Fisheries Statistics:
A Necessary Tool for Sustainable Fisheries?

by Theo Visser

Introduction

Fisheries are a major activity for many people living in inland and coastal areas in Southeast Asia and are considered to be the main basis for the livelihoods and food security of many rural populations. Information on actual levels of consumption and catch are scarce, but research data from the Mekong River Commission suggest that inland capture fisheries in the Mekong basin, for example, may produce over three million MT per annum. This estimate is based on a combination of consumption and catch assessment data, collected over a number of years, and including non-fish aquatic organisms like shrimp, frogs and water insects.

Official catch estimates, where available, do not normally include small-scale or subsistence fisheries, and therefore tend to massively underestimate actual fish production. 'Real' production is often at least two to three times higher than indicated by official catch estimates. For example, reported inland fisheries production from all ASEAN-SEAFDEC Member Countries combined (including the Mekong countries mentioned above) for 2000, based on FAO information, is only around 1.3 million MT. The contribution by the small-scale fisheries sector, both coastal and inland, to the livelihood and food security of rural people is in most cases underestimated, leading to a failure to appreciate the levels of required assistance to these sectors.

Statistics are, of course, essential to making informed decisions on policy, planning and management. At the same time, it is widely acknowledged that there is insufficient use of existing information.

Current statistics do not adequately provide information perceived to be required for policy, planning and management.
If this is true, it is time to make the fishery statistics more useful, or to make the outputs of the system ('information') more appropriate.

Targeted end-users of the information do not use the available information properly, and often, not at all.
This is often induced by the low quality or poor focus of available statistics, or simply by political considerations; under good governance, all decision making should be transparent and based on the best available information. In addition, the current fisheries statistics framework and objectives often have not been designed to be used for actions in the future, but are limited to records of past achievements of the industry.

Despite the lack of proper planning and management, inland

and marine catches have proved to be quite resilient, at least in absolute terms, such as gross weight.
This is an important observation. Collapsed fisheries have for the most part been mono-species fisheries. In tropical regions, multi-species fisheries are the norm, and species replacement, or fishing down the food-web, is common. Where mono-species fisheries do exist, tuna being an obvious example, they are managed effectively and depend on huge areas and shared stocks often from different origins. We cannot deny that there is over fishing, but it is apparent that relatively healthy ecosystems have ways to compensate.

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Fisheries and statistics

Although in some SEAFDEC Member Countries, marine fisheries are relatively well covered by a statistical system, the general situation of statistical coverage for coastal fisheries in the ASEAN region is very similar to that for inland capture fisheries – really appalling!

At the Millennium Conference, it was concluded that various shortcomings needed to be addressed in order to improve fisheries statistics in the region, in particular with regards to effective usage and collection of required information. In order to tackle such a challenging task, four countries – Cambodia, Lao PDR, Myanmar, and Viet Nam – were identified as initial recipients for training under a project executed by SEAFDEC. The aims of the project are to first mitigate the technical disparities among the ASEAN Member Countries, and to promote this challenging program while harmonizing the situation in the region. The focus of the project is on both inland and coastal fisheries.

As a first step, a set of methodologies appropriate for inland and coastal fisheries were compiled under the heading Guidelines for the Collection of Inland and Coastal Fishery Statistics. Special emphasis was put on the collection of economic and socio-cultural data necessary to answer many management, policy and planning questions that biological data alone cannot appropriately address. Most of these socio-economic data are not considered part of regular fishery statistics, and are rarely included in a comprehensive manner. As such, these are prominently featured in the Guidelines, while special emphasis on the design of a statistical system is also given.

This article is based broadly on the Guidelines, and will consequently focus mainly on inland and coastal fisheries.

What are fishery statistics?

Traditionally, fishery statistics include data and information that describe the current and past status of the fisheries, and show trends on the development of the sector that can be used for policy, planning and management. The nature of the most commonly collected statistics, catch and effort, is such that time series are required to be able to separate natural fluctuations in species or production from human-induced changes, in order to make them useful. However this classical approach to fishery statistics, to include just catch figures (by species) and effort (by fishing gear) is inadequate for the challenges facing the fishery sector. Moreover, this type of statistics has proved to be difficult to collect from small-scale fisheries.

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Statistics for inland and small-scale coastal fisheries are often considered exceptionally unreliable. This is true for both developed and developing countries alike. It is not just a question of available budget, as fisheries statistics for many developed countries are also poor. Inland fisheries statistics, especially, are of poor quality worldwide. This has only become apparent in recent times. It is not that the statistics have deteriorated, although in some cases this has also occurred; rather, it is that demands on statistics have increased due to growing participation in fishing activities and increasing pressure from within and outside the sector.

Whereas in times of expanding fisheries and plentiful unexploited stocks there was no real need for management, the situation nowadays has changed dramatically. Not only are most stocks now fully exploited, and in many cases overexploited, pressures from outside fisheries on resources have also increased,

due to pollution, development of coastal areas, and conflicts between resource users. The situation has changed considerably over the past few decades, with tourism and environmental issues increasingly having to be taken into consideration as well. This has added to the demands on data that needs to be collected.

There are two main problems with inland and coastal statistics:

1. The amount of detailed information required to be useful needs to be more diversified than those for high seas fisheries. The quality of the statistics therefore needs to be higher. For example, exact information on where fish are caught for high seas fishery is rarely available while often essential in order to assess the status of a species. The exact location where fish are caught (habitat information), and other micro information, are central for coastal and especially inland fisheries, with a special mention if the information is to be used for integrated resource management.

2. Collecting statistics for inland and coastal fisheries faces several methodological problems:
   a. The nature of fishing operations, which are mainly small-scale, scattered in space and time
   b. Use of inappropriate methodologies, designed for medium to large-scale marine fisheries
   c. Focus on the most visible components, namely large-scale fisheries with 'easy-to-collect' parameters
   d. Inappropriate management focus, in which the wrong focus is given to classical catch-effort and stock information
   e. Lack of funds, attention, and support due to the under appreciation of the sector
   f. Little or no evaluation of statistical system design.

Not all of these issues are typical for inland and coastal fisheries, but the combination of all factors together is unique, particularly for inland fisheries, but to a lesser extent also for coastal fisheries.

For all fishery sectors, the matter of timeliness is an important issue. It is not uncommon for statistics to become available for users only two years after collection. Since the main purpose of a statistical system is to provide relevant information to policy makers and managers, this kind of delay is unacceptable; for informed decision making, information has to be available almost immediately. The solution is mainly one of system design, unless information relies on reporting or questionnaires that can delay timely collection of data.

> "much of the information that may be requested by politicians, planners and managers cannot be extracted from routinely collected statistics"

Collecting more statistics information is not feasible, in view of shrinking available budgets, and the ever-increasing demands placed on statistics agency staff. But for a full understanding of fisheries, the scope of appropriate fishery statistics needs to be as wide as possible in order to accommodate other essential data sources. This scope goes well beyond typical fisheries statistics, and includes livelihood data, socio-cultural information, and economic data, in addition to production (biological) data. This approach is important, as fisheries cannot be regarded as entities separate and distinct from other sectors. For policy, planning and management, a more holistic approach has to be taken, focusing on basins and bays instead of specific fisheries that may cover a wide area and many separate stocks.

Obviously, a choice has to be made about what information should be collected by governmental fisheries agencies, and what should be collected by other organisations. Statistics are relatively expensive to collect, so what is collected should be usable and reliable. What exactly is collected depends on what

Cast net fishing in Vietnam

information is required, and since this depends on policy and management decisions often taken at a national level, the requirements and thus the statistical system will differ from country to country. Even so, very similar requirements need to be taken into consideration. In all cases, it is important not to be too ambitious and to limit the statistical system to a certain minimum set of parameters and expand it with other information and research from other sectors, including environment, biology and socio-economics.

Some of the 'statistics' required for a bay or basin wide approach are outside fisheries, or regarded as research rather than statistics. Research can also supply statistics, and contribute valuable information on the fishery sector. In fact, much of the information that may be requested by politicians, planners and managers cannot be extracted from routinely collected statistics, and must be provided by auxiliary (non-routine) information from other sources like (scientific) research.

Issues and uses of fishery statistics

Fishery statistics can serve many goals, but for most ASEAN-SEAFDEC Member Countries, inland and coastal fisheries statistics are only used to indicate the importance of the fishery sector in the national economy. Reliability and coverage are often such that the there is not much point in trying to use these statistics for other purposes. Even so, official statistics almost always underestimate the actual economic importance of fisheries, which can be more accurately obtained from results of research surveys into fisheries socio-economics.

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Fisheries statistics are normally used to illustrate the status of the sector for purposes such as tax and licensing, but such general practice sometimes fails to justify the required costs, and eventually lead to declining resources and support from government budgets with many other priorities. It is rare to find cases where fisheries management is actually based on available statistics. Instead, a combination of statistics and additional research information, as well as policy considerations, are used to provide the basis for management that eventually often says more about the status of fisheries in the national economy than about the status or trends of particular fishery resources. One of the major constraints on current statistics is that they often only illustrate fisheries in general, without showing details of individual fisheries where management actions are needed.

But let's take a different perspective. The main purpose of fishery statistics should be to monitor the status and trends of the fisheries, providing a focus on specific problematic fisheries where appropriate remedial actions and measures are required, with proper identification of priority deeds. The variables that are collected should therefore be used as indicators for changes in fisheries, or support calculations of composite indicators, such as Catch per Unit of Effort (CpUE), that do so. Although biological indicators can be used to monitor the state of exploitation of a fishery, they are inadequate for assessing the performance of the fisheries sector as a whole. From this perspective, other indicators are required:

1. **Economic indicators**, designed to measure the relative importance of fisheries to the nation or region at the macro- or micro-economic level.
2. **Socio-cultural indicators** that take into account

the diversity of needs and practices of different groups of people within the fisheries sector.

3. **Compliance indicators**, to monitor the effectiveness of management measures and to reduce conflict.

So to be able to guide decision making for management, policy formulation and planning, fisheries assessments should ideally combine biological, economic, socio-cultural and compliance indicators. This is often neither practical nor affordable, so in cases where choices have to be made to limit the coverage of the statistical system, core statistics at least should be collected, meaning information on catch quantities and applied fishing effort. But core statistics should only be collected where it makes sense to do so, for fisheries where this information is used for management purposes. This excludes most subsistence fisheries and many small-scale and part-time fisheries, where collection of fishery statistics and management of fisheries can better be replaced by co-management of the environment and collection of selected socio-economic indicators (like fish consumption).

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Moreover, for fisheries statistics to be useful, it is often necessary to have comparable and compatible time series available over a long period, with statistics collected consistently, using the same methods and approaches. This is a bit restrictive in relation to the available options to change the system or methodology, but it is not much of a problem for the basic fisheries statistical parameters, for which the methods and approaches are fairly well established and standardised. Time series for biological data are often available for considerable lengths of time; time series for economic and especially livelihood (socio-cultural) data are either non-existent or consist of largely incompatible data. In-depth knowledge of objectives and methodologies used then becomes even more necessary in order to be able to interpret the data.

Fisheries statistics for management

In discussions with fisheries officials, the use of flood-pulse concept). Environmental management still needs information to steer management interventions, but normally does not need the classical fisheries statistics used in stock assessment-based management. This could mean that for certain sectors no regular catch statistics will be collected; rather socio-economic indicators (such as fish consumption) or resource use indicators (such as livelihood strategies) may be used to steer multiple-use environmental management.

The only feasible way of management of small-scale fisheries is to transfer ownership of resources to resource users, and to allow them to manage the resource themselves. As long as local fishers can limit access to the resources, with good institutional support and rewards for those who participate in the scheme, such a decentralised management approach, both in inland and coastal fisheries, is desirable.

The process of putting such (co-) management systems in place is a complex, time-consuming task, but one that is essential to maintain a healthy fishery and sustained benefits from resources. The advantage of this type of management is that it does not just look at fisheries, but takes a holistic view and effectively works on management of the environment of a community. This means that guiding co-management can be a collaborative effort of all agencies working at the village and community level. In this way, community management and collaborative management (combining different sectors holistically) are combined into a single scheme. An added benefit of community management is that it can work in a data-poor environment, and that it can also be used to produce data. This bottom-up approach to data generation can be used to obtain valuable information on the state of the fishery and resource use without the need for expensive data collection schemes.

In such cases, where true fisheries management is required, such as for middle and large-scale commercial fisheries, it is important that management decisions are transparent, and that policies and management measures are explained in a way that people involved can understand. In general, the relationship between fisheries staff, on the one hand, and fishers and fisheries owners on the other, needs to be improved, the main challenge being to build trust and mutual understanding. Only when fishers understand reasons for management interventions, such as why there is a closed season and

statistics most frequently mentioned is for management. Although certain sub-sectors, especially inland river fisheries, floodplain fisheries, and small-scale fisheries in general, are seldom particularly well managed in Southeast Asia, management should at least be one of the main focus points for the use of statistics.

Managing fisheries solely through catch and effort restrictions does not work in inland and small-scale coastal fisheries. The bulk of all fishing operations are in effect unregulated, due mainly to practical constraints of enforcing catch/effort based management interventions. Although at a local level, enforcement may work, the costs are quite high, and are often unrelated to the economic value of the resource. Moreover, for inland fisheries and many small-scale coastal fisheries, overfishing by local resource users is not the largest threat to sustainable use of fisheries resources.

Although fishing pressure does have an impact on fisheries, environmental changes have in general a much more important impact on the status of fish stocks, particularly in cases of loss of fish habitats for spawning, nursing and feeding. The concept of environmental management taking precedence over fisheries management is not new. In floodplain-driven river fisheries in particular, it has long been recognised that the only way to understand the fluctuations in fish production is by looking at environmental fluctuations, such as the duration, timing and extent of the flood (the

why they cannot use certain gear, will there be a chance that they will implement and enforce management measures themselves.

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There is no good alternative to active participation, since enforcement will not work if fishing activities are scattered in space and time. It is much more efficient to involve fishers themselves. When there are clear advantages, such as bigger catches, bigger fish or the return of higher valued species, fishermen will cooperate. Cooperatives and reform of marketing structures, improving living standards, and creating alternative livelihoods all play important roles in restructuring and managing the fisheries sector, and this partly explains why co-management is such a demanding task.

Choices and approaches

Methods for collecting statistics are well established. In most cases, the main task is to design a statistical system using available methodologies and adapt these to the local circumstances and data requirements. This might be a complex process, depending on the exact fisheries situation, and beyond the scope of the current paper.

Several other documents cover this subject matter. Required reading for anyone involved in fisheries policy planning or management is the FAO's Guidelines for the Routine Collection of Capture Fishery Statistics (1999), which provides an excellent basis for evaluating or designing statistical systems.

"if there are no good reasons to collect statistics, don't"

The design of a new data collection system, or re-evaluation of an existing one, calls for the application of general guidelines to establish the requirements. Once these are determined, methodologies are selected and combined into a statistical system. In short, the focus is on a few key questions:

Why? Why are statistics required, and what will they be used for?

What? What statistics are required, and what information is necessary?

How? How will the statistics be collected, processed and used?

From the first question, it follows that there should be a clear objective for collecting statistics. In other words, if there are no good reasons to collect statistics, don't.

If there are good reasons, these reasons or data requirements will influence the answer to the second question. After having established the objectives of the data collection comes the difficult choice of what parameters to collect to be able to reach the objectives of the data collection system. This is a very important consideration, since what should be collected (and in what detail) will in turn decide the methodologies can be used.

It is essential to evaluate statistical requirements regularly, and design or adjust an appropriate statistical system to meet actual information requirements.

Fisheries line agencies do not operate in a vacuum, and often other agencies are involved in collecting fishery statistics at various levels. Such agencies work either in a supporting role, such as maintaining statistical standards or assisting with system design, or taking a leading role, with fisheries line agencies sometimes merely receiving the final statistics, without any active involvement in collecting them. In almost all countries, the central government statistics bureau at the very least influences how statistics are collected and sometimes collects nearly all statistics for different sectors. But fisheries line agencies normally have the opportunity to influence what is collected. As they should know the sector best, at least they should be able to steer the survey design process, and hence need to know what methodologies are available and be aware of the pros and cons of each method.

Each country and fishery is different. Each will therefore need a different approach for collecting fishery statistics. Differences in policy emphasis, preferred approaches, staffing, and budget make it almost impossible to formulate a 'minimum' set of parameters applicable to all ASEAN-SEAFDEC Member Countries. Each fishery will need a slightly different approach, possibly using the same general methodology, but with small differences in the actual implementation. This is the main reason why it is impossible to write a do-it-yourself, step-by-step manual. Even so, it is possible to indicate the different steps that need to be followed for the evaluation and design phase.

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System design in 11 (easy) steps

Floating fishing villages in the Tonle Sap, Cambodia

When considering the design of a new statistical system, or the redesign of an existing system, a number of steps need to be followed:

1. Collect information on the existing statistical system (objectives, data needs, methods used, and information produced)

Every country in the region has a statistical system already in place. It is essential to understand how current systems work, or more precisely what information is expected to be produced by those system, and what does and does not work. A new fishery statistical system will need to be built with the available staff and expertise, so existing structures, resources and capacity of staff should be known and evaluated. This needs to be done on a regular basis, and is in fact being done in several SEAFDEC Member Countries. This information should be readily available if the planning process has been properly performed and documented, and should be an integral part of the planning process.

2. Collect information on who is involved in fisheries policy and planning

It is necessary to be aware of who are the targets for the information produced by the fishery statistical system. This is particularly necessary for answering the question 'why'. It will also influence what type of information is required, what should be collected and how that information should be packaged. This exercise will not be limited to fisheries agencies; it will also involve irrigation, agriculture, forestry, environment and other organisations that may have conflicting policies that impact fisheries (say resources and habitats). Thus, all these agencies should be aware of the status of fisheries in order to make balanced decisions on the sector. Policy and planning are seldom directly influenced by the state of fisheries, unless it is a policy of the governmental agency involved in fisheries. But fishery statistics are also sometimes used to assess the impacts of policies, as a measurement for changes in the fishery situation.

3. Formulate the objectives of the fishery statistical system

It is necessary to clearly specify what the fisheries statistics will be used for, or more to the point, why there is a need for fishery statistics. Without proper objectives, it is impossible to define the data needs that the fisheries statistical system has to fulfil. If for example the only information requirement would be an overall production estimate for aquaculture, reservoir fisheries and river fisheries, this can be done without any surveys, and can be based on previous research, Morphological Edaphic Index (MEI) or adapted estimates from previous years.

4. Define the data needs

Before starting collection, data or information needs have to be formulated. Having done so, appropriate methods can then be selected. Each method needs to be fine-tuned and can provide data of different degrees of accuracy. For most statistics, a long-term commitment is needed to their collection.

Some countries targeted by the SEAFDEC training programme have almost no statistics for certain sectors, which rely almost entirely on 'guestimates'. In the absence of any policy or management for the capture fisheries sector, this is probably cost effective. Nothing

is collected that would not be used anyway, and what is produced is only there to show the relative importance of the fishery sector.

5. Review all existing information pertaining to fisheries

Before rushing out to perform all kinds of surveys, it may be an excellent idea to assess the current availability of information from within and outside the fisheries sector. Often it will become apparent that a vast amount of fisheries related information is already available. An important step in formulating or redesigning a fishery statistical system is to assess what is already there. This can be used in the survey planning process, but also to evaluate if the current information is sufficient, or what additional information is required. If the available information is sufficient for initial data requirements, it will not be necessary to initiate a survey for collecting it again.

Using available information may be a prudent first step in improving the available information on the fishery sector without spending more scarce money on relatively expensive surveys.

Moreover, the amount of fisheries-related information that is collected by non-fisheries agencies is often surprisingly large. General statistical surveys on employment, expenditure, and demographics may sometimes contain fisheries-related information. Obvious sources for fisheries information may be forestry, environmental, irrigation and agriculture agencies. Trade or economic agencies may have information on marketing, transport or even production estimates. Institutes and universities sometimes have excellent research on fisheries issues, and although this information may not be routine, it can provide valuable insights into fisheries.

Artisanal catches are important for local economy

Aid organisations may also have done fisheries surveys. If these have been done at a local level, the results may not have been distributed to the central government level. Of particular interest are socio-economic surveys, which in rural areas necessarily have some kind of fisheries focus.

This review of existing information is often done as a desktop study, and is an ideal target for external (donor) funding.

6. Determine appropriate methods to collect required data missing from existing information

The Guidelines prepared by SEAFDEC are an excellent basis for reviewing available methodologies and decide whether or not they are appropriate to local fisheries situations. For all surveys, complete documentation is essential, both for training purposes and for evaluating the methodology.

7. Train staff in using the selected methods

Training is an essential component of any statistical system. It is a continuous process, and should be a major focus of the development of statistical capacity at all levels, from data collectors to planners and decision makers.

8. Apply the methods and collect statistics

Collection of statistics may seem routine, but seldom is. Enumerators need to be closely supervised, some surveys may need continuous feedback to assess levels of reliability, and any statistical system has to be constantly reviewed.

In general, a number of steps should be taken in every survey:

1. Identify the survey area and target population
2. Identify what will be monitored and in how much detail. For example, for catch assessment surveys it normally does not make much sense to collect data on all species of fish and shrimp caught. Some species are especially important, because of their high value or because they form the bulk of the catches during periods of the year. Other species may be grouped. Although the obvious approach is to use local market groups, this may not be viable if survey results need to be compared over the whole country or for a basin that covers two or more countries. This would have to be implemented for the whole area covered. In Southeast Asia, this is usually a most difficult task.

3. Establish the units to be used, and standardise these.

4. Establish the sampling design, how the population will be sampled, and how many samples are required. This is a complex issue, and is covered in the Guidelines in greater detail. Sampling design should result in a field manual with exact guidelines for sampling, covering selection of villages, fishers, markets and households, as well as the composition and tasks for each survey team.

5. Perform pilot surveys to test the methodology and train data collectors and supervisors. It is likely that in the initial stages various problems will surface. This is the main reason for performing pilot surveys, both as training and to check the methodologies and procedures used.

6. Implement the full-scale survey.

9. Process and analyse the data

The term 'statistics' refers both to the methods applied to collect data and the analysed data. Without applying statistics, the raw data collected cannot be changed into something managers, planners and policy makers can understand, let alone want to look at. Statistical analyses can be complex, but for most purposes the statistical tools required for fisheries are straightforward and easy to understand.

Processing and validating survey data is an essential part of any statistical data collection exercise. Fast data entry and analysis is crucial to be able to assess survey methodology and to provide feedback to enumerators or participants in logbook surveys. It is also important to analyse the results of the survey as fast as possible. For standard surveys that will be conducted on a routine basis and the data processing, data handling procedures, and database should be well established before the survey starts. Data processing should be routine, and data should be available right away for analysis. For catch assessment and other basic surveys, the database should be capable of producing all required standard outputs automatically in order to facilitate use of the data.

The survey results should be representative, reliable and of consistent quality. The level of reliability, or the level of error, should always be indicated, as should be the variability of the survey results.

10. Produce relevant information for policy makers, planners and managers

Data processing, analysis and presentation are at least as important to a fishery statistical system as the fishery statistics themselves. Perfect statistics in themselves are of no use if policy makers and planners do not use them. This is therefore the most important stage of the statistical system, and a test of the applicability of the data collected. Does it provide the information necessary to make policy decisions? Can it be used for effective planning? Does it allow formulation of management plans?

Statistics are valuable in themselves only when the information obtained is used and brought to the attention of policy makers and planners. Publication in a yearly statistical yearbook is not the objective of a statistical system. But too frequently such publication appears to be the goal. Changing this perception takes persuasiveness and persistence if fisheries authorities are to influence the impact of other sectors on fisheries.

11. Analyse the system at all stages of implementation and provide feedback to improve the system.

As mentioned earlier, it is essential to critically evaluate all elements of the statistical system continuously, and discuss problems and suggestions for improvements. the system will progressively be adapted to function more efficiently, and hence provide more appropriate information.

Basic fishery statistical systems

Officials, planners and managers time and again ask what statistical parameters they should collect and what methodology they should use. There is not a single answer to that question that is applicable in all situations. Proposing a minimum system would in truth be risky, implying that this 'minimum' is all that need be collected, the *de facto* standard. At the same time, a few general comments can be made on the type of statistics required, and on which parameters should be emphasized, given resource constraints. A basic statistical system should provide:

Catch Assessment, giving estimates for catch and effort for different fishery sectors, with appropriate detail on species and effort:

- For family fishing and small-scale commercial fisheries, an overall annual catch estimate needs to be based on consumption surveys. Logbook surveys can be used for small-scale commercial fisheries, while average species detail is provided by separate species composition surveys. Effort data need not be collected, with the exception of selected important small-scale fisheries in terms of involvement (fishing days).
- For medium-scale commercial fisheries, conventional sampling surveys for catch and effort should be performed, providing catch/effort estimates by boat-gear type and catch estimates by species.

Catch assessment for inland and coastal fisheries can be done in a number of ways. Direct measurements of catch and effort are only appropriate for well-defined, medium-scale commercial fisheries. Alternatives for this sector include logbooks or interviews with fishers on catch related variables. Medium-scale fisheries should be monitored routinely, with monthly estimates for catch and effort by species and boat-gear type.

For most small-scale and family fisheries, the main methodologies for providing a reliable catch estimate are consumption studies and habitat area production estimates (by length of river, or surface area of flood habitats). Interviews with household catches may also be appropriate for determining catch, but are relatively labour intensive. These statistics require complex surveys, and are relatively difficult to collect. Such a survey could be carried out once every five years, or more frequently

Mobile traps on the move in the Great Lake of Cambodia

them are not broken, fisheries can withstand considerable fishing pressure, and continue to provide high yields over a long period of time in a sustainable way. A good example is inland fishery in the Tonle Sap River and Great Lake area of Cambodia (see Box).

This in no way reduces the need for proper fisheries statistics, simply shifting the management focus and information required. All involved in policy, planning and management of fisheries should be aware that an holistic approach needs to be taken at a basin or bay-wide level with decentralised management and devolution of power to the resource users themselves. This will dramatically influence the type and scope of information required.

As the fisheries sector throughout the region is depending on resources.

Economic data should at least include fish prices, exports and employment in the sector (including involvement). Fish prices should be collected at points of landing, wholesale markets, and consumer prices at least twice a month. Employment data should be assessed monthly for medium-scale commercial fisheries and annually for small-scale commercial fishing, whereas the numbers of full-time and part-time fishers can be assessed on less than an annual basis for family fishing, in combination with regular population census updates.

Official imports and exports of fish and fish products should also be monitored, but this trade data can often be obtained from customs department. Thus separate surveys will not be necessary. This data should be available annually.

The economic importance of separate, licensed commercial fisheries in macro-economic terms should be assessed every 5 years.

Livelihood data should at least include data on consumption and demographic data on age and gender related to involvement in fisheries activities. These data can be collected on a less than an annual basis, and can be the subject of research studies.

Structural data should be available mainly for medium-scale commercial fisheries. For small-scale and family fisheries, no structural data is required in a minimum statistical system. For medium-scale commercial fisheries, it is necessary to have information on fishing gear, landing sites, markets, processing plants, wharfs, and ice plants. This information should be collected every 5-10 years (with between-survey updates).

In conclusion

Collecting fishery statistics is not easy; it takes skilled and dedicated staff as well as long-term planning. In many situations, there is no need for fishery statistics in the traditional sense for planning and management purposes. An important observation, for both coastal and inland fisheries, is that management of the environment is more important than management of the fisheries itself. In practical terms, this means that as long as the major habitats for different stages of the life-cycles of fish are intact and the migration routes that connect

presently in flux, it is clear that any design or re-evaluation of an existing statistical system should be carried out most carefully. The steps outlined in this article, and the more in-depth set out in the Guidelines, should provide a consistent and rational tool for adjusting the information system to serve decision makers, planners and managers at all levels of government.

The Tonle Sap's Bountiful Harvest

For further reading, see for example:

Ahmed, M., Hab Navy, Ly Vuthy and M. Tiengco (1998). Socio-economic assessment of freshwater capture fisheries of Cambodia: a report on a household survey. Mekong River Commission Secretariat, Phnom Penh. 185pp.

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About the author

Theo Visser is a freelance fisheries expert currently based in Chiang Mai, Thailand. He mostly works in information management and fishery statistics and has been working for several international organisations. He was responsible for development of the MRC Mekong Fish Database, as well as for an interactive CD on Fish Migrations in the Mekong River. Recently, he has written a set of guidelines for the collection of fishery statistics in inland and coastal fisheries for SEAFDEC. He is involved in several projects related to database management, assessing information requirements for inland and coastal fisheries management ,as well as providing training in these areas.

The Tonle Sap's Bountiful Harvest

Cambodia has a unique fisheries sector, based mainly on inland fisheries, with aquaculture and marine capture fisheries playing a relatively unimportant role. As for the majority of the 66 million people living in the Mekong Basin (1997 estimate), fish and rice constitute the staple food of most people in Cambodia. With an annual population growth rate of approximately 2 percent, pressure on natural resources in the country will continue to increase severely in the near future.

Cambodia's Tonle Sap is a vast water body situated in the heart of Cambodia. So crucial is its flood pulse to the Mekong ecosystem that the seasonal expansion and contraction of the Tonle Sap can be considered to be the heartbeat of the Mekong. The Tonle Sap is connected to the Mekong by the Tonle Sap River, which responds to changes in water levels in the Mekong by reversing its flow early in the flood season, and again right after the peak flood. The people of Cambodia are well aware of the significance of these events, and celebrate it with festivals every year. Vast fish migrations are associated with periods in which the flow changes direction, as fish moving between the Great Lake and the Mekong need to pass through the Tonle Sap River. Fisheries there are the most productive in the Basin.

The most comprehensive independent data are largely based on MRC/DoF socio-economic and catch assessment surveys in various parts of the country.

- Cambodia's freshwater capture fisheries production of over 400,000 tons per year is large even by world standards, ranking fourth after China, India and Bangladesh. Even this figure is believed to be an underestimate.
- Estimated value at landing sites is US$ 200 million; estimated retail value US$ 300 million.
- Exports are estimated to exceed 50,000 tons/year; this is also believed to be an underestimation.
- The Tonle Sap annual catch is about 235,000 tons/year.
- More than 1.2 million people in the Tonle Sap area alone depend on fishing for their livelihoods.
- More than 100 species are regularly landed, although up to 200 species have been recorded in the Tonle Sap, and more than 500 species in the freshwaters of Cambodia. No species are found only in the Tonle Sap, but several are endemic in the Mekong. No known species have become extinct.
- The 1999 socio-economic survey of the National Institute of Statistics estimated that 6,386 Riel per person per month is spent on buying freshwater fish for home consumption. At an average fish price of 2,600 Riel per kg, this is more than 300,000 tons/year. These figures do not include fish captured and consumed by fishers themselves, nor does it include bartered fish.

The intensity of fisheries in the Mekong Basin has led to the popular belief that fish stocks are already suffering from overfishing. But for many decades, several hundred thousand tons of fish have been extracted annually, and overall, there is little indication of 'overfishing.' Were fishing pressure to increase further, it is expected that the catch would actually increase a little.

At the species level, however, the situation is more complex. Even in the absence of proof of decreased catches in absolute terms, the situation is different when we consider trends in catch composition. A few of the larger, more slow growing species, which mature later in life, are decreasing. This is because many other species are opportunists that become sexually mature after one or two years, and lay a large number of rapidly developing small eggs. Species with such a life cycle can be exploited intensively without serious impact on stocks, because recruitment and mortality of these species is much more dependant on the size and duration of the flood than on the intensity of fisheries. Nearly all species are much more sensitive to environmental changes than to overfishing. This implies that it is more important to manage the environment than to manage the fisheries *per se*, in order to sustain the fisheries (Coates 2002).

Overall, the Mekong Basin is still relatively unaffected by pollution, and except for a few locations near major cities, water quality is good. However, increased industrial development and rapidly growing human populations will inevitably lead to a considerable rise in the demand for water, energy and arable land. Pressure on natural resources in the region is building rapidly. Destruction of aquatic habitats is already widespread, and mainly consists in the conversion of natural floodplains into paddy fields and cutting down trees and bushes for firewood and for use in brush parks in the fisheries. Improving navigation through dredging of the riverbed and removal of rocks, now being carried out on other stretches of the river, will change water flow and may also affect spawning grounds of many species (see the article 'Fisheries Resource Management Trials in Cambodia - Fishing Reform and Community Fisheries', in this issue, for further reading on the topic).