 showed that Seto Chuletro (*Brassaiopsis hainla*) seedlings grown inside the plastic house had mean height of 16.3 cm as compared to those grown under normal shading condition (7.1 cm) between November to April. A 2nd trial was conducted at Lumle Agriculture Centre (1675 m asl) in 1991 in which seedlings of Raikhanim (*Ficus semicordata*), Seto Chuletro (*B. hainla*) and Badahar (*Artocarpus lakoocha*), germinated during Nov were pricked out and included in the study. The seedlings under plastic tunnel had lower mean mortality (11%) than the traditional practice of shading (18%). The rate was higher in Raikhanim (41%) than the other species. The trial conducted during 1993 was the modification of the one done in 1991 in which the experiment was a split plot design. The 1st factor was the shading regimes, viz. plastic tunneling, use of bhakari (day and night), use of bhakari (night and morning) and no shade, and the 2nd factor was the species, viz. Raikhanim, Seto chuetro, Badahar, Nimaro, Blue pine and Seto champ. The study was carried out between November 1993 and July 1994 and included seedlings (of the above species) that were pricked out during Sep/Oct, 1903 from mother beds. Seedlings mortality in this study was much lowered and there was no significant difference on it between the shedding regimes (P=0.2255). And in all the treatments, Raikhanim was 100% survived. In case of height growth, seedlings under plastic tunnel had significantly best performance (27 cm) than the rest. Likewise between species, Raikhanim showed highest growth (44.2 cm) as compared to other species. Normally, plastic tunneling is important in forest nurseries during winter for enhancing height growth of seedlings.

Vegetative propagation techniques of Badahar and Bamboos

Suwal MRS (1995). Vegetative propagation techniques of Badahar and Bamboos. *Working Paper No. 95/10*, Lumle Agricultural Research Centre (LARC), Lumle, Kaski, Nepal

A study was conducted twice during (1992 and 1993 at Lumle center's Lumbini nursery for nearly seven months (January-July) on the establishment of vegetative propagated seedlings. The experiment was a 2 x 7 factorial RCB design with four replications in which the first factor

consisted of root and branch cutting, and the second factor had seven propagation periods starting from the first week of January through first week of April at two weekly intervals. In two experiments of 1992 and 1993 had confounding results that in the first study, root cutting performed significantly better sprouting (54%) at mid July than the branch cuttings (4%)., whereas in the latter study, no significant difference was observed between the cutting types (13 and 13% respectively). Unlikely, in the latter study, branch cutting showed better sprouting performance than in the first. From the first study, the propagation time for root cutting was significantly better if done between the 3rd weeks of January through first week of March that the rest of the propagation periods. No such difference was observed between the propagation periods in the study of 1993. An interaction was seen only in the 1992 study. Another study was conducted at Lumle center between February and September 1994. The experiment was a split plot design with three replications in which the cuttings (single nodded) of Tame bans (*Dendrocalamus hamiltonii*), Gopi bans (*Dendrocalamus patderies*) and Dhanu bans (*Bambusa balcooa*) were planted between February and June at one month interval. Although species had no significant difference in sprouting of propagated cuttings, those propagated in June sprouted significantly better (40%) than other times of propagation. The interaction between the species and propagation time was mainly attributed by highest response of June propagation of Dhanu bans (64%). On the other hand, Gopi bans had shown the highest shoot number (3) and among the propagation period, February showed significantly the maximum number (4). In case of height of the shoots, no significant achievements was observed between the species types, however, the February propagation was still the best (71cm). The interaction was also caused mainly due to the exceptional height of Dhanu bans propagated during February.

Indigenous management and nutrient analysis of fodder trees and feed mixture in Chitawan

Devkota NR, M Sapkota, JL Yadav, SS Pant and KR Pande (1995). Indigenous management and nutrient analysis of fodder trees and feed mixture in Chitawan. *Journal of Institute of Agriculture and Animal Science (IAAS) Research Reports, Rampur, Chitawan (1993-94*), pp 105-116

A study on common indigenous management practices of fodder tree species was carried out in Vijayanagar and Saranpur villages of Mangalpur VDC in Chitawan, during April-May and Aug-Sep, 1994 with the objectives to understand the farmers indigenous knowledge on fodder tree species, to determine the nutrient content constituents of some preferred fodder species and feeding mixtures; and to suggest for improving feeding strategy. PRA was employed to collect basic information to determine the selected fodder species and group discussion was carried out to understand the indigenous management system. Selected fodder species and feeding ingredients were analyzed for their nutrient content. Results showed that commonly used fodder trees both the village were Badahar, Tanki, Kimbu, Dabdabe, Ginderi and Bakaino. Badahar and Tanki were top ranked by the farmers along with Kimbu, Bakaino and Dabdabe. There were not many differences with respect to fodder performance in the two villages. Farmers in Saranpur preferred Kimbu for feeding goats. Farmers had wide range of indigenous knowledge with respect to propagation and lopping of fodder trees. But the determination of productivity of the fodder trees needed further investigation. It was found that the nutrient contents, especially CP, of selected fodder species, were higher (15-20%) than that of feeding mixture (10%). Nutrient content of the fodder trees were not the whole reason to adopt particular species by farmers. They also looked on lopping frequency and easiness for establishment. It is suggested that more number of preferred fodder species should be distributed to the farmers. Also, scientific training based on farmers' knowledge could be helpful to increase the productivity of fodder species to improve the feeding practices.

Relationship between different nutrients available in the fodder tree leaves

Osti, NP (1995). Relationship between different nutrients available in the fodder tree leaves. *Proceeding of 2nd National animal Science Convention (NASA*), Aug 7-10, 1995, pp 61-65

This study was conducted to determine the correlation between the various constituents of the fodder tree leaves. Twenty-two species of fodder tree leaves were sampled from different parts of the country in November to December and analyzed in the laboratory for ten different constituents all on dry matter basis, without considering the species effect. The mean chemical composition of 22 different fodder tree species leaves were analyzed for dry matter (DM) 41.04 %, organic matter (OM) 91.33 %, crude protein (CP) 15.32 %, cell wall content (CWC) 22.53 %, hemicelluloses (HCL) 6.17 %, acid detergent lignin (ADL) 23.92 % and total ash (TA) 8.18 %. Therefore, because of chemical composition, DM production and nutrient contents in the fodder tree, it is suggested and recommended to farmers for further multiplication of some of the high nutritive fodder tree species to meet the deficient dry matter requirement especially during the winter.

Degradability of the dry matter and crude protein of tree fodder leaves from the eastern hills of Nepal

Gurung HB, NP Shrestha, IK Aryal and DB Subba (1996). Degradability of the dry matter and crude protein of tree fodder leaves from the eastern hills of Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **11**(2)**:**58-60

Seventeen tree fodders, including two bamboo species, commonly found in the eastern hills of Nepal were studied for rumen degradability of DM and CP. The DM degradability (DMD) value of tree fodders ranged from 36.3-80% and CP degradability (CPD) from 43-83.1%. The DMD and CPD valued of tree fodders were both highly significantly different ($P<0.01$) due to soecies, but neither differed due to season except for a few species (Chuletro, Painyu, Tanki and Raikhanim). Based on DMD and CPD, Bakaino, Dudhilo, Badahar, Ghurmish, Khasrekhanim, Painyu and Tanki are good quality fodders whereas Syalphusro, Kavro, Koiralo and Bans are poor quality fodders. However, farmers' ranking did not agree with these findings.

Seasonality of polyphenolic compounds in nine important fodders in the eastern hills of Nepal

Subba DB, HB Gurung and BB Tamang (1996). Seasonality of polyphenolic compounds in nine important fodders in the eastern hills of Nepal. *Veterinary Review*, Pakhribas Agricultural Centre (PAC), Pakhribas, Dhankuta, Nepal, **11**(1):8-10

Polyphenolic compounds in nine important tree fodders in the eastern hills of Nepal were measured in leaves at two stages (young and mature) and twigs during the spring, summer, monsoon and winter seasons of 1995. Among the species studied Kutmiro (*Litsea monopotela*), Koiralo (*Bauhinia variegate*), Syalphusro (*Grewia tiliefolia*) and Goagan (*Saurauia nepaulensis*) contained high lignin whereas Kutmiro and Koiralo contained high tannin. No specific trend of distribution of lignin between seasons was observed in any species. Although, statistically insignificant, the lignin level was found slightly higher in overall species during the pre monsoon and monsoon as compared to the spring and winter seasons. The level of tannin was higher during the spring in most of the species studied. However, the level of tannin is lower than that which adversely affects animals. There was also appositive relationship (r^2 0.72 at $P<0.01$) between the levels of lignin and tannin.

Vegetative propagation of Champ (*Michelin champak*), Badahar (*Artocarpus lakoocha*) and **Bamboos (*D. hamiltonii, D. patderies* and *B. balcooa*)**

Paudel KC, R Pundit and MRS Suwal (1996). Vegetative propagation of Chanp *(Michelia champaca), Badahar (Artocarpus lakoocha)* and *Bamboos (D. hamiltonii, D. patderies and B. balcooa*). *Working Paper N. 96/42,* Lumle Agricultural Research Centre, Lumle, Kaski, Nepal

Vegetative propagation of Chanp (*Michelia champaca*), Badahar (*Artocarpus lakoocha*) and Bamboos (D*. hamiltonii, D. patderies* and *B. balcooa*) were studied in a usual nursery production condition at Lumle Agricultural Research Centre (LARC) in 1995. Soft and hard wood bran cuttings of Chanp were planted at 5 different times at monthly interval from Jan to March in 1995 at Nayapul forest nursery (900 masl), Parbat district and in 1996 at Lumbini forest nursery (1350 masl), in Kaski district showed that only 20% of soft wood and 5% of hard wood cutting planted during 2nd week of March to may were sprouted. None of the sprouted cutting survived until planting out stage due to absence of rooting. Propagation of soft wood cuttings in nurseries could be tried using some kind of rooting hormones is recommended. Soft wood branch and root cutting of Badahar were planted at 7 different times in 2 weeks intervals from 1st week of Jan to 1st week of April 1995, at Lumle (1500 m asl), 23% of branch and 20% of root cuttings were sprouted (P=0.686). Effect of propagation time on sprouting was evident. Both the types of cuttings propagated during the 1st week of March sprouted better (46%) than in other times (7-37%). Soft wood cuttings propagated in 1st week of March sprouted highest (63%). However, poor growth of sprouts and rooting ability of the cuttings suggested repeat of this experiment with use of some rooting hormones in forest nurseries at lower altitudes. Propagation of 3 bamboo species viz, Tame (*Dendrocalamus hamiltonii*), Gopi bans (*D. patderies*) and Dhanu bans (*Bambusa balcooa*) using single node cutting planted during 1st week of February to June at monthly interval in forest nursery at Lumle Centre in 1995 showed significant difference in sprouting between the species (P=0.003). Dhanu bans sprouted significantly higher (63%) compared to Tame bans (34%) and Gopi bans (29%). Species did not vary significantly in terms of number of shoot production/cutting and their growth. Effect of propagation time was significant at species level. Propagation of Dhanu bans in May-June (80-83%), tame bans (69%) and Gopi bans (50%) in March is recommended.

Fodder biomass production from Badahar (*Artocarpus lakoocha*)

Paudel KC (1997). Fodder biomass production from Badahar (*Artocarpus lakoocha*). *Veterinary Review,* Animal Health Research Division, Tripureswor, Kathmandu, Nepal, **12**(1):25-27
A study on fodder production from Badahar was conducted in the farmers' homesteads in the western hills at the Jhobang village (1100 m), of Kaski district, Nepal. The relationship between the size of trees and fodder biomass production from Badahar trees investigated in a lopping trial carried out during in winters of 1991 and 1992 showed that diameter at breast height (DBH) gave the best prediction of fodder biomass production. The regression equation derived on the basis of two years data from trees between 3-50 cm DBH was calculated as Ln (biomass) =-2.8+2.16 Ln DBH (R^2 =95%). Among the total fodder harvested from this tree, 65% constituted the leaves and 35% were twigs of which approximately 70-85% of the fresh fodder was consumed by buffaloes.

Productivity and nutrient content of fodder trees

Upreti CR and MP Shah (1997). Productivity and nutrient content of fodder trees. *Proceedings of the 2nd National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, Sep 24-25, 1997, pp 50-54

Fodder trees measurement (canopy & height), palatability and nutrient content of major fodder trees available at and around the ARS, Bandipur (mid-hills) were assessed. Among the fodder

used in study, Barro produced highest fodder yield (57.08 kg DM/tree/year) followed by Dabdabe (49.6 kg DM), Badahar (80.2 kg DM), Ginderi (69.58 kg DM), and Kutmiro (61.47 kg DM and Khanayo (52.0 kg DM) Canopy and height of each species (n=5 fodder species) were recorded. The utilization of fodder edible parts was highest in barrow (85.8 % fodder leave were highly preferred (Utilization percentage varies from 77.6 to 87.8%) by the goat at normal feeding but if the flock forcedly fed, utilization of fodder edible parts was observed up to 97 %. Ginderi was highly nutritious (21% CP) compared to the other species. A lopping calendar and the DM requirement for one economic unit of goats (20 female + 2 male) was calculated and described.

Livestock feeds and feeding systems in western hills of Nepal

Paudel KC, IK Aryal, NP Osti, RP Bari, T Karki and DP Rasali (1997). Livestock feeds and feeding systems in western hills of Nepal. *Seminar Paper N 97/23,* Lumle Regional Agricultural Research Centre, Lumle, Kaski, Nepal

A samuhik bhraaman, a form of rapid appraisal was conducted in winter 1996 by a team of multidisciplinary livestock experts to study the livestock production and their feeds and feeding management systems in 13 villages sites of low, mid and high hills in the western development region of Nepal. The major livestock feeds available in the study area were crop residues (rice, millet and wheat straw, maize stover and legume vines), grasses (Banso and Bugi), tree fodders, grains (maize, rice bran and millet), salt and water. A total of 32 species of fodder trees were lopped for fodder between Ashwin to Chaitra (October-April). Chaitra and Baisakh (mid March- Mid May) were most critical livestock feed scarcity months. Fodder tree species such as *Ficuus lacor, Morus alba, Ficus semicordata* and bamboos were potential resources to support livestock during this period. Most of the crop residues and concentrates offered comprised of the home grown products across the hills whereas the contribution of tree fodder was higher from farm grown trees in the low to mid hills and from forest based trees in high hills. Grasses were collected more from farm land in the low hills and from the forest land and grazing in the high hills. Some tree fodder found to be purchased in cash or exchanged in kind (e.g. with ghee) in the low and mid hills. Livestock were fed mostly with grasses and concentrates during Ashad – Kartik (mid June- mid November) followed by feeding crop residues with supplementation of tree fodder up to Phalgun/Chaitra (February/March). During March-May months, supply of green fodder was limited from farm land and dependency on forest based fodder/grasses was higher. Major constraints in livestock feed resources included inadequate land holding, lack of irrigation, prolonged drought, degradation of forest land and declining soil fertility. Water scarcity was acute during Chaitra and Baisakh months. Farmers had a belief that feeding salt during the month of Shrawan (mid July-mid August) caused animals death, this requires more investigation. In the low and mid hill villages, most of the cattle, goats and sheep were grazed in the forest or fallow lands during day time and kept under shelter at night with a little or no feeds given. Milking buffaloes, improved cattle and fattening goats were stall fed, pigs were either left to scavenge or raised in confinement. In the high hills, cattle, buffaloes, goat and sheep were mostly under migratory system except for milking buffaloes and oxen during ploughing. Some amount of home made grain feed (kundo) mixed with salt and cooked was commonly offered to all kinds of livestock in the low and mid hills villages but it was practiced only among newly calved animals in the high hills. Farmers were found fairly aware and skilled to utilize available livestock feed resources but lacked information about nutritional value, seasonality and planning to grow fodder/ forage crops to meet their year round requirements. Use of improved technologies on maximizing fodder/feed production, conservation and improving crop by-products was found low. Researchable areas in the field of fodder production, conservation and utilization are suggested.

Observation study of different lopping methods on Kutmiro (*Litsea monopetala*)

Shrestha RK (1998). Observation study of different lopping methods on Kutmiro (*Litsea monopetala). Working Paper N. 98/3*, Lumle, Agricultural Research Centre, Lumle, Kaski, Nepal

Three lopping regimes were employed to see their effect on fodder production in Kutmiro for a period of 5 years. A significant different in fodder production between years (P=0.001) and between the treatment (P=0.023) were found. Among the 3 treatments, pollarded at 1.5 m above the ground level with lopping at pollarded height every year and pollarded at 1.5 m above the ground in the 1st year but followed by traditional lopping practice produce only a mean fresh weight of 16 kg whereas the traditional farmers lopping practice produce only a mean fresh weight of 11 kg. This shows that the pollarding regimes for lopping Kutmiro produced much fodder than the traditional lopping method. However, such study needs a long period of time to get more precise result.

Survey of high altitude Crude protein and mineral contents of some major fodder trees of Nepal

Rana RS, Yano F, Khanal SK, Pandey SB (1999). Crude protein and mineral contents of some major fodder trees of Nepal. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, 26-28 June, 1999, pp 25 – 28

Samples from 28 fodder species commonly fed to animals in Nepal were analyzed for crude protein and mineral contents (Calcium and phosphorus). Crude protein (CP) Calcium (Ca) and phosphorus (P) were found significantly ($P < 0.01$) different between fodder tree species. The CP contents ranged from 8.1 $\pm$ 0.7 % in Harro (*Terminalia chebula*) to 22.1$\pm$ 2.5 % Bakaino (*Melia azedarah L.*). Similarly, calcium and phosphorus contents ranged from 0.8$\pm$ 3.7 % in Banjh (*Quercus incana*) to 4.7+1.42% in Khari (*Celtis australis*) and Vioul (*Grewia oppositifolia*) 0.14$\pm$0.03 % to 0.47$\pm$0.01% Kimbu (Morus *alba*), respectively. It is learnt that the knowledge of the nutrient contents in the major fodder trees available in Nepal would certainly be useful to formulate ration that are cost – efficient, sustainable and increase production performances of the animals.

Tree fodders and browse plants as potential nutrient suppliers for ruminants

Subba DB (1999). Tree fodders and browse plants as potential nutrient suppliers for ruminants. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, 26-28 June, 1999, pp 1-14

The usefulness of tree fodder as a supplementary feed during the dry season has been well recognized traditionally. No attempts have ever been made to characterize them scientifically, those available, are often found incomplete and misleading. In this perspective, ARS, Pakhribas has evaluated a total of 264 different trees and shrubs generally fed to and browsed by ruminants. The samples were collected from east Nepal including the inner Terai. Mainly during the dry winter season at the time the tree leaves from the major component of the diet mix. Fodder trees were characterized on the basis of the soluble carbohydrate (NFE), CP and their fractionates (these include rumen soluble protein, total available protein, rumen bypass protein and indigestible protein), digestibility which included digestible organic matter in dry matter (DOMD), organic matter digestibility (OMD) and neutral cellulose digestibility (NCD), detergent fibres (modified acid detergent fibre, MADF), calculated metabolizable energy (ME). Polyphenolics (lignin and tannin) and mineral elements (major and trace). The paper critically examines the importance of the tree species on the basis of the lab indicators of quality and

discusses their adequacy in support to ruminant nutrition. The likely consequences of the negative associative effect of nutrients including high levels of polyphenolics or mineral toxicities are discussed. Animal experimentation studies on animal productivity and feed acceptability by various classes of ruminants on promising fodder types are suggested for future research.

Survey of high altitude fodder tree species

Bastola BR and NP Shrestha (1999). Survey of high altitude fodder tree species. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research* in Nepal, Agriculture Research Station, Lumle, Kaski, Nepal, 26-28 June, 1999, pp 163-166

In high altitude areas fodder trees are the main source of green fodder in winter season. In Rasuwa district the main fodder tree available are Dudhilo (*Ficus nerifolia*), Kimbu (*Morus alba*), Chuletro (*Brasiopsis hainla*), Gogan (*Saurauria nepalensis*) are mostly found in farm land and other species like Khasru (*Quercus semicarpifolia*), Banjh (*Quercus lanta*), Bains (*Salix babylonica*), Sanobanjh (*Quercus leucotrochophora*), Painyu (*Prunus cerasoides*), Bhotepipal (*Populus deltoids*) and Nigalo (*Drepanostachyum spp*) are found in forest land. The biomass production (edible and non edible portion) of these fodder trees were 130 kg from Khasru, 52 kg from Banjh, 51 kg from Bains, 65 kg from Sanobanjh, 68.5 kg from Dudhilo, 45 kg from Painyu, 35 kg from Kimbu, 55 kg from Gogan, 53 kg from Bhotepipal, 50 kg from Chuletro and 1 kg from Nigalo respectively. From this experiment, the maximum biomass (130 kg/year/tree) was obtained from Khasru. The fresh leaves and edible part was 51% and fuel wood was 49%. The lowest biomass was obtained from Kimbu (35 kg/year/tree). 80.3% edible portion was obtained and rest was non edible. Among the experimental fodder trees, the maximum edible portion was obtained (80.3%) from Kimbu. The minimum edible portion (51%) was obtained from Khasru. Nigalo was widely grown and very familiar shrub fodder during the pasture lean period. It was recorded that 0.4 to 1 kg shrub be harvested/year.

Effect of pit size on nitrogen fixing tree establishment and growth in degraded forest lands

Pariyar D, JR Adhikary, RN Kandel, RC Ghimire and RR Shrestha (1999). Effect of pit size on nitrogen fixing tree establishment and growth in degraded forest lands. *Proceedings of the 3rd National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Lumle, Kaski, Nepal, 26-28 June, 1999, pp 182-185

Across four districts under grassland and shrub land were divided into three altitude belt. A total area of 4.8 ha (3000 m2 in each site) was covered testing three planting technologies. The recommended method 50 cubic cm- pit size- tip soil- 250 gm DAP and 150 g Sulphur given treatment produced the highest plant height and more survival. With this intervention more number of fast growing trees could be harvested on the fourth year of the establishment.

Bamboo as important feed for ruminants in the eastern hills of Nepal

Subba DB and SK Singh (2000). Bamboo as important feed for ruminants in the eastern hills of Nepal. *Proceedings of the 4th National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Pakhribas, Dhankuta, April 24-26, 2000, pp 140-144

Nine different bamboo species commonly available in Dhankuta district was collected during spring, pre-monsoon, monsoon and winter season analyses of nutrient contents. The chemical analyses revealed that bamboo leaves can supply dry matter 44-51% nitrogen free extractives 40-47% crude protein 15-21%total available protein 11-18% digestible organic matter 50-

57%netural cellulose digestibility 45-58%and metabolisable energy 7.5-8.6 MJ/kg DM. The relative high content of available protein and higher dry matter content in comparison with tree fodders underline the considerable potential of bamboo as a feeding stuff for livestock. Based on the analytical findings, this report discusses the usefulness of bamboos as an important feed supplement for ruminants.

Predictability of digestibility (Neutral cellulose digestibility) from other simple chemical parameters

Subba DB (2000). Predictability of digestibility (Neutral cellulose digestibility) from other simple chemical parameters. *Proceedings of the 4th National Workshop on Livestock and Fisheries Research in Nepal*, Agriculture Research Station, Pakhribas, Dhankuta, April 24-26, 2000, pp119-126

A total of 8 different species / sub-species of common fodder trees were collected during winter (when the species are actually fed) from Solma VDC in the mid hills of East Nepal. The samples were collected in duplicates from six different wards within the VDCs. Thus, a total of 96 fresh samples were brought to the Agriculture Research Station, Pakhribas (ARS-P) laboratory for analysis of arrange of Chemical constituents. Based on the laboratory analyses, the study attempted to explore various combinations of simple quality attributes e.g. proximate principles including fibrous fractions to give a robust relationship so that the neutral cellulose Digestibility (NCD) could be predicted effectively. The equations predictable for NCD at reasonable degrees of accuracy are presented and discussed for use in a routine service laboratory for rapid evaluation of ruminant feedstuffs.

Tannin in tree fodder and browse plants in the hills of Nepal

Subba DB (2001). Tannin in tree fodder and browse plants in the hills of Nepal. *Proceedings of the 4th National Animal Science Convention (NASA),* Nepal Animal Science Association Kathmandu, Nepal, Nov 29 – Dec1, 2000, pp 77-86

Total of 250 different trees and browse species generally used to feed to ruminants were collected from the eastern hill farms at altitudes ranging from low to high hills (1100 to 2200m asl.) covering the seasons. From November/December to April/May when they form an important supplement to ruminant diets. Leaf samples were analyzed for the content of total phenols (Gallotannic acid equivalent). Fodder plants at and above threshold level of tannin toxicity are listed. Both deleterious and beneficial effects of tannins on health and nutrition of ruminant species are discussed and future lines of actions for further research are suggested.

Fodder resources and pastoral systems in Nepal

Panday SB and MR Tiwari (2002). Fodder resources and pastoral systems in Nepal. *Proceedings of the 5th meeting of the Temperate Asia Pasture and Fodder Network (TAPAFON),* RNR Research Centre Bajo, Wangdue, Bhutan, 30th Apr – 4th May, Pp 71-78

Livestock are a crucial component of farming system in Nepal. Traditionally, communal grazing areas and off farm fodder resources have been important for the nutrition of ruminants livestock. The fodder has been gathered in the form of leaves and grasses from common property forest areas. The feed supply is to be adequate only in the months of June- Sep; rest of the year animals is forced to face feed scarcity. Rangeland, forests, shrub lands and croplands are important forage resources in Nepal. Crop byproducts, which has been used as a major part of the diet during feed scarce period, is the largest source of TDN (53.8%) followed by forest (16.5%) and grazing land (10.6%). The grazing system of northern regions is seasonal according to a migratory system that varies depending on animal species, local geographical

conditions and traditional patterns. In the hills and Terai, forest and marginal lands and roadsides are main grazing spots available and in many areas are grazed over the year without any rest period.

An optimum plan for agro - forestry in the Chitawan district of Nepal

Shrestha HK and BR Bastola (2004). An optimum plan for agro - forestry in the Chitawan district of Nepal. *Proceedings of the 5th National Animal Science Convention (NASA*), pp 135-139

This study was conducted to assess the existing farming system and develop an optimum plan of agro forestry with multipurpose tree species in the Chitawan district. A household survey was carried out in Sukranagar VDC, a purposively selected site for collecting cross sectional data from 110 respondent farmers randomly selected. In the existing farming systems, area and number of multipurpose tree species were found positively correlated with farm size. Optimization of existing plan remarkably increased the gross margin by 32, 126 and 105 % for small, medium and large scale farmers respectively. In order to maximize the gross margin, the area under Bakaino was significantly increased whereas summer maize was significantly decreased in all farm categories. Land was found the scarce resource whereas labor was found the surplus one. Since the profitability of optimal plan was closely associated with the higher risk and uncertainly pertaining to perennial trees, the risk bearing farmers may gain higher profit as they can incorporate the tree species in their farming systems for firewood, timber and fodder.

Tree fodder decision support tool for planning the use of tree fodder for livestock feeding in the mid hills of Nepal

Parajuli AK (2004). Tree fodder decision support tool for planning the use of tree fodder for livestock feeding in the mid hills of Nepal. *Proceedings of the 5th National Animal Science Convention (NASA)*, pp 145-152

A field testing program of simple decision support tool for planning the use of tree fodder for livestock feeding in mid hills of Nepal was carried out by DFID, LPP project in cooperation with a local partner, UMN/RDC. The pilot field testing was done in 3 different VDCs of Kaski and Syangja districts from 9th Dec 2002 to 17th Feb 2003. Altogether 20 farmers from each VDC were selected as sample farmers for this work. A preliminary survey using different tools to determine the local circumstances and opportunities was conducted. Based on the available information, different sites of feeding ration and fodder tree information sheets were prepared and distributed to the selected farmers. The main purpose was to evaluate the sheets information, in terms of farmers' reflection on feeding values of the tree fodders. These farmers were visited 3 weeks later and their comments, feedback and inputs/suggestions were obtained by administering appropriate questionnaires. Most of the farmers reported that the feeding page and tree fodder information sheets were clear and understandable and found useful for feeding their livestock. By feeding a mixture of different ingredients such as maize, fodder and forage in appropriate proportion based on animal body weight did help them to increase milk production. They also reported that the sheets were useful to learn about different aspect of fodder species management. But they demanded that the ration sheet should be prepared by considering the locality and season, in addition to inclusion of technical packages on fodder harvesting pattern, time, techniques, pest and diseases management, nursery techniques and management on the sheet.

An optimum plan for agro-forestry in the Chitawan district of Nepal

Shrestha HK and BR Bastola (2004). An optimum plan for agro-forestry in the Chitawan district of Nepal. *Proceedings of the 5th National Animal Science Convention (NASA*), pp 135-139

This study was conducted to assess the existing farming system and develop an optimum plan of agro-forestry with multipurpose tree species in the Chitawan district. A household survey was carried out in Sukranagar VDC, a purposively selected site, for collecting cross sectional data from 110 respondent farmers randomly selected. In the existing farming system, are and number of multipurpose tree species were found positively correlated with the farm size. Optimization of existing plan remarkably increased the gross margin by 32, 126 and 105 % of small, medium and large scale farmers respectively. In order to maximize the gross margin, the area under Bakaino was significantly increased whereas the area under summer maize was significantly decreased in all farm categories. Land was found the scarce resource whereas labor was found the surplus one. Since the profitability of optimal plan was closely associated with the higher risk and uncertainly pertaining to perennial trees, the risk bearing farmers may gain higher profit as they can incorporate the tree species in their farming systems for firewood, timber and fodder.

Fodder development in leasehold forest areas

Chaudhary NP (2005). Fodder development in leasehold forest areas. *Proceedings of the Workshop on Fodder Oats, Fodder Technology Packages and Small Farm Income Generation*, Kathmandu, Nepal, 8-11 March, pp 39-44

The project described to improve the conditions of families living below the poverty line while improving environmental conditions in forest land in Nepal hills. Degraded land is allocated to poor households on long, renewable leases. The lessees land must be carefully, avoid grazing and undertake improvement work. Technical services provide training, technical support and some inputs. In the decade 1993-2003 some 7457 ha degraded land were leased. There has been impressive natural regeneration through closure to grazing thus making more fodder, including tree fodder; available fodder crops have also been sown. Firewood availability is much improved and time taken for fodder and fuel collection much reduced. Livestock condition and quality has been improved and the poorest families can now keep stall fed goats.

Nutritional status of different feed resources of Nepal

Panday SB and CR Upreti (2005). Nutritional status of different feed resources of Nepal. *Proceedings of the Workshop on Fodder Oats, Fodder Technology Packages and Small Farm Income Generation*, Kathmandu, Nepal, 8-11 March, pp 132-136

This paper analyses the nutritional status of different feed resources of Nepal. Different topographical conditions of Nepal favor a variety of feed resources. A traditional and unique mixed crop livestock farming system in the country contributes to produce different types of feedstuffs. The major sources are of plant resources such as fodders, green grasses, dry roughages, crop byproducts, and other non conventional feedstuffs. The recorded information so far revealed that the CP content of tree fodders and green grass is highly varied (10.7 to 31.8%). Most of these tree fodders and green grasses are given as supplements in the low quality cereal straw based diets of the ruminants. Most of the tree fodders contain high tannins (0.2 to12.76%) but they are found to be rich in mineral contents in particularly Ca (169.7 to 444.8 mmol/kg). and P (0.20 to 0.4%). The nutrient contents in the commercial feed mixture in particular CP contents have been found to vary from 10.9 to 22.1%.

Nutritional variation of some fodder tree species found in different parts of Nepal

Tiwari MR, SK Khanal, BK Shrestha and RK Jha (2005). Nutritional variation of some fodder tree species found in different parts of Nepal. *Nepal Journal of Science and Technology,* Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, **6**:109-120

Fodder trees are grown in Nepal from time immemorial. A variety of fodder trees exist in various parts of the country, from lowland Terai to the high hills. It has been reported that the total production from fodder trees accounts for about 15% TDN requirement in the country. It is estimated that 0.3 million tones of TDN is supplied by tree fodders in the hills. The nutritive values of fodder tree are not still evaluated well, even if evaluated, the results are not consistent. Altogether 802 samples of different fodder tree species were collected from Baitadi, Darchula, Dhankuta, Dolakha, Dadeldhura, Dhading, Gorkha, Ilam, Jhapa, Kailali, Kaski, Kavre, Lalitpur, Lamjung, Makwanpur, Mustang, Nawalparasi, Palpa, Rupandehi, Rasuwa, Sankhuwasava, Sindhupalchock, Solukhumbu, Surkhet, Syangja and Tanahun districts of Nepal during past 12 years and were evaluated for their nutrient content. Average, dry matter, organic matter, total ash and crude protein content of different fodder trees were found to be 32.62, 88.67, 11.33 and 14.7 percent respectively. Similarly, average NDF, ADF, Lignin, hemicellulose and cellulose content of different fodder trees were recorded 49.3, 41.73, 19.29, 7.5 and 22.51 percent respectively. Likewise average calcium and phosphorous content was noted 2.2 and 0.24 percent respectively. Highest content of dry matter (45.97%), organic matter (97.96%), total ash (26.63%) and crude protein (29.03%) was recorded for Malbans, Jangal jilebi, Batuke and Rajbrikchhya respectively. Likewise Nimbans had highest NDF and hemmicellulose content (74.99 and 35.89% respectively). Highest content of ADF (62.27%), lignin (44.91%) and cellulose (42.1%) was observed in Voldung, Batuke and white siris respectively. In terms of mineral Kamle was found to be superior in calcium content (5.31%) and Tale in phosphorous content (0.55%) as compared to other fodder trees.

Study on propagation techniques and establishment of some high altitude fodder tree species at Agriculture Research Station (ARS), Rasuwa

Shrestha KK, NP Bhattrai and NP Shrestha (2006). Study on propagation techniques and establishment of some high altitude fodder tree species at ARS, Rasuwa Dhunche. *Proceedings of the 6th National Workshop on Livestock and Fisheries Research in Nepal*, Khumaltar, Lalitpur, 1-2 July, 2004, pp 159-162

Field survey was done on farmlands and forest lands near by station during 1995-1997 and recorded the types of growing fodder trees. Dudhilo (*Ficus neriifolia*), Kimbu (*Morus alba*), Chuletro (*Brasiopsis hainla*), Gogan (*Saurauria nepalensis*) are mostly found on farmlands. Khasru (*Quercus semicarpifolia*), Banjh (*Quercus lanata*), Sanobanj (*Quercus leucotrichophora*), Bains (S*alix babylonica*) Painyu (*Prunus cerasoides*) and Bhotepipal (*Populus deltoides*) are found grown on forestlands. Dudhilo, Faledo, Chuletro, Kimbu and Bains are common fodder trees grown at station. The propagation methods and their establishment performance were studied during 1998-2002 at station. The seeds and vegetative cuttings were used for propagation methods on nursery rising of fodder tree sapling production. The performance of germination and survivability of seedlings of each fodder tree species were recorded. In case of Dudhilo (*Ficus neriifolia*), direct seed seeding in polythene bags and seeds mixed with cow dung paste (10:90) proportion and pasted on muddy wall was studied. The performance of survivability of Dudhilo seedlings in wall raising technique was more (81%) than direct seeding in polythene bags (72%). The propagation method of Chuletro (*Brasiopsis hainla*) by seeds in polythene bags was found better than saplings raised by vegetative cuttings whose survivability percentage was (86%) and (60%) respectively. Seasonal performance of vegetative cuttings was studied in case of Bains (S*alix babylonica*) and Kimbu (*Morus alba*). The

performance of winter cutting is found more survivability (81%) than summer cuttings (77%) for nursery raising technique. The performance of seed propagation of Faledo (*Erythrina verigata*) and Painyu (*Prunus cerasoides*) was found better than sapling production by vegetative method. The survivability performance of Chuletro was found highest 90% than Dudhilo 89% and Faledo 83% on their establishment trial at station.

Ground Bamboo (*Phyllostachys pubescens*): A source of livestock feed

Pradhan R (2006). Ground Bamboo (*Phyllostachys pubescens*): *A source of livestock feed. Green Field Journal of Himalayan College of Agricultural Sciences and Technology (HICAST*), Gathaghar, Bhaktapur, Nepal, **4**(1)**:**107-108

The main contents of bamboo wood are cellulose (50%), hemicellulose (15-25%) and lignin (15-35%). Protein and mineral are very low. Ruminants can not digest the bamboo wood (stem) without some treatment due to the structure of the cell wall. Grinding was identified as one of the best methods to increase the digestibility. The mechanical grinding of roughages partially destroyed the structural organization of cell walls, thereby accelerating their breakdown in the rumen and increasing food intake. The fractional heat generated by grinding softened lignin; and the cellulose fibers were then easily brushed loose. Grinding reduced the time and energy required for particles to pass through the rumen. It increased the surface areas and thereby the arte of rumen fermentation. It also increased the density of the feed and thereby increased the effective capacity of the animal. Ground stem part pf the bamboo can be used as maintenance diet for ruminants. It was found that there was no difference in dry matter intake, daily gain, feed conversion ratio and blood parameters among the experimental cattle kept in growth trial. Therefore, ground bamboo can replace other roughage source in the diet of fattening cattle.

Evaluation of selected species of fodder trees cultivated for feeding ruminant animals in the hills of Nepal

Khanal RC and CR Upreti (2007). Evaluation of selected species of fodder trees cultivated for feeding ruminant animals in the hills of Nepal. *Nepal Agriculture Research Journal (SAS/N*), **8**:00-107

Leaves and twigs from 4 species of tree fodders, *Actocarpus lakoocha* (Al), *Bauhinia purpurea* (BP), *Garuga pinnata* (GP) and *Ficus roxburghii* (FR) cultivated widely for feeding ruminants in the hills of Nepal and maintained at the Agriculture Research Station (Goat), Bandipur were investigated for there chemical composition and nutrient intake, digestibility and growth arte in growing female goats. Differences occurred between species of tree fodders on nutrient composition, which contained 286, 342 and 263 g/kg DM; 174,98, 116 and 178 g/kg total ash; 137, 163, 140 and 119 g/kg CP; 440, 458, 437 and 451 g/kg NDF; 383, 407, 382 and 406g/kg ADF; 177, 135, 181 and 143 g/kg ADL; 19.5, 21.6, 20.9 and 29.3 g/kg Ca; and 2.2, 2.8, 2.4 and 2.5 g/kg P on DM basis for AL, BP, GP and FR, respectively. The DM intake was higher for goats fed AL (432g/d) and GP 428 g/d) than BP (342 g/d) or FR (306 g/d). Nutrient digestibility was higher foe goats fed AL and GP, except Ca, which was higher for goats fed FR. Similarly, highest daily weight gain was observed for goats fed AL (71 g/d) and GP (64 g/d) than either of BP (54 g/d) or FR (30 g/d). Overall, leaves and twinges from three fodders supported moderate growth, but may not be advised for maximum production.

Agri silvipastoral approach in rehabilitation of the degraded land and poverty alleviation

Pariyar D (2002). Agri silvipastoral approach in rehabilitation of the degraded land and poverty alleviation. *Proceedings of the 5th Meeting of the Temperate Asia Pasture and Fodder Network (TAPAFON)*, RNR Research Centre Bajo, Wangdue, Bhutan, 30 Apr – 4 May, 2002, Pp 102-110

Improvement of degraded land is possible through proper technologies. Particularly approach of user's for development and utilization of resources help to increase household income and restore environment. Minimum tillage, suitable pasture legume species, use of starter fertilizers, protection of leased land and adoption of cut and carry system has together enhanced the socio economic condition of poor farmers. Similarly, technologies on livestock fodder interface, seed production from Stylo and Oat have resulted in household income increase.

Crude protein and crude fibre content of common forage under Melia tree based silvipastoral system

Barsila SR and NR Devkota (2007). Crude protein and crude fibre content of common forage under Melia tree based silvipastoral system. *Green Field Journal of Himalayan College of Agricultural Sciences and Technology (HICAST),* gathaghar, Bhaktapur, Nepal, **5**(1):49-60

An experiment was conducted at Livestock Farm of Institute of Agriculture and Animal Science to analyze the CP and CF content of mixed forages grown under 14 years old Melia tree shade maintained 1400 trees/ha. The experiment was carried out using a split plot design with three levels of shade as main plot along with one open plot, whereas forages in mixture were grown as sub plots. Shade level was standardized by measuring quantity light under the tree shade using digital lux meter, and considered as low, medium, and heavy shade. General agronomic practices were followed to grow the mixed forages. The forage, sampled from each sub plot was considered for DM estimation and subsequent analysis, both for the herbage harvest of July and September of 2004 and 2005. Shade effect for CP content of non leguminous forages was inconsistent; with the significant differences of shade only for July harvest in both the year, but with the no significant effect to the species. On the other hand shade effect for CP content of the leguminous species was only significant in the 2004 harvest. The CF content, however, was consistent and significantly differed in terms of both shade and species effect, which was more prominent in the case of non leguminous forages. Medium level of shade was more favorable for most of the leguminous species considering CP content, but CF content of blue panic was comparatively better irrespective of the shade level. In general, CF content of Desmodium in the shade was highest followed by Glycine and was similar for open condition, whereas performance of the blue panic was better in shade among the non-leguminous species. It is thus clearly revealed from the results of this experiment that although there were different kinds of response for CP and CF content across the shade levels and species, medium level of shade would be strategy to be maintained for non-leguminous species, whereas legumes would comparatively perform better at low level of shade under melia tree shade.