Review of data collection systems in BOBLME countries

by

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Introduction

Ideally the role of data collection is to support the monitoring of stated objectives and support for management processes. According to the preliminary findings of a recent review of existing policy in BOBLME countries[1], the use of formal policies to form strategies and implementation action plans for fisheries (and marine environmental) management has been successful in the countries around the Bay of Bengal. The detail of policy differs between countries, as well as policy process and implementation. However, the review found that there is a surprising degree of similarity between main policy trends.

A key finding of the review was that a majority of BOBLME countries are still committed to increased production in marine capture fisheries despite concerns over the sustainability of such goals. Furthermore, all countries state the goal of expanding fisheries offshore. What is not apparent in the above-referred review is that all countries also state sustainable use of resources as a goal, although this may formulated in different ways.

There is an increasing use in BOBLME countries of a variety of fisheries management targets (i.e. establishing fisheries management areas, fleet reductions, protected areas, gear restrictions, etc.), but there appears to be a need for significant progress in setting clearly defined management targets (i.e. fleet reduction targets, fishery management plans, harvest control rules, etc.). Data collection should thus support this process of defining management targets and monitor the results of adopted management measures.

The policy review also identified the recognition of and reference to small-scale fisheries in most policy instruments. It is thus important to consider whether current data collection systems in place are capable of covering small-scale fishing activities adequately. From an economic perspective, the emphasis is generally on traceability and certification (crucial for access to international markets) as well as increasing exports and value-added. In socio-economic terms, the main issues are food security, employment, micro-financing and alternative livelihoods. Again, relevant data is needed in order to monitor progress in achieving stated policy goals.

This study presents “a review on the collection of catch/landings statistics for hilsa and Indian mackerel (small pelagics) in BOBLME countries (national and decentralized levels), covering also value of catch, cost of fishing, and contribution to economy (socio-economic information)”, as defined in the terms of reference (Annex 1). To assess policy objectives and whether these are supported by adequate data collection is therefore outside the scope of the study, but the general policy context is presented above to give a perspective. Considering the BOBLME, this study should provide supporting information that can be used in the context of “Collaborative Regional Fishery Assessments and Management Plans” for selected key trans-boundary species through the development of regional and sub-regional management plans and harmonization of data collection and standardization.

The methodology used is presented in the following, bearing in mind that although the study objective is specified for hilsa and Indian mackerel, data collection systems are usually designed to cover the whole fisheries sector, albeit possible difficulties in achieving this for specific sub-sectors (e.g. small-scale fisheries, inland fisheries, etc.)

[1] Huntington, T., Macfadyen, G. 2011. Fisheries, marine environment, and integrated coastal management policy processes, content and implementation in the BOBLME countries. Poseidon ARM Ltd. BOBLME 2011 – Governance – 1 (draft version); 312pp.

Methodology

To reiterate, the main objective of the study is to provide a review on the collection of catch/landings statistics for hilsa and Indian mackerel (small pelagics) in the BOBLME area. This is to include data on catch value, cost of fishing, and socio-economic data. A secondary objective is to present, *where possible*, a brief description of ancillary data collection systems in each BOBLME country (e.g. cost and profit economic surveys, social data collection systems, environment data collections) in terms of who is responsible, what variables are measured and by what methods (Annex 1). Note that there is a reference to economic and/or socio-economic data in both cases, under the primary and secondary objectives. The main difference is the reference to environment data collection in the latter case.

Although the ToRs specify the requirement of a report consisting of two parts (Part 1: Fisheries data for hilsa, Indian mackerel and other small pelagics, and Part 2: Other relevant data for Ecosystem Approach to Fisheries Management), the structure adopted was to present both types of data on country-by-country basis, which facilitates understanding and the linkages between the different information systems. Thus, collection of socio-economic data can be seen as part of traditional systems but also essential for the implementation of the ecosystem approach to fisheries management.

Specific requirements are to describe the flow of information and to include:

(i) all agencies responsible for the collection of fisheries information (e.g. parallel systems for research institutes and statistical agencies, in some countries);
(ii) data variables covered and include a copy of the data forms used at different steps of the information flow;
(iii) the methods used for aggregation, extrapolation and production of information, as well as an estimate in the number of staff employed at each level of the information flow chain;
(iv) an assessment of the data quality, adequacy of the sampling design (e.g. coverage of landing sites) and taxonomic difficulties;
(v) a gap analysis and recommendations for improvements in data quality, and identification of capacity development needs.

In addition to this, case studies / examples of the types of best practices should be included in the report where these demonstrate good practice in data collection and analyses for both fisheries and ancillary data.

It is important to note that the tasks of assessing data quality and the adequacy of sampling design require an in-depth knowledge of national data collection systems. As mentioned before, these systems are usually not designed for specific species but for the sector in general. Since the available time in each country was limited it was agreed that this assessment should be a largely qualitative assessment, at least as a first phase, making full use of information gathered during the mission (Annex 2&3) as well as existing literature from previous efforts.

The FAO has provided significant guidance in the field of data collection and produced various supporting documents, including "*Guidelines for the routine collection of capture fishery data*" (FAO Fisheries Technical Paper 382). The following figure illustrates the chain of events in the design and implementation of fishery data and information collection systems, adopted from FAO guidelines, and describes the sequential pathway of designing and implementing a fishery data and information collection system, starting from the understanding of **WHY** data are needed, through the clarification of data requirements (**WHAT** data need to be collected), and the consideration of **HOW** data should be collected .

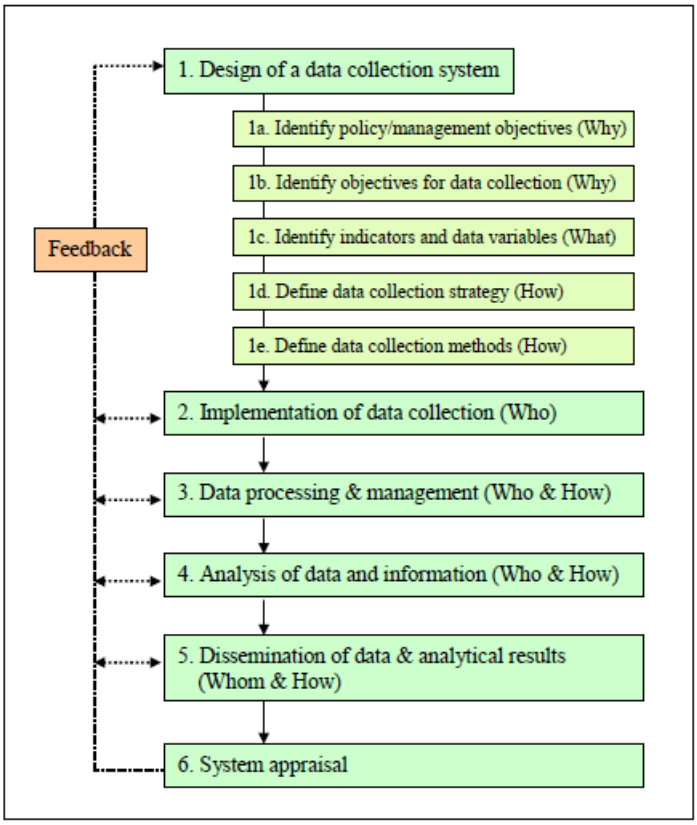


Figure 1. Schematic representation of the chain of events in design and implementation of fishery data and information collection systems. Source: FAO[2]

Considering the ToRs, the present study focuses on the Who, What, and How. Why data are needed are outside the scope of the study, although the need for basic data on catch, effort, value, fleet, fishermen, costs, income, etc., is obvious for fisheries management purposes. Nonetheless, it is important to note the broader regional objective of developing fisheries management plans for shared stocks such as hilsa and Indian mackerel (i.e. BOBLME context).

The study included travel to all BOBLME countries, which was carried out between 29 October and 12 December 2011 (Annex 2). This included one week in Phuket at BOBLME base at the beginning of the mission for the purpose of briefing, compilation of available information and planning of subsequent visits to BOBLME countries[3]. The itinerary in each country generally included meetings with the fisheries administration including the statistical services and research institutes, as well as visits to fish landing sites, ranging from large fishing ports to small fishing villages (Annex 2).

The results place emphasis on routine data collection which typically refers to landings and value data (by species/species group), fishing effort, no. fishermen and fleets/gears (fishing capacity), which are the basic data needed to identify production, revenue generation, fleet capacity, employment, contribution to the economy, etc. Data collection of other types of data (i.e. socio-economic and environmental) was addressed, albeit not systematically due to time limitations. The approach was to draw attention to possible sources of data that may be important for the objective

[2] FAO/SEAFDEC 2005. Proceedings of the FAO/SEAFDEC Regional Workshop on the Improvement of Fishery Data and Information Collection Systems in Southeast Asia. Bali, Indonesia, 15-18 February 2005. FishCode-STF-WP2005/1, 231p.

[3] Consultation with Thai stakeholders took place in Phuket, which proved to be essential as flooding in Bangkok made it impossible to consult with the central statistical services during the mission.

of introducing a trans-boundary and ecosystem approach to management of the Bay of Bengal. In relation to ecosystem data, the review focused on data such as by-catch and discards, incidental catches of sensitive species, indirect effects of fishing on the ecosystem, and spatial information on resources and catches.

Findings

Box 1: Species of hilsa and their importance

Hilsa is the most important single species fishery and national fish of Bangladesh, which also explains that more knowledge is available in Bangladesh. At present 50-60 percent of global hilsa catch is reported from Bangladesh waters, 20-25 percent from Myanmar, 15-20 percent from India, and about 5-10 percent from other countries (*e.g.,* Iraq, Kuwait, Malaysia, Thailand and Pakistan). This would imply total catches of roughly 500-600,000 MT in the Bay of Bengal.

Three species of shad occur in Bangladesh waters under genus *Tenualosa* and *Hilsa*. This includes two species of the genus Tenualosa, which are *T. ilisha* (ilish) and *T. toli* (toli shad or chandana ilish) and one species of the genus Hilsa, *Hilsa kelee/kanagurta* (five spot herring). *T. toli* is confined to the sea water whereas *H. kelee* occurs both in inland waters and the sea. There are other species which are found occasionally in the coastal waters of Bangladesh (*Ilisha elongata* (ramgacha/ramchowkka), *I. melastoma* (peti chowkka), *I. megaloptera* (Chowkka/Chowkka faisha) and *I. filigera* (coromandel ilish), and *Pellona ditchela)*.

At present, the main species of the hilsa fishery in Bangladesh is *T. ilisha* and contributes more than 99 % of total the hilsa catches in Bangladesh. Both genetic and otolith microchemistry data showed that hilsa from SE India and Myanmar were not significantly different from fish collected in coastal areas of Bangladesh and suggested that hilsa in the Bay of Bengal are a single stock. It may be concluded that hilsa in Bangladesh are a single population that is probably shared with India and Myanmar, and therefore this population should be managed as a single stock.

Bangladesh

Inland fisheries (capture and culture fisheries) are of particular importance in Bangladesh where marine fisheries play a relatively smaller role. According to 2010 DOF statistics, total annual fish production of the country from inland and marine fisheries which was approximately 1,540,000 MT (not including culture fisheries production of about 1,350,000 MT). Hilsa (*Tenualosa* sp. and *Hilsa* sp.) contributed about 313,000 MT, or 20% of total production (marine: 198,600 MT; inland: 114,800 MT). An estimated 460,000 fishers depend on the species for their livelihood. Production of Hilsa has gradually increased, but the size of the stock appears to have decreased due to fishing pressure and natural impacts such as silt deposition and river erosion due to change of the river hydrology and bottom topography, as well as anthropogenic impacts, such as the construction of dam and irrigation systems. Although hilsa is very important in Bangladesh, it should be noted that fisheries catch a wide variety of species such as carps, catfish, and snakeheads in inland waters, as well as shrimp, Bombay duck, jewfish, catfish, pomfret and various sharks in marine waters. Indian mackerel is of minor importance and does not even figure in official statistics.

Coast and marine fisheries account for about 517,000 MT, most of which is taken by artisanal fisheries, consisting of an estimated 22,500 non-mechanized and 21,400 mechanized fishing boats. Industrial fisheries, carried out by 177 trawlers, account for a minor part of production (less than 10%). Gillnets, set bag nets, trammel nets, longlines and other gears dominate in artisanal fisheries.

There are about 12 major landing sites along the coast, but numerous smaller sites. In inland fisheries, there are no definite landing sites for inland fisheries except one government landing site at Rajshahi. However, numerous private fish landing sites are evident depending on the location, market, town and facilities. The rule of thumb is that each city or major river port or water body has at least one major private landing site.

In Bangladesh, the Department of Fisheries (DOF)[4] is responsible for routine data collection through its Fisheries Resources Survey System (FRSS) for the purpose of planning and executing development schemes and monitoring the fishery resources for biological sustainable management. The FRSS is structured into two divisions dealing with inland and marine data and information.

Design of data collection system

The foundation for data collection was developed with the assistance of an FAO/UNDP fisheries project (BGD/79/015), executed in the early 1980s. This project included a comprehensive survey of resource potential in marine waters as well as the design of a sampling programme for fisheries.

It is important to note that a "Manual of Catch Assessment Survey" was prepared in connection with the project and is used to this day as the basis for data collection[5]. This manual explains the procedures to be followed by all types of fisheries, both inland and marine, as well as estimation processes. The types of data collected are primarily catch, number of operating fishing units (effort), and price data. In the following a summary is given for riverine and marine artisanal fisheries.

Riverine fisheries:

- Two larger[6] and two medium sized villages are selected from a list, considering major rivers (i.e. Padma, Meghna, Jamuna, and Brahmaputra) and secondary rivers. Representativeness is considered in terms of gear used, suitability of location and accessibility.
- For each sample village, two sample days are chosen per month with 15 days interval
- Fishing unit is defined as the minimum unit necessary for fishing (usually a boat). Guidelines on sampling intensity are given, ranging from 100% when there is only one fishing unit to a maximum of 5 fishing units for villages with 10 units or more. The total number of fishing units operating is also recorded (Form RF2: Annex 4)
- The Fishery Survey Officer (FSO) has to be on-board one or two sample fishing units while operating, and the other units are sampled by interview (Form RF3: Annex 4).

Marine artisanal fisheries:

- Sampling sites are defined in the manual, based on the use of a particular gear and landing of larger volumes (gillnet: 7 sites; set bag net: 7 sites; trammel net: 2 sites; longline: 3 sites; other gears: 12 sites).
- Sampling days are defined as number of days per month per site (gillnet: 4; other gears: 2 per month).

[4] Under the Ministry of Fisheries and Livestock

[5] A revised version was prepared in 1990; available at the FRSS, DOF

[6] Larger villages are defined as having 50 or more fishing boats

- Sampling intensity is defined as a maximum of 5 landings per sample day (Form MAF1: Annex 4)

There are 64 fishery survey officers to cover 64 districts in the whole of Bangladesh, of which 14 are coastal districts. Sampling methodology states that sample villages should be fixed for a number of years in order to capture seasonal variations, which appears to have resulted in a static fixed scheme for sampling (with very little random elements). Also, the sampling schedule for each FSO is fixed, considering the sites to visit and on which day. This applies to both inland and coastal districts. Although the defined sampling intensities appear to be reasonable, in practical terms they are too low considering the number of units operating. FRSS estimates coverage to be about 1-2 % of landing activity.

There is an attempt at validation in coastal districts where a separate sampling programme is carried out in 12 major landing sites, carried out by 5-6 scientific officers (also from DoF). It is however necessary to review whether the methodology used is valid. It appears to be the same landing sites that are also covered by fishery survey officers, so there is a danger that this would be the validation of biased data.

The commercial trawl fishery (177 vessels) is covered by a logbook system that records daily fishing activity (Logbook form: Annex 5). There is a strict requirement for these vessels to report data (i.e. subject to the non-renewal of license) and this appears to be verified by the physical presence of fishery officers at landing events.

Information flow

The FRSS unit in Dhaka compiles the information that is sent by the FSO and from industrial fishing companies (Figure 2). In the case of artisanal fisheries, sample data have to be raised to obtain total catches and value. The steps followed are:

- First estimate daily catch by sampling site and by gear, using the information gathered on total fishing activity (effort).
- Second raise to monthly catch by sampling site and by gear (raising factor is 30 days/ sampling days)
- Third raise to district total catches by using a raising factor (total number of fishing units/sampled units)

Processing is simplified in the case of industrial fisheries as this should in principle be a sum of daily catch reports.

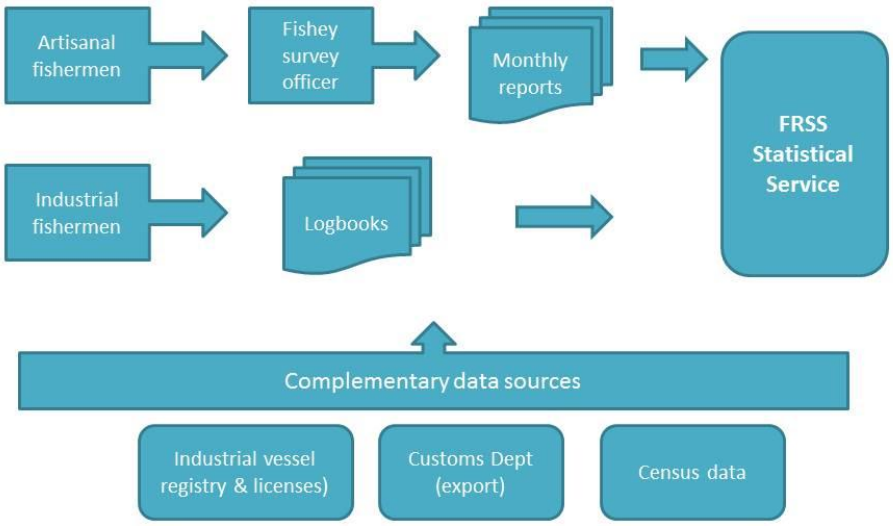


Figure 2. Schematic diagram of information flow in Bangladesh

Ancillary data

The latest available census data appears to be from a government sponsored project that took place in the period 1998-2003. It should be noted that this type of data is essential for producing reliable estimates based on sampling programmes.

Other types of data are available such as from Household Income and Expenditure (HIES) surveys (per capita fish consumption). The contribution of fisheries to the national economy is regularly estimates by the Bangladesh Bureau of Statistics. To convert the output (fishery catches) figures into value terms, wholesale prices by species types, obtained from Directorate of Agricultural Marketing (DAM) are converted into producer prices by deducting trade and transport margins. The gross value of production thus arrived at is then reduced by the following input proportion or intermediate consumption.

Fisheries research in Bangladesh is structured through the BFRI. It has several specialized stations and substations for R&D, often in association with universities offering degrees in fisheries. In relation to hilsa, BFRI and CSIRO Marine and Atmospheric Research (CSIRO) undertook a collaborative research project on Hilsa from 1996 to 2001, producing relevant information for stock assessment. BFRI has since followed up on this with new studies on hilsa. This includes recent work bioeconomic modelling of the hilsa fishery[7]. Note that the BFRI has a specific research section on socio-economics.

The logbook system in place for the industrial fishery collects data on discards (so-called trash fish), which is a problem in the shrimp fishery primarily. However, the available information on the indirect effects of fishing (detailed discards and bycatch data, incidental catches) appears to be limited and fragmented. Note that there is no observer scheme in place in Bangladesh to collect this type of data.

[7] Mome, M.A. (2007). The potential of the artisanal hilsa fishery in Bangladesh: an economically efficient fisheries policy. Fisheries Training Programme Final Project Report, United Nations University, Iceland. 57 pp.

Education and research on the marine biology/environment are however considered inadequate in Bangladesh. Until recently; resource exploitation and biota were the only focal points. Concern about the environment was practically nonexistent. Initiatives for coastal and marine environmental studies are few. The Institute of Marine Sciences & Fisheries (IMSF), at the University of Chittagong, is the only place which awards a degree in marine sciences. The University of Khulna and new established Noakhali Sci. & Technology University has a department focusing on education and research in Marine Fishery. The BUET (Bangladesh University of Engineering and Technology) provides limited courses in coastal engineering. The formation of a national institute primarily concerned with oceanographic research and marine environmental problems is still in the planning stage. The lack of sea-going vessels is a major impediment in this context.

A survey vessel is in the process of being procured by the DoF to carry out resource surveys. There is a need for updating the available data on resources from surveys that were carried out in the early 1980s (although some attempts have been made since with SEAFDEC). Ideally, it would be preferable to set up a system for the purpose of operating the vessel and serving the various interests apart from fisheries. An alternative would be to coordinate and collaborate with neighbours on the realisation of surveys. Placing the whole responsibility on DOF would place substantial strain on one institution in terms of costs, management and getting the required trained manpower.

Problems analysis (identified gaps)

Based on discussions with technical staff of the DoF, the manual and procedures on data collection are followed strictly to this day. This is commendable, but the consultant has some doubts about the methodology defined by the FAO/UNDP project in the 1980s. From a sampling point of view, the methodological document states that sampling should be fixed in time and space (sampling villages are to be fixed and sampled on the same day always). The justification for this is that seasonal variation can be covered in this way (and to facilitate the logistics of sampling). This is a misconception which is most likely causing possibly serious bias in produced estimates. The approach is effectively removing most of the random elements associated with the on-going sampling (i.e. sampling theory states that sampling should be random for accurate estimates).

Another possible source of bias is that the available census data is outdated (from early 2000s), which has a strong effect on the raising factors used.

Apart from the issues on methodology, the coverage is too low (1-2% of landing activity) to provide reliable estimates.

Data from logbooks should In principle be of good quality, bearing in mind that this is supposed to be a complete coverage of the industrial fisheries. But it is always a good idea to put observers on board on a proportion of the trips to check that the data is not misleading (i.e. discarding rates, location of catches) and to collect complementary data (i.e. species composition, incidental catches of sensitive species, etc.).

Recommendations

DoF is aware of the problems stated above. The current sampling framework is considered to be outdated and the procedures in place for data analysis and interpretation are currently being revised within the FRSS. BOBLME support is requested for this and this would appear to be a task that falls perfectly in the remit of the BOBLME project. A review of methodology is urgently needed and this should also look into alternative methods to estimate production and the sample frame (e.g.

population censuses, expenditure surveys, GIS, etc.), possibly involving collaborative efforts between different institutions in the country.

The review should also look into human resources available, logistics and the distribution of tasks. Efforts are needed in updating the vessel registry as this appears to be unreliable and covers only a small part of the fleets (mostly industrial vessels).

There is also a procedure for estimating subsistence fisheries specified in the current methodology, which also lacks more random components in sampling (again the choice of one village per district is fixed). It is in fact a type of household survey, which could be developed further to become one of the main tools for estimating production, etc.

Current sampling provides rough estimates of production and value by species groups as well as fishing effort. More detailed data is necessary if these are to be used for stock assessment, but it would be more appropriate to give this task to the BFRI through specific short-term projects to fill in the gaps in knowledge.

Box 2. Data collection through co-management in Bangladesh

The DfID-funded Community Based Fisheries Management (CBFM) Project implemented by the WorldFish Centre has established fisheries management committees (FMC) on 113 water bodies throughout Bangladesh. The co-management arrangements vary with some committees consisting only of professional fishers, while others involve representatives from a wide range of stakeholders groups ranging from the Department of Fisheries, local government structures, Department of Environment, Water infrastructure departments, water regulation departments, religious groups, NGOs and Community Based Organisations e.g. Beel Management Committees.

Although a range of information is collected by FMCs and Department of Fisheries officers, a review of the current systems revealed that information flows in generally upwards from the fishers to the Department of Fisheries will little feed-back. It was also found that catch records are often maintained by fishers, but this information is rarely compiled, analysed or shared.

The project showed that substantial improvements in data collection could be achieved by collaborative efforts in identifying indicators and required data, identifying common data needs, reviewing current data collection systems and agreeing on data collection and a sharing system. Potentially, this approach of involving all stakeholders in the process can result in cost-efficient solutions to obtaining high quality data, because it takes advantage of existing structures that have other functions as well.

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).

India

According to official statistics, total annual landings amounted to about 7 million tonnes (2007-2008), of which 2.9 million tonnes originated from marine fisheries. A comparison with FAO data indicates that this total includes about 3.5 million tonnes for fish culture and aquaculture, which is not clearly identified in the official statistics. Total inland capture fisheries are estimated at 975,000 MT. Eastern coastal states account for about 35% of marine landings and 50% of total production.

Total catches of hilsa (called Indian shad) were estimated to be 22,310 MT in 2007 for the eastern Indian Ocean, most of which was taken in the West Bengal State (16,000 MT). An alternative source of catch statistics from the CMFRI estimates total hilsa catch to be about 31,000 MT in 2006.

Total catches of Indian mackerel were estimated at 18,835 in 2007 for the eastern Indian Ocean, more or less distributed among the eastern States and Union Territories. However, catch estimates are missing for Tamil Nadu where important landings are known to occur. Alternatively, CMFRI estimates total Indian mackerel catch to be about 36,000 MT. There are remarkable differences in the catch composition between the NE and SE coasts of India. In relation to small pelagics, the hilsa shad (*Tenualosa ilisha*) and Bombay duck (Harpadon nehereus) dominate along the NE coast, but the oil sardine (Sardinella longiceps), lesser sardines and Indian mackerel (Rastrelliger kanagurta) dominate along the SE coast.

India is a vast country with an important fisheries sector. The Marine Fisheries Census carried out in 2005 covered 3322 fishing villages, and reported 107,448 traditional crafts, 76,748 motorized crafts, and 59,743 mechanized boats engaged in marine fishing activities. Furthermore, there are about 100 deep-sea fishing vessels. A wide range of fishing gears, including trawls, seines, lines, bag nets, stake nets and lift nets are deployed.

India is quite unique in the Bay of Bengal region by having several (large) institutions providing a supporting role to the fisheries sector. This includes the Fishery Survey of India (FSI) which is a government institution with the primary responsibility of survey and assessment of fishery resources in the Indian Exclusive Economic Zone (EEZ) and adjoining seas for promoting sustainable exploitation and management of the marine fishery resources. Other key institutions are the Central Marine Fisheries Research Institute (CMFRI) and the Central Inland Fisheries Research Institute (CIFRI), both of which are members of the Indian Council of Agricultural Research (ICAR). All of these institutions carry out data collection and support the State and Central Government in providing information for fisheries development and management purposes. The division of responsibilities between FSI and CMFRI in relation to marine fisheries is not always clear, but generally speaking, the FSI is responsible for offshore or deep-sea resources (starting at 40m depth contour) while the CMFRI is responsible for coastal resources.

However, it is ultimately the responsibility of the Department of Fisheries in each State Government to collect and compile data on fisheries by its own means or with the assistance of other institutions such as FSI and/or the CMFRI/CIFRI. Official statistics are then compiled by the Department of Animal Husbandry, Dairying and Fisheries under the Indian Ministry of Agriculture. It was not possible to consult with officials of the State Department of Fisheries (West Bengal, Andhra Pradesh, and Tamil Nadu) during the mission, so the findings may not be fully accurate on data collection.

Design of data collection system

Marine fisheries

The main function of the FSI is to carry out regular surveys of "offshore" resources but it also assists the State Fisheries Administrations in the process of collecting data. It is in fact these data that have so far been compiled by the Government of India and constitute the official fishery statistics. FSI has adopted the methodology of the CMFRI, providing training to State fishery officers and contracted personnel to carry out sampling in the various districts. This is also coordinated centrally from FSI HQ (Mumbai) but it is unlikely that there is much control of sampling activities as State fishery officers answer to the State and not the FSI directly. There are also problems with the high-turnover of FSI and State field staff (enumerators), contracted to support data collection, which creates problems in carrying out the tasks.

Considering that it is CMFRI methodology that has gradually been adopted by all parties involved in data collection for marine fisheries, an important recent development is that the CMFRI has been given the responsibility of reconciling and final estimation of fisheries data to provide to the Ministry[8]. The following focuses therefore on CMFRI methodology.

CMFRI has over a long period, starting in the 1950s, developed a multi-stage random sampling programme for the collection of data with the explicit goal of providing data for research and stock assessment purposes. This covers the 8,129 km coastline of mainland India (not Union Territories) where there are about 3,000 fishing villages and 1,400 fishing landing sites. The area is stratified over space where each maritime state is divided into suitable, non-overlapping zones on the basis of fishing intensity and geographical considerations. The number of centres may vary from zone to zone. These zones have been further stratified into substrata, on the basis of intensity of fishing. There are some major fisheries harbours/centres which are classified as *single centre zones* for which there is an exclusive and extensive coverage. The stratification over time is a calendar month. One zone and a calendar month is a space-time stratum and primary stage sampling units are landing centre days.

From a theoretical and operational point of view, the CMFRI data collection scheme is considered a robust system for obtaining reliable estimates. Some issues are of particular importance:

- The procedure for estimating landings at various level of aggregation is sound
- There is a truly random selection of sites; in each zone 9 landing centres are selected with replacement and allocated 9 cluster sampling days[9]
- Particular effort is placed on covering single centre zones where 16 to 18 days in a month are selected at random for sampling purposes
- Sampling methodology and procedures are documented in a manual[10]
- Sampling plans are elaborated by Kochi HQ on a monthly basis and implemented through its 10 regional centres, where officers have follow the plans with supervision
- Stratification appears to be the subject of regular revision and updating, taking into account changes in the dynamics of the fishery and results of census surveys
- There is a dedicated database and specific software for entry and analysis
- Expertise in statistical theory and analysis is available to support the system
- Field staff are generally on long-term contracts, strengthening the knowledge and dedication to the functioning of the system

[8] Minutes of the 8th meeting of the Technical Monitoring Committee (TMC) for the Central Sector Scheme on "Strengthening of Database and Geographical Information System for the Fisheries Sector. 28 June 2011, New Delhi, Dept. of Animal Husbandry, Dairying and Fisheries, Min. of Agriculture.

[9] This would correspond to 9 full sampling days but this is spread out to sampling activity during 18 days, consisting of sampling periods of 12:00 – 18:00 on one day and 06:00 – 12:00 on the next. Night time landings are covered by interviews, effectively covering a period of 24 hours.

[10] CMFRI 2005. Methodology for the Estimation of Marine Fish Landings in India. CMFRI Special Publication no. 86, 80p.

Another issue concerns sampling intensity which is defined in the manual. When the total number of boats exceeds 15, the following procedure is followed to sample the number of boats:

Number of units landed	Fraction to be examined
Less than or equal to 15	100%
Between 16 and 19	First 10 and 50% of the balance
Between 20 and 29	1 in 2
Between 30 and 39	1 in 3
Between 40 and 49	1 in 4
Between 50 and 59	1 in 5 etc.

Defining sampling intensity in this way appears to be adequate for sampling purposes. Note that this would correspond to about 10% for a landing site with 100 boats landing.

However, the number of staff is sub-optimal (about 75 field staff and 26 officers) to cover such a vast coastline.

Inland fisheries

When considering inland fisheries, the CIFRI does not have an equivalent sampling programme such as the CMFRI for marine fisheries. It carries out some sampling activities, including for small pelagics such as hilsa, but the scope is rather limited. These data are useful for research but are not designed for the purpose of estimating production.

It is the State Departments of Fisheries that are responsible for data collection in inland fisheries. As referred above, it was not possible to consult directly with the relevant staff from State administrations, but the impression was that there were many problems both in marine and inland data collection[11]. This included different approaches and methods used in different States, high staff turnover, lack of human capacity and funding, etc.

Information flow

Various forms are used to collect data.

- Form C For consolidated statement of units
-
- Form 1 For non-mechanized units (Annex 6)
- Form 2 For mechanized units/motorized (Annex 6)
- Form II For trawlers operating in major harbours (Annex 6)
- Form T For record of time of landings (Annex 6)

The flow of information is assumed to be as depicted in the Figure 3, which looks forward in time considering the central role that has been given to the CMFRI.

[11] Based on consultations with the FSI which have a supporting role in data collection.

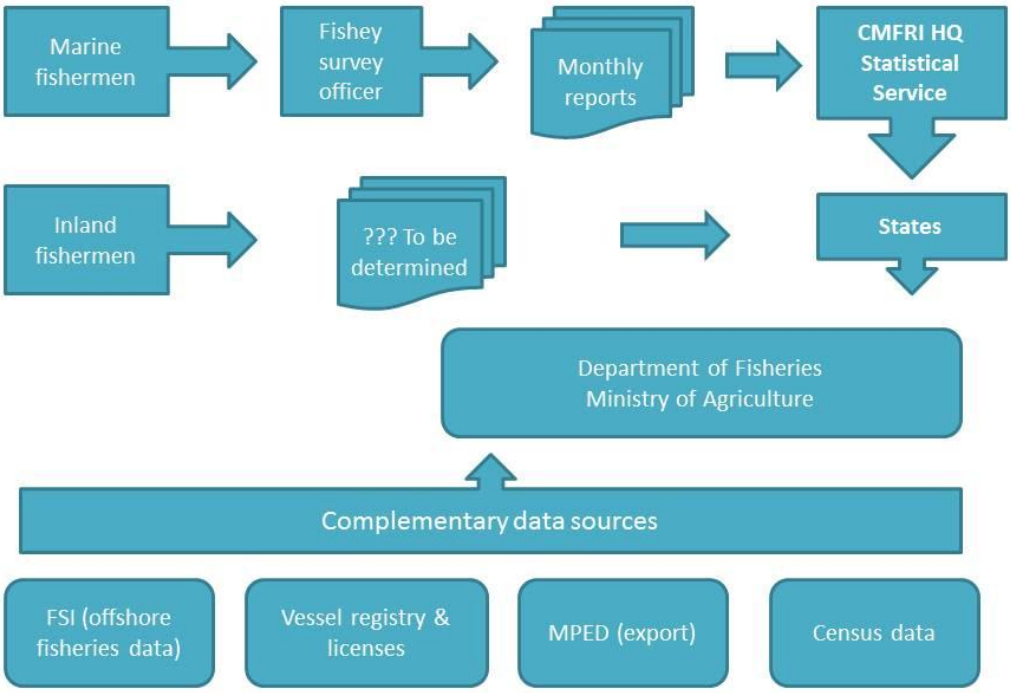


Figure 3. Schematic diagram of information flow in India

Ancillary data

Efforts are made to carry out census surveys every 5 years (not so in the past), where CMFRI is responsible for mainland India while FSI is responsible for Island Union Territories (Annex 7). The results of the 2010 census surveys are currently being compiled and are expected to be published in late 2011.

Apart from the task of running a sampling programme for fisheries in mainland India, the CMFRI is a large research institution with activities in the field of biodiversity, marine environment and economics. Some examples of relevant activities are:

- Bio-economic modelling of fisheries and cost-benefit analysis
- GIS systems to support work on biodiversity, resource mapping and MPAs
- Monitoring the factors influencing changes of marine bioresources in time and space for the establishment of environment baseline.
- Monitoring the conservation biology of economically important and threat-prone species and fragile ecosystems.
- Development and maintenance of database of Marine Biodiversity Museum to disseminate the information on the web to make it easily accessible to researchers all over the world
- Assessment of the impact of urban domestic sewage, industrial effluent discharge, dredging, port activities, oil spills, ship breaking, degradation of sensitive and threatened marine habitats, plastic materials and ghost fishing on marine environment and coastal fisheries.

The surveys carried out by FIS through its seven operational bases, involving 12 vessels of which 2 are longliners, are invaluable in providing fishery-independent data on fisheries and the marine ecosystem. Its work has traditionally provided support for the development of fisheries, introducing new technologies, identifying new fisheries, assessing potential, etc., but the data collected regularly

from surveys and the time series available is unique in the Bay of Bengal as well as globally. Monthly surveys typically include samples from 50-60 randomly selected trawl stations per month.

Problem analysis (identified gaps)

In the past there are two main sources of fisheries statistics in India, which are those provided by State Governments and the CMFRI. Significant discrepancies exist when comparing these two sources. For example, CMFRI estimates of hilsa and Indian mackerel landings are roughly double of official statistics.

Opting for CMFRI methodology as the standard to be adopted and followed is a positive development, but this will also require revision backwards in time in order to get consistent data over time.

CMFRI dedicates about 100 staff (about 75 field staff and 26 officers) to running the sampling programme. Ideally sampling coverage should be 10-15% of landing activity but in practice this is considered to be about 8-10%. Even if coverage is at this lower level, this can be considered adequate and an example of a cost-efficient solution. Ideally, there should be more staff to cover the complexity of situations. For example, major fishing ports present complex systems with large quantities being landed and entering different marketing channels (direct sale to women sellers which may not be weighed – baskets; sale to traders and processing plants – weighed; sale to dry-fish market – weighed).

It should be noted that the IOTC has recently carried out a review of Contracting Parties capacity to report the catch of their artisanal catches (vessels smaller than 24m according to IOTC definitions) in "close to real time", of yellow and bigeye tuna in particular[12]. India was found not to be in a position to do so and would require improvements to the system as well as funding in order to do so. The main issue appears to be the time delays in providing the data, which would not be such a crucial factor in the context of the BOBLME.

Judging from indirect information, inland fisheries are poorly covered and the available statistics may be biased. The situation is different from marine fisheries in that the CIFRI does not operate a sampling programme which can be used as the basis for a harmonized system.

Logbook systems are generally not used as the data collected this way are considered unreliable. However data collected in this way can be very useful, even if for specific fleet components, when there are procedures in place for verification.

Recommendations

The current review appears to have taken place during an important transition phase in the system of data collection in India. The Department of Fisheries under the Ministry is currently running a programme on "Strengthening of Database and GIS for Fisheries Sectors", including components such as i) sample survey for estimation of inland fishery resources, their potential and fish production; ii) census on marine fisheries; iii) catch assessment survey for inland and marine fisheries; iv) development of GIS; v) assessment of fish production potential in coastal areas; vi) evaluation studies/professional services; vii) registration of fishing vessels; viii) development of database of fisheries cooperatives of India; ix) mapping of small water-bodies and development of GIS based fishery management system; and x) strengthening of statistical unit at headquarter. Some

[12] This is essential if there is to be an allocation of yellowfin and bigeye tuna resources by the IOTC.

of these components are being finalised (e.g. censuses) while others are on-going. These address various issues presented above and which are necessary in the case of inland fisheries in particular.

However, it would be important to consider alternative approaches to cover inland fisheries, not necessarily creating the equivalent of what has been done for marine fisheries. BOBLME could possibly assist by providing international expertise in the process.

More detailed information is needed on inland hilsa fisheries in India, particularly in West Bengal. The CIFRI would be an ideal partner to carry out research in the form of a specific on intensive sampling over a period of for example one year to obtain data relevant for stock assessment (length frequencies, maturity, detailed catch and effort data, tagging, identification of spawning grounds, etc.).

Box 3. Improving the quality of inland fisheries statistics

Coates (2002)[13] proposes a set of strategies which can be followed in order to improve the information on inland capture fisheries and should be consulted for useful advice. The following concerns only the first point which is that countries should review their existing statistics based on impartial desk-top research using existing information (and involving the relevant stakeholders in the process).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. 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.

S*ocio-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.

[13] Coates, D. 2002. Inland capture fishery statistics of Southeast Asia: Current status and information needs. Asia-Pacific Fishery Commission, Bangkok, Thailand. RAP Publication No. 2002/11, 114 p.

(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.

Indonesia

Fisheries governance is exercised through a federal and provincial structure in Indonesia (i.e. similarities with India). Indonesia consists of 33 provinces, seven of which have been created since 2000. All provinces are coastal and about half of the districts are estimated to be so (out of a total of 420). Provincial governments maintain the right to manage natural resources in their areas, up to 12 nm from the base line, including responsibilities for fisheries management such as licensing, surveillance and control in respect of all vessels less than 30GT. Therefore, the management and control of the smaller vessels falls clearly within the mandate of the 33 provincial governments, while larger vessels are managed by the central Fisheries Administration.

In relation to fisheries data collection, this falls under the responsibility of the Directorate General of Capture Fisheries (DGCF) under the Ministry of Marine Affairs and Fisheries (MMAF).

Indonesia is an archipelagic nation, consisting of 17,508 islands and an estimated coastline of 81,000 km. Totally, Indonesia has 5.8 million km^2 of marine waters consisting of 3.1 million km^2 of territorial waters (<12 miles) and 2.7 million km^2 of EEZ (12-200 miles). For fisheries management purpose Indonesia waters is divided into eleven Fisheries Management Areas (FMAs) (Figure 4). FMAs 571 (Indian Ocean – Malacca Strait) and 572 (Indian Ocean – west Sumatera) largely coincide with the BOBLME region, except for the southeast part of area 572[14].

Indonesian marine fisheries are characterized by a multitude of species, vessel and gear types. Total landings were estimated to be 4.8 million tonnes in 2009[15], involving 1.1 million fishing (gear) units, 2.2 million fishers, and about 590,000 vessels. Total landings from inland fisheries were estimated at about 296,000 tonnes in 2009.

West Sumatra accounted for about 9%[16] of total landings (445,000 MT) while Malacca Strait accounted for ca. 7% (341,000 MT). Landings of mackerel (*Rastrelliger kanagurta* and *R. brachysoma*) are substantial, about 21,000 and 28,000 MT respectively. Minor catches of hilsa are reported, mostly in the Malacca Strait (i.e. 1,200 MT). Pelagic fisheries in these two areas (571 & 572) are dominated by catches of large and neritic tuna, more so in West Sumatra, as well as catches of various sardinella and scads.

[14] In area 572, the BOBLME project area extends down to include the North and South Pagai Islands only, not covering the total southern coast of West Sumatra. Roughly speaking, it does not include the Bengkulu and Lampung provinces.

[15] DGCF 2010. Capture fisheries statistics of Indonesia, 2009. Directorate General of Capture Fisheries, Ministry of Marine Affairs and Fisheries.

[16] Or roughly 8% of total landings when considering only the BOBLME area.

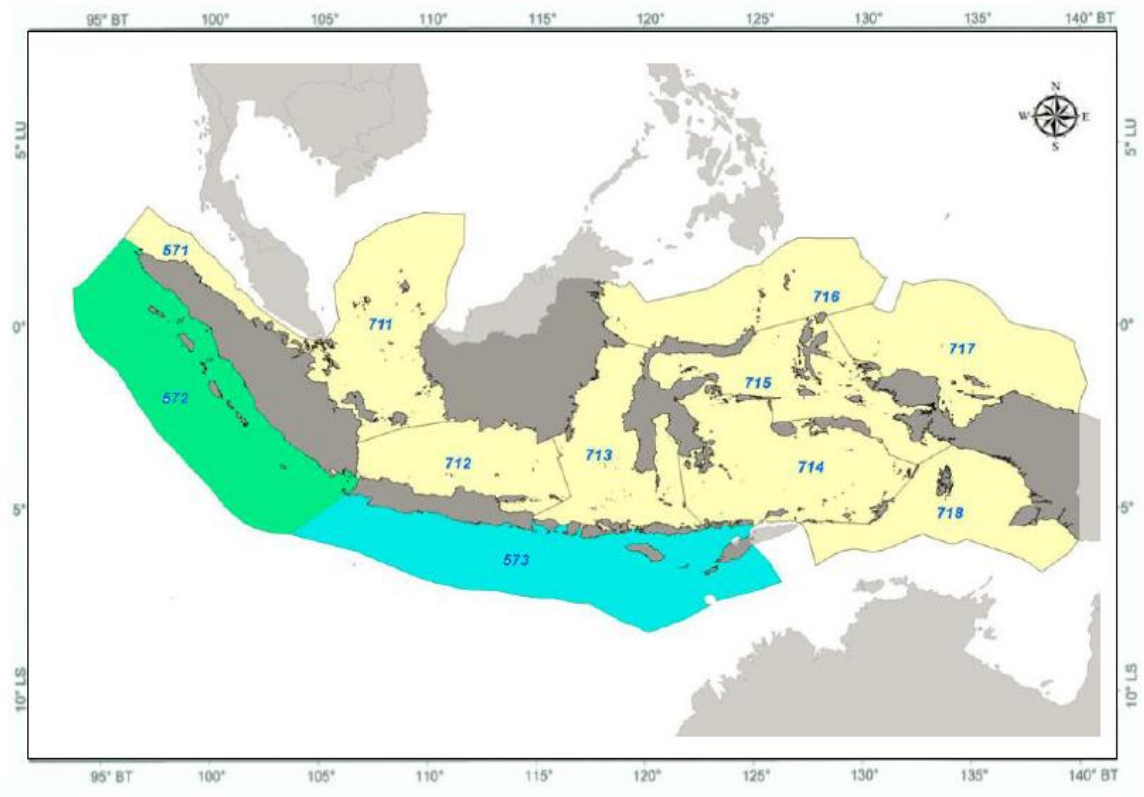


Figure 4. The eleven Fisheries Management Areas defined for Indonesia marine waters.

Design of data collection system

The Indonesia data collection system was designed and implemented in the 1970s by an FAO/UNDP project[17] and it remains similar although there have been some modifications over time. The system was designed to have two primary outcomes: 1) nation-wide statistics on annual marine and inland production for all species groups fished, both at the industrial and artisanal levels of fishing activity, and 2) annual inventories of the number of fishing units (households, companies, operators) and number, size, and gear-type of fishing vessels involved in the fishing activities at both levels in all provinces. Note that point 2 is essentially the execution of a yearly census to define the frame.

In simplified terms, data is collected from two types of sources; a) **Major fish landing places** – complemented by monthly activity reports from fishing companies and b) **Fishing villages** – essentially all the fish landing places smaller than "major fish landing place" and characterised by artisanal fisheries where catch is landed on the beach (no wharves or central port area), and catch is either wholly for subsistence or sold through local markets.

A multitude of forms were developed for implementation, including "survey forms" (the SL series) and "estimation forms" (the "EL" series) that together provide data for a series of "reporting forms" (the "LL" series) that are completed quarterly by District Fisheries Offices (DFO) and sent to Provincial Fisheries Offices (PFO) (Figure 5). Note that processing and estimation takes place at district level to a large extent. The PFO in turn collate data from all the LL-forms from DFOs within

[17] Yamamoto, T 1980. A standard statistical system for current fishery statistics in Indonesia. Fisheries Development and Management Project, Indonesia. FI:DP7INS/72/064, Field document 7, 79p.; available at www.fao.org/documents

the province, then forward the data onto DGCF each quarter, and also use the LL-form data to produce PFO annual reports with production statistics and fishing effort (vessels, households, establishments, units) tables similar to that presented in the DGCF annual reports.

There are three primary surveys that yield the data for producing catch (production) and effort tables in both the provincial and national level annual reports:

1. L-I survey of fishing companies: companies are required to keep records and make monthly reports of fishing activity and catch of their vessels (SL-3 form: Annex 8)
2. L-II survey of major landing places: originally this was a sampling activity but this has since been modified to be a complete enumeration approach. Major landing places typically have a central fish market or auctioning place through which most of the landings are channelled and these are required to complete monthly reports for each gear, including effort data given as fishing trips. Thus, the revised approach is to take advantage of existing records on volume and value. (same form used as above)
3. L-III survey of fishing village: quarterly surveys of smaller landing places (mostly fishing villages) not covered by the L-II survey. This is essentially a census of fishing activity, via interviews of all or some of the fishing households/establishments. Data is requested on estimates for total number of fishing units and average number of trips, and average catch per trip on a quarterly basis. If the village has an auction place, the management (typically fishers' cooperative/association) is required to complete monthly reports as above, regardless of whether this is a sampled village or not.

Considering the above, the primary source of catch landing/data is the main auction place (Tempat Pelelangan Ikan, TPI) which functions in most ports. The operation of the TPI is usually under the control of fishers' cooperatives (Koperasi Unit Desa, KUD) or a company appointed by the provincial government. The actual administration of the auction centres is often the responsibility of sub-district or district level fisheries offices, but may also be managed by the local port authority (particularly if the TPI facility is owned by the port authority).

It is important to note that the data collection has changed from a sampling approach to a complete enumeration method, complemented by census activity of smaller landing sites. It may appear that the same system is in place with some modifications (maybe using the same forms or updated versions of the same), but the change to complete enumeration is in fact fundamental[18]. In practice, estimation has become simplified and the EL forms have become redundant.

[18] See for example Indonesia country report in FAO-SEAFDEC 2005. Proceeding of the FAO/SEAFDEC Regional Workshop on the improvement of fishery data and information collection systems in Southeast Asia. Bali, Indonesia, 15-18 February 2005. Volume II: Regional synthesis and country papers

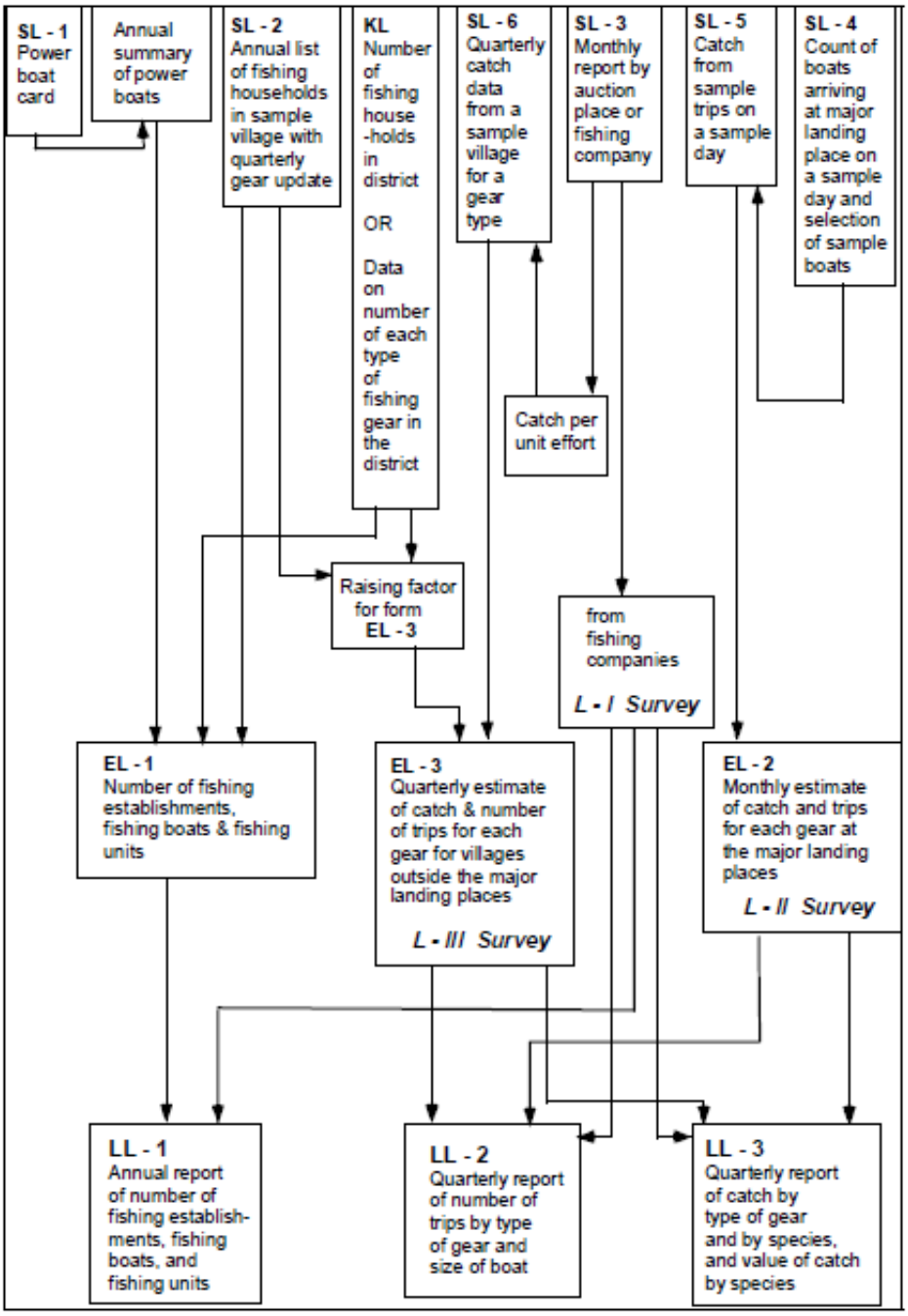


Figure 5. Key components of the Indonesia's national system of fisheries statistics, designed and implemented during 1974-1976. Letters and numbers in bold indicate titles of the various report forms[19].

[19] Proctor, C.H., Merta, G., Sondita, MFA, Wahju, R.I., Davis, TLO, Gunn, J.S., Andamari, R. 2003. A review of Indonesia's Indian Ocean tuna fisheries.CSIRO. ACIAR Project FIS/2001/079

Indonesia's fishing ports are classified according to port size, the size of vessels it can accommodate, the geographical range of fishing activity of those vessels, and the volume of fish landings that routinely occur at the port. 22 of the larger fishing ports are under direct management of the DGCF, while the rest are managed by the provincial administration[20].

Another modification to the original system is that districts collected all relevant information on fishing vessels. This has since been modified where the DGCF is now responsible for licensing of larger vessels (*≥ 30 GT)* while Province and District Offices handle smaller vessels. In practice this means that there numerous vessel registries in Indonesia.

Considering the current requirement for all landing sites to report on activity on a monthly basis, it is assumed that this covers a total of about 510 larger fishing ports and about the same number of "medium-sized" landing sites, which presumably cover a substantial proportion of Indonesia's fishery production (Table 1). However, there are at least a total of some 5,000 landing sites spread along the coast in fishing villages and many are not covered in this way (no formal auction or market body), which have to be covered by quarterly interviews (censuses).

Table 1. Categories of fishing ports in Indonesia[21].

Criteria	**Types of fishing port**			
	Type/Class A	Type/Class B	Type/Class C	Type/Class D
	Pelabuhan Perikanan Samudera	*Pelabuhan Perikanan Nusantara*	*Pelabuhan Perikanan Pantai*	*Pangkalan Pendaratan Ikan*
	Oceanic fishing port	Archipelagic fishing port	Coastal fishing port	Fish landing centre
Number of ports in DGCF listings	5	11	17	477
Size of fishing boat	>60 GT	15-60 GT	5-15 GT	>10 GT
Service capacity per day	100 units or 6,000 GT	75 units or 3,000 GT	50 units or 500 GT	Small scale fishing unit
Fishing area of the serviced boats	EEZ International waters	Archipelagic waters EEZ	Coastal waters Archipelagic waters	Coastal waters
Fish landing capacity (t=tonnes)	200 t/day or 40,000 t/year	40-50 t/day or 8,000-15,000 t/year	15-20 t/day or 3,000-4,000 t/year	10 t/day or 2,000 t/year
Market orientation	Local markets Export	Local markets Export	Local market Domestic markets	Local markets
Land use of port area	Port facilities Fishery industry Accommodation	Port facilities Fishery industry	Port facilities Small-scale fishery Industry	Port facilities

[20] The DGCF runs two of the ports in West Sumatra; Belawan and Sibolga.

[21] Proctor, C.H., Merta, G., Sondita,MFA, Wahju, R.I., Davis, TLO, Gunn, J.S., Andamari, R. 2003. A review of Indonesia's Indian Ocean tuna fisheries.CSIRO. ACIAR Project FIS/2001/079

A recent development is a renewed attempt to introduce logbooks in Indonesia[22]. Templates were developed under collaboration with IOTC, WCPFC, CCSBT and OFCF Japan for longline/handline; purse-seine/pole and line and other gear (Annex 9). In connection with this, the Ministry of Marine Affairs and Fisheries issued Regulation Number 18 Year 2010 of 5 October 2010, making a logbook report mandatory for the purpose of landing for vessels above 5 GT. Implementation has been problematic due to the lack of cooperation from fishermen (in spite of legal obligations) and concerns about the reliability of data provided.

Flow of information

There are typically 2-4 Fishery Extension Officers for each district which implies a staff total of about 1200 involved in data collection (roughly 400 districts in total). This is however misleading, as their title imply, FOEs have a number of other tasks to attend to (e.g. training, information gathering and dissemination, licensing, fisheries management). Assuming that they use about 10% of their time on data collection and reporting (120 man years), the available manpower would be appear to be sufficient for the purpose of receiving daily and monthly reports from companies and auctions, but not for carrying out the regular censuses (i.e. sample villages).

Total staff at the statistical services at DGCF HQ are about 25-30, including for data-entry staff and the running of the new logbook system.

DGCF provides funding for operational costs of data collection in the provinces through a so-called De-concentration Budget and provides enumerator training. However this is not sufficient to cover all sub-Districts and landing sites.

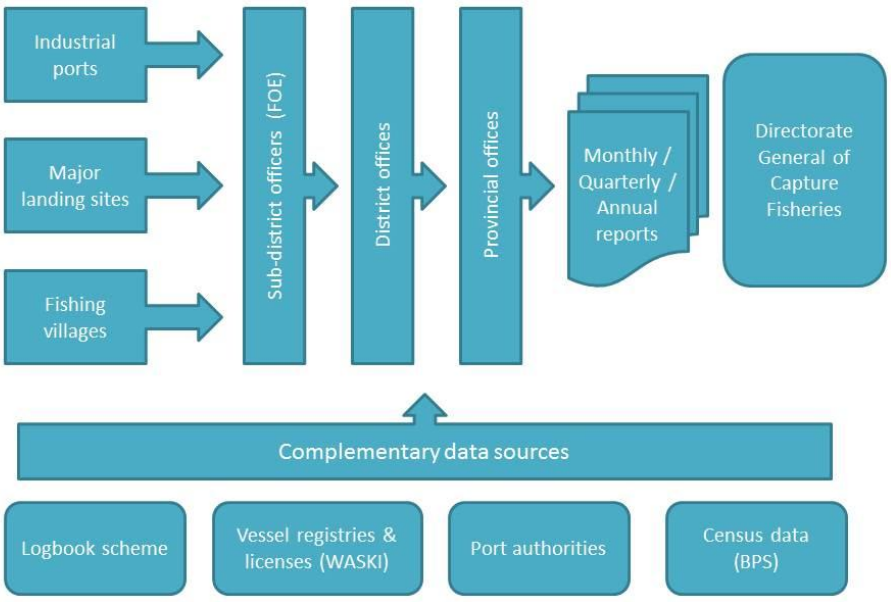


Figure 6. Schematic illustration of information flow in Indonesia.

[22] Note that this is a requirement under the IOTC (and other tuna RFMOs) for tuna fishing vessels in the Indian Ocean larger than 24 m LOA.

Ancillary data

Of particular importance is the recent creation of a Statistics and Information Centre under the MMAF which is placed above the level of the various Directorate Generals of the Ministry. Its mission is to collate and compile all relevant information on fisheries and marine affairs, including socio-economic and environmental information.

Establishing an observer corps is currently on-going. A total of 77 (as of 2011) have received training in preparation for implementation. A draft regulation appears to be in the process of being reviewed but a number of steps are still needed (i.e. adopt the legal basis, develop institutional and operational basis).

Previous efforts include the running of a scientific observer program in Benoa as part of a collaboration between MMAF and CSIRO Marine and Atmospheric Research (Australia). Indonesia's Research Centre for Capture Fisheries/Research Institute for Marine Fisheries (RCCF/RIMF) and Directorate General for Capture Fisheries (DGCF) continue port sampling activities and scientific observer program for tuna fisheries in the Indian Ocean, in particular. There also appears to be an ACIAR project in the pipeline developing capacity for management of Indonesia's pelagic fisheries resources (expected to run from 2012 to 2015), but this is presumably directed to tuna fisheries primarily.

The Central Bureau of Statistics (BPS) continues to share some of the responsibility with DGCF in the collection and reporting of fisheries statistics, primarily in relation to execution of annual censuses. There are BPS offices at district, provincial, and national level (sometimes even at sub-district level). BPS' main activities are undertaken in a regular cycle. The population census is conducted every ten years (in years ending with zero). The agricultural census is conducted in years ending with three and the economic census is conducted in years ending with six. In between censuses, BPS conducts statistical surveys every year, such as the National Socio-Economic Surveys, Surveys for Manufacturing Establishments, Inter-Censual Population Surveys, Labour Force Surveys, etc.

Considering the marine environment, there is currently an on-going USAID-funded project on Marine and Climate Support (IMACS) with the objectives of strengthening the management capacity of the Ministry of Marine Affairs and Fisheries (MMAF) and local government, enhance local communities and the private sector engagement through open and transparent governance, and provide technical support for key activities that support marine resources management and communities' empowerment.
IMACS has 4 major program areas that include:

- Institutional Development of the MMAF (ID),
- Sustainable Fisheries Management (SFM),
- Coastal Community Resilience and Climate Change Adaptation (CCR),
- Program Integration, Coordination and Administrative Support (PI).

The program is being implemented through a partnership with the Government of Indonesia (GOI) through MMAF, coordination with other USAID marine implementing partners, and other relevant stakeholders in Indonesia both at national and local levels.

In a wider context, the Ministry of Environment is responsible for controlling the quality of the environment and using several tools of policy to implement the environmental management. There are several national laboratories implementing research and analysis for environmental samples, especially for marine and coastal environmental areas, i.e.:

1. Research Center for Oceanography

2. Research Agency for Marine and Fisheries, Ministry of Marine Affairs and Fisheries
3. Center for Environmental Impact Control, Ministry of Environment
4. Agency for the Assessment and Application of Technology (BPPT)
5. Agency for Oil and Gas (LEMIGAS)
6. Various Universities

Problem analysis (identified gaps)

Statistics are characterised by high levels of inter-annual variability and inconsistencies, which is an indicator of possible weak points in the system (e.g. coverage, methodology, implementation, etc.). In such a vast country constituted by thousands of islands, it is a daunting task to make a data collection system work efficiently.

In 2000 Indonesia's national government granted greater autonomy to district/regency governments, and, as a result, DGCF and provincial fisheries offices now have less control over how district level offices collect and report their fisheries statistics. This is a problem primarily in relation to the collection of data from sample villages.

Sampling data (or census data) from sample villages is considered to be unreliable by the DGCF. This needs an in-depth review on possible ways of improving the system by adopting a more robust sampling programme or if it would be preferable to use alternative approaches. Inland production is estimated in the same way so this should also be considered.

Technical assistance for sampling design and estimation is needed. However, there is a danger that any such assistance will be ineffective without resolving the underlying issue of a clear chain of command in terms of sampling activities. There appears to be a problem in relation to districts in particular, as funding is not made available to cover operational costs of data collection. Capacity is limited in terms of manpower, equipment, and operating funds at the lower levels of the collection system.

The Central Bureau of Statistics (CBS or BPS in Bahasa) is supposed to have a central role in producing fishery statistics, but suffers many of the same problems (i.e. heavy workload, shortage of staff). As presented above, the CBS is responsible for carrying out a number of surveys. Thus, the role of CBS is essential when considering any sampling approach to be introduced.

For major landing sites, the approach used is complete enumeration. However, there appears to be limited attempts at cross-checking and verifying reported information. The system of complete enumeration is ideal, but it has probably resulted in limited contact with fishermen and experience shows that reported data has to be verified (especially if it is known that there is no cross-checking). Procedures need to be developed, taking advantage of available information sources and possible new ones, and should be applied in standard from across districts.

The increased autonomy gave the district governments the opportunity to generate revenue through tax (restribusi) on fishing companies for catch landed/processed. It was not possible to confirm whether district/provincial governments make direct use of statistics for tax purposes, but if this is the case, then there is strong incentives to under-report catch.

Another problem is what appears to be a fragmented system of fishing vessel registries (managed at state, provincial and district levels). This problem was made evident in Banda Aceh in connection the attempts to recover fisheries after the Tsunami, where a revision of the existing data on vessels was shown to be unreliable. Some of the errors are reportedly intentional, where vessels prefer to be

under local licenses instead of licenses from central administration. This is compounded by problems due to vessels operating from more than one home-port.

Implementation of the logbook scheme has so far been disappointing. Fishermen and companies are resisting and providing erroneous data in spite of legal obligations. The DGCF has set the practical goal of 10% coverage to be obtained in the future (it is currently around 1%). Effective logbook implementation will need enforcement of the existing regulation, but other approaches such as incentives can be used both for fishermen and civil servants in charge of implementation. Again, a logbook system would also need to develop procedures for cross-checking reported data, making it a reliable source of detailed data. The goal of a 10% coverage appears reasonable if the data is reliable and detailed. A specialized computerized system is still being developed.

The current data collection system is designed for providing production statistics and provides only basic input data for stock assessment purposes (i.e. landings and value but fishing effort is not sufficiently detailed for modelling purpose). Fishing effort is measured as number of fishing trips, but this can consist of 1-2 days for non-powered or out-board powered vessels, while for larger in-board powered vessels this may last 1 – 3 weeks. Although enumerators are aware of this, there appears to be no standardized approach to estimate fishing days and a new measure should be developed.

Scientific data collection appears to be very limited for the Northern Sumatra region. The separatist movement in Banda Aceh was a limiting factor for a long time but it also appears to be the result of exceedingly centralised research structures, limited human resources and limited funding. There appear to be no working relations with local universities (e.g. Riau).

In the drive to constantly improve official statistics, this has now resulted in the requirement of collecting landings of more than 120 species of marine fish. This is too complex, creating many possibilities for error and misidentification. Detailed species composition data should be the responsibility of scientific staff, along with the collection of detailed data on catch and effort, length/weight, maturity, etc.

Recommendations

An in-depth review should be carried out in relation to small-scale fisheries in the two management areas of relevance to the BOBLME (571& 572), considering possible modifications to the current methodology.

Training is needed at various levels for the implementation of a sample approach. An alternative approach would be to carry out a pilot project in one district, which could be used as a model for general application in Indonesia.

Procedures for cross-checking and validation of data should be introduced.

Considering the lack of awareness on the importance of data collection at local level, it is important to address this. Likewise for the effective implementation of the logbook scheme, it is necessary to increase efforts to introduce this scheme both to fishers as well as local fisheries officers.

Malaysia

In geographical terms, Malaysian fisheries are divided between Peninsular Malaysia, which has a western coast in the Indian Ocean and an eastern coast, which together with Sarawak and Sabah are in the South China Sea.

Total estimated landings were 1.4 million tonnes in 2009 taken by 48,745 vessels, according to official statistics produced by the Department of Fisheries. Vessels are classified as inboard powered, outboard powered, and non-powered, of which there are 21,604 licensed to operate in the west coast (7,856 outboard powered vessels). Production from the west coast accounts for 52% (729,558 tonnes) of the total, using a variety of gears. Landings of *Rastrelliger* sp. are substantial in the west coast, consisting of about 30,000 tonnes of Indian mackerel (*R. kanagurta*) and 128,000 tonnes of short-bodied mackerel (*R. brachysoma*).There are also landings of 10,000 tonnes shad species (*Tenualosa* and *Ilisha*), but these are distinct species from the large hilsa fishery in the northern Bay of Bengal. Catches of other small pelagics, mostly scads and anchovy, are also substantial as well as neritic tuna.

Malaysia does not have large river systems, or natural lakes, and with increasing industrialisation, many of the river systems are being polluted, leading to a decline in river fisheries. There are, however, a number of sizeable man-made reservoirs in Peninsular Malaysia (e.g. the Perak and Terengganu dams) that are being developed for inland fisheries, including for recreational fisheries. However, there is already evidence of decline in some of the reservoirs, e.g. the Kenyir dam in Terengganu. Several species of native river fish are considered endangered. The inland fisheries is estimated to have contributed an insignificant production of 4 208 tonnes in 2007. For inland fisheries, there is no regular programme and only rough estimates are made.

In Malaysia the Department of Fisheries (DoF) has the responsibility for the routine collection of fishery data. This concerns basic fishery data on landings, value, fishing vessels, fishing effort and employment. Data are collected at the administrative district level, of which there are 84. Each district has a designated fishery officer who is a full-time staff of the Fisheries Administration.

Design of data collection system

The approach used in Malaysia is that of a sampling programme and it is therefore essential to have reliable data on the complete population or the frame in order to raise sample statistics to the total. This can be the total number of vessels/gears operating which can be estimated through census surveys/vessel registries. Or even better, near real-time data on daily activities of vessels, which appears to be the method used in Malaysia.

The frame is established based on the on-line Vessel Registration System which records every transaction of licensing activities on all fishing boats. A frame survey is conducted every two years for every State and this is fine-tuned every month to include some illegal fishing activity and exclude inactive vessels. A sampling plan with defined targets and number of samples to be taken is then designed based on categories such as area (administrative districts), fishing gear, and size of vessel (GRT). Data are then collected, based on a combination of enquiry and observation, for each of these sub-strata.

It was not possible to obtain a reference document on methodology but data collection appears to be based on sound methodology of random stratified sampling with a stratification by area (i.e. district) and fleet segments (i.e. similar vessels using a specific gear). Sampling coverage varies from

100% for small number of vessels up to 15% for landings of 500 vessels, which is considered a good coverage rate (Table 2).

Table 2. Sampling plan defined by the Department of Fisheries.

Units in operation	No of samples	Additional sample (10%)	No of samples to collect
50	35	0	35
100	35	0	35
150	35	5	40
200	35	10	45
400	35	30	65
>500	35	40	75

Note that the approach used for the category deep-sea fishing vessels (offshore; approx. 1000 vessels > 70GRT) is that of complete enumeration where enumerators collect data after each trip.

Flow of information

Data are collected using special data collecting forms (Annex 10). The data are then keyed into a database using a computer system. Previously data was keyed in at the State Offices and then forwarded to the main database servers at Headquarters. However, presently this has been upgraded whereby data is keyed in at district level via a network PC. The PC is wired to the database server in the State Office via a Wide-Area Network. Data from the state database are then forwarded to the main server in Kuala Lumpur also through a leased line. Data entry machines used are normal PC, whereas database servers are mostly network servers. HQ uses a RISC UNIX based machine with Oracle Data Base Management System.

The main product is the Annual Fisheries Statistical Bulletin. This annual report is distributed to all in the department and also other agencies and the industry. Lately this annual report is produced in digital format (CDs) for easy dissemination and reproduction as well as providing the data in digital format. Presently the department's homepage displays only summarized statistics. Plans are being made to produce the whole bulletin on the homepage

Logbook systems are not used as the data collected this way are considered highly unreliable. However there is a comparable scheme in place involving the "Vessel Operation Reports (LOV)" which contains all the relevant information that would be gathered by a logbook. This includes also fishing area (Kawasan operasi) which is given according to a map with sub-divisions (Annex 11). The main difference from a conventional logbook scheme is that this is filled out by the enumerator on the basis of interviews and observations. In principle, this type of data should be more reliable than typical logbook data. Note also that there is cross-referencing with VMS data (for larger vessels; > 70 GRT).

Flow charts are given below on the LOV scheme (Figure 7) as well as the general flow of data from lower to higher levels in the national data collection scheme (Figure 8).

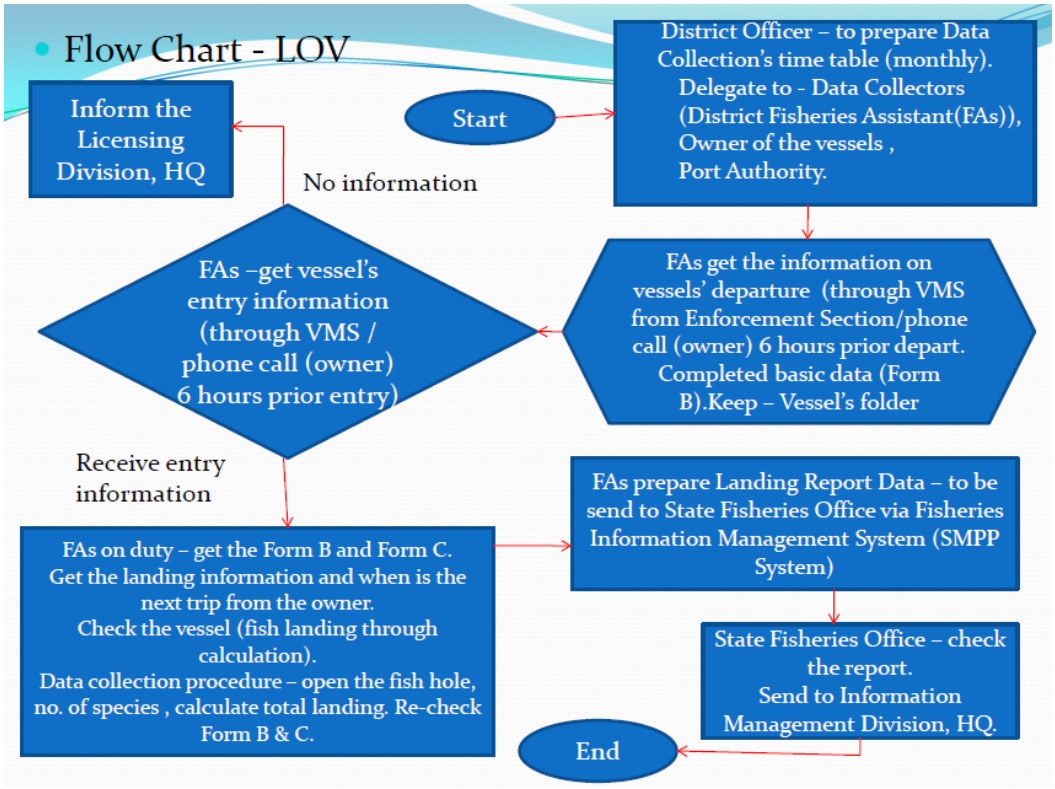


Figure 7. Flow chart concerning the Vessel Operations Report (LOV) scheme[23].

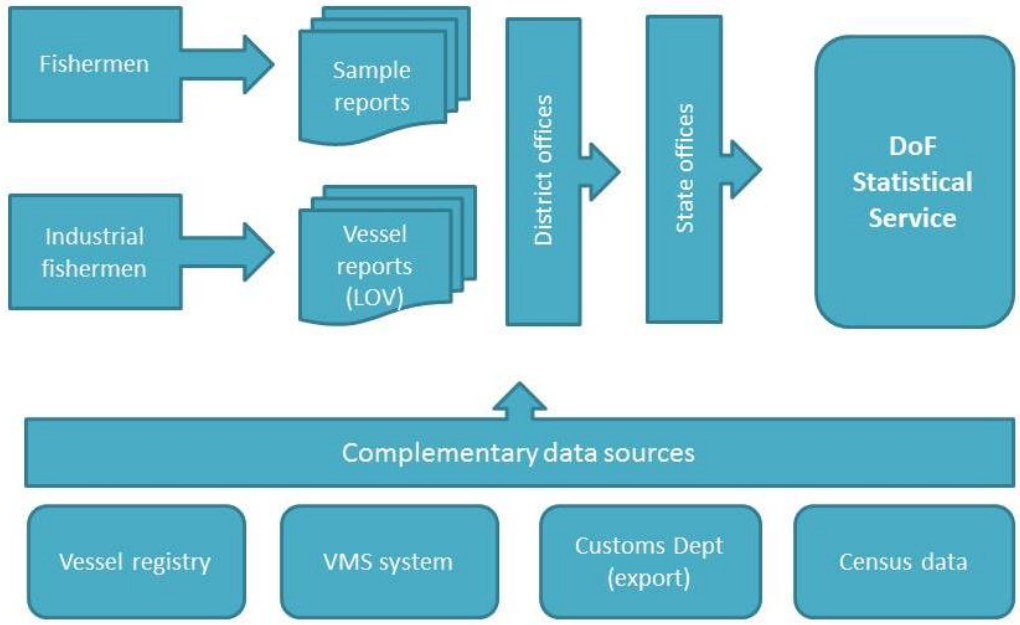


Figure 8. Schematic illustration of information flow in Malaysia.

[23] Presentation on Lessons Learned in Implementing Fishing Logbook and/or Observer Program. DoF, Malaysia. Presented at the special meeting on improvement of tuna information and data collection in Southeast Asia, 7-9 Sept. 2011, Songkhla Province, Thailand, SEAFDEC.

Ancillary data

The Fisheries Research Institute (also under DoF) carries out data collection for scientific purposes. This is carried out primarily on a project basis, depending on the provision of specific funding, which makes it difficult to sustain longer-term monitoring of for example the state of resources. The Institute does not own/operate a larger research vessel to carry out fishery-independent data collection, which has resulted in few and irregular resource surveys. However, there appears to be information available on ecosystem issues such as bycatch and incidental catches of sensitive species.

Of particular relevance to small pelagcis, Malaysia conducted the biological study of small pelagic survey through the SEAFDEC Tagging Program for Economically Important Pelagic Species in the Andaman Sea (2008-2010), as well as the Bio-socio-economy for capture fisheries in the West Coast of Peninsular Malaysia (2008-2010).

Various ad-hoc surveys take place at regular intervals such as the Census on Fishermen Socio-economic and Household data and Survey on Income of Traditional Fishermen, run by the DoF.

Other institutions are also involved in data collection with different objectives such as:

- Fisheries Development Board (LKIM)
- Ministry of Science, Technology & the Environment (MOSTE): stock assessment and environmental data
- Department of Statistics : structural information of the fisheries/aquaculture sector
- Department of Custom Exercise: Data on trade and export

The Fisheries Development Board is of particular importance as it runs its data collection system on all landings and corresponding value of product. The scheme covers some 240 landing sites, of which 47 are fishing infrastructure managed by LKIM itself. There are 502 enumerators to cover this. Although useful and important for production purposes, it is not clear why there appears to be a duplication of effort, as the DoF also collects data on price, albeit not wholesale and retail prices. LKIM runs the fuel subsidy scheme which may be part of the explanation, as there is a need for production data to run it effectively.

Problem analysis – identified gaps

The system for the routine collection of fisheries data appears to be a sound system in Malaysia, capable of producing reliable estimates. It appears to be based on sound methodology, using a sampling approach primarily but with some elements of total enumeration.

Nonetheless, DoF considers that are is a need for improvements on a number of issues, including:

i) the quality of data (in terms of accuracy, timeliness, consistency, accessibility, and appropriate format for management and policy planning),
ii) lack of sufficient staff and supervision, as well as data analysis capability,
iii) limited funding and the need for cost-effective schemes,
iv) the rapid IT development requires constant training,
v) the requirement of tools for data collection, analysis etc.,
vi) the difficulties in species identification,
vii) the collection of data (e.g. on small pelagic fishes) as aggregated species (not at species level),
viii) the need to strengthen inter-agency coordination.

A major gap appears to be estimates for small-scale fisheries. DoF expressed concerns about estimates concerning small-scale fisheries. The high number of fishermen and the low estimates on production does appear to indicate that these are not well covered. This would need more careful analysis but it is presumably related to the landing of catches outside the main channels covered by the DoF (i.e. not all landing sites are sampled).

Recommendations

Malaysia appears to have robust system for the production of reliable estimates. However, data collection systems continuously struggle with the classical problems of limited funding and capacity even in developed countries. Many of the issues have to be resolved nationally, but Malaysia could possibly benefit from international expertise on subjects such as cost-efficient methods, inter-institutional cooperation, risk assessment and data analysis.

The deficient coverage of small-scale fisheries appears to be a problem in Malaysia. More detailed analysis is required to determine whether this justifies to broaden coverage or if there are alternative methods to estimate these. This could be the subject of specific research project that includes the compilation of all available information.

More directed research on small pelagics is clearly needed. Some key issues are the need for detailed catch and effort data, length/weight data, and geographical location of fishing activity. The current system does not provide more than basic data for stock assessment.

Maldives

Tuna catches increased to an all-time record of 167,000 t in 2006 but have been steadily declining since then. The catch of 2010 was about 60,000 MT, more than 50% lower than catches reported in 2006, mostly because of lower skipjack tuna catches. Tuna fisheries dominate in the Maldives and data collection has focussed on this, including information on catch and effort, value, exports, fishing fleet, and employment.

Reef fish resources were almost unexploited until recent times, but the rising importance of tourism introduced a new local market for reef fish, as did the expansion of foreign labour in the Maldives. At the same time export markets have been developed, but an adequate catch monitoring system is still to be developed. Reef fish are mostly caught by simple hook and line, consisting mostly of jacks (Carangidae), snappers (Lutjanidae), groupers (Serranidae) and emperors (Lethrinidae).

Small pelagics such as scads (Carangidae) are caught in large numbers around some islands, mostly for local consumption, but there are no meaningful statistics on these catches. The main species taken are the bigeye scad (*Selar crumenophthalmus)*, but round scad (*Decapterus macarellus)* is also caught. There are only small catches of Indian mackerel, as the Maldives is on the limit of the distribution range of this species.

In the Maldives it is the Ministry of Fisheries and Agriculture (MoFA) which has the responsibility for the collection of fishery data, carried out by the Statistics and Database Management Service (SDMS). High priority is given to the collection and dissemination of reliable and timely fishery statistics for development, management and monitoring purposes. In practice there are limits on funding and trained personnel which can affect the quality, regularity and timeliness of the collection and dissemination of fishery statistics.

Design of data collection system

Systematic fisheries data collection in the Maldives started in 1959, which was designed to record tuna catches. Only three categories of fish were recorded initially (large skipjack; small skipjack and yellowfin; kawakawa and frigate tuna). The system was upgraded in 1970 to include five categories of fish (large skipjack; small skipjack; yellowfin; kawakawa; frigate tuna) and two categories of fishing vessel (*masdhonis* and *vadhu dhonis*) that dominate the fleet. Structural changes in the sector have brought almost complete mechanisation and a trend towards larger vessels (20-30m) and more powerful engines, resulting in the gradual phasing out of vadhu dhonis in fisheries.

Another special feature of the Maldivian fisheries is also the limited range of fishing gears employed, where various combinations of hook and line are the most frequently employed gears such as pole and line, handline, troll line and longline[24]. The use of nets is limited. Simple liftnets are used to catch livebait for the tuna pole and line fishery, consisting mostly of silver sprat (*Spratelloides gracilis)*, but a variety of other species are also caught including fusiliers (Caesionidae), cardinalfishes (Apogonidae) and anchovies (Engraulidae). The use of trawls, pelagic gillnets and purse seines is specifically banned in the Maldives.

With some 200 inhabited islands distributed among 21 atolls, there is a multitude of landing places. Most fishing boats land fish directly to the beaches of their home islands. However, there are about 20 government built ports that can be considered as the major fishing ports distributed among the islands. The approach used to collect fishery data is by total enumeration where skippers or boat owners are required to report daily at the local island office.

The Ministry of Atolls Administration maintains government offices on every inhabited island for the purpose of overseeing and facilitating all government activities in the atolls, including the collection of fisheries statistics. This is carried out by using the SDMS **Daily Report Form,** recording the catch from every boat that goes fishing (Annex 12). The form is usually completed by a clerk in the island office. Data may be provided to that person by the boat owner or skipper verbally, in a written note, or as a copy of a receipt for fish sold. Note that catch data is recorded for 7 tuna species categories (large and small skipjack, large and small yellowfin, dogtooth, frigate, and kawakawa tunas), billfish, sharks and 3 broad categories of so-called reef fish. These reef fish categories are in fact size classes that do not necessarily have anything to do with species identification.

A recent development is the introduction of logbooks for data, which was introduced for the second time in January 2010[25]. The introduction was preceded by a revision of the fishery regulation which required registration of vessels among others and mandatory reporting of data through logbooks. Fishery inspectors have also been placed in key landing sites (about 26) for supporting the implementation of the fishery regulation including facilitation to fishermen on completion of logbooks, as well as inspections in order to strengthen the capacity for MCS including catch certification (i.e. IUU regulation of the EU). Verification of logbooks has yet to be done.

Preparations on introducing an observer scheme are on-going including the training of observers. Accommodating observers on-board longline vessels has been made mandatory and it is expected that once observers have been trained a minimum requirement 5% coverage will be implemented.

[24] Longline fishing was previously associated with foreign licensed vessels operating in the EEZ (beyond 75 miles). Licensing of foreign vessels was suspended in early 2010 following an executive order of the Parliament, considering the policy of initiating a longline fishery by nationals. Currently there are four Maldivian vessels registered for longline fishing in theEEZ of the Maldives.

[25] Presumably the first attempt was not successful.

Note that this responds to an obligation under the IOTC to place observers on-board vessels larger than 24m and to cover their fishing activity with the use of logbooks.

Flow of information

Details of the daily catches are forwarded each day from each island to its atoll office, normally by radio. There the details of catches from the three best islands in the atoll are compiled and forwarded to MoFA (by fax). These form the basis of a daily report to the Minister.

Daily Report Forms are not forwarded to SDMS, but are summarized onto a **Monthly Fishing Report**, with catch and effort for each vessel kept separate. This summarizing is carried out by the same person who completed the Daily Report Forms (i.e. usually an island office clerk). The completed form is signed by the Island Chief. Skippers are also required to sign the monthly entries for their vessels, confirming their accuracy (but in practice they do not). The Monthly Fishing Report is often more complete than the Daily Report Forms since data omitted from the latter due to late returns can be included (Figure 10). In addition the Monthly Report Forms include information detailing why any particular boat did not go fishing.

The SDMS carries out the tasks of entering the received data in a database, applying conversion factors when relevant, cross-referencing with alternative sources of data (customs, state and private companies), compiling the information and dissemination. SDMS has a staff of about 18 of which 5 are dedicated to data entry. Also within MoFA, FiDEx (Fisheries Development and Extension Services) maintains a fishing vessel registry and oversees licensing (for fisheries other than the EEZ fishery) among other responsibilities. FiDEx has a staff of 19.

Alternative data sources include data collection at Malé fish market, which is the most important landing site in the Maldives. Data on catches of tuna and other types of fish are collected (e.g. reef fish and sharks) as well as price data, based on interviews of skippers or boat owners. Data on fish purchases are also collected from the state and private processing/exporting companies as well as tourist resorts. Total catch estimates for some species groups is obtained through the Customs Department such as for sea cucumbers, sharks, groupers), as these are not consumed locally.

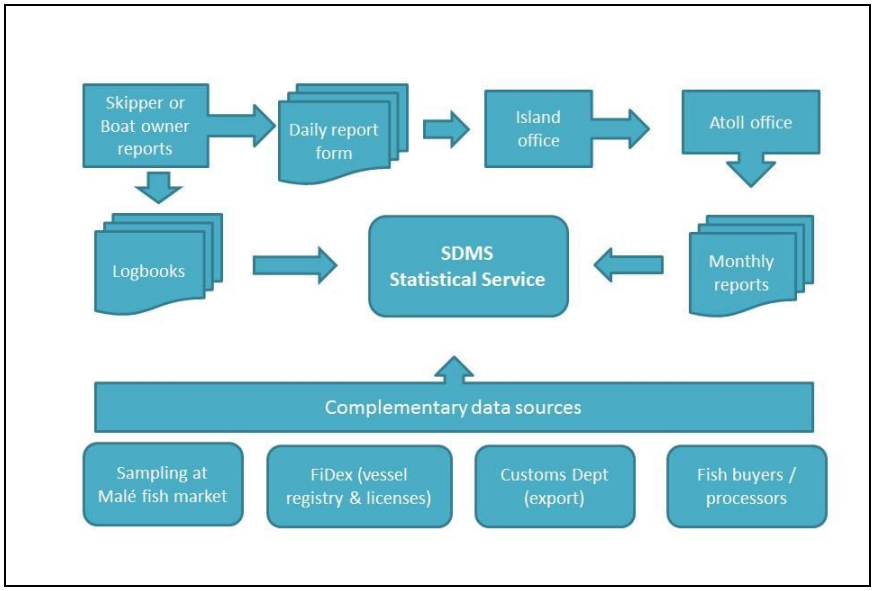


Figure 10. Schematic diagram of information flow in the Maldives.

Ancillary data

Census surveys are carried out regularly by the Planning Ministry which include data on the population of fishers and associated socio-economic data. The last available census data is 2006 and next is scheduled to take place in 2015.

Biological data are collected mainly by the Marine Research Centre (MRC) in connection with specific research projects or management goals. Of crucial importance to stock assessment is the collection of length/weight measurements. This is carried out by 10-12 fishermen that have been contracted specifically for this purpose, carrying out their duties while fishing.

On a broader ecosystem context, the MRC is active in various other fields such as biodiversity, coral reef monitoring, and climate change. MRC is also a stakeholder in the Maldives Environment Management Project (MEMP), supported by the World Bank / IDA, which is a five year project started in 2008. The main objective of the project is to build environmental capacity in the Maldives. Specifically, the project expects to advance the national development agenda by enhancing the environmental sustainability of growth in the Maldives and improving the management of its key environmental assets.

There is another service under MoFA that has responsibility for collection of socio-economic data, which is the Economic Research and Monitoring Service (ERMS). The objectives are to collect, compile and disseminate fisheries costs and earnings and other socio-economic data relating to specific research projects or management goals.

Problem analysis – identified gaps

The system in place in the Maldives has produced a consistent time series of tuna catch and effort data since 1970. It is based on total enumeration and it remains essentially the same system that is in place today, although it has been subject to several modifications and additions over the years. However, the accuracy of estimates is seen as declining due to structural changes in the sector.

Recent developments are reinforcing this system, particularly in the case of tuna fisheries, with the introduction of a logbook system and observer scheme. Logbook data is expected to produce better estimates for both catch and effort data, but this is still being implemented. Also, it will be important to create a system for logbook data verification.

Identified problems:

- Data transmission is not electronic and has to be transcribed manually several times before reaching the SDMS for electronic entry, so that clerical and data entry errors can be assumed to be frequent and sometimes significant.
- The general perception is that under-reporting occurs but there is no system in place for cross-checking or sampling for the purpose of verification (SDMS estimates indicate about 20-30% under-reporting).
- Fishing effort is measured in number of days fishing, but the changes in the fleet (vessel size, engine power, holding capacity, etc.) indicate that this measure of effort may no longer be appropriate.
- Catches are reported in number of fish and requires use of conversion factors to estimate total catch. The conversion factors in use are inadequate, leading to possibly significant bias in the estimate of total catches.

- Logbooks were introduced in 2010 but it appears that the goal is to cover the fleet that is licensed to export (licensing is not a general requirement in the Maldives). This would not solve the problems of coverage in relation to the local market and for subsistence purposes.
- Non-tuna fisheries are poorly covered, especially if these are not exported or landed through main channels.
- Recreational fisheries are developing in the Maldives in connection with the tourist industry, but these are not monitored.

Box 4. Reasonable sample sizes for length measurements

In a recent study[26], attention was paid to reviewing the status of herring in Sri Lanka and to propose a better sampling strategy to obtain length frequency data for future stock assessments. Capelin (*Mallotus villosus*) length-frequency survey data obtained from annual capelin surveys in Icelandic waters was used as the proxy population for this analysis. The results from the bootstrapping indicate that around 60 samples, each with around 40 measurements, are needed per month to follow the rapid growth of *A. sirm* over the year and conduct assessment. The minimum sample size and number of samples are determined by resource expenditure for taking length measurements and the degree of precision of the estimates made from collected length measurements. Therefore, 20 - sample size and 40 – number of samples might perhaps be adequate when cost for data collection is taken into account and this might be the optimal trade-off between cost and parameter precision.

Similar results were obtained in a different study[27], considering the optimal sample size for ageing purposes of cod. In this case, and the sample size of fish taken from fishing each trip could be reduced from approximately 85 to 20 without a significant loss in precision. Note however that this concerns a slower growing species.

Recommendations

In order to tackle some of the problems identified above, it has been proposed that the approach should be changed from total enumeration to a sampling programme[28]. A sample-based approach, if properly designed and implemented, would solve the problems of coverage and under-reporting as well as capture a broader snapshot of the fisheries including non-tuna. The Maldivian point of view is that it would be difficult and costly to cover fishing activity in the 200 islands, considering also the inherent variability of estimates and the logistics of a sampling programme. The consultant agrees with this view, considering also the lack of human resources to carry this out.

On the other hand, the current system has to be improved. Considering the BOBLME focus on small pelagics and sharks, the current system in the Maldives has failed to produce reliable estimates. The consultant recommends that scientific sampling activities are initiated in order to produce meaningful estimates (even if these are just snapshots). Ideally this could be carried out by MRC scientific teams with the objective of gathering information through short-term and properly designed projects (i.e. to fill the data gaps).

[26] Haputhantri, S. 2007. A data sampling strategy for coastal herring of Sri Lanka. Fisheries Training Programme. United Nations University, Iceland.

[27] Aanes, S., Pennigton, M. 2003. On estimating the age composition of the commercial catch of Northeast Arctic cod from a sample of clusters. ICES Journal of Marine Science, 60: 297-303

[28] See for example the Report of the 14th Session of the IOTC Scientific Committee, Dec. 2011.

There is a need for training in terms of sampling theory and sampling design in order to build up capacity (at the MRC) for the purpose of monitoring fisheries. For example, the current approach of hiring fishermen to carry length measurements in the fisheries may produce good results in terms of number of fish measured and weighed, but these data may be of limited use from a statistical point of view[29]. This is of utmost importance as the conversion factors being used to estimate total catches may be the weakest link in the Maldivian statistical system, requiring careful consideration.

Scientific sampling activities could also be used to address other issues such as monitoring of non-tuna fisheries, verification of catch estimates produced by enumeration and logbook schemes, improving the measurement of effort, etc. An example of this is the formulation of a specific project to monitor Indian mackerel and scad fisheries, to be funded by the BOBLME, presented at the meeting of the BOBLME Indian mackerel working group (Kochi, 1-2 Dec. 2011). The approach will use a combination of market sampling and observer trips.

Myanmar

Myanmar continental shelf covers approximately 230,000 sq km with a relatively wider portion in the central and southern parts. The Exclusive Economic Zone (EEZ) is about 486,000 sq km. The coastal zones of Myanmar can be subdivided into three main areas, namely Rakhine Coast, Ayeyarwady Delta and Tanintharyi Coast. Many rivers flow into the coastal zones such as the "Mayu" and "Kaladan" rivers in the Rakhine Coastal area; the "Ayeyarwady", "Sittaung" and "Thanlwin" rivers in Delta coastal area and the "Yae", "Dawei", "Tanintharyi" and " Lenya" rivers in the Tanintharyi coastal area.

Total fish production is estimated at 4.1 million tonnes in 2011 according to official statistics (provisional statistics). This includes 2.1 million tonnes from marine fisheries and about 1 million tonnes from inland fisheries, consisting of so-called lease fisheries and other types of capture fisheries. Lease fisheries take place in 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.

The marine fishing fleet consists of some 30,800 vessels, of which 2047 are larger vessels. Furthermore there are 396 foreign vessels operating in Myanmar waters under licensing agreements, most of which are Thai trawler vessels.

There is no reliable information on the species composition of production. However, export data indicates that hilsa is an important export item (about 11,000 MT exported in 2011). Hilsa (*Tenualosa ilisha*), Indian mackerel (*Rastrelliger kanagurta* (Cuvier, 1817), and the short bodied mackerel are considered to be economically-important fish species in Myanmar, but specific data is not available.

There are considered to be two distinct populations of hilsa in Myanmar. One is located along the Rakhine coast, undergoes migrations to Bangladesh and India, and appears not to be extensively exploited. The other Hilsa population is located in the southern area of Myanmar, and is targeted using purse seines and encircling gill nets. Over a ten year period (1991-2000), catches from this

[29] As rule of thumb when measuring length, small and numerous samples (20-30 fish) are much more useful than a few samples of hundreds of fish (200-300) from one fishing trip. See box 4

population declined from 106,000 t·year-1 to 42,000 t·year-1, and at the local markets of Hilsa, which used to average over one kilogram per fish, fell to an average of approximately 175 g.

In Myanmar it is the Department of Fisheries (DoF) that has the responsibility for fishery data collection. The types of data collected include:

- Production statistics: quantity of landings, export quantities and value
- Structural statistics: no. of fishing vessels, gears, cold storage, ice plants, fishmeal plants
- Socio-economic statistics: no. fishermen, companies

Design of data 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. There are 370 townships in the whole country and 110 fisheries township offices, where there will be a fishery officer attached. Some township offices cover more than one township. There are about 13 major marine landing sites which are covered by these offices.

In relation to offshore fishing, fishery officers are responsible for ensuring that fishing vessels are operating under the terms of Myanmar's laws. Thirteen checkpoints are used to inspect vessels on the way to and from fishing grounds and the national marine fishery statistics distinguish landings from inshore and offshore areas, including the collection of ex-vessel value (although not shown in the yearly statistical publication).

Officers at township level work only part-time on fishery statistics, their other duties including, for example, licensing, training and 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 about 20 staff in total.

The approach to data collection can be categorised as a complete enumeration approach, assuming that all fishermen report. It is likely that the system in place is biased because it appears to be based solely on the initiative of the fishermen to report and there appears to be no cross-checking or control functions in place to assess the reliability of the data, particularly from small-scale fisheries (Figure 11).

The total fishery-related population is determined by census. The last available census was carried out in 2003 and the next is expected to be carried out in 2013, thus a 10-year interval. Note however that total fisheries production in Myanmar has more than doubled during the last 10 years, according to the published fishery statistics.

Another complementary source is licensing and registration information. There have been attempts of introducing logbook systems in commercial fisheries, but this have not been successful due to the lack of cooperation on the part of fishermen and the data collected this way are considered unreliable.

Flow of information

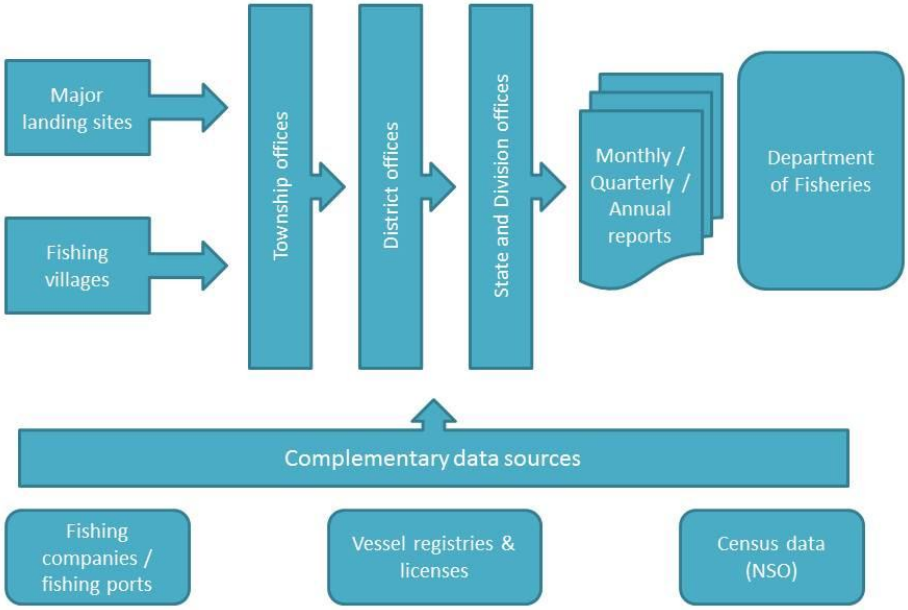


Figure 11. Schematic diagram of information flow in Myanmar.

Ancillary data

A FAO/UNDP fisheries project was instrumental in carrying out in-depth surveys of available marine resources in Myanmar during the early 1980s. This included research surveys by R/V Fridtjof Nansen. Since then there have been attempts to repeat these surveys in 2004 and 2007 in the context of SEAFDEC (which provided its research vessel at a cost). However the results of these latter surveys are not considered reliable due to limitations in terms of time and intensity (i.e. relatively few stations over short time period).

The Department of Fisheries collaborates closely with the Myanmar Fisheries Federation (MFF) which is a nation-wide association of fishermen's interest, ranging from large-scale to small-scale as well as fish farming and inland fisheries. The MFF receives support from the state for its on-going work in the promotion of fishing activities**.** Considering a possible role for the MFF in playing a complementary role in data collection, e.g. socio-economic data, the MFF does not consider this to be its role when consulted, and clearly a responsibility of the Dept. of Fisheries.

Box 5. Partnerships with the fishing industry for collecting information

A visit to fishing port of Szyh in Yangon, a privately owned and operated port, showed that the information collected appears to be of good quality. This includes landings by species, value, fishing costs, fishing ground, etc. In principle, these data would be very useful efficiency, profitability and cost structure of a reasonable sample of trawlers in the offshore fishery. Also, detailed information on catch and effort as well as origin of catches appears to be available. A total of 162 trawlers use this facility (using transhipment from fishing grounds) and constitute a reasonable sample size for analysis purposes. Total landings were 25,000 t of fish and 4,688 t of shrimp in 2010. The possibility

of establishing a partnership with this company (and possibly others) should be explored, as this type of information is invaluable for management purposes to make use of this data.

The National Statistics Organisation carries out various types of surveys which could potentially be used for fisheries purposes, such as:

- Household income and expenditure survey (2001)
- Integrated business enterprise survey (2002)
- Integrated household living conditions assessment surveys (2003, 2010)
- Industry census and survey (2001-2002
- Price surveys
- Labour force surveys

However, these surveys are reported to have little or no specific information on fishermen and their activities.

Considering scientific data collection for stock assessment purposes, the impression was that this was limited. Note that this type of activity is also under responsibility of the Department of Fisheries, which appears to have limited capacity to carry out such activities, including socio-economic and ecosystem related data. The organizational structure appears to indicate that these types of activities do not receive the required attention.

Problem analysis – identified gaps

Various constraints have been identified in this mission as well as through other fora, which are:

- Limited budget, manpower and training
- Lack of expertise
- Need for expert assistances in relation to census and surveys
- Lack of public awareness in relation to data and information collection

According to DoF, the priorities in relation to data collection are:

- the need to carry out a fishery census;
- the frequent conduct of surveys;
- the need for a computer based information system;
- the need for collecting of fishery statistics according to ISSCAAP species codes;
- training in relation to data collection;
- technical assistance and project support, e.g. on co-management approach to data collection, sampling theory and programme implementation

Ideally all of these issues should be addressed by a specific fisheries project to carry out the various tasks needed in terms of strengthening capacity information gathering and fisheries management, but this can be considered a medium to long-term objective.

The system in place uses the complete enumeration approach so it should in principle provide useful information, but there appears to be no verification procedures in place. Such a system 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. This problem of creating verification procedures could be addressed by using a sampling approach, designed specifically for that purpose to provide correction factors in the relative short-term.

It is interesting to note that a recent "re-construction" of the catch time series in Myanmar resulted in modified estimates[30]. Most notably, a downward adjustment was made in connection with the estimated impacts of Cyclone Nargis (2008) which was not apparent in official figures. This brings up the issue of the need for a possible revision of the time series based on analysis of available data.

It is also likely that many small-scale fishing activities, both marine and inland, are not adequately covered (and probably not licensed).

Recommendations

In relation to the need for expertise to improve their system of data collection, there appears to be a clear need for training at several levels, from the level of fishery officers to higher level on sampling design, methodology and implementation. Considering the system of total enumeration, sampling approaches could be used to establish alternative data sources for verification purposes.

One crucial issue is that of species identification. Currently, data is collected on the basis of only 3-4 categories (fish, shrimp, molluscs, others) which is clearly not of much use. This has to be improved but the consultant's view is that this should not result in the requirement to identify hundreds of species. In tropical fisheries, there will typically be around 20-40 species that dominate.

A priority would be to re-construct time series of catches by major species. It is recommended that this should also involve partners from academia to collaborate with DoF. A targeted scientific project appears to be the best way of addressing this.

Considering possible follow-up activities that would have more immediate results, the two fishing ports (or jetty) visited in the Yangon area collecting detailed information on fishing activity (i.e. species identification, first-sale price, statistical square of catch, fuel consumption, and possibly fishing effort). These two ports (Szyh & Annawar Aung Fishery Jetties) are managed by private companies that also operate a significant number of vessels (about 200, mostly trawlers). It is expected that these companies could provide detailed cost structure on fishing activity of their vessels. Other major fishing ports may not be of the same standard (i.e. approved for export) but it is likely that the same system of data collection exists, implemented by port authorities or private management. Basic data are provided to the fishery authorities by the ports but for some unknown reason, these data appear to lose resolution during the flow of information so that even species-specific data is lost. A concerted effort to recover/compile data from these ports, most of which may be in electronic format already, could provide valuable data on a significant part of commercial fisheries in Myanmar.

Another explicit request from the DoF is support to carry out resource surveys in order to update/revise the potential for fisheries. Note that the DoF has a specific division dealing specifically with research and resource assessment (but does own a vessel for such purposes). The last comprehensive resource surveys were carried out in the 1980s (under a FAO/UNDP fisheries project) and subsequent surveys carried out with the assistance of SEAFDEC (2004 & 2007) are not considered to have been adequate (i.e. limited time periods and low sampling intensity due to limited funds). A major justification for the need for resource surveys is that there are concerns about the state of resources but no clear justification to provide to policymakers on the need to reduce or at least manage the existing fishing capacity.

[30] Harper, S., O´Meara, D., Booth, S., Zeller, D., Pauly, D. 2011. Fisheries catches for the Bay of Bengal Large Marine Ecosystem since 1950. BOBLME project publication, Ecology 16 (available at www.boblme.org)

Sri Lanka

Sri Lanka has a narrow continental shelf with an average width of 22 km. Its extent is 30 000 sq. km which is a small percentage (5.8 %) of the country's ocean area. Marine and inland fisheries production in 2008 amounted to 252,670 MT and 38,380 MT, respectively.

The fisheries sector of Sri Lanka consists of three main sub sectors, namely coastal; offshore and deep sea; and inland and aquaculture. The whole sector (marine, inland, and aquaculture) employs around 250,000 active fishers and about 100,000 in indirect fishers. It should be noted that the fisheries sector of Sri Lanka was severely affected by the tsunami in 2004, but the sector has now recovered (possibly overshooting desirable capacity levels) with support from government, international aid agencies, and the private agencies.

Some 610 species of coastal fish have been reported in Sri Lanka. In relation to small pelagics, the more common species are *Sardinella spp., Amyblygaster sp., Rastrelliger spp., Auxis thazard, Anchova commersoni,* and *Hirundichthys coromandelensis*.

The Statistical Unit (SU) of the Ministry of Fisheries and Aquatic Resources (MFAR) is the key organisation responsible for the compilation and reporting of fisheries statistical information in Sri Lanka. The SU functions as a clearinghouse and coordination point for fisheries statistics in Sri Lanka. It receives fisheries data reports from various sources and also collects some limited data itself (visits to Colombo fish markets and specific surveys).

It is the Department of Fisheries that does the actual data collection through its network of 145 fisheries inspectors (one for each defined area/division). The approach used was developed by an FAO project in the early 1980s, which was designed in such a way as to produce rough estimates without going into too much detail. Apparently the documentation of this methodology, along with possible implementation manuals, has been lost over time. Most data are collected by means of interviews and/or guess estimates. Surveys carried out after tsunami give estimates of total no. vessels which are used as the basis for raising data.

There are various statutory bodies and one state-owned company under the MFAR, which are responsible for fishery data collection in their respective areas of responsibility- These include the National Aquatic Resources Research and Development Agency (NARA), Ceylon Fisheries Cooperation (CFC), Ceylon Fishery Harbours Corporation (CFHC), National Aquaculture Development Authority (NAQDA). NARA and NAQDA are research and development agencies including activities in training, while the CFC is a marketing organization and the CFHC is responsible for construction, maintenance and management of fishery harbours and anchorages respectively.

Design of data collection system

The system in place can be divided into two components, referring to the institutions that are running these;

i) A sample survey for the estimation of basic fishery data, run by the Statistics Unit (Ministry level) with support from the Department of Fisheries and Aquatic Resources (DFAR)
ii) The large pelagic fishery sampling programme (MBRD/NARA);

DFAR Fisheries inspectors select well representative landing sites as part of a sample survey within their division to collect statistics to estimate the monthly production. There are 15 fisheries administrative districts covered by 145 fisheries officers. Additional information relating to vessel activity, fishermen, quality control, etc. are collected.

The basic information collected by FIs are catch by each species/group, number of crafts operated per day (effort) and fish prizes. FIs do not have a standardized sampling system or procedure. There appear to be no set instructions or guidelines as to how many or which landing sites to be covered within his area. A monthly summary sheet is used to submit such data (Annex 13).

Information is also collected on the number of sea days spent by the sampled boats and the number of trips made by the boats on a monthly basis. These are used to estimate the monthly average of the number of sea days per trip and the number of trips per month. The monthly average of number of trips are added up and divided by 12 to obtain an annual average value for the number of trips per boat per month. SU also assume that 5% of the fleet is not operating. In simplified terms, annual production is thus estimated as:

- average Catch/ trip X Average no. of trips /month X 12 X 95% Fishing fleet

The SU also carries out some sampling activity in order to cross-check and validate the accuracy of data collected by other institutions. This may involve sampling at four main fishery harbours (Beruwala, Galle, Purana Wella and Tangalle) in order to obtain independent estimates of average catch rates.

The NARA Large pelagic fishery sampling programme is done through a sampling design conducted on a monthly basis. Fish landing sites are considered as the primary sampling unit. Secondary sampling units are the Boats. Production estimate are made for the fisheries by major tuna and tuna-like species according to the major gear types. Trained data samplers (12) visit selected landing sites on a daily basis to collect:

- Fish catch at landing day (By species, lengths, weights etc)
- Fishing effort (Boat types, gear types)
- Other related information (Fishing hours, fishing area, Crew details, fish quality etc.)

The selection of landing sites for sampling is done randomly. At the beginning of the each month, the responsible research officer prepares the time table for sampling. Sites are visited on a rotational basis according to the time table. Sometimes adjustments will be made in the time table due to the seasonality of the fishery. The number of days allocated for landing sites may vary from one month to another. Note that this appears to be the authoritative source of tuna production estimates, used by the SU and reported to the IOTC.

Another NARA sampling programme in place refers to small pelagics. Nine samplers and 3 scientific officers are responsible for the running of this programme, covering the 15 administrative districts. Two selected major landing sites are sampled per week in each district. Contrary to the tuna sampling programme, the objective is not to produce national statistics, bearing in mind the limited capacity to carry out the required sampling.

Flow of information

The SU has a relatively small staff of seven including a statistician, 2 Statistical Officers three Fisheries Inspectors (FI) and one Data Entry Operator, which appears to be a limited capacity to handle the flow of information, compilation, analysis and publication (Figure 12).

NAQDA Inland Fisheries & Aquaculture data	**Customs** Import & Export data	**DFAR** Coastal Marine & Lagoon Fisheries data	**CFHC** Industrial fishing vessel data?	**NARA** Large Pelagics Fishery data	**SU** Fresh Fish Prices data

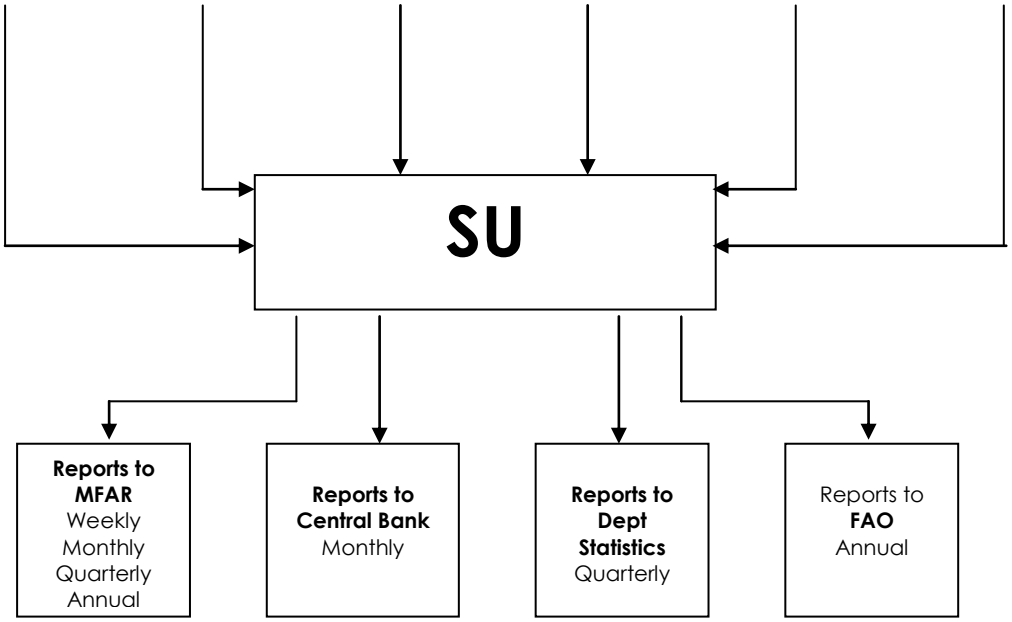


Figure 12. Flow of information into the Statistics Unit in Sri Lanka.

Ancillary data

NARA samplers are instructed to collect incidental catches, data on incidental fisheries conducting along with the main fishing such as ring net operation, troll etc., fish prizes, onboard processing, dry fish production on board etc. Thus, this sampling activity provides additional economic and ecosystem-related data.

The CFHC collects a variety of data on the activities of industrial and multiday boats in its fishery harbours, of which there are currently 18 in Sri Lanka (expected to increase to 23 in near future). Their interest is primarily vessel usage of their facilities, the collection of harbour fees, and the movements of vessels between their harbours. The CFHC has also been given the task of collecting data from foreign vessels landing their catches in Sri Lanka. However, MFAR is considering expanding this to include other vessels such as the multi-day boats that use the CFHC harbours by introducing a logbook system.

A logbook system is in the process of being introduced to cover so-called multi-day boats of which there are about 4,000. A VMS system is also expected to be introduced shortly (2012) to cover the activity of these larger vessels. The Department of Fisheries and Aquatic Resources has already completed the basic requirements for introduction of log books for the off shore fishing vessels of Sri Lanka. At the end of each fishing trip, the master of the fishing vessel has to submit the catch data (two copies) to the harbour manager and to the officer of DFAR. Subsequently, these data are to be entered to the electronic data base.

The latest frame data available for Sri Lanka was carried out in 2006/2007, limited to the no. of fishing vessels, which was carried out in connection with post-tsunami assistance. The full census for the fisheries sector dates back to the early 1970s, although one of the tasks of fisheries inspectors is to attempt to maintain and revise data concerning the frame (i.e. fishers, vessels, gears). Sri Lanka appears to be the only BOBLME country that is trying to take advantage of regular population censuses to identify the fisher/household population.

Box 6. Data collection for inland fisheries in Sri Lanka

The National Aquaculture Development Authority (NAQDA) in Sri Lanka is presented here as an example of best practice in relation to data collection for inland fisheries. Although its primary role is in the development of aquaculture and culture-based fisheries, it also collects data on inland capture fisheries. The approach used to collect these data is to take advantage of existing fishers associations (called societies) which have a strong role in Sri Lankan inland fisheries in terms of management. Detailed records are kept of landings from capture fisheries, as these are the basis for determining the fees to be collected for the functioning of the associations. Most production comes from reservoir fisheries which are well managed (i.e. limited access, motorization not allowed, mesh sizes followed, good catch rates and profit margins). This is a type of logbook data recording which the NAQDA extension officers take advantage of, covering about 80% of production. Furthermore, a sampling program is in place, 10 boats are sampled in selected landing sites four times a month in each district, which is an alternative source of data for validation purposes. NAQDA has a staff of 60 extension officers and 20 district officers to cover the 24 districts in Sri Lanka.

Problem analysis – identified gaps

It is important to note that NARA has the responsibility of providing tuna statistics to MFAR, which they do by covering major landing sites for tuna fisheries (about 12 sites used by so-called multi-day boats). A selection of smaller landing sites used by smaller boats (boats with outboard engines using gillnet primarily) are also sampled, providing important data on fisheries for small pelagics and demersals. However, NARA is aware of the fact that coverage of small-scale fisheries is too low which may also have impact on the estimation of total catches of tuna, as many smaller boats target tuna seasonally. The staff available (9 samplers and 3 research officers) is limited, covering about 8 landing sites per month in each division (roughly 50 landing sites out of a total of about 1000). Note that it is the same samplers that deal with tuna fisheries, which is given higher priority.

The fisheries statistics system currently in place for Sri Lankan marine fisheries are operated by several agencies, and the overall statistics system is quite complex and not up to required standards. There is considerable concern in the quality and reliability of the catch and effort data, market data including exports and imports, the individual systems produce, and there are some important gaps in the coverage of the parameters relevant to fisheries development and management. There is little integration of the system of different agencies other than the compilations of various annual reports. These inadequacies weaken the use of the data for fisheries development and management activities.

The current data collection system operated by DFAR at beaches and harbors is generally considered to be weak and unreliable. The majority of the problems focus on the activities of the Fisheries inspectors and specifically the instructions and conditions under which they work. These include the following problem areas:

- Standards, guidelines and procedures are lacking for the implementation of the sampling survey, carried out by FIs.
- The serious gaps in data, particularly for the north and east of the country, as there was a war duringthe last 30 years.
- Estimated catches are not linked to a specific boat type or fishing gear type.
- There are no standards for collecting data and raw data records are not attached to the monthly summary sheet, nor are they kept in the files of the FI's.
- Sampling schedules are not specified and depend on the initiative of FIs, as well as inadequate supervision and data validation.

- There are no standard procedures for the calculation / raising of production figures.
- At central level, both staffing and equipment (computers, printers, scanners) are inadequate to produce timely analysis, processing and dissemination of fisheries data. And there is a lack of dedicated software as well as a dedicated information system.
- Limited funds result in inadequate supervision and follow-up of activities (annual workshops, training, field visits, etc.)
- In relation to the NARA sampling programme, boat categories do not coincide with the definitions used by the Ministry, which is a serious lack of consistency and makes it difficult to make full use of available data (available registry and census data on vessels).

The Ministry is aware of the weaknesses in data collection, referring particularly to the approach used by the DFAR. Technical assistance is requested for an in-depth revision and designing a sampling programme and to provide training to fisheries inspectors (e.g. species identification, etc.) as well as the development of standards, guidelines and procedures.

It is interesting to note that a recent "re-construction" of the catch time series in Sri Lanka in the almost doubling of estimated catches, as small-scale and subsistence fisheries appear to be poorly covered[31].

Recommendations

Considering that NARA already has a sampling programme in place for small pelagics, albeit limited in coverage, the best solution may be to strengthen this. In this way, DoF and NARA would have distinct and complementary roles, although both institutions need support to strengthen their data collection systems.

The system for routine data collection clearly needs improvement, which would involve a review of methodology, preparation of guidelines and procedures as well as training of field staff.

Considering the gaps in information for the northern coast (and eastern), a re-construction of data on the fisheries, using local available information and expertise, is recommended as the subject of a research project. Note that the fishing for small pelagics may be relatively more important in the north, because of the more extensive continental shelf (Gulf of Mannar).

Thailand

The Thai fisheries sector is one of the top producers in the world. In 2007, total production was estimated at 3.68 million tonnes, including marine and inland fisheries as well as aquaculture. As of 2007, the total marine capture fisheries production was 2.08 million tonnes, of which 92% was from large-scale fisheries and 8% was from small-scale fisheries; 70% of the catch was from the Gulf of Thailand, and 30% was from the Indian Ocean (including Andaman Sea).

Pelagic fisheries constitute roughly 30% of marine catches, which are taken by using various types of purse seine nets, drift gillnets, encircling gillnets, lift nets and other surrounding nets. They can be divided into three groups according to size of pelagic fish: small, medium and large. In the past, Indo-Pacific mackerel (*Rastrelliger brachysoma*) or "Pla Tu" was the most popular for Thai consumers. However, the development of improved pelagic fishing gear and techniques, especially light luring, contributed to the increasing catch of small pelagic fish and squid. Based on 2004 data, pelagic fish

[31] Harper, S., O´Meara, D., Booth, S., Zeller, D., Pauly, D. 2011. Fisheries catches for the Bay of Bengal Large Marine Ecosystem since 1950. BOBLME project publication, Ecology 16 (available at www.boblme.org)

catch were comprised mainly of anchovies (19%), Indo-Pacific mackerel (18%), sardinellas (14%), scad (11%), longtail tuna (9%), eastern little tuna (6%), trevallies (6%), big-eye scad (5%), Indian mackerel (4%), king mackerel (3%), hardtail scad (2%), wolf-herrings (1%) and the other retained species (2%) were black banned king fish, mullet, pomfret and threadfin.

In 2007, catches of Indo-pacific mackerel amounted to about 137,000 MT, of which 30% (41,000 MT) were taken in the Indian Ocean. Catches of Indian mackerel were about 32,000 MT, where almost 60% (18,820 MT) is taken in the Indian Ocean. Catches of hilsa appear to be minor and very localised (southern part of the Andaman Coast, comprising a different species (T. toli) compared to the major fisheries in the northern Bay of Bengal (*Tenualosa ilisha)*.

The Department of Fisheries (DoF) in Thailand is responsible for the collection of fishery data. This is carried out by the Fishery Statistics Analysis and Research Group (FSARG) of DoF, responsible for design and methodology, planning, data input, processing and reporting on Thai fisheries statistics in collaboration with Provincial Fisheries Offices.

Design of data collection system

Fishery Statistics Analysis and Research Group (FSARG) of DOF is responsible for planning, data input and processing and reporting on Thai fisheries statistics in collaboration with Provincial Fisheries Offices. In each field of marine fisheries, inland fisheries, the Statisticians of FSARG design and plan surveys and enumerators, based at Provincial Fisheries Offices, implement data collection for each survey. They send back completed survey forms to FSARG where all of the data are processed with computers. This is carried out by a combination of the following components:

a) Census surveys conducted every 10 years approximately. The lack of adequate funding makes it difficult for DoF to carry out this task at more frequent intervals.
b) A logbook system for a sample of larger vessels which are chosen randomly. Sampling intensity has been fixed, ranging from 10% to 15% of landing events. It appears that the approach used is that enumerators fill out the respective logbook form by interviewing the owner/fishing master. This does not necessarily take place at the landing site and can consist of monthly visits to the vessels owners to record monthly data. If data is lacking, other sources of data such as fish sale tickets are used (records of fish landing by fish traders, brokers, Fish Marketing Organizations, Fishermen's Cooperatives).
c) Recording of landings that take place at 37 major landing sites. The sampling target is to cover 14% of landing events and the data is collected from existing records (i.e. Fish Marketing Organisation, fish sale tickets). It is important to note that these data are collected for cross-checking purposes.
d) Random sample of villages and fishing gears carried out once a year. About 400 fishing villages (total about 3,700) are selected as representative samples. Enumerators receive a sampling plan specifying the sample villages and fishing gears to conduct interviews with owners on estimates of catch by species for the previous year. The target is to sample 10% of landing events.

Only 10 out of the 24 coastal provinces have a full time enumerator staff employed. In other provinces, staff from the Administrative section conducts survey activities on a part-time basis and assists enumerators when required. Methodology notes and data collection manuals are distributed to support implementation as well as training/workshop activities to discuss needs and practical functioning of surveys. FSARG has reportedly made the following information available to guide the enumerator and/or users:

- .. Methodology notes
- .. Data collection manuals

- .. Other sources of data
- .. Import export data from Custom Department
- .. Marine Fishery Census from NSO
- .. Agriculture Census from NSO (used in connection with inland fisheries)

The approach used in Thailand consists of a so-called logbook survey which is a sample survey, covering about 10%-15% of landing activities by randomly selected larger vessels. For cross-checking purposes, about 14% of landing activities taking place in 37 major landing sites are recorded and used for comparative purposes. The raising of data is based on the frame survey (from census) as well as the fleet register and licensing database. This is complemented by collecting yearly information from randomly selected villages and gears, accounting for about 10% of landing activities (Figure 13).

This is a sound methodology for collecting relevant fishery data and an important aspect is that it has inbuilt cross-checking procedures to validate estimates. This is presumably handled centrally at HQ (Bangkok) by a core staff of four statisticians. However, DoF is in the process of introducing a decentralized processing system whereby the raw data collected are partly compiled / processed at province or district level, and also use external sources of information in processing.

Ancillary data

The marine fishery census is conducted by National Statistics Organization in collaboration with DOF. The objectives of the census are a) to collect data on basic economic structure of marine capture fishery and coastal aquaculture, b) to collect data on socio-economic characteristics of fishery establishment, fishery employees' households and demographic characteristics of fishermen, and c) to provide data to be used as the population frame for sample surveys. The Marine Fishery Census covers all marine capture fishery and coastal aquaculture establishments and fishery employees' households which are located in 24 coastal provinces in the central and the southern parts of the country. The latest marine fisheries census was conducted in 1995. In 2000, an inter-census survey of marine fisheries was carried out.

Fisheries research is carried out by the Marine Fisheries Research and Development Bureau (MFRDB), which is a large institution also under DOF. This organization carries out survey and research activities of marine fisheries and operates two offshore vessels, RV Chulaporn and RV Mahidon, for this purpose. Under this organization there are five Marine Fisheries Research and Development Centers along the Thai coasts. The Andaman Fisheries Research and Development Centre (AFRDEC) covers the Andaman Coast. As part of research activities, AFRDEC runs two types of landing statistics survey, namely (a) survey on landings by Thai vessels, and (b) survey on landing by foreign vessels, which provide more detailed scientific data for stock assessment purposes.

Flow of information

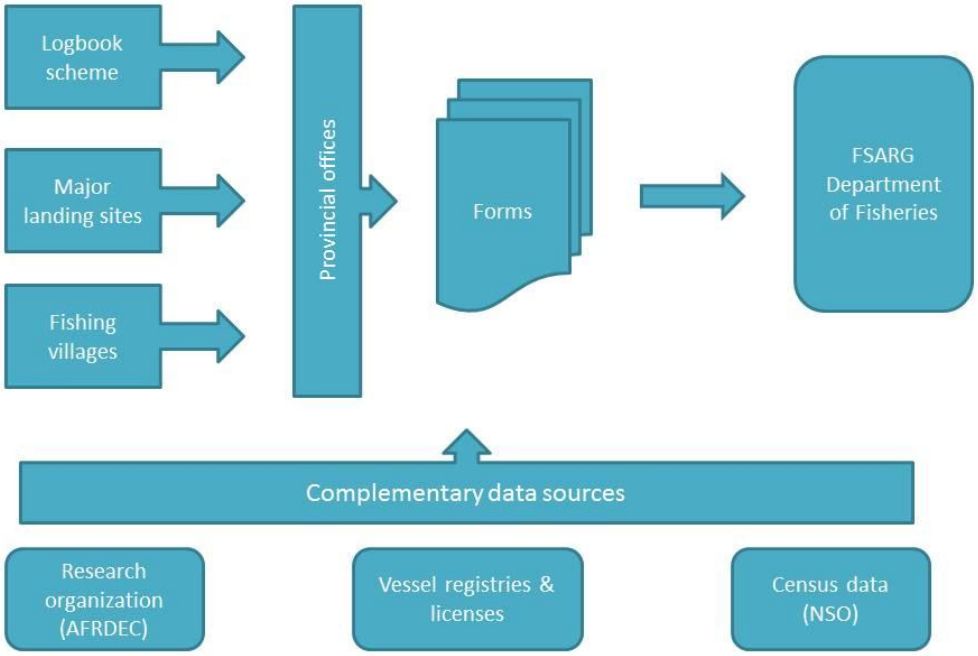


Figure 13. Schematic diagram of information flow in Thailand.

Problem analysis – identified gaps

Thailand suffers from the classical problems of fishery data collection systems such as limited budget, insufficient capacity and manpower in spite of a sound system design and methodology. Some of the identified problems are:

- Delays in the reporting of statistics
- Insufficient resources, personnel, budget and materials to meet demands
- Lack of cooperation in the provision of data by some fishermen;
- Difficulties in obtaining reliable and accurate information on the number of fishing vessels actually operating (i.e. census data and vessel register)
- Insufficient species breakdown to meet users' requirements
- Insufficient training and follow-up activities for samplers
- Annual surveys of fishing villages may be providing inaccurate data, as the approach is very dependent on the memory of fishermen/farmers for a whole year's activity
- There is a need to develop further cross-checking and validation procedures

A review of capture fisheries data in Thailand came to the general conclusion that the current system is under-estimating catches of small-scale fishing and inland fisheries, particularly in the latter case[32]. This indicates that the current approach to sampling of villages and small landing sites is not functioning adequately and possible new approaches should be used.

Recommendations

[32] Lymer, D., Funge-Smith, S., Khemakorn, S., Naruepon, S., Ubolratana, S. 2008. A review and synthesis of capture fisheries data in Thailand – Large versus small-scale fisheries. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand. RAP Publication 2008/17, 51p.

Thailand is in a similar situation as Malaysia, where there is essentially a sound system in place for data collection, albeit with some weak points (notably for small-scale fisheries). Thus, Thailand could possibly benefit from international expertise on subjects such as cost-efficient methods, inter-institutional cooperation, risk assessment and data analysis.

Technical assistance could be provided on the issue of deficient coverage of small-scale fisheries, considering possible alternative approaches for data generation and estimation.

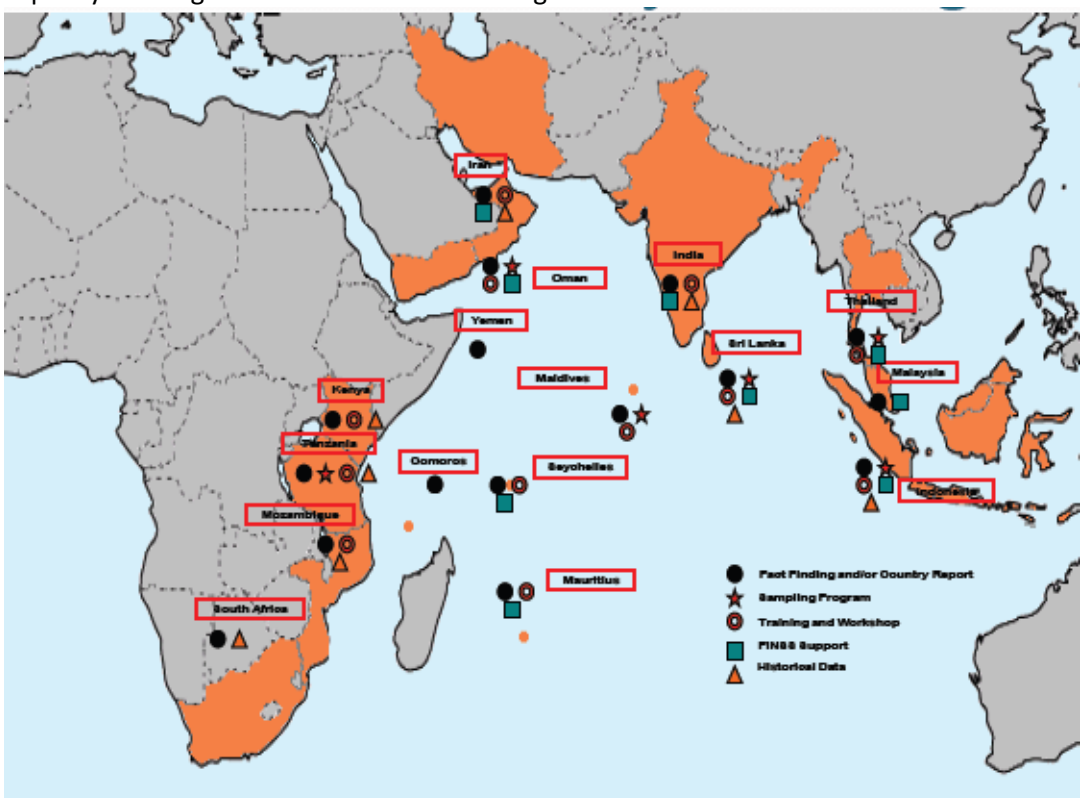
Box 7. IOTC-OFCF – a region-wide initiative on strengthening fisheries data collection

The IOTC has, since its inception, been providing support and assistance to developing coastal countries in the IOTC Region, in the areas of data collection and data management, the majority of these activities implemented under the framework of the IOTC-OFCF project, funded by the Japanese Government. These include:

- Documentation of statistical systems and estimation procedures
- Improving methodologies to achieve required accuracy of data/information
- Streamlining procedures for statistical data collection, processing, analysis, and reporting to improve the timeliness of information dissemination.
- Strengthening of field activities, including catch monitoring programmes (sampling programmes) and collection of other data (length frequency, biometric data, etc.), including training for field staff and enumerators.
- Compilation and computerization of historical data
- Capacity building in the area of data collection and management through workshops and training sessions
- Improving coordination with other national agencies.

A recent initiative is the review of statistics for small-scale tuna fisheries in the Indian Ocean, considering the need for close to real time data on catches of yellowfin and bigeye tuna[33].

BOBLME may need to implement similar capacity building activities and would benefit from establishing cooperation mechanisms with the IOTC, SEAFDEC or other institutions involved in capacity building activities in the BOBLME region.



[33] IOTC 2011. Evaluating the ability of IOTC CPCs and other fishing parties in the Indian Ocean to produce close-to-real time estimates of catches of yellowfin and bigeye tuna. IOTC-2011-SC14-38[E], 9p.

General discussion and recommendations

The focus of the present review is on small pelagics, Hilsa shad and Indian mackerel in particular, but the national data collection systems in BOBLME are designed to cover the whole fisheries sector, or at least as much as possible. The special case of Maldives is the only example of a data system which was originally designed to cover large pelagics (i.e. tunas) only, but this was for obvious reasons. Thus, the findings of this review are mostly generally applicable to the national systems on data collection. Much effort is needed in some cases to improve the current system in place in order to obtain reliable estimates for small pelagic and other fisheries. Nonetheless, recommendations were given in each case (i.e. country) with a special focus on the BOBLME context and small pelagics. It is however up to the national representatives to discuss these findings and agree on priorities as well as the scope of actions to be taken in the context of the BOBLME.

It is however important to note that limited time was available to carry out this review. In some cases there are previously published studies that were available, mostly in the context of the FAO, SEAFDEC, and IOTC, but these may have become outdated. National experts are kindly requested to review and draw attention to possible errors and/or misinterpretations.

The review places emphasis on the routine data collection of fishery data which typically refers to landings and value data (by species/species group), fishing effort, no. fishermen and fleets/gears (fishing capacity), which are the basic data needed to identify production, revenue generation, fleet capacity, employment, and contribution to the economy. Data collection of other types of data (i.e. stock assessment, socio-economic and environmental) was addressed, albeit not systematically due to time limitations.

All countries have in place a system of fishery data collection that should in principle give estimates of production in terms of landings and value, although in some countries there may be political pressure to inflate production estimates. Most countries have difficulty in covering certain components such as small-scale, recreational and subsistence fisheries. The similarities between countries in terms of flow of information and the types of data collected were evident. This is probably due to the influence of FAO in establishing data collection systems, directly through project implementation or indirectly by providing authoritative guidelines. In some cases, too much detail was being collected such as the requirement to identify numerous species (in some cases limited species data). When reviewing existing data collection systems and methodologies, it is recommended that this should not result in requirements for collecting overly detailed information. This would place further strain on national systems which all struggle with limitations in terms of funding, capacity, and expertise, some relatively more than others.

In a few cases, an in-depth review of methodology and sampling design is recommended for the system in place (i.e. Bangladesh, Sri Lanka) or technical assistance to review particular gaps such as inland fisheries (India) or small-scale coastal fisheries (Indonesia). All countries would benefit from international expertise to improve their systems in subjects such as logbook and observer schemes for the purpose of data validation and the collection of additional data on socio-economics and the ecosystem. There are some obvious opportunities to introduce alternative and cost-efficient solutions. For example, simply extending and broadening current systems to cover inland fisheries will most likely not be successful.

An important aspect to consider is the type of sampling scheme in place. Best practices to achieve representative data for the accurate estimation of key parameters normally involve a form of probability-based sampling that minimizes or eliminates systematic bias and allows for reliable estimates of precision. Probability sampling in surveys ensures that the sampling errors can be

estimated based on the data collected. In practice, this is often difficult to implement as fisheries administrations and institutes have to take into account costs, logistics, working hours, etc.

Total enumeration, for example by requiring all fishermen to report, is another approach that is not necessarily more burdensome. The problem is that it should also be accompanied with some means of verifying that the data being reported is reliable. In some cases, there were procedures in place for cross-checking information but in most countries validation of reported data is weak or non-existent. Introducing cross-checking and validation procedures would typically involve some form of sample-based routines. This should also include the direct weighing of catches, as there appears to be a trend for always assuming that a basket has a pre-defined weight.

Countries that have adopted a total enumeration approach for all or a major part of their data collection activities are the Maldives, Myanmar, and Indonesia. The system in the Maldives covers the main fisheries for tuna and large pelagics, ignoring other fisheries for non-tuna species. Myanmar uses this approach for all sectors, including inland fisheries. The system in place in Indonesia is generally considered to be the same design adopted in the 1970s, which was a sampling approach design with minor modifications. However, the consultant is of the view that the modifications over time have essentially changed it to a total enumeration approach covering the more important landing sites (using auction records as primary source for data collection). This covers a substantial proportion of fishing activity in Indonesia, but a sampling approach is still used for small landing sites and fishing villages.

Other countries such as Bangladesh, India, Malaysia, Sri Lanka, and Thailand use a sampling approach. In such cases, it is crucial to have reliable information about the sample frame which is structural information on the number, characteristics, and spatial distribution of vessels, gears, fishers, landing sites, and fishing communities. This is usually obtained through a frame survey which is essentially a fishery census. These should be updated regularly, but all countries struggle in doing so because of their high cost in terms of finances and manpower. Malaysia appears to be the most successful by making use of information technology (i.e. online registration and daily monitoring of fishing activity). Most other countries cope with this by making use of field staff to make regular revisions/estimates of the sample frame, albeit this may be introducing bias to estimates.

Small-scale fisheries generally appear to be under-estimated, even in countries with sound methodologies and well-developed systems. Again, this is related to unreliable information on the sample frame. Best practices for reliable information on the sample frame are to use information technology, which is expected to be successful for industrial and large-scale fisheries. Fishery regulations should oblige small-scale fishing vessels to be registered and boat-owners must have an official license to fish. Full registration, combined with the licensing and numbering of vessels, could provide basic structural data on small-scale fisheries, so could replace frame surveys. All BOBLME countries require registration and licensing for larger industrial vessels, but this is typically not the case for small-scale vessels, or if it is required then it is not strictly enforced.

However, structural information on subsistence fisheries cannot be obtained through frame surveys or registration. The only way to obtain a good sample frame is to make use of external resources, e.g. by including fishery questions in more general activities such as a population or agricultural census[34]. Considering the declining quality of agricultural statistics globally, the World Bank is promoting the “Global Strategy on Improving Agricultural and Rural Statistics” in collaboration with FAO, which is based on three pillars; a) establish a minimum set of core data, b) harmonise

[34] de Graaf, G. J., Grainger, R. J. R., Westlund, L., Willmann, R., Mills, D., Kelleher, K., and Koranteng, K. 2011. The status of routine fishery data collection in Southeast Asia, central America, the South Pacific, and West Africa, with special reference to small-scale fisheries. – ICES Journal of Marine Science 2011.

methodologies, develop a master sample frame, implementation of an integrated survey framework, and develop a national data management system, and c) governance and capacity building[35]. Best practice would clearly be to introduce an integrated system, which would be a cost-efficient way of addressing the needs of various sub-sectors.

There is a clear need for more coordinated and integrative approaches when fishery data collection involves more than one institution. In some cases there is a duplication of effort for no clearly discernible reason. Also, the available data at the national level is not used optimally due to the lack of intra-agency collaboration.

Data collection on small-scale and inland fisheries is deficient in most countries. Best practices include the co-management approach to data collection, of which there are several examples in the region. One unexplored possibility is partnerships with the industry (involving also scientific institutions as well as the fisheries administration) for the purpose of data collection, which was suggested for Myanmar but can be applied more generally. Alternative approaches should be used to provide estimates on inland fisheries (e.g. household surveys, fisheries-related questions in relation to population censuses, food consumption studies, GIS-systems). Best practice is not to extend traditional sampling schemes from the marine to inland fisheries.

Total enumeration should provide a complete picture and reliable estimates, but in practice this system is implemented without any or limited procedures for cross-checking and validation of data provided. Thus, the reliability of the information provided depends almost entirely on the willingness of fishermen to provide truthful information. If there are fees and levies to be collected, then experience indicates that the data provided are generally under-estimates. Some examples of best practice were identified such as the system in Thailand which uses a double approach of logbook surveys (essentially an interview) and sampling approaches. Malaysia has a good system called Vessel Operating Reports (LOV). And Bangladesh has a thorough checking of submitted logbooks from industrial vessels. Note that these examples are from countries with sample-based approaches to data collection, not total enumeration. The point is that sample-based approaches can be used to double-check data reported from total enumeration, taking a sample of fishing activity (e.g. a sample of 10-20%). If risk assessment methods are used to determine from where samples should be taken, then this becomes a particularly powerful and cost-efficient method for data validation.

Note that all BOBLME countries have taken the first steps to implementing EU Regulation 1005/2008 (the IUU Regulation) by introducing a catch certification scheme in order to maintain market access to the EU. This is an on-going process and provides opportunities also in the area of data collection.

It is the view of the consultant that data collection systems, typically run by the fisheries administration, should be relatively simple in terms of data collected. More detailed information such as those required for stock assessment purposes, or detailed socio-economic or ecosystem data, should be collected by scientific institutions through targeted and well-designed projects. It should be noted that in two cases (i.e. CMFRI in India and NARA in Sri Lanka) it is the scientific institutions that are generating national statistics and using a sound sampling methodology in the process. However, this can be considered to be the exception to the rule, brought about by special circumstances.

More directed research on small pelagics is clearly needed in most countries, although much information may be available (e.g. India, Thailand). Generally speaking, key issues are the need for detailed catch and effort data, species composition, length/weight and maturity data, and the

[35] World Bank 2011. Global Strategy on Improving Agricultural and Rural Statistics. Report No. 56719-GLB

geographical location of fishing activity. One major difficulty is that routine data collection systems do not appear to provide reliable estimates of fishing effort. There will generally be a tendency to aggregate data to a level that may provide an indicator on overall economic performance, but it becomes unreliable for stock assessment purposes. The current systems do not provide more than basic data for stock assessment. More detailed information on species composition is generally needed, but this should be the subject of targeted research. The systems which require detailed species information are too demanding (i.e. ideally samplers should be taxonomists) and open for the possibility of frequent errors.

The lack of electronic transmission of data and reports is another problem in many of the countries, making work much more tedious and time-consuming as well as introducing frequent errors in the data. Lack of dedicated databases and information systems is another problem in some countries.

Another major issue is the lack of resolution in terms of catch area or fishing ground (as opposed to area of landing). All countries have policies promoting increase in production by extending offshore including the high seas. There is an urgent need for higher resolution on the origin of the catches, as this movement offshore may give the false impression that stocks are in a stable state as production continues to increase. Observer schemes are particularly useful in this context, or a combination of logbook and VMS schemes which do exist in some countries.

Expertise is needed to develop sampling schemes, which can be applied for a number of objectives (e.g. cover small-scale fisheries, using observers and/or logbooks to cover a sample, cross-checking and validation purposes, for stock assessment data, for economic analysis, for ecosystem data, etc.). The necessary expertise on sampling theory and design as well as implementation is available in several countries. However, the CMFRI in India may be in the best position to offer this in the BOBLME region, as it has previous experience in doing so (i.e. BOBP-IGO).

Although the CMFRI has well-developed training capabilities it is important to note that this is not enough as a stand-alone activity. The constituted BOBLME Fishery Statistics Working Group appears to be the appropriate vehicle for this, but it is important to include more participants that have (or will have) the responsibility of developing new sampling programmes and implementing them. Another crucial aspect is that the working group should create working arrangements to provide support to follow-up activities (i.e. facilitators, support in sampling design and methodology, data analysis, implementation of pilot projects, travel if necessary, as well as a budget to support this).

Socio-economic data is generally available, at least to give a rough idea of value, fleet structure and employment. There are many alternative sources of data but these are generally fragmented and not always easily accessible. On economic data, the best sources of information are company data in relation to commercial fisheries. For small-scale fisheries, this may be available through fishery household surveys and in many cases, this information is available locally at community level. The problem is accessing this information. Another often ignored source of valuable information are the records of port management authorities, which in many cases can give an idea of cost-structure of commercial fleets as data on earnings and costs may be available. As indicated above, it is recommended that socio-economic analysis should be the subject of scientific research, making use of available data and making inferences on missing data when needed.

Ecosystem data appears to be very fragmented and lacking in many cases. Considering that the BOBLME has on-going initiatives on subject such as MPAs, remote-sensing, pollution and ecosystem health, the present review focuses on issues such as by-catch and discards, incidental catches of sensitive species, and spatial data on resources. The major impediments to collecting this type of information is that observer schemes are only starting to be introduced (linked to a requirement by the IOTC), logbooks are considered unreliable (true if no procedure in place for checking reports) and most BOBLME countries do not have research vessels, making it almost impossible to obtain fishery-independent data and of a decent coverage.

Numerous historical surveys have been carried out in the region and these can provide a baseline. The problem is that it is usually a considerable task to identify and recover the relevant data. In relation to expertise and means to carry out resource surveys, these are available in India and Thailand (Indonesia should receive its vessel shortly) as well as SEAFDEC. The possibility of coordinated surveys in neighbouring countries (e.g. Bangladesh, India, Myanmar) should be explored if this be identified as a priority by the BOBLME and Member Countries. Albeit costly, resource surveys (to provide fishery-independent data) have been identified by some countries as a priority (i.e. Myanmar, Malaysia, Indonesia) which could be supported by existing structures. This may be of particular importance when considering the broader context of ecosystem management (i.e. need for a wide range of data on the state of the ecosystems).

Annex 1: Terms of Reference

Food and Agriculture organization of the United Nations

Terms of Reference for Consultant/PSA

Job Title	Expert on Fisheries Data and Statistics		
Division/Department	RAP		
Programme/Project Number & information	[GCP/RAS/236/GFF] / TF5G11070919 8 / Subcomponent: 2.3 / Country: All		
Location	All BOBLME countries		
Expected Start Date of Assignment	10 October 2011	**Duration:**	50 days WAE
Reports to **Name:** Chris O'Brien		**Title:**	Regional Coordinator BOBLME Project

GENERAL DESCRIPTION OF TASK(S) AND OBJECTIVES TO BE ACHIEVED

Bangladesh, India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka and Thailand are working together through the Bay of Bengal Large Marine Ecosystem (BOBLME) Project and lay the foundations for a coordinated programme of action designed to improve the lives of the coastal populations through improved regional management of the Bay of Bengal environment and its fisheries.

The objective of Project Component 2: "Coastal/Marine Natural Resources Management and Sustainable Use" is to promote the development and implementation of demonstrative regional and sub-regional collaborative approaches to common and/or shared issues which affect the health and status of BOBLME. Subcomponent 2.3: "Collaborative Regional Fishery Assessments and Management Plans" supports the introduction and promotion of collaborative fisheries management approaches for selected key transboundary species through the development of regional and sub-regional management plans and harmonization of data collection and standardization.

The 2011 BOBLME Project Work plan adopted by the PSC in March 2011 has the following activities:

A review is prepared on the collection of catch/landings statistics for hilsa and Indian mackerel (small pelagics) in BOBLME countries (national and decentralized levels), covering also value of catch, cost of fishing, and contribution to economy (socio-economic information). *The existing (FAO) training course on fisheries data and statistics is adapted for implementation in the BOB through an established capacity development institution (e.g. SEAFDEC). Fisheries Statistics Working Group meets to review training course, confirm capacity development needs, promote harmonization of statistics and links to fisheries management advice. South Asia sub-regional workshop to discuss information on harmonization of fisheries statistics (promotion of Southeast Asian approach through SEAFDEC). Training or other activities to improve fisheries statistics undertaken.*

The proposed consultancy would undertake the work highlighted above.

Under the overall supervision of the FAO Regional Representative, the direct supervision of the BOBLME RC, the general technical guidance of the Lead Technical Officer and in close cooperation with the Chief Technical Advisor, the consultant will be responsible for drafting a plan for carrying out this review, then implementing the review.

Key performance indicators

Expected Outputs:	Required Completion Date:
Output 1. A draft itinerary and methods to be used, (e.g. meeting at the central statistical and/or research institute office, meeting at Provincial/state office and inspection at a sample of landing sites and ports) for undertaking in-country reviews of the data collection and statistical procedures for generating fisheries information systems for hilsa (both marine and inland), Indian mackerel other small pelagic in BOBLME countries (include only that part of the Country that falls within the BOBLME boundaries).	11 October 2011
Output 2. Report composed of 2 parts (see details in Annex 1): Part 1: Fisheries data for hilsa, Indian mackerel and other small pelagics Part 2: Other relevant data for Ecosystem Approach to Fisheries Management	31 December 2011
Note: The Maldives catch neither Indian mackerel nor hilsa but a description of their data collection methodology and an assessment of quality should be carried out.	
Outputs will be delivered electronically in MS-Word compatible format; as attachments to a brief report describing the work performed during the consultancy	

Required Competencies

Academic Qualifications

A Higher degree and/or equivalent experience in fisheries related sciences

Technical Competencies and Experience Requirements

The consultant will have a higher university degree in a field relevant to the project; demonstrated knowledge and experience in fisheries statistics (data collection and processing); familiarity with FAO project implementation.

He/she will be able to demonstrate his/her ability to work successfully in intercultural project teams. Prior working experience within the BOBLME countries is considered an advantage

Note

Dr Kim Stobberup is being proposed for this consultancy. See attached CV and PHF

CV.pdf

The consultant will work on a “when actually employed basis” (WAE). The current TOR covers the period up to 31 December 2011, but restricted to a maximum of 50 days.

Payments will be made on milestones and outputs as agreed with the Regional Coordinator.

Travel within the Bay of Bengal region (Bangladesh, India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka, Thailand) will be required and will be undertaken in accordance with FAO rules and procedures.

Annex to ToR:

Detailed description of the Report

Part 1: Fisheries data for hilsa, Indian mackerel and other small pelagics

A description of the flow of information from data collection at ports/landing sites/boats to the production of fisheries information for hilsa, Indian mackerel and other small pelagic fisheries (e.g Statistical Yearbooks) and databases (e.g. catch and effort time series) in the BOBLME countries. Where possible, visual diagrams and charts should be used.

The analysis should include:
(i) all agencies responsible for the collection of fisheries information (e.g. parallel systems for research institutes and statistical agencies, in some countries);
(ii) data variables covered and include a copy of the data forms used at different steps of the information flow;
(iii) the methods used for aggregation, extrapolation and production of information, as well as an estimate in the number of staff employed at each level of the information flow chain;
(iv) an assessment of the data quality, adequacy of the sampling design (e.g. coverage of landing sites) and taxonomic difficulties;
(v) a gap analysis and recommendations for improvements in data quality, and identification of capacity development needs.

Part 2: Other relevant data for Ecosystem Approach to Fisheries Management

Where possible, include a brief description of ancillary data collection systems in each BOBLME country (e.g. cost and profit economic surveys, social data collection systems, environment data collections) in terms of who is responsible, what variables are measured and by what methods[36]

Case studies / examples of the types of best practices should be included in the report where these demonstrate good practice in data collection and analyses for both fisheries and ancillary data.

The expected length of the report is approximately 40-60 pages of text. Some illustrations/photographs to complement the text are encouraged and should be provided separately to the document (i.e. not embedded in the document). The report will include an executive summary, and should also highlight information gaps that could be filled by BOBLME Project activities.

[36] BOBLME can provide templates of data collection agencies in some countries and more should be available shortly.

Annex 2. Itinerary and persons met

Month	Date	Day	Origin	Destination	No. Days	Acitivity
	29	S	Santiago, CL	Sydney, AU	1	Travel
Oct	30	S	Santiago, CL	Sydney, AU	2	Travel
	31	M	Sydney, AU	Phuket, TH	3	Travel
November	1	T			4	Briefing at BOBLME, consult project documents
	2	W			5	Prepare missions to countries, compile info
	3	T			6	Visit to Phuket fishing port, prepare missions
	4	F			7	Meeting at AFRDEC (P. Nootmorn), prepare missions
	5	S			8	Compile info
	6	S	Phuket, TH	Penang, MY	9	Travel
	7	M			10	Report writing (holiday in Malaysia)
	8	T			11	Meeting at FRI, visit to Penang fishing port
	9	W	Penang, MY	Kuala Lumpur, MY	12	Report writing, travel
	10	T			13	Meeting at DoF - Putrajaya (w/ SEAFDEC, LKIM, FRI)
	11	F	Kuala Lumpur, MY	Jakarta, ID	14	Travel, Meeting at DG Capture Fisheries
	12	S			15	Report writing
	13	S			16	Report writing
	14	M			17	Meeting at DG Capture Fisheries
	15	T	Jakarta, ID	Medan, ID	18	Meeting at Fisheries Research Inst., travel
	16	W			19	Meeting at Prov. DoF, visit to Belawan fishing port
	17	T	Medan, ID	Aceh, ID	20	Travel, meeting at Prov. DoF
	18	F	Aceh, ID	Medan, ID	21	Visits to Lampo-o & Lhoknga fish landing sites, travel
	19	S	Medan, ID	Bangkok, TH	22	Travel
	20	S			23	Report writing
	21	M			24	Meeting with S. Funge-Smith (FAORAP), report writing
	22	T			25	Report writing
	23	W	Bangkok, TH	Yangon, MM	26	Travel, meetings at DoF and Fisheries Federation
	24	T			27	Meeting with DoF & Federation, visit to Szyh jetty
	25	F	Yangon, MM	Kolkata, IN	28	Visit to Annawar Aung jetty, travel
	26	S			29	Meeting at CIFRI, visit Diamond harbour market
	27	S	Kolkata, IN	Visakhapatnam, IN	30	Travel
	28	M			31	Meetings at FIS & CMFRI, visits to Visakhapatnam Fishing Port, as well as Lawson's Bay and Pudiamadaka fishing villages
	29	T	Visakhapatnam, IN	Chennai, IN	32	Meeting with trader, travel
December	30	W			33	Meetings at FIS & CMFRI, visit to Nochi Kuppam fish landing sites
	1	T	Chennai, IN	Kochi, IN	34	Visit to Chennai Fishing Port, travel

	2	F			35	Attend BOBLME mackerel workshop, meeting with CMFRI scientists
	3	S			36	Report writing
	4	S	Cochin, IN	Dhaka, BD	37	Travel
	5	M			38	Meeting at DoF
	6	T			39	Visit to fish market, report writing
	7	W	Dhaka, BD	Colombo, LK	40	Travel
	8	T			41	Meetings at NARA, Univ. Kelaniya, Ministry
	9	F			42	Visit to Kalutara fishing village, meeting at NAQDA
	10	S	Colombo, LK	Malé, MV	43	Report writing, travel
	11	S			44	Meeting with MRC and Statistical Services
	12	M	Malé, MV	Santiago, CL	45	Visit to Malé fishing port and market, travel

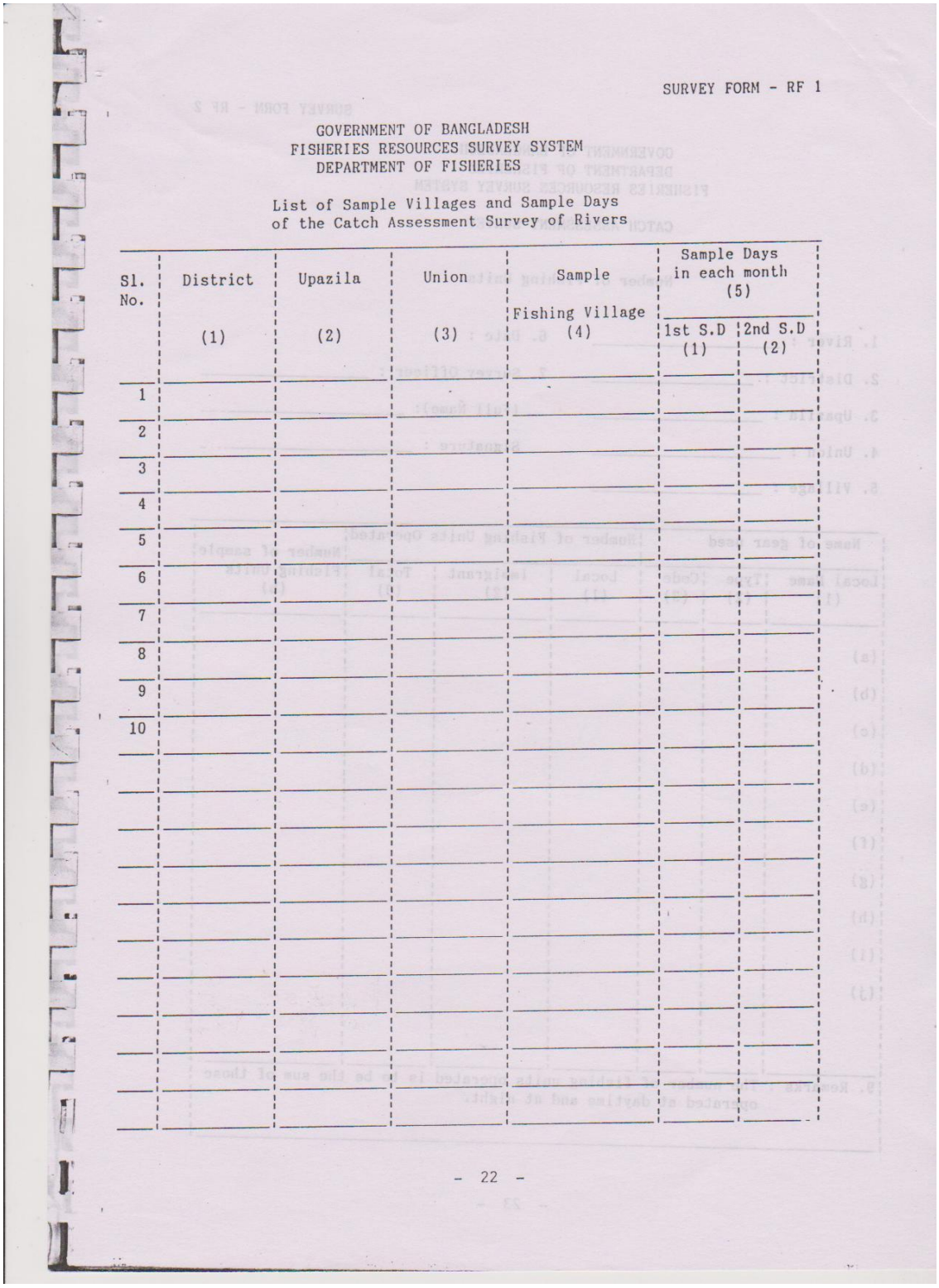
Annex 3. Person met

Country	Name	Position	Institution	Place
	Chris O'Brien		BOBLME	Phuket
	Rudolf Hermes		BOBLME	Phuket
	Rishi Sharma		BOBLME	Kochi/Dhaka
	Simon Funge-Smith		FAO	Bangkok
Thailand	Ms. Praulai Nootmorn	Director & BOBLME NC	Fish. Res. Dev. Institute	Phuket
	Ms. Issarapon Jithlang	Researcher - oceanogr	Andaman Fish. Res. Dev. Cen.	Phuket
	Ms. Thumawadee Jaiyen	Researcher - purse seine fish.	Andaman Fish. Res. Dev. Cen.	Phuket
	Supachai Rodphadit	Researcher - tuna fish.	Andaman Fish. Res. Dev. Cen.	Phuket
	Chalit Sa-nga-ngam	Researcher - small-scale fish.	Andaman Fish. Res. Dev. Cen.	Phuket
Malaysia	Ismail Bin Ishak	Coordinator, Intl Affairs & BOBLME NC	Fisheries Research Institute, DOF	Penang
	Zaki Mokri	Head of Statistics	Dept of Fisheries (DoF)	Putrajaya
	Mahyam Mohd. Isa	Chief	SEAFDEC-MFRDMD	Putrajaya
	Abu Talib Ahmad	Senior researcher	SEAFDEC-MFRDMD	Putrajaya
	Abdul Razak Latun	Research officer	SEAFDEC-MFRDMD	Putrajaya
	Zakaria Mohd. Nor	Head of Section - Marketing	LKIM	Putrajaya
	Ahmad Adnan Nuruddin	Director of Centre	Fisheries Research Institute, DOF	Putrajaya
	Abdul Haris B Ahmad Arshad	Researcher - Capture fish.	Fisheries Research Institute, DOF	Putrajaya
	Arfa Faris Hj. Mohd. Amin	Fisheries officer - Statistics	Dept of Fisheries (DoF)	Putrajaya
	Mohd. Noor Noordin	Head of Section - Tuna	Dept of Fisheries (DoF)	Putrajaya
	Tan Geik Hong	Head of Section - Intl affairs	Dept of Fisheries (DoF)	Putrajaya
	Ahmad Faizal Mohd Omar	Fisheries officer - Sector planning	Dept of Fisheries (DoF)	Putrajaya
	Vinson Embaran	Ass Director	Marine Sci. Tech. Inst. (MASTIC)	Penang
	Gairuzazmi Mat Ghani	Ass. Professor - Economics	Intl Islamic Univ.	Penang
Indonesia	Agus A. Budhiman	Director - Fish. Res. Management	DG of Capture Fisheries	Jakarta
	Simmi	Head - Fish. Res. Management	DG of Capture Fisheries	Jakarta
	Dicky	Head of Section	DG of Capture Fisheries	Jakarta
	Siti Kamarigil	Head of Section	DG of Capture Fisheries	Jakarta
	Diding Sudira	Head of Section	DG of Capture Fisheries	Jakarta
	Ms. Besweni	Dep. Director Statistics	DG of Capture Fisheries	Jakarta
	Ponca	Staff, logbook programme	DG of Capture Fisheries	Jakarta
	Fery Sutyawan	Staff, logbook programme	DG of Capture Fisheries	Jakarta
	Edwison	Staff, logbook programme	DG of Capture Fisheries	Jakarta
	Agustiani Widajati	Head, Eval of Fish. Res.	DG of Capture Fisheries	Jakarta
	Ikhsan Haryadi	Head, Fish. Extension	DG Fish. Extension Serv.	Jakarta
	Azmi Nasution	Staff	DG Fish. Extension Serv.	Jakarta

	Yulistyo Mudho	Director	Stats & Info Centre, Min of Mar. Affairs & Fish.	Jakarta
	Tuti Hariati	Head, Small pelagics res. Group	Mar. Fish. Res. Inst.	Jakarta
	Matius Bangun	Ass Director	Provincial Fish. Administration	Medan
	Jenny Masuiavi	Statistics unit	Provincial Fish. Administration	Medan
	A. Cholie Syahid	Director	Belawan Fishing port	Medan
	Martin Sadipun	Head of statistics	Belawan Fishing port	Medan
	Kimas Sidabkar	Enumerator	Belawan Fishing port	Medan
	Aritonang	Enumerator	Belawan Fishing port	Medan
	Hasan	Enumerator	Belawan Fishing port	Medan
	Ms. Hj. Hidayati	Director	Prov. Env. Protection Agency	Medan
	Ms. Bayou	Ass Director	Prov. Env. Protection Agency	Medan
	Endien	Director	Provincial Fish. Administration	Banda Aceh
	Ms. Nova	Ass Director	Provincial Fish. Administration	Banda Aceh
	Adriansyah	Statistics unit	Provincial Fish. Administration	Banda Aceh
	Aliman	Statistics unit	Provincial Fish. Administration	Banda Aceh
Myanmar	Mya Than Tun	Ass Director, BOBLME NC	Dept Fisheries	Yangon
	Tint Swe	Dep Director	Dept Fisheries	Yangon
	Myint Pe	Ass Director, Res. Surveys & research	Dept Fisheries	Yangon
	Moe Myint Kyaw	President	Myanmar Fisheries Federation	Yangon
	Han Tun	Exec Vice President	Myanmar Fisheries Federation	Yangon
	Hla Win	Dep Director-General	Myanmar Fisheries Federation	Yangon
	Aung Than Oo	Director	Szyh Fishing Jetty	Yangon
	Maung Maung Aung	Director	Annawar Aung Jetty	Yangon
	Zarni Maung	Ass Director	Annawar Aung Jetty	Yangon
India	Vijayakumaram Kandachamy	Director-General	FSI	Barrackpore
	A.P. Sharma	Director	CIFRI	Barrackpore
	Debabrata Panda	Scientist	CIFRI	Barrackpore
	B.K. Behera	Senior scientist	CIFRI	Barrackpore
	R.K. Manna	Senior scientist	CIFRI	Barrackpore
	R.C. Mandi	Technical officer	CIFRI	Barrackpore
	S.K. Naik	Senior scientist	FSI	Visakhaptanam
	B. Reddy	Chief operations	FSI	Visakhaptanam
	Ansuman Das	Scientist	FSI	Visakhaptanam
	C.S. Sethumadhavan	Skipper-R/V Matsya Shikari	FSI	Visakhaptanam
	A.P. Udayapan	First Mate-R/V Matsya Shikari	FSI	Visakhaptanam
	G. Maheswarudu	Director	CMFRI	Visakhaptanam
	Subhadeep Gosh	Scientist	CMFRI	Visakhaptanam
	V. Uma Mahesh	SRF	CMFRI	Visakhaptanam
	Rahmon Rao	Technical officer	CMFRI	Visakhaptanam

	A. Anrose	Zonal Director	FSI	Chennai
	C. Babu	Senior fisheries scientist	FSI	Chennai
	John J.C. Dhas	Fisheries scientist	FSI	Chennai
	E. Vivekanandan	Principal scientist	CMFRI	Chennai
	J.J. Jayasankar	Senior scientist	CMFRI	Kochi
	Sathianandan	Senior scientist	CMFRI	Kochi
Banglade sh	A.K. Yousuf Haroon	NTA - consultant	BMFRI	Dhaka
	Syed Arif Azad	Director General	DoF	Dhaka
	Sukamal Chandra Sutradhar	Dep. Director - Inland sector	DoF	Dhaka
	Md. Fokhrul Alam	Ass. Chief - Marine sector	DoF	Dhaka
	Abdullah Al Mehdi	Ass. Cartographer	DoF	Dhaka
	Rama Rani Das	Cartographer	DoF	Dhaka
Sri Lanka	S.S.K. Haputhantri	Head - Marine Biol. Res. Div.	NARA	Colombo
	Mrs. R. Maldeniya	Director - Marine Biol. Res. Div.	NARA	Colombo
	J.A.D.B. Jayasooriya	Head - Statistical Unit	Min. Fish. Aquat. Res.	Colombo
	Mrs. K.B.C. Pushpalatha	Director - Extension Services	NAQDA	Battaramulla
	U.S. Amarasinghe	Professor - Dept. Zoology	Univ. Kelaniya	Kelaniya
Maldives	Ms. Shafana Rasheed	Statistical Service	Min. Fish. Agric.	Malé
	Ms. Raufiyya Abdulla	Statistical Service	Min. Fish. Agric.	Malé
	Adam Ziyad	Senior Fishery Officer	Min. Fish. Agric.	Malé
	Mohamed Ahusan	Researcher	Marine Res. Centre	Malé
	Fahmada Islam	Researcher	Marine Res. Centre	Malé
	Mariyam Shidha	Researcher	Marine Res. Centre	Malé

Annex 4: Bangladesh – example forms used



SURVEY FORM - RF 1

GOVERNMENT OF BANGLADESH
FISHERIES RESOURCES SURVEY SYSTEM
DEPARTMENT OF FISHERIES

List of Sample Villages and Sample Days
of the Catch Assessment Survey of Rivers

Sl. No.	District (1)	Upazila (2)	Union (3)	Sample Fishing Village (4)	Sample Days in each month (5) 1st S.D (1)	2nd S.D (2)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

- 22 -

SURVEY FORM - RF 2

GOVERNMENT OF BANGLADESH
DEPARTMENT OF FISHERIES
FISHERIES RESOURCES SURVEY SYSTEM

CATCH ASSESSMENT SURVEY

Number of Fishing Units

1. River : _____
2. District : _____
3. Upazila : _____
4. Union : _____
5. Village : _____
6. Date : _____
7. Survey Officer : _____
(Full Name): _____
Signature : _____

Name of gear used			Number of Fishing Units Operated			Number of sample Fishing Units (b)
Local Name (1)	Type (2)	Code (3)	Local (1)	Immigrant (2)	Total (3)	
(a)						
(b)						
(c)						
(d)						
(e)						
(f)						
(g)						
(h)						
(i)						
(j)						

9. Remarks : The number of fishing units operated is to be the sum of those operated at daytime and at night.

SURVEY FORM - RF 3

GOVERNMENT OF BANGLADESH
DEPARTMENT OF FISHERIES
FISHERIES RESOURCES SURVEY SYSTEM

CATCH ASSESSMENT SURVEY

Sample Catch Record

Day Month Date

1. River : _____
2. District : _____
3. Upazila : _____
4. Union : _____
5. Village : _____

6. Date : ___ ___ ___ ___ ___

7. Survey Officer : _____

Name & Signature: _____

8. Type of gear used : _____

9. No. of fishing Units operated: _____

10. No. of sample Units: ___

11.	Name of the head fishermen						Producer price in Tk/Kg.
12.	Number of fishermen on the boat						
13.	Local name of gear used						
14.	Encircle number observed	1	2	3	4	5	
15.	Catch in Number and Weight	No. Kg.	No. Kg.	No. Kg.	No. Kg.	No. Kg.	
	(01) Major Carp Ruhi, Catla, Mrigal						
	(02) Other Carp Kalbaus, Ghania, Kalia						
	(03) Catfish Aire, Boal, Panges, Rita, Silon						
	(04) Snake Head Shol, Gazar, Taki						
	(05) Live Fish Koi, Singi, Magur						
	(06) Other Inland Fish Chapila, Bacha, Phali, Poa etc.						

Contd ...

FORM - MAF 1

GOVERNMENT OF BANGLADESH
FISHERIES RESOURCES SURVEY SYSTEM
DEPARTMENT OF FISHERIES
MATSHYA BHABAN, DHAKA-1000

CATCH ASSESSMENT SURVEY
OF MARINE ARTISANAL FISHERIES

Sample Catch Record

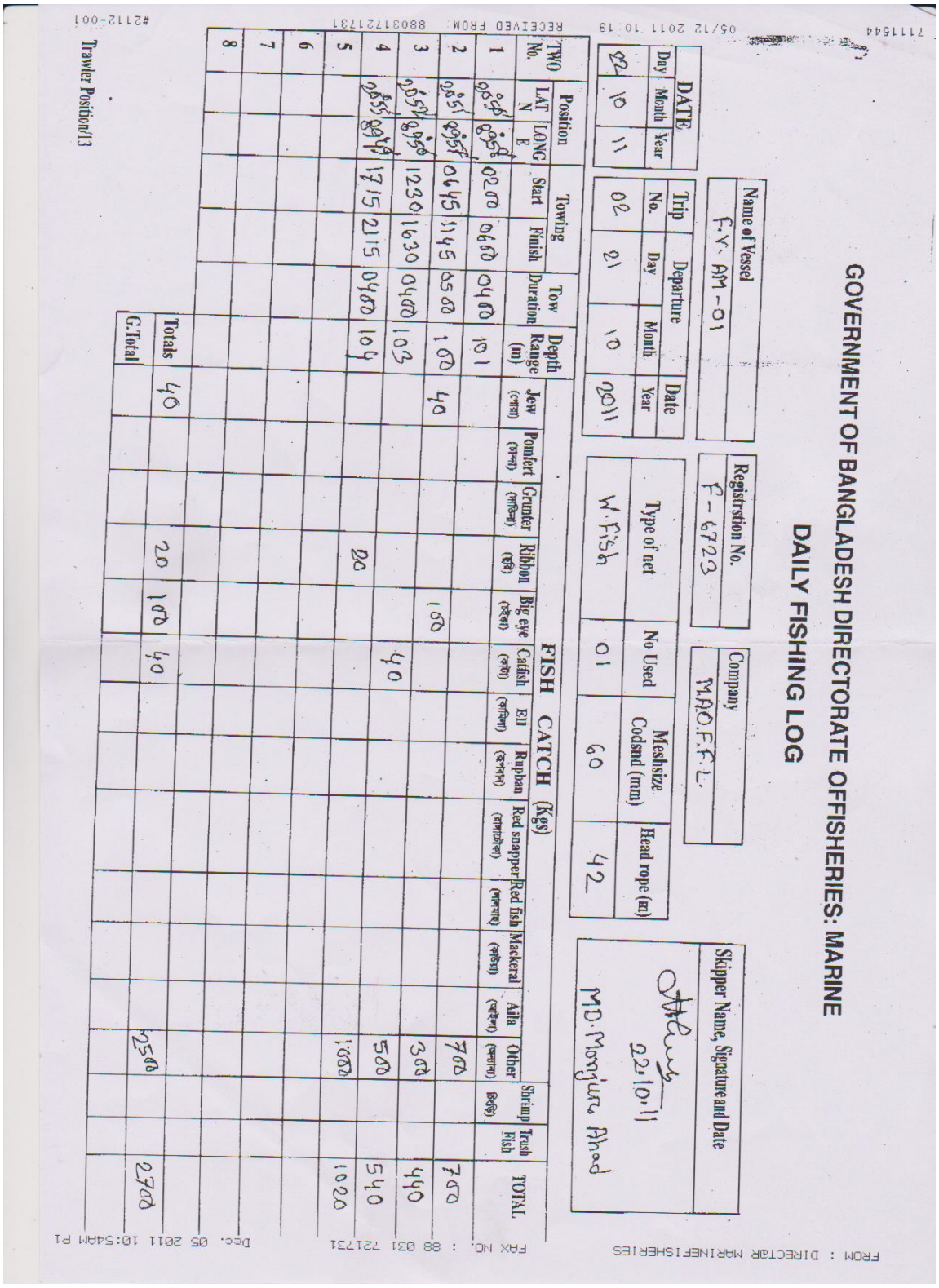
	DAY	MONTH	YEAR
6. Date:			

1. District:_____
2. Upazila:_____
3. Union:_____
4. Landing Center:_____
5. Fishing Village:_____
7. Survey officer's name & Signature:_____

8. Type of gear used_____ 9. No of all landings_____ 10. No. of Sample Landings_____

11. Serial No.	(1)	(2)	(3)	(4)	(5)	Producer's Price in Tk/Kg. (6)
12. No. of fishermen on board						
13. Fishing boat motorized/non-motorized						
14. Local name of gear used						
15. No. of days of this trip						
16. No. of trips during past 15 days						
17. No. of days on the sea during Past 15 days						
18. No. of setbag nets						
19. Catch by species	kg. (1)	kg. (2)	kg. (3)	kg. (4)	kg. (5)	
19.1. Hilsa						
19.2. Bombay duck						
19.3. Indian salmon						
19.4. Pomfret						
19.5. Sharks & rays						
19.6. Jew fish						
19.7. Snapper						
19.8. Mackerel						
19.9. Other (Specify)						
19.10. Large shrimp						
19.11. Small shrimp						
19.12. Miscellaneous						
20. Total:						

Annex 5. Bangladesh – industrial logbook form



GOVERNMENT OF BANGLADESH DIRECTORATE OFFISHERIES: MARINE

DAILY FISHING LOG

Name of Vessel: F.V. AM-01

Registration No.: F-6723

Company: M.A.O.F.F.L.

DATE: Day 22, Month 10, Year 11

Trip No.: 02

Departure: Day 21, Month 10, Year 2011

Type of net: W. Fish

No Used: 01

Meshsize Codend (mm): 60

Head rope (m): 42

Skipper Name, Signature and Date: MD. Monjur Ahmed, 22.10.11

TWO No.	Position LAT N	Position LONG E	Towing Start	Towing Finish	Tow Duration	Depth Range (m)	Jew (চেলা)	Pomfert (তাপসা)	Grunter (কাঁকিলা)	Ribbon (ফিতা)	Big eye (টাইলা)	Catfish (কাটা)	Eli (কোরিমা)	Rupchan (রূপচাদা)	Red snapper (লালচান্দা)	Red fish (লালমাছ)	Mackeral (ফাইসা)	Aila (আইলা)	Other (অন্যান্য)	Shrimp (চিংড়ি)	Trash Fish	TOTAL
1	০৫°০৫'	০৯°৫৫'	0820	0610	0450	101													700			700
2	০৫°৫১'	০৯°৫৫'	0645	1145	0500	100	40				100											440
3	০৫°৫৭'	০৯°৫০'	1230	1630	0400	103						40							500			540
4	০৫°৫১'	০৯°৫৭'	1715	2115	0400	104				20									1000			1020
5																						
6																						
7																						
8																						
Totals							40			20	100	40							2500			2700
G.Total																						

FROM : DIRECTOR MARINEFISHERIES

FAX NO. : 88 031 721731

Dec. 05 2011 10:54AM P1

Trawler Position/13

#2112-001

RECEIVED FROM 8803172173I

05/12 2011 10:18

7111544

Annex 6. India – example forms used

Fishery Survey Form C

NATIONAL MARINE LIVING RESOURCES DATA CENTRE

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE (ICAR), COCHIN – 18

CONSOLIDATED STATEMENT OF NUMBER OF MECHANIZED/NON-MECHANIZED FISHING UNITS LANDED

Zone ..... Name of observer .....

Month ..... Year ..... Date of submission .....

Period →		Afternoon (12-18 hrs)	Night (18-06 hrs)	Forenoon (06-12 hrs)	TOTAL
Centre	Gear → Date ↓				

Remarks Signature

Fishery Survey Form T

NATIONAL MARINE LIVING RESOURCES DATA CENTRE

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE (ICAR), COCHIN – 18

RECORD OF TIME OF LANDINGS

Name of landing centre ……..… [ ] Type of unit – Mechanized/Non-mechanized (Shoreseine/others)

Date …… [ ][ ][ ] Number of fishing units landed during the Previous night ……

Period of observation …….. [ ]

Serial No.	Time of landing	Remarks	Serial No.	Time of landing	Remarks	Serial No.	Time of landing	Remarks
1			34			67		
2			35			68		
3			36			69		
4			37			70		
5			38			71		
6			39			72		
7			40			73		
8			41			74		
9			42			75		
10			43			76		
11			44			77		
12			45			78		
13			46			79		
14			47			80		
15			48			81		
16			49			82		
17			50			83		
18			51			84		
19			52			85		
20			53			86		
21			54			87		
22			55			88		
23			56			89		
24			57			90		
25			58			91		
26			59			92		
27			60			93		
28			61			94		
29			62			95		
30			63			96		
31			64			97		
32			65			98		
33			66			99		
						100		

Fishery Survey Form 1

NATIONAL MARINE LIVING RESOURCES DATA CENTRE
CENTRAL MARINE FISHERIES RESEARCH INSTITUTE (ICAR), COCHIN– 18
DAILY RECORD OF CATCH AND EFFORT OF NON-MECHANIZED FISHING CRAFT – SHORE SEINES/OTHERS

State ..... District ..... Zone ..... Centre .....

Date Period ..... Number of shore seines/other units landed ..... No. of units selected .....

State of sea ..... State of sky ..... Direction of wind ....

Serial number	Allotted No. of selection of units examined	Type of craft		Type of gear		Length of craft	Absence from shore			Fishing ground			No. of hauls	Duration of actual fishing (hrs. & mts.)	Man power employed	Name, code and weight (kg) of fish landed										Total
		Name	Code	Name	Code		Dep. Time & Date	Arr. Time	Duration of absence (hrs)	Distance(km) from shore	Direction from L.C.	Depth (m)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Special attention : Report incidental catch/stranding of cetaceans and turtles with details													Prince in Rs per Kg													

Remarks

Name and signature of observer

Fishery Survey Form 2
Trawler (A) /Gillnetter (B) /Longliner (C) /Dolnetter (D)/Country craft with O.B.(E).

NATIONAL MARINE LIVING RESOURCES DATA CENTRE
CENTRAL MARINE FISHERIES RESEARCH INSTITUTE (ICAR), COCHIN– 18
DAILY RECORD OF CATCH AND EFFORT OF SMALL MECHANIZED FISHING CRAFT

State ..... District ..... Zone ..... Centre .....

Date ..... Period..... Number of units landed ..... No. of units selected .....

State of sea ..... State of sky ..... Direction of wind ....

Serial number	Allotted No. of selection of units examined	Name and/or craft number	Type of craft		Type of gear		Length of craft	Horse power	Absence from shore			Fishing ground			No. of hauls	Duration of actual fishing (hrs. & mts)	Man power employed	Av. Trawling speed in case of trawler (km/hr)	Name, code and weight (kg) of fish landed										Total
			Name	Code	Name	Code			Dep. Time & Date	Arr. Time	Duration of absence (hrs)	Distance (km) from shore	Direction from L.C.	Depth (m)																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Special attention : Report incidental catch/stranding of cetaceans and turtles with details															Price in Rs per Kg														

Remarks

Name and signature

Fishery Survey Form II
Trawler (A)

NATIONAL MARINE LIVING RESOURCES DATA CENTRE
CENTRAL MARINE FISHERIES RESEARCH INSTITUTE (ICAR), COCHIN– 18
DAILY RECORD OF CATC H AND EFFORT OF SMALL MECHANIZED FISHING CRAFT

State ..... District ..... one ..... tre .....

Date Period..... ber of units landed ..... No. of units selected .....

State of sea ..... tate of sky ..... rection of wind ....

Serial number	Allotted No. of selection of units examined	Name and/or craft number	Type of craft		Type of gear		Length of craft	Horse power	Absence from shore			Fishing ground			No. of hauls	Duration of actual fishing (hrs. & mts)	Man power employed	Av. Trawling speed in case of trawler (km/hr)	Name, code and weight (kg) of fish landed									
			Name	Code	Name	Code			Dep. Time & Date	Arr. Time	Duration of absence (hrs)	Distance (km) from shore	Direction from L.C.	Depth (m)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

Special attention : Report incidental catch/stranding of cetaceans and turtles with details

Price in Rs per Kg

Remarks

Annex 7: Summary of findings - Andaman & Nicobar

National Marine Fisheries Census 2005, Union Territories, of Andaman & Nicobar and Lakshadweep Islands, FSI – Fishery Survey of India, Government of India

Andaman and Nicobar Islands

- There are 103 fishing villages and 25 landing centres
- The total fisherfolk population is 15,266 living in 3,275 families
- Maximum number of fishing villages are in Andaman Islands (72)
- About 85.8% of the total fisherfolk population inhabit the Andaman Islands and 14.2
- % in Nicobar Islands
- Diglipur (North Andaman) consist of highest number of fishing villages (27) and households (664)
- About 70.9% of the population are actually engaged in fishing and allied activities
- There are 4,247 fisherfolk actually involved in fishing
- There are 6,570 fisherfolk engaged in fishing related acitivities
- Nearly 77.2% of the fisherfolk actually engaged in fishing activities are full time fishermen, 16.9% part time and 5.9% occasional fishermen
- Fishing related activities are predominantly by men (73.1%)
- Women, besides fish marketing, also do net making, mending, fish processing and labour works
- Only 7.92% of the fisherfolk population are members either in fisheries cooperatives or other cooperative societies
- There are three boat building yards in Port Blair
- Other fishery related infrastructure includes nine ice factories, six cold staorages and three freezing plants, all in Andaman Islands

Types of vessels

Mechanised: trawlers, gillnetters, purse seiners, ring seiners, dollnetters, liners, others
Traditional: catamarans, dugout boats, plank-built boats, ring seiners, fibreglass boats, ferro-cement boats, others

Fishing craft

District	Category	Gear	Number
Andaman	Mechanised	Trawlers	5
		Gillnetters	150
		Liners	5
		Others	5
		Sub-total	165
	Motorised		764
	Non-motorised		1610
Nicobar	Motorised		17
	Non-motorised		227
Overall total			2783

Fishing gears

Types of gears: trawls, dolnet, ring-seine, purse-seine, gillnet, driftnet, boat-seine, bagnet, shore-seine, hook and lines, troll lines, others

Gear	Andaman	Nicobar
Seine net	241	1
Bag net	89	0
Traps	204	0
Troll lines	155	0
Gillnets	11592	605
Hooks and lines	20081	4195
Longline	1885	4
Others	5637	0
Total	39884	4805

Annex 8. Indonesia – example form

1. No. of Trips 2. Catch by Species

Size of Boat		Species	Quantity (kg)	Value (Rp)	%	Price (Rp/Kg)
(1)		(2)	(3)	(4)	(5)	(4)/(3)
Non-Powered Boat	Small	Total	(Y)		100	
	Medium					
	Large					
Out-board Powered Boat						
In-board Powered Boat	< 5					
	5-10					
	10-20					
	20-30					
	30-50					
	50-100					
	100-200					
	≥ 200					

Note

1. This form is used for fishing companies for which L-I survey is applied and all fish auction market regardless of whether L-II or L-III survey is applied.
2. This form is prepared on monthly basis for each type of fishing gear separately.
3. Catch in quantity reported by fish auction market for which L-II survey is applied is used as base of ratio estimation.
4. Catch in quantity and the number of trips which are reported by other fish auction markets are used to estimate average catch per trip for L-III Survey.

Annex 9. Indonesia – logbook forms

INDONESIAN TUNA LONGLINE / HANDLINE - FISHING LOG BOOK

(1) PAGE ____ OF ____

NAME OF VESSEL (2)	NAME OF FISHING COMPANY (3)			FSIHING LICENSE NO (SIPI) (4)	YEAR (5)	TRIP NO .... THIS YEAR (6)
FISHING GEAR (LL or HL) (7)	GT (8)	LOA (9) m.	HP (10)	CALL SIGN (11)	PORT OF DEPARTURE (12)	DATE OF DEPARTURE (13)
LLYOD'S REGISTRATION NUMBER (14)	IND CREW (15)	FOREIGN CREW (16)	FMA (17)	FISHING GROUND (18)	LANDING PORT (19)	DATE OF ARRIVAL IN PORT (20)

DAY (21)	MONTH (22)	ACTIVITY CODE (23)	POSITION AT NOON (24)				START TIME (25)	NUMBER OF HOOKS (26)	HOOKS BETWEEN FLOATS (27)	CATCH COMPOSITION (KILOGRAMS) (28)																				
										ALBACORE		BIGEYE		YELLOWFIN		SOUTHERN BLUEFIN		STRIPED MARLIN		BLUE MARLIN		BLACK MARLIN		SWORDFISH		OTHER SPECIES		
			LATITUDE (DD° MM')	N S	LONGITUDE (DDD° MM')	E W				NO	KG	NO	KG	NO	KG	NO	KG	NO	KG	NO	KG	NO	KG	NO	KG	NAME/NO	NO	KG
							PAGE TOTAL (29)																					
							TOTAL LANDED (30)																					
							NOTE (31)																					

ACTIVITY CODES (23)

1 SETTING (LONGLINE ONLY)
2 FISHING (HANDLINE ONLY)
3 TRANSIT (NO FISHING ON THIS DAY)
4 TRANSHIPPING CATCH AT SEA
5 IN PORT - PLEASE SPECIFY PORT

NAME AND SIGNATURE OF MASTER (32)	NAME AND SIGNATURE OF INSPECTOR (33)	DATE (34)

INDONESIAN TUNA - PURSE SEINE, POLE & LINE AND TROLLING LINE - FISHING LOG BOOK

(1) PAGE____ OF ____

NAME OF VESSEL (2)		NAME OF FISHING COMPANY (3)				FISHING LICENSE NO (SIPI) (4)		YEAR (5)	TRIP NO .... THIS YEAR (6)
FISHING GEAR (PS, PL or TL) (7)	GT (8)	LOA (9)	HP (10)	CALL SIGN (11)		PORT OF DEPARTURE (12)		DATE OF DEPARTURE (13)	
LLOYD'S REGISTRATION NUMBER (14)	IND CREW (15)	FOREIGN CREW (16)	FMA (17)	FISHING GROUND (18)		LANDING PORT (19)		DATE OF ARRIVAL IN PORT (20)	

DAY (21)	MONTH (22)	ACTIVITY CODE (23)	POSITION AT NOON (24)				SCHOOL ASSOCIATION CODE (25)	SET or FISHING		CATCH COMPOSITION (KILOGRAMS) (28)														
			LATITUDE (DD° MM')	N S	LONGITUDE (DDD° MM')	E W		START TIME (26)	END TIME (27)	SKIPJACK	YELLOWFIN	BIGEYE	FRIGATE TUNA	BULLET TUNA	RAINBOW RUNNER	MAHI-MAHI	OTHER SPECIES							
																	NAME/NO	KG	NAME/NO	KG	NAME/NO	KG	NAME/NO	KG
								PAGE TOTAL (29)																
								TOTAL LANDED (30)																

ACTIVITY CODES (23)	SCHOOL ASSOCIATION CODES (25)		
1. SETTING (PURSE SEINE ONLY) 2. FISHING (POLE AND LINE ONLY) 3. TRANSIT (NO FISHING ON THIS DAY) 4. TRANSHIPPING CATCH AT SEA 5. IN PORT - PLEASE SPECIFY PORT 6. SEARCHING 7. NO FISHING (BUT NOT IN TRANSIT)	1. UNASSOCIATED 2. FEEDING ON BAITFISH 3. DRIFTING LOG 4. DRIFTING FAD OR PAYAO 5. ANCHORED FAD OR PAYAO 6. LIVE WHALE 7. LIVE WHALE SHARK 8. OTHER	NOTE (31)	
		NAME AND SIGNATURE OF MASTER (32)	NAME AND SIGNATURE OF INSPECTOR (33) / DATE (34)

INDONESIAN FISHING LOG BOOK

(1) PAGE_____ OF _____

NAME OF VESSEL (2)	NAME OF FISHING COMPANY (3)			FISHING LICENSE NO (SPI) (4)		YEAR (5)	TRIP NO. THIS YEAR (6)
TYPE OF FISHING GEAR (7)	GT (8)	LOA (9) ft.	HP (10)	CALL SIGN (11)	PORT OF DEPARTURE (12)	DEPARTURE DATE (13)	
LLYCDS REGISTRATION NUMBER (14)	IND CREW (15)	FOREIGN CREW (16)	FMA (17)	FISHING GROUND (18)	LANDING PORT(19)	DATE OF ARRIVAL IN PORT (20)	

FISHING DATE (21) (DD,MM)	POSITION (22)		FISHING TIME (23)	CATCH (KG) (24)													OTHERS SPECIES (25)	
	LONGITUDE	LATITUDE		Fish No / Kg	Fish No / Kg	Fish No / Kg	Fish No / Kg	Fish No / Kg	Fish No / Kg	Fish No / Kg	Fish No / Kg	Fish No / Kg	Fish No / Kg	Fish No / Kg	Fish No / Kg	Fish No / Kg	NONAME	KG
PAGE TOTAL (26)																		
TOTAL LANDED (27)																		

NOTE (28)

NAME & SIGNATURE OF THE MASTER (29)	NAME & SIGNATURE OF THE INSPECTOR (30)	DATE (31)

Annex 10. Malaysia – example forms used

Lampiran 3 **Borang C**

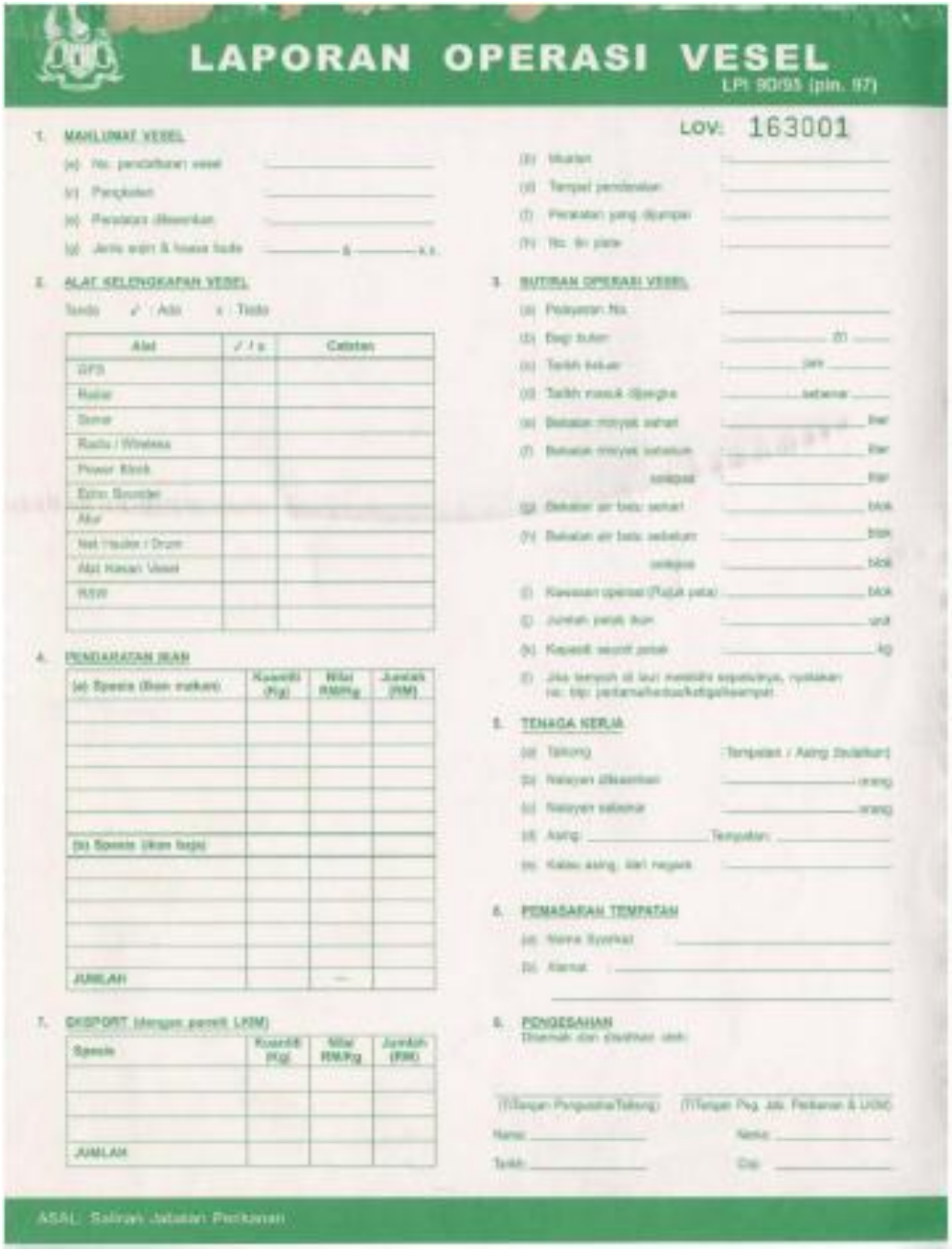
REKOD PENDARATAN IKAN LAUT VESEL LAUT DALAM

BUTIRAN VESEL	
Tarikh Pendaratan:	
No. Pendaftaran vesel:	

PENDARATAN IKAN				
Bil.	Spesis Ikan	Kuantiti		Harga (RM/kg)
		Kuantiti ikan makan(kg)	Kuantiti ikan proses (Kg)	
1	Ikan Baja			
2	Ikan Campur			
3	Pelaling/Tamonong			
4	Mengkerong/Ubi/Conor			
5	Kerisi			
6	Kembong			
7	Tamenggong			
8	Belak mata			
9	Gelama/Tengkerong			
10	Aya hitam			
11	Aya kurik			
12	Aya selasih			
13	Tuna Oceanik			
14	Selayang			
15	Sotong biasa			
16	Sotong katak			
17	Cincaru			
18	Selayor			
19	Lolong			
20	Selar			
21	Sebelah			
22	Pelata			
23	Tamban buloh			
24	Biji nangka			
25	Tenggiri			
26	Udang Pasir Kepala Besar			
27	Udang putih besar			
28	Aiu-aiu			
29	Cincaru			
30	Selayang			
31	Kembu			
32	Puntong darner			
33	Malong			
34	Demudok			
35	Yu			
36	Ketam renjong			
37	Ketam laut			
38	Lain-lain			
Jumlah Pendaratan (kg)				

Bil.	Spesis terancam yang dijumpai	Bilangan	Catatan
1.	Penyu		
2.	Yu paus		
3.	Yu gerpel		
4.	Dugong		
5	Ikan Lumba-lumba		

Annex 11. Malaysia – vessel operation report



LAPORAN OPERASI VESEL

LPI 90/95 (pin. 97)

LOV: 163001

1. MAKLUMAT VESEL

(a) No. pendaftaran vessel _____

(c) Pangkalan _____

(e) Peralatan dikeemkan _____

(g) Jenis enjin & kuasa kuda _____ & _____ k.k.

(i) Muatan _____

(k) Tempat pendaratan _____

(l) Peralatan yang dipasang _____

(n) No. ijin pasir _____

2. ALAT KELENGKAPAN VESEL

Tanda ✓ : Ada x : Tiada

Alat	✓ / x	Catatan
GPS		
Radar		
Sonar		
Radio / Wireless		
Power Block		
Echo Sounder		
Atur		
Net Hauler / Drum		
Alat Keran Vesel		
R/W		

3. BUTIRAN OPERASI VESEL

(a) Pelayaran No. _____

(b) Bagi bulan _____ (l) _____

(c) Tarikh keluar _____ pkl _____

(d) Tarikh masuk dijangka _____ selama _____

(e) Bekalan minyak sahari _____ liter

(f) Bekalan minyak seharusnya _____ liter

sebanyak _____ liter

(g) Bekalan air batu sahari _____ blok

(h) Bekalan air batu sebelum _____ blok

sebanyak _____ blok

(i) Kawasan operasi (Tuliskan peta) _____ blok

(j) Jumlah perahu ikan _____ unit

(k) Kapasiti seunit perahu _____ kg

(l) Jika berpuas di laut melebihi sepalamya, nyatakan no. blok pertama/kedua/ketiga/seterusnya

4. PENDARATAN IKAN

(a) Spesis (Ikan mahkan)	Kuantiti (Kg)	Nilai RM/Kg	Jumlah (RM)
(b) Spesis (Ikan baja)			
JUMLAH		—	

5. TENAGA KERJA

(a) Tekong Tempatan / Asing (tuliskan)

(b) Nelayan dikeemkan _____ orang

(c) Nelayan sebenar _____ orang

(d) Asing: _____ Tempatan: _____

(e) Kalau asing, dari negara _____

6. PEMASARAN TEMPATAN

(a) Nama Syarikat _____

(b) Alamat _____

7. EKSPORT (dengan permit LKIM)

Spesis	Kuantiti (Kg)	Nilai RM/Kg	Jumlah (RM)
JUMLAH			

8. PENGESAHAN

Diisemak dan disahkan oleh:

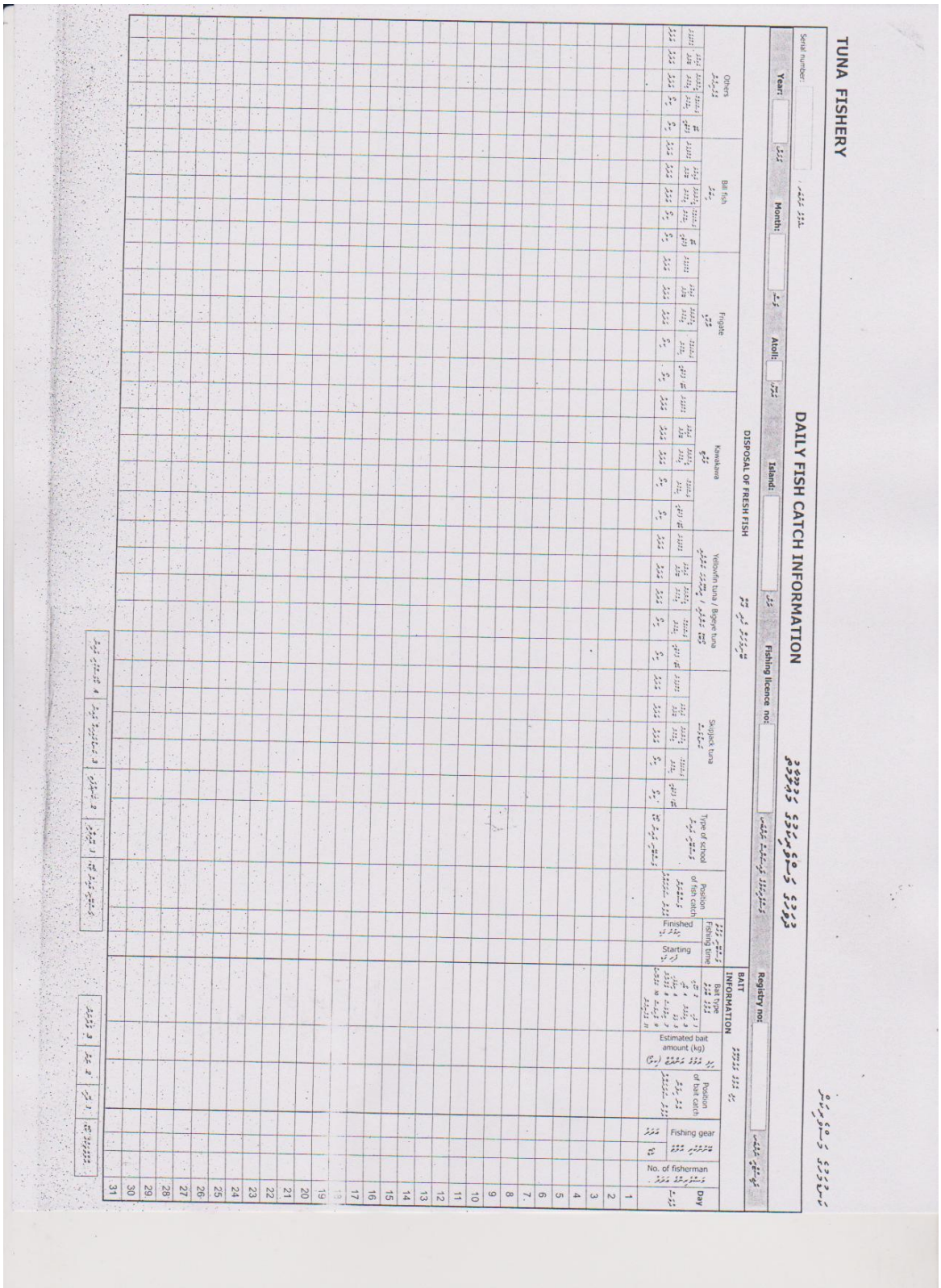
(Tandatangan Penguasa/Tekong) (Tandatangan Peg. Jab. Perikanan & LKIM)

Nama: _____ Nama: _____

Tarikh: _____ Cop: _____

ASAL: Salinan Jabatan Perikanan

Annex 12. Maldives – example forms



TUNA FISHERY

DAILY FISH CATCH INFORMATION

Serial number:

Year: Month: Atoll: Island: Fishing licence no: Registry no:

DISPOSAL OF FRESH FISH

Day	No. of fisherman	Fishing gear	Position of bait catch	Estimated bait amount (kg)	BAIT INFORMATION Bait type	Fishing time Starting	Fishing time Finished	Position of fish catch	Type of school	Skipjack tuna	Yellowfin tuna / Bigeye tuna	Kawakawa	Frigate	Bill fish	Others
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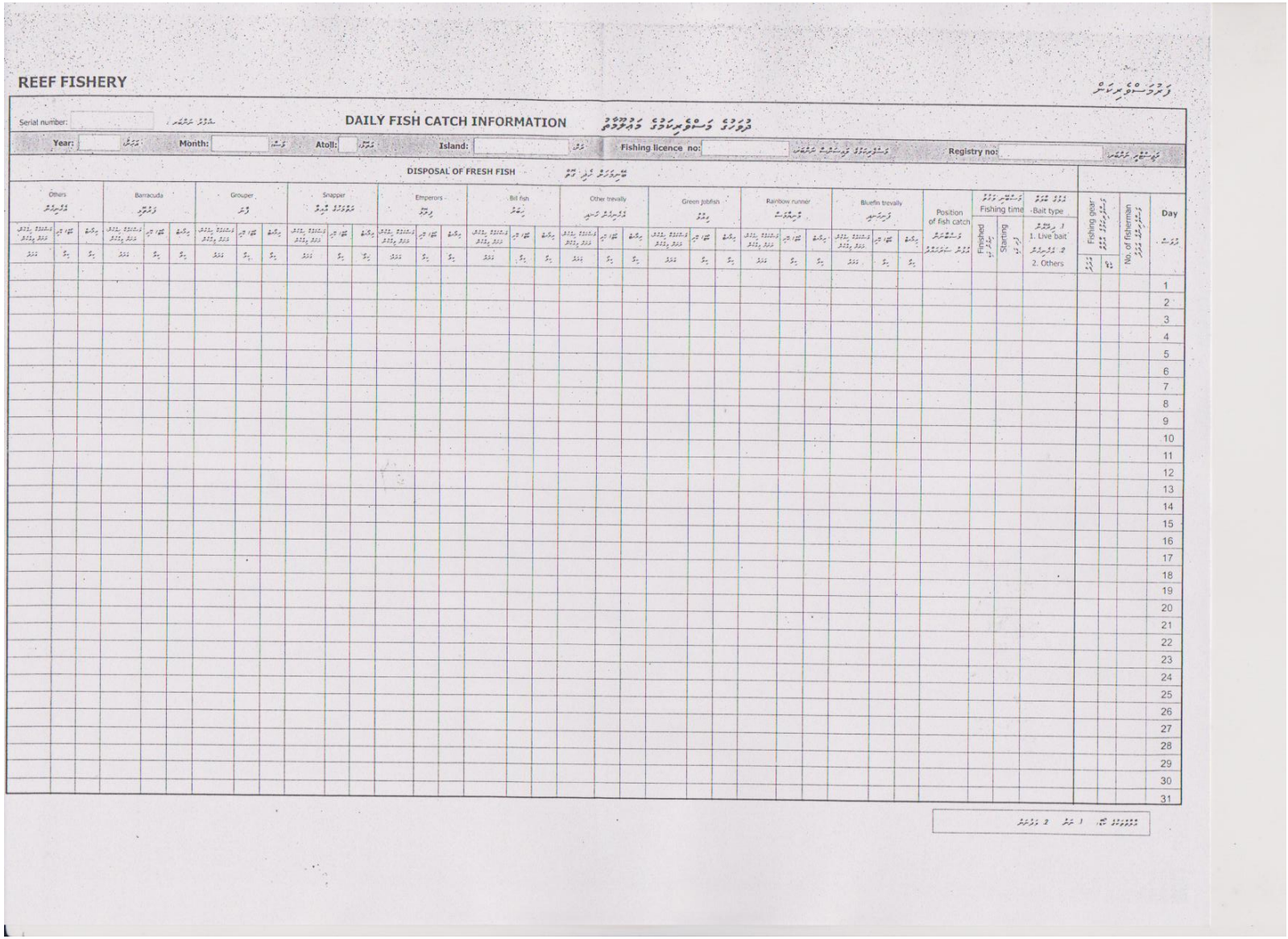

REEF FISHERY

ދުވަސްވަރު ފަށާ ތާރީޚް

Serial number: ސަރީގެ ނަންބަރު

DAILY FISH CATCH INFORMATION ދުވަހުގެ ފަސްވެރިކަމުގެ މަޢުލޫމާތު

Year: ހަވާލުވި Month: މަސް Atoll: ރަށު Island: ރަށް Fishing licence no: ފަސްވެރިކަމުގެ ލައިސަންސް ނަންބަރު Registry no: ރަޖިސްޓްރީ ނަންބަރު

DISPOSAL OF FRESH FISH ތާޒާ ފަސް ދޫކުރުން

Day ދުވަސް	Fishing gear: ފަސްވެރި ގިނަ ގިނަ	No. of fishermen ފަސްވެރިން ހަމަކުރި	Bait type ބޭނުންކުރި ގޮތް 1. Live bait 2. Others	Fishing time Starting ފަށާ ގަޑި	Fishing time Finished ނިމި ގަޑި	Position of fish catch ފަސް ހަނު ހިފި ތަން	Bluefin trevally ފަސް			Rainbow runner			Green jobfish			Other trevally			Bill fish			Emperors			Snapper			Grouper			Barracuda			Others		
							ދަރަނި	ތަކެއް	ތައްޔާ	ދަރަނި	ތަކެއް	ތައްޔާ	ދަރަނި	ތަކެއް	ތައްޔާ	ދަރަނި	ތަކެއް	ތައްޔާ	ދަރަނި	ތަކެއް	ތައްޔާ	ދަރަނި	ތަކެއް	ތައްޔާ	ދަރަނި	ތަކެއް	ތައްޔާ	ދަރަނި	ތަކެއް	ތައްޔާ	ދަރަނި	ތަކެއް	ތައްޔާ
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Annex 13. Sri Lanka – example forms used

Annex 4 :

Planning & Monitoring Division
Ministry of Fisheries and Ocean Resources
Maligawatte Secretariat
Colombo 10

Marine fishery statistics

D.F.E.O. Division: ..... Month .....

Fishery Inspector Area: .....

FI area	Fish production (kg)												Operating crafts				
	Spanish Mackere	Carangids	Skipjack	Yellowfin	Other Tuna	Shark/ Skates	Rock Fish	Seine Fish	Shrimp	Lobsters	Others	Total	In Board		Out Board		Non-motorized
													Multi -day	Day boats	17-23 FRP	Others	
1	2	3	4	5	6	7	8	9	10	11	12		13	14	15	16	17

Rock fish – Reef fish (Breams, snapper, etc.)

No.9 – Small seine fish (anchovy, sardine, l. Mackerel, etc.)

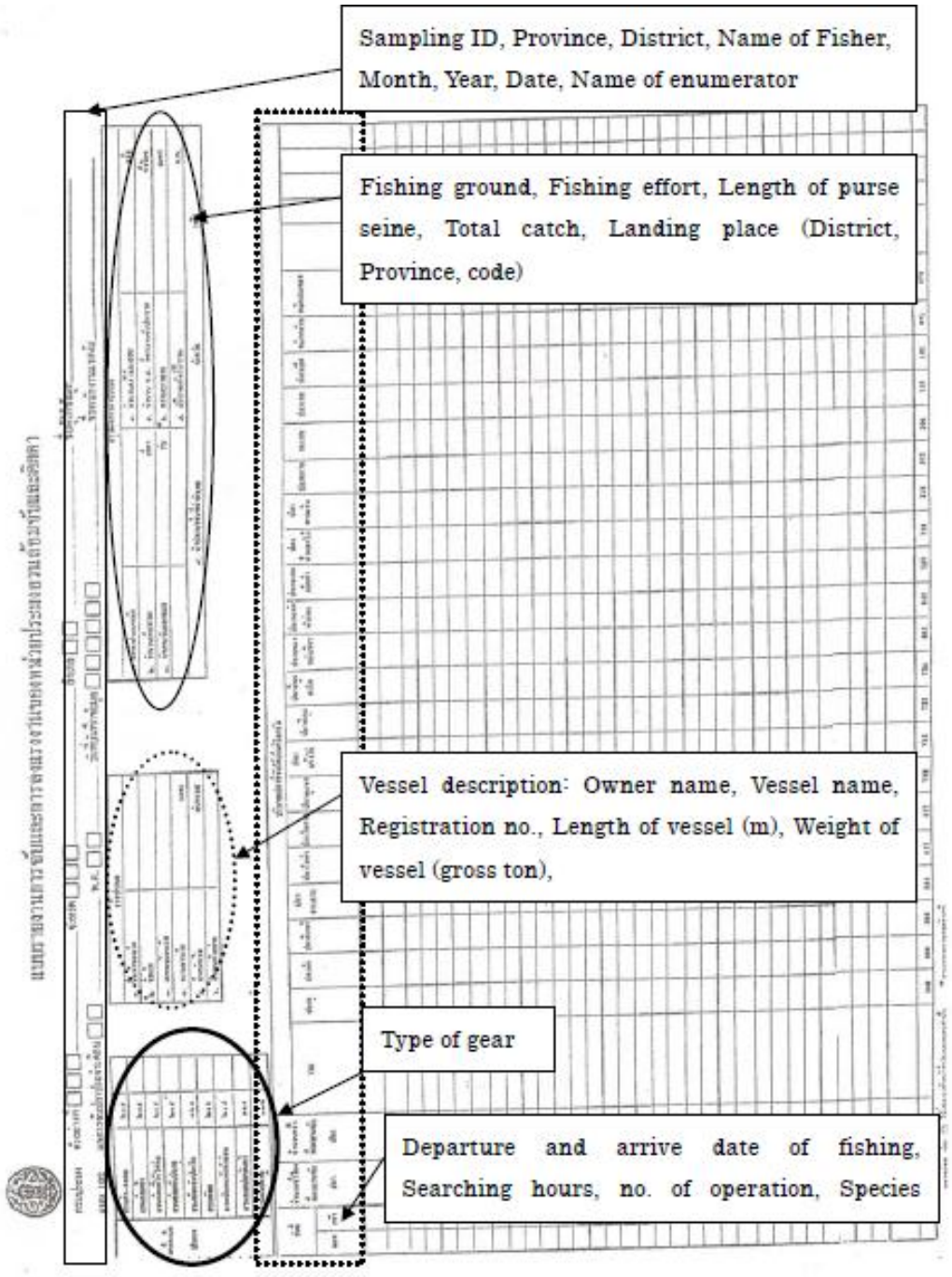
Operating crafts – Crafts used for fishing during the month

LARGE PELAGIC FISHERY
MONITORING PROGRAMME

	DATE										**LOCATION**							
	FLEET DETAILS			**UN1**		**UN2A**		**UN2B**		**UN3A**		**UN3B**						
	Number operated																	
	Number sampled																	
	Boat number																	
	Type of boat																	
	Days fished																	
	Pieces of net																	
	Baskets of hooks																	
	Other gear type																	
	Main bait type																	
In length			YFS															
	Yellowfin		YFM															
			YFL															
			SKS															
	Skipjack		SKM															
			SKL															
	Kawakawa		KAW															
	Frigate		FRI															
	Bullet		BLT															
	Bigeye		BET															
	Other tuna		TUX															
	Narrow barred		COM															
	Wahoo		WAH															
	Other seer		KGX															
	Black marlin		BLM															
	Blue marlin		BLZ															
	Sailfish		SFA															
	Swordfish		SWO															
In weight	Dolphin fish		DOF															
	Other bony fish		MZZ															
	Silky shark		FAL															
	Blue shark		BSH															
	White tip		OWT															
	Spot tail		SPT															
	Longfin mako		LFM															
	Shortfin mako		SFM															
	Bigeye thresher		BTH															
	Pelagic thresher		PTH															
	Thresher		THR															
	Scallop hammerhead		SCH															
	Smooth hammerhead		SMH															
	Great hammerhead		GRH															
	Other sharks		SKH															
	Manta ray		MAR															
	Devil ray		DER															
	Plap nose ray		PNR															
	Eagle ray		EGR															
	Other skates		SKA															
	Mammals		MAM															
	Turtles		TUR															
	No. of landings made in previous month																	

Annex 14. Thailand – example forms used

(Purse seine survey)



(Trawl survey)