



Sustainable Management and Development of NWFPs in Terai and Siwalik Regions of Nepal TCP/NEP/3403 Kathmandu, Nepal



November 2014

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November 2014

Rajendra K.C.

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Foreword

Nepal is considered as the reservoir of the high value medicinal plants. The unique geographical location and wide altitudinal variations provide the niche for the growth of a range of important and high value medicinal plants. The government records over 700 medicinal plant species. The sustainable conservation and promotion of the medicinal plants and Non-Wood



Forest Products (NWFPs) are very important for the inflow of the cash income and employment opportunities to the rural and remote areas of the country. Further, it provides the ground to open up the various industries and reduce international trade deficits, ultimately contributing in nation building and economic development.

The sector has gaining momentum in recent years. The Ministry of Forests and Soil Conservation/Department of Forests has started various programmes for the sustainable management and development of the NWFPs in Nepal. Several development partners including private sectors (industries, poor farmers and traders) and civil society organizations have been joining their hands for overall development of the sector. Being the principal authority, Department of Forests has been working as the facilitator, promoter and catalyzer in the conservation and development of the NWFPs in Nepal. The department has been successfully implementing 'Jadibuti Development Programme', in 15 districts from government resource, for last five years.

The recently completed Forest Resource Assessment (2014) has reported large number of NWFPs in Terai and Siwalik regions of Nepal. The government has prioritized 30 NWFP species for the focused programme implementation. In this regard, the book will be very much useful for the concerned organizations and individuals working for the domestication and conservation of NWFPs in the region. I am very much impressed with the short and concise information on the important NWFP species.

I would like to thank Dr. Rajendra K. C. for his hard work and continuous efforts to publish this book. My sincere appreciation goes to Food and Agriculture Organization (FAO) Nepal for its technical and financial support for the conservation and development of the NWFPs to this department. I am very much confident on the collective actions of all of us in bringing the positive transformation in the NWFPs sector in Nepal.

Thank you,

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Dr. Rajan Kumar Pokharel Director General

Foreword

Forest resources provide plenty of the goods and services to the people. Non-wood forest products (NW-FPs) are key products which are very important for the sustained enhancement of the rural livelihoods and economic growth of the nation. The abundance, diversity, proximity, low input requirement for harvesting and transportation as well as relatively short rotation period makes it as the poor's first choice forest products for their subsistence and livelihoods. The



complete reliance on various NWFPs for the foods and medicines during long drought, famine and food shortage period by some ethnic/tribal communities (such as Raute, Chepang etc.) has been well regarded. Besides fulfilling the subsistence needs, NWFP sector has tremendous potentialities to open up new horizons for industrial development, employment generations and earnings of foreign currencies for the nation.

Realizing the importance of NWFP sector in Nepal, the Food and Agriculture Organizations (FAO) of the United Nations and the Department of Forests, have been jointly implementing the project entitled 'Sustainable Management and Development of NWFPs in Terai and Siwalik Regions of Nepal' since February, 2013. The project aims to contribute in poverty reduction through better management of NWFPs in Terai and Siwalik regions of the country.

The project has established NWFP nurseries, seed production areas of wild Asparagus, and NWFPs demonstration plots in Sarlahi, Makwanpur and Rupandehi districts. It has been further supporting the Government on Herbs and NTFPs policy revisit and development of NWFPs database. Several trainings and exposure visits have been organized to local users, farmers and government staffs for their capacity enhancement in the areas of cultivation, value addition, processing and marketing of the NWFPs. In this line up, the book is targeted for the capacity development of the related stakeholders, practitioners, private entrepreneurs, academicians and policy makers. I am confident upon the wide usability of the book for all concerned individuals and institutions.

I thank Dr. Rajendra K.C. for bringing up a very informative and useful book. I sincerely request for the comments and feedback from all readers, practitioners, stakeholders and policy maker for further improvement of this book. Thank you.

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Dr. Binod Saha Assistant FAO Representative FAO-Nepal

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Acknowledgement

Development of non-wood forest product (NWFP) sector in Nepal is the topic of much discussion and limited action for decades. Nepal incorporated the topic into the national forestry agenda at the same time when it emerged as the key agenda in the international forestry. Master Plan for Forestry Sector (1989-2010) comprised 'Medicinal and Aromatic Plants (MAPs) and other minor forest product' as the priority forestry



programme. Despite adopting it as the priority programme, centuries long experience in local consumption and trade, and huge potentialities to reduce the rural poverty and contribute in nation's development; the sector could not flourish as it should be.

As the high value NWFPs are mainly found in the high mountains and mid-hills of the country, sole focus of the development programme in the past was remained there. Conservation and development of the NWFPs in Terai and Siwalik regions have always been neglected. Availability of the relatively developed physical infrastructure, largely cultivable areas and barren lands (reclaimed land from floods, public lands etc.) and proximity to national and international markets provide ample opportunities to develop the sector in the regions. Proper development of the NWFP sector endow with broad based and inclusive employment opportunities, contribute in the conservation of the forests and fragile Siwalik ecosystems and economic development.

The book comprises with basic information for the development of the sector in the region. It covers 20 NWFP species which are considered important in the regions. Extensive consultations were held with the multiple stakeholders in Sarlahi, Makwanpur and Rupandehi districts in order to select priority species. This book provides concise and complete information, pictorial whenever possible, on the basic topics of interests without going through pages and pages of hefty books. I hope that it will be useful for all concerned people and organizations working in NWFP sector in the regions.

There are so many people and organizations putting their blessed hands on my shoulder to bring out the book in this form. I owe deep gratitude to Dr. Ganesh Raj Joshi, former Secretary (Ministry of Forests and Soil Conservation), Dr. Rajan Kumar Pokharel, Director General, Mr. Bishwa Nath Oli (former Director General) and Mr. Resham Bahadur Dangi (former Deputy Director General) of the Department of Forests and Mr. Yam Bahadur Thapa (Director General, Department of Plant Resources) Mr. Krishna Prasad Pokharel (Chief, Community Forestry Division) for their complete guidance and thorough inspiration. The continuous support, encouragement and technical guidance from Dr. Binod Saha, Mr. Shrawan Adhikary, Mr. Arjun Singh Thapa, Ms. Sonam Dakhwa Genpo, Mr. Ram Sharan Thapa, Mr. Adhrit Regmi, Mr. Bhakta Baral (FAO-Nepal), Ms. Sophie Grouwels (FAO-Rome) and Mr. Kenichi Shono (FAO-RAP, Bangkok) can never be forgotten. Further, I would like to acknowledge the kind support of Dr. Uday Raj Sharma, Mr. Chhotelal Chowdhary, Mr. Lok Nath Pathak, Mr. Bishwa Raj Karki, Mr. Chandra Shekhar Badu of this project. Senior artist Mr. Bharat Lal Shrestha is acknowledged for the beautiful sketches of the selected species. Further, I thank my brother Mr. Krishna Bahadur K.C., better half Aasha Khattri and lovely children Ravi Raman, Avi Raman and Aarju for their complete support and thorough understanding. Additionally, I would like to thank all authors, researchers and contributors of the published and unpublished literatures, mentioned in the reference page.

I sincerely thank Dr. Krishna Raj Tiwari (Associate Professor at Institute of Forestry, Pokhara) for fruitful discussion about Moringa cultivation in Nepal. I owe my sincere gratitude to Prof. Dr. Reiner Finkeldey, Georg-August University, Goettingen, Germany for inspiring me always for hard work, honesty and patience.

I firmly believe that all beautiful sentiments/words in the world are less important than a single lovely action. I stop here with humble urge for the collective action by all stakeholders in order to flourish the NWFP sector and achieve its full potentials in Nepal.

Thank you.

Rajendra K.C., PhD Team Leader TCP/NEP/3403 Project FAO Nepal

Abbreviation and Acronyms

ANSAB	Asia Network for Sustainable Agriculture and Bio-resources
CF	Community Forests
CIMAP	Central Institute of Medicinal and Aromatic Plants
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DFO	District Forest Office/r
DoF	Department of Forests
DPR	Department of Plant Resources
EIA	Environmental Impact Assessment
FAO	Food and Agriculture Organization of the United Nations
FSC	Forest Stewardship Council
GACP	Good Agricultural and Collection Practices
На	Hectare
HPPCL	Herbs Production and Processing Company Limited
IEE	Initial Environmental Examination
I/NGO	International/Non-Governmental Organization
JABAN	Jadibuti Association of Nepal
LHF	Leasehold Forest
MAPs	Medicinal and Aromatic Plants
MAPDON	Medicinal and Aromatic Plant Database of Nepal
m asl	Meter above Sea Level
MoFSC	Ministry of Forests and Soil Conservation
NBS	National Biodiversity Strategy
NRs	Nepalese Rupees
NTFP	Non-Timber Forest Products
NTIS	National Trade Integration Strategy
NWFP	Non-Wood Forest Products
PA	Protected Area
PEFC	Programme for the Endorsement of Forest Certification Schemes
SPA	Seed Production Area
TEPC	Trade and Export Promotion Center
USD	American Dollar
VAT	Value Added Tax
VDC	Village Development Committee

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Non-wood Forest Products in Nepal

Non-wood forest product (NWFP) is a comparatively recent terminology that is being increasingly used in recent forestry documents and research articles. There have been various terminologies and thus confusions about the proper understanding of the fundamental essence of the topic, used by various organizations including government, private sector and research institutions. De Beer and McDermott (1989), who are among the pioneers and well respected non-timber forest product (NTFP) scientists, defined NTFP as all biological materials other than timber which are harvested from forests used for variety of purposes. Number of terminologies such as 'minor forest products', 'secondary forest products', 'wild products', 'non-timber forest products', iby-products of the forests' have been in use creating the ambiguity among various scholars, implementers, research organizations, decision makers and users. This ultimately created problems in comprehensive understanding, proper communication and comparison of various studies and statistics.

FAO organized an international expert consultation in 1995 to harmonize the definitions of NWFPs. Based on a recommendation from this consultation, FAO in 1999 adoped the working definition of NWFPs as "Non-wood forest products consist of goods of biological origin other than wood, derived from forests, other wooded land and trees outside forests." This definition includes the usual definitions of the Medicinal and Aromatic Plants (MAPs), JADIBUTI and wild life being used in Nepal. NWFP excludes all woody raw materials, such as timber, chips, charcoal, fuelwood and small woods (used for tools, household equipments and carvings) whereas NTFPs includes the fuelwood and small woods into its definition (FAO, 1999).

Medicinal and aromatic plants, bamboo and rattan, nuts, fruits, wild vegetables, spices, plant-derived pesticides, tannin, dyes, gums, resins and incense are included in the category of NWFPs in Nepal. However, the term NTFPs is most frequently used in the official documents/publications in the country.

Nepal is well known in the world for its extraordinarily rich biodiversity including high value NWFPs. The country retains about 7000 flowering plant species (2.6% of the world) despite small area coverage which accounts less than 0.1% of the global land area (NBS, 2002; DPR 2007). A total of 701 species of medicinal plants have been reported from Nepal (DPR, 2007). However, these include a few exotic species (such as *Palmarosa*) and cultivated species/agricultural crops (such as carrot, chili,

water melon, millet, banana, etc).

The NTFP database, the Medicinal and Aromatic Plant Database of Nepal (MAPDON), maintained by the Ecological Society of Nepal, reported the availability of 1624 species, being used as spices, medicines and foods. A total of 285 endemic plant species from 43 families are found in Nepal which has global biological significance (Rajbhandari and Adhikari, 2009; Rajbhandari and Dhungana, 2010; Rajbhandari and Dhungana, 2011).

Importance of NWFPs

Various NWFPs have been in use and trade for centuries. Most recently, some of the NWFPs have been in exceptionally high demand and thus bearing inflated prices. For example, good quality Yarsagumba (*Cordyceps sinensis*), found in the High-himal of Nepal, has been sold at the price of up to NRs.¹ 2.7 millions per kilogram in 2014. Some mountainous districts of Nepal such as Darchula, Jumla, Dolpa etc. have been obtaining over NRs. 1 billion annually, only from the sale of Yarsagumba. Another recently indentified species, named Bodhichita Briksha (*Zizyphus budhhensis*), has an extremely high commercial importance. The fruits produced from a medium sized single tree at Majhuwa VDC, Ramechhap district of Nepal, fetched about NRs. 3.6 million (Kantipur Daily, 13/08/2014). Extremely high commercial importance of the limited number of Bodhichita Briksha in Kabhrepalanchowk and Ramechhap districts has produced even security threats to the farmers and traders.



Figure 1: Natural gold, Yarsagumba distributed in Nepalese Himalayas is in extremely high demand and has significant commercial value (Photo courtesy: Ramanandan Saha, DoF).

Efforts by private nurseries and government organizations to propogate the species is constrained by future market uncertainties related to possible

¹ 1 USD=NRs. 97.53 (buying rate) as per 27 September 2014, Foreign exchange rate published by Nepal Rastra Bank

Prominent Non-Wood Forest Products of Terai and Siwalik Regions in Nepal fluctuations in demand and price.

The country is outstandingly rich in biodiversity. A large number of commercially valuable NWFP species are found here. New species of commercial importance have been identified and being traded as its demands from neighboring China and India rises. The recent identification taxol. which of the is extracted from the Lauth Salla (Taxus wallichiana) and is beneficial to the treatment of cancer, has resulted in the establishment of many pharmaceutical industries in the country. This has sharply increased the demand for the species and has also raised some management challenges.



Figure 2: Drying Bodhi Briksha (*Zizyphus budhensis*) fruits in the sunlight at Timal VDC, Kabhrepalanchowk (Photo: Ganesh Ray, DFO, Kabhrepalanchowk)

Unprecedented increase in the demand for Satuwa (*Paris polyphylla*) and Ban Lasun (*Allium wallichii*) in the Chinese markets has also augmented soaring prices. Few other products, which are not traded at present, may similarly become high demand in the future and thus command high prices. The country has a huge potentialily to utilize these resources for the benefit of the nation and people. This sector has the potential to eliminate rural poverty and contribute to the development of many remote districts of the country. The basic requirements for realizing its potential are: better information on resource availability, sustainable management, processing and value addition, publicity, proper marketing, good governance, research and development.

The National Trade Integration Strategy (NTIS), 2010 has identified MAPs/essential oils and handmade paper among the 19 priority export products and services of Nepal.

Non-wood forest products have been the source of rural livelihoods and important contributor to the local economies and forest conservation with negligible negative externalities. The National Biodiversity Strategy

(2002) has mentioned that up to 100% rural households in some remote districts rely on the collection and trade of NWFPs for their family income and livelihoods. Another study has found out that the NWFP sector contributes up to 40% of total annual family incomes of some rural hilly areas (Olsen and Larsen, 2003). Large Figure 3: Local trade of NWFPs in Lalbandi, Sarlahi number of ethnic communities



and rural people use several NWFPs as a safety net during the time of famine and food shortage. Despite impressive development in medical facilities and infrastructure, estimated 60% of the Nepalese citizens still do not have access to the modern medical facilities and thus largely depend on medicinal plants at least for the primary treatment.

The NWFP sector contributed NRs. 8,691 millions to the total export value of NRs. 76,917 millions in FY 2012/2013, which includes the export of medicaments, turpentine, kattha, brooms, ayurvedic drugs, cardamom and medicinal herbs (TEPC, 2013) (Table 1). The NWFP sector account for over 11% of the total Nepalese export to India and other countries. The export of NWFPs has been continuously increasing as shown in Figure 4.

Additionally, about 50-60% of the NWFP harvests are unrecorded, either consumed within households or sold in local markets without following any government procedures and channels. A significant quantity of the NWFPs are used by the local industries and pharmaceuticals. Nepalese pharmaceuticals and other companies also import various NWFPs, which in 2010 was valued at USD 1.01 million (a twofold increase compared to 2009) (TEPC, 2011).

The Nepalese hand-made paper was exported to 30 countries totaling the value of NRs. 55 million in FY 2012/013 (TEPC, 2013). The country also exports essential oils, extracted from various species, to 24 different countries valued for a total of NRs. 87 million in fiscal year 2012/013 (TEPC, 2013).

								Value in	'000 NRs.
		F.Y. 20	10/11	F.Y. 20	11/12	F.Y. 2(112/13	Annual C	hange %
Commodities	Unit	Quantity	Value	Quantity	Value	Quantity	Value	F.Y. 2011/12	F.Y. 2012/13
Cardamom	Kg.	4,821,971	2,043,716	5,311,393	3,496,733	5,102,811	3,849,995	71.1	10.1
Medicinal herbs	Kg.	9,424,397	710,593	7,276,891	805,371	5,726,553	1,272,947	13.3	58.1
Medicaments (pure ayurvedic and yunani)	Kg.	1,000,955	232,202	993,599	322,860	553,304	195,373	39	-39.5
Ayurvedi drug (for retail sale)	Kg.	297,840	251,911	475,109	510,511	427,653	483,912	102.7	-5.2
Turpentine oils	Kg.	1,347,909	110,846	1,976,909	182,268	2,658,041	266,884	64.4	46.4
Rosin and resin	Kg.	6,465,714	506,039	10,253,483	879,245	14,017,403	1,331,758	73.8	51.5
Nepalese paper		I	456,214	1	566,430	I	549,866	24.2	-2.9
Essential oils	Kg.	31,939	82,032	37,400	76,851	64,202	87,037	-6.3	13.3
Broom	Pcs.	502,391	5,185	693,146	5,608	1,369,011	11,343	0.08	1.02
Kattha	Kg.	I	I	2302527	910203	1723737	642365	I	-0.29
Total			4,398,738		7,756,080		8,691,480		0.12

5

Table 1: The export of major NWFP in last 3 years

FY: Fiscal Year, Kg: Kilogram, Pcs: Pieces

About 100 Nepalese NWFPs are in trade, however just 20 species represent the 80% of the total trade by volume and value. The total contribution of this sector to the overall national GDP was estimated to be 5% (CECI, 2006).

7000 **Export of the important NWFPs from Nepal** (in Million NRs.) 6000 5000 4000 3000 2000 1000 0 2005/06 2006/07 2007/08 2008/09 2010/11 2011/12 2012/13 2004/05 -Expon. (Total) Cardamom Rosin & Turpentine Nepalese Paper Total

Figure 4: NWFPs exports in different fiscal year from Nepal

Geographical distribution of NWFPs

Nepal is divided into three main geographic regions (Terai, Hills and Mountains) and five physiographic zones (MPFS, 1989). The distribution of the forest resources, ecosystem types, bioclimatic zones and population are given in table 2. Forests have been distributed in all regions and areas, containing various species, well known for important wood and non-wood forest products. About 380 timber species have been reported from Nepal (MoFSC, 2012). Over 1,648 non-wood forest products (including 701 MAPs) species have been found in the country, representing all geographic regions. The annual rate of deforestation in 20 Terai districts was 0.08% during 1990/91 and 2000/01, and 0.44% during 2001 and 2010/11 (DoF, 2005; DFRS, 2014).

Physiographic Zone	Area (%)	Elevation (m asl)	Forest Area (%)	Bioclimatic Zone	Ecosystem Types	Population
High Himal	23	Above 5,000	NA	Nival		12210705
High Mountaing	20	4,000-5,000	3%	Alpine	38	13318/05
rigii wountains	20	3,000-4,000	30%	Subalpine		(00.2770)
Middle	20	2,000-3,000	33%	Temperate	53	11394007 (43%)
Mountains	30	1,000-2,000		Subtropical		
Siwalik	13	500-1,000	26%	Tropical	14	1781792
Tarai	14	Below 500	8%	Tropical	12	(6.73%)
Total	100		100		117 (+1)*	26,494,504 (100%)

Table 2: Brief characteristics of the geographic regions of Nepal.

*A water ecosystem type is found in all regions except in Siwalik Hills (Source: MPFS, 1989; NBS, 2002; CBS, 2011).

The NWFPs are distributed in all geographical regions; the diversity and number of the NWFPs is probably the highest in lowlands of Terai. The recent Forest Resource Assessment (2014) has reported that a total of 329 and 666 NWFPs (of flora) used for various purposes are found in Terai and Siwalik regions respectively. Despite low plant diversity, commercial values of the NWFPs found in the mountains (highlands) of Nepal are the highest. For example the price of Kurilo (*Asparagus racemosus*) and Serpagandha (*Rauvolfia serpentina*) found in the Terai regions are below NRs. 500 per kilogram but the price of Yarsagumba (*Cordyceps sinensis*), Wild Morel (*Mochella esculenta*), Jatamansi (*Nardostachys grandiflora*), Panchaule (*Dactylorhiza hatagirea*) etc. are several times higher compared to the lowland species (Figure 5).



Figure 5: General trend of species diversity and commercial importance of NWFPs along the altitudinal gradient in Nepal

State revenue collected from the sale of NWFPs in the last three fiscal years was zero in 11 districts (Kanchanpur, Bardia, Kapilvastu, Rupandehi, Chitwan, Parsa, Rautahat, Dhanusha, Siraha, Morang, Jhapa) and very negligible in 9 districts (Kailali, Banke, Nawalparasi, Dang, Bara, Sarlahi, Mahottari, Saptari, Sunsari) of the 20 Terai districts of Nepal (DoF, unpublished). Most of the District Forest Offices collected annual revenue of less than NRs. 10,000. Only Sunsari district had earned significant revenue from NWFPs (NRs. 263,666 in FY 2010/011) (DoF, unpublished).

Challenges and threats

Despite huge potential, the NWFP sector in Nepal has not flourished according to expectations. There are various problems, challenges and threats for the development of the NWFPs sector in Nepal.

The depletion of the resources due to over exploitation is considered as one of the key problems. The national laws and international agreements have placed various NWFPs under different categories of protection. The IUCN has assigned 43 MAP species under various threat categories (critically endangered: 3, endangered: 14, vulnerable: 23, nearly threatened: 3) (Bhattarai *et al.* 2002). Similarly, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has listed 14 MAPs in its appendices (Appendix I: 1 species, Appendix II: 8 species, Appendix III: 5 species). The government of Nepal has also provisioned various level of protection to 6 plant species. They have to be managed with the principle of sustainable forest management. Besides the resource dedgradation and depletion, thre are number of problems. Some of the major problems are summarized below:

A. Cultivation and sustainable management

Some of the key challenges in sustainable management of NWFPs in the wild and in cultivation include following:

- Unknown status (lack of resource inventory and monitoring) and production potential in wild and cultivation.
- Lack of comprehensive domestication activities and reliable information.
- Low supply of input resources such as quality seeds/seedling, financial and technical supports.

- Lack of access of seeds of high-yielding varieties, unknown seed source and variable seed quality for large-scale cultivation. For example, the F₂ and F₃ generations hybrid seeds from unknown source (e.g. Asparagus) were massively cultivated in Nepal, which later failed to yield quality tubers.
- Lack of appropriate technology for cultivation, especially for some of the high-value NWFPs (Yarsagumba, Jatamansi, Paanchaule, Nirmasi, Bikhma, Olive etc.). Very little study on their cultivation techniques and growth potential has been carried out.
- No monetary and other incentives for the cultivation of the species in private lands.
- Fragmented land: extremely fragemented land in Nepal limits the large scale cultivation of NWFPs and use of the machineries for the susequent maintenance in the cultivation.
- Overexploitation, premature harvesting and resource degradation including illegal harvesting of commercially important species.
- Unscientifically determined "sustainable" harvest limit, which is mandatory by law. The species wise harvestable quota is fixed without any scientific resource inventory in District Forest Office's five-year working scheme.
- Insufficient research institutions and trained man power.
- Unknown, unpredictable and frequent policy changes in policy, government circulars and practices.

B. Business/Trade

The following problems/issues hinder the business/trade promotion of NWFPs in Nepal:

- Negative perceptions: NWFPs/MAPs trade is sometimes wrongly alleged as *illegal* and traders are taken as *smugglers*.
- Lack of the value addition and processing of the products.
- Lack of quality upgrading of the products to fetch high price and generate market demands. The product used to be sold without or with

very negligible grading, packaging and product promotion. Producers are not getting good price for their products.

- Small volume for industry and trade. Businessmen do not come to villages to buy small quantity of the NWFPs.
- Inadequate domestic and foreign investment in NWFPs sector in Nepal for the promotion of the infrastructures and markets.
- Lack of the forests and forest products certified under recognized international standards such as Forest Stewardship Council (FSC) and Programme of the endorsement of Forest Certification Scheme (PEFC) in Nepal hinders the access to international markets. Comparable national standards have not developed either.
- Market uncertainty and fluctuations. For example, the price of wild Asparagus was NRs. 500 per kilogram in 2013, but it has sharply dropped to NRs. 200-300 in 2014 (cases of Sarlahi, Makwanpur districts in Nepal).
- Monopoly or dominance by a few middlemen and traders keeps the producers from selling their products in open markets and compel them to sell their products at a rate fixed by the middlemen/traders.
- Limited quarantine, inspection and testing laboratories for NWFPs/ MAPs that negatively impacted export to Indian markets.
- Lack of market information and its elements. Poor farmers/ producers/ collectors do not have deep knowledge on the complex relationship between marketing elements such as product, price, place and promotion
- Tariff and non-tariff barriers such as licensing and unnecessary documentation requirements, fees, countervailing duties in some products etc. limit free access to Indian markets.
- Lack of storage facility (warehouse, cold stores) at border areas in India and China.
- Unclear guidelines for transport and export of NWFPs.
- Lengthy and costly export formalities. Short validity period of transport permit issued by Nepalese and Indian authorities creates problems to reach destination within stipulated time; compel to reach them frequently for the extension of transport deadline.

- Transportation difficulties associated with multiple check points and harassment of formal and informal groups. A total of 18 checkpoints are present on the way to transport NWFPs from Nepalgunj to Kathmandu, imposing extra burden to sell the products to the capital of the country (Personal communication with Rabindra N. Shukla, JABAN).
- Lack of accredited laboratory to check the standardization of the crude MAPs and oils. It is very difficult to receive good prices without guaranteed quality.
- Royalty fixation with no clear basis. The royalty and market price ratio varies from 0.5 to 20 (e.g. Tejpat and Yarsagumba).
- Various types of ban on 15 plant species; bans are very difficult and impractical to enforce, which promotes illegal transactions. Department of Forests (DoF) has proposed to remove all restrictions on four species such as chiuri (*Bassia butyracea*), ritha (*Sapindus mukorossi*), timur (*Zanthoxylum armatum*) and lapsi (*Choerospondias axillaris*), as they are generally found in cultivation, for promotion of cultivation and trade, but it is not yet endorsed.

C. Others management problems

- Illegal harvesting, transportation and export.
- Loss of habitat of various NWFPs through deforestation, forest encroachment and forest fires.
- Difficulty in obtaining collection permit at is issued only by DFO. It is very difficult to reach DFO from remote villages prior to harvesting.
- Forests to factory distances: the government had imposed the restriction to establish NWFP based industries within the distance of 3 kilometers in hills and 5 kilometers in Terai from forest edge. This was not practical and thus deters to establish forest based industries. It has just been amended by the decision of Council of Ministers dated on 22 September, 2014
- Locking of large NWFP reservoir inside protected areas (PAs). Various high value annual NWFPs are being decayed inside protected areas due to restrictions on collection and trade.

- Herbs and NTFP policy (HNDP) 2061 not completely implemented.
- Forest Acts, Regulations, National Park and Wildlife Conservation Act and related Regulations need to be amended to incorporate various policy prescriptions made in HNDP 2061.
- Unscientific and conventional EIA/IEE requirement as per the Environment Protection Act-1996 and Regulations-1997 for harvesting NWFPs and factory establishment etc.
- Insufficient allocation of financial resources to implement policy recommendation.
- Disposal of confiscated NWFP (ban items) is problematic; for example the protection of banned Raktachandan has been costed lots of security manpower and expenses but difficult to dispose due to the legal procedures and CITES provisions. Similarly, the decaying of the confiscated Jhayau (*Permesia* spp.) induces various problems and quality degradation.

NWFPs development initiatives

We have plenty of challenges and opportunities to address the above mentioned problems in order to contribute in poverty reduction and employment generation through the sustainable management and development of NWFPs in Nepal. The Ministry of Forests and Soil Conservation (MoFSC) through its five departments (mainly by the Department of Forests and Department of Plant Resources), has been implementing various programmes and activities for overall conservation, promotion and research related to NWFPs. It has been implemented programme focused on NWFPs, 'JADIBUTI BIKAS Karyakaram (i.e. MAPs Development Programme)' since FY 2010/011. Presently, the programme is being implemented in 22 districts as the first priority (P1) programme through Department of Forests, Department of Plant Resources and Department of National Parks and Wildlife Conservation. In addition, the government has prioritized 30 NWFPs species for the focused promotion of the commercially important species (Atis, Amala, Bhyakur, Bikha, Bojho, Chirayito, Dhasingre, Guchhi, Gurjo, Jangali sayapatri, Jatamansi, Jhyau, Kutki, Laghupatra, Lauthsalla, Majitho, Neem, Okhar, Paachaaule, Padamchal, Pashanbed, Pipala, Ritha, Sarpagandha, Satabari,

Sugandhakokila, Sugandhawal, Tejpat, Timur and Yarsagumba). Ten of these species are legally protected by Forest Regulations, 1995.

The ministry equally emphasizes the resource conservation, development and promotion of the forest-based enterprises. The MoFSC has just established a separate division viz. Forest Enterprise and Management Division under the division head of Gazetted I Class Officer (General Forestry). The department of forests promulgated the guideline for the inventory of NWFPs in 2011. Each district forest office has been mandated to allow collection and trade of NWFPs only after its resource inventory and provision of annual harvest quota have been approved in the 5-year working schemes.

The government of Nepal adopted the Herbs and NTFP Development Policy, 2004 to address issues related to NWFPs. It has emphasized conservation, sustainable utilization of NWFP and commercial plantations. The policy focuses on resource conservation (in-situ, ex-situ), programme mainstreaming in various management regimes, sustainable harvesting, commercial cultivation of selected MAPs, ensuring sustained supply, people participation promotion, simplification of certification and taxation system, awareness raising and research and development. However, due to lack of corresponding legal instruments, institutions and investment, the policy could not be properly implemented. A subjective assessment of Herbs and NTFP policy (HNDP) 2004 for its 22 policy strategies and 28 work strategies were found very poor (average scale of 0.91 and 0.71 respectively out of 4 full marks) implementation (Sharma, 2014, unpublished).

The government has recognized the need for revising and ameding the policy. FAO Nepal has recently completed the review of HNDP, 2004 and suggested various amendments to facilitate the smooth functioning of the NWFP sector in Nepal. The ministry is committed to the conservation of nation's rich biodiversity and NWFP resources through the participation of all stakeholders including private sector and civil society.

The upcoming Forestry Sector Strategy (2015-2025) of Nepal has also realized due importance of the NWFPs sector for the country. It has proposed for the expansion of NWFP cultivation in and outside forests, promotion of private sector involvement from cultivation to processing

and marketing of NWFPs, ultimately aiming for fourfold increase in the NWFPs export value (reaching NRs. 25 billion by 2025).

Besides the Ministry of Forests and Soil Conservation, several projects and programmes have been implemented for the promotion of NWFPs sector in Nepal. The FAO supported technical cooperation programme (TCP/NEP/3403), FFF (Forest and Farm Facility), GIZ supported INCLUDE and IN-MAPs are being implemented. Similarly, several I/ NGOs have been working for the development of the NWFPs sector in Nepal including the World Wildlife Fund (WWF), International Union for the Conservation of Nature (IUCN) and the Asia Network for Sustainable Agriculture and Bio-resources (ANSAB).

Various stakeholder consultations have identified the following activities as the most essential and important for the conservation and development of NWFPs sector in Nepal:

- Promote potential (focused) NWFP in each district based on ecological feasibility.
- Sustainable harvesting of NWFPs from natural forests (national, CF, LHF and others).
- Extension works, awareness building among various stakeholders about the importance of the sector and scientific cultivation practices, processing and marketing of NWFPs.
- Development of good agricultural and collection practice (GACP); cultivation, harvesting, value addition guidelines related to MAPs; establishment of Common Facility Centre in every development region.
- Promote applied research on domestication, cultivation and value addition of important species.
- Establishment of germplasm conservation plots in different geographic and climatic zones.
- Produce sizeable amount of commercially important species for sustainable trading.
- Recognize private NWFPs cultivation and provide monetary and other fringe benefits to the private growers.

- Conduct in-depth study in all PAs about the availability, abundance and potential of the NWFPs and provide the permission to collect and sell prominent NWFPs from protected areas based on the report.
- Training on identification of various traded NWFPs for check point staffs responsible for checking the loads of NWFPs.
- Develop capacity on identification, cultivation, processing, uses and trading of various stakeholders and concerned people/authorities.
- Promote private sector involvement in NWFPs sector. Develop strong public private partnership mechanism for the optimum utilization of the processing plant and other facilities available at DPR.
- Improve access to banking facilities and soft loans to the farmers, businessmen and industrialists.
- Back-up of domestic processing, technology development and infrastructure promotion in NWFPs sector.
- Establish various industries and pharmaceuticals for value addition and productions of medicines and cosmetics items from NWFPs.
- Strengthen market information system and collective trademark/patent right for the innovations and novel products.
- Establishment sufficient number of warehouses and storage facilities.
- Establish accredited laboratories for quality assurance for the processed and semi-processed items at national and regional level. Establish an accreditation body.
- Establish organic certification agency and national standards; organic certified NWFPs fetch better prices.
- Certification: assurance that products come from the forest managed sustainably (for both government and buyers). The Jatamansi (*Nardostachys grandiflora*) oil has been banned to import by European Union by suspecting the products come from the unsustainably managed forests, though it is wrong assumptions.
- The unsustainable harvest products are barred to import in lucrative markets such as Europe, USA and Australia. The mechanisms, procedures, national standards commensurable to international standards set by FSC/PEPC and such others, need to establish/

develop to assure the NWFPs come from the forests that have been managed sustainably. This will support government for the sustainable management of forests and control resource degradation and is used to fulfill the buyers aspirations to contribute resource conservation.

- Clear and categorical definitions of the processed items that will facilitate comfortable transport and export of processed items.
- Delegate collection permission authority to the Sector/Ilaka forest offices which are in the vicinity of collectors.
- Revise IEE/EIA provisions (mainly in quantity thresholds) for the collections and establishment of NWFPs factories, based on species, availability and resource inventory.
- Detail consultation with all stakeholders sufficient time prior to imposing and releasing bans on any items.
- Lift the various bans imposed on NWFPs based on scientific and participatory study.
- Periodical review of CITES and other banned plants/items for their status update. Enforce CITES species related provisions with more clarity.
- Review value added tax (VAT) and other taxation provisions.
- Prepare logical, rationale and scientific royalty rate of NWFPs and make regular revisions.
- Establish NWFPs database and information management system.
- Establishment and strengthening of a national level independent and autonomous Herbs and Non-Timber Forest Products Board to promote herbs and NTFPs related activities, strengthen policy provisions and implementation, and provide any other necessary facilitation.

Immediate implementation of above prescriptions are very important for the development of NWFP sector in Nepal. The government of Nepal has been working as the facilitator, catalyser and promoter of the NWFPs. With collective efforts of all stakeholders, including government, private sectors, civil societies and others, the NWFPs sector can change the fate and future of the country and her people.



Key Non-Wood Forest Products of Terai and Siwalik Regions



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Local Name	:	Amala, Aawla, Aadifal, Amalaki
English Name	:	Gooseberry, Emblic myrobalan
Botanical Name	:	Phyllanthus emblica Linn.
		(Syn. Emblica officianalis Gaertn.)
Family	:	Euphorbiaceae

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1. Amala (Phyllanthus emblica Linn.)



A. General information

- One of the most widely used medicinal plants in Ayurveda.
- Deciduous small tree up to 15 m tall. Government prioritized NWFP species in Nepal.
- Distribution: wild and cultivated. East to west from Terai to Mid-hills of Nepal.
- Most abundant in Far-western and Mid-western development regions of Nepal. It is generally found at the altitudinal range of 150 to 1400 m asl.
- Leaves small, simple, sessile, narrowly oblong, 10-13 mm long, 2-3 mm broad,
- Fruit: 1.5-3 cm in diameter, 6 vertical furrows.

B. Cultivation practices

- Propagation can be done by seeds and vegetative (stem cutting, grafting and budding) methods.
- Seed collection in November-December.
- 4-6 seeds per fruit. About 35,000 to 90,000 seeds per kilogram.
- Seed viability up to 12 months if properly store.
- Seeds are hard and take long time to germinate.
- Pre-treatment of seeds require soaking up to 24 hours in water before sowing.



Amala seeds (up) and nursery (bottom) in DFO, Rupandehi

Seed sowing: March-April, up to 30% seed germination.

Vegetative propagation: stem cutting/grafting/budding.

- Improved varieties of Amala used to be grafted/budded into local rootstocks.
- 🌕 Improved variety: Banarasi, Chakaiya, Francis, Kanchan, Bhavasagar (India).
- Stem cutting: thumb size shoot with 3 nodes.
- **Plantation:** one year old seedling.
 - Pit size: 45 cm x 30 cm x 30 cm (May-June), fill with 5-8 kg farmyard manure and 0.05 kg Phosphorus.
 - Spacing: 3 m x 5 m.

C. Management practices

- Irrigation: regular, at 15-day interval during summer. It requires well drained soil and does not tolerate water logging.
- Weeding needs to be done in early stage.
- Intercropping possible for first five years.
- Fruit collection should be done carefully without damaging the branches.
- Dead, diseased, weak and criss-cross branches should be pruned regularly.
- Aphid, white fly, bug, leaf roller, bark eating caterpillar (*Inderbella tetronis*) and amala rusts (*Rarenellia emblieae*) are common pests and diseases.
- Production: starts from 5 years after plantation, 10 years old tree produces 50-80 kg of fruits.



Damaged Amala trunk by Bark sucking Caterpillar at DoF premise at Babarmahal

Produces fruits for up to 70 years of the age if properly managed.

D. Uses

- For "Triphala" churna (used as laxative in stomach complaints).
- Rich source of vitamin 'C', antioxidant properties in fruits.
- Cooling, refrigerant, diuretic.
- Useful in hemorrhage, diarrhea and dysentery, anaemia, jaundice, dyspepsia, certain heart complains and cold.
- Used to prepare pickles; locally sold in market.
- Manufacturing shampoo and other cosmetics, dye/inks.
- Fodder for goats and other animals.
- Royalty: NRs. 1/kg. Price: NRs. 70-80/kg (market, green fruit at Kathmandu).
- Dry fruits: NRs. 90/kg (Kathmandu), NRs. 80/kg (Nepalgunj)- (ANSAB, July 2014).
- Export: average annual export (88,104 kg) during last 8 years, ranging from 18,400 kg (FY 2011-12) to 155,915 Kg (FY 2009-10).



Amala fruits; 'Triphala' churna and hair oil



A woman selling improved amala fruits at Newroad, Kathmandu


Local Name	:	Amariso, Amaliso, Kuchoghaans
English Name	:	Broom grass, Tiger grass
Botanical Name	:	Thysanolaena maxima (Roxb.) Kuntze
Family	:	Poaceae/Gramineae

2. Amariso (Thysanolaena maxima (Roxb.) Kuntze)



Amariso cultivation at Bihani community forest Sarlahi

A. General information

Tall, tufted, reed like perennial grass, monocotyledon, multipurpose plant with multiple stems, reaches up to 2 m height and clump size of 1 meter diameter.

" Ceaves, stem and clump resemble bamboo, therefore it is informally called as 'dwarf bamboo' by many people.

- Leaves: simple, large, bright green, similar to bamboo; linear and lanceolate leaf blade, up to 50 cm long and 6-10 cm broad, alternatively arranged at the distance of about 10 cm.
- Flowers during June-July, bear inflorescence (panicle) on the shoot apex at the end of vegetative growth, bisexual. About one and half years old plants start bearing panicles, panicle size: 50-70 cm long.
- Fast-growing species, attains it maximum growth and biomass in four years.
- It is distributed naturally in tropical and sub-tropical parts of Nepal, India, Bhutan, Myanmar, China, East Asia, New Guinea and Malaysia up to 2000 m asl (Watson and Dallwitz, 1992).
- It can be grown in marginal lands of Terai/Siwaliks and Mid-Hills of Nepal. Commercial cultivation has recently started in Sarlahi, Makwanpur, Bara, Chitwan, Nawalparasi, Gorkha, Tanahun, Rupandehi, Palpa, Dang and Banke districts.

B. Cultivation practices

- Prefers warm shaded areas, primarily logged over areas in hill slopes and ravines; can be grown from Terai to Mid-hills region of Nepal.
- Few extremely degraded hill slope areas of Palpa (Jhirubas), Nawalparasi (Hupsekot) and Tanahun (Devghat areas) districts have been extensively cultivated in leasehold forests (LHFs) with Amariso.
- It can grow in a wide range of habitats (pH 5.3-9.3). It is susceptible to frosts of long duration.





'A' Frame used for aligning the contour and Amariso cultivation in contour at Jhirubas, Palpa (Source: TA-LFLP)

- The species propagates by seeds or by horizontal rhizomes in natural conditions, but the germination from seeds is very difficult and the nursery technique is not much known.
- Wegetative propagation mostly done by slips and rhizome cutting.
- Rhizome cutting with 3-4 buds and 1-2 nodes.
- Slips prepared from about 2 years old healthy mother plants, and size maintained as 20-25 cm (shoot and root).
- 'A' frame can be used to plant Amariso in the contour line at hills.
- Pit (hole) sized 10 cm x 10 cm dug at the distance of 1.5 m to 2.0 m in the contour, and the slip/ rhizome with mud used to be planted there during monsoon.



Local Farmer raising broom grass in Sarlahi

The pit should to be filled with about half kilogram of well decomposed farmyard manure.

C. Management practices

- Weeding and irrigation: regular.
- Broom harvesting is done mainly in November to January. Harvested panicles used to be dried in sun.
- Fodder generally cut after harvesting brooms.
- Output to three cuttings per year can be done if it is managed only for fodder.
- Well seasoned/dried inflorescence used to be tied with thin bamboo strips, (choya) or with plastic ropes to make broom.
- Plantations used to be intensively disturbed by the mouse and small rodents.
- Manual killing and poison baiting are being practiced generally in Jhirubas, Palpa.
- Controlled fire is used after complete harvesting of inflorescence and grasses in Amariso cultivation area during March-April. It promotes vigorous sprouting after first rainfall.





Amariso cultivation in slope (Courtesy: TA-LFLP)

D. Uses

- Mainly used for the soil conservation, slope stabilization, brooms and fodders. It has also potential for paper manufacturing. Inflorescence used for making brooms.
- Mat like root structure is very effective in controlling soil erosion and nutrients from slopes during monsoon.
- Can be cultivated as the hedges. Stems can be used also as the fuelwood.
- Very good source of forages for small ruminants.
- Royalty: NRs. 2 per kilogram. Market price: Inflorescence: NRs. 70-85 per kilogram (in 2014), NRs. 60 per broom at Kathmandu (September, 2014). One kilogram inflorescence can produce up to four standard brooms.
- Nepal has exported about 1369,011 pieces of brooms valuing NRs. 11,343,000 in FY 2012/013. It was the straight 100% increased export in comparison to FY 2011/2012 (TEPC, 2013).



Sun drying the amariso brooms at Lalbandi, Sarlahi



Amariso is being cultivated with the gabion wall to control river scouring in Kamane, Hetauda



Broom stacks in local market of Jhirubas, ready to transport for Butwal (Source: TA-LFLP)



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Local Name	:	Ashwagandha, Asgandha, Punir
English Name	:	Winter cherry
Botanical Name	:	Withania somnifera (L.) Dunal
Family	:	Solanaceae

3. Ashwagandha (Withania somnifera (L.) Dunal)



A well grown up Ashwagandha plant at JABAN, Head office, Nepalgunj.

- Fruits: 0.5 to 1 cm diameter, reddish, orange red.
- It has been cultivated in Sarlahi, Bara, Dang and Banke districts. It can be grown from 150 to 500 m asl in Terai and Bhabar areas.

B. Cultivation practices

- From seeds (direct sowing and seedlings raised in nursery).
- Direct sowing in well ploughed and prepared land.
- It requires about 10-12 Kg seeds/ ha. Directly sown seeds germinate in two weeks.



Aswagandha plant after weeding in Sarlahi



A. General information

up to 1.5 m tall.

and bitter in taste.

Small and medium sized under shrub,

Leaves: simple, alternate, ovate and hairy up to 10 cm long, 3-5 cm broad

Flowers: pale green, small about 1 cm long, in umbelliform cymes.

Women users preparing soil for Ashwagandha cultivation.

- Nursery establishment during May-June.
 - **Nursery:** germinate in one week, transplanted in polythene bags after 10 to 15 days of germination.
 - About 5 kg seeds required for one hectare cultivation.
- Plantation at the distance of 60 cm x 60 cm during monsoon (July-August).
- Requires about 27,778 seedlings (including 2,778 for casualty replacement) for cultivating one hectare area.

C. Management practices



- Regular weeding suggested.
- Plant can grow in dry and marginal lands. However, occasional irrigation needed.
- Water logging is not allowed.
- May be infested with leaf spot disease by fungus named *Alterraria alternata*; immediately remove diseased plants and burn safely.

Matured Ashwagandha plant with ripe fruits in Sarlahi.

- Harvesting can be done after six months of cultivation. Careful digging is suggested to harvest roots.
- Remove soil dust and other materials and dry roots properly.
- **Production:** about 300-500 kg roots; 50-60 kg seeds per hectare.

D. Uses

- Useful parts: mainly roots but leaves, fruits and seeds also has various uses.
- 🏐 Also called as Indian Ginseng.
- Roots: aphrodisiac, tonic, deobsturent, diuretic, narcotic, abortifacient.
- Dried roots used to make various drugs useful in sexual and general weakness and rheumatism, ulcers, inflammations, insomnia, bronchitis, mange, syphilis, epilepsy, stress and neurodegenerative diseases such as Parkinsos and Alzheimer disorders.



A popular herbal product from Ashwagandha (Source: internet)

- Nepalese pharmaceutical companies import ashwagandha from India and other countries. Therefore, we have large domestic market for it.
- **Royalty:** not mentioned in Forest Regulations, 1995.
- Market price: NRs. 500-700 per kilogram (Delhi) as per the market price of August, 2014.



Dry Ashwagandha roots (Source: internet)



Local Name	:	Babariphool, Baabareephool
English Name	:	Sweet basil, Common basil, French basil
Botanical Name	:	Ocimum basilicum Linn.
Family	:	Lamiaceae/Labiatae

4. Babariphool (Ocimum basilicum Linn.)



Babariphool cultivation in Dumkibas, Nawalparasi (Photo: Loknath Pathak)

- Over 150 species under 'Ocimum' genus.
- Most of the species found in tropical rain forests of Africa.
- Distribution: cultivated plants, mainly in Sarlahi, Bara and few other districts of Terai in Nepal.

A. General introduction

height reaches 30 to 90 cm.

pale-purplish, 2-lipped tubes.

Erect, strongly aromatic, annual herbs,

Leaves: opposite, ovate to lanceolate, entire or glabrous, 4-5 cm long leaf. Flowers: small, 0.7 to 1.3 cm long, terminal racemose inflorescence, five toothed calyx. Corolla is white, pink,

B. Cultivation practices

- Improved varieties mainly developed by Central Institute for Medicinal and Aromatic Plants (CIMAP), Lucknow, India:
 - ✓ RLL-011 produces up to 50 tons/ha (green weight), oil content 0.45% (Oil : 320 kg/ha).
 - ✓ Vikarsudha: 3.7 tons/ha (green weight), oil content 0.7% (Oil: 260 kg/ha).
 - ✓ Kusmohak: yields 135 kg oil/ha.
- Can be grown in moderately fertile, even in marginalized, well drained and loamy soil. The species is very susceptible against frost.
- Soil preparation: 2 to 3 times ploughing. Add about 5-10 tons/hectare farmyard manure during soil preparation.
- Propagation by seeds raised in nursery; seeds are very minute. About 150 gram seeds are required for one hectare cultivation.
- Seeds mixed with fine sands or ash at the ratio of 1:15, broadcast over bed. Seeds are covered with fine soil or farmyard manure and watered regularly.
- Seed germinates after 3 days and completes germination within 10 days.
- After plant reaches to 5-10 cm height, seedling is transplanted into the field at the spacing of 40 cm x 60 cm. A total of 45,833 seedlings (including 10% casualty replacement) are required for cultivation in one hectare land.

C. Management practices



French basil cultivation in Tamagadhi, Bara, Nepal

- Regular irrigation once a week during the hot and dry summer.
- Weeding regularly at the interval of a month.
- Pests: leaf rollers. Diseases: leaf spot blight and basil wilt damages the productivity.
- Bio-insecticides is used and recommended to control the damages.
- Harvesting: after 2-3 months when plant completes flowering, second and third harvesting can be done at the interval of a month.
- Steam distillation is done for extracting oil either from entire plants or from the upper flowering parts only.
- 2-3 hours steam distillation is done to extract the oil from 24 hours wilted plants. It has 0.2 to 0.4% oil content. It usually produces 25 to 30 kg basil oil per hectare in Nepal.

D. Uses

- All plant parts (roots, leaves, flowers, seeds) used in traditional medicines.
- It has aromatic, diaphoretic, stimulant, carminative, anti-emetic, antidiarrhoeic and expectorant properties.
- Flowers: carminative, diuretic, stimulant, demulcent.
- Oil contains d-linlool and methyl chavicol. Can be used in culinary and making chocolate, chewing gums, soaps, perfumes, cream, toothpaste etc.
- Useful in treating fever, headache, gonorrhea, dysentery and chronic diarrhea etc.
- Also used for preparing drugs, useful in cephalalgia (headache), gout and as a gargle against stinking breath.
- Flavoring food stuffs, confectionery goods, toiletry products, mouth washes and dental creams.
- Used as flavoring agents of baked goods, spiced meat, sausages, sauces, ketchup, vinegars, pickles and beverages etc.
- Considered as the "King of Herbs" for culinary purposes.
- Royalty: not mentioned in Forest Regulations, 1995. Markets: mainly exported to India and Europe.
- Price: NRs. 3,798/Kg (HPPCL, September 2013). This price is unchanged from last year price.



Local Name	:	Bans
English Name	:	Bamboo
Botanical Name	:	Dendrocalamus spp. Bambusa spp., Arundinaria spp.
Family	:	Poaceae/Gramineae

5. Bamboo (Dendrocalamus spp.; Bambusa spp.)

A. General introduction

- Light demander species.
- Known as 'wood of the poor', 'friends of the people' and 'brother of rural people'.
- Rhizome bracts, culm sheath and foliage leaves present.
- Long and sharp leaf blade, lanceolate, hairy.
- Hollow stem (culm) varying in size, shape and color as per the species and variety.
- Multiple branches arise from a single node.



Bamboo culms growing at the bank of Bagmati River at Sinamangal, Kathmandu

- Around 92 genera and 5,000 species found world wide. 12 genera and over 52 species of bamboo found in Nepal (Das, 1999). Widely distribute from lowland Terai to Mid-hills of Nepal.
- Bambusa and Dendrocalamus genera are mainly suitable for vegetative propagation.
- One of the fastest growing species. It is a main food of Giant Panda, Red Panda and Lemurs.

B. Cultivation practices

Propagation by i) seeds ii) culm cutting and iii) rhizome

i) Propagation by seeds

- Bamboos flower at long intervals. It has erratic flowering.
- All plants from same stocks flowers at the same time despite different locations. Plant generally dies after flowering.
- Bamboos flower throughout the year.
- Mostly seed collected from the cleaned and plastic bedded ground by knocking the culms.
- Seed is separated by rubbing and winnowing.





Bamboo seeds and seedling raised in polythene bag

- Wiability is relatively short, remain only for one season.
- Baised in polythene bag; can be transplanted in the field after 4-5 months.

diameter.

parts of the culm.

a) Selection of culm

Culm cutting much lighter and practical. Small and large diameter sized bamboos are

January to March are appropriate months. Avoid branchless culm and bottom and top

not suitable for culm cutting. 2- 3 years old healthy culm, over 3 cm

ii. Propagation by culm cutting



Trimming unwanted branches from the culm (Sarlahi)

b) Preparation of cutting

- Fresh culm: no later than 2 days after harvesting.
- Do not damage branches by any means.
- Cut the main branch at 1 to 1.5 feet and secondary branch at 2-4 inches.
- Out in the mid point of culm from nodes of both ends with saw.
- Avoid splitting of cut end culms. ۲





From top: i. Bamboo culm ready for cutting, ii. farmers cutting the culms by power chain saw, iii. Pieces of culm ready for planting in the nursery and iv. culm ready for planting in the field at Sarlahi

iii. Propagation by rhizome (off-cut stumps)



C. Land preparation and planting

- Light demanding species therefore it needs to be planted in open spaces.
- Irrigate burrowed land before planting.
- On water logged, but adequate moisture needed in soil.
- Dig line ditch 15 cm deep with spade. Put cut culms from one end of line. Cover with soil from beginning.
- Branches should be upward side and slightly tilted.
- The successful cultivation and maintenance of bamboo in the row inside the Narayanhiti Palace, near to southern, eastern and northern walls of the palace, provides better aesthetic view, privacy maintenance of the palace and shade to the passersby.



Soil preparation for plantation (Photo: CL Chowdhary)

D. Management practices and harvesting

- Regular thinning of culms recommended (in winter).
- Damaged culms, debris and dead branches need to be removed.
- Harvested after 3 to 4 years of plantation.
- All culms older than 4 years should be harvested. Culm should be cut at the height of 30 cm.
- Should avoid splitting during harvesting.



Dense bamboo clumps at Sinamangal, Kathmandu

Water leaching, steeping, sap displacement, white wash and tar coating are few methods profitable for the treatment of harvested culms to increase durability.

E. Uses

- Widely used in scaffolding, making paper and pulp, musical instrument, police batons, ply and mat boards.
- Very effective in slope stabilization and controlling soil erosion and land slides.
- Estimated 1 billion people in the world live in bamboo houses.



- Used from cradle to cremation, A man preparing Sofa from Nigalo and Rattan at Makwanpur bamboo shoots, furniture, handicraft etc. Over 1500 products of daily uses (worldwide) and 33 traditional products (Nepalese) with 86 designs have been reported (MDBRPP/DFRS, 2011).
- Nepal has exported 4,226,613 pieces of bamboo valued about NRs. 37,037,000 in FY 2012/13 (TEPC, 2013).
- Royalty: NRs. 0.15 per culm (Nigalo); NRs. 10 per culm (Bamboo).
- Market price: varied as per the finish product. Bamboo shoots NRs. 80-150 per kg. NRs. 200 per 20 feet long culm (Kathmandu, August, 2014).



Young Nigalo (*Arundaria*) shoots, very popular for vegetables in Pokhara, Nepal



Local Name	:	Barro, Badero
English Name	:	Bedda nuts, Belliric myrobalan
Botanical Name	:	Terminalia bellirica (Gaertn.) Roxb.
Family	:	Combretaceae

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6. Barro (Terminalia bellirica (Gaertn.) Roxb.)



Grown up Barro tree, about 30 m tall, in Murtiya CF, Sarlahi

A. General information

- Sacred trees, believed as the resting place of the Demon, so local people do not stay in its shade,.
- Large sized deciduous tree, up to 40 m height, cylindrical but slightly buttressed bole, thick and grayish bark (10-20 mm), horizontally spreading branches.
- Leaves: simple, large, 10-20 cm long, 7-15 cm broad, elliptic or obovate, clumped at the branch terminals, long and stout petiole (2-8 cm long), entire leaf margin.
- Flowers: small, pale or greenish, long arisen at the auxiliary spikes, scented smell.
- Fruits: drupes, 10-30 mm in diameter, five ridged, gray colored, ovoid with whitish hairs, single seeded.
- It is distributed naturally from eastern to western parts of Nepal, at the altitude of 200-1100 m asl, mostly associated with Sal forests in Terai. It prefers semi evergreen and moist deciduous forests habitat.

B. Cultivation practices

Fruits mostly collected from the forests. Very negligible efforts have been made for the domestication and proper cultivation of the species.

Initial works have been started for

the cultivation in community forests,



Barro seeds

leasehold forests and private lands.Plantation is done generally in poor and marginal lands.

Propagation by seeds (direct sowing or raised in nursery) and vegetative (stem cutting and grafting)

- Pretreatment of seeds: soaking seeds in warm water for 24-36 hours before sowing.
- Sow at the distance of 5 m x 5 m (in direct sowing).
- Nursery raised seedling: best method for mass cultivation.
- Seed collection: November-March.
- Seed storage can be done up to 12 months.



Barro and Harro seedlings at NWFPs nursery, Makwanpur

Sowing: in line of 5 cm distance or to the polythene bag during April –May (in nursery), starts germination after 2 weeks and completes in 4 weeks.

Stem cutting

- I year old branch with 2-3 nodes.
- Out branch with sharp knife at the size of 10-15 cm long with 3-4 nodes.
- Dip into rooting hormones such as ROOTEX prior to planting in nursery bed, inclined planting is recommended.

Plantation: during monsoon, after 3-4 months (best after 1 year) in nursery

- Pit size: 45 cm x 30 cm x 30 cm (May-June), filled with 5-8 kg farmyard manure and 0.05 kg Phosphorus per pit.
- Spacing: 5 m x 5 m; requires about 440 (including 10% casualty replacement) seedlings for one hectare cultivation.



Land preparation for nursery establishment in Makwanpur

C) Management practices

- Weeding and irrigation regularly in the cultivation.
- Protect tree from harvesting for fuelwood and timber in natural habitat, and from grazing in cultivation.
- Farmyard or well decomposed organic materials provides better growth in the cultivation.
- Starts fruits production after 10 years of plantation.
- Collect fruits from the cleaned or plastic bedded floors, remove seed by pressing the fruit.
- Ory immediately in sunlight.
- Removal of the foreign materials suggested.
- Grading based on the size and color of fruits fetch good price in the market.

D) Uses

- One of the constituent of "Triphala" churna.
- Therapeutic properties, used in the stomach disorders such as diarrhea, indigestion, constipation, worms and piles.
- Useful in eye disorders such as myopia, corneal opacity, immature cataracts.
- Alleviating dropsy, fever and cough.
- Bark/fruit: tanning/dyeing.
- Seed content up to 40% oil.
- Good fuelwood (from dead, died, decaying trees), it is also used for fodder.
- Boyalty: NRs. 2 per kilogram (fruits).
- Market price: can be sold in local markets; NRs. 50 per kilogram in Kathmandu (ANSAB, July, 2014).





Barro fruits and locally manufactured 'Triphala' churna at Sarlahi



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Local Name	:	Bel, Bael, Srifal, Mahafal
English Name	:	Bengal quince, Wood apple
Botanical Name	:	Aegle marmelos (L.) Correa
Family	:	Rutaceae

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7. Bel (Aegle marmelos (L.) Correa)



Bel Tree and fruit at the bank of Mayadevi Pond at Lumbini, Nepal

A. General information

- Medium sized (8-15 m height), thorny and deciduous tree.
- Leaves: trifoliate, leaflets 5-10 cm long, 2-6 cm broad, ovate, crenate.
- Long petiole.
- Flowers: greenish white, scented. Flowering period: April-May,
- Fruits: 5-6 cm diameter, rind woody; up to 2 kg weight for improved variety.
- Bel is important from religious/economic aspects.
- Local variety is found in the wild and improved variety in cultivation.
- It is abundantly distributed in Siwalik and Terai regions of Nepal at the elevational range of 150 to 1200 m asl. It is distributed from eastern to western parts of Nepal.



Bel pulp and seeds

B. Cultivation practices

- From seed, root sucker and grafting.
- Seeds used to be collected from the fruits plucked from the tree.
- Seed collection: May-June.
- Short viability of the seeds.
- Seed sowing: June-July.
- 1-2 years old seedlings are good for plantation during monsoon in the field.
- Planted generally at the spacing of 10 m to 12 m. in the pit size of 45 cm x 30 cm x 30 cm. Root suckers are also used for plantation
- Grafting: improved variety's scion are grafted in the local species' root stock.





C. Management practices

- Regular irrigation and 1-2 times weeding every year.
- Regularly provide compost manure at the bottom of the bel plant for better production.
- Protection from cattle/grazing in early days of cultivation.
- Complete fruiting in about 20 years.
- It produces about 300 to 400 fruits per tree.



Grown up Bel tree at Ghari, Sarlahi

D. Uses

- Parts used: roots, leaves and fruits.
- Ripe fruit: aromatic, laxative, against constipation and dyspepsia.
- Unripe fruit: astringent, digestive and against diarrhea.
- Religious purpose: 'Bel Bibah (wedding)' (in Newari culture), Shiva worship (Hindu).
- Pulp is used to make Bel juice. Ripe fruits are sold in local market.
- Oracle Stress Royalty: NRs. 2/kg (fruit).
- Market price: NRs. 20 to 30 per piece (at local market), up to NRs. 150/kg (Kathmandu).



Sliced bel (Source: internet) and bel juice produced by CFUG, Nawalparasi



Bel fruit being sold at Bhatbhateni Super Market (Kathmandu)



Local Name: ChamomileEnglish Name: Chamomile, Scented mayweedBotanical Name: Matricaria chamomilla Linn.Family: Asteraceae

8. Chamomile (Matricaria chamomilla Linn.)



Flowers of chamomile in cultivation at Sarlahi

A. General information

Annual herb, height up to 60-90 cm.

- Mainly cultivated as winter crops. It is native species of Europe, largely cultivated in France, Spain, Germany, Italy. Started cultivation in India and Nepal (Sarlahi, Bara, Nawalparasi, Banke, Bardia districts). Organic cultivation in community forests and leasehold forests has greater economic scope in Nepal.
- Greenish, leafy and hollow stems.
- Terminal, solitary flower of 1.5 to 2.5 cm diameter, yellow disc surrounded by whitish petals (10 to 30 numbers).
- Small achene fruits with 3-5 ridges, contains 40-50 seeds.
- Chemical constituents: chamazulene, bisabolol, apigenin, luteolin and others.

B. Cultivation practices

- Cultivation can be done by direct seed sowing in the field or by producing it in the nursery.
- Most dominant way of cultivation is by sowing seeds in the furrows on well prepared/ploughed soils.
- Direct seed sowing is comparatively cheap, easier and less labor intensive method.
- Seed sowing in 4-6 cm deep furrows, made at the interval of 20-30 cm.
- Seeds are very small therefore mixed with sands/ash at the ratio of 1:40 for sowing.
- About 1.5 kg seeds required for one hectare cultivation.
- Improved variety: 'Vallary' released by CIMAP (Lucknow, India).





Chamomile cultivtion by direct seed sowing at Sarlahi

C. Management practices

- Weeding: 3 to 5 times per year.
- Irrigation: 5- 6 irrigation per year.
- No serious pests and diseases. However, black bean aphids (*Aphis febae*), flower shedders (*Nysius minor*) and defoliators (*Anthographis chryson*) may damage the crops.
- Use mainly organic methods to control these pests and diseases. Uproot and burn the infested plants.
- Harvesting of flowers: 4-5 times harvesting is done generally at the interval of 2 weeks by plucking the flower or harvesting about 7-10 cm below from the flowers.
- Flowers during February-April.
- Production: about 6,000 kg fresh flowers (1,000-1,500 kg dry flowers) per hectare and 150-200 kg seeds/ha.
- High moisture content (70-80%) therefore needs to dry in open air prior to distillation.
- Steam distillation provides 0.3 to 1.3% oil yield; 2-3 kg/ha.
- Oil needs to bottle in color glass, avoid direct sun light.
- Nepalese products contain low amount of chamazulene (0.6-0.9%) compared to European cultivation (2-4%).

D. Uses

distillation

- To prepare cosmetics and herbal tea. Essential oil is useful to flavor various beverages, confectionery, ice-cream, bakery items, chewing gum, cosmetics, cream, powder, body lotions, shampoo and perfumery etc..
- Considered useful in chest colds, sore throats, gum inflammation, anxiety, insomnia, psoriasis, acne and eczema.
- Royalty: not mentioned in Forest Regulations, 1995.
- Market price: NRs. 25,000 per kilogram by HPPCL in September 2013. But it has increased by 20% (NRs. 30,000) in September, 2014. Mainly exported to India and Europe. Nepal produces about 1.5 to 2 tons chamomile oil annually.



Chamomile tea, very popular in Europe and the USA

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From top: i) cultivation of chamomile, ii) flower plucking by local

women, iii) harvested and partly unharvested Chamomile farms

and iv) collection of the harvested chamomile flowers before the



Local Name: CitronellaEnglish Name: CitronellaBotanical Name: Cymbopogan witerianus JowittFamily: Poaceae/Gramineae

9. Citronella (Cymbopogan witerianus Jowitt)



A. General information

- Perennial aromatic herb/grass, up to 2 m tall.
- Long slender sugarcane like leaf (size: 1 m long and 1.5 cm wide).
- Reddish sheath at the node.
- Exotic species, mainly cultivated in lowland terai.
- Commercial cultivation started in Dhanusha, Sarlahi, Bara, Nawalparasi, Rupandehi, Dang and Banke districts of Nepal.
- Few private companies such as 'Shambala Herbal' and 'Male International' operate their distillation plants in Sarlahi and other districts in Nepal.

B. Cultivation practices

- 🌕 Require abundant sunshine and high humidity.
- Sandy loam soil, pH range: 5.0-7.0 preferred.
- Mainly from the slips, splitting the clumps of the age 6-12 months.
- Trimmed off fibrous roots and leaves at 30 cm height before planting.
- Can be grown up to 50 slips from one year old clump.
- Soil preparation is needed sufficient weeks prior to cultivation.
- Add about 10 tons of compost manure and plough.
- Slips with 2-3 roots from mother plant.



A local farmer adding the cowdung manure during soil preparation in Charpala CF, Butwal-14, Rupandehi



Citronella seedlings

- Grass cut at the height of 20-25 cm prior to planting.
- Plant 1-2 slips in the 10 cm deep hole.
- Do not allow root bending.
- Plantation is done during monsoon (May-June).
- Spacing: 40 cm x 50 cm. Requires 50,000 slips for cultivating one hectare land.
- 问 Survival: 70-90%.
- Varieties: Jorhat, Jalpallavi, Java-2, Manjusha, Mandakini.

C. Management practices

- Needs regular irrigation, but no water stagnation.
- Initial weeding (2 times) at the interval of 20-25 days. Thenafter it is done as per the need.
- Mulching (residues after distillation) between rows to control weeds and water evaporation.
- Citronella grass harvesting begins after 4 months of plantation. Pulled out the citronella stumps and recultivate the area by new slips after 4 years.



Distillation plant at Sarlahi established by private compnay

- Grass harvesting can be done 4-5 times in a year.
- Grass harvest at the height of 15 cm, preferably in the morning.
- Wilt harvested grass immediately for 12-24 hours.
- Cutting the grasses into small pieces produces higher oil yield (by 10-15%).
- Distillation: maximum 3 hours, prolonged distillation lowers oil quality.
- Production: 20-30 tons/ha/ year of wilted herbs.
- Oil content: about 0.8 % (Oil production: 80 to 100 kg/ha/ year).

D) Pests and disease

- Leaf blight by Carbularia eragrostidis,
- Control: Carbendazim (Bavistin at 1.0g/liter) followed by Benlate 50 @0.2% at 10 days interval,
- Yellowing and crinkling disease (due to mites),
- Control: Furadan @ 20 kg/ha or by spraying 0.5 % Dimethoate.

E. Uses

- Increasing international market; global demand: ~7000 tons/year.
- Scented leaves and oil, dried and powdered leaves used in tea, soups, curries. Also, used in manufacturing chocolate, cosmetic, perfume, creams, lotions, soap, detergent, washing powder, mosquito repellent etc.
- Essential oil yields geraniol (40.06%), citronellal (27.44%) and citronellol (10.45%) and such others.



Bottled Citronella oil

Royalty: NRs. 1/kg of leaves. Oil price: NRs. 1,100/kg in September, 2013 (HPPCL). But, the price has increased by over 35% reaching to NRs. 1,500/kg in September, 2014. Mostly exported to India and Europe.


Local Name	:	Harro, Jangali Harro, Thulo Harro,
		Harara
English Name	:	Chebulic myrobalan, Black myrobalan
Botanical Name	:	Terminalia chebula Retz.
Family	:	Combretaceae

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Harro leaves and fruits (Source: Internet)

A. General information

- Moderate sized tree, 20-30 m tall, found in Terai and Bhabar area.
- Simple leaves, opposite, 10-20 cm long and 5-8 cm broad, rounded or cordate.
- Flower yellowish white in terminal spikes.
- Orupe fruits, yellowish or brownish orange, 3-6 cm long.
- Flowering: April-May. Fruit: November to February.
- Distribution at the elevation of 150-1100 m in eastern and central Terai and Bhabar areas, associated with Sal and Barro.

B. Cultivation practices

- Output and the second secon
- Propagation by seeds and branch cutting.
- Seed collection during January-February. One kilogram contains about 500-600 fruits.
- Warm water pre-treatment for the seeds for 2 days prior to sowing.
- Need to sow in raised bed.
- Germination starts in about 15 to 20 days.
- Germination capacity: up to 75%, seed viability: up to 1 year.
- Or Transplanted into large size polythene bag after one month of germination.
- Out coming out of the polythene bag needs to be regularly pruned.
- By branch cutting: about one year old branch (January-February).
- Thumb size branch with 3-4 nodes cut and dip into root hormone prior to planting into nursery.
- One year old seedling planted in well prepared soil.
- Plantation: at 3-5 meter spacing; in 30 cm broad and 45 cm deep pit, filled with well decomposed manure.



Farmers preparing soil for raising Harro seedlings in nursery at Makwanpur

C. Management practices

- Harro tree needs to be protected in natural forests.
- It should not be removed during cleaning and tending operations in community forests.
- Weeding and cleaning to other unwanted species should be done.
- Fruits are collected from the cleaned ground and dried immediate after.



Poor quality Harro fruits, infected with Fungus, due to improper drying

- Aware local community forestry user group (CFUG) about its importance, protection measures and required management practices.
- Regular weeding and irrigation is recommended for better establishment of the plantation Plantation should be established on well drained soils.

D. Uses



Well dried Harro fruits

Market price: Harro is being sold in local market at NRs. 80 per kilogram. Various Ayurvedic companies such as Singha Durbar Vaidhya Khana, Dabur Nepal, Gorkha Ayurved Company buy the dry Harro fruits in Nepal. Main ingredients of the 'Triphala' churna, used as carminative and tonic. Very useful in curing the diseases of piles, cold, spleen and strengthening brain, eye and gums.

Royalty: NRs. 2 per kilogram (fruit).



'Triphala' churna made by mixing Harro, Barro and Amala (Source: Dabur Nepal)



Local Name: Kurilo, SatabariEnglish Name: AsparagusBotanical Name: Asparagus racemosus Willd.Family: Liliaceae

11. Kurilo, Satabari (Asparagus racemosus Willd.)



Area (SPA) at Jiteshwori CF, Butwal-15, Rupandehi

A. General information

- Perennial evergreen shrubby plant, semi climber, 50 to 150 cm height.
- Leaves: needle like phylloclades, uniform and shiny green in clusters of 2-6, and 1-2 cm length. Flowers: minute, white on spiky stems. Fruit: globular berry, greenish, turned to red and finally black when matured/ripe.
- Wild asparagus are relatively darker, thicker and shorter compared to hybrid asparagus; different varieties developed for the production of vegetable (shoots).
- Distribution: tropical to subtropical region, distributed in Terai and Siwalik regions of the country, used to be intensively harvested from wild in Makwanpur, Salyan, Arghakhanchi, Pyuthan, Surkhet districts of Nepal.



- Ontive to Nepal, India, Australia, Africa.
- Elevation: 150 m to 2200 m asl.

Fresh tubers of 27 kg from local Asparagus (left) and hybrid (right)

Racemosus is one of 4 species of Asparagus genus found in Nepal.

B. Nursery

- Propagation by seed is most reliable and practical.
- Seed collection: February to March.
- Ensure good quality, genetically diverse seeds for large scale cultivation.
- Seed sowing: February- March in nursery.
- Seed treatment: soaking in mild hot water up to 24 hours before sowing in the bed.
- Germination 70 to 90% if seeds are fresh and properly treated.
- Plantation of both naked root seedlings or from polythene bags are in practice. Naked root seedlings are preferred for long distance transport.



Ripe asparagus fruits, seedling raised in DFO nursery, Rupandehi and naked root seedling prepared for transportation (Sarlahi)

C. Cultivation practices

- 5-6 month seedlings bearing 8-10 tubers are best for cultivation (plantation).
- Adding organic manure increases yield.
- Spacing: 80 cm X 90 cm.
- Tuber collection is done during February-March.
- Production: 5 to 10 kg per plant (fresh weight).
 - Dryness 7:1 in the local Kurilo (green root: dry root ratio).

D. Management practices

Soil preparation for cultivation of Asparagus at Charpala CF, Butwal-14, Rupandehi (up), Three years old wild asparagus cultivated in Lilaban, Phaparbari-2, Makwanpur (down)

- Regular irrigation is needed. Water stagnation cause tuber decay.
- Weeding should be done regularly, slight soil loosening during weeding with trowel (khurpi) is beneficial.
- Remove the diseased plants.
- Pick up the ripe fruits after 2 years, depulp, dry and store in air tight plastic.



Watering individual Asparagus seedling in Jiteshwari CF, Butwal-15.

Seed production areas (SPAs) have been established for the first time in Nepal at Sarlahi, Makwanpur and Rupandehi districts of Nepal to produce good quality and genetically diverse seeds from wild Asparagus.



Six months old Asparagus in Seed Production Area (SPA) at Jiteshwori CF, Butwal-15.

E. Processing

- Dig the soil by spade, collect the roots (tubers) and remove the soil.
- Root needs to be gently boiled for 2-3 hours in drum covered by jute sacks.

Peel the outer bark without damaging the inner tubers.

- Ory under sunlight for 2-3 days.
- Grading of the dry Asparagus roots needs to be done based on its color, size and shape.
- Remove black color roots. It can be used to feed milking cows/buffaloes.
- Pack completely dry (seasoned) roots in the sacks.







From top: i) Boiling asparagus roots in drum, ii) Peeling of the root bark by local people, iii) peeled off roots, iv) sundrying of the peeled roots, v) testing the proper dryness of roots, vi) temporary storage (at Chaugheda, Makwanpur).

F. Uses





Good quality dry roots/tubers (top), weighting for the export (down)

- Nutritive tonic, rejuvenative, aphrodisiac, galactogogue, laxative, antispasmodic, antacid, diuretic, demulcent properties.
- Tubers are nutritious, lactatic to milking cattle and human being also.
- Used in the treatment of dyspepsia, constipation, stomach spasms, fever, nervousness and insomnia.
- Important for the preparation of traditional and ayurvedic medicines in Nepal and India.
- Useful for infertility, decreased libido, vulnerable miscarriage, menopause, leucorrhea for women.
- Good quality Asparagus roots are being purchased by Dabur Nepal (Bara), Singha Durbar Vaidya Khana (Kathmandu) and Patanjali Yogpeeth (Haridwar, India). Furthermore, huge quantity of Asparagus roots used to be exported to Delhi, India.
- Royalty: NRs. 5 per kilogram of tubers.
- Market price: NRs.230- 560/Kg for tuber. NRs. 230/kg (Kathmandu), NRs. 300/kg (Nepalgunj) and NRs. 560 (Delhi) (July, 2014, ANSAB).



The nutritive tonic, Chyawanparash is made by mixing over 40 different herbal ingredients. Asparagus root is one of the main ingredients of the Dabur Chyawanparash (Source: Dabur Nepal)



Local Name	:	Lemon grass, Pirheghaans,
		Kagatighaans
English Name	:	Lemon grass
Botanical Name	:	Cymbopogan citratus (DC) Stapf.
		Cymbopogon flexuosus (Nees ex.
		Steud.) Watson
Family	:	Poaceae/Gramineae

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12. Lemon grass (Cymbopogan citratus (DC) Stapf.)



A. General information

- Aromatic perennial grass, scented like lemon, height reaches up to 3 m.
- Long slender hairy leaf (size 130 cm long; 1.8-2.0 cm broad).
- Flower: grayish green, inflorescence; about 30 cm long.
- Over 80 species under this genus (worldwide distribution).
- Distribution: naturally distributed in tropical and sub tropical regions of Nepal, India, Philippines, Myanmar and Thailand. Started commercial cultivation in Sarlahi, Bara, Parsa, Chitwan, Banke, Bardia districts of Nepal.
- Cultivation possible in the elevation range of 100 to 1200 m asl.

B. Cultivation practices

From seeds

- Very small seeds, sown by mixing with ash (1/10 ratio) at the row to row distance of 15 cm. About 25 kg seed is required for 1 hectare cultivation.
- Mostly directly sown in the wellprepared fields to save time and cost.
- Transplant: 2-3 months old seedling; spacing: 50 cm x 70 cm (for nursery raised seedlings).



Soil preparation for Lemon grass cultivation



Lemon grass inflorescence and naked root seedlings

From slips

- Slips with 2-3 roots from mother plant, about 50 slips can be made from 1 year old plant.
- Grass cut at the height of 20-25 cm prior to planting.
- Prepared by ploughing 2-3 times the soil during May-June.
- Plant 1-2 slips in 10 cm deep hole,
- Plantation is done during monsoon (July-August).

C. Management practices

- Plantation needs regular irrigation.
- Compost manure is added at the rate of 2 tons per hectare.
- Sometimes infested by caterpillar.
- Grass harvesting at the interval of 3 months.
- Completely harvest the grass at the height of 15 cm.
- Oil content: 0.3 to 0.5% of the grass.



Large scale cultivation of Lemon grass in Laxmi Leasehold Forest, Sarlahi

D. Uses

- International market for the organic essential oils.
- Essential oil used for manufacturing chocolates, soap, pesticides, perfume and insect repellent.
- Used to make herbal tea.
- Royalty: NRs 1/kg of leaves.
- Oil price: NRs. 1500/kg in September, 2013 (HPPCL). The price has increased by 16.6% reaching to NRs. 1,700 per kilogram in September, 2014 by government owned Herbs Production and Processing Company Limited (HPPCL).



Bottled lemon grass oil



Distillation plant at Bihani CF, Murtiya, Sarlahi and Cinthol soap made by Indian company using Lemongrass oil



Local Name	:	Mentha, Pudinaa, Patena, Baabaree
English Name	:	Mentha, Mint, Japanese mint, Spearmint
Botanical Name	:	Mentha arvensis Linn.
Family	:	Lamiaceae/Labiatae

13. Mentha (Mentha arvensis Linn.)

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Mentha plant with flowers (Source: internet)

- 0 Distribution: widely cultivated in Bara. It can be grown up to 1000 m asl in Nepal, found in Nepal, India, China, Thailand, Angola, South Africa, Australia, Brazil etc. Local species of the Mentha, called Pudina, has been distributed in damp sites of Terai and Mid-hills of Nepal.
- Other species such as Mentha piperata Linn., Mentha spicata Linn. are also in cultivation in Nepal.

B. Cultivation practices

- Cultivation: lowland Terai to Mid-hills of Nepal.
- Propagation by seeds is unreliable and difficult. Therefore, it is usually propagated by root suckers and tissue culture.
- Propagated by sucker in January-February. It is very effective and efficient method.
- Output Section 1.2 Notes and the section of the cultivation.



Preparing root suckers for cultivation (left) and mentha roots for tranplant (right) in Tamagadhi, Bara

- About 5-7 cm long suckers with 3 nodes planted at the depth of 5-10 cm in well prepared soils.
- Starts sprouting in 2-3 week later.
- Spacing: 35 cm x 40 cm.
- About 350 Kg sucker required for cultivation in one hectare land.
- Variety: MAS-1, Kalka (Hyb-77), EC-41911 developed by CIMAP Lucknow (India).

C. Management practices



- Needs good quantity of fertilizers mainly Nitrogen (~100 kg), Phosphorus (50 kg) and Potassium (50 kg) per hectare.
- Organic manure or well decomposed cow dung manure recommended.
- Regular weeding (up to two times/month) and irrigation (at the interval of 23-30 days) recommended.
- Harvesting: after June is preferred. It recommended to harvest plants above 5 cm from the ground.
- Cutting can be done 3 to 4 times in a year. It yields 20 tons grasses/hectare/ year.

D. Uses

- Spices, flavoring and natural seasoning.
- Aromatic, stimulant, stomachic, carminative; used for the treatment of nausea, diarrhea, cough, headache, stress, vomiting and gastric.
- Tender leaves and stems used in bronchitis, asthma, fever and urinary problem.
- The menthol mainly used for the preparation of various food items, pickles, drinks, desserts, candies, chewing gum, mouth fresheners, cosmetics, perfumes, tooth pastes, soap, detergents, insect repellent etc.
- Essential oil: it constitutes about 60-70% menthol, 7-10% menthone and others.
- Boyalty: NRs. 2/kg (plants).
- Market: mainly exported to India and Europe.
- Market price: NRs. 1,800 / kg (HPPCL, September 2013). The HPPCL has increased oil price by about 11% reaching to NRs. 2,000/kg in September, 2014.



Mentha juice (up) and chocalate (down) (Source: internet)



Local Name	:	Neem, Nim
English Name	:	Margosa tree, Neem tree
Botanical Name	:	Azadirachta indica A. Juss
		(Syn. Melia azadirachta L.)
Family	:	Meliaceae

14. Neem (Azadirachta indica A. Juss)



Five years old Neem tree at Forestry Complex, Babarmahal, Kathmandu, Nepal

A. General information

- Evergreen tree with stout stem, reaching up to 20 meter height. It can survive up to 200 years.
- Fast growing tree, may reach 10-12 m crown diameter.
- Very well known tree of medicinal use to almost every Nepali and Indians, mostly found in the home yard.
- Pinnately compound leaves, 20-40 cm long, dark green, serrated leaf margins.
- Flowers: small, white in short axillary bunches, about 150-250 individual flowers of 1 cm diameter (5 petals) forms an inflorescence.
- Fruits: one seeded, 1-2 cm long, green (unripe) turned yellow (ripe), fruiting starts from August.
- Deep tap root with extensive lateral spreading, root suckers occur.
- Distribution: Terai, Siwaliks, Inner Terai and Midhills, mostly at public land, roadside plantation and farmyard, up to 900 m asl.
- International Neem Network was established in March, 1994 with the technical and financial support of many organizations including FAO and DANIDA.



Neem fruits and leaves in September, 2014 at Babarmahal, Kathmandu

B. Cultivation practices

By seeds and root/stem cutting.

Raising seedlings in Nursery

- The international provenance trial for Neem was established in 1996 from the seeds of 27 provenances of 20 countries and 3 continents.
- Seed collection: July-August, mature, green-yellow fruit, collect directly from tree, depulping immediately.
- Seeds need to be collected from at least 25 trees, maintaining the distance of at least 50 m from tree to tree, to reduce the family structures and inbreeding depression.
- A total of 3,000-6,000 seeds per kilogram.
- Recalcitrant seeds, very short seed viability, very poor storability.



Neem seedling raised at DFO nursery, Rupandehi

- Sowing within 7 days of seed collection.
- Sow in the nursery at the spacing of 3 cm x 15 cm.
- Transplant 3-5 leaved plantlets into polythene bag.
- Keep seedling in polybag up to 4 months (usual practice) and up to 12 months (advanced practice in recent days) prior to planting in the field.
- Regular root pruning is suggested for the seedling kept for longer period in polythene bag.
- Bark/shoot cutting: 3 cm diameter, 20-25 cm long root or stem cut during January-February, and transplant into nursery.
- After 4-5 months, it can be planted in the field.
- Plantation: 5 m x 5 m spacing, requires 440 seedlings (including 10% for casualty replacement) to cultivate one hectare land.
- Pit size: 45 cm x 30 cm x 30 cm (filled with compost).



Matured Neem tree inside DFO compound, Rupandehi

C. Management practices

- It can be grown without any intensive management practices. Seeds dispersed by birds and bats contribute in natural regeneration.
- Requires two times weeding in the first year and one time per year afterwards.
- Irrigate the cultivation area as per the soil time, climate and need.
- Protect the plants from browsing/grazing animals.
- Starts fruiting after 5 years of plantation.
- Production: up to 350 kg leaves and 50 kg fruits per mature tree.
- Leaves trimming can be done during Spring.
- About 1/3 portion of the tree should be left with green leaves while harvesting leaves.
- Generally pest free due to the presence of Azadirachtin, However, some plantations have been badly damaged by a scale insect (*Aonidiella orientalis*) in Africa and in India.
- Biological/mechanical control methods are suggested for insect control.

D. Uses

- Parts used: leaves, bark, flowers, fruits, roots etc.
- Popular tree among all classes of people for various uses, such as ornamental plants in garden and homeyards, himalava
- for shade along the roadside plantation.
- brush (Datiwan), pulverized leaves are used as antiseptic to heal wounds, skin boils and even to treat psoriasis.



Face wash (left) and medicines made by Neem (Source: internet)

Azadirachtin and other chemical extracts can be used as the insecticides.

- Insect repellent, considered very hygienic, normally called that if a person stay few hours every day under the shade of the Neem tree, most of the diseases will disappear.
- Dried stem bark, leaves and root bark can be used as drug. It is astringent, antihelminthes and anti-periodic; could be used to prepare medicines for the problems of eye, kidney, jaundice, skin diseases and boils.
- Some components of oil are useful to prepare contraceptives.
- it is used to prepare oil, toothpaste, soap, shampoo, cosmetics etc.
- Goyalty: NRs. 5/kg (bark) and NRs. 1 (seeds).
- Market: leaves and branchlet locally sold. Leaves: NRs. 20-40/kg for dry leaves in Nepal.



Neem branchlets are mainly used as the tooth brush directly by the rural people and religious persons in Nepal and India (Source: Dreamstime.com)



Local Name	:	Palmarosa, Pamarosa
English Name	:	Palmarosa, Rosagram
Botanical Name	:	Cymbopogon martinii (Roxb.) Watson
Family	:	Poaceae/Gramineae

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15. Palmarosa (Cymbopogon martinii (Roxb.)Watson)



Palmarosa cultivation in Sarlahi

B. Cultivation practices

- Hardy plant; can grow in poor and marginal soil.
- Well drained loamy soils with pH in the range of 6.0 to 7.0.
- Well ploughed, harrowed to a fine tilth prior to onset of monsoon.
- Mix well decomposed farmyard manure (5-10 tons/ ha) during soil preparation.
- Propagation by nursery raised seedlings/slips from one year old plants.
- Raised bed preparation in April-May.
- Sow the seeds by mixing with fine sands or ash in the ratio of 1:10.
- Sow in the line of about 15-20 cm apart, mulching is recommended.
- Seed requirement: 2.5 kg/hectare.
- Plantation is normally done from established seedlings of 15 cm height.
- Plantation in rows at the distance of 30 cm x 30 cm to 60 cm x 60 cm.
- Direct seed sowing in the field.



Soil preparation for the cultivation of Palmarosa in Rupandehi

Slips segregated from one year old mother plant.

A. General information

to 3 m height.

cm long, reddish.

Aromatic, perennial grass, reaches up

Leaves: linear, lanceolate, 10-90 cm long and 1-3 cm broad, panicles 10-30

Inflorescence: 15-30 cm long, reddish. Distribution: mainly cultivated in lowlands of Terai. Commercial cultivation has been started in Sarlahi, Bara, Nawalparasi, Rupandehi, Banke and Bardia districts of Nepal.

- Trimmed slips at the height of 20 cm before to plantation.
- Plant 1-2 numbers of trimmed slip in the 10 cm deep hole.
- Variety: 'Trishna', 'Tripti' and 'PRC-1' by CIMAP (Lucknow, India).
- 'Trishna' produces up to 40% more oil and 93% extra Geraniol content.





- Manure: mainly farmyard manure/organic manure (5-10 tons/ha).
- Mix 10 to 20 kg Zinc (micronutrient)/hectare to increase oil yield.
- Weeding: regular weeding.
- Irrigation: 5-7 times, at the interval of 15-20 days.
- Casualty replacement or gap filling of dead plants.

First harvesting after 4 months of cultivation, mainly during October-November, 3-5 times grass cutting in a year, commercial harvesting up to 5 years.

- Harvesting at the height of 15-20 cm with sharp sickle.
- Production: 15-20 tons grass/ha/year.

Palmarosa cultivation (up) and

harvesting (down) in Laxmi Leasehold Forest, Sarlahi

- Wilt in open space, well aerated areas under sun light for 24 hours before distillation, steam distillation in stainless steel vault is recommended.
- Distillation period: 3-4 hours. Production: 0.3-0.4% oil from grass and 50-60 kg oil/ha/year.
- Oil is volatile. Therefore needs to well packaging and storage in color bottles in safe and cool room.



Transporting harvested Palmarosa grass by tractor to the distillation plant established by Male International in Sarlahi

D. Uses

- Useful parts: whole plants.
- Mainly used for the production of the essential oil.
- leaves: aromatic, carminative, diuretic, cardio tonic and febrifuge properties.
- ۲ Essential oil used as ingredients in the production of good quality soap, tobacco, sweets, biscuit and lotions. Used to create appetite, improve digestion, treatment of cough, fever and skin diseases.

Market price: NRs. 2,520/kg (HPPCL,

Royalty: NRs. 1/kg (leaves).



September, 2013). This price has been increased to NRs. 3,000 (by 19%) in September, 2014 by HPPCL. Oil is mainly exported to India and Europe.



Local Name	:	Patchauli, Pachauli, Patchouli
English Name	:	Patchouli
Botanical Nam	e :	Pogostemon cablin (Blanco) Benth
		(Synonym: P. patchouli Pellet.)
Family	:	Lamiaceae/Labiatae

16. Patchauli (Pogostemon cablin (Blanco) Benth)



Patchauli plant growing in Sarlahi

- Distribution: exotic species, mainly found in Philippines, Malaysia, Indonesia, Madagascar, Paraguay and Singapore. Locally planted in Sarlahi, Nawalparasi and Rupandehi districts of Nepal.
- Cultivation can be done at the altitude of 100 to 1000 m asl.

B. Cultivation practices

- Improved varieties: 'Johore', 'Singapore', 'Indonesia" etc. Johore produces best quality oil.
- Can be grown in wide soil types, but flourish in fertile soil with pH 5.5 to 8.0.
- Cannot grow in frost prone areas, prefer warm and humid climate, shade bearer.



Small scale cultivation of Patchauli in Bhaktipur, Sarlahi

Leaves: simple, ovate to oblong ovate, coarse, light yellowish, serrated

A. General information

Aromatic, perennial, exotic

1 m.

margin, shape and size similar to that of 'Rudhilo' plant. It has glands on dorsal surface.

herbaceous plant, reaches the height of

Flower: January to February, seed setting is very rare.



Patchauli leaf and flowers (Source: internet)



Farmers working in Patchauli Nursery in Sarlahi

- Plough the soil 3-4 times during May-June by plough or tractor. Mix Furadan 20-30 kg/ha during the soil preparation to control nematodes.
- Stem cutting is the best method for propagation. Cut the stem at the size of 10-15 cm with 3-4 nodes, from 9-12 months old and healthy mother plant.

- Plant the cut stem either in nursery bed or polythene bag by dipping into the root hormones such as ROOTEX, Root-on etc.
- Output after 3-4 months raised in Nursery. Plantation is done during the late monsoon (August- September) at the spacing of 60 cm x 90 cm.

C. Management practices



- Weeding is very important within 2 months of the plantation. The plant should be protected from the weeds especially in the initial period.
- Regular irrigation is required but the cultivation area should have well drainage facilities.
- Should be protected from the animal trampling.
- Root-knot nematodes (Meloidogyne incogonita and M. hapla) causes root galls called root-knots, may cause stunted plant growth and wilting. Use healthy propagules, nematicides and scientific management practices to control nematodes.

D. Uses

- Antidepressant, antiseptic, astringent, aphrodisiac, deodorant and sedative properties.
- Boost energy and immune system, inhibits fungal growth, soothes inflammation etc.
- Patchauli oils used in making soaps, cosmetics, scented sticks, perfumery, energy drinks etc. Further, it is used in treating acne, eczema, dermatitis and fatigue.
- Useful for the treatment of other skin diseases, frigidity, hair care and dandruff etc.
- Royalty: not mentioned in Forest Regulations, 1995.

markets for Nepalese products.



Market: India and Germany are main Few products from Patchouli (Source: internet)

We have very high demands but extremely low supply of Patchauli oil.



Local Name: Pipala, PipaliEnglish Name: Long pepper, Dried catkinBotanical Name: Piper longum Linn.Family: Piperaceae

16. Pipala (Piper longum Linn.)



Pipala found in the Lalbandi forest at Sarlahi

- leaves: broadly lanceolate or cordate, arranged alternatively.
- Catkin: inflorescence, self pollinating, found mono-sexual to hermaphrodites flowering varieties. Fruits: single seeded berry.
- It is a government prioritized MAP species in Nepal.

A. General information

Considered as the king of spices. Slender aromatic climber with perennial woody roots, grows over 10 m length, vines branch horizontally from nodes. It has three types of aerial shoot. They are terminal shoot, runner shoots and fruit bearing lateral branches. Seems like epiphyte sometimes on tree and branches.

- Pipala climbing a old tree
- Distribution: 100 to 1000 m asl in Eastern Terai Nepal. It is found in India, Srilanka, Bhutan, Malaysia and Nepal.
- Garage Favor humid tropics with adequate rainfall and humidity.

B. Cultivation practices

- Cultivation: lowland Terai to Mid-hills of Nepal.
- Majority of cultivated peppers are monoecious.
- Over 75 cultivars developed and released for cultivation in India.
- 🧼 Major cultivars: Kottamandan, Narayakkodi, Neelamundi, Uddagare etc.
- Fruits turns into grey black when ripen during December-February.
- Propagation can be done by seeds, secondary branches and sucker with nodes.



Pipala seedlings produced at nursery



at Joshi Nursery, Hetauda

Propagation by seeds

- It is conventional method but not in much practice at present. It is a lengthy process. Germination takes place after 30 days of seed sowing. Transplantation of six months old seedling is normally done in the field.
- Propagated by cutting runner shoots of 15-22 cm size, 2-3 nodes (February-March), planted either in nursery or directly into the polythene bag.
- Ready for plantation in June-July.
- it is a shade bearer species therefore needs to be protected from direct sun.
- Spacing: 1.5 m x 1.5 m. Apply manure in proper quantity in time.

C. Management practices



- No water logging sites. It prefers the site full of organic materials.
- Pruning of the unwanted terminal shoots, hanging shoots and growing vines, facilitates vigorous growth of fruit yielding branches.
- Frequent watering in the first year.
- Fertilizers: about 150 gram Nitrogen, 50 gram phosphate and 270 gram potassium per vine per year is optimum in two doses.
- Provide firm support for its growth and climbing.

Pipala stem and fruits (Source: internet) Foot rot (wilt disease) caused by *Phytophthora capsia*- most destructive; and stunt disease.

- Removal of diseased plants and promote adequate drainage to control.
- Beetle (Longitarsus nigripennis), top shoot borer (Cydia hemidoxa), leaf gall thrips (Liothrips karnya). Apply biological and chemical control measures, such as integrated pest management (IPM).
- Starts yielding after 3 to 4 years after cultivation, attains full bearings in 7 to 8 years, starts declining after 20 to 25 years.
- Flowers in May-June.
- Spikes are harvested when mature and turn into grey blackish color.
- Spike harvesting: winter (November-February),
- Dry the harvested spikes in mild sunlight for 4 to 6 days until the outer skins become black and shrunken.
- Vield: 250 to 450 kilogram per hectare is usually produced in mono-crop cultivation in South Asia.
D. Uses

- Mainly in spices. It is one of the oldest classic spices and has been traded for many centuries.
- Known for piperine, which is responsible for sharp taste, that heals respiratory problem.
- Roots, fruits, leaves and stems also used locally.
- Seeds contain 1.0-2.5% essential oil, 5-9% piperine, 1% chavicine, 8% peperidine, 6-8% fatty oils, 0.5% resin, 22-42% starch and 8-13% water (Naturland, 2001).
- Useful in cough, bronchitis, asthma, abdominal pain and disease of spleen.
- Analgesic in muscular pain and inflammation.
- Official export of the Pipala was less than 5,000 kg/year from Nepal.
- local states and the second states and the s
- Market price: NRs. 525 (Kathmandu), NRs. 500 (Nepalgunj), NRs. 1,040 (Delhi)
 Aurvedic medicine from Pipala fruits (Source: Internet) (ANSAB, July 2014).





Annual average export of Pipala (Quantity in kilogram and revenue in Nepalese Rupees) from Nepal in last 8 years (Source: DoF, unpublished)



Local Name	:	Saijan, Sahijan, Shitalchini
English Name	:	Moringa, Drumstick tree, Ben Tree
Botanical Name	:	Moringa oleifera Lam.
		Moringa pterygosperma Gaertn.
Family	:	Moringaceae

18. Saijan (Moringa oleifera Lam.)

A. General information



Saijan plant in at home yard in Chisapani, Hetauda

- About 13 species is found under this genus. It is one important species under monogeneric family.
- Fast growing, perennial tree, maximum height reaches 10-12 m tall and diameter at breast height is 20-40 cm.
- Short straight stem, extended branches, umbrella shaped canopy.
- Leaves: compound, alternate, twice or trifoliate (at the tip), 30-60 cm long, petiolated, 8-10 pairs of pinnate leaflets, oppositely arranged, elliptic or obovate, 1-2 cm long.
- Flowers: white/cream colored, yellow dotted at the base, 2.5 cm wide, fragrant.
- Pods: 3 lobed pods, 30-75 cm long, 5-30 seeds per pod. Seeds are round with a brownish, permeable and winged hull.
- Found in subtropical region. This species is native to the part of Asian and African countries.
- Distribution: cultivated mainly in Siraha, Sapatari, Dhanusha, Sarlahi, Bara, Makwanpur, Rupandehi, Kapilvastu and Banke districts of Nepal.

B. Cultivation practices

- Light demander and drought resistant tree, but cannot tolerate cold and long duration frost.
- Cultivation can done from stem cutting and seeds (direct sowing or by planting nursery raised seedling).
- Direct sowing: sow 2-3 seeds per hole in raised bed at the distance of 3 to 5 meters. No or very little pre-treatment is done for seeds. Soaking seeds overnight into the water prior to planting gives better germination result. Seed viability up to 80%.



Saijan seeds and its sowing (Source: WikiHow)

Institute of forestry (IOF), Pokhara has been successfully raising the seedlings by sowing two Moringa seeds into a polythene bag without any pretreatment. Needs to remove the weaker seedling by keeping the strong and stout one after 2-3 weeks of germination.

Planting the nursery raised seedlings:

About 50 cm tall plants will be transplanted into the polythene bag filled with 3 parts forest soil and one part sand.



- Select the branch of 5-7 cm diameter, at the length of 60 cm to 80 cm from at least one year old plant.
- The cut stem can be directly planted in the field by dipping into rooting hormones.
- Plantation developed by stem cutting grows faster but the roots used to be weaker and can be damaged by wind.
- Improved variety of Moringa i.e. PKM-1 had been developed in India.
- For the first time in Nepal, the Institute of Forestry (IOF), Pokhara has started applied research on the cultivation potential and growth of the Moringa. The



Moringa seedlings in IOF nursery (Courtesy: Krishna Raj Tiwari)



Saijan raised from stem cut (Courtesy: Dr. Krishna Raj Tiwari)

cultivation of the species raised in Nursery from Nepalese and Indian seed sources and from stem cutting has been done in Halkhoriya Collaborative Forest (Bara), Leasehold Forests (Makwanpur), Charpala CF (Rupandehi),



(Courtesy: Suman Bhattarai, IOF)

Tiprikot CF (Kaski), and in private lands (in Chitwan and Kawasoti, Nawalparasi). The research has been financially supported by Multistakeholders Forestry Programme (MSFP).

- The seeds have been collected from various provenances from Nepal and mixed in the concept of the progeny trials to recommend the best provenance for the mass cultivation in future.
- Mr. Hari Prasad Bhattarai has been doing Moringa cultivation, in relatively large scale in private land, at Sainamaina area of Rupandehi district.

C. Management practices

- Fast growing tree, can grow 3-4 m per year.
- Fruiting starts after one year of the plantation, twice a year production of the pods is possible.
- A mature single tree can produce 500-100 pods per year.
- Alley cropping can be done in between the rows of the plantation with other vegetables and fruit species.



Pollarding is needed for maximizing pod production

- Leaf eating hairy caterpillar (*Eupetorate molifera*) may completely devastate the plantation. The caterpillars mostly colonize in the clusters. Mechanical methods of the collection and destroy, sometimes by putting into the kerosene pot, is useful.
- Other insects/pests reported from Indian literatures are aphid (*Aphis caraccivera*), caterpillars (*Tetragonia siva, Metanastia hyrtaca* and *Heliothis armigera*), a scale insect (*Ceroplastodes cajani*) a borer (*Diaxenopsis apomecynoides*), fruit fly (*Glitonia* sp.) and termites. It can be controlled by spraying various insecticides.
- Root rot by Deplodic sp. in water logged areas.
- Pollarding promote branching and increases pod production.
- Proper and sufficient manuring increases pod production by threefold.



Matured Saijan pods and plant (source: wikipedia)



Moringa cultivation research has been conducting, for the first time in Nepal, by Institute of Forestry, Pokhara (Photo courtesy: Suman Bhattarai)

D. Uses

- Useful parts: leaves, flowers, pods, seeds.
- lich in protein, vitamin 'A', vitamin 'B', vitamin 'C' and several minerals.
- Cardiac and circulatory stimulants, possess antitumor, antipyretic, antiepileptic, anti-inflammatory, antiulcer, antispasmodic, diuretic, antihypertensive properties.
- Roots are thermogenic, digestive, carminative, anthelmintic and antiinflammatory. Bark: abortifacient, antifungal and cardiac stimulant. Leaves are rich in vitamin 'A' and 'C'.
- Mainly used as vegetable and fruits, with highest nutritional value, which are very useful in curing liver and spleen diseases, articular pains, tetanus, paralysis and venerable diseases.
- Oil from its seeds are used in foods, perfume and hair care.
- Royalty: not mentioned in Forest Regulations, 1995.
- Markets: pods are mainly sold at local markets for vegetable, at the price of NRs. 80 to 150 per kilogram.



Moringa pods together with other vegetables to be sold at Kathmandu in August, 2014.



Local Name :	Serpagandha, Sarpagandha, Chaandmaruwaa, Pagalbuti
English Name :	Rauvolfia, Serpent wood, Serpentine root
Botanical Name :	Rauvolfia serpentina (L.) Benth.ex Kurz
Family :	Apocynaceae

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19. Serpagandha (Rauvolfia serpentina Benth. ex Kurz)



A. General information

- Evergreen woody shrub, height ranges between 60 and 90 cm.
- Among 30 prioritized MAPs of the country.
- Leaves: whorled, lanceolate or oblanceolate, acute or acuminate, tapering gradually into the petiole, 7-10 cm long and 3-5 cm broad, shiny green.
- Flowers: white or pinkish, many in cyme.

Serpagandha plant with flowers at Sarlahi

- implies Fruit: single or didmous, 1 cm diameter, drupe, purplish black when ripe.
- Roots: prominent, tuberous, usually branched, 0.5 to 3 cm diameter, spread in 40-70 cm deep soil, contains 40-60% root bark, bitter in taste.
- Distribution: 100 to 1200 m. in eastern Nepal, distributed in Nepal, India, Srilanka, Bhutan, Malaysia etc.
- Vulnerable category of IUCN and CITES-II indexed plant species (since 2007). Export has been banned in the raw form. Need to receive permission by Department of Forests for export.

B. Cultivation practices

- Cultivation: lowland Terai to Mid-hills of Nepal.
- Seed collection during August-March.
- Propagation by seeds, root cutting, root stump, stem cutting and tissue culture.



Serpagandha flowers and fruits (left). A farmer working in the Serpagandha cultivation field (right)

- Seed propagation is the best methods for mass cultivation of Serpagandha.
- Seed viability remains 50-60% after 6 months.
- Pre-treatment of seeds by soaking in water (24 hours).
- Seed sown at 2 to 3 cm distance generally in April.
- Seed germination: 30-50%. About 6 Kilogram seeds required for 1 hectare cultivation.
- Seedling ready for plantation in July-August.
- Shoot cutting: 15-22 cm size, 3 nodes (April-May).
- After sprouting (in nursery), transplanted in the polythene bag.
- Site preparation: mix farmyard manure (15-20 tons/ha) during soil preparation.
- Plantation of naked root or seedlings raised in polythene bag.
- Spacing: 40 cm x 50 cm. Seedling required: 55,000/ha (including 10% casualty replacement).
- Improved variety: R.S.-1 (released by Jawaharlal Nehru Agriculture University, India).

C. Management practices

- Regular weeding, cleaning, soil loosening twice of the year.
- Irrigation recommended although it is cultivated as rainfed crop.
- Regular defloration to increase root and shoot growth.
- Seed collection: periodically plucking during August-February.



Weeding in Serpagandha cultivation by local farmer at Ranigunj-8, Sarlahi, Nepal

Root harvesting: after 2-3 years of plantation during December and January thin mathematical and any set of the set of

- of plantation during December and January, thin roots are also collected.
- Due care to keep root intact as it contains larger portion of alkaloids.
- Dry the harvested roots in the shade.
- Production: 0.1 to 0.4 Kg dry roots per plant; 2500-3000 kg roots and 100-200 kg seeds per hectare.



Seeds of Serpagandha

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D. Pests and diseases

- Stunted growth, etiolation and leaf size decrease by nematode.
- Damage to leaves by Pyrallid caterpillar (Glyphodes vertumnalis).
- Drying up the seedling by cutting root collar by Cockchafer grubs (Anomala polita).
- Leaf spot disease by Cercospora rauvolfiae and Alternaria tenuis.

E. Uses

- Parts used: roots, roots with bark and leaves.
- Rich in alkaloids such as serpentine, surpentinine, reserpine, agmaline and many others.
- Known for reserpine that reduces blood pressure.



- Roots of Serpagandha (Source: Department of Plant Resources)
- Roots also used as sedative and hypnotic.
- Useful during labor pain to increase uterine contractions.
- Beneficial in bowels and in fever.
- Also used as the ornamental plant in the garden/office.
- Various stakeholders are involved in export of the Serpagandha items (certificate of origin by Federation of Nepal Chamber of Commerce and Industries (FNCCI), Transit permit by Department of Forests, Product certificate: Department of Plant Resources, Export license by Department of Industries and Export Duty by Custom Offices of Government of Nepal).
- Boyalty: NRs. 20 per kilogram
- Market price: NRs. 200-300 per kilogram (in 2011).



Common Ayurvedic products from Serpagandha (Source: internet)



Local Name	:	Tejpat, Sinkauli, Sinkouli, Taj
English Name	:	Cinnamon
Botanical Name	:	<i>Cinnamomum tamala</i> (BuchHam.) T. Nees and Eberm.
Family	:	Lauraceae

A. General information

- Medium sized (5 to 10 m height); evergreen tree species.
- Out 300 species are found under this genus.
- - One of the oldest known spice species.

20. Tejpat (Cinnamomum tamala Nees and Eberm.)

- Leaves simple, short stalked, lanceolate, 10-15 cm long, 3 conspicuous nearly parallel veins.
- Flowers: pale yellow. Fruits: ovoid, drupe, black, succulent.
- Cinnamomum tree
- Flowering and fruiting: March-April.
- Distribution: tropical to subtropical region.
 - ✓ Distributed mostly in the mid-hills of the country.
 - ✓ Native to Nepal, India, China, Bhutan.
 - ✓ Palpa and Udaypur districts are known for Tejpat production.
 - ✓ *Cinnamomum zeylanicum* (Dalchini) mainly grown in south India and Srilanka.





Six months old Tejpat seedling

B. Cultivation practices

- Both vegetative and sexual propagation possible.
- Seed collection: October November.
- Seed sowing: February March (in nursery).



Tejpat seeds, seedlings grown in DFO nursery and newly planted seedling (clockwise direction)

- Pre-treatment of seeds: one night prior to sowing.
- Seed viability completely lost after 6 months.
- Propagation by shoot cutting (size 15 to 20 cm) during January and February.
- Dipping cut stem into rooting hormone gives good result.
- Plantation: mostly grown up (1 year) seedling planted in July-August.

C. Management practices

- Regular irrigation and 1-2 times weeding every year.
- Leaf collection: after 5 to 10 years during November-April.
- Complete lopping of the foliage is in practice however it is suggested to leave at least 1/3 of leaves without harvesting.
- Life span: 70-80 years.
- Production: 10 to 25 Kg dry leaves per mature tree.
- Bark collection: February to April.
- Shoot borer damages the stems (as seen in the left photo) in Brindaban, Makwanpur. Regular monitoring and



Reddish dust at the bottom of the stem due to the stem borer

apply biological/mechanical methods to control. Bordeux mixture can be painted at the bottom of the stems up to the height of one meter.



Flowering shoots of Tejpat at Brindaban Botanical Garden, Hetauda

D. Uses

- Leaves and barks used for spices, food flavor and medicines.
- Antidiabetic, antifungal, antioxidant, hypolipidemic properties.
- Leaves are carminative.
- 🍪 Barks useful in diarrhea, flatulence and nausea (DPR, 2007).
- Of the second second
- To produce essential oil.
- Nepal has exported a total of 1,277,349 kg of Cinnamon valued to NRs. 72,065,314 in FY 2012/13 (TEPC, 2013).
- Department of Forest's data on the export of Tejpat (Quantity and revenue received) seems under reported compared to the export data presented by TEPC.
- Boyalty: NRs. 20/kg (bark), NRs. 10/kg (leaves).
- Market price: NRs. 100/kg bark (Nepalgunj); NRs. 61/Kg leaves (July, 2014).

Bottled Cinnamon oil

Oil price: NRs. 6,200/kg; USD 119/kg (Airport price) in September 2014 (HPPCL). The price in Nepalese currency does not commensurate with the FOREX rate of Nepal Rastra Bank.



Dry leaves and bark of Cinnamon



Annual export of Cinnamon from Nepal (Quantity in kilogram and revenue in NRs.) in last eight years(DoF, Unpublished)

References

ANSAB, 2014. Price list of selected NTFPs and spices in Nepalese and Indian markets (July, 2014).

Bhattarai, K. R. and Ghimire, M., 2006. Commercially important medicinal and aromatic plants of Nepal and their distribution pattern and conservation measure along the elevation gradient of the Himalayas. Banko Jankari, 16(1): 3-13.

Bhattarai, K.R., and Ghimire, M.D., 2007. Sustainable collection and cultivation practices for medicinal plants and non-wood forest products (in Nepali language).

CBS, 2012. National population and housing census 2011 (National Report).

CECI, **2006.** Synthesis of seminar presentation and discussions. First national trade show and seminar on Herbs, Herbal Products and Spices, 12-14 November 2005. Published by CECI in March 2006.

Csurhes, S. 2008. Pest plant risk assessment-Neem tree (*Azadirachta indica*). Department of Primary Industries and Fisheries, Queensland, Brisbane, Australia.

Das. A.N. 1999. Socio economics of bamboos in eastern Nepal. Thesis submitted to University of Aberdeen, the UK.

De Beer, J., and McDermott, M., 1989. The economic value of non-timber forest products in Southeast Asia. Netherlands Committee for IUCN, Amsterdam.

Department of Forests, 2005. Forest cover change analysis of the Terai districts (1990/91-2000/2001).

Department of Forests (2008-2013). Hamro Ban (several issues).

Department of Plant Resources, 2007. Medicinal plants of Nepal (revised), Adhikari, M.K., Shakya. D.M., Kayastha, M., Baral, S.R. and Subedi, M.N. (eds). Department of Plant Resources, Thapathali, Kathmandu, Nepal.

Department of Plant Resources, 2011. Prioritized medicinal plants for the economic development of Nepal (in Nepali language).

Department of Plant Resources, **2013.** Quality standards, good agricultural and collection practices (GACP) of *Rauvolfia serpentina* (L.) Benth. Ex Kurz.

DFRS, 2014. Terai forests of Nepal. Forest Resource Assessment Nepal project. Kathmandu, Department of Forest Research and Survey.

Edwards, D. M., 1996. The trade in non-timber forest products from Nepal. Mountain Research and Development, pp 383-394.

Elmer, W. H. 2004. Combining nonpathogenic strains of *Fusarium oxysporum* with sodium chloride to suppress Fusarium crown rot of asparagus in replanted fields. Plant Pathology 53:751-758.

Elmer, W. H., and Pignatello, J. J., 2011. Effect of biochar amendment on arbuscular mycorrhizae and Fusarium crown and root rot of asparagus in replant soils. Plant Disease. 95:960-966.

Farooqi, A. A. and Sreeramu, B.S., 2001. Cultivation of medicinal and aromatic crops. Revised Universities press, Bangalore, India.

His Majesty's Government of Nepal, Ministry of Forests and Soil Conservation (**HMGN**), **1989.** Master plan for the forestry sector, Nepal, main report. Master Plan for the Forestry Sector Project of HMGN/ADB/FINNIDA, Kathmandu.

HPPCL, 2013 (unpublished). Price list of important essential oils from Nepal.

HPPCL, 2014 (unpublished). Price list of important essential oils from Nepal.

Jain, S.K., 1968. Medicinal plants. 3rd edition, 7th reprint in 2003 by National Book Trust, New Delhi India.

Lamichanney, D. and Karna, N. K., 2007. Harvesting methods of *Cinnamomum tamala* in private land a case study from Udaypur District, Nepal. Banko Janakari, Vol 19(2).

Malla, S.B., Shakya, P.R., Rajbhandari, K.R., Subedi, M.N., Shrestha, B.L., 1996. Identification manual for some Non-Timber Forestry Products of Nepal, FRISP project paper series No. 8. Forest Resource Information System Project (FRISP), HMGN/FINNIDA, Kathmandu, Nepal.

McCracken, I.J., 1992. Bamboos: field manual for community and private forestry in Nepal, part II, Field document No. 20, HMGN/FAO/UNDP, Kathmandu, Nepal.

MDBRPP/DFRS, 2010. Market opportunities and constraints for Bamboo and Rattan products in Nepal. Market Development of Bamboo and Rattan Products with Potential Project, Department of Forest Research and Survey, Kathmandu, Nepal.

MoCS, 2010. Nepal trade integration strategy-2010. MoCS, Kathmandu, Nepal.

MoFSC, 2002. Nepal biodiversity strategy. MoFSC, Kathmandu, Nepal.

MoFSC, **2012**. State of forest genetic resources of Nepal. Food and Agriculture Organization of the United Nations.

Naturland, e.V. 2001. Organic farming in the tropics and subtropics exemplary description of 20 crops; organic cultivation of pepper. http://www.naturland.de/

NEHHPA, **2012.** Introduction of major medicinal and aromatic plants of Nepal (in Nepali language).

Olsen, C.S. and Larsen, H. O., 2003. Alpine medicinal plant trade and Himalayan mountain livelihood strategies. Geogr J 169:243–254.

Rajbhandari, T.K., Joshi N.R., Shrestha, T., Joshi, S.K.G. and Acharya, B (eds.), 1995. Medicinal plants of Nepal for ayurvedic drugs, Department of Plant Resources, Thapathali, Kathmandu, Nepal.

Rajbhandari, K. and Adhikari, M. K., 2009. Endemic flowering plants of Nepal, Part I. Department of Plant Resources, Kathmandu, Nepal.

Rajbhandari, K. and Dhungana, S. K., 2010. Endemic flowering plants of Nepal, Part II. Department of Plant Resources, Kathmandu, Nepal.

Rajbhandari, K. and Dhungana, S. K., 2011. Endemic flowering plants of Nepal Part III. Department of Plant Resources, Kathmandu, Nepal.

SAWTEE, **2011**. Promoting exports of medicinal and aromatic plants (MAPs) and essential oils from Nepal.

Sharma, U.R. 2014. A review and analysis of policies on non-wood forest products of Nepal (unpublished). Submitted to Food and Agriculture Organization of the United Nations, Kathmandu, Nepal.

Shanley, P., Pierce, A., Laird, S., 2005. Beyond timber: certification of non-timber forest products. Forest Trends / CIFOR.

Shrestha, U.B. and Shrestha, S., 2004. Important non-timber forest products of Nepal. Bhudipuran Publisher, Kathmandu, Nepal (in Nepali language).

TEPC, 2013. Trade statistics. Trade and Export Promotion Center, MoCS.

TEPC, 2014. *Trade statistics.* Trade and Export Promotion Centre, MoCS, Government of Nepal, <u>http://www.tepc.gov.np/tradestatistics/</u> accessed on 15 September, 2014. Kathmandu, Nepal.

The Himalaya Drug Company, India http://www.himalayaherbals.com/products/index.htm.

Watson, R., and Dallwitz, H.J., 1992. The grass genera of the world, 952-953.

Nepal is well-known for the rich biodiversity and high value Non-Wood Forest Products in the world. Various studies showed that the country retains over 1600 NWFPs, being used for multiple purposes, has the huge potentialities for the development of the nation. NWFP sector alone occupies over 11% (by value) of the total export commodities from Nepal. The sustainable development of the sector is crucial for the rural livelihoods, economic and employment generation.

NWFP development programme in the past had mainly concentrated in the mid-hills and high mountain regions of the country. Very few NWFP development programmes were executed in the Siwalik and Tarai regions despite great economic potentials. In this context, the FAO and Government of Nepal have agreed to implement a two years (February, 2013 to December, 2014) technical cooperation project with the financial and technical support of the FAO. It has aimed to contribute in poverty reduction and sustainable livelihoods through improved cultivation, processing and marketing of NWFP in the regions.

The project has established NWFPs nurseries, demonstration plots and seed production areas for wild Asparagus in Sarlahi, Makwanpur and Rupandehi districts. Further, it has been supporting in the NWFPs policy revisit, capacity development of the multiple stakeholders, preparation and functional operation of NWFPs database system.

This book aims to deliver the comprehensive information on major aspects of 20 prominent NWFPs in the Terai and Siwalik regions of Nepal. The concise information on general introduction, cultivation, management practices as well as markets will be very beneficial to all concerned individuals and organizations working for the promotion of the NWFPs in the regions.



Department of Forests Babarmahal, Kathmandu Nepal



Food and Agriculture Organization of the United Nations