



Inland capture fishery statistics of Southeast Asia: current status and information needs



**Asia-Pacific Fishery Commission
Food and Agriculture Organization of the United Nations
Regional Office for Asia and the Pacific**

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PREPARATION OF THIS DOCUMENT

In recent years, there has been increasing discussion as to the status of the inland fisheries of Southeast Asia. In recognition of the shortcomings of current inland fisheries information and statistics worldwide, a review of the status of inland fisheries statistics in Southeast Asia was commissioned by the Asia-Pacific Fishery Commission (APFIC) in 2001. The consultant, Dr. David Coates visited Indonesia, Malaysia, Myanmar, the Philippines and Thailand to discuss the issues concerning inland fisheries information and statistics with the authorities concerned. During this time the consultant was also able to collect the most recent information on the inland fisheries in these countries. In addition, the consultant also drew on considerable experience of inland fisheries in Cambodia, Lao PDR and VietNam for incorporation into this report.

The opinions expressed in this report are those of the author alone and do not imply any opinion whatsoever on the part of APFIC or FAO. The conclusions and recommendations as given in this report are considered appropriate at the time of its preparation, but may be subject to change in the light of subsequent information.

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ABSTRACT

Inland capture fisheries in Southeast Asia are characterised by great diversity in the range of gears used, types of environments in which they are used and the socially and culturally complex societies within which they operate. This presents unique problems for the collection of inland fisheries statistics. This report assesses the quality and relevance of existing statistics on inland capture fisheries and the extent to which the statistics meet management objectives. The report suggests ways in which the existing statistics might be improved through cost-effective means and explores the information needs for inland capture fisheries.

Based upon the statistics currently available, there is no apparent trend of declining production for any country (except possibly for the Philippines, less so for VietNam). This is somewhat at odds with the frequently expressed view that inland capture fisheries are in terminal decline, and illustrates that the perceptions of these fisheries are not influenced by the available statistical information. This seriously questions the purpose and value of inland fishery statistics. Inland capture fisheries are clearly seriously under-reported in all of the countries reviewed. The discrepancy between officially reported catches (where available) and estimates based upon independent scientifically based surveys (*i.e.* collection of actual data), varies by a factor of between 4.2 and 21.4. Overall, for all the countries combined, the total reported production from inland waters appears to be under-estimated by a factor of between at least 2.5 and 3.6

Participation in inland capture fisheries is very high, but adequate information on this is rarely collected. Most fishers are not licensed and operate on a part-time or seasonal basis. Large numbers of people are also involved in processing, marketing, transportation and other service sectors. Where information exists, it suggests that participation in inland fisheries might equal that in marine fisheries and possibly exceeds that in aquaculture by a factor of at least three times.

In many countries, “statistics” are compiled because they are requested or demanded by central government. The actual purpose of these statistics is often uncertain and countries are reluctant to admit to FAO, and even within or between their own agencies, the true nature of the information reported. Consequently, the “statistics” reported are often taken as factual and are accorded unwarranted authority. A wide variety of methods are used by the countries covered in this review, to estimate inland capture fisheries production. There are also widespread suspected, unofficially recognized or officially confirmed, differences between the official systems in place and actual practice. This report makes recommendations as to what information is appropriate for inland fisheries management and strategies for obtaining the required information.

Distribution:

Members of the Asia-Pacific Fishery Commission (APFIC)
FAO Member States in Southeast Asia
FAO Fisheries Department
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EXECUTIVE SUMMARY

The objectives of this review are to: assess the quality and relevance of existing statistics on inland capture fisheries; assess the extent to which the statistics meet management objectives; suggest ways in which the existing statistics might be improved through cost-effective means; explore the information needs for inland capture fisheries; and, recommend strategies for obtaining the required information.

Five countries were visited during the review mission: Indonesia, Malaysia, Myanmar, Philippines and Thailand. Three other countries are included based upon prior experiences: Cambodia, Lao PDR and VietNam.

Inland capture fisheries are characterised by great diversity in the range of gears used, types of environments in which they are used and the socially and culturally complex societies within which they operate. Inland fisheries have many of the features of marine fisheries and many others that the latter does not possess. The greater complexity of inland fisheries has a major influence upon the type and quality of statistics it is possible to collect and the problems with obtaining them. Collection of fishery statistics generally favours the marine sector, both in ease of collecting information and motivations for doing so (taxation, export revenue generation etc.). Aquaculture information is generally easier to collect than inland capture fishery information due to better defined areas and ownership. Although statistical information for marine fisheries and aquaculture are not perfect, it is certainly more representative than that available for inland capture fisheries.

According to recognised definitions, it can be generalized that most published figures for inland capture fisheries in Southeast Asia do not actually qualify as “statistics” because they are not based upon data. Even for the exceptions, qualification as true “statistics” is debatable, since none of the information is based upon measurement or observation. This is not necessarily a problem, however there is the serious issue that this information is reported as real data and subsequently accorded an importance and veracity that is undeserved.

A wide variety of methods are used by the countries covered in this review, to estimate inland capture fisheries production. These range from estimates made in offices without any information collection (verging on guesses), through basic or elaborate sampling based surveys, to attempts to obtain full cover of the entire fishery based upon the compulsory licensing of all gears. There are also widespread suspected, unofficially recognized or officially confirmed, differences between the official systems in place and actual practice. In only two countries, out of the eight covered in the review, is there any degree of confidence in the level of knowledge of the system that is actually used in practice. In one case, the official system is that no information is actually collected; and the other where it has been subject to extensive independent research over the past six years.

None of the countries reviewed derive their statistics based upon direct observations, report verification, sampling of catch or landings, or any other form of independent monitoring. This includes Cambodia, where the statistics have recently been substantially revised (*i.e.* corrected). This revision was made based upon new information produced by research, not through the introduction of an improved statistics collection system. Estimations are inherent in all of these country's systems and range from responsible attempts to estimate actual catches through to arbitrary supposition. Many are genuine attempts by over-worked and under-resourced staff. But underlying some of the field level estimates is a general disinterest in accuracy and occasionally mis-reporting.

Based upon the statistics currently available, there is no apparent trend of declining production for any country (except possibly for the Philippines, less so for VietNam). This is somewhat at

odds with the frequently expressed view that inland capture fisheries are in terminal decline, and illustrates that the perceptions of these fisheries are not influenced by the available statistical information. This seriously questions the purpose and value of inland fishery statistics.

Two countries have reported significant increases in actual production in recent years. Thailand's increase is attributed to the impacts of stocking in reservoirs. Myanmar, however, reports a 65 percent increase in production from already substantial river and floodplain fisheries over the past 4 to 5 years, achieved through improved aquatic resources management (environmental restoration and rehabilitation, restocking floodplains and improved governance); which has not required any substantial physical resource inputs. This example eclipses any known production increase that has been achieved through aquaculture development that started from a similar point, and strongly challenges the widely held view that river fisheries cannot be improved.

Inland capture fisheries are clearly seriously under-reported in all of the countries reviewed. The discrepancy between officially reported catches (where available) and estimates based upon independent scientifically based surveys (*i.e.* collection of actual data), varies by a factor of between 4.2 and 21.4. Overall, for all the countries combined, the total reported production from inland waters appears to be under-estimated by a factor of between at least 2.5 and 3.6

Participation in inland capture fisheries is very high, but adequate information on this is rarely collected. Most fishers are not licensed and operate on a part-time or seasonal basis. Large numbers of people are also involved in processing, marketing, transportation and other service sectors. Where information exists, it suggests that participation in inland fisheries might equal that in marine fisheries and possibly exceeds that in aquaculture by a factor of at least three times. The figure published by FAO for the number of inland capture fishers worldwide (4.5 million, including all levels of fishing) is easily exceeded by those fishing in inland waters in the eight countries covered by this review alone! The role and importance of inland capture fisheries to the livelihoods of participating fishers should be defined by the stakeholders themselves, not externally. This importance is not necessarily related to the gross production figures. Equally, the significance of inland fisheries to a national economy should also not be assessed using narrow or inappropriate economic criteria.

The total reported freshwater aquaculture production for 1999 in the eight countries covered in this study was 1 268 968 MT. This figure is slightly exceeded by the reported freshwater capture fisheries production (1 303 247 MT). Reported figures for inland capture fisheries are almost certainly under-estimated and in this report, it is argued that the actual production from inland capture fisheries is likely to be at least three times that reported for freshwater aquaculture. This raises questions as to the relative attention and investment made in the two sub-sectors.

Major sources of error in officially reported statistics include: errors in catch reporting; under-estimates of the importance of small-scale fishing activities (a serious problem in inland fisheries because most of the catch arises from this sub-sector); mis-reporting by government officials; and estimates made without data collection. Other constraints include inadequacies in recording the level of participation in capture fisheries, lack of description of the species composition of catches, inability to monitor fishing effort, lack of attention to bio-diversity considerations, ornamental fish and recreational fisheries, and livelihoods aspects. Compounded to this is the considerable problem of the almost universal uncritical acceptance of the information being produced.

Countries cannot be ranked in order of those having the "best" statistics. The current statistics must be considered not only in terms of potential accuracy, but also in terms of the effort expended (cost) in obtaining them. Interestingly, there does not appear to be a direct relationship between effort (costs) expended on information collection and the accuracy or

relevance of the information produced. This has very significant implications for those thinking of investing heavily in improved inland fishery statistics based upon existing models.

One of the most interesting and relevant areas investigated by this review, was that of the objectives of compiling inland capture fishery statistics and the use to which the information is put. In many countries, “statistics” are compiled because they are requested or demanded by central government, however the actual use to which these statistics are put is often uncertain. National fishery statistics are sometimes compiled primarily, as a perceived obligation to FAO, therefore the information that FAO requests has a major influence on what is collected or compiled. Countries are reluctant to admit to FAO, and even within or between their own agencies, the true nature of the information reported. Consequently, the “statistics” reported are often taken as factual. Most countries report that the statistics are used for “fisheries management purposes” but few countries are actually managing their inland capture fisheries. Even if they were, the information produced through their statistics is not adequate for most management purposes. In the few cases where fisheries management occurs, the national statistics are of limited use in assessing the impacts of management, or meaningful statistics are only gathered in controllable situations (e.g. for reservoirs).

All countries regard the main value of their inland capture fisheries as sustaining the livelihoods of poor rural communities and contributing to food security (notwithstanding that many countries still have significant commercial/industrial inland fisheries). By contrast, in general, marine fisheries are regarded as being important for revenue generation, export earnings and formal economic benefits. In most cases so is aquaculture. All countries agree that the current information collected, even if it were accurate, does not provide adequate information for addressing, monitoring or managing issues that relate to rural livelihoods. There is a clear realisation of the need to obtain such information but considerable uncertainty regarding how it can be done and who should do it. All countries reviewed also agree that the main threats to inland fisheries, particularly for rivers and associated wetlands (less so for reservoirs), is habitat loss and environmental degradation. The information currently collected does not assist in monitoring such trends, nor does it contribute to moderating the degradation itself. All countries recognise the importance of issues relating to sustaining bio-diversity in inland waters, but the current statistics are widely regarded (correctly) as irrelevant to this subject also.

The history of fishery research and management has had a significant impact upon statistics collection systems and levels of attention to the various sub-sectors. The complex multi-gear, multi-species, inland capture fisheries have been a casualty of this process. The research and management needs for inland capture fisheries have generally been addressed by trying to translate approaches and methods originally developed for marine fisheries. These have not generally worked and tend to ignore the differing characteristics of this sub-sector.

More recently there have been significant shifts in policy emphasis towards: (i) poverty issues and “livelihoods centred approaches”, (ii) the environment (and bio-diversity), and (iii) the promotion of co-management systems for fisheries. All three of these are beginning to emphasize the importance of inland fisheries. However existing statistical systems are incapable of addressing information needs for the first two policy areas and are not particularly compatible with the third, being primarily based on extractive assessment methods.

A significant challenge for FAO is to respond rapidly to these shifts in policy and emphasis by adjusting its information generation and dissemination activities to cater to these new needs. It will be constrained in doing so, because many member countries themselves will have difficulties in shifting emphasis towards more pro-poor, livelihoods oriented forms of information generation. There is an excellent opportunity for FAO to be pro-active and to start to request such information, and to assist members in deciding how best it can be generated. The initial step in this process is to raise the awareness of member countries to this need and is probably more important than obtaining the information itself.

The move towards co-management approaches for fisheries offers significant opportunities to improve information generation. Effective co-management should improve confidence and trust between fishers and government staff together with the willingness to divulge more accurate information, and more cheaply. It is largely because most of the current information systems are extractive by nature that they are inherently unreliable.

This review mission has been given the overall impression that the countries in Southeast Asia, in general, struggle with limited resources to compile information that, in many cases, they do not themselves trust, need or use. At the same time, most of these countries are aware of what information it would be more logical to collect, but lack the methods and support to obtain it.

Strategies that might be adopted by individual countries to improve their information on inland capture fisheries will largely depend upon the extent of their current inland fishery statistical systems and the degree to which they have specific requirements. The general recommendations made by the mission are that:

1. Countries should review their existing statistics based upon impartial desk-top appraisals using existing information. (Some methods for doing this are described)
2. Countries should incorporate improved and more accurate information into their current national statistics.
3. Where appropriate, countries should make significant efforts to explain the inadequacies of their current statistics to relevant parties.
4. Where possible, countries should endeavour to incorporate inland capture fishery information requirements into surveys done by other agencies.
5. Countries should promote more research on the production of, participation in and dependency upon inland capture fisheries.
6. Countries in Southeast Asia should share their information on inland capture fisheries and statistical/information systems. They have much to learn from each other.
7. Those countries with existing extensive inland capture fishery statistical systems should consider how best to improve them, without necessarily incurring significant additional costs. (Some ways on how this can be done are described)
8. Those countries that currently have more limited statistics collection activities should be careful about investing in improved systems, if they are based upon the models currently in place in other countries.
9. Countries should recognise that as policies and priorities change, information requirements change along with them. This represents an opportunity for countries to re-vitalise their statistical systems in response to these emerging opportunities.
10. Countries should focus on livelihoods related information in their statistics and information generation activities.
11. Countries should integrate co-management approaches and the generation of fishery information.
12. Countries should be more flexible/adaptive in the way they generate and report their statistics.

13. Statistics and information systems should be reviewed, revised or developed with the full involvement of appropriate stakeholders at governmental level (*i.e.* appropriate statistical agencies, collection agencies).
14. Existing statistical systems should be revised to make it easier to incorporate ancillary information (*i.e.* that generated outside of fishery statistics collection systems) into estimations and subsequent reports.
15. It should be widely and openly acknowledged that most existing statistics are not useful for monitoring trends in inland fisheries because of their poor quality.
16. Countries need to explore options for obtaining better information enabling trends to be tracked, using low-cost and sustainable methods. They should not assume that tracking trends in fish stocks is the priority.
17. Countries should devote more effort to monitoring trends in the environment relevant to inland capture fisheries.
18. Countries need to adopt better strategies for monitoring trends in biodiversity.
19. The current statistics for inland capture fisheries produced by FAO should include better indications as to their basis and meaning. FAO should consider inclusion of qualifying notes, indicating the reliability of the information in its yearbooks of inland capture fishery statistics.
20. The information and statistics activities at FAO should reflect the requirements for improved livelihoods related information more obviously and explicitly.
21. FAO should provide improved advice to member nations on what kinds of livelihoods relevant information should be collected and how it can be obtained cost-effectively.

PART I

Overview of inland fishery statistics in Southeast Asia

Overview of inland fishery statistics in Southeast Asia

1 Introduction

The inland capture fishery statistics for many countries are commonly regarded as being poorly reported and/or inaccurate. Those who are familiar with officially reported figures, and how they are derived, frequently mock them as meaningless. Whilst some exceptions exist, this perception is probably valid. But such statistics are important as they still tend to form the basis of opinion, policy, planning and management decisions, even amongst those who recognise the weaknesses of the statistics. Unfortunately, those who are unfamiliar with the shortcomings of this information often take it at face value. Therefore, official inland fishery statistics, whether good or bad, do significantly influence perceptions. Not surprisingly, this has tended to promote significant under-valuing of inland capture fisheries. This happens at local, national and international levels, even globally, since ultimately, national statistics are reported to FAO. Published FAO statistics form the basis of major perceptions of the relative value of, and trends in, the fisheries sub-sectors.

Recognising the need for improvement, a mission was initiated by FAO Regional Office for Asia and the Pacific, to review the current status of inland capture fisheries in Southeast Asia. Short field missions were made to four countries (Indonesia, Malaysia, Myanmar and Thailand) and further information was based upon recent professional experience in three other countries (Cambodia, Lao PDR and VietNam). The objectives of this review were to:

1. Assess the quality and relevance of existing statistics on inland capture fisheries
2. Assess the extent that the statistics meet management objectives
3. Suggest cost effective ways in which the existing statistics might be improved
4. Explore the information needs for inland capture fisheries
5. Recommend strategies for obtaining the required information

This review takes a broader perspective of the problem and goes beyond simplistic reviews of shortcomings in statistical approaches. The opportunity has been taken to highlight the flaws in the current information system and point to the significant opportunities that exist to re-evaluate the information requirements and look at novel approaches to how to meet them. Some country-specific observations and recommendations are reported in Part II. Even for these, time has not permitted a thorough analysis of each situation, nor in-depth recommendations. Each country needs to follow-up on this report in much more detail locally. What has been learnt, however, is that the countries do have common problems for which there are common solutions. This is the focus of the first part of this report.

Throughout this review conclusions have been made based upon two important factors, these are:

- That solutions to meet information needs should be cost-effective (most countries have limited financial resources and will be reluctant or unable to suddenly make substantial investments into improving their inland capture fishery statistics).
- That there is considerable scope for information sharing between countries (in many respects this is essential because for many countries the only way to verify the current figures, or obtain indicative ones from scratch, is to use information from elsewhere).

A desk-top review of inland fishery statistics was undertaken by FAO (2000b) which included several generic recommendations, most of which are endorsed here. The current report extends that review by exploring the problems and opportunities in more detail based upon the mission to selected countries. It presents a more detailed analysis of the data currently being produced, its actual origins, potential accuracy and relevance. Particular attention has been given to information needs for inland fisheries and the practicalities of addressing those needs in the countries in question.

2 Statistics versus information

“Statistics” generally refers to the recurrent (repeated) collection of data for specific information purposes. This is normally done through specialised agencies, e.g. departments of statistics, which may or may not operate through, or delegate collection duties to, sub-divisions of relevant line agencies (e.g. departments of fisheries). These agencies report the summarised information to national authorities and to FAO usually on an annual basis.

According to the *Oxford English Dictionary* **statistics** means:

“ 1) the science of collecting and analysing numerical data, especially in or for large quantities, and usually inferring proportions in a whole from proportions in a representative sample; 2) any systematic collection or presentation of such facts”

The same dictionary defines **data** as:

“known facts or things used as a basis for inference or reckoning”

FAO (1999a) defines the term **data** in relation to capture fisheries as:

“facts that result from measurements or observations”

The first conclusion of this review is that, in general, the published figures for inland capture fisheries in Southeast Asia do not qualify as “statistics” because most are not based upon data. Even for the exceptions, qualification of the information as “statistics” is debatable as none of the information is based upon measurement or observation. This in itself is not necessarily a problem, but the difficulty lies with the fact that the information is reported as real data, which are subsequently treated as such.

This review considers the subject in question more broadly, preferring the term “information”, which includes but is not limited to “statistics” or “data”. According to the dictionary: **information** means “knowledge”. This implies that the subject matter has a certain degree of utility. This is not necessarily so for statistics or data, which can take on almost abstract features and their collection become an end in itself; as witnessed admirably by inland capture fishery statistics.

In view of this background, two recent initiatives have significant relevance to the current review:

(i) FAO (1999a) provide guidelines for the routine collection of capture fishery data. At first sight this publication would appear to have significant relevance to the subject of this review. But since few of the statistics for inland capture fisheries reported for Southeast Asia are based upon actual data, the publication is of limited use. It does, however, remain the definitive work for guidance for those who are thinking about obtaining some data in the near future. All of those interested in the specifics of data collection, sampling strategies and protocols, statistical approaches etc. are referred to this work.

(ii) The “STREAM” initiative (STREAM, 2001) provides support to regional aquatic resources management in the Asia-Pacific region. The objective is to promote participation, communication, and policies that support the livelihoods of poor aquatic resource users in the Asia-Pacific. A cornerstone of the initiative is improved information generation, communication and sharing between countries. The subject of this review is, of course, highly relevant to STREAM. Although STREAM focuses on sharing information relevant to improved management, and not directly to that relating to fishery valuation/assessment/monitoring, these two aspects of information are, of course, closely related. For STREAM to function effectively,

it is, for example, essential to have knowledge of the realities of the relative importance of various sub-sectors in the aquatic resources arena (*e.g.* capture *versus* culture). STREAM, for example, is itself influenced by an over-reliance in its formulation upon existing national statistics for inland capture fisheries, which might potentially lead to a bias towards aquaculture.¹ But more importantly, improved information on the aquatic resources sector is essential if governments and other stake-holders are to support STREAM to the extent warranted by the actual importance of the sector, as opposed to that indicated by the current statistics.

3 The nature and perceived status of inland capture fisheries

Inland capture fisheries are characterised by an extremely diverse range of gears, environments in which they are used and socially and culturally complex societies within which they operate. They include all features of marine fisheries and many that the latter sub-sector does not possess which makes them much more complex. Some generalised differences between inland capture fisheries and marine fisheries, in relation to statistics, are summarised below:

<i>Inland Fisheries</i>	<i>Marine Fisheries</i>
<ul style="list-style-type: none"> • Bulk of the catch taken by dispersed small-scale gears • Fishing activities largely dispersed and less visible because of (i) informal nature, and (ii) operating in remote rural areas masked by geography/vegetation • Bulk of landings dispersed and informal • Part-time fishing the norm, especially mixed farming/fishing lifestyles on river floodplains • Most produce consumed domestically and much of it within the communities where fishing occurs 	<ul style="list-style-type: none"> • Bulk of the catch taken by large commercial/industrial gears • Activities more visible in open waters/sea • Bulk of landings centralised and visible • Professional fishing dominates the sector • Most is exported

These differences have a major influence upon the nature of statistics and the problems of obtaining them. In general, they favour the marine sector, both in ease of collecting information and motivations for doing so (taxation, export generation etc.). Comparisons with aquaculture also suggest that statistics for the latter are easier to collect. Aquaculture is invariably household based, or site specific. Activities are more visible and participants tend to have better monitoring of outputs because they must gauge this against inputs (labour, feed etc.) in order to track profitability. Information may be more difficult to obtain for some small-scale and more extensive aquaculture activities (typically small-scale aquaculture represents the weakest of the aquaculture statistics). Although statistics for marine fisheries and aquaculture are not perfect, they are likely to be more representative than those for inland capture fisheries.

¹ For example, it draws attention to the relative importance of inland capture fisheries in Cambodia but makes no mention of the sub-sector in VietNam (this report, however, suggests that the sub-sector is bigger in VietNam than in Cambodia). In several places, STREAM uses the terms “aquatic resources management” and “aquaculture” interchangeably. They are not necessarily the same, as demonstrated convincingly by the significantly improved inland capture fisheries achieved in Myanmar in recent years (see Part 2 of this report).

The habitats in which fishing occurs can be numerous and have very different characteristics. In most, if not all, countries in Southeast Asia, almost all areas of inland waters, which are not polluted beyond the ability to sustain fish, have vibrant and active capture fisheries associated with them. They can be very roughly divided into categories, each of which has particular relevance to the subject of statistics:

3.1 Reservoirs and lakes

These can be of significant importance nationally. Fisheries on larger reservoirs and lakes are relatively visible, often with well-organised landing sites. Access is from the shore. The use of boats (motorised or not) is common. Problems facing data collection are similar to smaller-scale marine fisheries. The fish stocks, in terms of natural variations, tend to be more stable both within and between years. Problems with reservoir fisheries management, in general, centre on managing over-exploitation. Management actions tend to generally include stocking. Small reservoirs and water bodies can be a significant resource and cumulatively more important than larger reservoirs. Deeper lakes with higher gradient banks present similar features to reservoirs. Lakes that are part of river floodplains (*e.g.* the Great Lake in Cambodia) tend to take on features of river floodplains (see below).

3.2 Rivers

Rivers (*i.e.* flowing freshwaters, including streams) form networks covering nearly all inland areas, except extreme deserts. Traditionally, human settlements are located near rivers. Rivers, consequently, are traditionally heavily fished. Access tends to be from the shore. Use of boats is more limited on smaller tributaries and hill streams. On rivers with extensive floodplains, resource availability in river channels is highly seasonal as fish migrate through channels in response to flood conditions on the plains. There can also be large variations in resources between years due to between year variations in flood extent (rainfall). Rivers are generally suffering from severe environmental degradation arising from other sectors. Riverine fisheries are very diverse, generally informal and dispersed. They have been traditionally extremely difficult to get representative statistics for.

3.3 Floodplains

River and lake floodplains are very productive and their fisheries highly seasonal. Peak catches are taken as flood waters recede and migrating fishes are caught in appropriate gears (especially barrage fences with traps). Most people tend to be already living on floodplains themselves and do not “access” the fishery (*i.e.* travel to it) because it comes to them. The seasonal cycles, and fish migrations they stimulate, can produce significant opportunities for migratory fishers. In Southeast Asia, a mix of farming/fishing lifestyles predominates on river floodplains. Floodplains are very productive for agriculture too and represent the best land. They support some of Southeast Asia’s highest concentrations of human populations. Floodplains and adjacent river fisheries are intimately linked. Key fishing grounds or opportunities tend to be leased, either officially or through community-based management systems. Floodplain fisheries are very diverse covering the full spectrum of gears. They are very resilient to over-exploitation. Main threats are habitat loss and environmental degradation (particularly loss of floodplain area through flood control and water extraction from rivers). Floodplain fisheries are very difficult to get statistics for: the larger gears produce valuable catches, information for which is jealously guarded, corruption over licensing is common; smaller-scale operators, particularly part-time, are difficult to see and monitor. Catches from all gears are highly seasonal. The bulk of catches can often be taken within very limited periods. Such variation is difficult to monitor.

3.4 Estuaries and deltas

These areas can be extensive and their fisheries often have a mixture of river and floodplain characteristics, depending upon the hydrological conditions. In addition to freshwater riverine species, large migrations of brackishwater/estuarine species can occur, including for marine prawns. Environments vary from freshwater to full seawater according to flood and tidal conditions. Estuaries receive large nutrient inputs from floodwaters. Their fisheries are naturally highly productive. Estuarine fisheries can be hugely important. One problem with statistics is that many coastal/marine fishers are based in estuaries and deltas and land their catch there. Separating coastal/marine production from inland catches can be problematic. Some countries report their catches based upon classifications of salinity (freshwater vs. marine), some based upon geography (inland v. coastal). Much of the catch from inland areas near the coast (estuaries/deltas) is reported as coastal or marine fisheries production. Again, this significantly under-values inland fisheries. Estuaries in Southeast Asia tend to have severe environmental problems due to pollution and water management activities arising both upstream and locally, particularly through deforestation and the conversion of wetlands.

3.5 Rice-fields

Rice is the main staple crop throughout most of Southeast Asia. Traditionally “wet” rice is grown, particularly in lowlands through paddy farming. The local aquatic fauna naturally tends to treat rice fields as floodplain and colonise fields during the aquatic phase of rice farming. This can result in significant quantities of aquatic animals (not only fish, but also a wide variety of crustaceans, molluscs, reptile, amphibians and insects) being taken regularly from rice-fields throughout the growing season or when they are drained. Most rice farmers have traditional systems for enhancing aquatic animal production mainly centring on enhancing recruitment and controlling predation. Traditionally, external feeds are not used. Intensification of systems has included stocking with fish and supplemental feeding. Separating production between capture and culture can be very problematic. Rice intensification has led to sub-optimal water management regimes and increased pesticide use, which has resulted in significant losses of this secondary crop of aquatic animals. Capture fisheries production from rice fields can be very significant but is rarely accurately reported, if at all.

3.6 Categories of fishing activities

- (1) *Commercial/industrial fisheries* – where activities produce significant commercial quantities of fish at localised sites, usually involving high capital input gears and often using significant inputs of professional labour. Some impressive commercial/industrial river fisheries occur in Southeast Asia. Examples of gears used include river bagnets and large barrage fences. Such fisheries are usually found where resource availability and access to markets justify significant capital investment (financial, manpower and/or in the construction of gears) and where access can be controlled. Key fishing sites or opportunities are often allocated through well developed licensing and auction systems. Many of these systems were in place in historical times.
- (2) *Middle-scale fisheries* - here catches per operating unit are smaller and gears are normally operated at the individual or family level. Examples are: trawlers, beach seines, long-lines.
- (3) *Small-scale fisheries* – a very diverse and diffuse sub-sector whereby individual catches generally are not high and activities tend to be rather informal. Part-time fishing dominates. Participation in this sector can be very high. Catches per unit can be small but cumulative catches are significant and can surpass those from commercial and middle-scale fisheries combined.

Activities associated with inland capture fisheries such as: processing, marketing and transportation can be significant. In particular, the seasonal nature of floodplain fisheries can result in huge local surpluses, which enter significant processing routes particularly in Southeast Asia for fish paste and fish sauce. This produce helps spread the benefits of the fishery throughout the year and is very important for local and regional food security.

There are three main motivations, or objectives, for fishery-related activities:

- (1) *Commercial/profit*. This is a primary motivation for many fishers, including at the small-scale level. This group is not limited to the commercial/industrial sector since the scale of profits generated is not relevant.
- (2) *Food and subsistence*. Where the produce is consumed directly by the fisher or the immediate family or household.
- (3) *Sport and recreation*. Where the fishers do not depend directly on the fishery for employment (although others may be employed servicing sport fishers), and fishing is undertaken for leisure purposes. The fish may be returned to the fishery, used as a trophy or eaten or sold but neither of the latter are the main motivation for capture.

Throughout this review, the term “*subsistence fisheries*” (where the catch supports the family diet directly) will be avoided for several reasons. This is because true subsistence fishers are in fact quite rare, fishers in poorer communities will still tend to sell their catch if they have access to suitable markets. The definition “subsistence fisher” is more often concerned with lack of opportunity to derive income rather than a deliberate livelihood strategy; this term also undervalues the importance of fishing activities. Even where fish is not sold but consumed locally, it has an economic/commercial value because it contributes to family, local or regional welfare and food-security, thereby enabling other more obvious financially oriented activities (such as commercial fishing, aquaculture) to take place. “Subsistence” fisheries are included here under small-scale fisheries.

A detailed study of sport/recreational fisheries is beyond the scope of this review. They are, however, important for several reasons. They can have an extremely high economic value, which is not always obviously related to total catches and landings. The requirements for information and statistics are considerably different, not least because total landings are irrelevant, since much of the catch is returned live to the fishery after being caught. Sport/recreational fisheries tend to develop as countries become more affluent, a process which provides both financial resources to invest beyond basic needs and a higher priority on leisure time. Sport/recreational fishers can be extremely influential as they may represent more affluent sections of society who have leisure time and the sector tends to become very well organised and politically and economically powerful. This presents both management opportunities and challenges. Inland sport fisheries are not limited to the rich industrialised countries of the west. Southeast Asia already has well-developed inland sport fisheries and the sub-sector is developing rapidly, particularly in Malaysia and Thailand (amongst the countries covered by this review). The sub-sector is also very relevant because elsewhere, where they have developed further, they present some of the best examples of effective co-management approaches in fisheries. The fishers are usually well organised. They also, in general have little motivation to withhold information about catches (possibly being the only group to tend to actually exaggerate catches!). Sport fishers also can be one of the most active and influential groups promoting improved environmental management, restoration and rehabilitation. In the mission’s experience, several countries in Southeast Asia (see Part II) are under-estimating the value and potential of their inland sport fisheries. This is largely because they have no statistics on them. There is a need for separate and more detailed advice to relevant FAO member countries regarding information and statistics issues relevant to sport/recreational fisheries. For the present purposes it is sufficient to note: (i) that information systems can, and should, be funded through revenue generated from the fisheries themselves (user pays); countries with developing

sport fisheries need not re-direct funds away from pro-poor fisheries management and development; and, (ii) co-management approaches to information generation and management are not only logical, as elsewhere, but are likely to be much more easily implemented (sport fishers are better educated, better resourced, and better organised).

4 Review of current inland capture fishery statistics in Southeast Asia

The countries for which inland capture fishery statistics are reviewed have a wide range of population characteristics, economies and natural resources (Table 1.1). Not surprisingly, their inland fisheries differ according to level of economic development and freshwater resource availability. They all have significant inland capture fisheries, particularly in areas where poor rural communities live in proximity to significant freshwater resources.

Table 1.1 Some population, land, economic and resource data for the countries reviewed.

Country	Population (year)	Land area (km ²) & population density (no./km ²)	GDP per caput US\$ (year)	Major freshwater resources*
Cambodia	10 000 000 (1995)	181 035 55.25	309 (1995)	Mekong River Floodplains, Tonle Sap and the Great Lake
Indonesia	206 338 000 (1998)	1 900 000 108.6	1 018 (1997)	Reservoirs. Large river systems particularly on the islands of Kalimantan (Kapuas and Mahakam Rivers), Sumatra, Sulawesi and Irian Jaya. Widespread estuaries, deltas and mangrove systems.
Lao PDR	5 032 000 (1995)	236 725 21.25	362 (1995)	Large rivers. Mekong mainstream and large tributaries.
Malaysia	21 830 000 (1999)	329 758 66.2	4 523 (1998)	More limited on peninsular Malaysia. Substantial rivers in Sabah and Sarawak provinces (Borneo). Inland fisheries differ significantly between these two areas.
Myanmar	50 000 000 (2000)	676 577 73.90	220 (1994)	Very large river and floodplain systems, particularly the Ayeyarwaddy (Irrawaddy) River and a number of others. Resource area rivals that of the entire lower Mekong Basin.
Philippines	73 130 000 (1998)	304 212 240	890 (1998)	Limited to several lakes, most rivers severely polluted, major islands Luzon and Mindanao, large number of reservoirs
Thailand	60 300 000	514 000 117.3	1 906 (1996)	Reservoirs. Large rivers, Mekong River Tributaries, Chao Phraya River basin. Extensive estuaries and deltas.
VietNam	75 181 000 (1996)	329 560 228.2	267 (1995)	Reservoirs, Red River and its Delta in the north, Mekong River Delta, estuaries/deltas

*all countries have extensive smaller river networks, rice farming and variable numbers of larger reservoirs and smaller dams

4.1 Methods of statistics collection and reporting

The methods that the reviewed countries use to collect or compile their national statistics for inland capture fisheries are summarised in Table 1.2. A wide variety of methods are used to estimate inland capture fisheries production ranging from estimates made in offices (verging on guesses), through basic or elaborate sampling based surveys to attempts to obtain full cover of the entire fishery based upon (officially) compulsory licensing of all gears. There is also either

suspected, officially admitted or known (confirmed) differences between the official systems in place and the actual practices. Of the countries covered in this report, there are only two for which there is a degree of certainty (*i.e.* recognized by government) regarding the level of accuracy of the system that is actually used in practice: Lao PDR, where there is no sampling system and reports are entirely based upon estimates derived in the office, and Cambodia, where discrepancies between figures generated through the official system, and more accurate figures that have been established through significant independent research spanning the last six years.

None of the countries estimate the statistics based upon direct observations, report verification, catch or landings sampling or any other form of independent monitoring. This includes Cambodia where recently the statistics have been revised (*i.e.* corrected) based upon new information produced by research, not through an improved statistical system. The degree of estimation inherent in most of these systems ranges from responsible attempts to estimate actual catches through to arbitrary guesses. Most are genuine attempts by over-worked and under-resourced staff to actually reflect the situation with the fisheries. However, it must be said that underlying some of the estimates at field level is a general disinterest in accuracy and, on occasion and as openly reported by the relevant authorities themselves, mis-reporting.

Table 1.2 Summary of inland capture fishery statistics estimation systems in the countries reviewed. See Part II for further details for each country.

Country	Official basis of information collection	Description according to categories described by FAO (1999a)	Likely actual basis	Comments
Cambodia	<p>Fishery split into large-scale, medium scale and family fishing. Licenses for large scale and medium scale required. Statistics based upon catch reports from licensed fisheries. Figures produced monthly. Monthly meetings held to “discuss” the statistics.</p> <p>Small-scale family fishery statistics based upon guesses or not included at all.</p>	Registration based on gears. Reporting and open-ended interviews.	Under-reporting by licence holders and by local government staff (reported and confirmed by research). Most statistics based also upon estimates made in field offices and not upon actual collection of information.	<p>System based upon licensing regulation and revenue generation as the priority.</p> <p>Statistics were revised in 1999 based upon the results of research. But the statistical system itself, or the information collected, has yet to be significantly changed.</p>
Indonesia	Extensive structured sampling approach applied nationally. Sampling forms record vessel and gear inventories for each district – revised annually. Sampling based upon an older frame survey. Households sampled at random in selected villages. Catch estimates based upon gear records and reported or estimated catches per unit of effort and reported number of trips. Catches are reported quarterly (3 months) but the actual survey is done only once per year.	Registration based upon vessels and gears (includes households with no vessel). Sampling based upon reporting.	<p>Authorities report serious manpower problems and it is believed that many districts estimate catches without doing actual sampling.</p> <p>Sampling frame also likely focuses on commercial/licensed gears.</p>	<p>Sampling methodology recently revised based upon experiences from aquaculture surveys.</p> <p>The sampling frame used is based upon an agricultural survey in 1973. Information collected is complex and time-consuming to collect.</p>
Lao PDR	Estimates made in offices. No data or information collection. Once per annum. Estimates based upon a standard figure for river fisheries, yields per unit area for reservoirs and rice-fields.	Not applicable. Estimates.	As stated.	Estimations not based upon survey data or research relevant to Lao PDR. They are basically guesses.
Malaysia	District officers estimate production based upon “visual market surveys, enquiries and observation”. Monthly. No formal reporting or sampling. Estimates are made by production system: river, ex-mining pools (of which there are numerous), embankments/reservoirs/dams, and others.	Not applicable. Estimates.	As stated.	Estimates are not made for the provinces, Sabah and Sarawak, with by far the biggest inland capture fisheries. Estimates reported to FAO recently apply only to Peninsular Malaysia.
Myanmar	<p>Fisheries divided into “lease fisheries” (where rights are auctioned) and “open fisheries” which includes all gears set outside lease areas.</p> <p><u>All</u> fishing gears officially require a license.</p> <p>Production estimates derived from compulsory reporting from license holders. Reporting of catches done about every two weeks but monthly estimates compiled.</p>	Registration (officially of all gears). Compulsory reporting of catches.	Cover for registration purposes for commercial gears probably quite comprehensive. Licensing authorities concentrate on commercial fishers. Coverage for small-scale, family/subsistence fishing, likely much less comprehensive.	<p>The extent of under reporting and misreporting of catches is not known but the fishery has licensing and management characteristics similar to that in Cambodia where under-reporting is widespread.</p> <p>Reports do not include production from reservoirs. Rice field fishing does not require a license and therefore production is not reported and is not included in estimates.</p>

Country	Official basis of information collection	Description according to categories described by FAO (1999a)	Likely actual basis	Comments
Philippines	<p>Stratified random sampling of official landings centres. Supplemented by random sampling of households stratified by location by water body types.</p> <p>Non-probability surveys of key informants wherever and whenever proper sampling cannot be undertaken.</p>	Sampling reports: of landings and of fishers.	The surveys of households are likely non-random due to problems with the underlying frame. In recent years no comprehensive surveys have been done and estimates are based upon opinions of key informants.	Surveys (when conducted) are based upon pre-determined concept of "fishing households" established in a frame survey undertaken in 1992 and now likely out-of-date. The survey likely targets households recognised as "fishing households", the basis of which is unknown. This system seriously under-reports part-time/informal fishing. Projection-based reporting by government officials is common, particularly for aquaculture. Under-reporting by fishers widespread because of taxation fears.
Thailand	<p>Stratified sampling based upon water body size. Interviews conducted with key informants. Yearly recall. Surveys done annually. Production estimates extrapolated by production area for larger water bodies. For some larger reservoirs landings reports are collected with a standard correction for subsistence/home consumption.</p> <p>Some figures produced for other areas are based upon catch estimates for licensed gears, particularly pond traps.</p> <p>No sampling of catches or landings undertaken.</p>	A mix of registration (license records), open-ended interviews and estimates based upon sampling reports.	As stated, but quality of reports varies between provinces and districts. Some reports are based upon estimates made without sampling.	<p>The Thai figures apply mainly to reservoirs and small water bodies (village ponds). There is no structured sampling or estimation for river and swamp fisheries.</p> <p>Production from estuaries and mangrove areas reported as coastal. "Inland" refers exclusively to freshwater catches.</p> <p>Production from rice fields reported exclusively as aquaculture irrespective of production system.</p>
VietNam	<p>Very uncertain and varies between provinces.</p> <p>Where information is known to be collected it is officially based upon reported landings for the commercial licensed gears and a vague estimate for the other parts of the fishery. Where sampling occurs it is based upon reported catches from fishers and occurs once per year.</p>	Not applicable. Estimates or incomplete reporting.	Where information is produced it is likely often based upon estimates by district and/or provincial officials. Such estimates favour the commercial parts of the fishery and licensed gears.	<p>Some provinces actually collect information/reports; others likely do not or produce their own estimates without sampling.</p> <p>There is a problem of reporting between provinces and central government, at least as reflected by the figures provided to FAO. National statistics appear not to include all official provincial reports, or they are not received.</p>

4.2 The statistics produced

The actual published national figures for the reviewed countries are presented in Fig. 1-01, and the current section will focus on common problems, sources of error and areas requiring improvements. Part II of this report presents and discusses the information produced in much more detail for each country.

In view of the analysis of the methods used by each country to produce these statistics, the information in Fig. 1-01 should in general be regarded very sceptically. The statistics do not necessarily represent reality. Nevertheless, they do show some interesting features. First, there is no apparent trend of declining production for any country (except possibly for the Philippines, less so for VietNam). This is somewhat at odds with the widely held view that inland capture fisheries are declining and illustrates that perceptions of the fisheries are held independently of the statistical information. There are two explanations of this: (i) perceptions are wrong and the fisheries in general are not in decline, or (ii) perceptions are not based upon statistics, which begs an obvious question as to their function. The most relevant point for the present purposes is that for most countries the statistics produced do not enable any confidence in the analysis of trends.

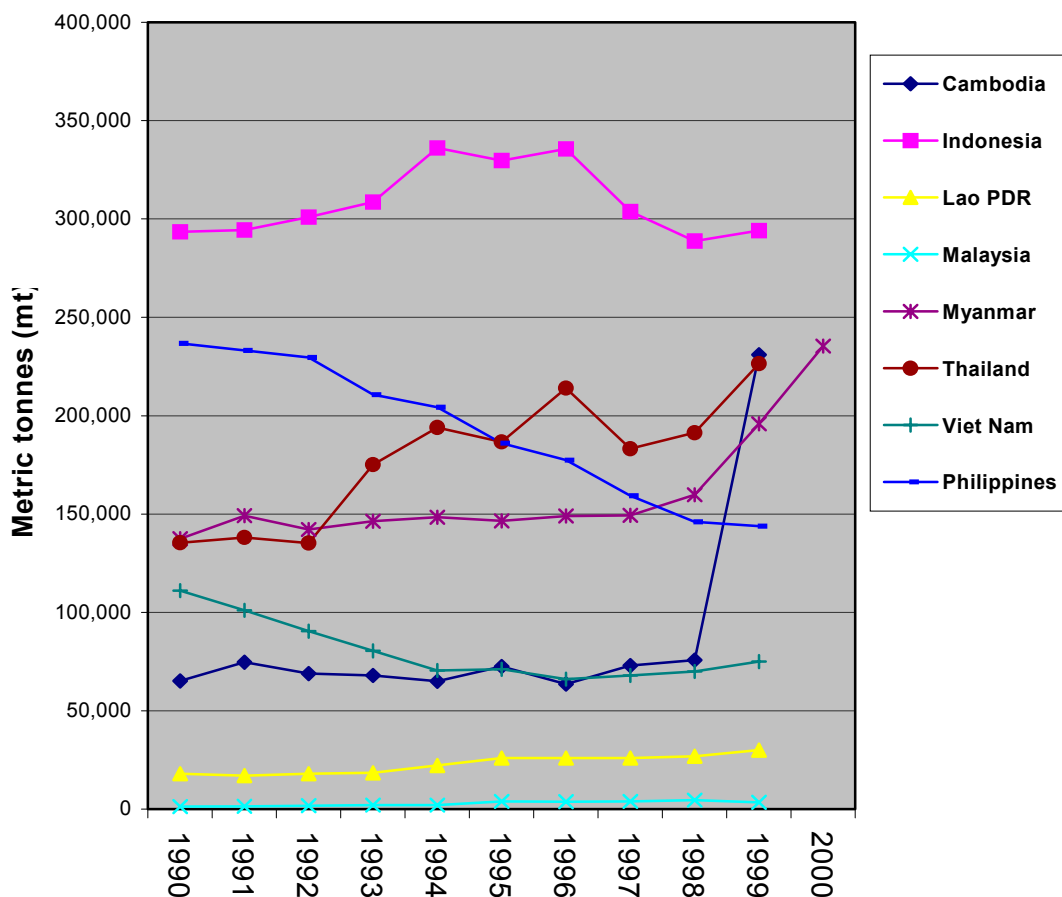


Fig. 1-01 Total reported annual production from inland capture fisheries for selected countries in Southeast Asia. (Figures supplied by Myanmar differ from those reported by FAO)

The increase in reported production for Cambodia in 1999 is due to re-estimations based upon scientific surveys. However, two countries report significant increases in actual production. That for Thailand is stated to be due to the impacts of stocking in reservoirs; and the Thai statistics apply mainly to reservoirs. Myanmar reports significant increases in production from river and floodplain fisheries over the past 4-5 years. It was achieved without any significant physical inputs (e.g. fish feed) and is based purely upon improved aquatic resources management (environmental restoration and rehabilitation, restocking floodplains and improved governance). Of all of the countries reviewed, Myanmar has the most extensive and comprehensive inland capture fishery statistical system and there is more confidence than in most countries that the reports may be representative (but likely still underestimates). This is a most interesting case, which demonstrates the great benefits on offer through applying management effort to riverine fisheries. The reported increased catches are 45 percent and 65 percent per annum from leased (large fenced areas of floodplain) and open fisheries respectively; and this is from a fishery of already significant proportions. This example eclipses any known benefits arising from investments in aquaculture (when starting from similar production levels) and emasculates the widely held view that river fisheries cannot be improved and therefore do not warrant investment.

However, the general degree of confidence in these statistics, based upon methodologies applied to generate them, varies considerably. Assessing their accuracy is of course difficult, because better statistics are normally not available for comparison. But a number of approaches can be taken to try to verify the figures. The mission stresses that such verification should be done in more detail, and by the competent authorities in question. Statistics should not be revised externally. The current analysis is used to provide a general overview of the possible extent of mis- and under-reporting.

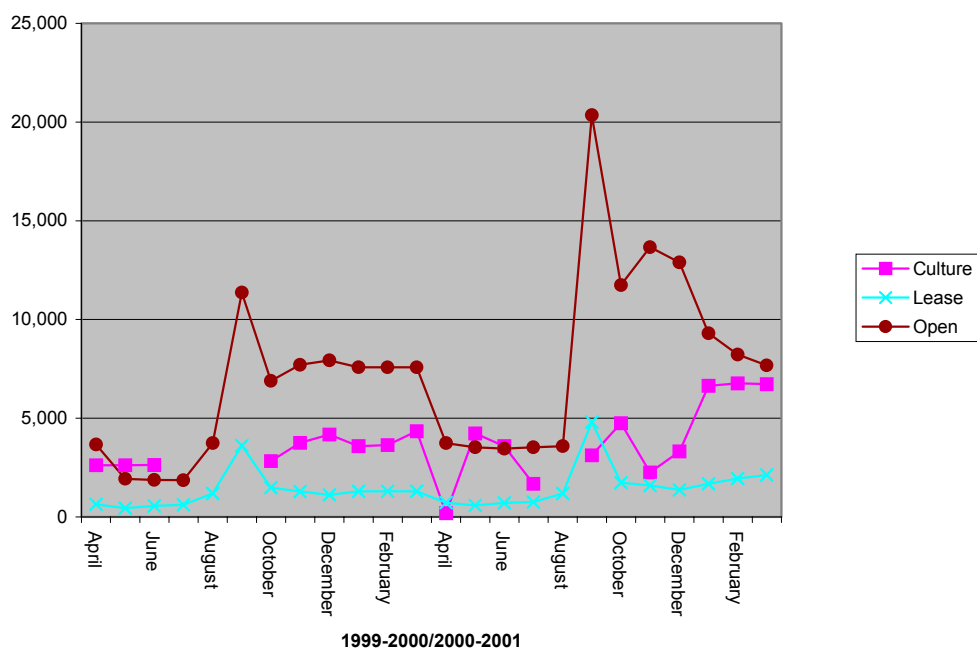


Fig. 1-02 Reported production by month for aquaculture, lease and open fisheries (1999-2001, MT) for Ayeyarwaddy Division, Myanmar

Riverine fisheries in the tropics, for example, are known to be highly seasonal. Statistics for inland capture fisheries for areas dominated by rivers should, if representative, reflect such seasonality. The mission has been able to obtain catch statistics dis-aggregated by month or by quarter in only a few cases (see Part II). Catches from river/floodplain fisheries are supposed to show within-year variations as illustrated in Fig. 1-02. Unfortunately, monthly (or quarterly)

reports for areas dominated by riverine fisheries in Indonesia and Malaysia show no such seasonality and question, if not discount, the validity of the underlying data (see Part II).

It is known that in many countries the statistical methods exclude or seriously under-estimate some parts of the fishery. Estimates for such sub-sectors can be applied based upon experiences from scientifically based surveys from elsewhere (preferably within the same country, or for equivalent types of fishery in broadly equivalent areas). It is also known that statistics based upon reporting can be unreliable and potential corrections can be applied using known variations between actual and reported catches. This applies particularly to the more prominent licensed and leased fisheries where large taxes are levied or revenues extracted. Such approaches have been applied superficially in Part II. A summary of the findings is presented in Table 1.3.

For all of the countries reviewed, the analysis shows that production from inland capture fisheries is clearly seriously under-reported. In many cases, reported production has been checked by making comparisons with independent survey data available for the same countries. For those countries, or areas, where survey data are not available there is no reason to assume that the statistics reported are any more accurate. The discrepancy between officially reported catches (where available) and estimates based upon independent scientifically based surveys (*i.e.* collecting actual data for the same areas) varies by a factor of between 4.2 and 21.4. Overall, for all the countries combined, total reported catches from inland waters appears to be under-estimated by a factor of at least between 2.5 and 3.6 (Table 1.3). Based upon actual survey data the latter figure could still be an underestimate of the discrepancy. This margin of error agrees with the minimum thought to be applicable to reported catches from inland waters worldwide (FAO, 2000a).

Total reported freshwater aquaculture production in the same Southeast Asian countries for 1999 was 1 268 968 MT. This figure is already surpassed by only the reported freshwater capture fisheries production (1 303 247 MT). Actual production from inland capture fisheries, amongst the countries in question, likely exceeds reported aquaculture production by a factor of between 2.5 and 3.6 (Table 1.3). This is also after the supposed “decline” and “degradation” of inland capture fisheries. If the decline is real, one is left wondering what production was like before. The most interesting question that these figures raise is why most countries (Myanmar and Cambodia to a lesser extent) continue to disinvest in inland capture fisheries, some favouring aquaculture almost exclusively. A common answer, apart from the perceived decline, is that it is assumed that production from inland capture fisheries cannot be increased. This is not the case, as clearly demonstrated by Myanmar in this review. And even if true, is not a fishery of these proportions worth effort in sustaining it?

Naturally, many will find the figures in Table 1.3 difficult to accept. They are, however, based upon available information; amongst which the mission has only been selective by favouring facts over fiction. All the calculations need to be repeated properly and methodically and not be done externally to appropriate government authorities. At the very least, Table 1.3 suggests that this is worth doing.

Table 1.3 Summary of comparisons between official statistics and estimated production for inland capture fisheries for selected countries in Southeast Asia (from Part II).

Country	Officially reported annual catches (MT)	Estimated indicative figures for actual catches (MT)	Factor increase from reported to estimated production	Sources of likely error in the official statistics	Basis of the indicative figures
Cambodia:					
(a) Average 1990-1998	69 537	290 000 – 430 000	4.2 – 6.2	Mis-reporting for commercial catches. Mis-reporting by government staff. Under-estimates of small-scale family and rice field fisheries.	Comprehensive scientifically based research and sampling spanning more than 6 years. Historical scientifically based records. Indicative figures based upon internal estimates made by Fisheries Departments themselves.
(b) 1999	230 700	290 000 – 430 000	1.25 – 1.86	Under-estimates of small-scale production and continued disputes over methodologies for statistics interpretation.	As above.
Lao PDR					
(a) National figure (1999)	25 521	150 000-200 000	5.9 – 7.8	Invalid estimates.	Based upon extrapolations from fisheries survey data from various sources and upon a thorough national census of fish consumption.
(b) Luang Prabang province only (1999)	700	10 000-15 000	14.3 – 21.4	Official figures are for the licensed commercial fishery only. Excludes extensive small scale and rice field fisheries.	Sjørsløv (2000).
Indonesia					
(a) Total national (1999)	294 110	800 000-900 000	2.7 – 3.06	Invalid estimates.	Sarnita and Djajadiredja (1968). Indonesia has a very varied inland fishery dispersed over many different islands, some very large. Difficult to estimate production in detail. The indicative figures are based upon resource areas and modest estimates of yield per unit area. Comparison with known production from survey data for Papua New Guinea corrected for population differences.
(b) Irian Jaya only (1999)	2 582	6000	2.3		
Malaysia					
(a) Total national (1999) – peninsula Malaysia only	3 336	10 008	3.0	Based upon DOF's own estimate of under-reporting.	Statistics for Malaysia exclude the main inland fishery provinces of Sabah and Sarawak.
(b) Sabah and Sarawak	0	50 000 – 100 000	***	Rough estimate based upon conservative catches per caput catches from similar areas elsewhere in Southeast Asia.	

Country	Officially reported annual catches (MT)	Estimated indicative figures for actual catches (MT)	Factor increase from reported to estimated production	Sources of likely error in the official statistics	Basis of the indicative figures
Myanmar Total (2000-2001)	235 376	600 000 – 900 000	2.5 – 3.8	Incomplete coverage of fishery. Underestimates (reports) of catches No ricefields/reservoirs included.	Comparisons with known under-reporting for very similar fisheries in Cambodia, estimates based upon resource areas, plus allowances for rice fields and reservoirs. Official figures exclude reservoirs and rice fields. Myanmar has the population and resources to justify the upper estimate based upon data for similar areas with comparable fisheries in Southeast Asia.
Philippines Total (1999)	143 857	***	***	Inappropriate or out-dated frame survey upon which sampling is based. Likely under-estimation of small-scale informal catches. Under-reporting by licensed fishers.	Only limited time was available to review the Philippine statistics and attempts at re-estimating the figures were not made.
Thailand (a) National total (1999) – primarily reservoirs	226 510	122 314 to 318 909 (reservoirs only)	0.54 – 1.4	Virapat <i>et al.</i> (2000).	The Thai figures apply mainly to reservoirs which are confirmed by reference to estimates made by Virapat <i>et al.</i> (2000). Available but localised survey data for Thailand and comparisons with similar areas.
(b) National total – all inland areas	----	350 000 – 800 000	-	Inadequate coverage of fisheries beyond reservoirs. Catch estimates only from licensed fishers (the minority).	These figures include the full range of estimated production for reservoirs and between 200 000 – 500 000 MT for fisheries outside reservoirs including capture production from rice-fields and brackish-water inland fisheries (currently reported as coastal production).

Country	Officially reported annual catches (MT)	Estimated indicative figures for actual catches (MT)	Factor increase from reported to estimated production	Sources of likely error in the official statistics	Basis of the indicative figures
VietNam					
(a) Total (1999)	75 000*	600 000 – 800 000	8.0 – 10.6	Lack of reporting from Provinces to central register. Inadequate cover of the fishery Invalid estimates based on licensed gears with under-reporting.	Rough estimates based upon survey data, resource areas and populations. *There is likely reporting error in the figure for national production (as reported to FAO) since the official figure for a single province is 64 000 MT.
(b) An Giang province only (1999)	64 000	273 118	4.2		Based upon survey data (Sjørøsløv, 2001). Official figures refer mainly to licensed gears. Using survey data to calculate production using the official statistical method gave a result within 4percent of the official figure. The official figure therefore was concluded to be accurate but did not adequately cover the whole fishery.
TOTALS	1 159 390	2 850 008 – 4 140 008	2.5 – 3.6		
(using national production figures only; 1990-1998 average for Cambodia; excluding Philippines)					

4.3 Sources of error in the official statistics

Potential sources of sampling error when routinely collecting data for capture fisheries are covered in detail in FAO (1999a). This includes much more attention to statistical errors and adequate sampling approaches. The following summary refers to general problems with inland capture fishery statistics in the countries in question.

Although problems and their significance vary between countries (see Part II), the following general errors are inherent in the current inland capture fishery statistics.

4.3.1 Errors in catch reporting

Obviously, catches reported by fishers depend on two major factors:

- (a) The ability to recall what actual catches were. Most methods of collecting statistics require at the best monthly recall of catches, many require yearly recall. Scientific surveys have shown that the ability to accurately recall (remember) what catches were drops off significantly beyond only 48 hours. Most inland fishers do not record their catches, but many do and this group falls generally under the problem area below. Recall is particularly a problem where household heads are asked about total household catches. They tend to report only their own catches and are unaware of catches made by other household members, particularly women and children.
- (b) The willingness to report. In most countries, fishers are subject to licensing and other regulations enforced by the same personnel that collect catch information. Quite logically, they see links between catch reports and taxation or other costs to them. Not surprisingly this does not encourage accurate reporting. [Although this is a potential problem with marine fisheries also, in that sub-sector reports can be reconciled against landings, processing/marketing, export records and expectations based upon catch/effort, e.g. vessel size].

These problems can be significant. For example, even with the relatively well monitored commercial, industrial and middle-scale sections of inland capture fisheries in Cambodia, by the Fisheries Department's own estimates, catches are under-reported by a factor of at least 3.0.

4.3.2 Under-estimates of the importance of small-scale fishing activities

This is particularly a problem in inland fisheries. The high levels of participation in small-scale activities may produce small catches per caput but cumulative catches can, and usually do, exceed those from the more professional, full-time, fishers. This is a serious problem because most, if not all, countries that produce statistics based upon some consideration of fishing effort and reported catches derive these on the basis of records of professional fishers. The few examples which reportedly include small-scale activities, seriously under-estimate their extent. Table 1.4 provides some examples from amongst the countries in question that illustrate the potential sources of error by under-estimating, or not including, the small-scale sector.

Table 1.4 Some examples of the importance of small-scale fisheries to inland capture fisheries production in Southeast Asia. (Further details are included in Part II)

Country / region	Percentage of households involved in small-scale fishing	Proportion of total catch for the area taken by small-scale gears	Notes	References
Cambodia, Tonle Sap	64%	62%		Ahmed <i>et al.</i> (1998) Van Zalinge and Tana (1996).
Lao PDR Luang Prabang province	83%	<95%		Sjørnslev (2000).
VietNam Floodplains, An Giang province.	63%	<85%	"Part-time" fishers catch more than twice as much as "professional" fishing category. Fishery cannot be adequately described or monitored using "professional" fishers as the main representative group.	Sjørnslev (2001).
N.E. Thailand	60 - 93%	<90%	Only 5.5 percent of fishing households are headed by a professional fisher but this category is used as the sole basis of sampling for statistical surveys.	Suntornratana (2001); Department of Fisheries, unpublished.

4.3.3 Mis-reporting by government officials

There are examples of mis-reporting by local government officials for inland capture fisheries in Southeast Asia. Some fisheries produce very lucrative licensing or other forms of revenue; the most valuable ones generally associated with auction or tender systems. Corruption encourages officials to down-grade the catch reports they submit, to be more in-line with reported revenue, which is less than that paid by fishers. This is recorded in the literature for fishing lots in Cambodia and probably occurs elsewhere. This has a knock-on effect on national statistics, because many countries will also estimate small-scale production as a proportion of reported production from licensed gears.

4.3.4 Estimates made without collecting data

Obviously, estimates made without collecting data or information are subject to significant potential sources of error. Some countries openly report that their estimates are made in this fashion. But for others, at field level, such estimates often substitute for those that are officially supposed to be based upon sampling (Table 1.2, and Part II). Some people are actually quite good at producing reasonable estimates but they require much local knowledge, experience and motivation. Invariably, they favour the more visible and "commercial"/professional parts of the fishery. But more often than not, such estimates are produced in an arbitrary way by people whose main interest lies elsewhere; often with aquaculture. Such methods are also more vulnerable to subjective assessments of trends. Nevertheless, there is considerable scope for improving this method through better quantified approaches, appropriate training and increasing transparency. The method does offer some significant advantages, low-cost being one.

4.4 Other constraints with the existing statistics

4.4.1 Recording participation in capture fisheries

Very few of the countries record participation in the capture fisheries sector to any significant degree in their statistics. Most do not record it at all. Some only report licensed fishers. None record participation in fishery-related activities of processing, marketing, transportation and gear construction etc.

In addition to some indicative figures for participation of households in fish capture as noted in Table 1.4 the following information illustrates the extent to which participation is an important element (summarised from Part II):

- Indonesia reports approximately 500 000 fishers operating in inland waters and part-time fishers outnumber full-time fishers by a factor of about two to one; but this is still considered an under-estimate and likely excludes small-scale (un-licensed) fishers and activities in rice-fields. This compares with about three times as many fishers reported for marine fisheries where the split between part- and full-time is about equal. Correcting inland figures to include small-scale fishers and rice fields would certainly exceed the number for marine fisheries.
- Myanmar has a more extensive licensing system and reports 1 398 410 fishers operating in inland waters in 2000-2001. This is higher than for the marine sector (1 278 000 fishers) and is approximately 3.5 times the number of fish farmers. Even so, the figure for inland waters is based on license records, in practice many small gears are not included and rice-field and reservoir fishing is excluded.
- In Luang Prabang province in Lao PDR (a more remote, mountainous region with a relatively low-key fishery by Mekong standards), 83 percent of households are involved in fisheries and on average 41 percent of those household members actively fish, 20 percent of which are children. If this pattern is typical, this gives an estimate of about 1.7 million fishers nationally (in a country of only about 5 million people).
- In a single province in the Mekong delta in VietNam, survey data suggest that about 1.35 million people rely to various extents on capture fisheries, out of a total of 2 016 949; 45 percent of people actually actively fish (900 000 fishers), 9 percent of these are children and 30 percent women; 5.7 percent of households are involved in fish processing and/or trading, with 32 500 traders in the province, 60 percent of which are self-employed; 66 percent of households are involved in capture fisheries compared to only 14 percent in aquaculture. Yet the popular perception of the inland aquatic resources sector in VietNam is one dominated by aquaculture, where even the existence of capture fisheries in rivers/floodplains is widely denied in some circles.
- A conservative estimate is 1.7 million fishers in the VietNameese part of the Mekong delta alone.

According to FAO (1999b), globally there are 28.5 million people fishing or involved in aquaculture. Of these 15 million are marine fishers, 9 million are fish farmers (freshwater and marine combined) and only 4.5 million are inland fishers. The latter number, however, is exceeded amongst the countries reviewed in this report. The figures above also suggest that at least for Southeast Asia the numbers of inland fishers may at least equal or exceed the number of marine fishers and certainly surpasses involvement in aquaculture by a significant margin. It is unlikely that the countries reviewed are unique in these respects, although the prominence of rice farming in Asia, which includes rice-field fisheries, significantly increases involvement in fishing. The FAO (1999b) report also suggests that globally 41 percent of fishers are full-time (*i.e.* those receiving at least 90 percent of their livelihood from fishing), 35 percent are part-time (deriving between 30-89 percent of their income from fishing) and only 6.5 million people (23

percent) are occasional fishers who derive only less than 30 percent of income from fishing. The latter figure is ludicrous in the extreme.

The problem with these FAO figures on fishers, of course, is that they are based upon a survey of reports from countries. The majority of these do not have figures for numbers of fishers, those that do usually cover full-time professional fishers (usually only for marine) and fish farmers. It is hardly surprising, therefore, that the reports bias perspectives. This is yet another illustration of the danger of summarising the fisheries sector based upon incomplete, inaccurate and in many cases prejudiced reporting.

There will be controversy over the inclusion of occasional and part-time fishers in such statistics. A common argument is that most inland occasional fishers are not “real” fishers. This is an inappropriate view for two good reasons: First even if “occasional” fishers were a lower status category, the definitions used by the FAO report require that proper numbers should still be included (the figures reported ostensibly include any kind of fishing). Second, and more importantly, the relevance of fishing to a person’s livelihood is not directly or simply related to the total amount caught or whether fishing is the main “occupation”. Does the average catch of 280 MT per person per annum make professional fishers in Iceland a higher status category than the 50 kg per annum caught by a poor rural fisher in Southeast Asia, who may not have an income upon which to calculate the contribution of fish to, but without which the family would literally starve?

The importance of fisheries cannot be determined externally and certainly not by applying western formal economic criteria. The valuation of a fisheries and its importance should be defined by the stakeholders themselves and it is crucial that they be given the opportunity to do so. As a basic indication within the complex livelihoods of rural people, nothing is done without reason and we can assume that the level of participation in fishing is a clear indication of its importance.

FAO reports are influential (FAO, 1999b) and may have significant influence on policies. It is suggested that FAO seriously reconsider the potential impact of the inland fishery statistics it reproduces if the figures are known to be inaccurate. An effective first step in this process would be an explanation as to the possible sources of error in relation to inland capture fisheries, coupled to some indication of likely veracity.

4.4.2 Species composition of catches

Most countries report only very basic information on the species composition of catches from inland waters (Fig. 1-03); some countries have slightly better information on species composition at field levels. Where species composition is recorded it tends to include only those considered to be economically important, even then, many taxa tend to get grouped into species groups. Even the most comprehensive systems are generating only basic information and the quality of such information is widely regarded as suspect by most agencies. Some countries do not even have catch composition data enabling them to properly evaluate their own stocking programmes.

Without exception, none of the countries are compiling statistics that are in any way useful for obtaining information on trends in biodiversity; although some obtain such information independently of their statistical systems, usually via research. Monitoring vulnerable species for example is almost impossible using the current statistical system because such species are not common enough in catches to warrant inclusion as a distinct category (although in theory such could be done).

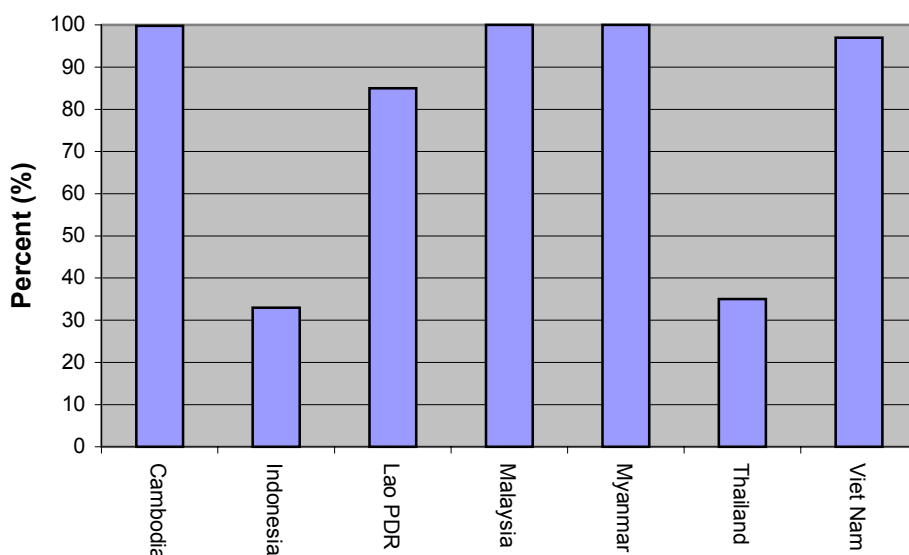


Fig. 1-03 Percentage of reported catches composed of "freshwater species not elsewhere included" (FAO, 1999a)

The Philippines was visited at the end of this mission and unfortunately could not be reviewed in as much detail as would have been liked. The country, however, reports some curious things. An example is the reported catch from inland waters (about 145 000 MT per annum recently), of which about 65 percent is accounted for by molluscs (which is not from culture). This includes a mix of brackishwater (inland) but also freshwater species. There is no reason to assume the country has the only mollusc fishery in Southeast Asia. What is intriguing is how, or if, this catch is reported elsewhere. It is common for fishery statistics to be biased towards fin-fish and it is possible that in many cases these mollusc fisheries are ignored. This is also a problem with rice-field fisheries where a significant proportion of the catch is non-fish, but often only fish are reported, if at all. The prominence of molluscs in the Philippine catches suggests that this subject deserves closer attention.

4.4.3 Monitoring fishing effort

Catch per unit of effort (CPUE) data are useful for monitoring trends in the fishery, particularly for monitoring the state of stocks. A number of countries also base their statistical system on the foundation of calculating catches using CPUE calculations (based on total numbers of gears and total numbers of fishing trips). However, with inland capture fisheries defining and monitoring fishing effort is extremely difficult. Certainly, effort cannot be defined simply in terms of the existence of gears in an area (which is what most countries currently record). The real effort applicable to any particular gear depends largely upon where, when and how it is used, which is not necessarily best enumerated by number of trips. These problems are no different to other fisheries but become more important in inland fisheries because of the predominance of smaller gears, which take the majority of the catch. Also, passive gears are common in inland fisheries and are particularly difficult to assess effort for. Gear use is also influenced largely by social factors external to the fishery. Changes in participation in the fishery can be significant and rapid. For many gears, effort also varies in response to environmental conditions (and the latter are not recorded). For example, effort for some of the larger industrial sized gears such as barrage fences and river bagnets depends on river flow rates (how rapidly floodwaters recede), which can vary significantly within and between years.

These difficulties result in two problems: First, attempts to calculate total catches for the whole fishery based upon CPUE data for gears is very problematic and likely requires a depth of knowledge of effort currently unavailable, and likely unattainable, for most fisheries as a whole. For small-scale activities a better unit of effort is the household (by ignoring for present

purposes how fish are actually caught). But most countries do not record catches by household and those that do often fall into the trap of applying CPUE approaches for gears to household activities. Second, without adequate data on CPUE, statistics for total catches, even if accurate, are of limited use for tracking trends in the fishery stocks in any detail. This does not mean that CPUE data for individual gears are not valuable. They are, and should be collected where feasible and cost-effective. But such cannot be obtained for the whole fishery, not even for the bulk of it.

4.4.4 Aquarium fish

A number of countries have capture fisheries based upon the collection of ornamental species for sale in the aquarium trade. It is important in Indonesia and should not be under-estimated in Thailand (possibly Malaysia and Myanmar also). Few of the countries collect statistics on the activities. It is therefore difficult to establish the relative importance of this fishery, but the ornamental fish industry in Southeast Asia is huge. Capture of ornamental fishes can be locally quite significant and many activities tend to be concentrated in more remote areas where other sources of income are more limited. The fishery is also unusual in that as species become rarer they become much more valuable which can contribute to over-exploitation. This is a specialised area which might perhaps be subject to a regional review, including information and statistics requirements.

4.4.5 Uncritical acceptance

A serious underlying constraint with the current statistical systems in Southeast Asia is the uncritical acceptance of the information that is produced. There are numerous reasons why this happens including:

- (i) Complacency; some authorities are little motivated to try to improve the interpretations of their statistics
- (ii) In some cases there are vested interests at stake in keeping the production figures low (especially where large revenues are involved with licensing, but also sometimes to justify investments in alternative sectors)
- (iii) Reluctance to admit previous figures are wrong (this is especially a problem for districts and provinces reporting to higher authorities)
- (iv) Incompatibility between statistical systems and data or information arising externally to them (government statistics are compiled in certain ways and it is often difficult to incorporate better information into them from other sources)
- (v) There is a tendency to treat the information that is collected as actual statistics that are based upon data. When working with data there is less scope for interpretation than when acknowledging that a figure is an estimate or even a guess ('ballpark figures'). The official statistics that are produced are often regarded rigidly; although for any data, the methods used to obtain them, including sampling aspects, leave more flexibility than is currently used for inland fishery statistics. Most, if not all, statistics on inland capture fisheries in Southeast Asia are not founded upon data, thus presenting them as data limits options for interpretations. Formal acknowledgement of the limitations of information collection would allow greater flexibility and ultimately more meaningful information. Hopefully, this report will be comforting to many countries as they learn that they are not alone in having unreliable statistics or problems with the methods of collecting them. Perhaps the greatest progress can be made by simply admitting this.

4.5 Relationships between the methods used and the accuracy of the statistics

A major objective of the current review is to advise countries how they might improve upon their information and statistics for inland capture fisheries. With such a wide range of countries, methods used to compile the statistics and the growing knowledge on the accuracy of the information, it should be possible to draw some conclusions by comparing experiences between them.

The first conclusion is that countries cannot be ranked in order of those having the “best” statistics. The current statistics must be viewed not only in terms of potential accuracy but in terms of effort expended (cost) in obtaining them. For example, Lao PDR has statistics that differ from survey based estimates by a significant margin but spends practically no money generating them. Its system also has the considerable advantage that, in theory, figures can be modified relatively easily in the light of improved information availability from non-statistical sources. But most importantly, its figures are not that much less accurate than some countries that spend significant effort compiling them. Some countries with elaborate, formal and rigid statistical systems are in fact arguably worse off. Costs are high and they tend not to work. But because these systems are in place it can be difficult to produce better information in different ways, and more cheaply.

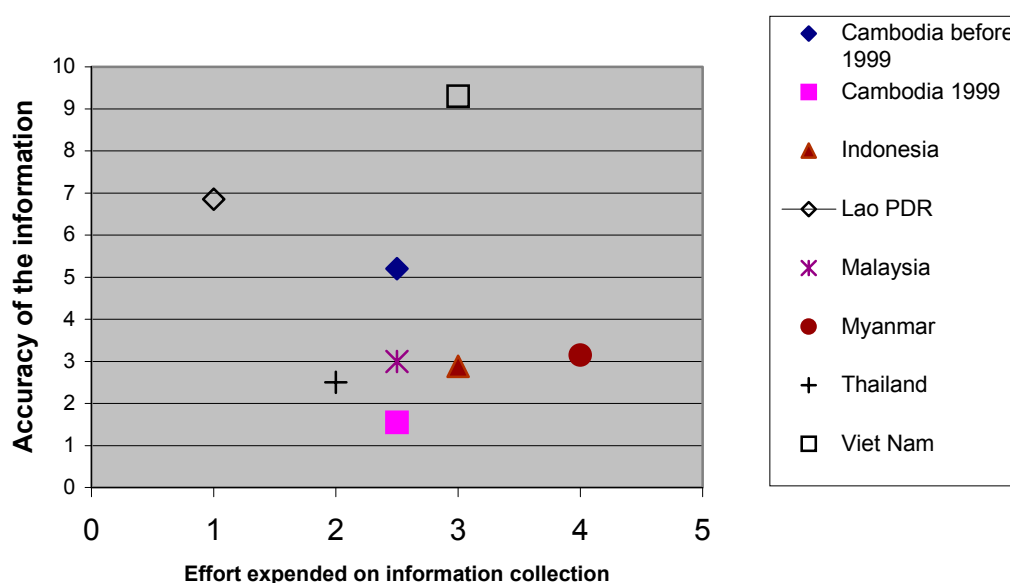


Fig. 1-04 The relationship between effort expended on collection of inland capture fishery information and the perceived accuracy of that information

A graphic representation of conclusions on this subject drawn from the information presented in Part II is illuminating. Fig. 1-04 presents the relationship between the estimated inaccuracy of current statistics (based upon mean indicative figures for likely actual production from Table 1.3; a value of 1.0 being total accuracy) and rough indicator of effort expended on information collection (based on a scale of 1, the least, to 4, the highest; from details on statistical systems provided in Part II). It is of course difficult to draw firm conclusions from such a simplistic analysis but one major one is obvious: One would expect accuracy to increase with increasing effort in data collection, but there appears to be no straightforward relationship between effort (costs) expended on information collected and the relevance of the information. This has very significant implications for those thinking of investing heavily in improved inland fishery statistics based upon current models.

Perhaps the most relevant example is for Cambodia. Two “data” points are provided in Fig.1-04, the first for statistics up to 1999, the second for 1999. The mean factor of uncertainty in the latter estimate is about 1.55 compared to 5.2 prior to 1999 (that is, the 1999 estimate has improved in accuracy by 335 percent). However, both estimates for production are based upon the same statistics collection system. Infrastructures and data collection methods were not significantly changed. The 1999 figures essentially represent earlier figures re-estimated in response to considerable research. Therefore, Cambodia has shown that statistics can be improved without changing statistical effort. The same statistics could indeed quite likely be obtained with significantly less effort; in fact, probably without any statistical data collection effort at all (by estimating from research data). However, what is most informative about the Cambodia experience is that despite a considerable (donor funded) investment in research and survey work spanning six years, and focussing heavily (but not exclusively) on improving fishery statistics, the current estimates of actual production made by the Department of Fisheries itself shows a range of 290 000 to 430 000 MT which is still 1.25 to 1.86 times the official statistics. It would appear, therefore, that there is a limit to narrowing the inaccuracy of such statistics (within reasonable limits of investment and effort). Two further conclusions can therefore be drawn:

- (i) There is a level of accuracy with inland fishery statistics beyond which it is unreasonable, if not impossible, to go beyond. In other words, statistics should purposefully provide indicative figures, not necessarily highly accurate ones, and
- (ii) In addition to this “optimal range of accuracy”, due to statistical methodologies, there are known significant but unpredictable natural variations in the fisheries between years. Therefore, statistics of the nature currently collected will be near useless for tracking all but the most drastic of trends, even if their accuracy is improved. And they certainly will not be able to explain why the trends are occurring. This is the likely explanation as to why most statistics indeed do not currently reveal any trends, not that they are not there. In other words, information on trends must be obtained in other ways.

4.6 The purpose of inland capture fishery statistics in Southeast Asia

One of the most interesting and relevant areas investigated by the mission was that of the objectives of compiling inland capture fishery statistics and the use to which the information is put. The following is a general synthesis of opinions of senior managers and a summary of actual practice (these do not all necessarily apply to all countries; specific comments by country are included in Part II):

- (i) There is a definite feeling, in many countries, that “statistics” are compiled because central governments request them. But the use to which the statistics are put is often uncertain.
 - *Whilst many specialists appreciate the shortcomings of the information compiled, forwarding incomplete or unrepresentative information to central government agencies is extremely dangerous.*
 - *Those that know the data might moderate policy considerations accordingly, but those that do not, might take the statistics at face value. Hence, there are examples of planners in central governments who are unaware that significant inland capture fisheries exist in their countries. Getting appropriate information to these people is important.*

- (ii) National fishery statistics are frequently compiled primarily as a perceived obligation to FAO.
- (iii) The information requested by FAO has a major influence on that which is collected or compiled.
- (iv) Countries are reluctant to admit to FAO (and often to their own agencies) the true nature of the information compiled. Consequently, the “statistics” are often taken as factual.
 - *For example, of the 8 countries reviewed, only the statistics for VietNam are listed in FAO documentation as estimates. Those for Lao PDR are listed as estimates to 1992 but thereafter presented as actual statistics (which is not the case; the Lao figures have never been based upon data collection). Of the other five countries, in reality most also estimate their catches.*
- (v) Most countries report that the statistics are used for “fisheries management purposes”
 - *but few countries are actually managing their inland capture fisheries, at least at the national level (except for reservoirs, usually through stocking)*
 - *even if they were managing the fisheries the information produced through their statistics is not adequate for most management purposes*
 - *in the few cases where fisheries management occurs, the national statistics are of limited use in assessing the impacts of management; or meaningful statistics are only gathered where management is in place (e.g. for reservoirs)*

The most important conclusions, however, are that without exception, the countries:

- (i) Regard the main value of their inland capture fisheries as relating to sustaining the livelihoods of poor rural communities and associated aspects of food security (not withstanding that many countries still have significant commercial/industrial inland fisheries). By contrast, in general, marine fisheries are regarded as being important for revenue generation, export earnings and formal economic benefits, and in many cases so is aquaculture.
- (ii) Agree that the current information collected (even if it were accurate) does not provide information of the kind necessary for addressing, monitoring or managing rural livelihoods issues
- (iii) Have a clear realisation of the need to obtain such information but considerable uncertainty regarding how it can be done and who should do it
- (iv) Agree that the main threats to inland fisheries, particularly for rivers and associated wetlands, less so for reservoirs, is habitat loss and environmental degradation, the information currently collected does not assist in monitoring such trends, nor with moderating the degradation itself
- (v) Recognise the importance of issues relating to sustaining biodiversity in inland waters, but that the current statistics are widely regarded (correctly) as irrelevant to this subject
- (vi) Recognise that improved and effective governance of the fisheries must be founded upon co-management approaches.

During this review, the mission could not avoid the overall impression that the countries in Southeast Asia, in general, struggle with limited resources to compile information that, in many cases, they do not themselves trust, need or use. Meanwhile, most appreciate what information would be more logical to collect but lack the methods and support to obtain it.

4.7 Historical influences upon the current statistical systems

The history of fisheries research and management has had a significant impact upon statistical collection. The subject of research was reviewed by SIFR (1992). Development projects in the 1950s and 1960s promoted improved gear and vessel technology, almost to the exclusion of other, non-technical considerations. The quest was for increases in gross production to maximise profit and to feed rapidly growing populations, no matter what the other implications were. This was based originally partly upon the concept of inexhaustible stocks or exploiting new ones as existing ones showed signs of fatigue. In some areas there were deliberate policies of maximising “profit” by using more and more effective gears, which required, often deliberately, the reduction of participation in exploitation, especially marginalisation of the poor.

But in the 1970s it became apparent that the marine fisheries were in trouble and that limits to production were being reached. Some stocks were even collapsing, a trend which escalated thereafter. Fisheries began to run out of stocks. Aquaculture became the argued panacea for the problems and was to save the world from starvation, despite much of the initial effort being devoted to high value luxury species that are net consumers of fish. Aquaculture did indeed progress well and even later included more attention to the production of fish for less affluent consumers. It was particularly successful in Asia, but aquaculture production was frequently promoted solely on the concept of maximising production and profit. Equity, participation, livelihoods, food security were not issues that had been considered until recently. Neither were the environmental impacts of aquaculture or underlying constraints to its development immediately acknowledged. This situation has been slowly changing as we begin to better understand the potential role of aquaculture and also its limitations.

The emphasis of attention through this period was on declining marine catch, and subsequently aquaculture development. Inland fisheries were largely ignored and they were not covered in detail by the SIFR report itself. Research and development in the fisheries sector was dominated by marine scientists, a trend which continues. Additionally, the dispersed nature and relative inaccessibility of many inland fisheries resources made it difficult to maximise profits by placing exploitation in the hands of a few. The fact that the major inland fisheries were not easily (or rather comfortably) accessible to most western scientists contributed to their neglect. Most inland fisheries were also, and still are, so well developed in terms of traditional exploitation that the opportunities for improved gears and technology were limited, leaving technocrats in a quandary about what to do in freshwaters. To this day, the level of participation in inland fisheries, the near impossibility of compartmentalising the resources into the hands of the few and the extent of use of appropriate technologies remain their greatest assets. In the light of recently changing policies towards more livelihoods centred approaches, these attributes may yet be properly acknowledged and some overdue attention paid to the valuable role played by inland fisheries.

This brief history of fisheries was accompanied by three other relevant developments:

- (i) Capture fisheries research was driven mainly, if not exclusively, by the presumed need to understand biological and ecological aspects of fish stocks and their responses to increased exploitation. The objective was to establish maximum sustainable yields (which, with hind-sight does not appear to have prevented the decline of many stocks). Technology centred on how to catch the most fish and what to do with it once it was caught. Aquaculture research also focussed on biological and ecological aspects, the objective being to maximise production with minimal inputs of feed. The concept of aquaculture was narrow, focussing only within easily managed boundaries (*e.g.* ponds, cages, raceways) that could be easily defined. Simplification of production was the goal, to be achieved through complete control the production cycle and, as far as possible, by deliberately minimising participation. More people meant more overheads and less profit. (Extensive aquaculture is a relatively recent area of interest, at least for western scientists). Economics figured largely in both sectors but only in the narrow sense of maximising profits. The more qualitative social, environment, equity and alternative management aspects were largely neglected.

- (ii) Alongside this, a fisheries training and education infrastructure developed to support these perceived and narrow needs (e.g. large numbers of people were taught how to calculate mortality rates for fish and why it was essential to know this, yet few were taught about practical issues such as what poor people needed in order to survive, and how their options were narrowed by the degradation of their local environment).
- (iii) The current statistical systems in place, by-and-large, grew up in parallel with this process. We can only speculate if the statistics reflected the above developments or were responsible for them. The reinforcement of one by the other resulted in serious lack of attention to inland fisheries.

One result of this process has been that the research and management needs of inland fisheries have generally been addressed by trying to impose upon them approaches and methods developed for marine fisheries. The most relevant illustration of this is the inland capture fishery statistical systems in place in Southeast Asia. They are all based upon concepts, methodologies and objectives developed for marine fisheries. Some have even recently been modified as a result of experiences from aquaculture. Of course, it is prudent to learn and improve by experience, but are inland fisheries just small, poor relations of marine fisheries and aquaculture? This review has attempted to show that in fact inland capture fisheries are neither small nor “poor” and that the time has arrived to accord them their deserved status. These fisheries are important enough to develop statistics/information systems and also management approaches that are specific to their unique characteristics.

The above description has been included because this history continues to dog attempts to better the situation of inland fisheries. In Southeast Asia, inland capture fisheries at least equal aquaculture in terms of production based only upon official statistics, and actually is likely to be at least double. Participation is probably in the order of at least three times higher than aquaculture and is dominated by the rural poor. Despite this, there is not a single regional institution or agency providing significant long-term support to inland capture fisheries (management, research or training) in Southeast Asia²; and probably very few at national level. Projects supporting the sub-sector are also rare. The situation is no better worldwide; institutions covering marine fisheries or aquaculture are almost so numerous as to be vulnerable to claims of duplication of effort. What has been the role of statistics in this historical neglect?

4.8 Shifts in policy emphasis by countries, donors and international agencies

Recently, there have been three significant and inter-related shifts in policy emphasis. Firstly, towards policies in which poverty issues are becoming more prominent, if not central (social exclusion from fisheries, poverty reduction and alleviation, equity, gender, food-security etc.). Secondly, greater emphasis on the environment, the biodiversity it supports and how these are linked to sustainable development. Both of these are part of “*livelihoods centred approaches*”. Thirdly, the promotion of co-management systems for fisheries, based largely on the concept of participation of stakeholders in the governance process. It has already been noted that the existing statistical systems fall well short of addressing the first two needs, to which now can be added the observation that they are also, being based essentially on extractive methods, not particularly compatible with the third.

4.9 Opportunities for shifts in information support at FAO

FAO has historically been one of the few international agencies with competence and interest in inland fisheries and has had its achievements in this field. Nevertheless, FAO has been an active participant in the aforementioned history of fisheries research and development and its implications for current perceptions of inland fisheries. FAO has had a high profile role in some of the priorities and policies that have been developed over the years, particularly so in

² The MRC Fisheries Programme is considered short-term, it is scheduled to be decentralised to national governments, and it is not a core activity of the organisation.

developing countries. FAO is also the leading international organisation in terms of statistics for food and agriculture. In this respect it continues to have a pivotal role. Many countries have based their statistics either upon advice from FAO or upon the information that FAO requests. Many will continue to do so.

The *Strategic Framework for FAO 2000-2015* prominently includes an institutional strategy focused on poverty eradication and food security. Among its main components that Member Nations decided to indicate as fundamental are:

- (i) Improving the opportunities available to the rural poor to strengthen, diversify and sustain their livelihoods by taking advantage of the potential synergies between farming, fishing, forestry and animal husbandry, including through pre- and post-production income-generating enterprises;
- (ii) Supporting efforts to strengthen local institutions and to enact policies and legislation that will provide for more equitable access by both women and men to natural resources (particularly land, water, fisheries and forests) and related economic and social resources;
- (iii) Improving the efficiency and effectiveness of public and private sector response to the multiple and differing needs of disadvantaged rural populations, notably of women and youth;
- (iv) Promoting gender-sensitive, participatory and sustainable strategies and approaches, based on self-help, capacity-building and empowerment, to improve the skills of the rural poor and local, civil society and rural people's organizations;
- (v) Assisting in the targeting of investment in the agricultural, fisheries and forestry sectors - from public and private, domestic and international sources - that contributes to food security and poverty eradication.

The framework includes sustainable livelihoods as one of its goals, therefore, it is mandatory. Sustainable livelihoods principles (rather than a particular framework) are to be more widely and systematically incorporated into FAO's normative and field programme. The strategy includes a number of proposed initiatives to internalise and consolidate sustainable livelihoods approaches. Oddly, this does not appear, based upon a superficial review by the mission, to have explicitly included amending statistics to incorporate more meaningful cover of livelihoods relevant information (although such would be implied from the strategic framework).

A visit to the FAO website (www.fao.org) reveals that the Fishery Information, Data and Statistics Unit (FIDI) describes its function as:

“FAO is the only source of comprehensive global fishery statistics and most reviews of the state of world fisheries, past trends and future prospects rely on FAO statistics. FAO analyses these statistics in order to monitor many aspects of world fisheries such as fishery production from capture fisheries and aquaculture, production and trade of fishery commodities, fish consumption, fishery fleets, and employment in fisheries. On the basis of these analyses, FAO prepares advice on fisheries policy to member countries.”

FIDI maintains various databases relevant to these fields, based largely upon information inputs from member countries, and they are indeed widely used. The information currently collected is important. However, as already intimated, statistics for “production”, “trade in commodities” (by which is largely meant international trade), “fleets” and “employment”, whilst relevant, are not those areas of most direct relevance to sustainable livelihoods issues (especially for inland fisheries). “Food security” is more directly relevant but the current FAO statistics favour simplistic analysis at the national level based upon information on domestic supply (production, minus exports, plus imports).

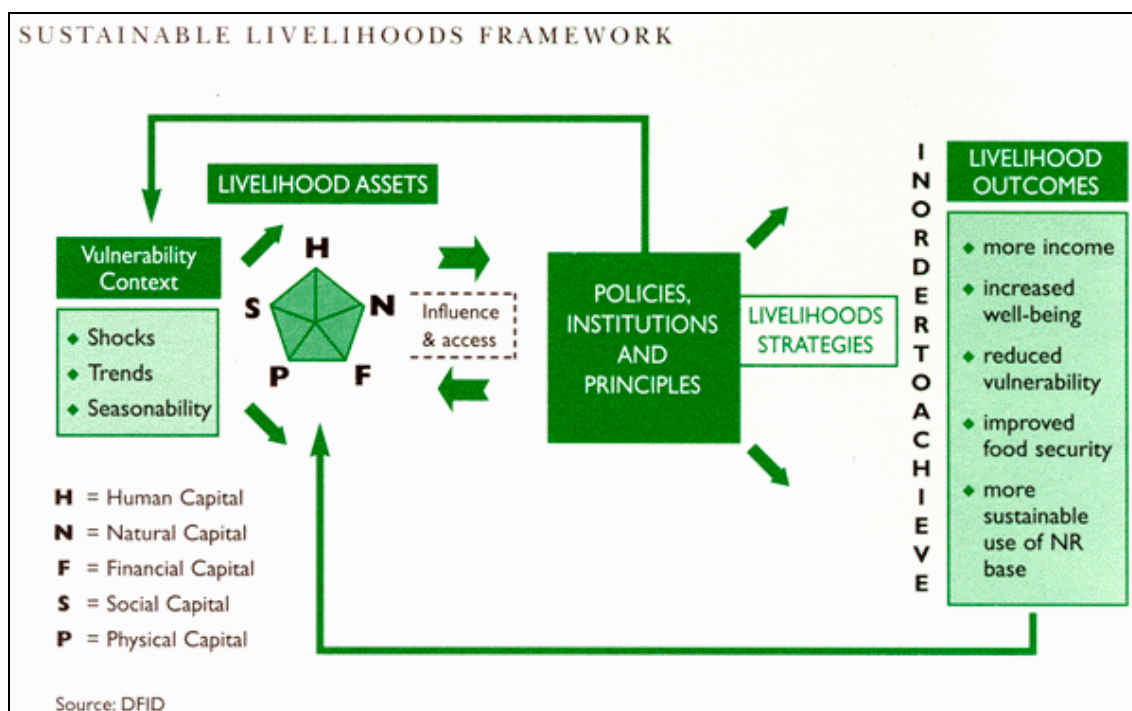
The information strategy of FIDI “----- aims to remove constraints relating to effective and efficient utilization of data and information for the sustainable contribution of aquaculture and fisheries to the food security and improved nutrition for all, thus helping the Member countries to address new and emerging challenges in the management and development of aquaculture and fisheries sectors.” Subsequent descriptions of activities, however, are not particularly focussed on sustainable livelihoods. Again from the stated strategy: “The whole purpose of compilation and analysis of data and information is to put usable information in the hands of target users, thus facilitating problem solving and informed decisions and actions.”

It is not obvious that “sustainable livelihoods” related information is a priority requirement currently at FIDI. If it is, none of the fisheries departments in the countries covered in this review appear to be aware of it.

A significant challenge for FAO and an important step in the new millennium, is whether it is able to respond rapidly to shifts in policy and emphasis by adjusting its information generation and dissemination activities to cater for these new needs. It will be constrained in doing so because many member countries themselves will have difficulties in shifting emphasis to more pro-poor, livelihoods oriented, information generation. But there is the opportunity for FAO to be pro-active and to start to request such information, and to member countries on how it can best be generated. Presently, alerting countries to this need is more important than obtaining the information itself.

4.10 “Sustainable Livelihoods” approaches

All people interviewed in the countries visited are aware of the subject of “sustainable livelihoods” and why it is important in relation to inland capture fisheries. There is however considerable confusion over terminology. There is also widespread uncertainty as to how to incorporate such approaches into information and management systems, but full acknowledgement of the need to do so. Unsurprisingly, local communities, who have the relevant livelihoods most at risk, understand the concepts better than scientists or managers do. Sustainable livelihoods and co-management approaches therefore go well together, if not being the same thing. There are a number of frameworks or descriptions of livelihoods principles one of which is illustrated below (DFID-FAO, 2000).



For anybody experienced in inland fisheries, such livelihood framework concepts are not new. We have, in fact, been arguing for such approaches, in differing ways, for a long-time. The frameworks do no more than formalise the setting of inland fisheries within rural livelihoods. And inland capture fisheries fit very nicely indeed into such a framework. The “livelihood outcomes”, of management/development actions (see above) are exactly those most relevant to inland fisheries.

The promotion of sustainable livelihoods focused information does, however, present a number of challenges. Livelihood “capital” (human, natural, financial, social and physical; see above) can obviously vary according to circumstances. Some communities might, for example, have substantial financial capital (money), others less so but have more natural capital (natural resource assets, e.g. wetlands). It is obviously the combination of these assets that underpins livelihoods. However, it is quite legitimate to exchange different kinds of capital assets, provided the overall outcome is improved livelihoods.

For example, reduced reliance on natural assets is achievable if compensated by increased sustainable financial assets. This in effect is the argument put forward by many planners for decades regarding river fisheries; that is, that the natural assets of rivers should be stripped or re-allocated for the benefit of macro-economic growth (improved financial capital); degradation of the environment, and the fisheries along with it, was justified; damages were argued to be compensated for through reservoir fisheries and aquaculture. There is a certain simplistic superficial credibility to such a policy, but applying the above sustainable livelihoods framework would force those promoting it to justify their claims and to show that those incurring the impacts of river degradation were net beneficiaries of the developments causing it.

This trading of benefits of various forms of assets forces the inland capture fisheries sub-sector to adopt a more holistic position. For example, sometimes it is indeed logical to sacrifice fisheries for other benefits, provided it is planned and the livelihood outcome objectives are reached. But this has significant implications in terms of information requirements. That is, information on livelihoods and fisheries is only relevant in relation to information for other livelihoods assets. Therefore, fisheries information must not be generated independently. This requires all the various sectors to work together much better. Fortunately, the challenge is not as daunting as might be thought: First, most government agencies are, or should be, moving in the same directions regarding information. Second, co-management requires participation of the stakeholders in the processes; and the rural agrarian poor, generally, and particularly on floodplains, tend not to compartmentalise their livelihoods into sectors in the first place.

The biggest challenge, however, is to develop the tools with which to cost-effectively generate information (statistics) relevant to livelihood considerations. Some background to the kinds of information relevant to such policies is provided, for example, by DFID (1999 – and related information). For those without adequate access to such information an overview of information requirements is included in Annex I. Unsurprisingly, the information required to cover the full spectrum of livelihoods relevant considerations is substantial. However, those interested in improving livelihoods and poverty aspects of inland capture fisheries information should note the following:

- (i) Nobody expects authorities to make sudden and drastic leaps towards these goals, it is more important in the short-term to recognise the needs than to meet them.
- (ii) A gradual shift towards relevant information is logical, by identifying where opportunities exist and, where necessary, within existing information systems.

- (iii) Fisheries related agencies would not be expected to produce the full spectrum of information; they would be working alongside others with similar goals, including other agencies, NGO's and local communities.
- (iv) Fisheries related agencies may, in fact, not be required to produce the information at all. Requirements might be met by such agencies promoting others to generate the information. An appropriate role of fisheries agencies, in the long-term, could well be overseeing the information generation and compiling that part of it relevant to government statistics.
- (v) It is not necessarily the case that existing information generating activities be abandoned (although priorities, methodologies and approaches should be reviewed – but that is necessary in any case).

But reviewing current literature and information will not help most agencies interested in such approaches to decide what to do in practice nor how to do it. Therefore, this review recommends that a priority is to produce guidelines (or provide direct technical assistance) to assist countries how to move their information generation activities, for inland fisheries or more broadly, towards livelihoods centred approaches.

4.11 Co-management and information generation

The move towards co-management approaches for fisheries offers significant opportunities to improve information generation. Information systems based upon catch reporting by fishers will always be unreliable as long as fishers and government officials are at odds with each other. In fact, it is largely because current information systems are extractive by nature that they are inherently unreliable. Effective co-management should improve confidence between fishers and government staff and along with it the willingness to divulge more accurate information. Not only does this obviously offer potential improvements in accuracy but it could well significantly reduce information generation costs (enabling government staff to focus on other aspects of information generation).

The current inland fishery statistics in Southeast Asia, in general, are notable for the apparent absence of links between the information and management. This does not encourage either government officials or fishers to take their generation seriously. What is required is for stakeholders to be able to recognise that the information that they provide results in benefits accruing to them, or to the broader community in which they live.

Co-management and revenue generation are not incompatible and it is incorrect to assume that stakeholders are always unwilling to pay fees or taxes. They do however, expect to see benefits from it in return and making appropriate, and visible, links between revenue and benefits is not easy. Myanmar (see Part II) has shown that it can be done, even with complex river fisheries, by re-investing a substantial part of its revenue from lucrative lease fisheries back into visible improvements in the fishery. Others in Southeast Asia can learn from that example. But perceived links between revenue and information on catches may continue to be a problem for report-based statistics. Agencies should remove these links wherever possible.

4.12 Recommended strategies

Strategies that might be adopted by particular countries will depend upon the extent of their current inland statistical systems and the degree to which they have specific requirements. Some countries, for example, have extensive licensing systems for their fisheries, which are coupled to information generation. For others, licensing requirements (if any) are separate. Each country will need to establish at what point it enters the level of considerations below and the need for restructuring.

Some of the following recommendations are low-cost activities that can be implemented immediately. Some may even reduce actual costs of information generation. But some will take much longer to implement (although do not necessarily involve significant costs).

(1) All countries should review their existing statistics based upon impartial desk-top appraisals using existing information.

This is the immediate priority and is by far the most important short-term task countries can undertake. This has been partially undertaken in Part II of this report. It should be done more thoroughly and in a more systematic fashion by the appropriate agencies themselves. The re-assessment of information would also serve as a better basis for frame surveys for future data collection, or at least contribute to it. Consideration should be given to coupling this activity with a review and description of their inland capture fisheries sector. This would serve to inform relevant authorities (other agencies, donors etc.) of the features of inland fisheries, their extent and importance.

Very reasonable estimates of the importance of the sub-sector can be obtained using existing local information, comparative data from elsewhere and fishery independent information. In many cases, this can be done without the need for additional surveys. Inland fisheries can be described and estimated by a number of simple variables: the location, nature and area of the resources, population distributions (access to resources) and socio-economic variables.

Resource areas

This information can be obtained from locally available maps. Some countries already have basic information on this, but it tends to be outdated and only general. Much more detailed, and recent information, can be obtained using remote sensing imagery which is already available in most countries (although not necessarily in Departments of Fisheries). Areas of wetlands, including reservoirs, lakes, river/stream systems, floodplains/swamps, rice-fields and coastal marshes and mangroves should be clearly located. It is particularly important to obtain accurate information on the location, extent and duration of flooding in river basins. The information should be kept in digital, geo-referenced format, so that it can be used in a GIS (Geographic Information System).

Population distributions

Population census data should be compared with resource availability. Human populations, located nearby inland aquatic resources, translate into inland fisheries. The nature of the fishery will depend largely upon these two factors. If countries are lucky, their population census data will already be digitised and enable geo-referencing. Once it is in that format it can be analysed in a GIS – enabling computer aided analysis of relationships between populations and resources. If the census data is not digitised or geo-referenced, it is a relatively simple task to put into this format. Disaggregated data on populations must be obtained. Summaries by district or province are usually not discrete enough but can be used as a last resort.

Socio-economic considerations

These can usually be quite basic and are very much country specific. Some relevant factors are:

- (i) The level of economic development in areas. Areas with better economic development tend to be less dependent upon inland capture fisheries. But care should be taken to use disaggregated data (average income, for example, is not necessarily the best indicator of the absence of poverty, or poorer communities).
- (ii) The level and kind of agricultural development. Rice-farming for example usually has considerable fisheries activities associated with it, oil-palm less so.
- (iii) Access to markets. This is important because fishery resources will be exploited only to the level of demand. Demand is not unlimited. Access to markets can usually be evaluated, for example, in relation to closeness and accessibility to urban areas.

- (iv) Ethnic, cultural or religious considerations. Some ethnic groups (or religions) may be more or less dependent upon inland capture fisheries than others. In Southeast Asia, this consideration is usually only important in local areas.

Pollution and habitat degradation

Pollution as such is usually less of a problem than thought, except near urban or industrial areas. Heavy use of pesticides in farming should be accounted for (particularly in rice-fields) but it does not normally totally reduce fish production. An idea of the general level of habitat degradation should be obtained (but will usually already be known). The relationship between water quality and fish production can, however, be difficult to assess. It has to be severe to totally halt fish production. Actual habitat loss is often more important and information relating to this should be accounted as described in 'Resources areas' above.

Once this information is compiled, it is relatively easy to apply certain relevant and reliable assumptions about the fisheries based upon local information and information from other similar areas. When doing this it is essential to favour information based upon impartial research and survey work where actual data are available. Making comparisons to other areas where information is based upon dubious or uncritical statistics is pointless (because most countries under-estimate or under-report).

Estimates for inland fisheries should not be limited to gross production. Particular attention should be given to obtaining indicative figures for livelihoods aspects of fisheries. It is usually possible, for example, to make rough estimates of the involvement of people in fishing (as well as processing, transportation, trade and gear construction etc.). Indicative figures for household dependencies on fishing are valuable.

This approach is guaranteed to provide a more reliable and representative estimate of inland capture fisheries than most of the statistical systems currently in place in Southeast Asia. The information will not necessary be of any use for monitoring trends, unless of course the approach is repeated at intervals and the information up-dated; but neither are most current statistics. Obtaining a reasonable idea of the base-line situation is the priority. The activity will also clarify, or form, the frame upon which other surveys are, or can be, based.

(2) Countries should incorporate improved and more accurate information into their current national statistics.

Obviously, improved assessments of the inland capture fisheries (as above and elsewhere) should be reflected in national statistics. Although the current statistics are often mistrusted, even sometimes ridiculed, they are important. They have a major impact on government policies and on donor perceptions. National statistics reported to FAO have the same impact on the international/global scale. It is important to correct them.

(3) Where necessary, countries should make significant efforts to explain the inadequacies of their current statistics to relevant parties

It is important that those that use inaccurate, unrepresentative or unsubstantiated statistics are made aware of the pitfalls of the information.

(4) Where appropriate, countries should endeavour to incorporate inland capture fisheries information (questions/surveys) into surveys done by other agencies.

Often fisheries departments have more limited resources for survey work than others (e.g. agriculture departments, statistics agencies). A great deal of very valuable information can be obtained by incorporating information requests into these other surveys. Opportunities for questions can be limited in surveys designed for other purposes and time should be spent

considering the most appropriate information. A priority is to get information on dependency upon fisheries. For example:

- (i) In Lao PDR, a very reliable estimate of inland capture fisheries production was obtained by asking a very limited number of simple questions in a national income and expenditure survey (see Part II).
- (ii) In Myanmar, the mission advised the Department of Fisheries to incorporate some simple questions about rice-field fisheries into a proposed agriculture census (because the department's statistics did not cover rice-fields).

(5) Countries should promote more research on the production of, participation in and dependency upon inland capture fisheries.

Much progress can be made by using existing information from within Southeast Asia, but for full accuracy there is usually no substitute for specific data obtained for local situations. Research should be promoted amongst all relevant agencies (line-agencies, universities, aid projects, NGO's etc.). Researchers, and particularly social scientists, often need to be encouraged to produce quantitative data which enables extrapolations to be made to non-surveyed areas. Research should focus upon quantifying dependency of households on inland capture fisheries and on the relationships between such dependency and the environment. Studies can be broadened to include "aquaculture" to investigate dependency on "aquatic resources" more generally. The latter is more appropriate but often better information on aquaculture is already available. Care has to be taken to avoid an aquaculture bias in such research and surveys (history has shown that aquaculture specialists can be remarkably uncritical in such surveys). Countries should focus the research on priority areas, which compliment existing national or regional information (see recommendation # 6).

(6) Countries in Southeast Asia should share their information on inland fisheries and statistical/information systems

In all countries, human and financial resources are limited. Their inland fisheries also do not compete. There is little point in countries trying to re-invent the wheel in terms of research work. And there is much valuable information to share. For example, Lao PDR has some good experience and information now with fisheries in mountainous areas and using national surveys to obtain basic information on fisheries where there is limited information to start with. Cambodia has much experience in assessing the true nature and production of commercial/industrial fisheries on floodplains (and small-scale fisheries), of considerable relevance to Myanmar in particular, but also Indonesia, Malaysia and VietNam. In Myanmar, there is much knowledge to share on enhancing lease fisheries (lots/Inns) relevant in particular to Cambodia but also others. All countries now have considerable cumulative information on rice-field fisheries and reservoirs. Most countries have undertaken extremely valuable local studies of river and swamp/floodplain fisheries. Sharing this information base is a fundamental part of improving overall assessments of inland fisheries (as recommended above). They also all have different systems for collecting the information and can share experiences on what works and what does not.

(7) Those countries with existing extensive inland capture fishery statistical systems should consider how best to improve them, without necessarily incurring significant additional costs.

This should include:

- (i) Investigating the reduction of costs where feasible. Some countries arguably try to collect too much information

- (ii) Re-allocation of survey effort. More emphasis should be placed on quality of information, not quantity. The existing human resources, for example, could perhaps be divided, each unit to focus better on smaller sections of the fishery. Some people could concentrate on rice-fields, some on reservoirs, some of floodplains, some on commercial gears etc. Trying to get the same people to collect all information (including in most cases for marine fisheries and aquaculture) will not encourage accuracy of the information.
 - (iii) A good baseline understanding (frame survey) of the fisheries is required as a starting point (see recommendation # 1). Sampling strategies (where they occur) should be re-assessed in the light of recommendation # 1 above.
 - (iv) Extensive reporting systems based upon the same individual personnel trying to cover everything will often result in selective reporting. Where too much is expected reports will tend to focus on the more visible activities (reservoirs, aquaculture or only the professional/commercial activities).
- (8) *Those countries currently with more limited statistics collection activities should be very careful about investing in improved systems based upon the models currently in place in other countries.***
- (i) There is no evidence that the current systems will necessarily yield accurate information, even if significantly up-graded (within reason)
 - (ii) Short-term donor funded investments in strengthening domestic capacities (manpower) are unlikely to be sustained (but technical assistance including training and improving communications and co-ordination may be appropriate)
 - (iii) Countries should be innovative and take the opportunity to adopt new and more appropriate approaches (some of these are outline here, more can be developed)
- (9) *Countries should recognise that as policies and priorities change; that the information requirements also change***
- (i) In particular, recent attention to pro-poor, livelihoods centred, policies and sustainable development and biodiversity issues require different information approaches
 - (ii) This represents an opportunity for countries to re-vitalise their statistical systems in response to these opportunities
 - (iii) There is in any case no evidence that, in general, the current type of information collected through statistics actually influences policies. In fact, the opposite appears to be the case. Therefore, the correct information is not being collected.
- (10) *Countries should focus on livelihoods related information in their statistics and information generation activities***
- (i) Information on gross production is still relevant and should be produced, as should ancillary existing information on licensing etc. where necessary and appropriate.
 - (ii) The true value of inland fisheries lies in their relevance to rural livelihoods. Information generation should reflect that.
 - (iii) Livelihoods based information is quite likely the only kind of information that will influence policies, particularly those relating to natural resources allocation and use (e.g. water resources management planning). It is certainly well proven that information based upon gross production and participation in licensed fisheries does not generally influence policies for the benefit of fisheries; at worst it may well reinforce inappropriate policies.

(11) Countries should amalgamate co-management approaches and the generation of fisheries information

- (i) The accuracy and relevance of information can only be improved and sustained if stake holders are fully involved in the information process
- (ii) Generally, and in the longer-term, fishery dependent communities or groups should be the main focus of information generation. They should be motivated and empowered to produce the necessary information. This will also reduce the costs of information generation (to fisheries departments).

(12) Countries should be more flexible in the way they treat and report their statistics

- (i) Information systems are not currently based upon data. The information should therefore not be treated as data (*i.e.* taken at face value).
- (ii) Where known errors or misrepresentations occur, these should be rectified at the reporting stage. This is more important, and much cheaper, than trying to improve the statistical basis of the reports themselves.

(13) Statistical and information systems should be reviewed, revised or developed with the full involvement of appropriate stakeholders at governmental level (i.e. appropriate statistical agencies)

- (i) This is somewhat obvious. But there are examples where information relevant to statistics has been generated externally. It is subsequently often difficult to incorporate into existing statistical systems, even where motivation to do so exists.

(14) Existing statistical systems should be revised to make it easier to incorporate ancillary information into estimations and subsequent reports

- (i) Currently, statistics are often produced with rigid methodologies (*e.g.* regular surveys undertaken by specific agencies). Subsequently it can be difficult to incorporate ancillary information that can improve the accuracy and relevance of the information, even when it is accepted as valid by the appropriate agencies.

(15) It should be widely and openly acknowledged that most existing statistics are not useful for monitoring trends in the fisheries

- (i) They are currently not accurate enough to pick up anything but drastic changes.
- (ii) Even if significantly improved (within reason) they will still likely not yield information of the quality required for trend analysis.
- (iii) In any event, trends in production may not be the primary information required. Trends in livelihoods are more relevant (and current systems do not track this).
- (iv) A significant issue related to this recommendation is that countries need to re-assess whether they need to collect the current kind of information every year. Why do it regularly if it is not accurate enough for time-series considerations? This question should be assessed on a case-by-case basis. But it is essential to ask it.

(16) Countries need to explore options for obtaining better information enabling trends to be tracked – using low-cost and sustainable methods

- (i) The fisheries should be assessed to see which parts of it can be accurately, cost-effectively and sustainably monitored.
- (ii) Countries should avoid trying to obtain accurate information (enabling trend monitoring on a year-by-year basis) for the entire fishery. It will not work and scarce resources would be better used in ensuring quality rather than quantity of data.
- (iii) There is no substitute for long-term catch-effort data for assessing the state of fish stocks. But in multi-species, multi-gear inland fisheries, care must be taken in selecting which gears are monitored. It is important to record effort properly and the effort for many gears inland is influenced by environmental variables. For example, fishing “lots” (“Inns”) and river bagnets offer easily accessible and relatively obvious gears to monitor, but their efficiency is influenced by environmental variables (extent of flooding, river flow rates) which must also be monitored. It is also not necessarily easy to get truthful catch reports. Care must be taken to avoid assuming that trends with any gears represent trends in the overall fishery; and covering all gears is near impossible. An option is to monitor selected gears on an annual (including daily, monthly, as appropriate) basis, together with less frequent, but broader reaching surveys that cover a wider range of fishers and gears.
- (iv) Countries should not assume that monitoring fish stocks is the priority. It is important, but so are trends in livelihoods and the environment. Some would argue the latter to be more important. But where livelihoods information is linked to fish species groups and the environment (which it should be) then monitoring livelihoods trends should provide information on trends in stocks.

(17) Countries should devote more effort to monitoring trends in environment relevant to inland capture fisheries.

- (i) Most commentators agree that the greatest threat to inland fisheries, especially riverine fisheries, is habitat loss and degradation. Most “trends” in these fisheries, and in biodiversity, are argued to be due to environmental influences. Therefore, it is essential to monitor these trends in the environment if trends in the fisheries are to be understood.
- (ii) This is arguably more important than trying to monitor the fisheries themselves. A strong case can be put for river fisheries that as long as the environment stays intact, the fisheries might be sustained. Most river fisheries have been lost not because we did not monitor them properly, but because the environment that supports them was undermined and at least in part because it was not monitored.
- (iii) Whilst this may not appear immediately to be the role of fisheries agencies, and in some countries may not be, those agencies must become more pro-active in promoting appropriate environmental monitoring.
- (iv) Where necessary, environmental agencies need to be made more aware of which environmental changes are relevant to inland fisheries. In particular, aquatic specialists may tend to focus on water quality issues, whilst the major issues (particularly for larger rivers) can be habitat loss and degradation.
- (v) Inland fisheries specialists must adopt the philosophy that environmental management is an important part of fisheries management.

(18) Countries need to adopt better strategies for monitoring trends in biodiversity

- (i) Biodiversity is a fisheries issue (Coates, 2001). Countries need to explore how biodiversity in their inland fisheries can be better monitored. Naturally this should be done in conjunction with other initiatives in this area. Monitoring biodiversity should incorporate the same concepts as for other information (statistics) collection systems. Ecosystem diversity should be monitored as noted under recommendation 17. Cultural and social diversity should be monitored through livelihoods monitoring. The role of fisheries agencies should include advising other agencies on aspects of biodiversity relevant to fisheries. An obvious problem in practice with genetic diversity is that concerns tend to become greater as species (or varieties etc.) become rarer. One option is for countries to short-list their most vulnerable genetic resources and implement monitoring programmes for them – using fisheries based information collection systems where appropriate (e.g. catch-effort data for selected species).

(19) The current statistics for inland capture fisheries produced by FAO should include better indications as to their basis and meaning

- (i) Inland capture fishery statistics are likely to be more unreliable than any other statistics that FAO reports.
- (ii) The general tendency is for under-reporting.
- (iii) Statistics should not be published in the absence of details as to how they were collected. This should include explanation as to likely sources of error and possible extent of under-reporting. It is not unreasonable, for example, to suggest that FAO include such a by-country explanation in its yearbooks of inland fisheries.
- (iv) Statistics that have been based upon estimates should be clearly indicated in both yearbooks and FAO reports. This would also include an indication as to the basis of the estimations. This requires both that countries report such information to FAO and that FAO requests it.

(20) The information and statistics activities at FAO should reflect the requirements for improved livelihoods related information more obviously and explicitly

- (i) This can be achieved by FAO requesting better livelihoods focussed information on fisheries.
- (ii) Alerting countries to this need is an urgent priority.

(21) FAO should provide improved advice to member nations on what kinds of livelihoods relevant information should be collected and how it can be cost-effectively obtained

- (i) For inland capture fisheries there is a need to back-up the broad recommendations made in this report (with emphasis on the deriving information on the role of fisheries and livelihoods) with specific and practical advice on how to implement.
- (ii) Logically, this might be better implemented as a compliment to a broader based strategy regarding livelihoods information.

PART II

By-country review of inland capture fishery statistics in Southeast Asia

By-country review of inland capture fishery statistics in Southeast Asia

In most countries where information is actually collected, the process originates at district/sub-district level. Often, the only way to fully investigate the statistical validity of such an information system is to review activities at that level. The travel schedule of the mission did not allow this. This report is therefore based upon information obtained primarily in head offices and analyses of the officially reported statistics. This is sufficient for the purposes of this general review, which concentrates on information gaps and needs at the planning and management levels. It should be followed by more in-depth reviews of the national statistical and information systems by the appropriate authorities in the proposed follow-on activities (including a proposed regional TCP on Addressing the Quality of Information on Inland Fisheries, AQUIF)

The mission visited four countries as part of the current assignment (Indonesia, Malaysia, Myanmar, and Thailand). A fifth (the Philippines) was visited as part of the AQUIF formulation mission and more brief details of the inland capture fishery statistics have been incorporated into this report as an addendum from that mission. In addition, the mission has recent experience with inland fisheries data in three others (Cambodia, Lao PDR and VietNam).

The summaries, observations and recommendations presented in Part II are specific to the countries in question. These should be viewed in conjunction with the synthesis of common problems and general recommendations contained in Part I.

5 Countries visited as part of the mission

5.1 Indonesia

5.1.1 Background

Indonesia is a very diverse country. The nation includes several islands with significant land mass, high rainfall and, consequently, has significant freshwater resources, especially rivers. Particular mention can be made of Sumatra (which has several good sized rivers), Kalimantan (“Borneo”; which includes the Kapuas and Mahakam Rivers both of which are large by world standards, plus several others), Sulawesi and Irian Jaya. The latter is the eastern half of the world’s largest tropical island, New Guinea, which has the large Idenburg/Mamberamo system in the north, equivalent to either the Fly or Sepik Rivers in Papua New Guinea, and several other decent sized systems to the south. Although inland waters in parts of Indonesia are reported to be suffering from severe environmental stress, good inland fisheries are known to still occur, particularly on Kalimantan and the mid to southern region of eastern Sumatra. The least environmental degradation likely occurs in Irian Jaya, partly due to lower population pressures there.

A notable feature of Indonesia is that the islands cover two of the world’s most prominent zoogeographic zones separated at “Wallace’s Line” running roughly north-east to south-west between Sulawesi and Kalimantan. East of this line (notably New Guinea), primary freshwater fishes, for example carps (cyprinids), do not naturally occur and the depauperate nature of the fish fauna limits biological production (Coates, 1985; 1993); although a large number of species have now been introduced into that area. Inland fisheries in Irian Jaya are significantly different from the rest of Indonesia (especially Sumatra and Kalimantan) but fortunately, for current

purposes, valid comparisons can be made with fisheries in the eastern half of the island (Papua New Guinea).

The licensing requirements for inland fisheries vary widely between provinces and districts. In general licenses are officially required for the more commercial gears but compliance (and surveillance) may be reduced beyond Java. Access to prime fishing opportunities (either by sites for major gears or by demarcated areas) is often allocated by auction systems. This is especially so for the major opportunities (or areas) on river floodplains. The system is similar to the “lot” system of Cambodia and the “Inn” system of Myanmar. Auction income can provide an important source of revenue for government agencies (up to 75 percent of income in some areas, for example, southern Sumatra). Auction systems are widespread on Kalimantan but tend to be more village based. They are traditionally absent on Irian Jaya because of the resource base limits the partitioning of exploitation in this fashion.

Fisheries associations are common in inland areas, especially for reservoirs. Fishing competitions are popular (using hook and line). This fledgling recreational/sport fisheries sub-sector appears to be growing rapidly.

Most commentators agree that a major requirement for inland waters is improved environmental management but that a major constraint to achieving this is limited co-ordination between the various agencies involved.

Indonesia has no significant national management policies or strategies for its inland capture fisheries excepting a general policy of sustaining the resources. There are many localised activities, such as stocking, which can be widespread and significant, especially in reservoirs. A substantial degree of survey work and/or research has been done in localised areas (southern Sumatra, Kalimantan). The country includes some of the best studied freshwater fisheries in Asia although, as usual, the mission found it difficult to obtain published information on fisheries production based on empirical survey data.

The Directorate General of Capture Fisheries has a stated policy to emphasise co-management approaches within a national policy promoting the increasing role of local communities in managing areas.

5.1.2 The statistical collection system

Previously, “freshwater” and “brackishwater” fisheries were jointly covered under an inland fisheries section. Now there are separate divisions for marine, freshwater and brackishwater fisheries. Production from inland brackishwaters is still included under inland production statistics. The definition of “inland” is problematic locally but this is thought not a serious problem with the statistics. The definition of aquaculture is more of a problem (ref. how to treat production from extensive stocking). In Indonesia, the term “inland fisheries” includes both aquaculture and capture fisheries activities (the latter sub-sector is referred to locally as “inland open water fisheries”).

Indonesia has a very elaborate fishery statistical collection system involving a large amount of manpower and information collection based upon a structured sampling approach applied nationally but implemented at provincial and district levels. Sampling approaches are based on earlier designs with significant inputs from FAO (as is the national statistical systems for agriculture/forestry/fisheries at large). Recently, modified sampling strategies and forms for inland areas have been introduced based upon experiences from a JICA aquaculture project. Statistics are compiled at district level with actual information collection being accomplished through staff at sub-district level. District officers report the information to provincial offices, which compile it and forward it to the Sub-Directorate for Data and Statistics within the Directorate General of Capture Fisheries (DGCF) in Jakarta. From there it is forwarded to the

National BPS Statistics Indonesia and to FAO. DGCF Jakarta is largely responsible for determining the content of the statistics themselves.

Three types of forms are used. Those prefixed “S” for actual field surveys, “E” for estimations based upon the surveys (*i.e.* from “S” forms), and “L” for reporting the figures (derived from estimates, “E” forms) to the central office.

Sample villages are determined by staff at district level as are the households sampled within sample villages. Ostensibly, selection of sample villages is based upon a previous frame survey with households being selected at random. The *SP1* form covering inland open water fisheries provides a list of every household in sample villages and details of all vessel types held by the households, including no-vessel households, and the total number of fishing units by gear type. The list of gear types naturally favours the more commercial gears and/or those requiring licenses. Information on *SP1* forms is recorded by quarter (3 months) but the actual survey is reportedly undertaken only once a year. Between 3 and 5 households in each village sampled are then surveyed using *SP2* forms. *SP2* attempts to obtain production by household based on numbers of trips and average catches per gear type per trip (*i.e.* catch-effort sampling based on reported catches by gear type). Information is collected for each month but surveys are reportedly done every three months. Species composition and estimated values of the catches are also recorded. Information is also collected by habitat type where the fishing occurred: “river, lake, reservoir or swamp”. This requires a separate *SP2* to be completed in each household for each habitat type where fishing occurs by that household (although it is reported that sample villages are often selected based upon habitat criteria, the basis of which is unclear). Information from *SP2* forms is then entered directly onto E forms from which point estimates begin to be derived based upon information from *SP2*'s in relation to sample sizes etc. derived mainly from *SP1*s. Various known raising factors are applied to the original information to obtain estimates. *EPI* estimates from *SP1* the number of households, boats and fishing gears etc. *EP2* estimates total production by vessel, gear type, species and by habitat type (from *SP2* forms). *EP3* estimates the value of catch by habitat type (from *SP2*). An *EP4* form is specifically designed to estimate the nature of disposal of the reported catch and information is collected by species (Part 1 covering weight of fresh fish, Part 2 – weight of preserved products). *SP1* and *SP2* do not contain information on disposal. *EP4* information is based upon a separate estimation process, which in theory involves discussion with the sample groups.

At all levels, the information recorded is officially based upon reports by households and/or fishers (presumably biased towards the latter). At no time does the survey method measure any production (etc.) directly.

The current system is labour-intensive also at the level of information compilation, analysis and reporting. DGCF Jakarta intend to computerise the system to streamline the operations including using appropriate statistical software.

A comprehensive annual fishery statistics bulletin is produced. At the time of drafting this report the latest available was for 1998. Figures for 1999 have now been produced.

There are a number of constraints with this system:

(1) The sampling frame. The original frame survey upon which the current sampling strategy is based originates from an agricultural frame survey done in 1973, which apart from now being 28 years out of date, likely did not cover inland fisheries considerations anyway. Although household based sampling surveys are generally a good approach for inland fisheries, it is unclear for example, how the system covers those gears which are not owned by the household (*e.g.* some very productive gears can be leased or owned communally). The mission did not have time to investigate the sampling strategy in detail (the strategy is implemented at district/sub district level) and cannot currently make valid detailed comments on how the strategy might be improved. To do so would require a much more substantial study. It can be concluded, however, that there are serious doubts about the statistical validity of the official

sampling programme in relation to inland fisheries (a point well acknowledged by DGCF themselves).

(2) It was reported that the information required is comprehensive but complex and time consuming. The most serious problem reported by DGCF Jakarta was insufficient manpower (budget) to undertake surveys properly. Each district has only one staff assigned to statistics. Each sub-district (where information is actually collected) usually has only one person assigned to statistics collection part-time (their duties also include *e.g.* extension work, licensing/surveillance duties etc.). Where appropriate, these staff are expected to collect statistics for marine, open water inland fisheries and aquaculture. Not surprisingly, it was reported that sub-districts will often (usually?) complete the *L* forms (reporting forms) without undertaking surveys (using *S* forms). District offices may also do this on behalf of sub-districts.

(3) The survey design is based upon the application of a system and strategy developed for marine fisheries, which is applied to inland areas. The emphasis in the forms to recording vessel types and gears represents these origins in design (although in theory the surveys include households without vessels). There are serious doubts about whether surveys of this nature based upon trying to record catches through estimating effort and catch per unit of effort are, in general, suitable for inland fisheries (see Part I). Although it may be valid for certain prominent gears, the approach is problematic for more informal and dispersed fishing activities. It is also unclear how the survey technique was “improved” through experiences with aquaculture. Whilst considerable overlap between culture and capture tends to occur, in most river basins there tends to be an important geographic separation between the two. For example, aquaculture tends to be more important in areas where inland fisheries are less so; for example, away from floodplains (primarily because aquaculture, in general, cannot compete with productive inland fisheries).

(4) In common with all systems based upon reporting, the information provided by respondents will depend upon (a) the willingness to be truthful, and where there is an actual or perceived link between information and licensing/regulation it is realistic to expect under-reporting; and (b) even if motivated to be truthful, the ability of the respondent to accurately estimate actual production; the sampling strategy requires a three-month recall by respondents, more importantly, for household based surveys for inland fisheries, key respondents (*e.g.* household heads or main fishers) have been shown to seriously underestimate household production as they tend to report only their own catch and can be unaware of other catches in the household (Sjørsløv, 2000; 2001).

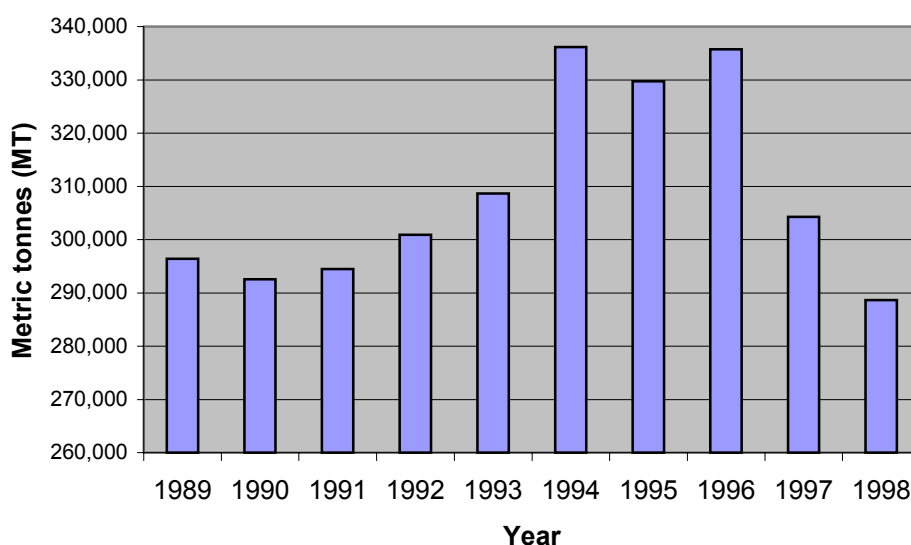


Fig. 2-01 Indonesian inland open water fisheries - total reported production

5.1.3 The information produced

Reported total production from inland capture fisheries is shown in Fig. 2-01 above. There is an apparent peak in the years 1994-6. However, given the known natural variations between years in inland capture fisheries, based on this information there is no evidence that production has declined over the 10 year period in question. A relatively high gross production (for Southeast Asia) is reported but this is consistent with the high population and extensive freshwater resources. This production is disaggregated by species category in Fig. 2-02. There is no apparent trend in species composition of catches except that “others” (= mainly freshwater fishes not elsewhere included in FAO Statistics) apparently account for most of the aforementioned increase in reported gross production over the period 1994-6. The large proportion of the catch being recorded as miscellaneous is a common constraint in inland capture fishery statistics. Amongst other problems, the information is effectively useless for analysing trends in vulnerable/rare species.

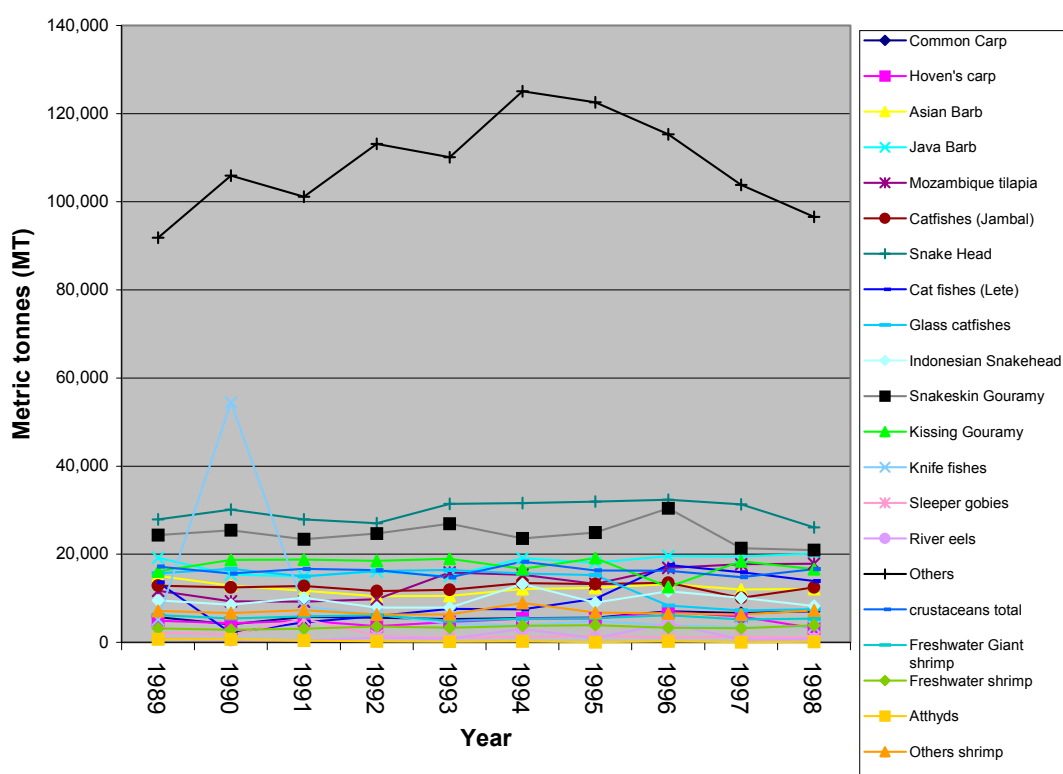


Fig. 2-02 Indonesian inland open water fisheries - gross production by species/category (incomplete listing)

Catches by main gear types are shown in Fig. 2-03. Again, obvious trends are absent. Not much can be made of this information except that most production arising from “other” gear types is likely typical of inland fisheries where normally a huge variety of gears are in operation. It is odd that set gill nets and hook and line, each account for a higher proportion of catches than guiding barriers (barrage fences). On river floodplains, the latter gears are normally very efficient and produce high catches. However, the most productive of such gears are usually associated with stringent licensing and revenue collection systems where under-reporting of production is likely common (if not universal). There may also be a bias in the information towards reports from reservoirs and lakes (which would also account for the dominance of production from gillnets).

The high catches from guiding barriers are also evident from Table 2.1 but the reported catch per gear is still only about 4 or 8 times that from gillnets and hook and line respectively. The mission would expect catches per gear to be relatively much higher for guiding barriers.

Hoggarth *et al* (1999) report that such barriers account for 49 percent of the catch from an Indonesian river. Also, the mission considers that the mean catches reported per gear are high for many of the other gears. If the reports represent actual catches, this is quite possibly because there is a reporting bias towards commercial/professional fishers.

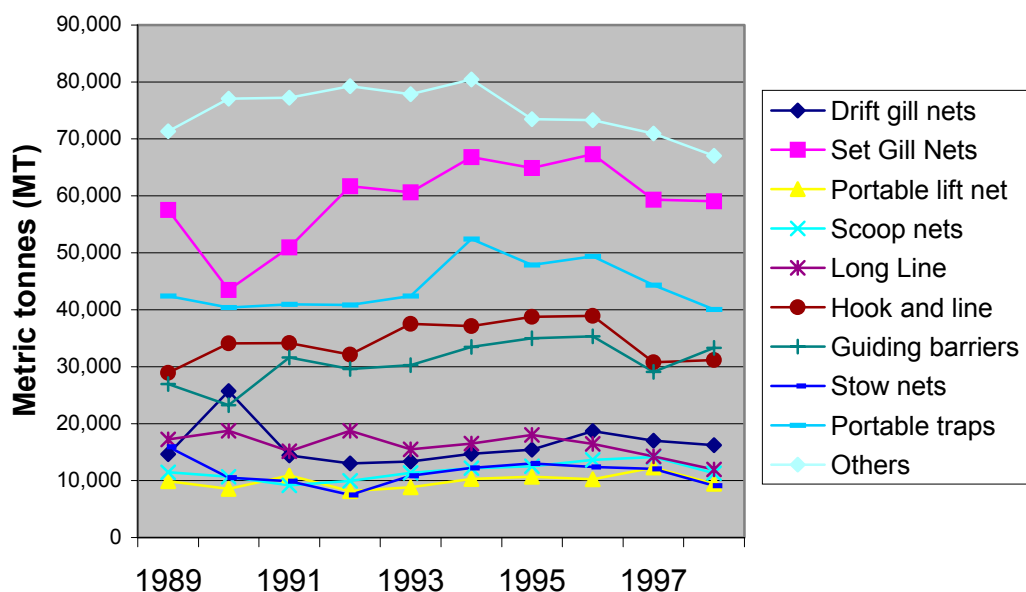


Fig. 2-03 Indonesian inland open water fisheries - gross catches by gear type

For example, an average annual catch per gillnet of about 450 kg for a professional fisherman is reasonable but as a mean catch per gear perhaps less so (since there are likely a large number of gillnets in only part-time use). However, the best illustration of peculiarities in the reports is the extremely high catch per gear under “other gears” which is the fifth highest ranked gear by production per unit and rivals that of gillnets (Table 2.1); it is also higher than the mean catch per gear for all gears combined (meaning the majority of gears have a mean catch lower than that for “others”). The majority of gears under the category “others” for tropical inland fisheries should include a myriad of small gears in intermittent, low-profile use (for example, millions of small basket traps in rice fields catching only a few kilograms per year). Even if some individual gears do produce large catches, the mean catch per gear unit should be relatively low.

Table 2.1 Indonesian inland open water fisheries - mean catches per gear (1998)

	Number of gears	Total catch (kg)	mean catch per gear (kg/yr)
TOTAL	678 826	288 666 000	425.2
Drift gill nets	36 014	16 229 000	450.6
Set gill nets	85 350	59 046 000	691.8
portable lift net	29 642	9 414 000	317.6
scoop nets	41 304	11 292 000	273.4
long lines	35 211	11 979 000	340.2
hand lines	161 783	311 96 000	192.8
guiding barrier	20 395	333 26 000	1 634.0
stow nets	9 304	91 22 000	980.4
portable traps	102 314	40 037 000	391.3
others	157 509	67 024 000	425.5

One possible explanation for high unit catches for “other” gears is that production comes from a productive (per unit) gear type(s) but the gear type(s) is not listed elsewhere (if so, it should obviously be listed separately). Even so, this explanation would require that the large number of small, less productive, gears is not recorded under “other”. Again, the reports, if meaningful, could be biased towards commercial/professional catches. Such problems may be significant

because the gear category “others” accounts for roughly 25 percent of the reported total catch. Much would depend upon the methods applied in the field and an analysis of disaggregated catches within the category “other” gears. For example, there would be a serious error if the data for availability of “other gears” (or by disaggregated category if applicable) were not collected on SP1 forms (*i.e.* it is necessary to know within the population sampled what is the overall ownership of “other gears”). It is unlikely the category “others” is uniform throughout the country. These examples illustrate the difficulties, and some possible pit-falls, of attempting to estimate inland capture fisheries production based solely on catch-effort data, particularly in the absence of a good frame survey.

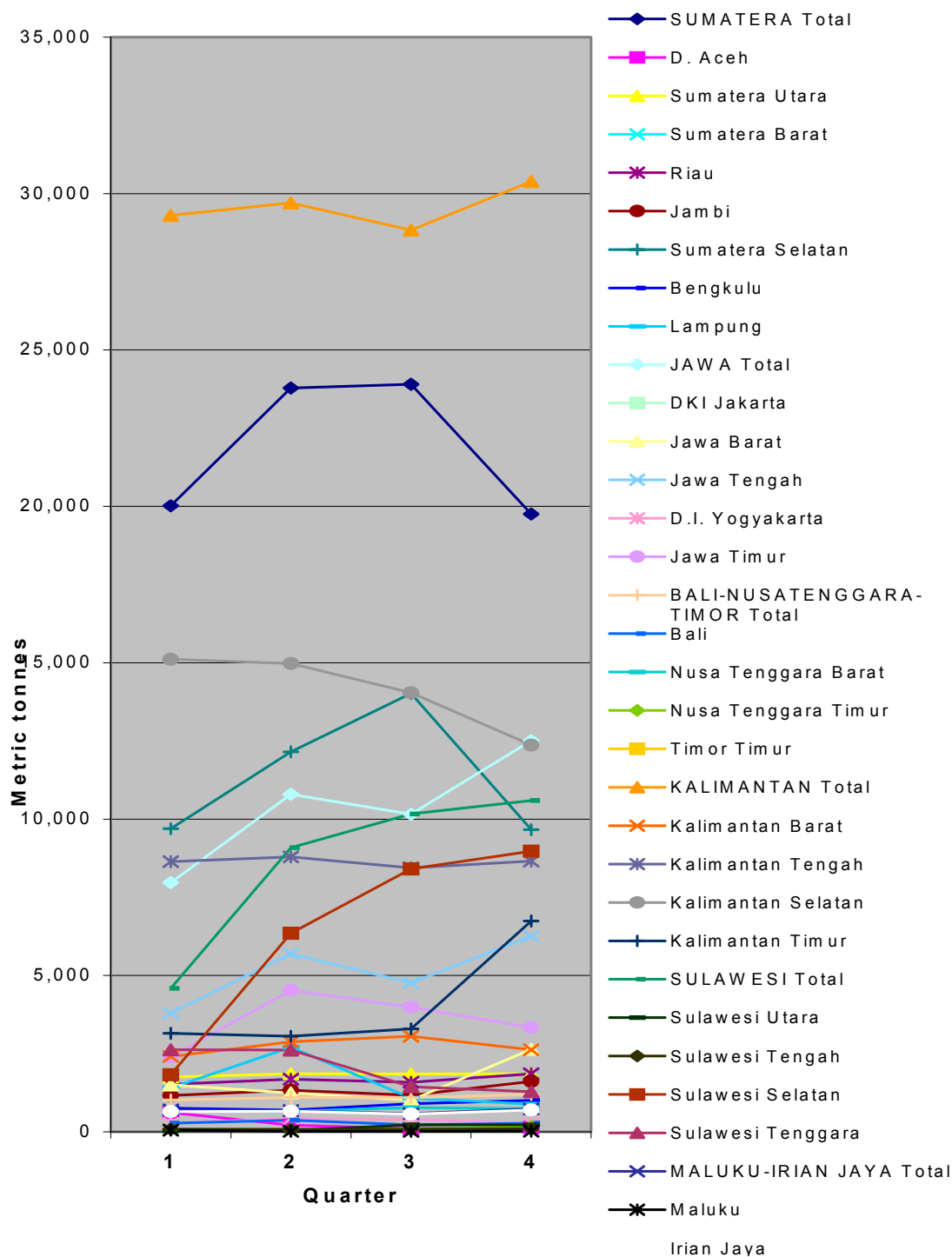


Fig. 2-04 Indonesian inland open water fishery - production per quarter by province - all provinces (1998)

Reports for production are available by province. These also show no consistent trend over the last ten years. However, analysis of reported production over a one year cycle provides information. Inland capture fisheries in rivers in the tropics should show gross seasonal changes in production related to river flood cycles (see notes for Cambodia and Myanmar). Whilst there is much variation in reported production within years in some provinces, there is little consistency between them (Fig. 2-04).

For purposes of illustration, the annual cycles of reported fish production for all provinces where river and swamp fisheries account for more than 75 percent of total production (the remainder coming from lakes/reservoirs) are shown in Fig. 2-05; that is for those provinces expected to have the most seasonally variable fisheries. Three of the seven provinces show flat lines. In the others, variations occur but they are not consistent between provinces (they should be because all provinces have approximately the same seasons) and do not relate to monsoon river hydrological cycles. The absence of consistent natural cycles in these reports raises serious doubts as to the validity of the underlying information.

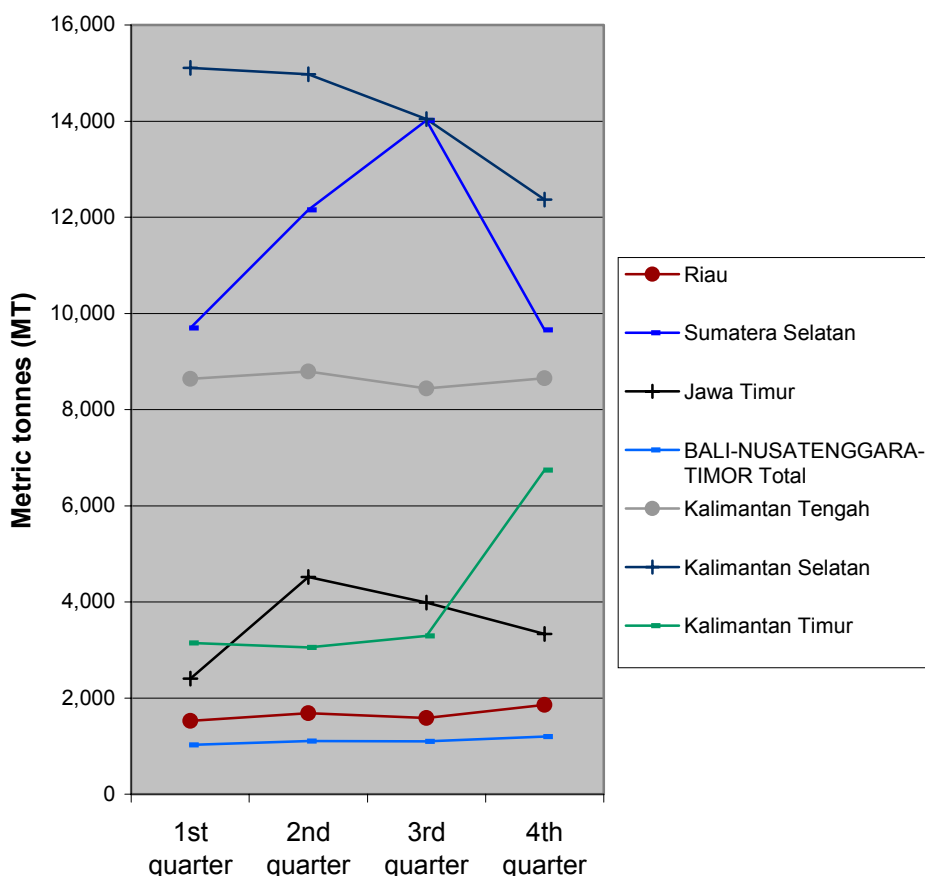


Fig. 2-05 Indonesian inland open water fisheries - production by quarter for each province where rivers and swamps account for greater than 75 percent of total production (1998)

Reports on numbers of fishermen per fishing household make very interesting reading (Fig.2-06). It is not certain whether reports are gender biased or whether the term “fishermen” includes women and children fishing. There is some logic in the figures in that provinces with probably more important inland capture fisheries have a higher mean number of fishermen per household. What is surprising is that a large number of provinces have a mean of less than one fisherman per fishing household (which is impossible; unless fishing households include households with no fishers). For other provinces the mean number of fishermen per household seems rather large, even for inland capture fisheries. Whilst it is not uncommon for all members of households to be involved in fishing, the mean number of fishermen in households in Sumatra

Selatan, for example, is 6.5 compared with a mean provincial household size of 4.6 (BPS, 2000). For Kalimantan Barat and Kalimantan Timur, mean number of fishermen approximately equals mean household size (which has a national mean of 3.9 with a range from 3.4 to 5.0 by province, BPS, 2000).

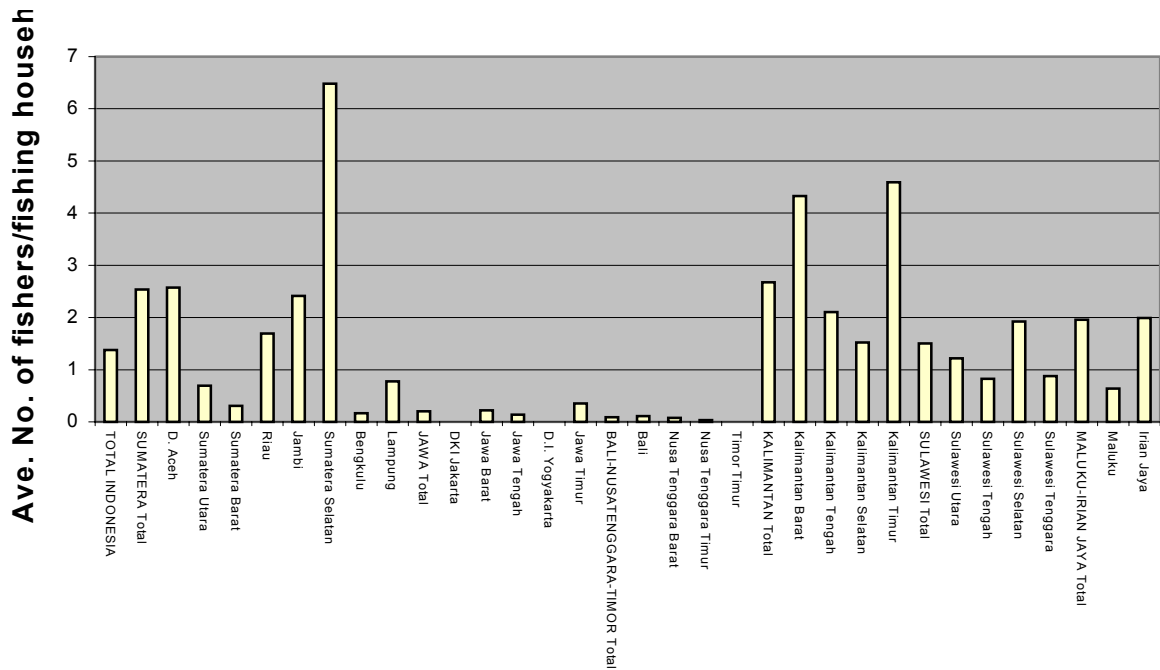


Fig. 2-06 Indonesian inland open water fisheries - average number of fishers per fishing household by province (1998)

The number of households by category of vessels is shown in Fig. 2-07. As might be expected in inland capture fisheries, households with non-powered boats greatly outnumber those with motorised vessels. Fig. 2-08 shows the reports for the total number of vessels in inland capture fisheries by vessel category, whilst Fig. 2-09 shows reports for the total number of gears in the fishery over the recent 10 year period.

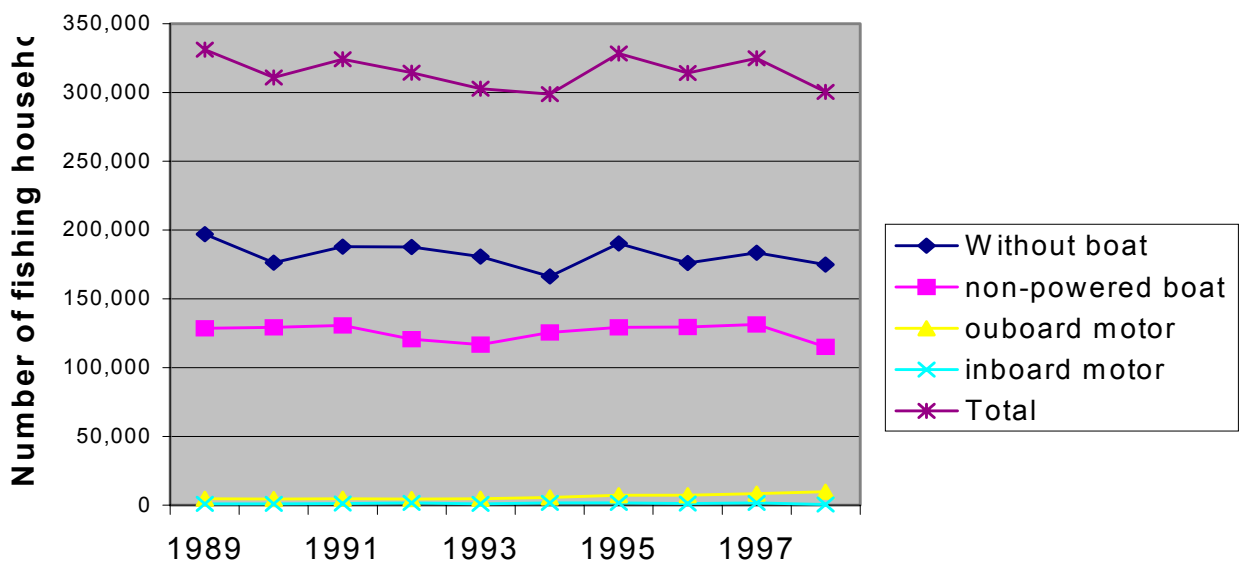


Fig. 2-07 Indonesian inland open water fisheries - numbers of fishing units (households) by management size (type of vessel)

Numbers of fishermen by category of involvement in fishing are shown in Fig. 2-10. Reports suggest that part-time fishers outnumber full-time fishers by a factor of about 2, which is logical for inland capture fisheries, although possibly still an underestimate of part-time fishers. It is unlikely that fishing in rice-fields or small water-bodies/canals/streams etc. on an infrequent basis is included in these reports. If it were, we would expect the number of part-time fishers to vastly outnumber full-time fishers.

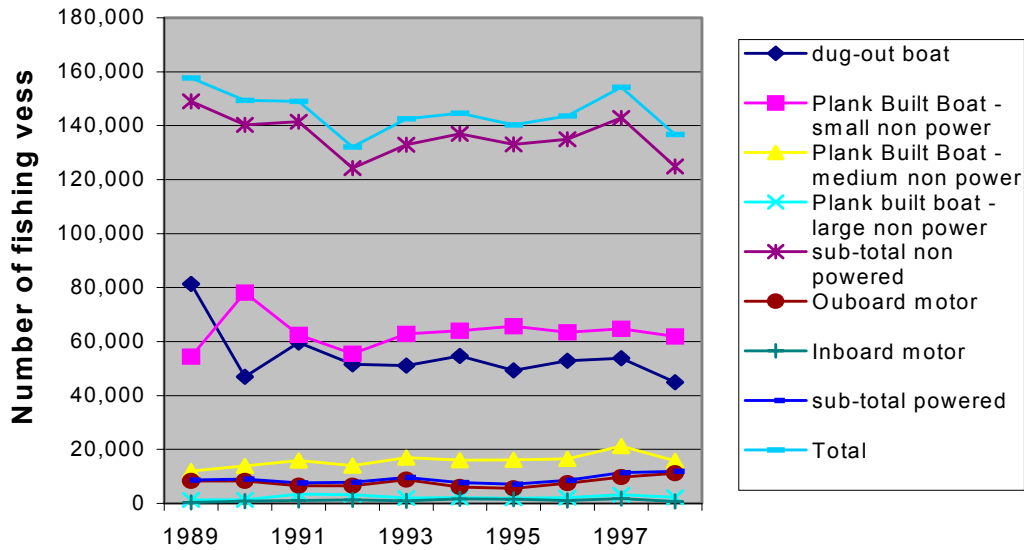


Fig. 2-08 Indonesian inland open water fisheries - total number of fishing vessels by category

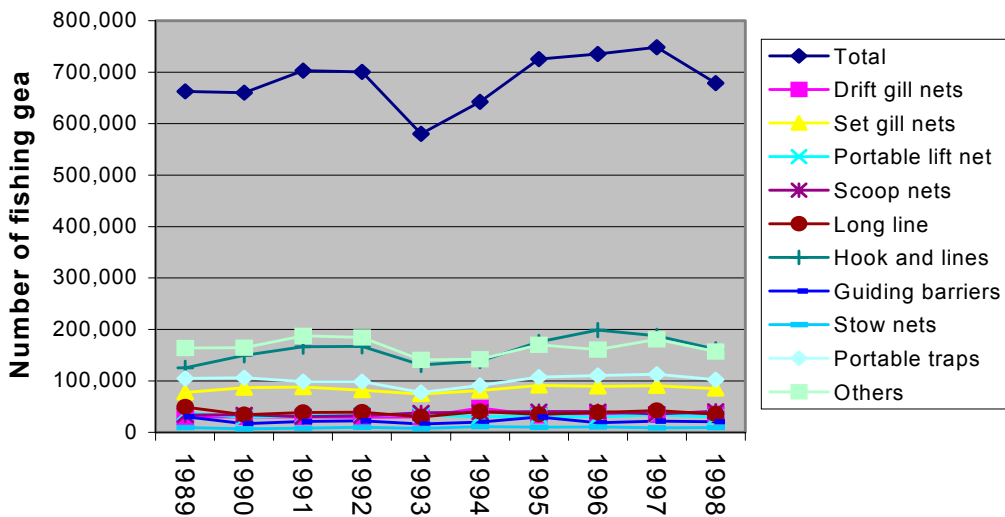


Fig. 2-09 Indonesian inland open water fisheries - total number of fishing gears by category

However, the most revealing feature of the reports in Figs. 2-07 to 2-10 is the lack of any apparent trend. First, there should be a trend in all these reports showing an increase in households involved in fishing, total numbers of vessels and gears in operation and total numbers of fishers due to population growth over the 10 year period (about 15 percent, BPS 2000). Second, there should be a clear increase in all these reports as a result of the “Asian Economic Crisis” (early 1997) which was accompanied by a significant return to fishing as a low capital activity, accompanied with emigration from urban areas. Several reliable commentators in Indonesia confirmed that in inland areas participation in fishing increased by

an estimated 30-40 percent as a result of the economic down-turn. But this is nowhere to be seen in the reports. However, both the long-term trend in participation in marine fisheries due to population growth, and the more rapid increase expected in 1997/8 are clearly evident for reports for marine capture fisheries (Fig. 2-11). Not only does this analysis reinforce the view that the reports for inland capture fisheries are unreliable, the latter observation suggests that the reports are much more meaningful for marine fisheries.

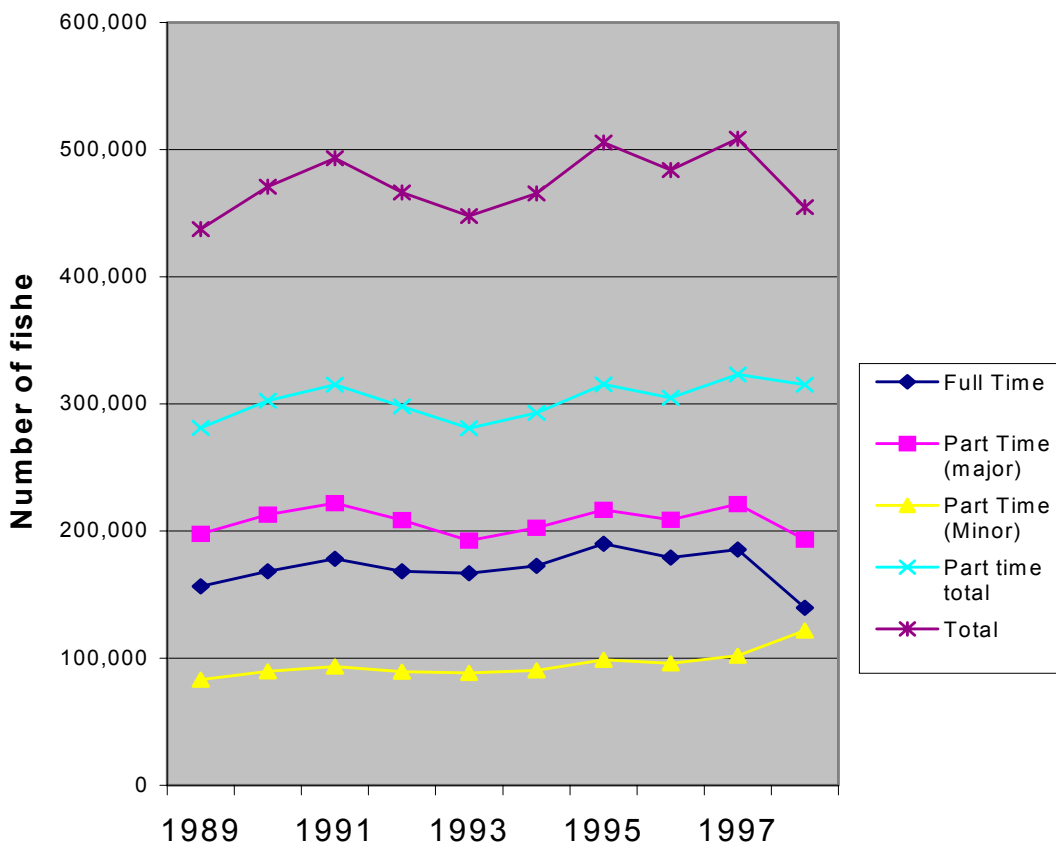


Fig. 2-10 Indonesian inland open water fisheries - number of fishers by category

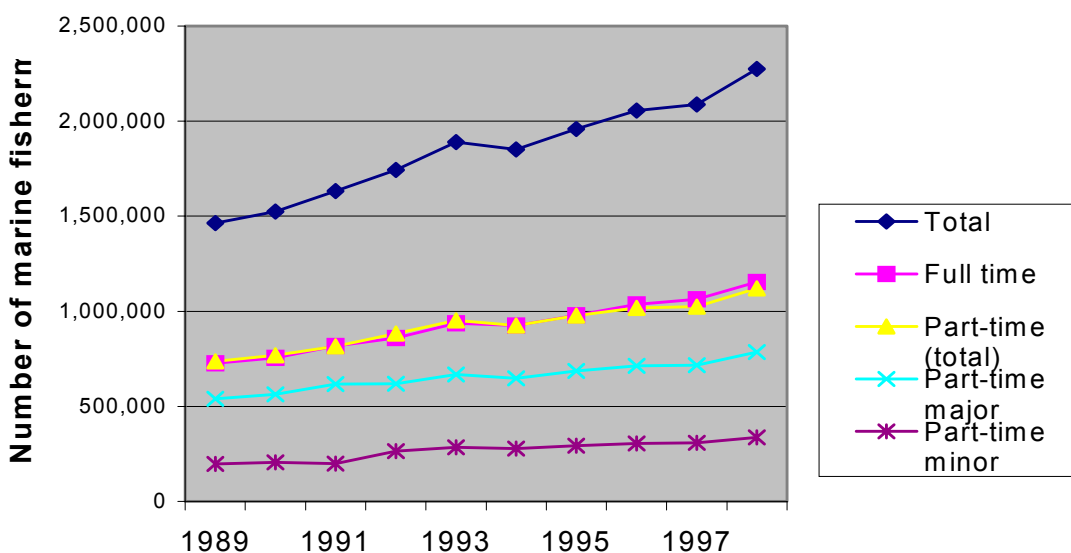


Fig. 2-11 Indonesian - number of marine fishermen by category

Data from fish consumption surveys are available (BPS, 1999). Total fish consumption estimates for various provinces are shown in Table 2.2 together with reported landings from inland capture fisheries. These comparisons are useful as a rough and independent test of the reported catch figures. Fish consumed, of course, can include that from any source (imported,

marine, inland capture or aquaculture). But in freshwater resource rich areas with large rural populations, contributions from inland capture fisheries should make the major contribution to fish consumed locally. This is partly reflected in the information for Kalimantan Tengah and Kalimantan Selatan where reported inland catch accounts for more than 95 percent of fish consumed locally. However, it is unclear why the contribution of inland catches to consumption should be drastically lower in Kalimantan Timur and especially Kalimantan Barat (Kapuas River system). Similarly, for the Sumatera region, Sumatera Selatan has a reasonable contribution from inland capture of 58.7 percent of fish consumed but it is unclear why Riau and Jambi, for example, have significantly lower contributions at 13.9 and 18.8 percent respectively. Production figures for inland capture for Sulawesi would appear to be particularly low in relation to fish consumed. Unfortunately, for these figures, it is not known which reported catches (at provincial level) are the most representative, if any. It is also likely that the fish consumption estimates (BPS, 1999) are also underestimates since the FAO figure for per caput fish supply for Indonesia (based on production statistics and export/import figures) is about 16.3 kg/caput/year, and this is without allowing for under-reporting of inland catches, compared to the national average fish consumption per caput of 10.5 kg/caput/yr from the BPS reported survey.

Table 2.2 Total fish consumption (from fish consumption surveys, BPS 1999) compared with reported catches from inland capture fisheries for selected provinces in Indonesia

	Total population	Reported production from inland capture fisheries MT (1998)	Total fish consumption (kg/caput/yr) Urban areas	Total fish consumption (kg/caput/yr) Rural areas	Estimate total fish consumed (MT)	% of consumption arising from reported inland catches
Sumatera Utara	11 476 000	6 979	19.9	18.7	229 520	3.05
Sumatera Barat	4 228 000	6 651	10.6	10.4	44 394	15.0
Riau	4 734 000	12 488	18.9	19.2	89 946	13.9
Jambi	2 401 000	5 287	12.0	11.5	28 091	18.8
Sumatera Selatan	7 756 000	45 523	10.3	11.5	77 560	58.7
Bengkulu	1 405 000	3 359	10.9	11.0	15 314	21.9
Lampung	6 654 000	6 078	8.4	8.1	54 562	11.1
Kalimantan Barat	3 740 000	10 969	21.0	14.6	63 580	17.3
Kalimantan Tengah	1 801 000	34 524	18.7	20.2	36 020	95.8
Kalimantan Selatan	2 970 000	56 494	20.0	18.6	59 400	95.1
Kalimantan Timur	2 436 000	16 240	18.6	16.4	48 720	33.3
Sulawesi Utara	2 821 000	528	25.8	23.6	67 704	0.8
Sulawesi Tengah	2 066 000	366	22.1	16.0	39 354	0.9
Sulawesi Selatan	7 787 000	25 570	20.3	24.7	171 314	14.9
Sulawesi Tenggara	1 772 000	7 974	30.7	25.6	49 616	16.1
Irian Jaya	2 113 000	2 582	26.6	12.8	31 695	8.1

It is likely that the inland capture figures are affected by overall under-reporting. But the extent of this is difficult to assess. The figures for Irian Jaya are certainly an under-estimate. This province has similar characteristics to Papua New Guinea where inland capture production is estimated (based upon extrapolations from sampling survey data) to be 14 500 MT per annum. Correcting for differences in populations, this would give an estimate of about 6 000 MT per annum (2.3 times the official figure). It is highly likely that the existing reports refer mainly to less remote areas and in particular to Lake Sentani near Jayapura.

Table 2.3 provides some estimates of the potential production from inland waters in Indonesia. The estimated potential averages about 65 kg/ha/yr which is likely on the low side, especially for heavily fished floodplains. Even so, the estimates support the view that production from inland capture fisheries is likely, and is feasibly, much higher than official reports suggest. A

proper analysis along these lines would need to factor in the effects of environmental degradation on inland waters.

Table 2.3 Indonesian area and potential fish yield of open waters (from Sarnita and Djajadiredja, 1968)

Island	Area (ha)	Potential yield (MT per annum)
Java	96 400	30 000 - 35 000
Sumatra	4 053 850	300 000 - 330 000
Bali and Nusa Tenggara	17500	7 000 - 10 000
Kalimantan	9 029 000	400 000 - 450 000
Sulawesi	492 200	50 000 - 55 000
Maluku and Irian Jaya	63 300	13 000 - 20 000
Total	13 752 250	800 000 - 900 000

5.1.4 Perceptions of inland fisheries and objectives of the statistics

It is no secret in Indonesia that there is limited confidence in the statistics for inland open water (capture) fisheries. The mission was impressed by both the frankness of authorities concerning this issue and the genuine desire to try to improve the situation. The issues are complex because quite probably the reports are meaningful (possibly even representative) in some areas but meaningless in others. But this is unhelpful unless we know for certain which is which.

In common with other countries, Indonesian authorities clearly see inland open water fisheries as being important for food security, nutrition, poverty alleviation in rural areas (etc.); although some impressive commercial/industrial inland capture fisheries occur. They also regard environmental degradation etc., together with sustaining biodiversity in freshwaters, to be major issues but possibly ones for which solutions are largely beyond their control. Aquaculture development is regarded as having a major negative impact on inland capture fisheries. The need for improved co-management approaches for fisheries and environmental management is well recognised.

According to DGCF (2000), the purpose of the fishery statistics for Indonesia is “*primarily to provide fishery statistics for the planning of fishery development programmes, evaluation of the progress of fishery development, and stock assessment of fishery resources. However, this book should be of great value also to readers who wish to obtain a picture of the present status of Indonesia fisheries by means of statistics*”. But it is difficult to see how the current statistics for inland open water fisheries help achieve these objectives. In fact, by being unable to reflect trends, and thereby intimating there is none, they may be counter-productive in terms of these aims. Although those familiar with the statistics are unlikely to rely unduly upon them, there are those less familiar who do. This is a common problem and as such discussed further in Part I.

5.1.5 Conclusions and recommendations

The Indonesia inland capture fishery statistical system essentially suffers from the application of methods promoted for marine fisheries. More recently, perhaps equally inappropriately, the system has been fine-tuned even further by applying techniques from aquaculture statistics. This history begs the question of whether anybody ever attempted to develop a system designed from the outset for inland waters.

Because of its history, the system is focussed on essentially a catch-effort based approach attempting to calculate, via report sampling, landings based upon knowledge of gears in use, the effort for each gear and catches per unit of effort. In itself, this is not illogical, since all fish are caught through fishing effort. The question is not whether the approach is technically valid but

whether it is cost-effective and viable. One clear conclusion from Indonesia is that it probably is neither.

The problem with gear based catch-effort approaches in inland waters include: (i) a tendency to under-report for most of the more productive gears (especially where fees are levied, formally or informally), (ii) the complexities and varieties of gear in use and resulting problems in defining effort for most, (iii) usually larger areas need to be surveyed (in comparison with marine fisheries – where fishing grounds may be bigger but activities are more visible and landing sites are more concentrated), (iv) the lower profile of inland fisheries which tends to reduce investment in and motivation for statistics collection (partly because the statistics themselves do not reinforce the need for investment), and (v) the related problem that inland capture fisheries occur in the same regions (inland) where much aquaculture production arises; normally, where government resources are shared with aquaculture, the latter sub-sector tends to get more attention. This does not mean that gear-based catch effort approaches are not valid for some parts of the fishery. There are clear examples of where the approach might be justified.

The DGCF in Indonesia has already identified that investment in computerising the statistical system will yield rewards in terms of increased efficiency of information compilation, analysis and reporting. The mission agrees. There would appear to also be some opportunities for utilising specialist fishery statistics software (an area in which the mission does not claim expertise). But, importantly, improving this aspect of the statistical system will not improve the quality (validity) of the underlying information. For inland open waters, it will be interesting to see what impact computerisation has. If some districts/sub-districts do actually generate information without sampling (as is thought likely), then computerisation may force them to generate the information at a lower level (*i.e.* invent actual sampling data). This could be worse.

There are essentially two broad options for improving the relevance of the information collected via the current system: (i) modify the system with a view to obtaining less information but of a higher quality, in particular by sub-dividing the fishery and applying more focussed sampling to each sub-sector (this requires a decent frame survey); and (ii) make higher investments in the overall system (especially increasing the manpower available, and motivation, at sub-district level etc.). Naturally, the Sub-Directorate for Data and Statistics favours the latter. Although the mission is not against such investments in general, it recommends caution before they are made because: (i) there are doubts if substantial investment in the current system would improve the quality of the information (for technical reasons and others outlined here), and (ii) even if it were achieved it may well generate information that is not entirely in-tune with development and management objectives (a subject covered in more detail in Part I).

Improving the specific design of the Indonesian survey methodology is beyond the scope of the current report. That will require considerably more inputs and familiarity with the current system. But some general observations/suggestions can be made. One obvious requirement is to improve the frame survey upon which the actual sampling system is based (a point well known to DGCF already). Without that, further investments in the current system may be inappropriate in any case. It is critical that such a survey be designed specifically to cater for the characteristics of the inland fisheries sector. It should provide, for example, comprehensive details of the distribution, seasonality, locations (habitats), methods and timing of deployment, labour requirements etc. for all major fishing gears. The objective should include identifying those gears operating beyond the household level (*e.g.* communally, by industrial operations, operators from beyond the sample area etc.) or those highly productive gears used in low numbers that might bias household surveys conducted at random. Obviously, information on these larger gears might be obtained through statistically valid sampling based upon frame survey guidelines based upon modified catch-effort approaches. For the multitude of smaller gears the household sampling approach is very appropriate. It is debatable, however, if estimates of household production should rely on gear based catch-effort approaches. In the mission's experience, the most practical approach for small-scale fisheries is to have the household itself as the defined unit of effort. With this approach, it makes no difference how the households catch the fish. Basically, household's catches can be assessed by summing individual

household members' catches (including women and children). Meaningful information on this is not easy to collect and care has to be taken in survey design; questionnaires need to prompt household members on various aspects of potential fisheries activities. But it is no less accurate than asking how much was caught by particular gears and the problems analysing the resulting information are considerably reduced. It may still be useful to gather gear-effort information but it is not essential for the estimation of household catches. Information on gears used is also required to determine or interpret a sampling strategy (particularly where random sampling picks up a low-frequency household using a more productive gear). Care has to be taken when sampling households to obtain information representative of the household as a whole. It is important to include the activities of women and children and persons who are not regarded, or do not regard themselves, as "fishers".

The most important need for Indonesia, which is in common with the other Southeast Asian countries, is to re-assess the objectives and requirements for information on inland open water fisheries in relation to the general discussion in Part I. There are opportunities for making cost-effective improvements to the current system but it is strongly recommended that this be considered within this much broader framework.

Regarding estimates of the likely production from inland capture fisheries in Indonesia, the most relevant conclusion is that, despite the considerable effort in statistics collection, the answer to that question remains elusive. In addition to doubts about the actual sources of current estimates, the sampling methods will promote under-reporting from the major gears (possibly also for minor ones), almost certainly do not include production from small/informal fishing activities (which cumulatively can be significant) and the sampling frame underlying the whole process likely under-represents inland capture fisheries (probably being more focussed on agriculture and aquaculture considerations). Estimating actual current production is speculative (but so are the current statistics). But based upon the aforementioned considerations and analysis, freshwater resources (although severely degraded in many areas) and inferences from similar fisheries elsewhere (see other sections of this report) it is not unrealistic to suggest that production is at least twice the currently reported level. Guidelines on how to cost-effectively undertake such estimates properly are provided in Part I. But doubling the production estimate does not double the reported value of the fishery (see Part I). To assess that, better information on the levels of dependency on inland open water fisheries is required.

5.2 Malaysia

5.2.1 Background

Malaysia is one of the more affluent of the countries in Southeast Asia and therefore, as expected, has a more efficient and effective infrastructure than most. There are, however, major differences between peninsular Malaysia and the distant States of Sarawak and Sabah. The latter account for about half of the total land area of the country but only about 20 percent of the total population. The latter States are the poorest in terms of economic development but both have good freshwater resources including several medium to large sized rivers. Water resources on Peninsular Malaysia are heavily impounded and there are large numbers of ex-mining pools or dams.

Malaysia is notable within the countries surveyed for having the most advanced facilities for remote sensing and GIS. The Malaysian Centre for Remote Sensing (MACRES) is an impressive facility available both nationally and regionally. Currently, fisheries applications at this facility are limited to coastal zones, particularly aquaculture mapping and planning.

5.2.2 The statistical collection system

Administratively, Malaysia is divided into States (provinces) each divided into clearly demarcated districts, including for inland areas. The State Department of Fisheries has in each district a permanently employed officer who is responsible for compiling statistics (amongst other things). These officers are responsible for compiling statistics for marine capture fisheries, aquaculture and inland capture fisheries. Each district officer reports to the State DOF who then reports to the Federal DOF (Kuala Lumpur) where the statistics are compiled. The Federal DOF has a relatively high degree of control and influence over State DOFs. A good State/district infrastructure exists. Federal DOF has a high degree of confidence in the staff involved and considers them to be comparatively well trained. Training activities continue to upgrade/update skills. Exceptions to this are primarily the large States of Sabah and Sarawak, and likely some minor islands. Here infrastructure is more limited. The problem is compounded by inland capture fisheries and freshwater aquaculture in Sarawak being under the Department of Agriculture. As far as is known, there is basically no effective reporting system for inland capture fisheries for these two States (but time did not allow this to be checked). This is important because these areas have the lowest level of development and the highest availability of inland fishery resources and, hence, are expected to have the biggest inland fisheries.

A special budget appropriation for fishery statistics is made. Annual and comprehensive Fishery statistics are published. District officers “estimate” inland capture fisheries on a monthly basis. The method of estimation involves “visual market surveys, enquiries and observation” but no formal reporting or sampling. In theory, estimates are made by production system: river, examining pools (of which there are numerous), embankments/reservoirs/dams, and others. Estimates are disaggregated (in districts) by species (28 categories included in monthly reports).

Marine capture fishery, and aquaculture, statistics are collected with the same infrastructure and largely by the same personnel. In contrast, to inland capture statistics, those for the marine fisheries and aquaculture are collected through an elaborate and comprehensive system of sampling based upon data collection. These statistics are computerised and considered to be comprehensive. For marine fisheries, information is also collected on numbers of fishers, based upon licensed gears or those working onboard licensed vessels. Aquaculture information includes areas of culture systems, species and marketing data.

5.2.3 The information produced

Population data for Malaysia by State are provided in Table 2.4. Gross production statistics for inland capture fisheries by State are shown in Fig. 2-12. Estimated gross national production varies around 4000 (\pm 500) MT per annum over the six years in question. This estimate applies mainly to peninsular Malaysia. The figures agree with those reported to and by FAO. No estimates are available for Sabah and a fixed 1 700 MT per annum is reported for Sarawak 1995-8 which is reduced to 89.6 and 51.1 MT per annum for 1999 and 2000 respectively (undoubtedly a reporting anomaly). When questioned regarding these apparent trends in the production figures, staff at DOF thought these more likely due to reporting constraints than to actual changes in the fishery. For example, the increased reported production for Selangor State in recent years was explained as likely being due to “increased effort to collect data”.

Table 2.4 Population statistics for Malaysia by State (Department of Statistics, 1999)

State/area	Population (1991) x 1000			Population Density (people/km ²)
	Total	Urban	Rural	
Perlis	190.2	50.8	139.4	239
Kedah	1 364.5	451.3	913.2	145
Pulau Pinang	1 116.8	840.4	276.4	1083
Perak	1 974.9	1072.4	902.5	94
Selangor	2 413.6	1810	603.6	303
Negeri Sembilan	722	306.5	415.5	109
Melaka	529.2	208.7	320.5	321
Johor	2 162.4	1 038.4	1124	114
Pahang	1 081.1	330.4	750.7	30
Terengganu	808.6	360.6	448	62
Kelantan	1 207.7	406.5	801.2	81
Sarawak	1 718.4	652.6	1 065.8	14
Sabah	1 808.8	600.5	1 208.3	25
Kuala Lumpur	5 048	-	-	-
Labuan	602	-	-	-
Total	17 098	8 129	8 969	

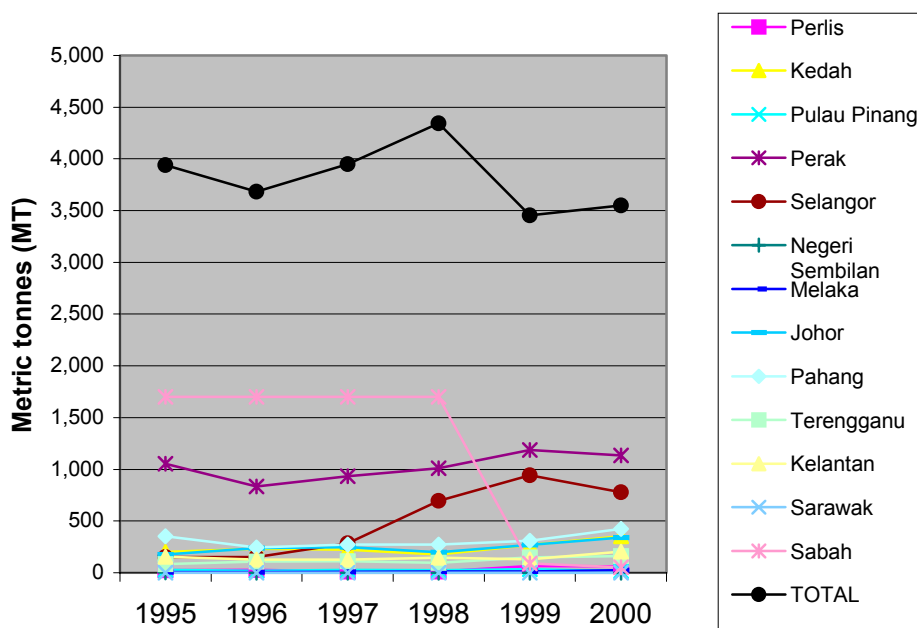


Fig. 2-12 Malaysian inland capture fishery statistics - by State

Reported landings of freshwater fish from inland open waters by province and month for 1998 are shown in Fig. 2-13. These reports clearly do not reflect the seasonal nature of catches from inland fisheries (especially rivers) that are known to occur in the humid tropics. The estimates may have a bias towards landings reports for reservoirs, which are less seasonal. At the very least the estimates for Sabah, where the resource base is definitely dominated by rivers, are not normal for a tropical inland fishery (landings from rivers, floodplains and swamps should show seasonal increases in catches at the onset of the dry season – see reports for Myanmar and Cambodia). It is possible the reports do not include rivers but it is more likely they do not reflect the true nature of the fishery at all.

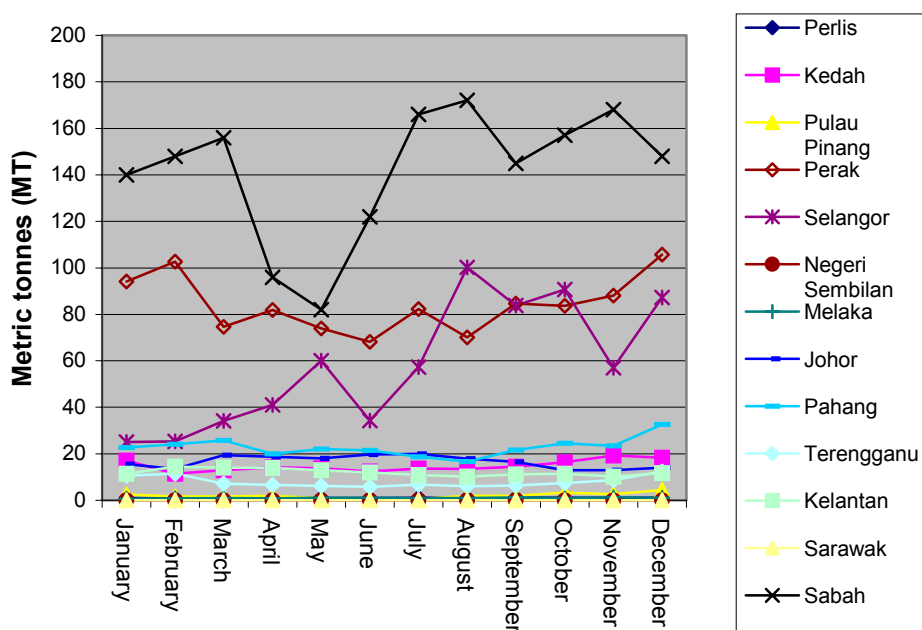


Fig. 2-13 Malaysian reported landings of freshwater fishes - by province in 1998, by month

Malaysia produces a relatively large number of ornamental fishes for the export trade, mainly through culture especially in Johor, Perak and Selangor States. Department of Fisheries (2001) lists a production in 2000 of 306 million individuals with a reported value of 71.9 million RM (about US\$ 18.9 m). However, it is likely that there is also a significant fishery for wild ornamental fishes especially in Sarawak and Sabah but no information on this could be obtained.

Malaysia has a modest open-water stocking programme. Department of Fisheries (2001) lists approximately 4.5 million fish stocked into open water bodies for 2000. The main species are Java Carp, Common Carp, Giant Freshwater Prawn, Red Tilapia, River Catfish and others. This compares with about 17.5 million individuals distributed from government hatcheries to culturists (it is assumed that considerably more are provided by private hatcheries). Fish caught as a result of stocking in open waters are reported as capture fisheries.

Malaysia has significant areas under rice production and the dominant system is wet-rice, mainly irrigated. There appear to be limited attempts to get figures for aquatic animal production from rice fields and it is assumed that this production is not reported. DOF (Kuala Lumpur) consider production of aquatic animals from rice fields to be limited due to the intensified agricultural system and especially the extensive use of pesticides.

Recreational fisheries are undertaking rapid and significant development. A new Act is being developed which covers sport fishing. Whilst marine sport fishing is considered to be a major sector (and possibly is based upon individual license fees) participation in, and gross revenues from, freshwater sport fishing are potentially very significant. Currently, no information is collected or reported on the recreational fishing sub-sector.

Malaysia reports no significant activities or projects in its inland capture fisheries sub-sector except for some local activities relating to attempts at conservation measures for certain threatened freshwater species or stocks. Particular note was made of the problems with the Terubok (*Hilsa macrura*) fishery, which is suffering from a multitude of problems of over-exploitation and environmental impacts.

Most research on freshwater fishery related issues have focussed on the biology/ecology etc. of fishes and the ecology/limnology of freshwaters. No studies on fishery economics or socio-economics, particularly production estimates, for freshwater fisheries, could be located.

It was reported that “most Malaysians prefer marine fish” but this is difficult to reconcile with prices of freshwater fish reportedly often being higher than for comparable marine grades, especially in the interior.

5.2.4 Perceptions of inland fisheries and objectives of the statistics

Most staff interviewed saw clear distinctions between the inland fisheries situations in peninsular Malaysia *versus* Sarawak and Sabah. In the former region, although locally important inland capture fisheries for food likely occur, the main areas of interest are biodiversity, environment, rehabilitation/restoration and recreational fisheries. In Sabah and Sarawak, authorities are fully aware that issues include poverty, livelihoods and food security values of inland fisheries.

The existing inland capture fishery statistics appear to have limited, if any, use. They do not form the basis of any current management system and appear, generally, not to form the basis of policy generation (accepting in a negative way – to reinforce the view that the sector is not important). The existing statistics are of no use as a basis for biodiversity/environmental management. There are clearly stated needs for information for policy and management in Sabah and Sarawak but useful statistics may be absent there.

The main threats to inland capture fisheries throughout Malaysia, and especially in Sabah and Sarawak, are perceived by most people interviewed to be due to environmental degradation and habitat loss arising through activities in other sectors.

5.2.5 Conclusions and recommendations

The inland capture fishery statistics in Malaysia are compiled as a secondary activity to the production of information for the marine and aquaculture sectors. Obviously, any system based upon estimates made by district officers in the absence of a statistically based sampling/observation programme, done probably as a secondary activity in most areas, cannot be expected to generate accurately representative information. The skills of staff in estimation would be highly variable. With such systems, at best normally only a cursory estimate of the fishery is made which is normally biased towards the most visible parts of the fishery (both in terms of access by the observer and nature of the activities). In particular, informal fishing activities in rural areas, particularly where fish are not landed at regular sites, and especially for rivers and swamps, are often overlooked. Malaysian authorities are well aware of these constraints.

A general consensus at DOF is that the statistics for peninsular Malaysia under-report actual production by a factor of at least 2 and possibly 3 times. However, even when corrected by an optimistic amount the production remains low relative to the marine and aquaculture sub-sectors. What is intriguing is that despite the entire system being based upon personal estimates, the experienced staff at DOF (whose own personal estimates usually put production much higher) make no attempt to increase the nationally reported estimates to a more realistic level. That is, estimates at district level are treated as though they were actual data, which they are not. The problem here likely stems from having to work within the confines of a national statistical system that, for most information, is based upon statistically valid and assessed data. Appropriately in most cases, this discourages adjustments of figures at higher levels of analysis. But this constrains re-assessments for inland capture fisheries.

For peninsular Malaysia there appears to be limited justification for significant investments in improved statistics aimed at ascertaining gross production through strengthening the existing system. Certainly, this would not be cost-effective in terms of investment returns and it would also yield the wrong information. Where objectives relate to biodiversity/environment issues etc., the information generated should help achieve the relevant objectives. However, gross production figures, even when dis-aggregated by species and production system, are of limited or no use. Investments would be, and are being, more wisely made in the areas of direct monitoring of biodiversity and the environment.

Malaysian authorities already recognise that Sabah and Sarawak are priority areas for improved information in relation to inland capture fisheries. They voiced the opinion that they would like information for those States to be up to the standard for marine fisheries. They are also keen to develop sound pro-poor development policies and resource management plans in these disadvantaged areas. Investments in improved information there are clearly justifiable. In this report, the two States fall into the category of areas where important inland fisheries for food occur but effectively no data currently exist. General recommendations for useful practical methodologies for obtaining cost-effective information, and the kinds of information required, in these circumstances are made in Part I of this report.

A cursory look at Sabah and Sarawak shows a reasonable availability of freshwater resources. The total population of both States is about 2 274 000 with 65 percent living in rural areas. As a guideline, a reasonable average annual per caput 20-40 kg fish captured from freshwaters in such areas (see comparable data for other regions in this report) gives a first guess production estimate of 50 000 to 100 000 MT per annum for the two States combined. This does not fully reflect the true value of the resource (see Part I) but initially indicates that investment in improved information is warranted.

Malaysia is likely to experience the continued rapid development of its recreational fisheries sector and all of the problems and opportunities that this will entail (see Part I). Information requirements and data collection opportunities for recreational (sport) fisheries in inland waters differ significantly to those for capture for food. It is recommended that DOF anticipate these opportunities and develop appropriate information and management systems. These should centre on developing co-management systems by promoting the full participation of resource users who, in this sub-sector, are generally more enthusiastic and able to co-operate effectively with the government. Additional general comments are made in Part I.

There is considerable potential in Malaysia in utilising the substantial national capacity in remote sensing and GIS to assist with natural resources and inland fisheries mapping and inventories. This approach is particularly useful for obtaining baseline indicative information in areas where limited empirical data exist (see Part I).

5.3 Myanmar

5.3.1 Background

Myanmar has impressive freshwater capture fisheries. The inland waters are made up mainly of the interlocking/mingling of riverine and estuarine systems of the Ayeyarwaddy (Irrawaddy, 2150 km long), Chindwin (844 km; a tributary of the main Ayeyarwaddy) and Sittaung Rivers (563 km) plus the large Thanlwin River (2400 km) to the east. The first three have adjacent deltas and are arguably part of a larger joint system. Together these systems extend from the eastern part of the Bay of Bengal to the Gulf of Moattama and along the eastern edge of the Andaman Sea. The Ayeyarwaddy River alone has a mean discharge of $13\,500\text{ m}^3\cdot\text{sec}^{-1}$ from its catchment of $424\,000\text{ km}^2$ (Welcomme, 1985), notably, practically all within Myanmar. It shares a watershed with the Mekong River which has only a slightly higher discharge ($15\,000\text{ m}^3\cdot\text{sec}^{-1}$) but a greater length (4880 km^2) and larger catchment ($795\,000\text{ km}^2$) (MRC, 2001). Aquatic resource area of the river systems within Myanmar encompasses a total of 8.2 million hectares (FAO, 1996); there were 53 123 ha of fishponds in 1999. The department of fisheries (DOF) in Yangon give a figure of 6 m ha of floodplains, which likely excludes river area and floodplain lakes. This approaches that of the entire Mekong (7 m ha, MRC, 2001). The country also includes a small section of the Mekong River basin but is not a member of the Mekong River Commission. With a total population of about 50 million, Myanmar potentially has an inland fishery greatly exceeding that of any single national part of the Mekong River basin, and quite feasibly rivals that of the lower Mekong Basin in its entirety. Indeed, in 2000-2001, the reported inland catch for Myanmar, at 235 000 MT per annum (excluding rice-fields and reservoirs), is three times that reported for Cambodia in 1998 and exceeds that reported for Cambodia, Laos and the Mekong sections of Thailand and VietNam combined in that year. Cambodia revised its figures upwards in 1999 as a result of research to verify its previous reporting system. Therefore this comparison is not valid for the 1999 onwards reports for Cambodia.

There are also great similarities in the fisheries of the Ayeyarwaddy and Mekong and the country presents a fascinating opportunity to compare statistics and experiences between these regions.

For management (licensing/regulation) purposes Myanmar divides its inland capture fisheries into two main categories:

(i) ***Lease fisheries***. These are almost exclusively key fishing grounds on floodplains which are primarily fished through the erection of barrage fences around the lease area with fish collected in various collection pens or traps. The peak season involves capturing fishes migrating off the floodplain at the beginning of river draw-down. Lease holders enjoy exclusive rights to fish the lease area including preventing access by others and a certain degree of environmental management and control. This is referred to locally as the “Inn” fishery. For present purposes it is the same as the floodplain (and Great Lake) barrage fishing components of the “Lot” system in Cambodia. There are currently 3 722 leasable fisheries in Myanmar of which 3 490 are still exploitable. Of these, 1 738 (52.3 percent) are located in Ayeyarwaddy Division (the lower floodplains and delta of the river). Leases have been auctioned ever year but DOF are extending the lease period to up to 9 years to promote improved long-term management. There are no government owned leases. A register of leases is kept and details of lease arrangements held on Land Revenue Forms.

(ii) ***Open fisheries***. These are fisheries in all other areas including all types of fishing operation. The right to fish in these areas is licensed out by DOF. All fishing gears require a license. For most this is a set fee. Some of the larger gears, particularly “bagnets” set in rivers (comparable to those used in the lower Mekong), are allocated by a tender system (“tender fisheries”). Fees are variable between regions according to production and

capacity. License fees for smaller-gears are low. Although the policy is for complete coverage of licenses for all gears (a monumental task in such a fishery) it was intimated that licenses tend to be neglected for smaller gears and the system concentrates on those people perceived as fishing for “profit”.

Officially, it is a requirement for all licenses that holders report their catches. The entire fishery is closed during June, July and August (to allow spawning and recruitment). In practice this is probably enforced only for the Inn fishery, tender fisheries and larger gears. The small-scale fishery occurs year-round and is considered technically “illegal” during these months.

DOF have recently tested an interesting management approach to lease fisheries whereby a modest 1 percent of the revenue is returned to the fishery through a stocking programme. An impressive 30 percent is however returned in the form of grants to lease holders for improved management. These funds are used mainly for undertaking environmental rehabilitation, restoration or enhancement measures. Common activities include, the clearing of floodplain channels to allow improved access of fish to feeding/breeding grounds, and improved capture, the planting of trees and river bank engineering works using local materials. This is important because the impacts of this appear to be reflected in reported catches. Some trials are also being conducted on rearing fish in pens (1-50 ha) within lease areas. Currently this is done on a modest scale and production within pens is included in production reports for leases (if the activity expands then DOF intend reporting productions separately).

Revenue from the fisheries (1999) were as follows: lease fishery - 621.89 million Kyats; tender fishery - 83.519 million Kyats; implements (gears) (= others) - 6.298 million Kyats.

DOF report that reservoirs are now under the control of the Ministry of Agriculture and Irrigation. Fishing there is now officially not allowed, reportedly as a temporary measure to allow stocks to recover, although it is odd that a significant stocking programme for reservoirs has been on-going. For the current purposes it is sufficient to note that reservoir catches are not included in the current or recent reports. DOF gave an estimation of reservoir and lake area of about 1.8 million ha (which is consistent with the difference between the DOF floodplain estimates and the FAO total resource estimate).

A fledgling freshwater aquarium fish industry was reported. Its extent is unknown but it could be quite significant either potentially or in reality.

5.3.2 The statistical collection system

Administratively the Union of Myanmar is divided into States (and Divisions) – Districts – Townships – Villages. All fishing license holders are required to report their catches to the local township official. For lease fisheries the lease holders keep records and local officers collect these records. No sampling of catches or landings is undertaken. It is however likely that the reporting requirements are enforced, or monitored, predominantly for the larger gears. Some township officers estimate catches themselves. Township offices obtain reports approximately every two weeks and report monthly to the DOF, Yangon. Local officers are expected to check local reports including visiting fishing locations. Rural areas are covered by the local township office. There are 370 townships in the whole country and 110 fisheries township offices. Some township offices cover more than one township. Usually townships with lease fisheries have a resident officer for statistics, including nearly all those in the delta area and Yangon Division. Officers at township level work only part-time on fishery statistics, their other duties including, for example, aquaculture extension. These staff may call upon other officers to gather more statistics when required. There are approximately 90 staff (DOF) in 15 district offices; a total of 70 in the State and Division offices. DOF Yangon is responsible for the nature of information collected and sends summaries to the National Statistics Organisation. Planning and Statistics Division (DOF Yangon) has 19 staff in total.

It was reported that the tax register is used as the basis for a frame survey upon which reporting is based. But the system essentially does not officially involve sampling but is based upon attempted complete-reporting. It is assumed that the tax register is used to assess where reports are expected to be submitted. Again, this suggests a possible emphasis on the more commercial sectors of the fishery.

Licenses for gears normally apply to both the gear type and locations where fishing is allowed. Information disaggregated by production system (habitat) is therefore, in theory, available at local level. Lease fisheries divide their catch reports into two categories by value/quality (high and low). Open fishery reporting is not done by any category. There is therefore limited information on species composition. Although some modest surveys have been done, often by university students etc., DOF are not confident about their information on the composition of catches.

Aquaculture statistics are collected through the same system by the same personnel. Rice field fisheries are not licensed and therefore production is not reported. Production arising from stocking in open waters is reported as “capture”.

Myanmar reports statistics by the fiscal year (April to March).

DOF have stated confidence in their data but appreciate the need for checks/verifications. They stated a need to modernise their system for data collection, storage, handling and reporting. Computerisation is a high priority, but funds are limited. There is a need for training to use specialised fishery statistics software. These problems/needs are common to all sub-sectors of their fisheries reporting system and general assistance from FAO in these respects was requested.

5.3.3 The information produced

The reports for Myanmar, in general, show some interesting trends and features. They may actually represent what may be happening in the fisheries, which is a useful start.

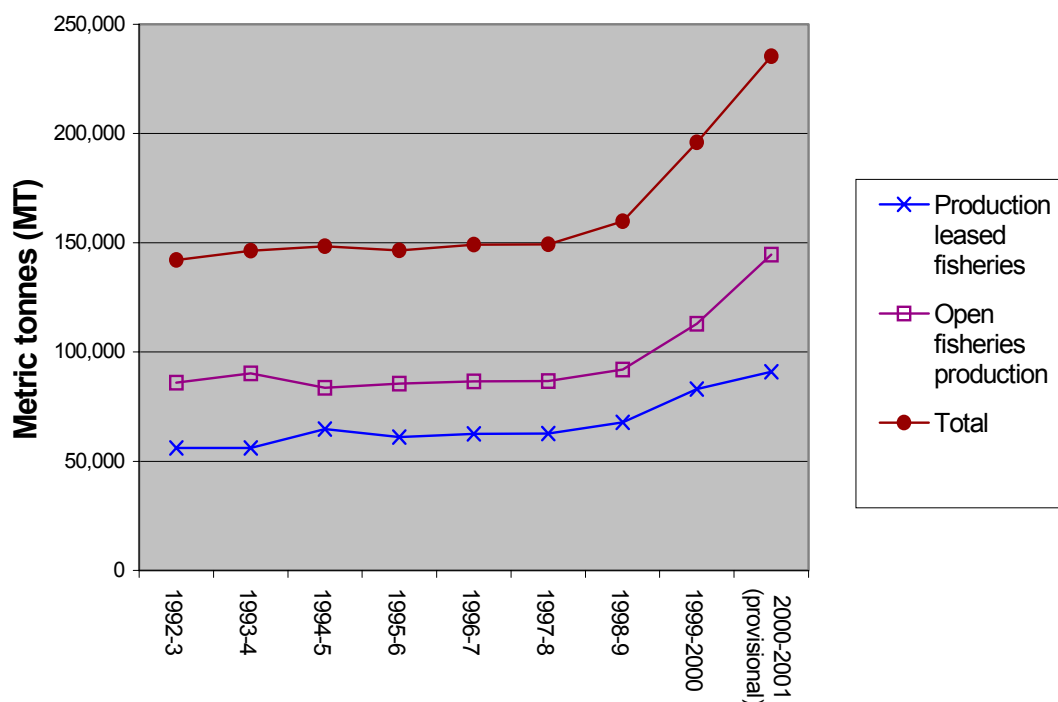


Fig. 2-14 Myanmar - reported production from lease and open fisheries

Reported catches are shown in Fig. 2-14. Although not conclusive, there is an apparent trend of increasing production from 1992-3 to 1998-1999, which may well be in-line with population growth. The reports also suggest that most of the increase in total catches during this period arose from the open fishery, which is logical (access to the lease fishery is controlled but open fisheries are more openly accessible and therefore would reflect increased effort due to population changes more). It is, however, problematic that there is so little difference between years due to natural variations in flooding extent (due to long-term global oscillations in weather). But the reports are a refreshing change from the flat-lines common to many other inland fishery statistics.

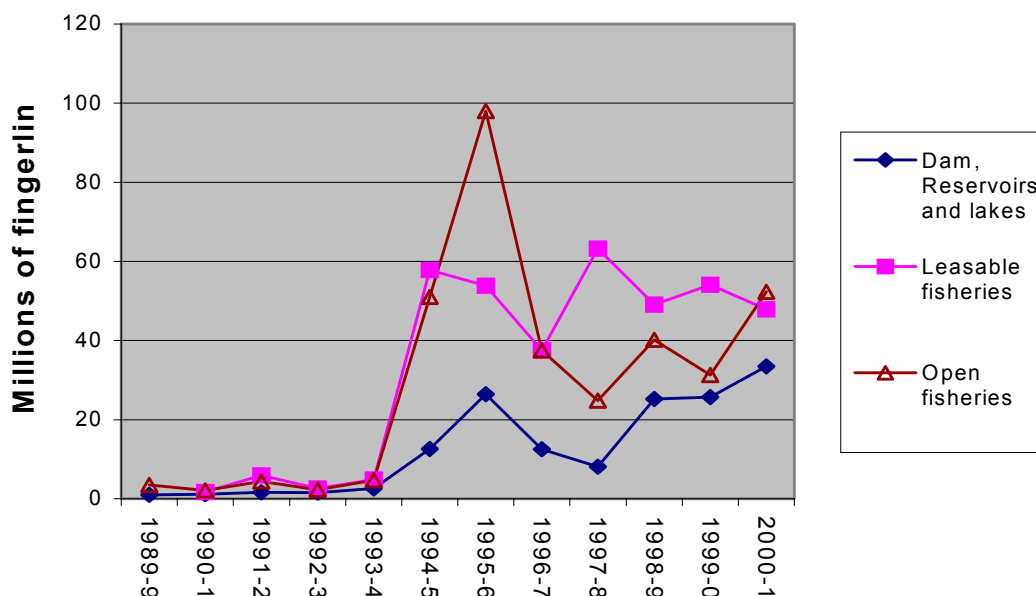


Fig. 2-15 Myanmar - numbers of fingerlings stocked

Most interestingly the reports show a significant increase in production from 1998-9 onwards. DOF attribute this to the results of their management activities: restoration/rehabilitation work and in particular stocking. This is likely correct. Reports of fingerlings stocked are shown in Fig. 2-15. Over the period 1997-1998 to 2000-2001 production from lease and open fisheries increased 28 271 and 57 828 MT respectively. From 1994-1995 to 2000-2001 the total number of fingerlings reported to be stocked into lease and open water areas was 335.125 and 363.445 million respectively. This gives an estimated average return per fingerling stocked of 85 g and 159 g for lease and open fisheries respectively. This is not unreasonable, although the environments in question would be expected to harbour a high level of predators. The higher return with open fisheries could be due to differences in fishing methods. Lease fisheries would catch most fish primarily in the same season as stocked. Unfortunately, due to manpower constraints, DOF appear not to have collected adequate information on the composition of catches to be able to confirm links between stocking and production. Obviously, this needs to be done. But the existing reports of stocking and production are not without problems. First, major stocking started in 1994/5 but significantly increased production started only in 1998/9. This delay in benefits is too long. Second, from 1996/7 onwards stocking levels remain fairly uniform but fish production continues to increase (alternatively, the trend in production increase is more smooth than the trend in stocking). The situation is complicated because other enhancement activities were occurring alongside stocking (e.g. environmental rehabilitation). Production can differ significantly between years through natural cycles and such could either mask or enhance the impacts of management. Also, the recent extension of lease periods has encouraged lease holders to undertake their own enhancement and conservation including promoting re-stocking activities. Production reports when based upon stocking programmes can also include a certain amount of subjectivity (anticipation of a response to management measures). Therefore, analysis of the increased production achieved in recent years is very

complex. The mission does conclude that the approaches to river fisheries management adopted in Myanmar should indeed produce benefits of the orders being indicated.

The fishery statistics reports certainly suggest that the recent experiences with management approaches with river fisheries in Myanmar warrant further study. They also illustrate the pitfalls of using traditional fishery statistics to obtain feedback on management activities. Clearly, Myanmar needs to compliment the existing information system with a research programme to look deeper into the impacts of stocking and environmental management. But based upon the reported statistics, they are to be complimented on their approach so far. The reported increase in production over the past three years represents an increase of about 45 percent and 65 percent for lease and open fisheries respectively. This is in a fishery that was already large, with a high level of exploitation. To the mission's knowledge it also eclipses anything ever achieved in aquaculture (when starting from a similar point). Most importantly, this experience annihilates the widely held view that there is no scope to increase production from inland capture fisheries in rivers.

Reported production analysed on a monthly basis showed some encouraging results. Monthly figures over two years for Ayeyarwaddy Division (the heart of the Irrawaddy floodplains/delta) are shown in Fig. 2-16. These show the gross seasonal changes that are expected from floodplain fisheries. The peak catches are reported to occur in September which is when floodplain waters begin to recede and thereafter remain higher, declining towards the dry season to the flood season. The more rapid drop-off in catches from lease fisheries compared to open water fisheries is also entirely logical. The former tend to target fish fleeing the floodplain and heading towards more permanent waters fished more by the latter.

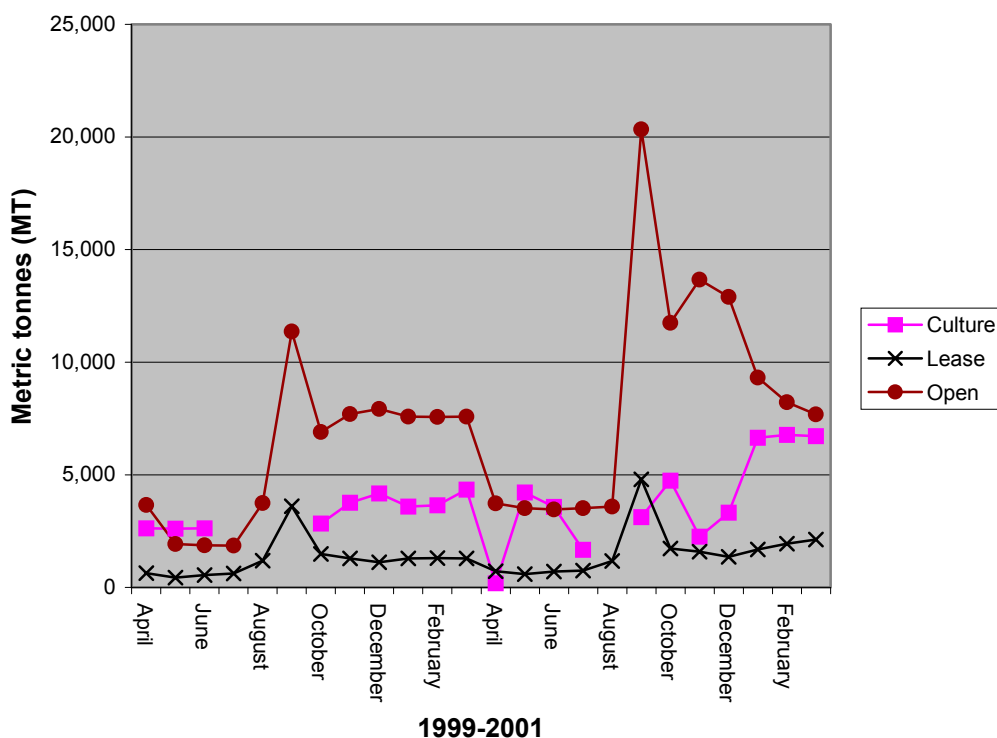


Fig. 2-16 Myanmar - reported production by month for aquaculture, lease and open fisheries (1999-2001) for Ayeyarwaddy Division

It is interesting that the reports show fishing all year-round. It is obvious that the stated “closed” season has little impact on reported production. Also, production from lease fisheries is reported beyond the period of river draw-down which means that the reports cover more than the main

lease gear (barrage fences; because these only work for receding floodwaters). Presumably fishing continues in dry season refuges (pools etc.) in lease areas. Also leaseholders may hold fish in pens and sell them later in the year when prices increase. It is also reported that amongst the catch held during the dry season is much smaller fish, which are released again by lease holders at the start of the next flood. This approach is promoted by DOF and is becoming more sustainable in view of the increased duration of leases (giving fishers improved incentives to restock). This illustrates fish stocking undertaken by lease holders and based upon naturally recruited stocking material – a system with much potential for promotion in other countries.

Unfortunately, the reports for aquaculture are incomplete (Fig. 2-16) but there is possibly evidence of the expected inverse relationship between production from capture and culture in such an area. Capture fisheries on river floodplains, during peak periods, will easily out-compete aquaculture in their vicinity, as documented for the lower Mekong. The monthly reports for aquaculture also change abruptly which is likely explained by them representing marketing and not production (*e.g.* farmers likely hold back produce until prices recover after the influence of seasonal influences from river fisheries). The sudden drop in freshwater capture production in April 2000 is explained by DOF as being due to a sudden increase in production from the marine fishery at that time which depresses fish prices.

But again these reports (Fig. 2-16) are not without problems. Catches outside the period of river draw-down (October – August) appear too consistent (apart from the aforementioned drop in April). Catches would be expected to decline over this period as fish that have retreated into dry season fishing areas are exploited and as they migrate away from the area. (This phenomenon is illustrated for Cambodia later). Significant differences in catches between years, as is apparent in Fig. 2-16, are normal for river fisheries and can reflect natural variations in production. Interpretations here are also complicated by the fact that the reports apply to a fishery where a considerable degree of management effort (stocking/rehabilitation) is being applied.

The average reported production per lease is shown by State/Division in Fig. 2-17. Some States/Divisions away from floodplains have high reported productions per lease. This is possibly because some leases apply to lake areas, likely, for example, in Shan State and Kachin. The odd thing is the low reported production per lease for Ayeyarwaddy, although having over half the total leases since it represents the best fishing grounds. But lease areas there could be on average smaller. It is also reported by DOF that there are some differences between State/Divisions in the allocation of catches from “flood fisheries” (a previous category used until 1991) into lease *versus* open fisheries.

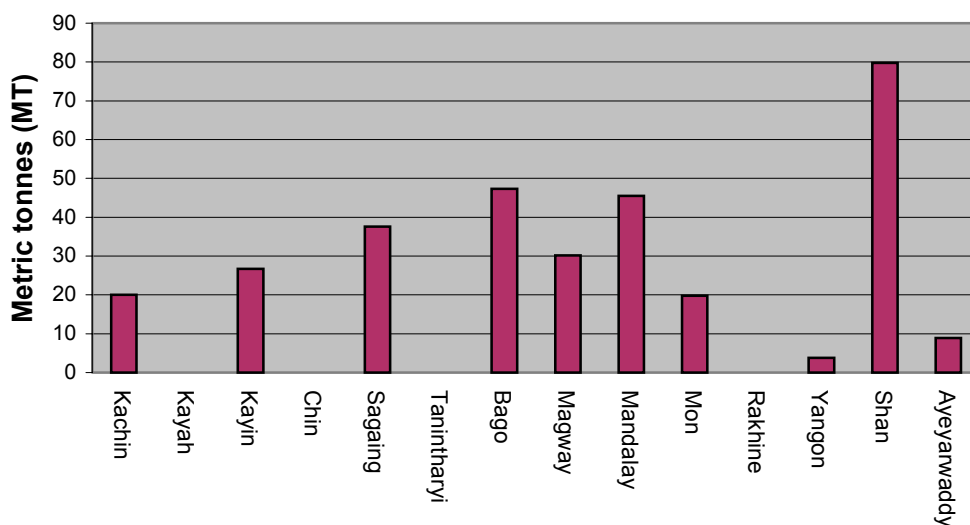


Fig. 2-17 Myanmar - mean reported production per fishing lease (1999-2000)

Reports of wholesale fish prices (for the 8 highest volume species, excluding prawns) in Yangon markets for 1999-2000 show that the lowest and highest prices for marine fish are only 44 percent and 61 percent, respectively, of those for freshwater fish. These reports confirm experiences in most countries that freshwater fish (by-and-large) are preferred to marine fish; in denial of popular perceptions to the contrary. This is likely due to the majority of people living (or coming from) inland areas (preferring traditionally available fish) but the quality of produce is likely another major factor (inland fish is produced locally and tends to be of better quality).

The reported number of fishers operating in inland waters was 1 398 410; higher than the 1 278 000 in the marine sector, and approximately 3.5 times the number of fish farmers (2000-2001 Fig. 2-18). These figures are entirely logical. Although marine fisheries production is far higher in Myanmar (721 904 MT, 1999), the level of participation in inland fisheries is the key factor. These reports also should be viewed in the light that it is unlikely they represent all inland fishers. In particular, the multitude of small-scale activities are probably not covered. Rice field fishers are definitely not covered and although catches may be low, rice field fishers could outnumber those in open waters and lease fisheries combined; neither are reservoir fishers included. That this section is not included is also indicated by reports for the narrow coastal Division Tanintharyi where fish farmers are reported but no inland fishers. It is a certainty that even coastal areas have people fishing in freshwaters (reports are missing for Rakhine State).

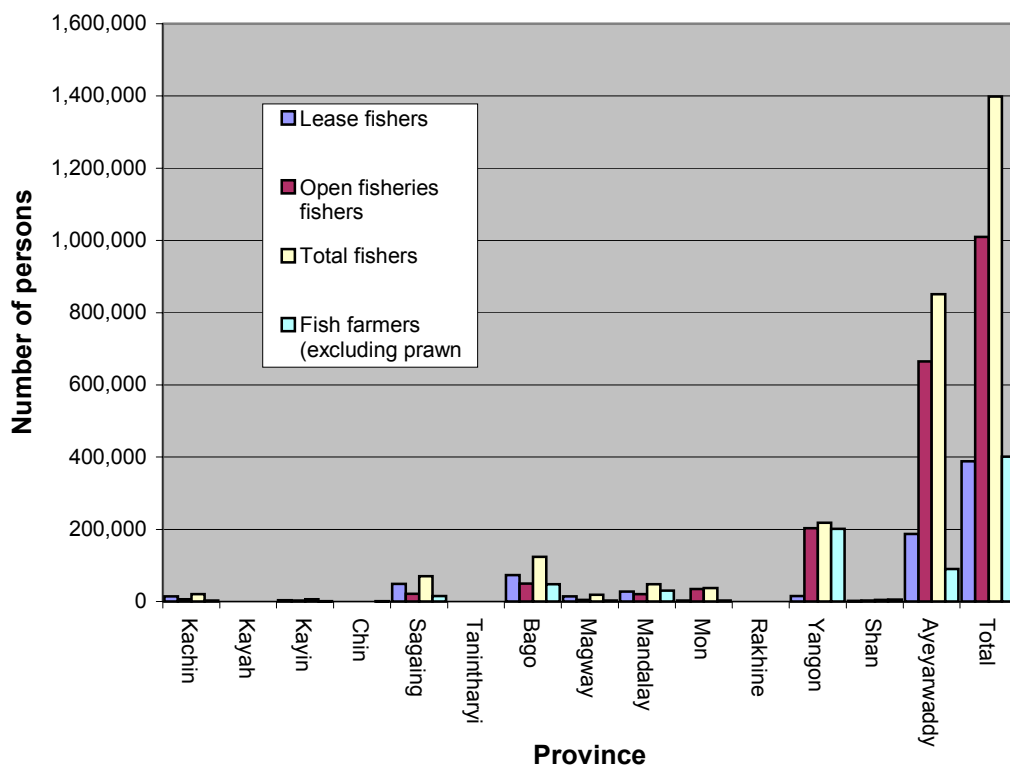


Fig. 2-18 Myanmar - total reported number of fishers and fish farmers (2000-2001)

The mission concludes that there is reason for some confidence in the reports for Myanmar. Despite some difficulties and anomalies, the reports do appear to reflect what is expected to be happening in the fishery and there is reason to believe the reports may be useful for picking-up trends in the fishery (partly because some are already evident). However, giving a picture of the fishery is one thing. Whether they accurately estimate actual production is an entirely different issue. It appears that Myanmar have no actual data based upon sampling the fishery itself (for production, participation or anything else). Obviously, the facts of this matter can only be obtained by having a research programme to investigate and verify the actual figures. But there are good reasons to think that reports are still underestimating the fishery:

- The reporting system probably does not properly cover the small-scale, informal sections of the fishery - although catches per caput can be small, participation can be very high. Such activities can produce significant quantities of fish (for example, three times that reported for commercial/licensed gears in the Mekong Delta, see VietNam this report).
- The system is based upon reporting which, as always, relies on the willingness of the fisher to be truthful and the ability to recall catches (although in Myanmar the system expects a shorter recall period than in most other countries). This is particularly so for fisheries where there are linkages between license fees and catches – especially for commercial gears and lease/tender fisheries.
- Experiences in Cambodia have shown that where large revenues are involved (especially for leased/tender fisheries) not only do lease/tender holders under-report, but government officers deliberately under-report also. The mission has no reason to believe the same problem occurs in Myanmar.
- Cambodia has a fishery very similar to that of Myanmar (at least for the floodplain areas) and a similar reporting system based for the larger gears on catch reporting and license records. Considerable research during the mid 1990's has confirmed that the reporting system grossly under-reported catches. In response to this information, Cambodia elevated its catch reports for 1999 by a factor of about three times. Despite this increase, recent reports are still considered under-estimates (see Cambodia in this report).
- Estimates of catches based upon sampling in the Mekong Delta in VietNam (an area very similar to that in the heart of Ayeyarwaddy Division in Myanmar), showed actual catches to be more than four times higher than estimates made from reports and license information (see VietNam in this report). The latter area in VietNam is a net exporter of fish (as is likely for Ayeyarwaddy) with a per caput catch roughly 100 kg per person (of the total population). If applied to Ayeyarwaddy this gives a total catch for that Division alone of over 500 000 MT (although a proper comparison needs to take account of a number of variables where information was unavailable to the mission).
- Fish consumption figures for Ayeyarwaddy Division suggest a local product requirement for that area of about 235 760 MT in 1999-2000³. But in the same year the Division reported a production of only 90 813 MT (lease and open fishery combined) and 30 317 MT from culture (total 121 130). It is unrealistic to explain the difference through supply from the marine fishery. There is no doubt that such an area would be a net fish exporter (domestically – *i.e.* to other Divisions). Taking into account such domestic export (and much of the culture production is likely also exported) this suggests an under-reporting for inland capture fisheries by a factor of at least 2, possibly 3 times.

It is beyond this report to try to accurately re-calculate catches for Myanmar, an activity that should in any case be done by Myanmar itself. However, it is interesting to note that multiplying the current reports by three (on the basis of experiences in Cambodia) gives a production of about 700 000 MT per annum - excluding reservoirs and rice fields. By taking such approaches, the eventual figure reaches lofty heights, but not unreasonably so. Based on a resource area of about 6 million hectares of floodplain alone, estimated production in Myanmar reaches 900 000 MT per annum based upon figures for capture fisheries for the lower Mekong (150 kg/ha, MRC, 2001). Even very highly degraded floodplains with heavy exploitation may yield in excess of

³ (CSO, 1999). The figure is difficult to calculate as conversion factors are not known. The author used an average factor of 3.0 to convert from processed to fresh fish, which may be conservative. This gives average per caput consumption of 40 kg (the survey was for 1997 but it is assumed consumption patterns have not changed). This is a low figure for such an area based on data for the Mekong, although meat consumption is higher.

100 kg per ha (Hoggarth *et al.*, 1999). This brief overview confirms the opening summary of this section, that Myanmar has both the resource area and population to rival the production of the lower Mekong Basin. At the very least, the extent to which this is realised should be investigated through further more detailed analysis and surveys (via methods suggested in Part I of this report).

It is also patently obvious that there is great scope for information exchange between Myanmar and the countries of the lower Mekong Basin (particularly Cambodia, but also VietNam). This is not only for information relevant to interpreting fishery statistics, but also on fisheries management systems, particularly for lease/tender (lot) fisheries.

5.3.4 Perceptions of inland fisheries and objectives of the statistics

DOF Myanmar is already well aware of the importance of their inland capture fisheries. It is regarded, largely, as a sector which has “looked after itself” for a long time, presenting few management problems. The main threat to the fishery is regarded as environmental degradation. Myanmar is also one of the few countries with comprehensive and active involvement in fisheries improvement for its rivers through stocking and rehabilitation/restoration; apparently, with already significant rewards. Inland fisheries are regarded as primarily “for the local people” whereas marine fisheries, and to a large extent commercial aquaculture (especially prawns), are regarded as export earning sectors.

DOF stated that the fishery statistics are used to draw national plans, determine social factors in communities (*e.g.* consumption/production), understand the biological dynamics of fisheries for management purposes (stock assessment etc.), to monitor supply and demand, and to identify and monitor strategies for increasing production. The information provided through their reporting system meets some of these needs and certainly more so than in some countries. But it clearly falls short for some other requirements. There was stated concern that the reporting system did not adequately satisfy information needs relating to poverty, livelihoods, food security and other such factors.

5.3.5 Conclusions and recommendations

It is obvious that Myanmar needs to undertake some studies to verify the accuracy of their reports, or more likely, to evaluate the extent of under-reporting (see Part I for methods). The information currently produced appears to be of sufficient quality to justify this. However, experiences have shown that obtaining accurate information, particularly with licensed fisheries (and especially lease fisheries) can be problematic. It is essential that verification includes impartiality and is perhaps best done through a research process in small representative areas. Even then it is not easy to get accurate data (see Cambodia in this report). But it would appear that there is potential for Myanmar to justifiably use its fishery statistics for basic management and policy considerations, provided they are verified, checked and re-assessed. The important issue is not whether the statistics are accurate but whether they are representative (*i.e.* to what extent they represent a sample of the fishery). With reasonable information, inaccuracy can be accounted for once the sources of errors are known.

The current reports have limited use for the purposes of assessing management inputs, including assessing the impacts of stocking and other forms of enhancement. For these considerations, precise information on catches, and species composition, is required. Again, this might be obtained through targeted research initiatives and it may not be necessary, or feasible, to modify the entire reporting system to meet these requirements.

One way of investigating the relevance of reports for lease fisheries is to analyse relationships between lease areas (for equivalent habitats), lease fees and reported production. There are logical biological and economic relationships between these factors. Deviations from these are

an indication of anomalies in reporting. This should be done and is a relatively low-cost exercise. If research is eventually done to verify production, then these parameters can also be used to extrapolate from researched areas to the fishery as a whole.

The fishery statistical system in Myanmar is based primarily upon a method of revenue generation. The country has already been complimented on its willingness to reinvest some of that revenue back into the fishery. But the issues of statistics and revenue are difficult to divorce. From a purely statistical perspective, a shift from quantity to quality of information would certainly be a benefit. If information is available on the relative abundance of some of the more prominent gears, it is not necessary to have catch reports from them all. But the system in Myanmar still requires near full coverage (at least for the commercial gears) for licensing purposes. The problem then is that it is difficult, without significant increases in investments, to shift the emphasis to a smaller sample in order to get better quality reports. There are also doubts about whether such can be achieved based upon the current reporting approaches. But certainly, for the smaller gears, there is a point at which the costs of collecting licenses outweigh the benefits in terms of revenue (a stage probably already reached, possibly surpassed, in Myanmar). Under such circumstances it is better to have more open policies, which acknowledge the realities of inland fisheries and thereby promote new ways of obtaining fisheries information and less rigid ways of considering existing statistics. A basic problem with the system in Myanmar is not that the reports miss certain parts of the fishery (which almost any system would) but that it portrays itself (officially) as covering it all. And the latter makes it difficult to adjust the figures by acknowledging incomplete coverage.

The strategy of Myanmar should obviously to be to improve its existing reporting system where possible but also to consider inland capture fisheries information more broadly (for example, whether the information collected meets management requirements). The latter is crucial if significant new investments are to be made. Both aspects are discussed in more detail in Part I.

5.4 Philippines

5.4.1 Background

Philippines was visited only briefly and as part of a second mission to formulate a proposed TCP to improve the quality of information for inland fisheries. Brief details of the statistical system in operation, and the information produced, were subsequently included here. The mission was unable to explore the system or data produced in as much detail as for the other countries.

The Philippines is a country composed of many islands, only a few of which are of any size. Not surprisingly its fisheries are certainly dominated by the marine capture sub-sector. Aquaculture is also well developed and has a long tradition in the Philippines which ranks in the top 10 of the world's producers. Even so, the Philippines were ranked fourth in Southeast Asia in 1999 in terms of reported catches from inland waters.

All inland waters are extensively fished. The main producing areas centre on the larger lakes including Laguna de Bay (89 076 ha) and San Pablo Lake in Laguna; Taal Lake (24 356 ha) in Batangas; and Lake Bato (3 792 ha) in Bicol. Most rivers in the Philippines are now highly degraded, as are the lakes. A recent natural volcanic eruption has decimated the inland fisheries in some of these areas.

According to the Philippines Fisheries Code of 1998, inland fisheries occur in freshwater and brackishwater. Resource areas are shown in Table 2.5. The 1998 Fisheries Code is very comprehensive. Municipal/City Governments have jurisdiction over municipal waters as defined by the code. This includes all inland areas. In addition to problems of pollution and over-exploitation of inland waters there are severe conflicts of interest between capture and

culture considerations in inland areas. For example, the extensive development of fish pens in inland waters has limited access to resources by capture fishers.

Table 2.5 Inland fishery resource areas in the Philippines (ha)

Environment	Ha
1. Swamplands	246 063
Freshwater	106 328
Brackishwater	139 735
2. Existing fishpond	253 854
Freshwater	14 531
Brackishwater	239 323
3. Other Inland Resources	250 000
Lakes	200 000
Rivers	31 000
Reservoirs	19 000

The Philippines has much involvement in “coastal zone management” with many past, current and pipeline projects devoted to this subject. However, there is no parallel for coastal zone management for inland areas, despite the increased environmental and resources management problems there.

The Bureau of Fisheries and Aquatic Resources (BFAR) has undertaken some studies on inland capture fisheries management. One division is engaged in capture fisheries in inland waters but works mainly on fishing technology. Some biological and fisheries assessments studies have recently been undertaken in 7 major lakes. Some livelihoods aspects were covered. The final report on this is pending. There has been a National Stock Assessment Project for Marine Fisheries but not for inland fisheries. In general, for inland fisheries there has been only a limited programme/involvement in biological aspects and very little on socio-economics etc.

5.4.2 The statistical collection system

BFAR is the main government agency responsible for fisheries and has the responsibility for management and development. However, responsibility for statistical data collection rests with the Bureau of Agricultural Statistics (BAS). Both BFAR and BAS are under the Department of Agriculture. BFAR has a major role in determining the nature of statistics to be collected but the implementation of surveys, including appropriate methods, is determined mainly by BAS. BFAR is supplied with statistics by BAS.

The statistical system used by BAS in general focuses on monitoring landings at a sample of landings sites. However, this information for the inland fishery is supposedly supplemented by a sample survey of households.

The sampling method is simple random sampling of landing centres by province, and simple random sampling of households. The sampling frame for the latter is a listing of municipal fishing households conducted nationwide in 1992. The basis of this frame for the household survey is not clear. Households are stratified by fishing grounds (lake, reservoir, river etc.). According to BAS, for inland fish producing provinces, about 2123 “fishing households” were interviewed in 1997 out of the 34 000 inland fishing households “listed” nationwide. It is unclear how the definition of an “inland fish producing province” is derived or what constitutes a “fishing household”. The reported system is confusing because a random sample of all households should be what determines which are involved in fishing and which are not. It is not possible, for example, to have truly random sampling of “fishing households” unless those households fishing, and not fishing, are already known. And that information should be gathered frequently because participation in inland fisheries by households can vary significantly

between years in response to a number of factors. It is, however, highly likely that the choice of the sampling pool of households is based upon fishing gear records or records of some other attribute of the fishery recorded in the 1992 survey. The system is, therefore, probably not random but based upon random sampling of a pre-determined section of the fishery (which in any case is now out of date). This can cause serious problems. For example: In Thailand in many areas only about 5 percent of households involved in the inland capture fishery use licensed gears, sampling those households is, therefore, fairly irrelevant to assessing the extent of the fishery; in Indonesia, as likely elsewhere in Southeast Asia, there was a reported increase in involvement in inland capture fisheries of an estimated 40 percent as a result of the economic crisis of 1997, therefore a frame survey undertaken in 1992 is unlikely to be an accurate basis the frame for the Philippines for recent surveys. The frame survey for inland fisheries is apparently being updated.

Surveys are organised by Municipal Officers but based upon hiring labour specifically to undertake surveys. Data collectors are paid per operator interviewed. They are trained and supervised for one week. Surveys last 15 days and the inland capture survey is supposed to be undertaken every three months, simultaneously with the aquaculture survey. The frame upon which aquaculture statistics are gathered was recently redesigned by BFAR. A farm inventory is planned for next year (designed by BFAR, implemented by BAS).

Two basic approaches are taken to obtaining capture fishery statistics for inland waters:

(1) The frame survey of inland municipal fisheries.

For the survey of municipal fish landing centres the frame is the List of Inland Municipal Fish Landing Centres (for provinces with LC's). Information collected includes: landing centre category; unloading information; number of boats; daily volume of catch; fishing gears and fishing ground; species. The frequency of data collection is officially a three times a week interview of fishing boat owners or fisherman at sample fish landing centres during peak hours of unloading (for landings centres).

For provinces without Landings Centres, a survey of landings by household is undertaken. For this the frame is the List of Fishing Households (1992). Information obtained includes: unloading information; daily volume of catch; fishing gears and fishing ground; species.

Survey forms for the household survey are based upon questions directed at individuals in the household (presumably the head fisherman); a system which elsewhere has been shown to seriously underestimate household catches because respondents tend to report only their own catch. Questions are asked on fishing ground, fishing gear, species caught, monthly average catch and price information, total number of fishing days, daily average fish catch, average price per kg and remarks. The whole survey is based upon quarterly recall by respondents.

According to the survey manual, inland fishing is defined as "the catching of fish, crustaceans, molluscs and all other aquatic animals and plants in inland water like lakes, rivers, dams, marshes, etc., using simple gears and fishing boats some of which are non-motorised with a capacity of less than three (3) gross MT; or fishing not requiring the use of fishing boats". Inland waters are defined as "a body of water within the shoreline which includes brackishwater and freshwater, such as lakes, rivers, reservoirs/dams, etc." Fishing ground codes in use include "rivers, lakes, swamps/marshes/lagoon, dams/reservoir/irrigation/swim, others (includes creeks, rice-fields, channel, spring, stream, drainage etc.)". The list of freshwater species on forms includes only 20 fishes, 7 crustaceans and 4 molluscs.

2. Non probability surveys

This occurs when scheduled sampling surveys (as above) cannot be undertaken. With non-probability surveys, trends in fish production and price are monitored through interviews with key informants. For inland capture fisheries these include: fishers, fish vendors and boat owners. The system is obviously subjective and also does not capture any information on entry into and exit from the fishery.

BAS has experienced severe budget reductions from 1995 to date. Consequently, due to insufficiency and delay in the release of funds, estimates have recently been generated based on surveys with reduced sample sizes and/or monitoring activities with key informants as respondents. The results of limited probability and non-probability surveys were the basis of generating fishery statistics for the provinces since at least 1995. BAS report that “normally, the information for inland capture fisheries is based upon key informants”.

Currently BAS is designing an inland fishery statistical survey for 29 provinces. But this assumes that it will get adequate funding.

Data processing systems appear to be in place and functioning reasonably well. The statistical system is de-centralised to provinces/municipalities. Availability of computer hardware is limited in provinces. The database system was prepared by BAS data programmers etc.

All production from rice-fields is recorded under culture.

5.4.3 The information produced

Reported production from inland capture fisheries is shown in Fig. 2-19. A gradual decrease in production is evident from these reports and this is widely attributed to be due to over-exploitation and habitat/environmental degradation. However, it should be noted that the accuracy of these statistics is unknown. Certainly, from at least 1995 these reports are based mainly upon the perceptions of key informants and not upon statistically valid data.

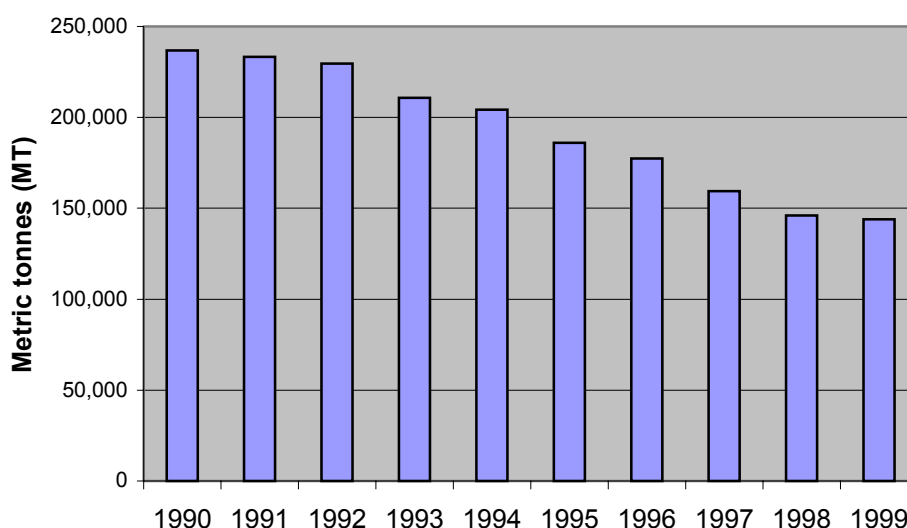


Fig. 2-19 Philippines - reported production from inland capture fisheries

Inland municipal fish production by fisheries region is shown in Table 2.6. Over the 5 years covered in Table 2.6, 78 percent of the landings were from one fisheries region (Southern Tagalog).

Table 2.6 Philippines - inland municipal capture fisheries production by region (MT).

Region	1993	1994	1995	1996	1997
CAR National Capitol	264	247	236	198	254
I Cordillera Administrative	2 190	3 766	1 421	1 274	1 080
II Cagayan Valley	4 226	3 670	4 769	4 829	4 762
III Central Luzon	2 903	3 886	4 377	4 488	3 995
IV Southern Tagalog	161 192	167 357	148 395	139 731	120 085
V Bicol	459	367	243	229	382
VI Western Visayas	3 038	4 144	3 335	2 779	2 288
VII Central Visayas	36	53	32	32	59
VIII Eastern Visayas	-	1	5	4	4
IX Western Mindanao	391	316	615	541	286
X Northern Mindanao	208	116	114	194	131
XI Southern Mindanao	670	560	956	948	987
XII Central Mindanao	8 308	2 969	3 428	3 432	6 713
XIII Caraga	9 382	5 516	6 763	6 555	5 227
ARMM Autonomous Muslim Mindanao	17 508	12 763	11 985	12 706	13 486
Total	210 775	205 731	186 674	177 940	159 739

Inland municipal capture fisheries production by species category is shown in Table 2.7. Molluscs, fish and crustaceans account for 66.8 percent, 30.8 percent and 2.4 percent respectively of the reported catches over the five years in question. The high contribution of molluscs to the catches presumably reflects some inclusion of fishing in bays and estuaries although molluscs can also be important in purely freshwater areas. Including molluscs in gross statistics in this fashion can be misleading since a large proportion of the weight is composed of shells. The contribution of molluscs to food supply is therefore seriously overestimated based upon gross weight. But on the contrary, molluscs can have a high commercial value. These data on composition should be investigated in more detail and in particular to separate the molluscs by species (if possible) and in particular to separate brackishwater and freshwater types. However, what is most relevant about these statistics for current purposes, is that such high productions of molluscs from inland fisheries appear to be absent from the production statistics for most other countries. This is likely because production of molluscs is not being properly recorded. There appears no reason to believe that fisheries for molluscs in the Philippines are particularly unique to that area.

Table 2.7 Philippines - composition of inland capture fisheries production from municipal fisheries (MT).

Category	1993	1994	1995	1996	1997
Fish	70 980	52 321	60 340	49 083	52 929
Crustaceans	4 904	6 223	5 651	6 217	4 969
Molluscs	134 891	147 187	120 683	122 640	101 841
Total	210 775	205 731	186 674	177 940	159 739

Although there is widespread attention to tilapia farming in the Philippines, it is interesting to note that in 1997, for example, about 35 percent of the total national freshwater production of tilapia arose from capture fisheries (Table 2.8); and the latter production is likely underestimated. Similarly, production from capture fisheries for four other cultured groups greatly exceeds that from aquaculture (Table 2.8). This capture production would mainly

include the exploitation of feral/wild populations but also some fish escaping from aquaculture establishments.

Table 2.8 Philippines - contributions to reported production of selected species by production system, capture *versus* culture, for 1997

Species group	Capture fishery production	Aquaculture production
Tilapia	20 935	39 005
Carps (all kinds)	5 717	291
Mudfish	4 547	2 144
Hito (freshwater catfish)	2 396	1 052
Gouramy	2 065	132

5.4.4 Perceptions of inland fisheries and objectives of the statistics

According to the BAS manual for the inland fisheries survey, *“For the past years, inland fishing has contributed significantly to total fish production. The existing fishery household-based survey has generated statistics monitoring the levels of production. Ultimately, the sub-sector will provide the necessary data input for effective policy formulation particularly regarding food security concerns”*. Unfortunately, the household surveys are unlikely to meet these objectives since they are not being undertaken fully due to funding constraints and data collected on food security aspects is very limited in any case.

The Director of BFAR noted the marked shift from capture to culture that has occurred in inland areas in the Philippines. But in some areas, capture fisheries are still important. BFAR is very supportive of the need to improve data/information. In particular, improved information on vulnerable species, the impacts of introduced species and the importance of inland fisheries for livelihoods and development in rural areas is required. BFAR has strong emphasis on these aspects. Even if undertaken fully, the existing survey methods do not generate adequate information in these respects. There is also a need to delineate areas for fisheries versus culture in order to minimise conflicts between the two sub-sectors. Information is required that is relevant to achieving this aim. This is not currently being generated.

BFAR is currently “not happy” with the quality of inland statistics. BAS agrees, but lays the blame more squarely upon funding problems. BFAR also note that the quality of contracted survey personnel is also a problem. Technical interpretations of the statistics are, therefore, constrained. For example, BFAR staff expect high productions from some regions seasonally but this is not “reflected in reports”.

BFAR also regard much of the statistics reported in the field to be based upon projections and not upon reality. They also reported widespread “doctoring” of data to meet production targets. In addition, BFAR suspects wide discrepancies from respondents who do not declare actual harvest for reasons of taxation.

It would appear that the statistics for inland capture fisheries serve no real purpose except to form the basis of national reporting requirements. There appear to be no major national or provincial inland capture fisheries management or development programmes, and certainly none using the statistics as the basis either for policy development or monitoring. Several commentators noted that the inland fishery statistics for the Philippines have little more than “cosmetic” value.

5.4.5 Conclusions and recommendations

The Philippines inland fishery statistics, in common with all countries, suffer from the attempted application of marine statistical system to inland waters. It provides yet another example of the pitfalls in doing this. Statistical systems based upon landing records, particularly at official landing sites, are especially inappropriate for inland fisheries, largely because, in general, most fish tends not to be landed at official sites (depending upon the area in question). However, the Philippines are to be complimented by adding to their system a survey of household activities for inland fisheries. Unfortunately, this progress is undermined by the doubtful basis of the frame underlying this survey and the practicalities of implementing the surveys, including funding constraints. This also illustrates the dangers of designing statistical systems that rely upon substantial manpower (funding) to undertake them. These systems do not work, and are statistically invalid, under circumstances where designed sample sizes and strategies are not maintained. The result, as has occurred recently in the Philippines, is the continued production of statistics in which there is little confidence.

It is difficult to assess the Philippine statistics based upon the current brief overview. However, even if the statistical surveys were to be implemented according to plan, it is highly likely that the system would still produce gross underreporting from three main sources: (1) inadequacies of the frame underlying the household survey, (2) household surveys focussing on the main fisher as the respondent (a system which tends to exclude informal fishers in the household), and (3) likely deliberate underreporting by respondents. Added to this must be the consideration that in recent times the surveys have been inadequate in terms of coverage and/or based mainly upon the views of trends supplied by key informants. Consequently, it is difficult to assess what the likely figure for inland capture fisheries production for the Philippines actually is. It is also difficult to assess if the recent reported decline in production is realistic. In terms of recommendations for improvements to the system, most of the general comments made in Part I of this report apply to the Philippines.

5.5 Thailand

5.5.1 Background

Thailand is amongst the economically better developed countries in Southeast Asia having undertaken rapid development in the past 30 or so years. However, economic well-being is not evenly distributed. In particular, the northern and north-east regions are economically depressed by comparison with the south and in particular in the vicinity of Bangkok. It is an environmentally diverse country and can be roughly divided into the northern section representing the main land mass and the southern peninsular bordering Myanmar and leading into Malaysia. Most rivers in Thailand have been dammed and consequently the country has a large number of reservoirs ranging from very small to extremely large. There are two significant drainage basins, both with large rivers. That draining N.W. Thailand enters the Chao Phraya system. Its upper catchment is a mountainous area, remote in places, and some sub-catchments are still in reasonable environmental condition. The lower Chao Phraya, however, drains most of the key industrial areas of Thailand including the massive urban area of Bangkok. Consequently it is highly degraded in its lower reaches. The N.E. section ("Isaan") contributes about 184 000 km² to the catchment of the Mekong River which forms the international border with Lao PDR for a considerable distance. This is about 36 percent of the total area of the country. Thailand contributes about 18 percent to the total annual flow of the lower Mekong River. In Isaan, the major sub-catchments are the Mun-Chi basin and the Songkhram River basin. Of all the main tributaries of the Mekong originating in Thailand, the Songkhram is the only one still without a mainstream dam (although it has a considerable number of small dams on tributaries). Despite the extent of damming, recent remote sensing images confirm that N.E. Thailand still has considerable areas of seasonal wetlands (flooded areas). These are obviously located in flat areas and flooded mainly from local rains. Much of this area is already converted

to rice agriculture with a substantial degree of irrigation development. Thailand is a major exporter of rice. Most of the lowlands of Thailand are already converted to intensive agricultural uses. Much environmental degradation of rivers has occurred. A reasonable catchment and floodplain system still occurs in the Songkhram and particular the Yom River (a tributary of the Chao Phraya) plus some other localised areas. All of the latter areas still have important and vibrant fisheries. Fisheries in degraded areas, even if a shadow of their former status, are still present. Fishing is a very popular activity in Thailand, having a long tradition. It is considered an integral part of the heritage/culture, particularly in rural areas.

Thailand has a rapidly growing sport/recreational fisheries sector of substantial proportions but it is currently un-quantified. A cursory look in larger supermarkets or department stores will usually reveal angling to be the largest amongst the sporting sections. And most equipment on sale is for use in inland waters. In most rural areas, particularly on holidays, most accessible waters are literally awash with fishers. Often the division between these by motivation (food, income or leisure) is difficult to make. Similarly, the country (in common with most economies in transition) has a very significant ornamental fish industry. The extent to which this relies upon domestic inland capture fisheries is not known, but a proportion of catches from rivers and swamps does certainly enter this industry.

Thailand has a very extensive stocking programme. This has concentrated on reservoirs and rice-fields but also includes rivers and swamps. Largely, stocking is seen as a means of providing benefits to poor communities. There is very limited information on the benefits of stocking in open waters.

Fisheries development has focussed on promoting aquaculture (with some considerable success over the past 15 years) and the management of reservoir fisheries. River and swamp fisheries have largely been ignored, apart from localised research on biology, ecology and limnology. This policy arose partly through insufficient appreciation of both the extent and importance of river fisheries but more so through the perception that little could be done to improve them, particularly in the face of rapid environmental degradation arising from water utilisation and pollution from other sectors. The policy has been very much one of trying to compensate for this trend by undertaking mitigation stocking and developing reservoir fisheries, with aquaculture successfully boosting total production and leading exports from the inland sector. But there is clear evidence of late of changes in attitude. NGO's and local communities are becoming increasingly more influential. Their attentions focus on social justice, livelihoods, biodiversity and the environment. DOF is already aware of and responding to these changes. This is evident, for example, in the growing recognition of the importance of inland capture fisheries (including reservoirs, rivers, swamps, rice fields etc.) to poverty reduction, livelihoods and environmental issues. Co-management is promoted, as is attention to environmental rehabilitation. Thailand represents an interesting case in terms of its inland capture fishery statistics, not dissimilar to Malaysia. Not only does the country have a (relatively) good infrastructure and human and financial resources, it is also at a watershed in terms of re-defining the role of government and fisheries in inland areas.

5.5.2 The statistical collection system

Each province has a fisheries office with one "statistician" (often a substitute). Each year this person is in-charge of collecting the statistics. Actual information is collected by fisheries extension officers, based at district level, in close co-operation with officials at village level. Provinces send the information to the Division of Fishery Economics, Statistics Sub-Division, at DOF (Bangkok). This Division is in-charge of the information system. They forward the reports to FAO and to the national statistics authority (The National Statistics Office, Office of the Prime Minister).

The sampling strategy is based upon water body size (0-5, 5-10, 10-50, 50+ rai⁴). Information is collected by sampling approximately “10 percent” of each category. At each a survey is undertaken by asking a person about production. The person can be anybody considered knowledgeable: professional fisher, local official etc. For each interview, a pre-designed information form is used. This contains sections for gear types used, number of fishers, catches per person per year, total catches (estimated from the former), remarks, and for estimated species composition of total catches (in weight and value). Information requested covers a full year (yearly recall) but is not recorded by month. The total information sample is collected over a period of about 3-4 months during the dry season (February-May).

Water bodies are divided into three categories: (1) reservoirs and irrigation ponds, (2) village ponds (=communal/open access areas, not aquaculture ponds) and (3) “natural” water bodies (including rivers, swamps, streams and canals).

Production statistics are extrapolated largely based upon resource areas. The reservoir survey includes both natural lakes and man-made reservoirs. Seven species and five species groups are distinguished in this survey. Production is calculated on the basis of a nationwide inventory of water bodies, which is updated every five years. Total production for a particular water body is estimated in the above fashion, in close collaboration with local officials. The basis of this appears to be using both or either (i) estimated catches per unit effort related to total effort, and (ii) catches per unit area related to total area. DOF are confident they know the numbers of fishers operating in reservoirs and can calculate yield on this basis. In addition, in the larger reservoirs, landing statistics are gathered from middlemen on a weekly basis. For some of the larger reservoirs, catches are estimated solely through landings records. DOF estimate that based upon previous surveys, about 75 percent of the catch goes through official landing sites. For example, surveys at Ubolratana Reservoir have shown that about 17 percent of the catch goes for family consumption. In reservoirs, “small-scale” production is estimated by subtracting recorded landings from total estimated production. Species composition information is supplemented by observations at landing sites. There is no actual sampling of catches or landings.

In addition, DOF have some estimates of production from dry season “pond-traps” which require a license. (These are large dry season depressions, which trap fish as they retreat from flooded areas. They are fished with a variety of gears). Owners of flooded land will often construct pond traps. Some are natural dry season refuges. Some other types of inland fishing methods/gears require a license (*e.g.* barrage fences) but no catch data are collected. There is widespread non-compliance with licensing requirements in inland waters.

The system for aquaculture is very similar with 10 percent of installations being sampled against inventories held at village/district level. Estimates are based upon yearly reports of production, species, prices and stocking information. Since aquaculture installations are more visible and in fixed locations (compared with fishing operations in open waters), the aquaculture statistics are likely more robust.

Notably, no surveys are conducted for “natural” water bodies (particularly rivers and swamps). In some areas, total production for rivers and canals is estimated by provincial officers based on estimates of standing stock and average yield per unit area (reportedly derived from both previous studies the extent of which is unknown to the mission, and the experience of the officer). The actual methodology involved is unclear. But it is extremely unlikely such an approach gives accurate estimates for rivers, especially floodplain fisheries, particularly as accurate data for riverine fisheries production are rare. It is unclear if floodplain (swamp) fisheries are included under “rivers”, but they are quite possibly often not included at all.

The fishery production estimates (capture and culture) are discussed at a meeting at the sub-district level before being submitted to the province; a system which reflects the possibly

⁴ 1 rai = 1600 square metres, 1 ha = 6.25 rai

arbitrary nature of some parts of the estimation process. Provincial officers send the information to DOF (Bangkok) where it is compiled, edited, processed, encoded, and analysed with the aid of a UNIX based system for input and retrieval. DOF have developed their own software for this purpose.

DOF report that estimates vary considerably in quality. Statistics collection personnel have a low status (pay) and continuity of personnel involved is a major problem. Staff at lower levels than the province do not receive special pay for information collection and it is unlikely that this system encourages accuracy of the estimates.

The National Statistical Office is responsible for conducting the marine fishery census every 10 years. There is no comparable census in operation for inland fisheries (particularly for rivers). The Conservation Division of DOF reportedly initiated data collection from some important landing sites in the Mekong since 1995. These estimates are incorporated into the production figures for 1997 onwards.

Production from estuaries and mangrove areas is reported under coastal fisheries production. "Inland" catches are considered to be those exclusively from freshwater. This is not a problem for the north of the country (as there is no coast) but it can be assumed that a significant proportion of the inland catch (*i.e.* that not caught in the sea) from coastal areas in the south is reported under coastal fisheries. This can only contribute to downgrading the perceptions of the importance of the inland sector.

Production from rice-fields is reported exclusively as aquaculture – irrespective of the production system (*e.g.* stocked or natural recruitment). DOF consider that most production now arises through stocking activities anyway although their statistical system is not accurate enough to verify this. Even so, a considerable proportion may still arise through capture fishery related activities. Again, this information policy is to the detriment of capture activities.

There are obviously some serious potential problems with this statistical system. Not least of these is the virtual absence of sampling based information on river/floodplain fisheries. A major potential source of error is also with the inventory of water bodies. Obtaining such information, especially for small water bodies, is quite difficult. Additional constraints include problems with recall and estimations made by respondents. Although some people are good at this, many are not, and almost all under-estimate small-scale production. DOF also admit that their system favours commercial/professional fishers simply because they are more visible and accessible. However, the most serious potential problem is possibly the issue of impartiality of information collection. Provincial fisheries offices (and national DOF) spend a considerable part of their budget on the stocking programme. Often the same personnel involved in stocking are involved in statistics collection. In many countries this leads to mis-reporting through either attempts to disguise discrepancies between reported stocking and actual stocking (it is not known if this occurs in Thailand) or simply through more benign over-optimism on the impacts of their activities. The statistical system in force in Thailand is highly subjective and therefore very vulnerable to this kind of misreporting.

A further problem is that the statistical system is very much production oriented. There appears to be limited information collected on participation in fisheries (including catching, processing and marketing). Again, the best information here is for reservoirs where numbers of commercial/professional fishers are thought to be known reasonably well. There is some information on river fisheries based upon numbers of licensed gears but this is likely meaningless considering the level of non-compliance and the gear categories themselves being unrepresentative of the fishery as a whole.

5.5.3 The information produced

Reported catches from inland capture fisheries over the recent 10 year period are shown in Fig. 2-20. As explained, it is believed that these reports reflect mainly production from reservoirs. The overall trend for increasing production (average 136 272MT during 1990-2, to 200 364MT during 1997-9) is explained by DOF as due to stocking. This represents an increase in production of about 47 percent over the ten years in question, which is well within the limits of reason considering the stocking effort. There is, however, no way to check if these reports are accurate (which in any case should be done by DOF not the mission). There is currently no reason to assume that the reports are not representative of the general fisheries situation in reservoirs (within the limits of the constraints to the statistical system as described).

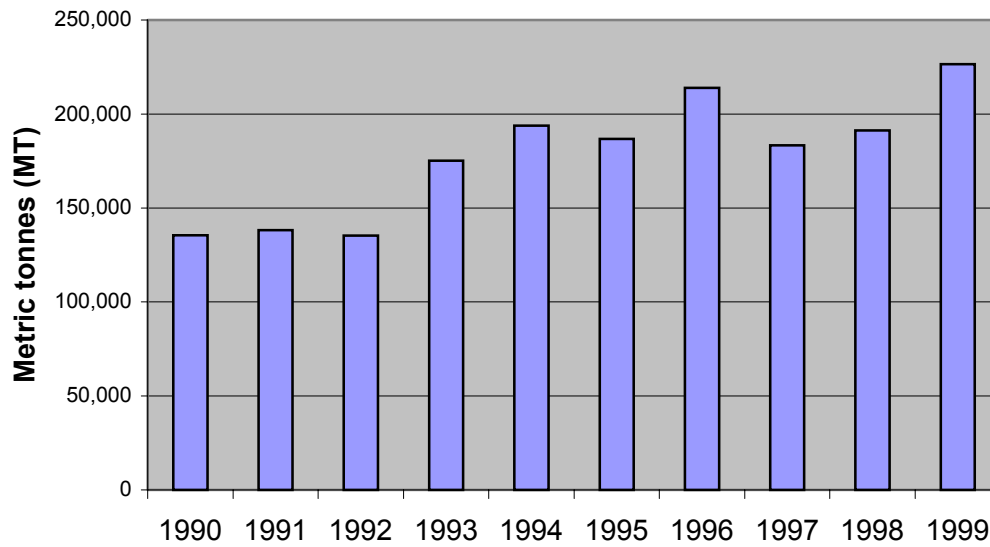


Fig. 2-20 Thailand - reported total inland catches

The problem is, of course, how to assess the likely errors due to not properly including reasonable figures for fisheries outside reservoirs. This can only be done, initially, by using cost-effective techniques as outlined in Part I. Some indications of likely errors can be suggested here:

Virapat *et al.* (2000) give an estimated inventory of 28 956 reservoirs in Thailand ranging from 0.01 to more than 1000 ha. They estimate production from these reservoirs, using similar methods to DOF (*i.e.* extrapolations based upon reservoir inventories and yield) to be between 122 314 and 318 909 MT. This in fact confirms that the official statistics (Fig. 2-19) likely refer to reservoirs almost exclusively. The same report also describes reservoir fisheries as being the same as “inland capture fisheries” (production from reservoirs is discussed and reported as total production from inland capture fisheries). This confirms that the perception of inland capture fisheries in Thailand is one of reservoirs. Whilst reservoirs are obviously important, as the aforementioned inventory shows, Thailand in fact does still have considerable river and swamp fisheries, plus some production from rice-fields. In addition, production from inland brackish-water areas is reported as coastal fisheries production.

A recent detailed survey of the Songkhram River Basin in N. E. Thailand (Department of Fisheries, unpublished) has produced much valuable information on fisheries in rivers and floodplains/swamps. The survey was based on reports from villages and random sampling of a statistically valid sample of households. Over 40 percent of village leaders reported that capture fisheries were important in their village for income. Overall, more than 60 percent of households in the Songkhram River basin are involved in capture fisheries. The average catch per fishing household was 224 kg per year. The proportion of the total catch taken from various habitats was as follows: rivers, streams and canals – 34.23 percent; swamps/marsh (floodplain)

– 31.32 percent; rice-fields – 22.18 percent; reservoirs – 8.27 percent; lakes – 2.06 percent; aquaculture ponds – 1.97 percent. These figures confirm that capture fisheries in such areas are not only important but cumulatively produce large catches. Production from capture greatly exceeds that from aquaculture. Although the area is notable for still having reasonable floodplains (although a relatively short flood season) catches from river channels and rice-fields are still significant. Production from rice-fields (which in this area generally are not stocked) averages about 50 kg/household/year (but this includes all households, production for rice-farming households has yet to be estimated). These figures are important when considering the potential extent of inland capture fisheries elsewhere in rural Thailand. Although the Songkhram river has no major dam (reservoir) the extent of fishing in rivers, smaller water bodies and rice-fields is likely not untypical of Thailand.

The potential degree of underreporting in the official statistics is also illustrated by the fact that only 5.5 percent of households listed fishing as the main occupation but 57 percent of households list that part-time fishing is important. But the official fishery statistics are based solely upon households where fishing is the main occupation.

It is widely held that dams have significantly reduced fisheries in major rivers in Thailand. This is probably true and has certainly been used as a major reason to devote most attention to reservoir fisheries and aquaculture. However, the impacts of dams on flooding and river fisheries and upon migratory fish stocks are mainly downstream. Much of the capture fisheries activities in rivers occur in side branches and local swamps and other discrete water bodies where longitudinal migrations (along rivers) are less important. Recent flood cover maps of Thailand show that much of the country is still flooded (including in rivers with major dams). Although the major river floodplains have been severely reduced and degraded, localised rainfall still produces large expanses of freshwater habitat available for fishing. Much of this is rice-fields and canals associated with them. But there are still large cumulative areas of smaller rivers, localised swamps and marshes etc.

What is a reasonable guess as to the possible production for inland capture fisheries in Thailand? This is highly speculative largely because much of the freshwater resources are degraded and the economy is relatively well developed (which tends to down-grade involvement in fishing for income and/or food). But Thailand still has large relatively poor rural populations. For freshwaters alone, a conservative figure of 10 million relatively (*i.e.* within Thailand) poorer rural people catching an average of between 20 and 50 kg per caput per year (outside reservoirs) gives an annual production of 200 000 to 500 000 MT (these indicative catches are not unrealistic; it is 20 kg per caput for river fisheries in the remote mountain areas in Lao PDR, which are not dissimilar to mountainous areas in Thailand, and more than 50 kg per caput for the Songkhram river which is probably typical for rural Thailand). Added to this would be that part of the coastal (brackish-water) fishery caught inland, which would also be significant.

These examples do at least show that it would be worthwhile to properly undertake a re-assessment of production estimates for inland capture fisheries in Thailand for areas outside reservoirs. This can be done relatively easily and Thailand has good GIS and remote sensing information and expertise to assist these efforts. This should be done in a more formal and thorough way than presented here. Further recommendations are made in Part I.

5.5.4 Perceptions of inland fisheries and objectives of the statistics

In Thailand, inland capture fisheries are regarded as activities undertaken by the poor in rural areas (there are some exceptions but this is mainly correct). They are important for food production and security and have some “economic” importance for household incomes etc. It was clearly stated that inland fisheries in these terms were significantly more important than marine fisheries (which are regarded more as a source of revenue/exports). When asked if this

was not an over-simplification, DOF responded that “even a poor marine fisherman is rich compared to a poor rural (inland) fisherman”.

There is an admitted over-emphasis on reservoirs at the expense of attention to rivers and other areas. This is partly reinforced by the biases in the statistical system. Recently, more thought has been given to rivers but DOF appear uncertain as to their options for such fisheries. There are no significant management strategies for riverine fisheries other than on-going mitigation stocking. Main problems within the fishery are reported to be non-compliance with regulations and over-fishing. This is particularly so in reservoirs. More recently the government has been seriously promoting co-management approaches to improve governance of fisheries. In rivers, environmental degradation is clearly recognised as the major problem. There is a general feeling that in many areas the river and swamp fisheries are already decimated beyond recognition. This is unfortunately true for those areas. On a more positive note this points to the considerable scope for rehabilitation. But some areas still have important river and floodplain fisheries. Most of these are under immediate threat from further environmental impacts from other sectors (particularly dams). Although aware of the opportunities, DOF has yet to become fully involved and active in river fishery restoration and there is considerable scope for this in Thailand. The recent shift in policies towards being more directly pro-poor and pro-environment should in theory enable DOF to become more involved in this area.

Thailand uses its current inland fishery statistics for: (i) calculating GDP (a requirement from central government), (ii) monitoring the status of inland fisheries (production, production area and stocking activities etc.), and (iii) as a management tool, mainly for large water bodies (reservoirs), to calculate the impacts of stocking etc. The current statistics might meet some of these requirements for reservoirs (although there is obviously scope for improvement) but obviously not so for rivers/swamps. For current purposes, the DOF generally consider that they have the information needed for reservoirs, but that there is scope to improve the accuracy and coverage. However, there was a clear consensus at DOF that different, additional, information is urgently required when trying to develop and implement policies and management aimed at poverty alleviation, improving livelihoods and biodiversity/environment considerations. But there is considerable uncertainty about who is supposed to collect such information and particularly regarding what information to collect and how.

5.5.5 Conclusions and recommendations

Apart from technical constraints in the reporting system (as outlined above), a major problem with the Thai system is that it seriously biases perceptions of the inland fisheries sector towards reservoirs and aquaculture. It has been an almost deliberate policy to either disregard river/swamp fisheries, or to accept their demise, and compensate for losses through production from other sources. This policy is not unique to Thailand and not entirely without justification; aquaculture and reservoir fisheries have developed well. But in parallel to this, a statistical system has developed that is not only biased towards aquaculture and reservoirs, but towards reporting increases in production in those sectors in response to government management measures. This has likely had a cyclical impact – reinforcing further investments in those sectors, partly at the expense of river fisheries. In hindsight, it would have been nice to have statistics reporting the losses being incurred from river fisheries. But a more interesting question, and not entirely academic, is whether the statistical system itself has contributed to such loss by reinforcing pro-aquaculture/reservoir policies or is simply a result of those policies. We can only conclude that countries should at least be cautious when basing policies on incomplete statistical coverage and be especially vigilant where such statistics reinforce policies.

It is doubtful if the current national system yields information of adequate quality to assess stocking, especially considering its subjective nature. But Thailand can, and often does, obtain better information on stocking through alternative local means. This is usually through a more focussed research process where more specific and detailed information can be gathered. What

is certain is that the current information is next to useless in terms of livelihoods, poverty, biodiversity or environment related considerations.

Naturally, in relation to its current inland fishery statistics, Thailand has the option of checking the information through verification processes (research) and making subsequent improvements in both accuracy and cover (see Part I for suggestions on how this can be cost-effectively achieved). This should be done where possible. But the current Thai system has certain advantages which should not be discounted. It is (presumably) relatively cost-effective. It is based upon a rather simple technical approach. The information collected is not too technical and can be collected relatively easily. These are valuable attributes for a statistical system. The Thai system should not be discarded as a model for obtaining basic information. Before significant changes, and more importantly new investments, to this system are made, the question of whether the system satisfies modern information requirements should be addressed. According to DOF, apparently it does.

Future directions in information improvement need to consider the changing emphasis in policies. The current statistical system on its own will be a considerable constraint to DOF (and Thailand more generally) becoming more directly involved in poverty reduction, livelihoods, biodiversity/environment and inland fisheries restoration etc. The information generated is simply not particularly relevant to these issues. No matter how much is invested in the current system (within reason), the mission doubts if it will ever produce the necessary information. Thailand has the option to make some cheap and effective improvements to its current system, but to largely leave it alone, and to make new investments in more appropriate approaches for information generation under a wider, modern framework (see Part I).

Some of the recommendations for cost-effective approaches to obtain better information, specifically an improved “overview”, for inland fisheries outside reservoirs are based upon utilising remote sensing GIS approaches (see Part I). It is noted that the Thai Department of Fisheries has a relatively well resourced and competent GIS support unit. There is considerable scope for using this facility to improve information for inland areas and using remote sensing for fisheries environment monitoring purposes. This particularly applies to areas where empirical survey data are weak. Remote sensing is also cost-effective, impartial and accurate for undertaking resource surveys (*e.g.* reservoir inventories and aquaculture installations). One opportunity is to improve co-ordination and utility of resources within DOF by training GIS specialists in inland fisheries applications and inland fisheries specialists in GIS applications so the two can work better together. The technology is particularly useful for natural resources management planning (*e.g.* undertaking impact assessments for major development schemes).

DOF should give some consideration to becoming more involved in the recreational fishery sector (although not at the expense of attention to other more pressing issues of livelihoods and biodiversity etc.). DOF consider that the sub-sector is, and will be, largely serviced by the private sector (but oddly this has not stopped them being involved with aquaculture for which the same can be said). Even so, there is still a need for a government overview. Involvement might be based on co-management approaches and the principle of costs being recouped from the sector (which is more feasible for sport fisheries than other sub-sectors; see Part I and further comments in this part of the report for Malaysia).

In short, Thai inland fisheries are changing rapidly. Therefore, information requirements are also changing rapidly. DOF have already identified most of the opportunities but are unsure how to meet the technical challenges. Hopefully, Part I of this report will assist with this.

6 Countries not visited during the consultancy

The mission has direct involvement in relevant experiences with inland capture fishery statistics elsewhere in Southeast Asia (Cambodia, Lao PDR, Thailand and VietNam) from two main sources: (i) in 1996 an inland fishery statistics project formulation mission was undertaken by the MRC (Sverdrup-Jensen, Coates and Visser, unpublished), and (ii) since 1993 fisheries research and development work has been undertaken by the MRC, much of which is relevant to the current subject matter including the now comprehensive knowledge of capture fisheries production and statistics in Cambodia and comprehensive and systematic sampling based surveys of river capture fisheries in Lao PDR, Thailand and VietNam.

6.1 Cambodia

6.1.1 Background

Cambodia has impressive freshwater resources. It lies at the heart of the lower Mekong River floodplains and includes the upper section of the Mekong River delta. As part of this system, the Tonle Sap River joins the Mekong at Phnom Penh, draining vast areas of floodplains to the north-west. Chief amongst these is the area around the Great Lake, which undergoes extensive seasonal expansion partly through the reversing flow of the Tonle Sap River. The area of this lake alone extends from 2000-3000 km² in the dry season to 10 000-12 000 km² in the flood season. This floodplain adjoins that of the Mekong mainstream forming a large interconnected expanse of prime fish habitat, much of it tropical floodplain forest. The Great Lake and Tonle Sap floodplains account for some 60 percent of reported fisheries production. There are no large reservoirs but a modest number of smaller water bodies exist. Rice field fisheries are however important.

The fisheries of Cambodia are legendary. However, this is mainly because historical records exist, in particular formal and accessible publications made by the French in the 1930's and 40's. Hopefully, this important archive might encourage others to publish research properly also. Based upon official catch reports over the past 10 years the fishery is less impressive (until reports were revised in 1999); although historically, before the late 1970's reports were much higher. This represents another anomaly of fishery statistics: where published scientific records exist, they are, quite rightly, favoured over official statistics, at least in some circles. The country is often quoted as having the largest inland fishery in Southeast Asia. This is not the case: it is certainly easily surpassed by at least Myanmar and challenged by both Indonesia and VietNam. But these countries have much larger populations. For its size, Cambodia has a very impressive river fishery indeed.

The modes of exploitation are typical for Southeast Asian river fisheries. Where opportunities exist, large commercial/industrial gears are used. Major ones include barrage fences and river bag-nets. These supplement huge cumulative catches taken by a multitude of other gears in what is a very diverse and vibrant fishery. Cambodia also has a well developed and extensive fishing "lot" system whereby most of the productive areas or fishing opportunities are leased out. This is generally achieved through bi-annual auctions. Major lots include bagnets along the Tonle Sap River (which target fish migrating from the Great Lake) and areas of prime floodplain which are fenced-off and usually fished with barrage-fence/traps and other gears within the lot. Some of these fences can be up to 60 km long. The management system closely resembles that for the "Inn" fishery in Myanmar where the system appears to be more intensive, but lease areas in Cambodia may, on average, be larger. The two systems have

similar histories (being in place since at least the mid-1850's). The system also occurs in Indonesia, possibly Malaysia and on small local scales in Thailand.

As expected, the fishery is highly seasonal. Scenes at fishing lots during peak periods are still reminiscent of the bye-gone days in many marine fisheries. At these periods, huge quantities of fish are preserved by drying and making fish sauce but especially fish paste. There is considerable participation in fish processing, marketing and transport. Large quantities of fish and fish products are exported to both VietNam and Thailand.

For descriptive, management and legislative purposes the fishery is divided into:

- large-scale stationary gears, where the use of gears or areas is auctioned (the fishing “lots”).
- medium-scale mobile gears, where gears are subject to licensing, and
- small-scale or “family” fishing which has open entry but only open access to fishing grounds outside lot areas

The fishing lot system in Cambodia has come under considerable criticism of late. First, the current system is regarded, in places, as being socially unjust because it excludes the rural poor from access to the fishery. In response to this the system is currently under review, apparently with considerable political backing. The objective is not necessarily to demolish a system which, in principle, has much to offer, but to address issues of equity, governance and management. Second, and more relevant to the current report, the fishing rights (auction) system is less than transparent and widely regarded as involving much corruption.

Freshwater aquaculture production is modest at about 13 500 MT in 1999. Freshwater aquaculture is developing, as expected, mainly in areas where there is less competition from capture fisheries.

The country is also interesting for the present purposes because its statistics, and the basis for them, are probably the best researched in Southeast Asia. A Danida funded project, based at the Department of Fisheries in Phnom Penh, has, amongst other things, for the past seven years been researching the actual fisheries production based upon catch-effort sampling and socio-economic surveys. This information, together with the historical records and a number of related recent initiatives, has made Cambodia, in terms of its national inland fisheries, probably the best researched country in Southeast Asia. One odd result of this is that its fisheries are often regarded as “unique”, and therefore not relevant elsewhere. But they are only “unique” because we know much more about them, not because they are necessarily different to those in comparable areas. Nevertheless, apart from being one of Southeast Asia's major producers, the country provides very good and credible examples of what is actually happening in the more productive sub-sectors of inland captures fisheries and how this may or may not be reflected in statistics.

6.1.2 The statistical collection system

The freshwater capture fisheries data collection system was reviewed by Thor Sensereivorth *et al.* (1999). Recent statistics have been collected from the burden books (lease documents), fishing licenses and interviews with lot owners. The middle-scale fishery is estimated from license information and estimates or reports of catch-effort. These statistics are collected by the provincial fisheries offices before being sent to the Fisheries Department and are based partly upon the annual planned figures. Estimates are made for other sub-sectors.

The large-scale or industrial capture fishery is covered mainly by the means of an activity logbook, which the Lot owner updates with the daily production (catch). The production figures for each month are collected by “data” collectors either based at the provincial fishery unit or at the community level (which might include several villages combined). There are around 5-6 data collectors in every province. Total production is reported monthly, by the provincial fisheries staff, to the Department of Fisheries in Phnom Penh. Traditionally, this occurs after a provincial meeting to discuss and estimate the monthly production figures - a system which illustrates the high degree of estimation in the production figures. All but one province has provincial fisheries staff. Since there is no time to sort fish into species level at the Lot, no data on species are recorded. Instead, fish are graded by value into no more than three categories. The same provincial staff collect information for the total aquaculture production from cages, ponds and pens from households by means of a sampling census. It is, however, assumed that this system is far from ideal and at field level there are doubts as to how extensive the census actually is. Provinces submit a yearly report to summarise the data and make projections for following years. These, unsurprisingly, often form the basis of future actual production reports.

Production from the middle-scale fishery is estimated based upon license records and reported catches. In theory, monthly surveys are supposed to be undertaken. In practice estimates are often made by district fishery officers. It appears that the small-scale fishery has traditionally been assessed, if at all, using a “guesstimate” since, until recently, there was no data on the extent of the fishery.

The National Institute of Statistics (NIS) does not collect data on fisheries or fish consumption and is totally dependant on the DOF to supply relevant data. NIS does produce a Consumer Price Index, which includes a quite comprehensive price listing for fish and fish products at several markets over the country. This is very useful supplementary information. The NIS is officially responsible for the general statistical methodology for all the government departments officially has to approve any methodology applied. However, this is largely ignored by the line departments.

In 1994, the Project for Management of Freshwater Capture Fisheries of Cambodia (Danida/MRC) began a stratified random sampling approach to data collection based upon a frame survey of fishing gears. This recorded all species captured, catch by gear, by month, by season, by sector districts, price and total value landed, initially only for the large and middle scale fisheries. The first comprehensive survey of the small scale fishery was completed in 1995-6 (Ahmed *et al.* 1998). It should be noted, however, that this work continued in parallel to the recurrent statistics collection system, figures for which were not amended in response to this sampling until 1999.

6.1.3 The information produced

Reported production is shown in Fig. 2-21. The figures prior to 1999 are effectively meaningless. In 1999, the official reports were revised, under considerable pressure, partly as a result of catch sampling research that has been undertaken by the Danida/MRC fisheries project. This resulted in roughly an increase by the factor 3.3 on previous reports. But even the recent report (1999) is considered likely an under-estimate.

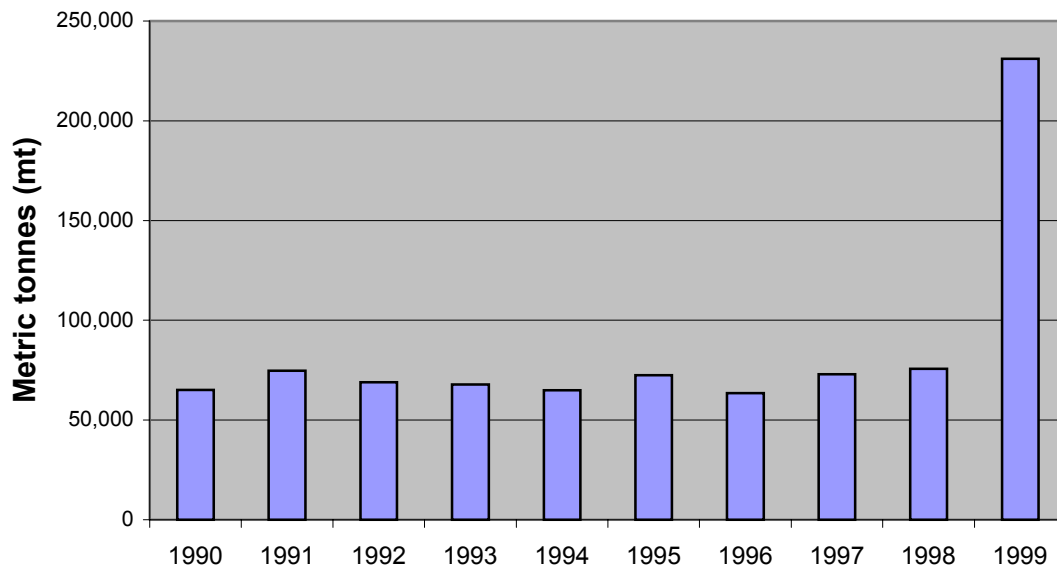


Fig. 2-21 Cambodia - total inland capture fisheries production

A partial review of the Cambodia statistics is presented in Thor Sensereivorth *et al.* (1999). A full review of the Cambodia statistics is beyond the scope of this report. This should be done elsewhere and would also be of great benefit to other countries interested in the subject. This review identified the cause of under-reporting was derived from four main sources:

- Under-estimates of the participation in, and cumulative catches from, small-scale family fisheries
- Under-estimates of middle-scale fisheries due to inadequacies in license cover (miscounting gears)
- Deliberate under-reporting by fishers, because licenses and fees are linked with revenue collection and fishers consider landings information as confidential for a number of other reasons
- Under-reporting by local government staff for licensed and lease fisheries, related to revenue collection (the revenue officially collected differs from that actually paid and, therefore, proper catch reports are suppressed accordingly)

Current estimates of the freshwater capture fisheries production in Cambodia are presented in Table 2.9. Uncertainty continues in a number of areas. First, whilst catches from the bagnets are relatively easy to verify through catch sampling, catches from lease fisheries are difficult to verify because it is often difficult for sampling officials to either gain proper access or, even if they do, to report independently. Even well intentioned officials can be harassed by powerful lot owners. Hence the uncertainty with production from lots. Given the lack of transparency in the lot fisheries, Baran *et al.* (2001), in consultation with most knowledgeable local commentators, applied an arbitrary (but considered conservative) value of three times to the officially reported catches from lots. In addition, most of the current information on catches, and the current official statistics, apply only to the main fishing areas located around the Mekong and Tonle Sap Rivers and floodplains. Areas remote from this will have lower catches per caput but totals would still be significant. This factor contributes to uncertainties with the figures especially for the small-scale family fishery. The importance of rice field

fisheries should be noted in Table 2.9. These fisheries were not included in previous official reports at all.

Table 2.9 Estimates of freshwater capture fisheries production in Cambodia (from Sensereivorth *et al.*, 1999)

Sub-Sector	Annual catch (MT)
Large scale fisheries:	
- Fishing lot	30 000 – 60 000
- Dais (Bagnets)	15 000 – 20 000
Middle scale fisheries	85 000-100 000
Family fisheries	115 000-140 000
Rice field fisheries	45 000-110 000
Total	290 000 - 430 000

These figures are between 4 and 6 times the previously reported production in most of the 1990's (Fig. 2-21). Oddly though, they are still higher than the revised figures for 1999. The discrepancy is presumably due to continued reluctance by the people compiling statistics to accept scientifically based sampling over traditional methods, and, despite the inaccuracy of the traditional system which is itself based upon estimates at best, to accept estimates for areas where no data are actually collected.

The Cambodian experiences are highly relevant to the current review in a number of other respects:

- The official statistical system proved reluctant to accept more accurate and representative data, and did not do so until a long time after new figures were available. But this was not entirely because of the aforementioned problems with transparency and governance. A major problem was that the traditional system collected information through a network independent to the research work and with different methods. Despite the availability of better data, it could not be easily incorporated into official statistics. This illustrates the need to either (i) generate improved figures within the existing system, or (ii) if figures need to be changed, change the statistical reporting system first and in particular, modify approaches so they can more readily accept in-direct information. This points to the danger of assuming that improved information based upon rational and credible research will automatically change fishery statistics. Governments should be more flexible in the way they generate statistical information.
- These new figures arose from a significant donor funded investment in research. The information generated is highly valuable and has forced changes in official perceptions of the fishery. But it is interesting to ask if the results only endorsed what people actually already knew about the fishery. For example, Chevey and Poulain (1939) had already estimated production from the Great Lake and Tonle Sap to be 100 000 MT, not that dissimilar to recent estimates, allowing for population growth (Baran *et al.*, 2001). The overall information generated, of course, has great value well beyond its relevance to fishery statistics, but a very relevant question is should other countries embark on the same kind of programme if revising the statistics is the objective ?
- There are doubts about whether the methods used to obtain more accurate recent figures can be sustained (especially so for the small-scale fisheries). They require

high levels of training inputs, motivation, supervision and monitoring. Whilst improvements can be made in the traditional system, an option is to use the research information to reassess what the traditional figures mean (which is presumably what happened in 1999).

- Even with the improved information, based upon sampling data, a large error of uncertainty still exists. The estimates in Table 2.9 give range of between 17 and 144 percent for the sub-sectors and 48 percent for total production (based upon the lower estimate of production range in each case). Whilst these levels of accuracy are workable for useful indications of the extent of the fishery, they are all but useless for monitoring overall trends. Why then, continue to collect the data every year?
- In relation to the narrow subject of statistics, the considerable investments in research have shown two important points:
 - they only confirmed that the recent official reports (to 1999) were essentially bogus (but hopefully more sustained realistic figures will emerge). Even so, current and medium-term figures will likely be based upon re-assessing the figures produced through the traditional means, not necessarily by adopting *prima face* new methods or data.
 - investing significantly in strengthening the statistical system based upon current methodologies and objectives is not necessarily a good idea, and it may not yield data accurate enough for monitoring and other purposes.

Another problem with the statistics in Cambodia is that they continue to be driven by the quest for gross production data. They are of limited use for management where livelihoods, poverty, food security and environment/biodiversity are becoming more important issues. The mission notes that although some useful information on these latter aspects is now emerging in Cambodia, it arises through research, not through the statistical system.

When assessing the recent significant re-estimation of the official Cambodian statistics (for 1999) it is important to keep in mind and separate the contributions of research and recurrent statistics collection systems.

Some other information of considerable relevance to fishery statistics regionally is available for Cambodia (most based upon research, not the statistics collection system). These are included here mainly for the benefit of other countries that might be reviewing their information systems, particularly for rivers.

Fig. 2-22 illustrates well the highly seasonal nature of river fisheries where gears are primarily catching fishes migrating from floodplain areas. Such gross variations in catches over the year should be typical for tropical rivers, particularly those with large floodplains. However, catches are also influenced by the extent of flooding in any particular year (Fig. 2-23). This is likely because (i) bigger floods produce more fish, and (ii) the gears are more effective in bigger floods (because stronger currents in river channels are found in big flood years). This phenomenon also likely affects catches for barrage gears.

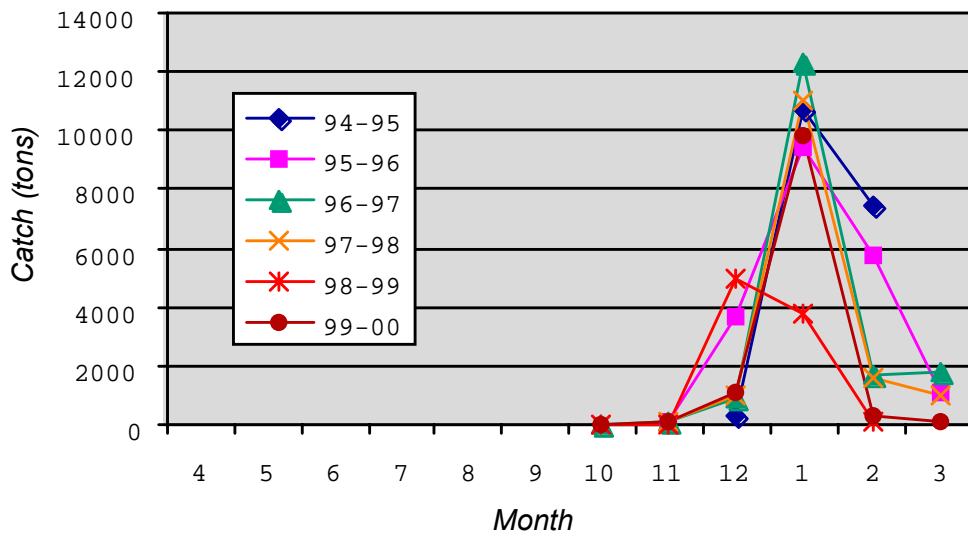


Fig 2-22 Monthly variations in catches from bagnets (dais) in the Tonle Sap river (from Baran *et al.*, 2000)

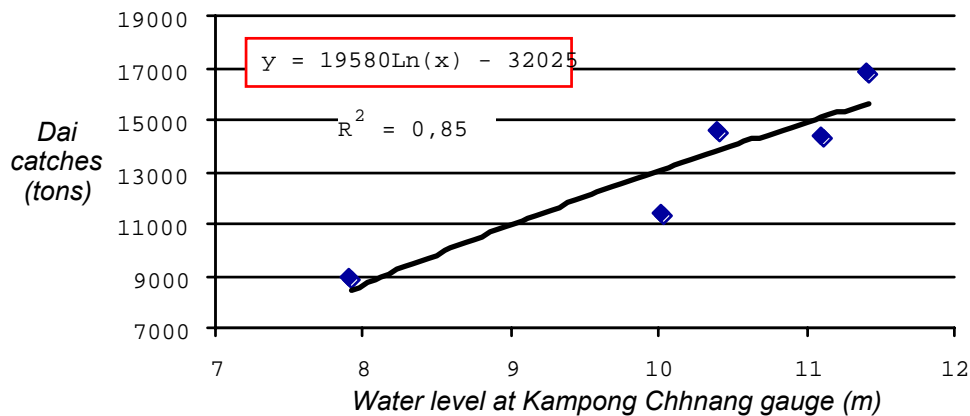


Fig. 2-23 The relationship between bagnet (dai) catches and river level height (flooding) in the Tonle Sap river (from Baran *et al.*, 2001)

According to Ahmed *et al.* (1998): fish consumption in floodplain areas is on average of 76 kg/caput/year, compared to only 8 kg/caput/year for other animal products; only 1 percent of fishing households engaged in fishing lots or large-scale fishing, 6 percent engaged in middle-scale (licensed) fishing, whereas almost all households were involved in small-scale fishing; production per household ranged from an average of 647 kg for family fishing households to 3 319 kg for middle-scale fishing households; 78.6 percent of households are actively involved in fishing related activities.

Fisheries yield from Mekong floodplains in Cambodia has been estimated at between 225 and 375 kg/hectare/year (MRC, 2001). Production from un-stocked rice fields is: in the region of 100-125 kg/hectare/year (Gregory *et al.*, 1996, Guttman, 1999), 38 kg/caput/year for rice farmers (APHEDA, 1997), 201 kg/household per year amongst farmers for a 5 month period (Numa Sham and Try Hong, 1998).

6.1.4 Perceptions of inland fisheries and objectives of the statistics

One thing is for certain, Cambodians know fully the importance of their inland fishery. And in that, the country, along with Myanmar, is unusual. But what is revealing, and of immense relevance in this review, is that this appears to have made little difference to their statistics (until recently). There exists this curious separation of perceptions and statistics, illustrated best in Cambodia.

According to Thor Sensereivorth *et al.* (1999):

“The role of statistics is very important and basic for the assessment and solving of problems relevant to the fisheries management. If we can manage fishery statistics properly and correctly, we can make proper plans for fisheries management based on (1) an assessment of the biological and economic effects of a change in fishery regulations or in hydrology, and (2) an early warning of a species in decline and (3) essential baseline data for Environmental Impact Assessments (EIA’s)”.

It can only be said that this is an extremely optimistic assessment of the role of statistics as the term is currently understood, and that the existing official figures have not assisted these goals in any significant fashion, and recently revised figures are unlikely to help with most. Another problem inherent in such statements and objectives is widespread confusion regarding the nature of “statistics”. There is now a lot of information available in Cambodia that will indeed assist with some of these stated objectives, but it was produced by research, not regular (formal) statistics collection. As far as is known, there are no current or planned management initiatives based upon the current statistics (which is perhaps fortunate).

There has been a recent significant shift in emphasis with Cambodian freshwater capture fisheries. Whilst the fisheries retain significant commercial importance, there is increasing emphasis on social justice, poverty reduction, improved governance (co-management approaches) and biodiversity and the environment.

The main problems with the fishery are reported as largely due to over-exploitation and non-compliance with existing regulations (Ahmed *et al.*, 1998). It appears that this is a common gripe amongst fishing communities, as there is little evidence of actual over-exploitation, except perhaps for a number of prominent, but never abundant, species (Coates, 2001). The more usual complaint of habitat loss and environmental degradation in rivers applies less immediately to Cambodia as the resources are still in reasonable shape. But Cambodia’s aquatic resources are extremely vulnerable to water management activities and pollution arising mainly, but not exclusively, from upstream. There are signs of growing environmental stress but it is not yet critical. Will the existing statistics enable these influences to be monitored?

6.1.5 Conclusions and recommendations

It is beyond the scope of this report to advise Cambodia on specific measures it should take to improve its statistics. Better informed advice is available locally, and some local initiatives are already underway. But despite recent improvements in knowledge of the fisheries, Cambodia is yet to offer examples of how actual recurrent statistical systems can be improved and sustained (other than demonstrating the levels of previous under-reporting). The experiences in Cambodia are, of course, highly relevant to statistics, and options for their improvement, in other countries.

To a large extent the statistical system in Cambodia, even if it functioned effectively, suffers from its historical origins whereby a priority has been to track trends in gross production. This it has clearly failed to do. Neither is there evidence that the recent improvement (increase) in the figures will help in this respect. The system also has a bias towards the more prominent gears and this is likely at least in part because of the revenue generating aspects of the sector (which does not mean that that consideration is unimportant).

Inland capture fishery statistics are clearly in a state of transition in Cambodia. In view of recent experiences with the statistics, and the now relatively advanced state of knowledge of the fisheries (in comparison to some countries), the time is certainly ripe for the on-going re-assessment of the whole statistics and information system. Part I of this review recommends that countries should first consider what information they actually need. Only then should they worry about how to get it. Fundamental to this issue in Cambodia, as elsewhere, is for the relevant authorities to recognise that the fishery sector and its objectives are changing, together with its information requirements.

It is peculiar, therefore, that despite the level of knowledge of Cambodian inland capture fisheries, and particularly the recent attention to improving statistics, that this report has to conclude that the country is in the same boat as everybody else in terms of what to do to improve things; although it is better armed than some with information once it has decided. Reference is therefore made to the summary recommendations presented in Part I.

6.2 Lao PDR

6.2.1 Background

Lao PDR is the only landlocked country covered in this report. The country is amongst the poorest in Southeast Asia. It comprises some 202 000 km² of the total Mekong catchment which accounts for about 97 percent of the total area of the country. It contributes some 35 percent of the average annual flow of the Mekong. Freshwater resources are dominated by rivers and the country includes some of the most pristine of all the Mekong tributaries. River fisheries dominate the sector. Floodplain/swamp fisheries occur in localised areas and are generally more common in the south of the country than in the north, although nowhere are they extensive. The country has one large reservoir, Nam Ngum, with modest production and a number of smaller reservoirs used for hydropower and mainly irrigation. Rice agriculture is widespread and is being intensified although pesticide use is currently less than elsewhere in Southeast Asia.

Lao PDR still has some impressive fisheries, mainly river-based. Population density is quite low and there is much potential for river capture fisheries to develop further. Aquaculture is poorly developed by Southeast Asian standards. This is likely partly due to the low level of marketing opportunities but also through competition from wild fisheries (including rice field fisheries). Information on trade is inaccurate but Lao PDR is likely a net exporter of fish. Considerable quantities of fish pass informally between Lao PDR and Thailand, especially in the south and along the Mekong River, which forms much of the 1800 km international border between the two countries.

6.2.2 The statistical collection system

The Fisheries Division was created only in 1995 as a distinct unit within the Department of Livestock and Fishery of the Ministry of Agriculture and Forestry. No information on national capture fisheries production has ever been collected in a systematic and comprehensive fashion. Some information has been collected for the fishery in the Nam Ngum reservoir, where collection is relatively easy since the local fishers are only allowed to sell their catches to one middleman. Despite this, information on the small-scale fishery in this reservoir, where the catch is consumed directly and not marketed through the middleman, has been lacking.

Although not currently functioning properly for providing fisheries information, a basic structure for data collection seems to be in place and is currently used to collect statistics on livestock, agriculture and forestry. Data collection at village level is performed by means of the village headman, a "model farmer" or the relevant veterinarian worker. Usually at least one, but more often, all three of these are present in each village. Each is responsible for data reporting to the Ministry of Agriculture and Forestry. These people submit completed questionnaires through the district and provincial authorities to the national line departments in Vientiane. However, it is reported that relationships between villagers and government officers are less than ideal and there is widespread under-reporting. The main problem appears to be the usual fear that statistics will be used for taxation purposes. The level of formal training in data collection and statistics, in general, is weak at both provincial and district level.

The National Statistics Centre (NSC) has been developing methodologies and standards leading to a uniform system of data collection. The NSC policy is to work with a de-centralised structure where all line Ministries will be responsible for data collection in their own field.

6.2.3 The information produced

The official production figures, both for capture and culture fisheries, are based entirely on estimates. In some cases these are more accurately described as guesses. These may or may not include extrapolations using previous documented estimates and, needless to say, may not reflect actual production. Official estimates are derived from yields per unit area for reservoirs and rice/fish culture and a standard figure for river fisheries. The latter figure has not changed much over the years and originates from a study by the University of Michigan in 1973. Singh (1990) re-estimated total production and included more realistic estimates for reservoir fisheries. Again this was based on no sampling data from Lao PDR. This estimate has been used as the basis for recent statistics submitted to FAO.

The recent official figures for total production from inland capture fisheries are shown in Fig. 2-24. The reported increase in production since 1993, and variations between years, are assumed to be explained by re-estimates or perceived increased production from reservoirs. There is no sampling or statistical basis to the information reported in Fig. 2-24.

A household survey was performed by NSC in 1992 comprising 3000 households in 147 villages in 18 provinces. The survey included a limited number of questions relevant to fisheries. The summary information suggests that nationally about 66 percent of the households interviewed own at least 1 fishing net. The NSC has also developed a "Village Book" for the regular reporting of various data.

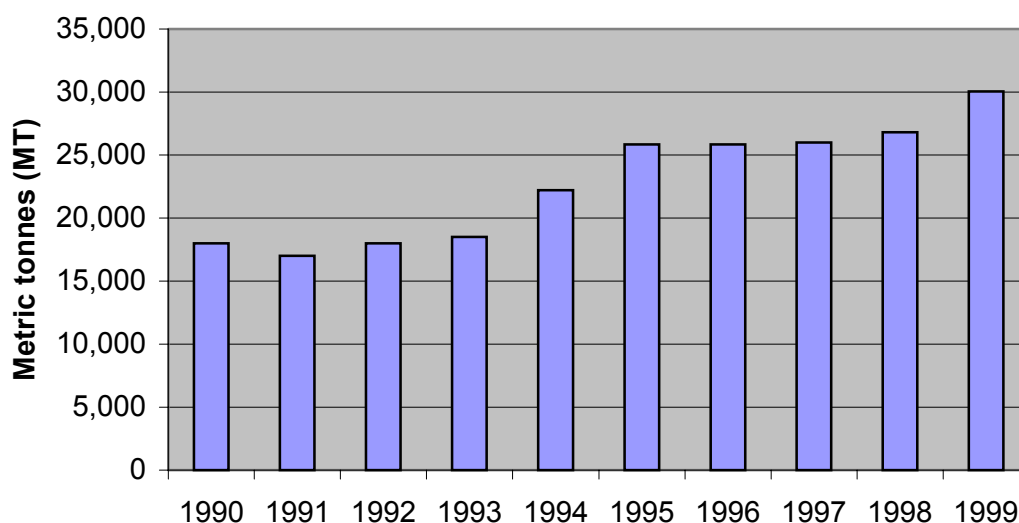


Fig. 2-24 Lao PDR - reported total production inland capture fisheries

There have been a number of localised studies of capture fisheries, notably in southern Lao PDR. *e.g.* In the area of Khone Falls, where there is a traditional fishery targeting migratory fishes (Viravong *et al.*, 1994, Singhanouvong *et al.*, 1996a, 1996b, Warren *et al.*, 1998). This work includes some excellent and extremely valuable time-series data for catch-effort for this fishery but is of limited use for estimating production.

Recently, research and survey work has enabled a reasonable re-evaluation of the likely capture fisheries production. Sjørølev (2000) reported results of a sampling survey of fisheries in Luang Prabang province in the northern part of the country. This mountainous province is has high terrain gradients gradient and there are no significant lakes, reservoirs or swamps. There is an extensive network of rivers and streams, which is typical for such areas. A second major aquatic resource is rice-fields. Aquaculture is poorly developed. The area is regarded as one where capture fisheries production, on average, would be at the lower end of the range for the Mekong Basin. Even so, catches of individual fishers have a mean of 54 kg per year with a variance of 30 to 78 kg. Although not spectacular by capture fisheries standards the significance of the catches is considerable because participation in the fishery is very high (which is normal). In 63 percent of surveyed villages, more than 95 percent of households depend on capture fisheries, with an additional 22 percent of villages having between 75 and 25 percent of household dependents. Fishing was ranked as the third most important household activity after rice-farming and livestock. Only two villages (7 percent) had “professional” fishers, each with about 10 percent of households involved. Overall, 83 percent of households are involved in fishing, and 41 percent of household members, 20 percent of which are children. The average yearly per caput consumption of fish and other aquatic animals was estimated at 29kg with fresh products accounting for between 16 and 22 kg. Fishery products accounted for about 43 percent of total animal products consumed but about 55-59 percent based upon animal protein equivalent. Margins of error using various methods to estimate total catch (based upon catch-effort data) were high (± 30 percent). Final estimates were reached with some degree of confidence by combining a number of approaches. The use of fish consumption data injected considerable confidence into the overall estimates both as a way of calculating total production and as a check against catch-effort data. The survey concluded that total production from capture fisheries was between 10 000 and 15 000 MT per annum (as much as half of which is processed locally after being caught). This wide range (error) in the estimates should be viewed in context. It is the indicative figure, not its absolute accuracy that is important: First, there is much natural variation in such fisheries and therefore trying to be super accurate in any one year is somewhat pointless. Second, and more

importantly for the present purposes, official statistics for the province put capture production at a meagre 700 MT per annum (between 4.5 and 7 percent of the likely figure). Apart from the lack of actual data in the official figures, two main factors contribute to the under-reporting: First, it is understood that official reports cover only what is considered to be “proper” (“professional”) fishing. Second, they only include finfish landed at regular marketing sites (the survey showed that most fish is not formally marketed and between 20-30 percent of the total catch is not fish but composed of a variety of other taxa – crustaceans, molluscs, insects, amphibians etc. taken especially from rice-fields).

Where imports and exports are known (either nationally or locally) then fish consumption figures can be used to estimate fishery production and are a very credible check for local statistics. As already noted, Lao PDR is unlikely to be a significant net importer of fish, and has no marine fishery. Therefore, most fish consumed will be produced domestically. Lao PDR undertook an Expenditure and Consumption Survey in 1997/8 based upon a nationwide household survey. The inclusion of a limited number of simple questions in this survey, relating to expenditure and consumption of fish, enabled a very accurate indicative figure for fish production for the whole country to be calculated. However, it was important to include in this approach estimates of consumption for fish products (particularly fish sauce, fish paste and dried fish). The resulting estimate of national fish consumption (= production) for Lao PDR is in the region of 200 000 MT (Sjørølev 2000). The largest potential source of error (which could be either positive or negative) in the calculation arises from figures for processed fish (both consumption data and fresh-fish conversion factors). The survey data produced an estimate of consumption (production) of 100 000 MT per annum for fresh finfish alone. The estimate of 200 000 MT per annum is considered reasonable and equates to an average of about 36 kg per caput per annum which is realistic for a country in Southeast Asia with good water resources and a predominantly rural/agricultural population. The proportion of this arising from the various sub-sectors has yet to be calculated but aquaculture is known to represent only about 14 000 MT nationally in 1998, which was re-estimated at 30 000 MT for 1999 (7 to 15 percent of the total production). Production from rice-fields, however, is significant.

A conservative estimate of capture fishery production of about 150 000 MT per annum is 5 times the officially reported annual figure. Lao authorities are currently discussing how to incorporate more realistic revised estimates of capture fisheries production into their official figures. Why this is problematic is a lesson in reality regarding statistical systems. One difficulty, common to many countries, is that despite the official figures having no sampling or valid statistical basis the system of generating national fishery statistics is incompatible with more accurate data generated through other mechanisms. For example, there is no formal requirement to reconcile estimates in the national fishery statistics and those from the national expenditure and consumption survey. New figures also question the validity of old figures which can, understandably, be taken personally by those involved in their production (also a common problem).

The current official statistics in Lao PDR result in some interesting phenomena. For example, the objective of a recent major aquaculture initiative is to raise per caput fish consumption from 7 to 11 kg per annum (the former figure is based upon official production divided by population number). It is already (or more likely traditionally) likely in the region of 36 kg. That this enables the development target to be exceeded simply by re-estimating consumption is a minor point. What is more significant is that policies are being based upon the official national statistics, despite the general lack of confidence locally in them. But without better figures, what else can be done?

6.2.4 Perceptions of inland fisheries and objectives of the statistics

Lao PDR clearly recognises the value of its living aquatic resources sector (fisheries). This is exhibited, for example, by the recent establishment of a separate division for fisheries and a significant research institute (LARReC). These developments show that, despite funding and human resource constraints, the country is willing to invest in the sector. This is a welcome and encouraging start. But a significant question is on what basis are sector and sub-sector policies set. This brief review has suggested that whilst Lao PDR appreciates its capture fishery, it seriously under-estimates its true quantitative value and extent. Recent surveys have helped reinforce the recent emphasis but the official figures remain.

It was previously reported (Sverdrup-Jensen, Coates and Visser, unpublished) that the usage of the current data on fishery production is extremely limited in Lao PDR and appears to be divorced from fishery planning exercises, which are, in any case, in their infancy. Whilst there is an element of truth to this, the official figures do still have a major influence on national policies, especially so amongst those less familiar with the sector. In particular, the figures have a major influence on donor perceptions and therefore their investment strategies.

There is a widespread belief, as well as occasional reports, that in Lao PDR that total production from capture fisheries from rivers and swamps is undergoing drastic decline due to over-fishing and environmental degradation. Oddly, there is no substantiated information or data to support this belief. In fact, the official statistics show an increase over the past 10 years. Of course, the latter are relatively meaningless in this context. But the point is that officials, not surprisingly, do not base their opinions on official statistics and this therefore raises the question as to why are they collected in the first place?

These examples also illustrate that official statistics are used or ignored arbitrarily, depending upon whether or not they support a particular policy or perception.

6.2.5 Conclusions and recommendations

The complete separation of the historical and current fishery statistics from fishery planning should be further encouraged.

Clearly, a major and immediate task for Lao PDR is to re-assess its current official figures for capture fisheries based upon a review of historical and recent information and data for the fishery. Some suggested methods for doing this are included in Part I. Much information is locally available and certainly more than enough to produce very realistic estimates. In this process, information based upon data from credible surveys should take precedent over all other information. Once survey data are accepted (within the normal margin of error) extrapolations based upon resource and population distribution are difficult to challenge. This must be done by the appropriate Lao authorities, not externally. The current report serves only to illustrate the need to do this. In common with many countries, Lao PDR needs to consolidate a more flexible, interactive and inclusive approach to the generation of national fishery statistics. There are encouraging signs that this is happening. It appears to have already been achieved recently with the figures for aquaculture. Only when this is achieved also for capture fisheries should the information be allowed to influence planning.

What could be done in the future? Lao PDR can perhaps take comfort from the fact that its inland capture fishery statistics are no worse than in many countries, and at least it has not invested significant resources in compiling them. An infrastructure does exist with which to collect data and information. Used wisely this is a significant asset. One danger is that Lao

PDR will attempt to use this by duplicating systems in other countries. There is no evidence that this will work, and better information is already on hand and can be used for estimating gross production, more accurately and without significant investment. The more optimistic scenario is that Lao PDR, because it has not already heavily invested in fishery statistics, is ideally placed to consider its options more rationally and impartially than most countries. Fundamental to this process is to clearly establish what information is needed and then to identify the best options for obtaining it. Some ways in which this can be done are discussed at greater length in Part I.

6.3 VietNam

6.3.1 Background

VietNam is among the more densely populated countries in Southeast Asia. The highest densities occur in the south especially within the delta of the Mekong River which represents the country's most important agricultural area. Economic development has accelerated in recent years. Almost all freshwater areas are still heavily exploited for fisheries. The major river fisheries are centred on the Red River and its delta in the north, now highly degraded, and more importantly the Mekong delta in the south. Remote sensing flooding imagery shows that up to 40 percent of the area of the delta in VietNam is still flooded seasonally, mainly in the upper section. This is essentially an extension of the highly productive Tonle Sap floodplain system of the lower Mekong in Cambodia. Coastal regions are now largely under flood "protection". A considerable amount of fish migrates into VietNam from Cambodia (and quite possibly the reverse occurs also). The Mekong delta also has a large brackishwater/estuarine fishery in its lower reaches. VietNam also has very extensive rice cultivation and has recently challenged Thailand as the world's top exporter. However, production is intensive with very high pesticide use and rice-fish production has no doubt suffered as a result. Aquaculture is very well developed with 407 000 MT reported national production in 1999.

6.3.2 The statistical collection system

Sverdrup-Jensen, Coates and Visser (unpublished report of a trip in 1996) found the fishery statistics collection system in VietNam to be very unclear. It has continued to prove difficult to establish exactly how statistics are collected. One reason for this is that there is a large degree of delegation of the statistical system to provinces and it can be challenging to establish exactly what is happening at that level. In provinces where a Department of Fisheries exists it is responsible for collection and processing of information on fisheries production at the district and village/community levels. This information is heavily biased towards aquaculture statistics. Out of a total of 53 provinces, 23 have a Department of Fisheries including all provinces in the Mekong delta. In general, most provinces now have fisheries extension offices but for inland areas these mainly service aquaculture. In other provinces, staff of the Department of Agriculture and Rural Development will collect the information on fisheries via their staff employed at district level and report directly to the Ministry of Fisheries (MoF), Department of Planning and Investment, in Hanoi. Provinces are requested to report every 3 months and produce a yearly report on the total area and total production. Only a limited number of species are distinguished, in particular, shrimps/prawns, marine crabs, *Gracilaria* spp. and a number of commercial fin-fish (in particular snakeheads and Pangasiid catfishes), which have export potential. All other production (culture or capture) is lumped together and reported simply as "freshwater fish". Since production figures

are used as a basis for government revenue and tax it might be expected that this system results in a certain bias in reporting.

The Ministry of Fisheries has no budget to collect their own data and rely entirely on the data supplied by provincial offices. An independent (parallel) system is in place through the General Statistics Office (GSO). This office has, since 1994, mobilised people at community level to ascertain, amongst other things, the total production area and the average production per production method by means of a sample. Again the bias is towards aquaculture. There seems to be some communication at different levels between the two systems, although it is admitted that this co-operation is far from optimal.

There is a licensing system in place for fishing in the larger reservoirs. Licensing systems also occur in open water (river/floodplain) fisheries and these target the larger professional gears. Compliance is not high and relationships between fishers and district officials in general leave room for improvement. The government is promoting improved co-management approaches to try to improve governance and management of the fisheries.

A complicating factor is that four different departments (excluding the Ministry of Fisheries) are responsible for the management of the different inland water bodies. Whilst all might lay claim to revenue from the fishing, few of them systematically collect data on the number of fishers involved or the capture fisheries production on a national basis. The government Ministries or Departments went through a major re-organisation and reform in the mid-1990's and this, together with the still ongoing shift to market oriented economy, does not clarify matters in terms of responsibilities and competence of different offices for collecting data. A detailed investigation of the actual data gathering systems on a provincial, district and village level is necessary to obtain a clear picture of the usefulness and potential of any specific statistics. This can be time consuming and requires significant local knowledge.

A major overhaul of the fishery sector was proposed by the Fisheries Sector Master Plan project (Danida in 1996). The marine fishery remained the main target for changes in the way data are collected. Again the emphasis has been on the export sub-sectors and aquaculture. There is currently an on-going Danida funded project to improve fisheries information systems. This has not fully addressed the needs for inland capture fisheries but is attempting to incorporate some aspects through liaison with the Danida funded MRC Fisheries Programme.

Collecting data on the small scale fishing activities, in general, is not currently considered feasible. Inland capture fisheries are considered only to constitute a minor fraction of the total fishery and aquaculture sector. The government takes the view that the main thrust for growth from inland areas will be from aquaculture. There is a perception, not universally held, that there is probably little point improving the statistics for inland capture fisheries. Needless to say, in the absence of hard data on the inland capture fishery, this attitude is somewhat irrational. In the few areas where improved statistics have been collected it has also been shown to be incorrect (see below). Nevertheless, emphasis by the government on generating export revenue has placed inland capture fishery statistics as a low priority.

Where statistics do exist for inland capture fisheries, based upon information collection, they appear to be founded mainly upon estimates from records of licensed gears. These may or may not include an element of catch reporting by fishers. Some districts may undertake surveys of reports from fishers. Better statistics might be available on a local basis for individual reservoirs, but the mission has been unable to find any that are relevant to obtaining estimates of reservoir fisheries on a national basis.

6.3.3 The information produced

Inland capture fisheries production reported to FAO, together with freshwater aquaculture for comparison, is shown in Fig. 2-25. Based upon this information, the relative degree of attention to, and investment in, aquaculture would appear justified. It is certainly the case that the aquaculture sector has performed well and the figures suggest it outstrips capture by a significant margin. But the reality regarding inland capture fisheries is quite different. For example, official reports of production from freshwater capture fisheries by a single province in the Mekong Delta (An Giang – see later) have averaged around 65 000 MT per year. It is hard to believe the province accounts for 86 percent of total national capture production from freshwaters; especially considering it is only one of at least 12 other provinces in the delta (subject to definitions on boundaries). An Giang province, being located near Cambodia, still with extensive seasonal flooding, is noted for its inland capture fisheries but a number of other provinces have similar freshwater resources, not least Dong Thap province which is adjacent in the north-east section of the delta (also bordering Cambodia), plus large sections of several others. Even those areas where the annual flooding is now largely eliminated are not expected to have totally insignificant capture fisheries, not least because all still have extensive networks of canals and many still have fisheries on the Mekong distributaries. Also, those closer to the sea begin to have brackishwater/estuarine fisheries (inland).

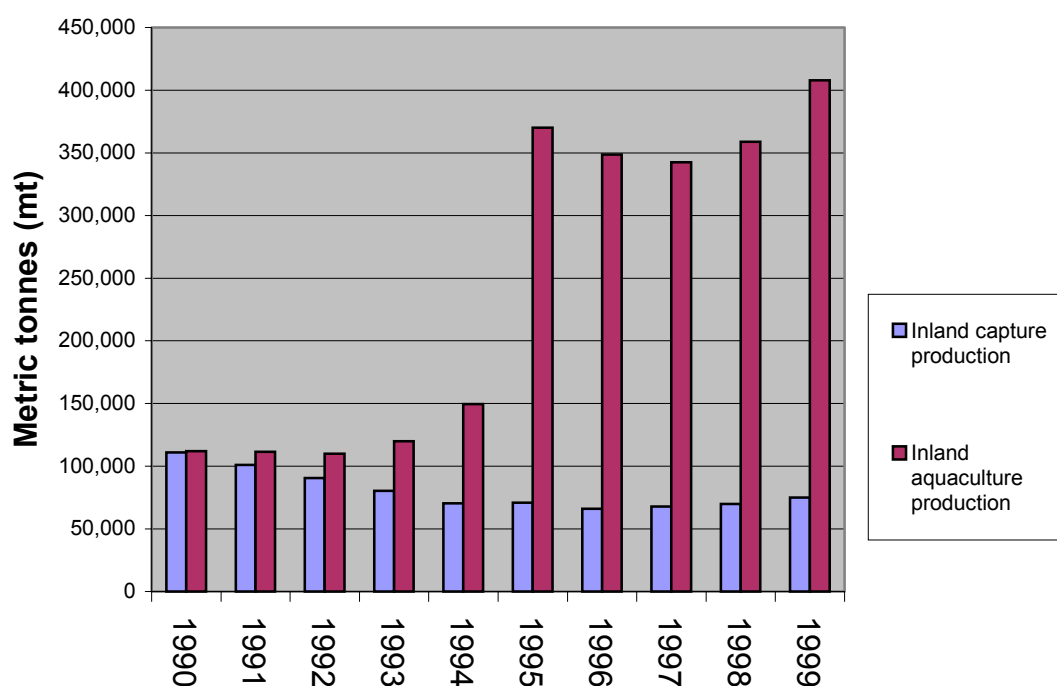


Fig. 2-25 VietNam - Inland capture fisheries and aquaculture production (national totals)

The first problem in VietNam with the national inland capture fishery statistics (at least as reported to FAO) is that they do not include all available provincial information; or, more likely, the information is not reported to national authorities (unless An Giang is the only province with reports).

Following this information, the apparent 25 percent reported decline in inland capture production over the past ten years (Fig. 2-25) would seem to be baseless. Certainly the figures are incorrect in absolute terms but is the trend representative? Has there been a decline in the fishery or decline in reporting? Do the figures represent a degree of subjectivity due to

perceptions of what is believed to be happening? Is there actual misreporting (at provincial/district level) to justify management activities in other sub-sectors? For present purposes, these questions are less relevant than the fact the information produced, when viewed in any impartial fashion, does not enable them to be answered. So what then is the purpose of this information?

In addition to these discrepancies in compiling national statistics, at least as forwarded to FAO, recent statistically based sampling surveys of inland capture fisheries have shown that, as usual, the existing reporting/statistical system still grossly under-estimates the fishery. In 1998-9 the MRC commissioned a survey in An Giang province which was undertaken by a local university and provincial and district fisheries officers with technical assistance through the Research Institute for Aquaculture Number 2 (Ho Chi Minh City). A team report was produced (Sjørølev, 2001) and the information produced on freshwater capture fisheries in the area was as follows:

- 66 percent of households rely significantly on capture fisheries either for income or food. This equates to about 1.35 million people who rely to various extents on capture fisheries (out of a total of 2 016 949) in just one province.
- 45 percent of people interviewed reported that they went fishing. This equates to about 900 000 people.
- 9 percent of fishers are children below the age of 15. About 30 percent of fishers are women.
- 5.7 percent of households are involved in either fish processing or trading.
- About one person per 62 households is involved in fish trading (about 60 percent of which are self-employed). This equates to about 32 500 traders in the province.
- By comparison, only 14 percent of households are involved in aquaculture, either solely, or more often in combination with capture fishing.
- Only 25 percent of “professional fishing” households actually operate larger-scale gears such as bag-nets and larger traps/barrages.
- “Professional fishers” spend about 10 months per year fishing, but “part-time” fishers still spend an average of 7.3 months per year fishing.
- The total catch estimate for “part-time” fishing households was approximately twice that from “professional” fishing households (and the latter also includes some small scale catches from non-licensed gears).
- The fishery cannot be adequately described or monitored by using “professional” (= licensed) fishers as the prominent group.
- 80 percent of the total catch is sold (including from part-time fishing households).
- The mean catch per household was 792 kg/year with a median of 300 kg/year (excluding households using highly productive gears such as bagnetts). This estimate includes non-fishing households.
- Consumption of aquatic animals (fish plus other taxa) was 58.4 kg/person/year of which fresh fish (plus other taxa) accounted for 54.3 kg with 4.1 kg/person/year of processed fish. The fresh fish equivalent was 61 kg/person/per year.
- Fish accounts for 75 percent of the total animal food intake.
- 76 species of fish were reported to be caught (and that section of the survey only related to recent catches, the number of species over a full year would be much higher).
- Total production from the capture fishery was estimated at 273 118 MT for 1999. About 28 percent of this is used as fodder/feed for commercial aquaculture (the region has very significant cage culture particularly for carnivorous snake-heads, *Channa spp.*, and catfish). About 23 percent is likely exported (probably domestically) from the province.

Naturally, when these figures were first produced they were received with some scepticism locally. Fortunately the figures could be verified by making comparisons with other regions. The figures were, for example, remarkably similar to those obtained by a number of independent studies for the same adjoining ecosystem in Cambodia (see Cambodia this document). Catches per household were comparable as were catches per gear, consumption figures and the levels of participation in the fishery. This is not surprising as it is effectively the same fishery. What gives the relatively high production estimate is the relatively high population living in the province (over 2 million people). Estimates of catches per unit area have still to be made (this is complicated because large quantities are caught from rivers and canals where fish may be migrating through the area).

The official provincial report for the capture fisheries in An Giang province for 1999 was 64 000 MT. The estimate from the actual survey was therefore about 4.25 times higher (which is comparable to the error for other similar fishery statistics documented elsewhere in this report). However, the provincial figures are based upon catch reports and estimates for the larger gears (mainly bag-nets, barrages, trawls, big lift nets and stationary gillnets). Interestingly, by applying the same statistical methods as the province, but using the data from the aforementioned actual survey for the same gears and effort, an estimate of 66 679 MT was derived – a difference of only 4 percent. This endorses the survey data. It also shows that the provincial statistics are, in fact, reasonably accurate or at least representative. The problem with the provincial statistics is that they apply only to a small sub-sector of the total fishery.

The aforementioned survey and statistics refer to a single province. The same correction (factor 4.25) cannot be applied to the national figures because we know they do not include all provincial reports. Also, not all provinces may have statistics of the same nature as in An Giang (meaning they most likely under-report even more). What then is a realistic total estimate of freshwater capture fisheries production in VietNam?

A cursory look at the Mekong delta in VietNam suggests, based upon data for An Giang, that the upper half, which includes the major seasonally flooded sections, when allowances are made for resource areas and population numbers, might be producing in the order of 400 000 to 500 000 MT. Based upon production per caput, this is conservative and less than production per caput in Cambodia. Added to this should be a smaller amount for the middle to lower sections of the delta (with limited flooding) but an unknown but likely substantial amount for the inland areas of the estuary/coastal region. A figure of 500 000 to 600 000 MT per annum for the Mekong delta in VietNam is therefore not unreasonable and compares reasonably with the estimates for the Ayeyarwaddy (Irrawaddy) delta in Myanmar, which has some similar characteristics. An average of a conservative production of 35 kg/caput/year (it is nearly twice that in the upper section) gives a figure of 600 000 MT. Whilst such production might be considered high for the Mekong delta, it should be related to resource area and population size. There are 17 million people living in the VietNameese part of the Mekong delta; this is 1.5 times the total population of Cambodia (including those not living in fishery resource rich areas). Taking a rough figure of 10 percent of the population involved in fishing (very conservative based upon the An Giang data) gives an estimate of around 1.7 million VietNameese fishers in the delta alone (and it is arguably likely twice that). Added to this should be those also involved in fish processing, marketing and transportation. Whilst all of these people may not be involved full-time, they all depend significantly upon capture fisheries. More importantly, so do the other members of their households (multiplying the total dependency by a factor of about 4.0). The entire population also depends upon fish for food security. Added to this estimate for the Mekong total will be production from areas outside the Mekong basin and from reservoirs. This might be speculated to be at least another 100 000 to 200 000 MT per annum.

Calculations in this fashion are unlikely to yield either accurate or accepted estimates. But the analysis shows at least three important things: (i) that the current reported production of 75 000 MT from inland capture fisheries nationally is a gross under-estimate, (ii) any reasonable impartial estimate based upon available data (locally or by comparison with relevant regions elsewhere) would conclude that inland capture fisheries production likely exceeds that from freshwater aquaculture, and (iii) whatever the realistic figure is, it is sufficiently high enough to justify investing some effort into obtaining a more accurate estimate in a more systematic fashion.

6.3.4 Perceptions of inland fisheries and objectives of the statistics

VietNam is certainly a country which generally seriously under-estimates the importance of its inland capture fishery, particularly so for the Mekong delta. It is hard to say whether this has been due to the fishery statistics or whether the statistics themselves have been influenced by pre-determined policies. In general, there is also the widespread view that the fishery is in decline (primarily through environmental pressures) and that, in any case, there is limited scope to improve it.

The use of the current statistics seems to be limited for reporting purposes to the Ministry level and is purely descriptive. There appear to be no national freshwater capture fishery management actions or plans based on the currently available data (at least for river fisheries). Neither could any be realistically undertaken. It is more likely that the current statistics have encouraged a lack of interest in the sub-sector. There are some local initiatives, with related statistics etc., for reservoirs. These relate mainly to assessing the impacts of stocking programmes.

6.3.5 Conclusions and recommendations

Obviously, VietNam needs to re-assess its inland capture fishery statistics. A more representative picture of the sub-sector can be obtained with limited cost, using existing information. This might include exploring in more detail the information available at provincial and district levels and especially establishing the basis of that information. Doing this does not necessarily require substantial investments in the statistical system itself. Further recommendations as to optional approaches for other ways of improving information in areas where statistics are currently weak are provided in Part I.

Regarding improving the current statistical collection system, there are two separate problems: (i) the way in which national figures are compiled (or reported to the national level), and (ii) the relevance of the original statistics. A statistical system including staff is currently in place. There are certainly low cost solutions to improving the current information, where it is already being collected. The example from An Giang suggests that at least for some areas valid corrections can be applied to current statistics, without extra costs. It is not unreasonable to suggest that such changes might indeed result in overall savings. In addition, the replicate collection system by GSO and the MoF could be merged to rationalise the investment of effort (if this has not already been done). There is no technical reason why local authorities, given limited support and advice, could not make many improvements on their own. The problem is very much one of motivation to pay attention to these fisheries. To address that problem, policy changes at national level would help.

This does not mean that VietNam need necessarily invest substantially more in its current inland fishery statistical system. On the contrary, this review concludes that such investments should proceed with caution. A better approach is to first ascertain what kinds of information are required for policy, planning and management purposes. The existing system, provided improvements are made where feasible, even if scaled-down, may provide the current information more effectively and cheaply, and certainly more reliably. It is the additional information that may be required, but is not currently collected, that is important. Investing in the current system may not necessarily provide that. In particular, the current system is unlikely to provide information relevant to monitoring trends in the fishery, livelihoods, poverty and food security aspects or biodiversity and the environment. Further details are included in Part I.

It is, of course, for VietNam to set its own policies and priorities. All this review can contribute is to illustrate the dangers of basing policies on poor statistics. The downgrading of inland capture fisheries has been fuelled at least in part by the statistics themselves. This has spiralled into further downgrading of the fisheries. A national policy of promoting commercial aquaculture and export-oriented fisheries is not necessarily inappropriate in itself, and is not being questioned here. Indeed, exports and aquaculture have responded admirably. The danger lies in when the policy results in insufficient attention to an inland capture fishery of the extent and importance of that in VietNam.

The evidence suggests that the inland capture fisheries in VietNam, particularly in the lower Mekong River, are worth sustaining. But VietNam, in common with many countries, is certainly making an error of judgement by assuming that its inland capture fisheries cannot be improved. Evidence from Myanmar in this report, and experiences elsewhere, conclusively show the substantial benefits that can accrue by applying cost-effective enhancement techniques to such fisheries (through better management of the environment and/or stocking). There is much scope for such techniques to be applied to river fisheries in VietNam, particularly since most of the environments are already under substantial management. In common with most countries in the lower Mekong basin, VietNam has yet to adopt closer co-ordination of water and fisheries management activities to optimise resource utilisation for which will require improved statistics and information.

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EXAMPLES OF LIVELIHOODS RELEVANT INFORMATION

(Source: DFID 1999)

What type of information is required to analyse the vulnerability context?

Livelihoods analysis does not have to be exhaustive to be effective. Rather than trying to develop a full understanding of all dimensions of the *Vulnerability Context*, the aim is to identify those trends, shocks and aspects of seasonality that are of particular importance to livelihoods. Effort can then be concentrated on understanding the impact of these factors and how negative aspects can be minimised. This requires a prior understanding of the nature of local livelihoods – what types of livelihood strategies are employed by local people and what factors constrain them from achieving their objectives. Such understanding cannot be gained without social analysis so that particular social groups and their relationship with factors within the *Vulnerability Context* can be identified.

While it is important to narrow down the extent of analysis, it is also important to think broadly about factors within the *Vulnerability Context* that *might* affect local people, so that less-obvious issues are not neglected. For example, when thinking about **seasonality**, it is important to consider both immediate and more distant effects.

In a rural setting, it may be necessary to find answers to the following types of question:

- Which groups produce which crops?
- How important is each crop to the livelihoods of the groups that produce it?
- Is the revenue from a given crop used for a particular purpose – e.g. if it is controlled by women is it particularly important to child health or nutrition?
- What proportion of output is marketed?
- How do prices for different crops vary through the year?
- How predictable is seasonal price fluctuation?
- Are the price cycles of all crops correlated?
- What proportion of household food needs is met by own consumption and what portion is purchased?
- At what time of year is cash income most important (e.g. school fees might be collected one or more times during the year)? Does this coincide with the time at which cash is most available?
- Do people have access to appropriate financial service institutions to enable them to save for the future? Does access to these vary by social group?
- How long and intense is the ‘hungry period’?
- What effect do the ‘hungry period’ and other seasonal natural events (e.g. the advent of the rainy season) have on human health and the ability to labour?
- Has the length of the ‘hungry period’ been increasing or decreasing?
- How do income-earning opportunities vary throughout the year? Are they agricultural or non-farm?
- How does remittance income vary throughout the year (e.g. falling off at times when it is most needed because of food price rises)?

What type of information is required to analyse human capital?

There are many quite well-developed indicators of human health, though some – such as life expectancy – may be difficult to assess at local level. Rather than focusing on exact measures,

it may be more appropriate to investigate variations. Do different social groups have obviously lower or higher life expectancy? Are the children of indigenous groups, for example, more poorly nourished than other children? Does the quality of health care available to different groups differ markedly?

Education indicators may be easier to assess. It is relatively simple to determine the average number of years a child spends in school, or the percentage of girls who are enrolled in school. What is far more difficult is understanding the quality, impact and value to livelihoods of these years in school, the correlation – if there is one – between years in school and knowledge, and the relationship between either of these and leadership potential.

Formal education is certainly not the only source of knowledge-based human capital. It is equally important to understand existing local knowledge, how this is shared, added to and what purpose it serves. For example, some knowledge can be highly useful for production – think of knowledge about modern, intensive farming techniques – but be neutral or negative in terms of its effect upon the environment and environmental sustainability. Or some knowledge – again, think of knowledge for production, either agricultural or industrial – may be effectively useless unless it is coupled with other types of knowledge (knowledge about how to market goods, about appropriate quality standards, etc.)

The following types of questions are likely to be important when thinking about human capital:

- How complex is the local environment (the more complex the problems, the greater the importance of knowledge)?
- From where (what sources, networks) do people access information that they feel is valuable to their livelihoods?
- Which groups, if any, are excluded from accessing these sources?
- Does this ‘exclusion’ affect the nature of information available? (e.g. if women are excluded, then knowledge of traditionally female production activities may be limited.)
- Are knowledge ‘managers’ (e.g. teachers or core members of knowledge networks) from a particular social background that affects the type of knowledge that exists in the community?
- Is there a tradition of local innovation? Are technologies in use from ‘internal’ or ‘external’ sources?
- Do people feel that they are particularly lacking in certain types of information?
- How aware are people of their rights and of the policies, legislation and regulation that impact on their livelihoods? If they do consider themselves to be aware, how accurate is their understanding?

What type of information is required to analyse social capital?

Levels of social capital are hard to gauge from the outside. They may be discernible only after lengthy analysis (which may be beyond project/programme resources) and it is unlikely that they will be quantifiable. For example, simply counting the number of registered groups in a community is not likely to yield a measure of social capital; group nature and quality is as important as group numbers. Often we will be looking at trends – whether the state of social organisation appears to be becoming better or worse for livelihoods – rather than trying to gauge exact levels of social capital.

It is very important not to permit these difficulties to cause neglect of social factors when working with communities. Over time it will be vital to develop an understanding of the nature of civic relations at a wider community level, of the types of social resources upon which households rely and of who is excluded from these benefits. Groups with overlapping

membership can be particularly problematic if it emerges that people with a particular social profile are excluded from all groups.

Another important point for observation is people's coping strategies in times of crisis and the extent to which they have relied on social resources to see them through.

What kind of information is required to analyse natural capital?

It is not only the existence of different types of natural assets that is important, but also access, quality and how various natural assets combine and vary over time (e.g. seasonal variations in value). For example, degraded land with depleted nutrients is of less value to livelihoods than high quality, fertile land, and the value of both will be much reduced if users do not have access to water and the physical capital or infrastructure that enables them to use that water.

With natural resources it is also very important to investigate long-term trends in quality and use. This is familiar territory for those skilled in the practice of rural appraisal techniques (mapping, transect walks, etc.). Typical issues for analysis might include:

- Which groups have access to which types of natural resources?
- What is the nature of access rights (e.g. private ownership, rental, common ownership, highly contested access)? How secure are they? Can they be defended against encroachment?
- Is there evidence of significant conflict over resources?
- How productive is the resource (issues of soil fertility, structure, salinisation, value of different tree species, etc.)? How has this been changing over time (e.g. variation in yields)?
- Is there existing knowledge that can help increase the productivity of resources?
- Is there much spatial variability in the quality of the resource?
- How is the resource affected by externalities? (For example: the productive potential of different parts of watersheds is affected by the activities of other users and the way in which resource systems operate; the value of fisheries depends upon the number of other users who have access and the choices they make about their catches; biodiversity is often damaged by intensive agriculture.)
- How versatile is the resource? Can it be used for multiple purposes? (This can be important in cushioning users against particular shocks.)

Environmental economists have invested considerable effort in trying to determine overall values for natural assets that take into account:

- direct use value (e.g. of land used for agricultural production or of recreational areas).
- indirect use value (e.g. biodiversity, erosion protection and other ecological services).
- non-use value, or existence value (often calculated on the basis of the amount people would be willing to pay to see the continued existence of a given resource, regardless of whether they use it).

This type of valuation exercise helps remind us of the many uses of natural resources and also of our obligations as 'custodians' rather than 'owners'. However, most livelihoods analysis of natural capital will not go this far. Indirect use values are likely to feature prominently in calculations only when they are problematic or where they offer significant income prospects.

For example:

- Problems might arise where tree felling has caused knock-on erosion problems, or over-exploitation of coastal areas is leading to increased storm damage in adjacent areas.
- Significant income earning opportunities might exist in areas of high natural biodiversity.

What kind of information is required to analyse physical capital?

The approach to analysing physical capital must be participatory. Users may place a greater importance on some services than others and these priorities must be taken into account. For example, people may prefer to use a surface water supply a long way away rather than to pump a well near at hand.

- Does the infrastructure support a service? There is little benefit in a school building if there are no teachers, or the pupils cannot get to it when classes are being held.
- Is the infrastructure appropriate? Can the physical capital provided meet the needs of the users in the long term? This involves not just the sustainability of the service as it stands but an analysis of the ability of the capital to be adapted and upgraded in response to changing demand.

Access is also a key concern. Sometimes costly infrastructure exists in an area, but this does not mean that the poor have access to it. This might be because the user-fees are too expensive for them or because richer groups use their strength and influence to control or monopolise access.

What kind of information is required to analyse financial capital?

First it is important to gain a straightforward understanding of:

- Which types of financial service organisations exist (both formal and informal)?
- What services do they provide, under what conditions (interest rates, collateral requirements, etc.)?
- Who – which groups or types of people – has access? What prevents others from gaining access?
- What are the current levels of savings and loans?

Understanding the nature of savings behaviour requires finding answers to questions such as:

- In what form do people currently keep their savings (livestock, jewellery, cash, bank deposits, etc.)?
- What are the risks of these different options? How liquid are they? How subject to changes in value depending upon when they are liquidated?

In the past, the existence and effects of what can be quite sizeable flows of remittance income have often been over-looked. To correct this, it is important to understand:

- How many households (and what type) have family members living away who remit money?
- How is remittance income transmitted?
- How reliable are remittances? Do they vary by season? How much money is involved?
- Who controls remittance income when it arrives? How is it used? Is it reinvested?

What type of information is required to analyse structures?

It is relatively straightforward – though time-consuming – to analyse through observation and survey which structures exist and what they do. What is more difficult to understand is how different structures relate to each other (the processes that govern their interactions) and how, in conjunction with various processes, they impact upon the poor, and *vice versa*.

Depending upon the importance attributed to various structures it may be important to understand the:

- legal/constitutional basis, authority and jurisdiction (including degree of decentralisation);
- membership/ownership structure;
- leadership/management structure;
- objectives and activities;
- financial basis (sustainability); and
- geographic location/extent.

At the same time it is obviously important to understand **how** they operate (processes), the extent to which they are held in popular trust and the nature of their relations with other structures.

This type of information is required in order to establish whether and how existing structures can act as building blocks for the promotion of the interests of the poor.

What type of information is required to analyse processes?

In order to understand the impact of existing processes on livelihoods, it is necessary to be able to trace through the effects of given processes on particular groups. The understanding gained through this analysis will then assist with the development of more effective processes, if this is a priority.

Analysis of policies and legislation is complicated by the need to know:

- what is written in statute books;
- what the intended effects of policies and associated laws are; and
- what happens in practice.

Some policies and legislation – including some of governments’ more impressive pronouncements -are never acted upon or are not enforced. In other cases they may have perverse outcomes (e.g. legislation preventing tree-felling may reduce the amount of trees planted, changes in factor prices under adjustment policies may not have the expected impact on production). Unless this is known, it will not be easy to think about the effects of processes on livelihoods and whether change is a priority.

Further work is required to develop more effective methodologies for analysing policies, their effects on livelihoods and how they themselves are influenced by what happens at local level.

What type of information is required to analyse livelihood strategies?

It is very important that preconceptions about what the poor do – what their livelihood strategies are – should be put aside. It has been common in the past to make untested assumptions about the poor, and as a consequence, to misdirect support (e.g. supporting agriculture on the assumption that most of the poor are farmers, when the poorest of the poor may be wage labourers outside agriculture).

The following types of issues are important when thinking about livelihood strategies.

- What does the livelihood ‘portfolio’ of different social groups look like (percentage of income from different sources, amount of time and resources devoted to each activity by different household members, etc.)?
- How and why is this changing over time? (Changes may be, for example: long-term, in response to external environmental change; medium-term as part of the domestic cycle; or short-term in response to new opportunities or threats.)
- How long-term is people’s outlook? Are they investing in assets for the future (saving)? If so, which types of assets are a priority?
- How ‘positive’ are the choices that people are making? (e.g. would people migrate seasonally if there were income earning opportunities available closer to home or if they were not saddled with unpayable debt? are they ‘bonded’ in any way? are women able to make their own choices or are they constrained by family pressure/local custom?)
- Which combinations of activities appear to be ‘working’ best? Is there any discernible pattern of activities adopted by those who have managed to escape from poverty?
- Which livelihood objectives are not achievable through current livelihood strategies?

As always, it is important to take a socially differentiated view of livelihood strategies in order to focus support in the most appropriate area. This means thinking about variations in livelihoods strategies between different social groups, why these exist and what effect they have.

What information is required to analyse livelihood outcomes?

When thinking about *Livelihood Outcomes*, it is important to understand not only the aims of particular groups, but also the extent to which these are already being achieved. If certain social groups are systematically failing to achieve their aims, it may be because their aims conflict with the aims of other, more powerful groups. Or it may be because they do not have the means (assets) to achieve them. This distinction will help inform activity in support of the weaker groups.

Assessing non-tangible outcomes, which may be very subjective and private, is a challenge. When thinking about well-being, for example, the following types of issues might be important:

- To what extent are people aware of their rights (political, human, social, and economic)?
- Do they have any access to means of ensuring that their rights are met?
- How ‘secure’ (against physical damage, violence, seizure by the state, natural and economic shocks, etc.) are people and their assets?
- What sources of information are open to people? How high is the quality of that information?
- To what extent are particular groups represented within the political process?
- How good is the access of different groups to core services (e.g. education, sanitation, health)?

For all issues it will be important to investigate what the current situation is, how it is changing over time, and whether securing change is a priority for local people.

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