FAO Fisheries and Aquaculture Report No. 940 **FIRF/R940 (En)**

ISSN 2070-6987

Report of the

SECOND WORKSHOP ON THE ASSESSMENT OF FISHERY STOCK STATUS IN SOUTH AND SOUTHEAST ASIA

Bangkok, 5–9 October 2009

Web site: www.fao.org/documents/

Report of the

SECOND WORKSHOP ON THE ASSESSMENT OF FISHERY STOCK STATUS IN SOUTH AND SOUTHEAST ASIA

Bangkok, 5–9 October 2009

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2010

ISBN 978-92-5-106595-2

PREPARATION OF THIS DOCUMENT

This report documents the discussions, conclusions and recommendations of the second Workshop on the Assessment of Fishery Stock Status in South and Southeast Asia held in Bangkok, Thailand, from 5 to 9 October 2009. The workshop aimed to review the state of fishery resources in each participating country. This information will contribute to the global review of the state of the fishery resources that FAO updates on a regular basis. Furthermore, the workshop offered an opportunity to discuss key priorities related to improving fishery stock assessments and capacity in the region.

FAO.
Report of the second Workshop on the Assessment of Fishery Stock Status in South and Southeast Asia. Bangkok, 5–9 October 2009.
FAO Fisheries and Aquaculture Report. No. 940. Rome, FAO. 2010. 54p.

ABSTRACT

This report covers the main outcomes of the second of two workshops held in Bangkok (Thailand) in June and October 2009 respectively, with the main objective to review the fisheries data and information available in South and Southeast Asia region and identify appropriate methods to update the assessment of the state of the fishery resources in this area.

The workshop was attended by 38 participants from 10 countries, the Southeast Asian Fisheries Development Centre (SEAFDEC), the WorldFish Center and FAO.

Despite the scarcity of data, by using participants expert opinion it was possible to compile summary tables on the state of the main stocks for most countries. Key recommendations included the need for increased reliability and accuracy of fishery statistics; the desirability of fishery policies and management strategies to be designed based on stock assessment results; and undertaking training in stock assessment and fishery management.

Establishment of a stock assessment working group was also considered as a priority.

CONTENTS

1. BACKGROUND

As part of a global effort to improve the information on the state of fishery resources, FAO planned two workshops in South and Southeast Asia region in 2009 to review the data and information available and, based on these, identify appropriate methods to update the assessment of the state of the fishery resources in this area.

The main objectives of these workshops were to determine data availability, local management issues, and appropriate assessment methods, as a basis to:

- review the state of fishery resources in each participating country;
- review data availability, particularly auxiliary data, of major fisheries;
- identify management and social-economic issues that demand immediate attention and action;
- discuss and identify the most appropriate methods that can incorporate auxiliary data and improve the assessment of fishery resource status.

At the first workshop held in June 2009 in Bangkok, Thailand, participants agreed that four methods could be applied in the assessment of stock status of fisheries resources in their respective countries. These methods were the depletion-adjusted average catch method, which does not require effort data, the Productivity Susceptibility Analysis (PSA), found particularly useful in multispecies and data poor fisheries, stock assessment using life parameters, and using CPUEs from scientific surveys to identify the level of exploitation in relation to reference points derived from the time series of CPUEs form surveys. A work plan was also developed for each participating country to assess its fish stocks using the four methods, and to report results back to the second workshop to be held in October 2009.

The workshop was attended by 38 participants from 10 countries, the Southeast Asian Fisheries Development Center (SEAFDEC), the WorldFish Center and FAO.

The workshop prospectus and the list of participants are attached in Appendixes 1 and 2, respectively.

2. OPENING

The Secretary-General and Training Department Chief of the Southeast Asian Fisheries Development Centre (SEAFDEC), Dr Chumnarn Pongsri, opened the workshop recalling that while the importance of the information on fishery resources, of catch statistics, exploitation rates and overall state of the resources is well recognized, this information is often not available or incomplete. He expressed the hope that this workshop could introduce methodologies to deal with the above situation and produce results that could be used by the countries in support of their efforts to manage the resources in a sustainable manner.

Dr Gabriella Bianchi recalled the background against which this initiative had been taken. There is a general perception globally that fishery resources are declining and that the marine environment is deteriorating because of fishing and other human activities. This is true also for South and Southeast Asia. In these regions, overall positive catch trends may be masking a more compound picture, with serial depletions and high catch levels being so far maintained by enhancing technology and exploitation of new fishing grounds and resources. The lack of detailed information on the state of fish stocks may be lulling decision-makers in the region in believing that the continuous increase in catch means potentials for further expansion of fishing. Moreover, food security considerations, alleviating poverty and increasing employment are often incentives that encourage increase in fishing activities. However, it should be recognized that if landings continue to increase in the region, productivity of fish resources and ecosystems will be undermined and that ultimate loss of food, employment and income will be unavoidable. The knowledge of stock status of fish resources could provide decision-makers with necessary information for designing harvest strategies that aim at long-term sustainability and ecological conservation.

3. COUNTRY REPORTS AND STOCK STATUS ASSESSMENT

3.1 Introduction

Two workshops were planned together for the South and Southeast Asia region in 2009 to review the data and information available and to identify appropriate methods to carry out assessment of the state of the fishery resources. At the first workshop in June 2009, three simple methods were presented: depletion-adjusted average catch, stock status assessment using life parameters (Beddington and Kirkwood, 2005), and productivity susceptibility analysis (PSA), which is not a stock assessment method but used to assess the risk of fishing impact on fish species. It was made clear at the workshop that these simple methods have very strong assumptions and not been tested comprehensively. Therefore, a great uncertainty might exist when applied to practically fisheries, particularly tropical fisheries. They should be used only as the last resort for stocks that have no formal assessment and very limited data available.

For the purpose of capacity building, the first workshop discussed the practical fishery situation in each country and determined a list of works for the representatives to complete and report back to the second workshop after interactive consultations with each country's representative.

To follow on the first workshop, the second workshop carried out an exercise that requested each country to list major fish species and provide information on their catch trend, survey index, current stock status and capacity level of fishing fleet. The selection of major species was mainly based on its catch volume with a target that the total catch of those major species should constitute 40–70 percent of the total marine fish landings. Current stock status of each fish species can be determined based on existing stock assessment results or some informal evaluation such as abundance index or expert judgment. Fishing fleet capacity is classified as either overcapitalized or not based on the best information available such as overfishing, historical catch trend, variation in fishermen's income and economic performance of the fishery.

Stock status and fishing capacity are two most crucial attributes that give information on the health of fish stock and its fishery. If a stock is overexploited, its abundance is lower than the level that could produce the maximum sustainable yield and therefore the potential of production of the stock has not been fully utilized. If no management actions are taken to reduce fishing pressure to rebuild the overexploited stock, the extent of overfishing will become even more serious or the stock may be further depleted.

Stock status can be used for the biological diagnosis while fleet capacity reveals if the current fleet size exceeds the level at which the desired harvest can be carried out in the most economically efficient way. To put it simply, the fleet has too many vessels for harvesting the potential production of the fish stock, i.e. excess capacity. The desired level can be the maximum sustainable yield (MSY) or the maximum economic yield (MEY) or any level that is determined based on consideration of a number of social, economic and ecological factors. Overcapacity often leads to overfishing if no strict control over the fishing activity is in place. However, overcapacity of a fishing fleet does not necessarily result in overfishing provided that the exerted fishing effort is controlled at the right level. It is noteworthy, in such a case, that vessels of the fishing fleet may remain at port for most time of the year and, as a result, economic efficiency is very low.

Overcapacity is a symptom of economic inefficiency and reflects the unhealthiness of the fishery. The evaluation of overcapacity is difficult to diagnose and often requires economic modeling. At this workshop, participants were asked to use the best information available to determine if the fishery has excess capacity. To eliminate overcapacity often demands for joint effort between fishery and other sectors of the community. Therefore, overcapacity is a symptom that reveals problems more than fisheries alone.

To record what has been achieved at the workshop and to provide information on the state of fish resources and their fisheries, the report on each country in this chapter is divided into three sections: country report, workshop exercise report and fishery status report. The country report provide some general information about fisheries and marine capture fishery in each country; the workshop exercise report simply records the results of the assessment of the fish species with the methods agreed on at the first workshop; and the fishery status report presents the results of the assessment of the major species compiled by each country.

3.2 Thailand

Fish production in Thailand increased from 3.6 million tonnes in 1995 to 4.1 million tonnes in 2004, with a value of 105 400 million Baht. Thailand's marine fisheries started a rapid and continuous increase period in the early 1960a and peaked in 1995 at about 2.8 million tonnes (Figure 1). Since then, total marine catch has declined down to 2.4 million tonnes in 2007. A closer examination of the production by region reveals that the drop in production was mainly caused by the reduction of production in the Gulf of Thailand.

Fisheries contribute approximately 1.6 percent of the national GDP, or 16.2 percent of the agricultural sector in Thailand. Contribution of the fisheries sector is significant to the country's economy. Apart from generating substantial incomes and employment, it also supports the various downstream industries, e.g. ship building and fish processing industries, including fishmeal factories.

Fish products are a main source of animal protein in the Thai diet, and national fish consumption increased from 25 kg per capita in 1995 to 35 kg per capita in 2004. Fisheries are an important source of foreign currencies through export in Thailand and earned a total registered trade surplus of 125.2 billion Baht in 2004.

Figure 1: Historical catches from Thailand's marine capture fisheries.

Stock assessment of economically important species such as threadfin bream, lizardfish, and bigeye, clearly indicates that these fish resources are overexploited, especially demersal species. The recovery of these fish stocks may require 50–60 percent reduction of the current fishing effort. It was also found that the stocks of crustaceans (e.g. large-sized shrimp and oriental flathead lobster), and cephalopods (e.g. squid and soft cuttlefish) have begun to decline. Overfishing has also seen in pelagic fish stocks. The pelagic fisheries began in 1973 and have managed to increase their total catch by fourfold from 141 608 to 614 814 tonnes in just two decades from 1973 to 1994.

Highly efficient fishing gear and methods expanded fishing effort significantly, and fishing fleets target specifically brood stocks, particularly during spawning seasons. Highly effective fishing effort and capturing of spawning stocks result in destructive effects on fish stocks and lead to serious overfishing. Total landings of pelagic species have levelled off in recent years, with an annual catch of 642 472 tonnes in 2000. Most pelagic fish stocks are fully exploited, including chub mackerel, bigeye scad, sardinellas and anchovy. The round scad stocks are considered depleted and therefore require immediate management actions. It can be concluded that the marine fishery resources, especially in the Gulf of Thailand, are overexploited.

Workshop exercise report

At the first workshop, Thailand agreed to apply two methods, Method 1 and Method 3, to its major fisheries. Method 1 is most useful for stocks that have a low natural morality. Application of Method 1 resulted in negative biomass for all selected species. In most cases, the method failed to estimate MSY. With Method 3,

the results showed low risk levels for all the species examined. When applying Method 3 to specific fisheries, we believe classification of life parameters should be adjusted based on the specific characteristics of fisheries in the region.

There has been a reduction in licences in the trawl fisheries in Thailand because of declined resource abundance. However, no management plans have been developed and, therefore explicit management objectives do not exist at present. Stock assessment has been carried out for most commercially important species, and MSY and the time needed to rebuild overexploited stocks have been estimated.

Both the methods (Method 1, Depletion-Adjusted Average Catch, and Method 2, Stock Status Assessment using Life Parameters[1])) may not be applicable to the Thai fisheries without significant refinement/modification. Most tropical fish species grow fast and have a short life-span together with a high natural mortality rate. The Productivity/Susceptibility Analysis (PSA) helps with assessing the relative impacts of fishing on different species in a fishery, but it is not for stock status assessment. Such a risk assessment can be used to identify what species are at high risk and deserve further study or management actions.

An apparent difference was also noticed between survey trends and production statistics. The former showed a decrease of one order of magnitude over three decades while production showed an increasing trend. This was believed to be caused by the expansion of fishing from the Gulf of Thailand to other areas of the South China Sea. The FAO Regional Office for Asia and the Pacific (RAP) provided data for threadfin bream to show that the majority of reported catch in the Gulf of Thailand came from waters outside the Gulf. SEAFDEC also conducted a study on the reliability of the landing data of longtail tuna and eastern little tuna in Thailand and found that 50–88 percent of the reported catch came from outside Thailand's EEZ, from 1998 to 2005

Fishery status report

Table 1 shows stock status of the top 14 commercially important (based on catch volume) species in the Gulf of Thailand. Of the 14 species, the first five are demersal species, the following six are pelagic species, and the last three cephalopods. They contribute 66 percent of the total catch in the Gulf and the assessment was mostly based on yield per recruitment analysis. Due to the data scarcity, growth parameters and fishing mortality rates were estimated using length-based methods and natural mortality was based on Pauly's (1980) empirical equation.

Of the species listed in Table 1, eight are overexploited and the remaining 6 are fully exploited. In general, demersal fish species show a dimmer picture than pelagic ones. This is probably because demersal fish often have a higher market value and are often captured by trawls. Another alarming phenomenon is overcapacity, i.e. the number of fishing vessels targeting the species or the total fishing effort the vessels can potentially exert on the species is too high. Overcapacity has occurred to all the top 14 species. If no practical measures were found to remove those excessive fishing capacity, overfishing will spread to the species that are not yet overexploited. This is because the low abundance of overexploited stocks will result in lower catch rates and support less fishing effort and fishing vessels will have to switch to targeting other more abundant species.

[1] FAO, 2009. Report on the 1st Workshop on the Assessment of Fishery Stock Status in South and Southeast Asia. 16 -19 June 2009, Bangkok, Thailand

Table 1 Stock status assessment of the top 14 species in the Gulf of Thailand. "Catch trend" and "Survey index" provide the general changing pattern over the last five years. + : increase; – : decrease; and = : stable. In the column of status, U indicates underexploited, M moderately exploited, F fully exploited, O overexploited, and D depleted. "s" , in the column "Remarks" indicates that stock status was obtained from stock assessment.

Selected species		Catch trend	Survey index	Over - capacity	Status	Remark
Threadfin breams	*Nemipterus hexodon*	+	–	O	F	s
Bigeyes	*Priacantrus tayenus*	+	–	O	O	s
Lizard fish	*Saurida elongata*	–	+	O	O	s
Lizard fish	*Suarida undosquamis*	–	+	O	O	s
Orangefin ponyfish	*Leiognathus bindus*	–	+	O	O	s
Yellowstripe scad	*Selaroides leptolepis*	=	–	O	O	s
Indo-Pacific mackerel	*Rastrelliger neglectus*	–	–	O	F	s
Indian mackerel	*Rastrelliger kanagurta*	–		O	F	s
Scads	*Decapterus maruadsi*	–	–	O	F	s
Sardinellas	*Sardinella gibbosa*	–		O	O	s
Anchovies	*Encrasicholina heteroloba*	–	+	O	F	s
Squids	*Photololigo duvaucelii*	=	+	O	F	s
Squids	*Photololigo chinensis*	=	+	O	O	s
Cuttlefish	*Sepia aculeata*	=	–	O	O	s

3.3 Malaysia

Marine fishery production in Malaysia has been increasing linearly since 1950 and reached 1.38 million tonnes in 2007 (Figure 2). This represents about 89% of the total national fish production, with a value of RM5.1 billion (US$1.41 billion). Almost 50% of the total catches were from the Straits of Malacca, 24% from the South China Sea off the east coast of Peninsular Malaysia and the remaining 26% were from the South China Sea, Sulu Sea and Celebes Sea off the coasts of Sabah and Sarawak.

Inshore waters (area of less than 30 nautical miles from the coastline) contributed 81% of the catch and fishing vessels were usually below 70 gross tonnes. This is consistent with the big number of inshore fishing vessels, 97% of fishing vessels in the country. Trawls and purse seines are the two major gear types and contribute up to 78% of the landings. Currently, there are 6 090 trawlers and 1 265 purse seiners licensed and operating in Malaysia.

Stock assessment was completed mainly using holistic methods, including fishery independent surveys, swept area methods for demersal species and acoustic survey for pelagic species. The Malaysian fisheries usually capture multiple species because tropical marine ecosystems have a high biodiversity. The concept of target species is quite weak.

As in many Asian countries, fisheries in Malaysia are an important industry in terms of employment, food security and export. The marine fishing sector directly employed almost 100 000 persons or about one percent of the national labour force to work as fishers onboard of 39 268 licensed fishing vessels. However, contribution of fisheries to national employment decreased continuously from 2.4% in 1970 to 1.9% in 1990 and 1% in 2007.

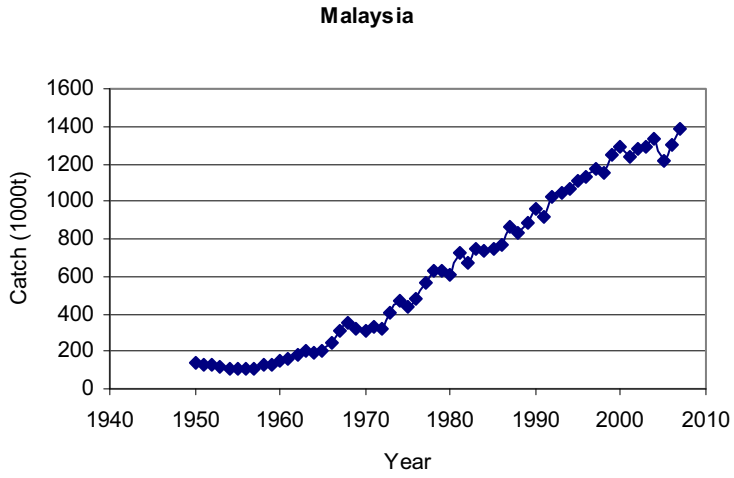


Figure 2: Historical catches from Malaysia's marine capture fisheries

Workshop exercise report

Method 1 (Depletion-Adjusted Average Catch) and Method 3 (Productivity Susceptibility Analysis [PSA]) were applied to the available data from the west coast of Peninsular Malaysia. Method 1 was applied to 22 species. The catch data used in this exercise were from the annual fisheries statistics from 1970 to 2007, which only represents the Andaman Sea area of the Straits of Malacca on the west coast of Peninsular Malaysia. Measures were taken to ensure that catch data of specific species are reliable. This area is in the FAO Statistical Area 57. Natural mortality (M) was quoted from published sources, either estimated for Malaysia or (mostly) for other countries in the region. The values of α were estimated based on the ratio of CPUEs between 2007 and 1970 or 1980, which are the earliest year of the data series and assumed to have stock abundance close to virgin stock status. CPUE is calculated by dividing the total catch of a species by the number of vessels recorded of the major fishing gear targeting that specific species. To take into account of fishing efficiency creep over time, e.g. technical improvement, introduction of new add-ons, longer fishing time, better skills and cumulating knowledge, the number of vessel for 2007 was doubled (for fish) and tripled (prawn) in the estimation of the α values.

All the 22 species (7 pelagic species, 8 demersal, 5 prawn and 2 cuttlefish) exhibited a continuous increasing trend in annual catch, particularly over the last few years. Probably this ever-increasing pattern makes the model failed to estimate MSY and Biomass at MSY.

Method 3 (PSA) was applied to four major fisheries on the western coast of Peninsular Malaysia, covering both the Andaman Sea and the South China Sea regions of the coast. The four main fisheries are: (i) trawl fishery; (ii) purse seine fishery; (iii) driftgill net fishery; and (iv) trap fishery. The criteria used for PSA analysis are presented in Tables 2 and 3, respectively.

Table 2 Cut-off scores for productivity attributes

Criteria	Comment	Low risk (score=1)	Medium risk (score=2)	High risk (score=3)
		High productivity		Low productivity
Maturity	Average age at maturity	<2 years	2–4 years	>4 years
Maximum age	Average maximum age	<10 years	10–25 years	>25 years
Fecundity	Fecundity	>20 000 eggs/year	100–20,000 eggs/year	<100 eggs/year
Maximum size	Average size at maturity	<60 cm	60–150 cm	>150 cm
Size maturity	Average size at maturity	<30 cm	30–50 cm	>50 cm
Reproduction	Reproductive strategy	Broadcast spawner	Demersal egg layer	Live bearer/brood
Trophic level	Trophic level	<2.75	2.75–3.25	>3.25

Table 3 Cut-off scores for susceptibility attributes

Criteria	Comment (value used)	Low risk (score=1)	Medium risk (score=2)	High risk (score=3)
		High productivity		Low productivity
Availability	Vulnerability	<30 of 100	30–60 of 100	>60 of 100
Encounterability	% caught+fish group	Trawl:<50%+Pel. Others:<50%+Dem	Trawl:<50%+S–P Others:<50%+S–P	Trawl:>50%+Dem. Others:>50%+Pel.
Selectivity	Fish shape	Rounded	Less rounded	Flat or compress
Post-capture mortality	Resilience – pop. doubling times	<15months	1.4 – 4.4 years	4.5 – 14 years

Table 4 summarizes the findings of the analysis. The results show that only purse seine fishery ranks as “low risk while trawl and trap fisheries are in the upper level of “medium risk” rank.

Table 4 Summary results of the PSA for the four main fisheries on the western coast of Peninsular Malaysia

Fishery	No. of species	PSA score	Risk rank	Species by risk rank (%)		
				Low	Medium	High
Trawl	159	3.03	Medium	0.1	44.9	55
Purse seine	36	2.61	Low	52	40	8
Drift-gillnet	102	2.85	Medium	18	64	18
Trap	32	3.00	Medium	–	94	6

There are some problems encountered with the Depletion-Adjusted Average Catch method:

(i) Annual catch data from statistics provides valuable information of catch for the stocks examined, but not good enough for this model since changes in fishing capacity and efficiency are not taken into consideration. Catch data from monitoring survey (standardise kg/hr) is a better option, if available. The δ value is also better from survey data.

(ii) Few M values are available in the study area, and the available M estimates need to be validated.

(iii) Most of the national waters in this region are belonging to the same ecosystem. Therefore assessments done by individual country (particularly on pelagic species) might not be accurate. Assessment at ecosystem level (South China Sea, Andaman Sea and Straits of Malacca, etc.) should be a better option.

While applying PSA to real fisheries, the use of expert judgement to reduce the proportion of unknown attributes (to the level below 50 percent of the total) may produce more reliable results of the analysis.

Both the methods can be used as alternatives to existing methods used in the region. The results of PSA can easily be understood by the managers and policy makers and disseminated to fishermen and the public. However, further interpretation of the results and the management measures required in response to the results need to be clarified.

Over the last ten years, not many training courses were available on data collection and stock assessment. New scientists and researchers are not well trained to do this work.

In the discussion, concerns were raised that stock assessment is often perceived as not needed in the region. University courses do not offer training courses on stock assessment and emphasis is instead put on aquaculture. Lack of fisheries management plans and mechanisms of developing scientific advice for fisheries management largely explain why stock assessment is not prioritized or perceived as priority.

Fishery status report

In Malaysia, species diversity is very high and the top 76 species contribute only ~70 percent of the total catch. Most fisheries catch multiple species or most species are caught by different types of gear. This nature makes stock assessment extremely challenging. Although stock assessment for some species has been carried out, it was difficult to evaluate stock status for the major 70 species, of which only two species dropped its catch from 1990 to 2007. It must be noted that it is impossible to link this change in catch with stock status.

The state of marine fishery resources in Malaysia was evaluated by group and region (Table 5). Most groups are either moderately or fully exploited in most regions. However, it is worth to note that no overfishing was diagnosed. This may reveal promising side of the Malaysian fishery or indicate the urgent need for more detailed assessment as assessment by group often tends to mask the fact of overfishing for some species.

Table 5 State of marine fishery resources in Malaysian waters. Fully=Fully exploited, Moderately =Moderately exploited, Under=Underexploited, and Approach fully=Approaching the state of being fully exploited.

	Resource	Peninsular Malaysia		Sarawak	Sabah
		West coast	East coast		
1.	Demersal fish				
	Inshore	Fully	Fully	Fully	Moderately
	Offshore	Fully	Fully	Moderately	Moderately
2.	Pelagic fish				
	Inshore	Fully	Fully	Moderately	Approach Fully
	Offshore	Fully	Approach Fully	Under	Moderately
3.	Shrimp	Fully	Fully	Fully	Fully
4.	Anchovy	Fully	Fully	-	Not certain

3.4 Cambodia

Cambodia's marine capture fisheries play an important role in food security, national income and employment. According to the statistics of the Fisheries Administration 2008, total production of marine capture fisheries accounted for 66 000 tonnes, which was equivalent to 8 percent of the total fish production in Cambodia. Marine fishery production has seen a sharp increase since the late 1980s and a levelling off over the last 3 years (Figure 3).

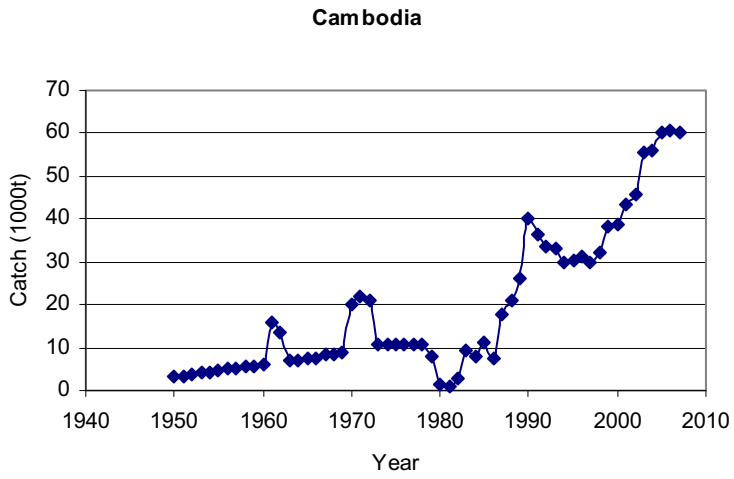


Figure 3: Historical catches from Cambodia's marine capture fisheries

Catch statistics were estimated by species groups, rather than by species in Cambodia. Therefore, it was impossible to evaluate stock status of any particular species. The increase in numbers of fishermen and fishing effort, illegal fishing activities, pollution, and habitat destruction put further pressure on marine fish resources.

There is very limited scientific data/information available for the assessment of catch and stock status in Cambodia. Even worse, the quality of the patchy existing data is very poor and it is therefore difficult to do stock assessment based on these data and develop management plans for the sustainable use of marine fish resources. Lack of infrastructure and human resources is another major problem that deserves immediate attention. At present, there is no marine research institute or laboratory facility that can carry out research and provide advice on fishery management

The need for collecting catch statistics and other relevant data is obvious. At the minimum, landing statistics of commercial species should be gathered. This certainly leads to the requirement for establishing a statistical data collection system in Cambodia. Cooperation and assistance from international organizations may be needed to start the process.

Despite the paucity of information and data, some catch statistics were presented at the workshop. Questions were raised regarding the origin of these statistics, because no system for data collection exists in Cambodia. It was explained that some catch data, at least on trend, was derived from estimations based on experience and traditional knowledge. A large portion of marine catches were trash fish, but unfortunately it was not possible to separate trash fish from the total as the volume of trash fish catch was often estimated based on the economic value.

Workshop exercise report

Cambodia did not carry out any exercise assigned at the first workshop.

Fishery status report

The situation described above, i.e. lack of fishery data and very limited financial and human resources, prevents formal stock assessment of the resources exploited in Cambodia. At the workshop, the participant from Cambodia provided the best expert-based assessment for the major fish species (Table 6). It seems that overfishing is common, although the species that were not included in the table may be in a different situation. It should be noted that while expert-based evaluations may be biased or unreliable, they prove often no to be totally unfounded. Fishermen and fishery managers can have insights on fish stock status and on the state of the fisheries particularly in those cases where they have first-hand information about catch, catch rates, size composition, etc., over a long-time period. When there is inadequate data and information for stock assessment purposes, such expert opinions are very valuable and can be used for management and for policy development. While the importance of expert opinion is recognized, in order to improve the quality of the information base for fisheries management, any effort should be made to establish a statistical data collection system in Cambodia and improve staff capacity to carry out resource assessments.

Table 6 Catch trends and stock status assessment of the major fish species in Cambodia. "Catch trend" and "Survey index" provide the general changing pattern over the last five years. + : increase, – : decrease, and = : stable. In the column of status, U indicates underexploited, M moderately exploited, F fully exploited, O overexploited, and D depleted.

Species name	Scientific name	Catch trend	Survey index	Stock status	Overcapacity
Spanish mackerel	*Scomberomorus commersoni*	+/=	–	O	?
Short mackerel	*Rastrelliger brachysoma*	=	–	O	?
Three lines tongue sole		+/ =	–	O	?
Robust bigeye		=	–	O	?
Obtuse barracuda		=/+	–	O	?
Trash fish		+			?
Crustaceans	*Oratosquilla nepa* *Metapenaeus ensis* *Penaeus latisulcatus* *Aristeus antennatus*	=/+	–	O	?
Squid/cuttlefish	*Sepioteuthis lessoniana* *Sepia pharaonis* *Loligo formosana*	+/ =	–	O	?
Giant mud crab					?
Blood cockle					?
Lower crab/swimming crab	*Portunus pelagicus*	+	–	O	?
Mussel (mixed)		+	?		?
Bullet tuna	*Auxis rochei rochei*	+/ =	–	F	?

3.5 Philippines

Annual production of fish and other aquatic resources in the Philippines amounted to 4.71 million tonnes in 2007. Marine fishery production has kept an increasing trend since 1950 and shows no sign of any change (Figure 4).

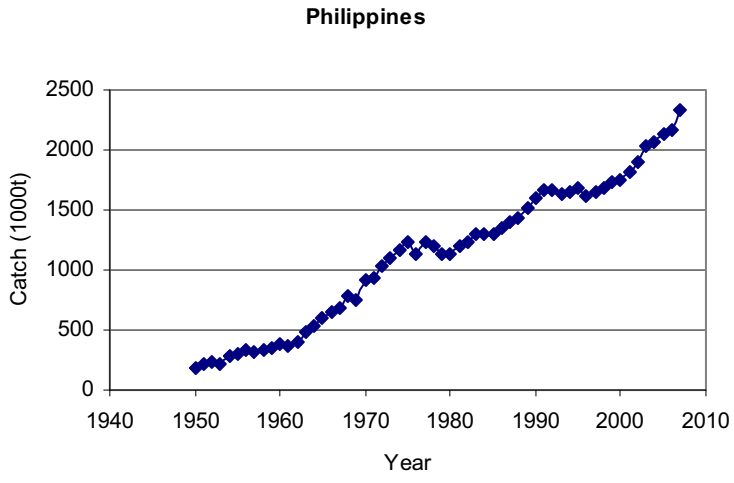


Figure 4: Historical catches from Philippines' marine capture fisheries

The Philippines' marine fish landings are dominated by pelagic, schooling fish species. While large pelagics, such as tunas, monitored with the assistance of the Western and Central Pacific Fisheries Commission (WCPFC), constitute a large part of the catches, small pelagic fishes are the most abundant and account for more than 50 percent of the total marine fish landings. For this reason, the Bureau of Fisheries and Aquatic Resources (BFAR) – National Fisheries Research and Development Institute (NFRDI) is compelled to monitor/study this group. However, due to the limited financial resources available, only a small portion of the country's vast fishing grounds have been studied and/or monitored.

Fisheries contribute to national gross domestic product (GDP) in the Philippines, 2.2 and 4.3 percent at current and constant prices, respectively, and employ a total of more than 1.6 million fishing operators, with the municipal sector having more than 1.3 million.

Report on workshop exercise

Substantial amount of conventional stock assessments (mostly length-based fish stock assessments with surplus-production modelling) have been undertaken on specific fishing areas in the past, through the assistance of dedicated projects. Today, the BFAR and its Regional Field Offices are trying to conduct stock status monitoring, even with limited human and financial resources.

The status of Philippine fishery resources are under threat of overexploitation, aggravated by increasing population, environmental degradation, a condition that makes management very challenging. Fisheries management is still based on the traditional top-down approach that uses licences and permits as the main management tool, designed for optimum exploitation as the primary goal. The Fisheries Code of 1998 provides specific management measures to conserve and manage the fisheries resources of the country. The issuance of a Fisheries Office Order (No. 217, 2008) by the BFAR for adoption of an Integrated Fisheries Management Unit scheme is an initial step in the direction of ensuring the well being of fisheries resources. Several administrative orders have also been issued such as the moratorium on the issuance of new fishing vessel and gear licence.

It was noted that in this country, similarly as in other countries of the region, the situation of open access undermines other management efforts. Although entry to the industrial fishery is now limited and has levelled off, in the municipal sector no control exists. It is a big challenge to coordinate management strategies and regulations between the commercial and municipal sectors.

Fishery status report

Stock assessment was undertaken for a few major fish species, despite the fact that data for these were rather patchy. Most assessments have been carried out through special projects, the short-term nature of which leads to lack off continuity and consistency. Stock assessment of tuna species are usually undertaken by the Western and Central Pacific Fisheries Commission and updated regularly. However, stock status of these species at country level is difficult to determine. The top 10 most important species in the Philippines and their stock status are listed in Table 7. Most are moderately or fully exploited and no stocks have been diagnosed as overexploited.

It should be noted that the evaluation of stock status presented in Table 7 was based on existing reports, publications and expert-judgement and may involve a great amount of uncertainty. The Philippines are located in the tropics and species diversity is high. A fishery, particularly, trawl fishery, may catch many fish species, and this is certainly one of the major reasons for the lack information on stock status in the Philippines.

Table 7 Catch trends and stock status assessment of the major fish species in the Philippines. "Catch trend" and "Survey index" provide the general changing pattern over the last five years. + : increase, – : decrease, and = : stable. In the column of status, U indicates underexploited, M moderately exploited, F fully exploited, O overexploited, and D depleted.

Species name	Scientific name	Catch trend	Survey index	Stock status	Over-capacity
Round scad	*Decapterus* spp.	+	+	F	
Indian sardine	*Amblygaster* spp.	+	+	M	
Frigate tuna	*Auxis* spp.	+		M	
Skipjack	*Katsuwonus pelamis*	+		?	
Yellowfin tuna	*Thunnus albacares*	+		?	
Bigeye Scad	*Selar* spp.	+		F	
Fimbriated sardine	*Sardinella* spp.	+	+	M	
Slipmouths	*Leiognathus* spp.	+	+	M	
Eastern little tuna	*Euthynnus* spp.	+		?	
Indian mackerel	*Rastrelliger* spp.	+	+	F	

3.6 Bangladesh

Total fish production in Bangladesh was 2.56 million tonnes in 2007, of which 2.06 million tonnes came from inland fisheries and the remaining 0.50 million tonnes from marine capture fisheries. Marine fishery production increased from a very low level in 1950 to 0.5 million tonnes in 2007, and the growing trend got more momentum in the early 1980s (Figure 5).

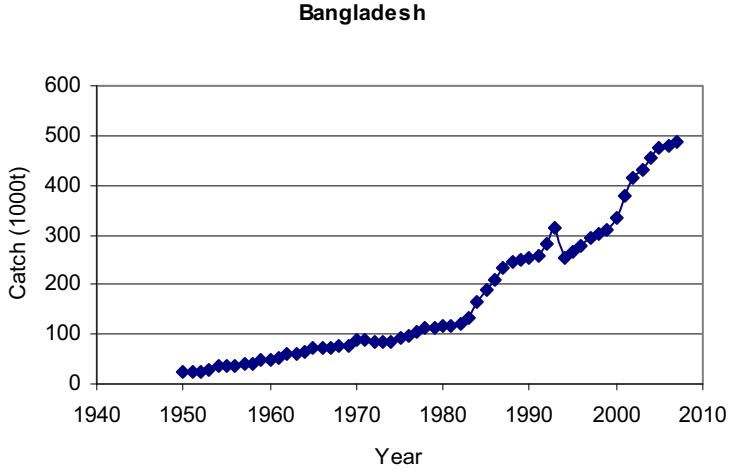


Figure 5: Historical catches from Bangladesh's marine capture fisheries

Fisheries play an important role in Bangladesh in terms of nutrition, income, employment and foreign exchange earnings. The sector contributes 5.71% of the total export earning and 4.92% to national GDP, while about 12 million people are directly or indirectly involved in this sector with an annual increase of labour employment by about 3.5%. Fisheries contribute about 22% of the total agricultural production and 63% of the total animal protein intake of the country.

Aquaculture, inland and marine capture fisheries contributed 39.2%, 41.4% and 19.4% of the total production, respectively. In marine fisheries, artisanal fisheries contribute about 95% of the total marine catch, utilizing gillnets, set-bag-nets, seine nets, push nets, hooks and lines, trammel nets, etc. In contrast, industrial fisheries (trawl fishery) contribute only about 5% of the total marine production. There were 127 industrial fishing trawlers, 21 433 artisanal motorized boats and 2 257 artisanal non-motorized boats in 2008.

Hilsa shad (*Tenualosa ilisha*) is the most important species in marine capture fishery and accounts for nearly half of the national marine catch and 12–13 percent of the total fish production of the country.

Workshop exercise report

Results of an assessment of the hilsa shad (*Tenualosa ilisha*) in Bangladesh waters using Method 1 were presented. Commercially harvested important species were: hilsa shad (*Tenualosa ilisha*), Bombay duck (*Harpadon nehereus*), ribbonfish (*Lepturacanthus savala*), jewfish/croakers (*Johnius* spp./*Otolithus* spp.), pomfrets (*Pampus* spp.), mackerels (*Scomberomorus* spp./*Rastrelliger* spp.), little tunas (*Euthynnus affinis*), catfish (*Arius* spp.), carangids (scad, trevally), clupeids (anchovy, sardine), sharks (hammerhead, dogfish), skates and rays (guitarfish, stingrays), shrimps (tiger shrimp, *Acetes*, white shrimp, brown shrimp), etc.

A comprehensive action plan for the management of the hilsa shad has already been formulated and partly implemented. The plan includes protection of juveniles, breeding and nursery grounds, and rebuilding of stock abundance of this species. The Government allocated some financial support for alternate livelihood of the affected fishers. Implementation of the action plan resulted in a 35 percent increase in the abundance of Jatka and about 40 percent increase in Hilsa production.

The action plan was formulated based on the level of exploitation (E) estimated from length frequency data using ELEFAN/FiSAT and on catch and abundance. MSY was not used as a reference point. The value of $E = 0.5$ was considered as optimum (which actually corresponds to the level for MSY when $B=B_{MSY}$), but $E = 0.5 + 0.1$ was also considered as acceptable. Exploitation level has increased since 1989. As a result, catch trends started to decline in 1994 until the management plan implemented in 2004, a positive sign. Since 2005, catch started to increase due to the increased biomass/recruitment resulting from the protection of juveniles and spawning stock.

In addition to the stock assessment exercise of Hilsa, some important statistical and/or approximate stock information for other important species/groups were presented in the workshop in a tabular form.

It was encouraging to see successful cases in which alternative livelihoods were provided while conservation measures were implemented. This may provide valuable lessons to other countries of the region.

It was noted that recent studies on hilsa shad fishery in India show that fishing is expanding at sea, but decreasing in upstream waters (freshwaters).

Fishery status report

Based on the best available information, the representative from Bangladesh provided information on stock status of the most important fish species (Table 8). All the major species show an increasing trend in catch over the last 5 years. The most important species of hilsa shad was considered fully exploited, and other species were either moderately or underexploited. However, the fishing fleets that capture hilsa shad, Bombay duck and ribbon fish were believed to be overcapitalized

Table 8 Catch trends and stock status assessment of the major fish species in Bangladesh. "Catch trend" and "Survey index" provide the general changing pattern over the last five years. + : increase, – : decrease, and = : stable. In the column of status, U indicates underexploited, M moderately exploited, F fully exploited, O overexploited, and D depleted.

Species name	Scientific name	Catch trend	Survey index	Stock status	Over-capacity
Hilsa	*T. ilisha*	+		F	Yes
Bombay duck	*H. nehereus*	+		M	Yes
Ribbon fish	*L. savala*	+		M	Yes
Croakers	*Johnius* spp. *and Otolithus* spp.	+		M	
Pomfret	*Pampus* spp.	+		M	
Tuna (little tuna)	*E. affinis*	+		U	
Mackerel/seerfish	*S. guttatus*	+		U	
Catfish	*Arius* spp.	+		M	
Carangids	Carangidae (mixed)	+		M	
Sardines/anchovies	Clupeidae (mixed)	+		M	
Mullets	*Mugil* spp. *and Liza* spp.	+		M	
Snappers	*Lutjanus* spp.	+		U	
Sharks	*Sphyrna* spp., *Scoliodon* spp.	+		U	
Skates	*Rhynobatos* spp.	+		U	
Rays	*Himantura* spp.	+		U	
Tiger shrimp	*P. monodon*	–		F	Yes
Others	*other species*	+		U	

3.7 China (northern South China Sea)

China is a fishing country having a significant impact on the statistics of the region. Its total production was 47.5 million tonnes in 2007, of which 12.4 million tonnes from marine capture fishery and 1.07 million tonnes from distance-water fishing. In terms of percentage, marine catch accounted for 26.2 percent of total fishery production.

China's marine capture fishery went through a rapid development phase from the early 1980s to the mid-1990s, increasing production from 2.2 million tonnes to a peak of close to 14 million tonnes in 1998 (Figure 6). The Chinese government adopted a zero-growth policy in 1999 that seems having capped marine production at the level of about 12 million tonnes.

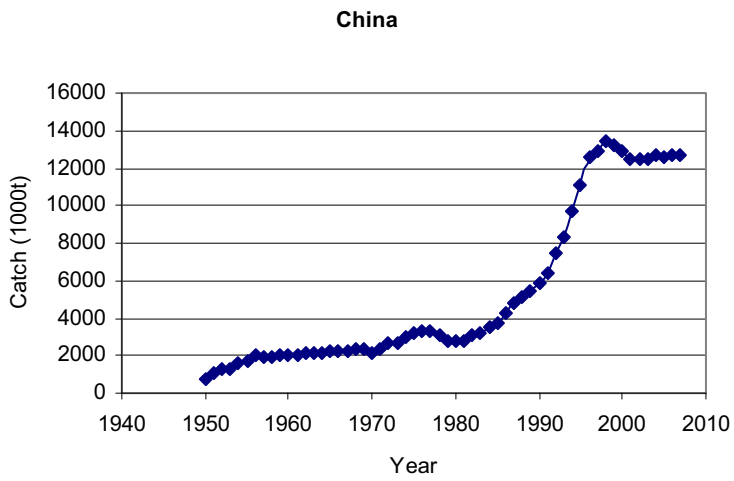


Figure 6: Historical catches from China's marine capture fisheries

Although China is the largest fishery country in the world, contribution of fisheries to China's economy is relatively small, about 2.26 percent of national GDP in 2007. The importance of fisheries in national economy has been decreasing over time as other industries have experienced faster development. The number of people employed in marine fishing and aquaculture in China was about two million in 2007. Development has not been even among different sectors of fishery production; marine fishing has gradually decreased its share while mariculture increased about 100 percent over the past five years.

The workshop has a focus on northern part of the South China Sea (SCS) and, therefore, the country report for China concentrates on the northern South China Sea. Marine fishing in southern China mainly takes place in the Northern Shelf and the Beibu Gulf (Tonkin Gulf) of the northern South China Sea. Fishing fleets are composed of 85 000 motorized and 5 600 non-motorized fishing boats, and the total engine power of motorized fishing boats amount to 3730 000 kW. Fishing capacity has grown rapidly since the 1970s. The government enforced a policy of limiting fishing capacity in the late 1990s and the growth of fishing capacity was slowed down. Fishing capacity has been further capped in recent years. Fishing vessels were dominated by bottom trawlers in terms of horsepower, but small vessels using gillnets outnumber bottom trawlers.

Because of overcapacity, the majority of fish stocks in the northern SCS are overexploited, as reflected in the declining trawl CPUEs and standing stock densities from trawl surveys. The reality of overfishing is also echoed somehow by the increased proportion of low-value fishes in the catch. The stock densities in inshore waters are lower than in offshore waters due to the heavy fishing pressure along the coast. However, there are signs in recent years showing that the declining trend of stock density has ceased. This is probably due to the reduction of trawl fishing caused by high oil price. This was reflected by the increase in offshore stock density and decline in total mortality of some demersal species.

Workshop exercise report

There was a change of participant from China for the second workshop, and therefore no assessment using the three methods presented at the first workshop was carried out. Surplus production models were used to evaluate three species groups: demersal species in inshore areas, demersal species in deeper waters, and low-trophic species, based on Gulland-Fox exponential plots. The results show that catches of the fishery followed a dome-shaped trend, corresponding to a monotonic growth in fishing effort, first in the inshore demersal fisheries in the 1950s, and then in the offshore demersal stocks in the 1960s, while the catch of low-trophic species showed a rising trend until 1990 and eventually experienced a decline under high fishing pressure.

Based on length-frequency data collected from trawl surveys, Beverton-Holt models were fitted for major target species. The results indicate that the current targeted species could sustain a high fishing mortality

should the size at first capture be increased. The optimal rate of exploitation, $E = F_{max}/ (M+ F_{max})$ can be as high as 0.8. The major problem of the fishery is the small size at first capture. Increasing first capture size will result in a higher yield and a higher stock density for the target species. The problem of capturing juveniles has existed for a long time in the northern SCS fishery. Protecting juveniles is a better strategy for the fishery management and can be easily implemented through a summer closure and mesh-size regulations.

The impact of climate change in general and the higher frequency of tropical cyclones in particular were discussed. Apparently, there is a close correlation between stock abundance and frequency of tropical cyclones, most probably because of the increased primary productivity resulting from better water-mixing caused by tropical cyclones.

Fishery status report

Stock assessment was completed for the top 33 species that contribute about 45 percent of total catch in the northern South China Sea (Table 9). Almost all species showed a decreasing pattern in both catch and survey index over the last five years except jack mackerel and squid. Among the 33 species, 16 species (about 50 percent) were depleted and another 15 overexploited. Only one species jack mackerel was diagnosed as fully exploited and another species *Loligo edulis* moderately exploited. Overcapacity of fishing fleets exists for all species except *Loligo edulis*. In general fish stocks in this region are in a serious situation and the common phenomenon of overcapacity further alarm the urgent need for appropriate management actions.

The assessment of stock status was based on yield per recruit models for most species, except a couple that relied on expert-judgement based on trends in catch and survey abundance index together with other information from its fishery. Such assessment does not only provide information on stock status, but also offer valuable advice on potential approaches to enhance conservation and increase production. For example, it was clearly stated in China's country report to the workshop that a larger age at first capture can increase production as well as improve quality of the catch. In such a case, controlling fishing effort can lend further positive impact on stock abundance and production and consequently improve economic performance of the fishery.

Table 9 Catch trends and stock status assessment of the major fish species in China (Northern South China Sea). "Catch trend" and "Survey index" provide the general changing pattern over the last five years. + : increase, – : decrease, and = : stable. In the column of status, U indicates underexploited, M moderately exploited, F fully exploited, O overexploited, and D depleted.

Species Name	Scientific name	Catch trend	Survey index	Stock status	Over-capacity
Chinese herring	*Ilisha elongata*	–	–	D	Yes
Anchovies	*Stolephorus* spp.	–	–	O	Yes
Pomfrets	*Pampus* spp.	–	–	D	Yes
Spanish mackerels	*Scomberomorus* spp.	–	–	O	Yes
Jack mackerel	*Trachurus japonicus*	+	+	F	Yes
Japanese scad	*Decapterus maruadsi*	–	–	O	Yes
Blood snapper	*Lutjanus sanguineus*	–	–	D	Yes
Marine catfishes	*Netuma* spp.	–	–	D	Yes
Flounders	*Pseudorhombus* spp.	–	–	D	Yes
Croceine croaker	*Larimichthys crocea*	–	–	D	Yes
Conger pike	*Muraenesox cinereus*	–	–	D	Yes
Longfin mojarra	*Pentaprion longimanus*	–	–	D	Yes
Groupers	*Epinephelus* spp.	–	–	D	Yes
Grunts	*Pomadasys* spp.	–	–	D	Yes
Threadfin	*Eleutheronema tetradactylum*	–	–	D	Yes
Goatfishes	*Upeneus* spp.	–	–	D	Yes
Threadfin bream	*Nemipterus japonicus*	–	–	D	Yes
Threadfin bream	*Nemipterus virgatus*	–	–	O	Yes
Threadfin bream	*Nemipterus bathybius*	–	–	O	Yes
Mi–iuy croaker	*Miichthys miiuy*	–	–	D	Yes
Hairtails	*Trichiurus* spp.	–	–	O	Yes
Silver croakers	*Pennahia* spp.	–	–	O	Yes
Big-eye snapper	*Priacanthus macracanthus*	–	–	O	Yes
Big-eye snapper	*Priacanthus tayenus*	–	–	O	Yes
Filefishes	*Thamnaconus hypargyreus*	–	–	O	Yes
Threadfin porgy	*Evynnis cardinalis*	–	–	O	Yes
Greater lizardfish	*Saurida tumbil*	–	–	O	Yes
Brushtooth lizardfish	*Saurida undosquamis*	–	–	O	Yes
Sharks		–	–	D	Yes
Cuttlefishes	*Sepiella spp. and Sepia* spp.	–	–	O	Yes
Squid	*Loligo chinensis*	–	–	O	Yes
Squid	*Loligo edulis*	+		M	No
Octopus	*Octopus* spp.	–	–	D	Yes

3.8 Indonesia (Natuna Sea, Malacca Strait/Andaman Sea)

Indonesia has a maritime territory of 5.8 million km^2, 2.7 million km^2 of territorial waters and 3.1 million km^2 of EEZ. Total landings from marine capture fisheries reached 4.73 million tonnes in 2007 after a long-continuous increase since 1950 (Figure 7). There is no sign of any slowing down for the moment. The sustainable yield (MSY) of marine all-combined species were estimated at about 6.4 million tonnes, 1.67 million tonnes higher than the current landings.

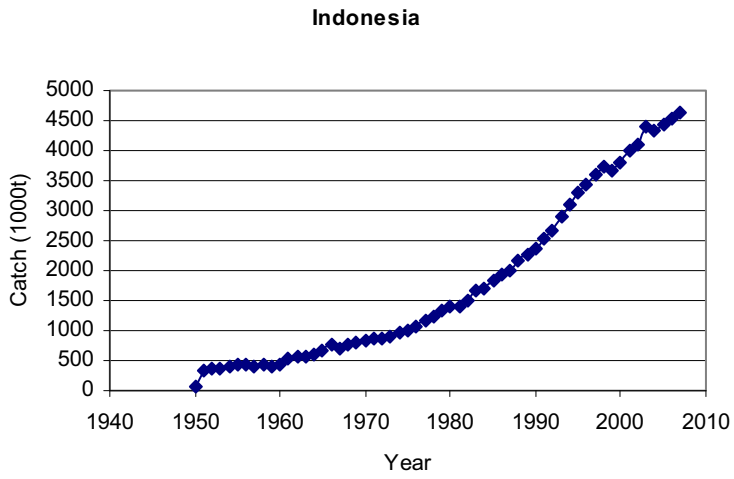


Figure 7: Historical catches from Indonesia's marine capture fisheries

Fisheries in Indonesia play a significant role in export and foreign exchange earnings, providing employment opportunities, income for fishers as well as national income, and supplying fish and aquatic products to improve the nutritional standard of the nation. The annual contribution of fisheries to national GDP is about 2.5 percent. The total number of employees in 2007 was 2.5 million in capture fisheries and 2.2 million in aquaculture.

Report on workshop exercise

Area FMA 711 (Natuna Sea and its adjacent waters) was selected as a case study at the first workshop and data from national statistics database were used for analysis. The main findings from the exercise are:

- Applying the depletion-adjusted average catch method gives indication that biomass of each species is declining. However, landing data are unfortunately not fully reliable and should be validated.

- Due to the limited time available, comprehending and determining the attributes and their ranks in the Productivity-Susceptibility Analysis has proven difficult.

- Quick evaluation on stock status by species shows that the majority of the Indonesian commercial species were already at the medium-high exploitation level.

The following became clearer after the assessment exercise:

- It was too ambitious to review stock status in Indonesia within such a short period of time.

- The guidance provided was insufficient and the examples presented at the workshop were not very general. Furthermore, all the reference papers were based on findings and experience from high latitude fisheries.

- The biological reference points Indonesia is presently using will be updated within the next 5 years.

Based on the above, it was proposed that assessment should be carried out based on national/regional data and information over a longer period of time. The two workshops were beneficial for testing new methodologies of stock status assessment and for exchanging experiences and information from neighbouring countries.

The following may be recommended for future assessment and reference:

- Monitoring the progress of resource assessment that was regularly carried out by regional representative organisations.

- Annual regional publications on stock status should be compiled.

- A Web site for regional data and information exchange would be very helpful. It could also be used to show national/local stakeholders the relevance of their contribution to providing real-time data as part of national plans for fisheries management.

- National status on updating stock status should be published annually to remind managers and stakeholders of the current status and future outlook of the fisheries. Poor information on the state of fishery resources should lead to a higher level of precaution as the stock might be at high risk.

The follow-up discussion emphasized the poor performance of Method 1. This probably happens because the catch data show an one-way increasing trend throughout the time series and lacks contrast. Data quality may also be a problem. For example, the observed drop in catches around the year 2000 is probably due to a change in the responsibilities for data collection, rather than a drop caused by a decline in stock abundance. Statistics for the Java Sea may have a better quality. It was also noted that survey data as well as data (receipts) from fishmongers could be used to complement the analyses that are solely based on fishery-dependent data.

It was asked whether the tsunami affected fishery productivity in Indonesian waters. The answer was that such impact might have been limited to coral reefs.

Fishery status report

Indonesia's EEZ is divided into 11 management areas (Figure 8). There are major types of fishing gear in use in Indonesia: purse seines, pelagic Danish seines, demersal Danish seines, surface and bottom gillnets, trawl-like nets, longlines, poles and lines. The Indonesian marine ecosystems have a high species diversity. As a result, each fishing gear catches a number of species, and sometimes it is even hard to define what the target species is. Consequently, each area has as many as 40 species that can be considered as major species. There is also a great variation in species composition between areas. Therefore, it is a large and challenging task to assess the stock status of the major species in Indonesia's exclusive economic zone (EEZ). As this workshop has a focus on South China Sea, two management areas, FMAs 711 and 571, were selected for the assessment as they are adjacent to South China Sea.

Stock assessment has been undertaken for a few commercially important species in Indonesia. However, such assessment took place irregularly and selection of species and assessment methodologies were not systematically designed. The multispecies and multigear nature of the Indonesian fisheries add further complication to such a task. Therefore, the Indonesian participant kindly requested the scientists of the Institute of Marine Fisheries Research to carry out the assessment in the two months following the Bangkok workshop, using the best data and knowledge available.

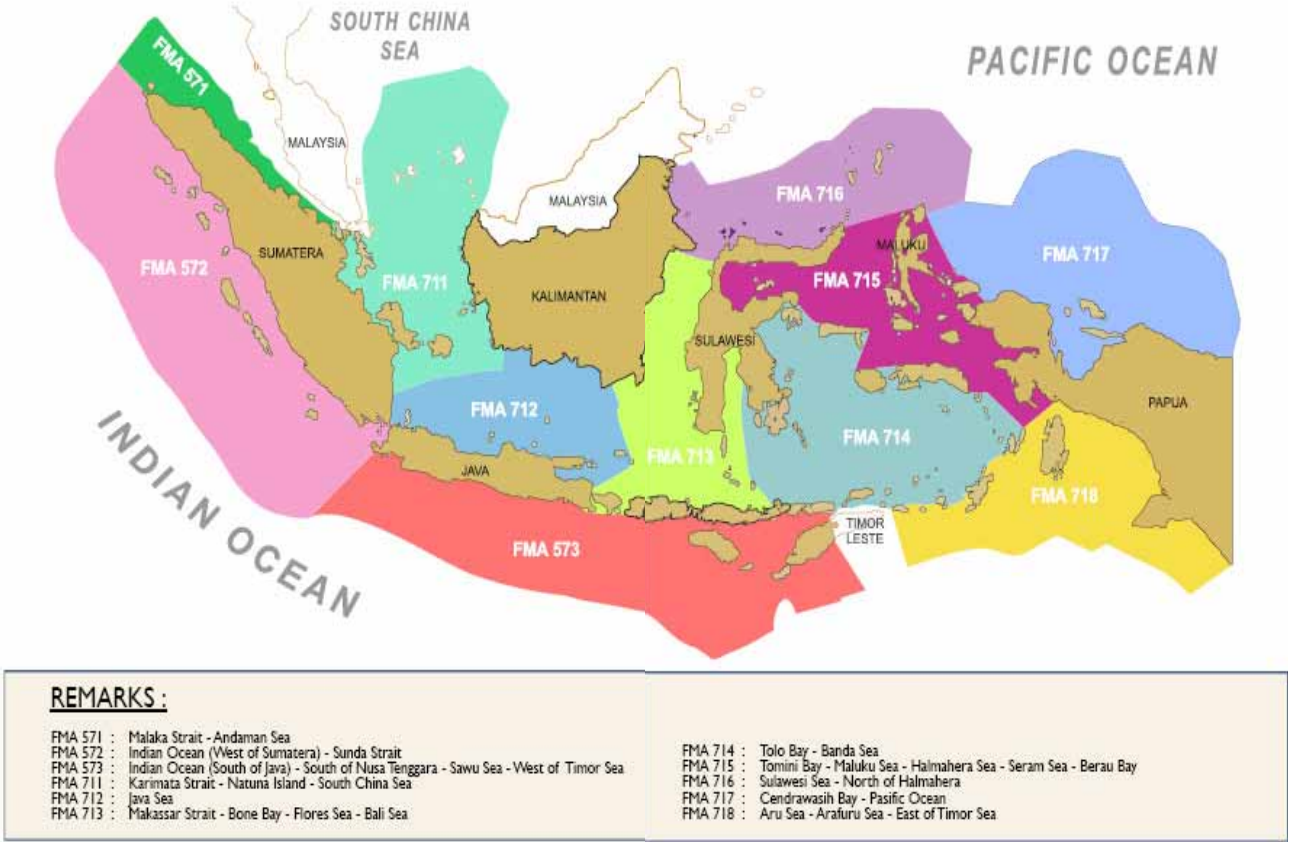


Figure 8: Fishery management areas (FMAs) in Indonesia territorial waters

In FMA 571 (Malacca Strait-Andaman Sea), 13 stocks/species of the top 25 species were diagnosed as "fully exploited", other 8 species were moderately exploited and the remaining 4 species were believed to be underexploited (Table 10). In FMA 711 (Karimata Strait-South China Sea), of the 23 species assessed, 3 species were overexploited, 14 fully exploited and the remaining 6 were moderately exploited (Table 10).

Overall, the proportion of overexploited stocks in these two areas is low. No species has been overexploited in FMA 571 and fish resources in this area are in a better state than FMA 711. Overcapacity is happening to a limited number species in the areas. Obviously, overcapacity is hard to diagnose for multispecies and multigear fisheries like the Indonesian ones.

Table 10 Catch trends and stock status assessment of the major fish species in Areas FMA 571 (Malacca Strait-Andaman Sea) and FMA711 (Karimata Strait-South China Sea). The trends of catch and survey index were the general pattern of catch changes over the last ten years. "Catch trend" and "Survey index" provide the general changing pattern over the last five years. + : increase, – : decrease, and = : stable. In the column of status, U indicates underexploited, M moderately exploited, F fully exploited, O overexploited, and D depleted.

Species name	Scientific name	Catch trend	Survey index	Stock status	Over-capacity
Malacca Strait – Andaman Sea					
Black pomfret		+	–	F	No
Croakers		+	+/–	M	No
Dorab wolf herring		+	+/–	M	No
Emperors		–	–	F	No
Fringescale/deepbody/goldstrip Sardinella		–	+/–	M	No
Giant catfish		–	–	F	No
Groupers		+/–	–	M	No
Indian goatfish		+	+/–	M	No
Indian Halibut		+/–	+/–	U	No
Kawa kawa/eastern little tuna		+	+	F	No
Narrow–barred spanish mackerel		+/–	–	U	No
Ornate threadfin bream		+	+/–	U	No
Bigeye scad		+	+/–	F	No
Rainbow sardine		+	+/–	U	?
Red big eye		+	+	?	?
Red snappers		+	–	F	Yes
Saddle grunt/spotted javelinfish		+	–	M	No
Sardine		+	+/–	F	Yes
Scad		+/–	+/–	F	Yes
Silver pomfret		+/–	–	F	No
Skipjack tuna		+	–	F	No
Slipmouths/pony fishes		+	+	F	Yes
Spotted chub mackerel		+	+/–	F	Yes
Threadfins		+	+/–	F	No
Tongue sole		+	+	M	No
Torpedo scad		+	+	M	No
Karimata Strait–South China Sea					
Barramundi/giant sea perch			–	M	No
Black pomfret			–	M	No
Croakers			–	F	No
Dorab wolf herring			+/–	F	Yes
Frigate tuna			–	F	No
Fringescale/deepbody/goldstrip sardinella			–	F	Yes
Giant catfish			–	F	No
Groupers			–	F	Yes

Species name	Scientific name	Catch trend	Survey index	Stock status	Over-capacity
Hairtails			–	M	No
Indian halibut			–	M	No
Indo-Pacific king mackerel			–	F	Yes
Jack trevallies			–	O	No
Narrow-barred spanish mackerel				F	No
Ornate threadfin bream				M	No
Rainbow sardine				O	Yes
Red snappers				F	Yes
Saddle grunt/spotted javelinfish				F	Yes
Scad				F	No
Sharks				M	No
Short-bodied mackerel				O	Yes
Silver pomfret				F	Yes
Slipmouths/pony fishes				F	No
Threadfins				F	No

U: underexploited; F: fully exploited; M: moderately exploited; O: overexploited; D: depleted

3.9 India

Marine fish production in India is almost exclusively from capture fisheries and its annual production increased from 0.58 million tonnes in 1950 to 3.21 million tonnes in 2008, about 5.5 fold increase in nearly 60 years. However, the marine catch has stagnated over the last decade (1996–2007) with some fluctuations. This trend is similar to the global capture fishery production, which has levelled off at around 82 million tonnes over the last 15 years (Figure 9).

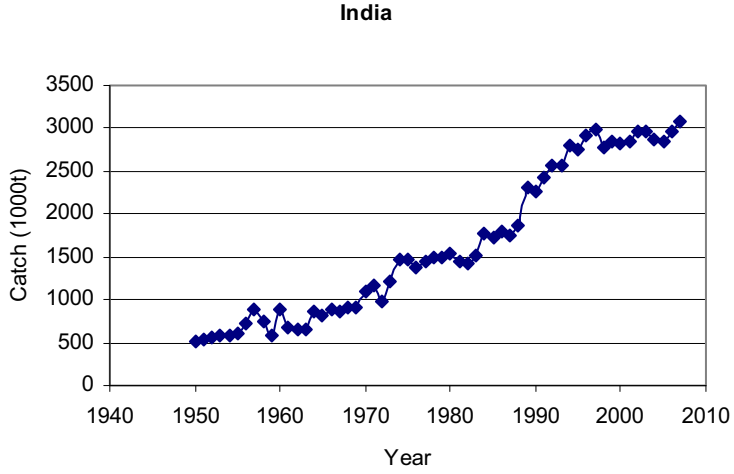


Figure 9: Historical catches from India's marine capture fisheries

Fisheries play an important role in India's national economy and contribute about 1.1 percent of national GDP. The Indian marine capture fisheries employ about one million people and provides 3 million tonnes of fish annually with a value of about US$3 billion at production level. India earns US$1.6 billion each year by exporting fish and fishery products. The Indian fishing fleet consists of 58 911 mechanized craft, 75 591 motorized craft (with outboard engine) and 104 270 non-motorized craft at present.

Workshop exercise report

The Indian presentation at the second workshop showed an attempt to (i) consolidate the available marine fish stock assessments in the last 50 years; (ii) develop a Sustainability Index based on available information (SiFish); and (iii) validate depletion-adjusted-average catch method.

It was found that more than 3 000 publications are available on the characteristics of marine fish stocks in the form of Annual Reports, grey literature and in peer-reviewed journals. Taking advantage of the availability of 264 records on the biological characteristics, exploitation status and population parameters for 140 stocks belonging to 98 species of finfish, crustaceans and molluscs belonging to 40 families, a methodology (SiFISH) was developed to integrate much of this information.

SiFISH is to rank fish species based on thirteen attributes under four broad categories, viz. biological, exploitation, distribution and habitat productivity. The 13 attributes are as follows:

- biological: annual growth coefficient, asymptotic length, mean trophic level, maximum body depth-standard length ratio, length-at-maturity/asymptotic length ratio, annual spawning duration, measured fecundity;

- exploitation: susceptibility to gear, ratio of length-at-recruitment to asymptotic length, exploitation ratio (F/Z), price index;

- distribution: distribution within the continental shelf; and

- habitat productivity: coastal productivity index.

Each attribute was ranked from 1 to 6 based on the minimum and maximum values. A score of 6 is assigned to highly sustainable species/stocks; 5 to sustainable; 4 and 3 to moderately sustainable stocks; 2 to low sustainability and 1 to stocks of very low sustainability.

The sustainability index ranged from 2.17 (*Carcharhinus sorrah*) to 5.45 (*Oratosquills nepa*). Most fishes had values between 3 and 4, indicating a medium level of sustainability. In general, elasmobranchs had very low sustainability index values. At the other end of the index were shrimps, other crustaceans and molluscs. It was found that 12 species had Index values below 3, which may be considered as low-sustainable species. They are sharks *Carcharhinus sorrah*, *Sphyrna lewini* and *Rhizoprionodon acutus*, guitarfish *Rhinobatos granulatus*, needlefish *Ablennes hians*, catfish *Tachysurus dussumieri*, black pomfret *Parastromateus niger*, sciaenid *Otolithoides biauritus*, giant trevally *Caranx ignobilis*, ribbonfish *Lepturacanthus savala* and *Trichiurus lepturus,* and cuttlefish *Sepia aculeata*. Among the three regions for which sufficient data are available, the index for northwest, southeast and southwest coasts were 3.67, 3.59 and 3.71 respectively. The mean index value for all the regions was 3.65.

The country paper attempted to validate Depletion-Adjusted Average Catch method for two species namely threadfin bream *Nemipterus japonicus* and squid *Loligo duvauceli*, for which stock estimates from conventional methods are available. The time-series data of catch did not have a downward trend for both the species. Moreover, natural mortality was higher than two. When we applied the suggested minimum alpha value of 0.4, the beta and delta have to be as low as 0.15 and 0.1 to get positive estimates of biomass. These two factors, which are typical of tropical stocks, did not allow the estimation of MSY for the two species.

The discussion that followed explored various aspects of the sustainability index. One issue was how the values of different attributes were averaged. In particular, the inclusion of one fishery-related attribute, and many fisheries independent attributes raised the question whether fishery aspects (e.g. exploitation rate) were underrepresented. Another issue was the use of the index in fisheries management and whether meaningful reference points could be determined.

Another question was raised as to how the analyses had been performed. After 2005, research projects in India have been carried out by maritime states, on specific fisheries (type of gear) and species. Four

ecological regions have been defined for the country, and stocks in different regions are considered separated. Stock assessment is now carried out at state level.

With regard to the use of stock assessment results for fisheries management, it was explained that each state has a task force to review fisheries management plans and resource status. Stock assessment results are presented by scientists within the group. However, open access to fisheries limits the efficacy of fisheries management. The decline in resource abundance perceived recently by fishermen has resulted in scientific advice on management that are more valued by stakeholders.

Fishery status report

The Indian territorial waters were divided into four areas: Northwest, Southwest, Southeast and Northeast coasts. Twenty, thirteen, twenty five and sixteen species were selected for the assessment of stock status respectively from the four areas (Table 11), contributing 68–71 percent of areal total catch. Stock status of these 74 stocks/species was evaluated. Fisheries in the Northwest, Southwest and Southeast coasts have sufficient data for stock assessment and therefore theirs status were evaluated based on formal stock assessment. In contrast, fisheries in the Northeast coast have very limited data available, and their stock status was diagnosed based on informal methods such as indicators and expert-judgement except hilsa shad.

In the Northwest coast, three stocks were diagnosed as underexploited, six moderately exploited, nine fully exploited and one stock was overexploited. In the Southwest coast, four stocks were moderately exploited, seven fully exploited, one overexploited and one depleted. In contrast, the Southeast coast has ten stocks moderately exploited, eleven fully exploited and four overexploited. In the Northwest, all the species assessed were moderately exploited except one stock horse mackerel that was underexploited.

In general, Southwest and Southeast coasts are more severe exploited, with five stocks overexploited and one stock depleted, than the Northwest coast, and the Northeast coast is the lightest exploited as most stocks are only moderately exploited.

Overcapacity is occurring to all the top thirteen species in the Southwest coast and a similar but slightly better situation exist in the Northwest and Southeast coasts. The Northeast coast is the only area that does not have the problem of overcapacity.

Table 11 Catch trends and stock status assessment of the major fish species in India waters

The Indian territorial waters has been divided into four areas: Northwest, Southwest, Southeast and Northeast. "Catch trend" and "Survey index" provide the general changing pattern over the last five years. + : increase, – : decrease, and = : stable. In the column of status, U indicates underexploited, M moderately exploited, F fully exploited, O overexploited, and D depleted.

Species name	Scientific name	Catch trend	Survey index	Stock status	Over-capacity
Northwest coast					
Paste shrimp	*Acetes indicus*	+		U	No
Bombay duck	*Harpadon nehereus*	–		F	Yes
Largehead hairtail	*Trichiurus lepturus*	+		F	Yes
Shrimp	*Parapenaeopsis stylifera*	+		F	Yes
Bullseye	*Priacanthus hamrur*	+		M	Yes
Threadfin bream	*Nemipterus japonicus*	–		F	Yes
Threadfin bream	*Nemipterus mesoprion*	+		M	Yes
Croaker	*Johnieops macrorhynus*	+/–		F	Yes
Blacktip sea catfish	*Tachysurus dussumieri*	+		M	Yes
Palaemon shrimp	*Nematopalaemon tenuipes*	+		M	Yes
Indian squid	*Loligo duvauceli*	–		F	Yes
Oil sardine	*Sardinella longiceps*	+		U	No
Catfish	*Osteogeniosus militaris*	+		U	No
Golden anchovy	*Coilia dussumieri*	+/–		F	Yes
Cuviers croaker	*Otolithes cuvieri*	+/–		M	Yes
Bronze croaker	*Otolithoides biauritus*	+		O	Yes
Pharaoh cuttlefish	*Sepia pharaonis*	+		F	Yes
Spotted seer	*Scomberomorus guttatus*	+		M	No
White pomfret	*Pampus argenteus*	+		F	No
Speckled shrimp	*Metapenaeus affinis*	+		F	Yes
Southwest coast					
Oil sardine	*Sardinella longiceps*	+		M	Yes
Indian mackerel	*Rastrelliger kanagurta*	+/–		F	Yes
Threadfin bream	*Nemipterus japonicus*	–		O	Yes
Anchovy	*Stolephorus devisi*	–		F	Yes
Shrimp	*Metapenaeus dobsoni*	+/–		F	Yes
Largehead hairtail	*Trichiurus lepturus*	+		F	Yes
Mantis shrimp	*Oratosquilla nepa*	+		M	Yes
Malabar sole	*Cynoglossus macrostomus*	+		F	Yes
Indian squid	*Loligo duvauceli*	+/–		F	Yes
King seer	*Scomberomorus commerson*	+/–		F	Yes
Kiddi shrimp	*Parapenaeopsis stylifera*	+/–		M	Yes
Pharaoh cuttlefish	*Sepia pharaonis*	+		M	Yes
Catfish	*Tachysurus*	–		D	Yes
Southeast coast					
Oil sardine	*Sardinella longiceps*	+		M	No
Indian mackerel	*Rastrelliger kanagurta*	+		F	Yes
Gold stripe sardine	*Sardinella gibbosa*	+		M	No
Silverbelly	*Leiognathus bindus*	–		O	Yes
Trigger fish	*Odonus niger*	+		M	No
Lesser sardine	*Sardinella sirm*	+		M	No
Lesser sardine	*Sardinella fimbriata*	+		M	No
Anchovy	*Stolephorus devisi*	+/–		F	Yes
Largehead hairtail	*Trichiurus lepturus*	+		F	Yes
King seer	*Scomberomorus commerson*	+/–		F	Yes
Little tunny	*Euthynnus affinis*	+		F	Yes
Blue swimming crab	*Portunus pelagicus*	+		M	Yes
White sardine	*Escuaolsa thorata*	+		M	No

Species name	Scientific name	Catch trend	Survey index	Stock status	Over-capacity
Scad	*Decapterus russelli*	+		M	No
Blacktip sea catfish	*Tachysurus dussumieri*	–		F	Yes
Thryssa	*Thryssa mystax*	+		M	No
Shrimp	*Metapenaeus dobsoni*	+		F	Yes
Lizardfish	*Saurida undosquamis*	+		F	Yes
Threadfin bream	*Nemipterus japonicus*	–		O	Yes
Brown shrimp	*Metapenaeus monoceros*	+		F	Yes
White pomfret	*Pampus argenteus*	+/–		O	Yes
Spottted swimming crab	*Portunus sanguinolentus*	+		M	Yes
Trevally	*Caranx leptolepis*	+		O	Yes
Goatfish	*Upeneus taeniopterus*	+		F	Yes
Barracuda	*Sphyraena obtusata*	+/–		F	Yes
Northeast coast					
Hilsa shad	*Tenualosa ilisha*	+		M	No
Bombay duck	*Harpadon nehereus*	+		M	No
Paste shrimp	*Acetes indicus*	+		M	No
Largehead hairtail	*Trichiurus lepturus*	+		M	No
White pomfret	*Pampus argenteus*	+		M	No
Lesser sardine	*Sardinella fimbriata*	+		M	No
Golden anchovy	*Coilia dussumieri*	+		M	No
Blacktip sea catfish	*Tachysurus dussumieri*	+		M	No
Horse mackerel	*Megalaspis cordyla*	+		U	No
Cuviers croaker	*Otolithes cuvieri*	+/–		M	No
Indian mackerel	*Rastrelliger kanagurta*	+		M	No
Black pomfret	*Parastromateus niger*	+/–		M	No
Savala hairtail	*Lepturacanthus savala*	+		M	No
Croaker	*Johnieops macrorhynus*	+		M	No
Spotted seer	*Scomberomorus guttatus*	+		M	No
shrimp	*Metapenaeus dobsoni*	+/–		M	No

3.10 Sri Lanka

Marine fisheries have been developing continuously since 1950 in Sri Lanka. Annual marine fish production peaked at 300 000 tonnes in 2004 (Figure 10) and after a sharp drop in 2005 recovered to 280 000 tonnes in 2007. Marine wild fish production accounts for 84 percent of the total fish production in Sri Lanka. Marine fisheries consist of three sectors, coastal, offshore (deep-sea) and high-sea fisheries. Coastal area is defined as the waters above the continental shelf and the average width is 22 km from the coast line. Offshore fishing takes place beyond the continental shelf up to the boundary of the EEZ, high-sea fishing takes place in international waters. Although offshore fishery is the growing sector, coastal fisheries still contribute more than 50 percent of the total production.

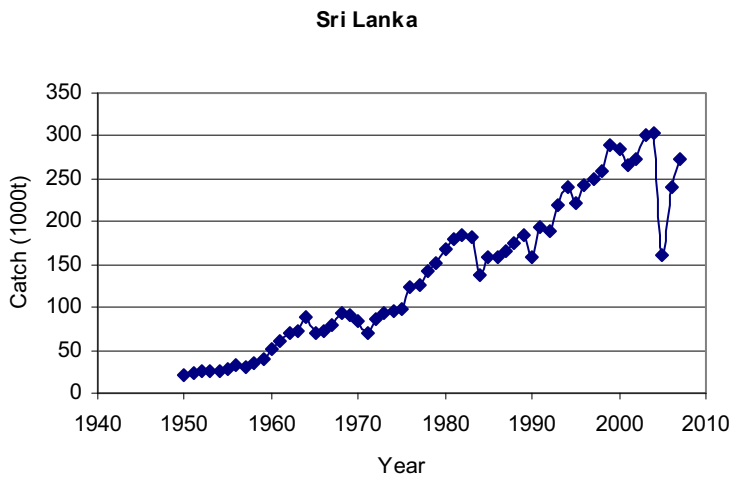


Figure 10: Historical catches from India's marine capture fisheries

Marine capture fisheries are very important in Sri Lanka's economy. The sector contributes 2.7 percent of the national GDP. Annual per capita consumption of fish and fishery products in the recent past has varied between 17.5 kg and 18.5 kg per capita. The total number of crafts engaged in both offshore and coastal fisheries amounted to around 42 000 and nearly 200 000 people directly involved in fisheries.

Workshop exercise report

As the participant from Sri Lanka was unable to attend the first workshop in June 2009, no assessment based on the proposed methodologies was undertaken. At the second workshop, the Sri Lankan participant delivered a presentation about the general situation of fisheries, current state of fish resources, management practice and issues the country is facing.

The participants from India raised the issue of sea cucumber exploitation in the Gulf of Mannar, considering that this resource is shared between India and Sri Lanka. While on the Indian side there has been a ban on sea cucumber fishing, there were concerns that fishing would be allowed on the Sri Lankan side. Also, there seems to be problems with trespassing of fishing vessels between the respective national jurisdictions.

Fishery status report

Fishery data are scarce and stock assessment is rarely carried out for most species in Sri Lanka. Nonetheless, catch data are available though not by species, and research organizations have also conducted studies on fisheries and stock assessment and provided advice on management strategies. During the workshop, the Sri Lankan participant was very cooperative and lent her greatest support to fulfil the workshop objective – collate information on the exploitation state of marine fishery resources. Based on the best information and data available, the stock status of the most commercially important species in Sri Lanka was listed in Table 12.

Although the marine capture fishery in Sri Lanka may seem not as developed as other participating countries, overfishing has occurred in the offshore gillnet and longline fisheries for *Carcharhinus falciformis*, *Carcharhinus longimanus*, *Sphyrna* sp., *Istiophorus platypterus*, *Isurus oxyrhynchus*, *Alopias vulpinus*, and *Amblygaster sirm*. In lobster fishery, *Panulirus penicillatus*, *P. versicolor*, *P. dasypus*, *P. ornatus* and *P japonicus* were also considered overexploited. Trawl and bottom set-net fisheries were believed to have moderately exploited fish resources.

Overcapacity was found only for *Amblygaster sirm* in the pelagic fishery. In general, the scarceness of fishery statistics and data has made such a diagnosis very difficult. With the foreseeable improvement in data collection and management system, stock assessment and fishery policy formulation will certainly make significant progress in the near future.

Table 12 Catch trends and stock status assessment of the major fish species in Sri Lanka's waters. "Catch trend" and "Survey index" provide the general changing pattern over the last five years. + : increase, – : decrease, and = : stable. In the column of status, U indicates underexploited, M moderately exploited, F fully exploited, O overexploited, and D depleted.

Fishery	Scientific name	Catch trend	Survey index	Stock status	Over-capacity
Offshore gillnet fishery and longline fishery					
	Katsuwonus pelamis	=		M	No
	Thunnus albacares	=		?	No
	Makaira mazara	–		?	No
	M. Indica	–		?	No
	Istiophorus platypterus	–		?	No
	Xiphias gladias	=		?	No
	Carcharhinus falciformes	–		O	No
	Carcharhinus longimanus	–		O	No
	Sphyrna spp.	–		O	No
	Istiophorus platypterus	–		O	No
	Isurus oxyrhynchus	–		O	No
	Alopias vulpinus	–		O	No
Small/medium pelagic fishery					
	Amblygaster sirm	–		O	Yes
	Sardinella albella	+		?	
	S. gibbosa	+		?	
	S. longiceps	+		?	
	Stolephorus spp.	+		?	
	Decapterus spp.	+		?	
	Selar crumenophthalmus	+		?	
	Auxis spp.	–		?	No
Trawl fishery and bottom set nets					
		?		M	No
	Lethrinus nebulosus	?		M	No
	L. miniatus	?		M	No
	Lutjanus lentjan	?		M	No
	L. rivulatus	?		M	No
	L. malabaricus	?		M	No
	Epinephelus spp.	?		M	No
	Carangidae	=		M	No
	Leiognathidae	?		M	No
	Pomodasyidae	?		M	No
	Acanthuridae	=		M	No
	Rays	=		M	No
	Carcharinidae			?	
Lobster fishery					
	Panulirus penicillatus	–	–	O	Yes
	P. versicolor	–	–	O	Yes
	P. dasypus	–	–	O	Yes
	P. ornatus	–	–	O	Yes
	P japonicus	–	–	O	Yes
	P. polyphagus			?	
Prawn fishery					
	P. semisulcatus	=		M	No
	P. indicus	=		?	No
	P. monodon			?	No
	P. merguensis			?	No
	M. dobsoni			?	No
Sea cucumber and chank fishery					
		–	–	O	Yes
Sea cucumber and chank fishery (South, east and northwest coasts)					
	Holothuria spp	–	–	O	Yes
Sea cucumber and chank fishery (Gulf of Mannar)					
	Turbinella pyrum	na	na	U	No
	Holothuria spp.				

3.11 Myanmar

The Union of Myanmar has a coastline of some 3 000 km with a continental shelf area of over 228 751 km^2 and an exclusive economic zone (EEZ) of 486 000 km^2. Fishery production in 2007–2008 was 3.2 million tonnes, of which freshwater fisheries accounts for about 47 percent and marine fisheries 53 percent. Marine fisheries have developed continuously since 1950 and gone through a phase of rapid growth since the late 1990s, increasing production from 0.6 million tonnes in 1998 to about 1.6 million tonnes (Figure 11). Based on surveys and scientific research, annual maximum sustainable yield (MSY) of Myanmar's marine fisheries was estimated at about 1.05 million tonnes by FAO experts in 1980–1983.

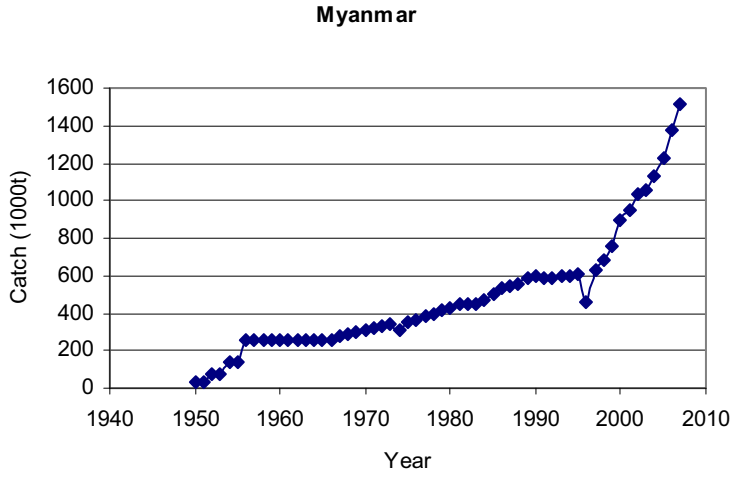


Figure 11: Historical catches from Myanmar's marine capture fisheries

Fisheries play an important role in Myanmar's national economy and contribute 7.6 percent to national GDP in 2007, which is higher than most countries in the region. However, statistical information on fishery employees and the size of fishing fleet seems not readily available.

Workshop exercise report

Due to the change of participant, Myanmar did not carry out any assessment using the methodologies agreed on at the first workshop. Lack of fishery statistics and capacity to analyse fishery data, diagnose stock status and then provide advice on fishery management are the two most critical issues the Myanmar fisheries face at present.

Two fisheries officials from the Department of Fisheries were trained in Norway and the Philippines for fishery biology during the above-mentioned 1980–83 FAO project. Fish stock assessment was in this way introduced to marine fishery research in Myanmar. This was the first and also the last fish stock assessment training Myanmar received from FAO. Following retirement of these two officials, there is no stock assessment expert left in the Department of Fisheries. It is therefore very difficult for Myanmar to complete questionnaires for FAO or SEAFDEC on issues related to fisheries information, especially fisheries statistics and stock assessment.

Despite the lack of trained personnel in fish stock assessment, Myanmar has tried to use some fishery indicators such as length frequency, species composition and CPUE data for the purposes of fisheries management and resource conservation. Based on these indicators, closed seasons and areas have been identified and established for the sustainable development of Myanmar's fisheries.

It would be highly desirable if training in fish stock assessment is organized (e.g. by FAO or SEAFDEC) for fishery scientists in Myanmar. This would enhance Myanmar's capacity, including interaction with FAO and SEAFDEC in this area of work.

Fishery status report

Formal stock assessment was rarely conducted in Myanmar and therefore no information on fish stock status is available. However, some fishery indicators seem to indicate a declining trend in marine resource abundance. Size composition of the catch of some commercially important fishes such as pomfret and hilsa shad has become smaller and smaller, and the CPUE of bottom trawl fisheries is also declining year after year. Therefore, we can assume that some of marine fishery resources in Myanmar may be overexploited. This seems consistent with the fact that the current landings are 50 percent higher than the estimated MSY, although the estimation might need to be revised as ecosystems and their productivity may have changed over the last 30 years.

Another phenomenon worth noticing is the change of catch species composition over time in marine capture fisheries. Demersal species contributed 44% of the total catch in 1980, but down to 35% in 1990 and only 22% in 2000 (Table 13). In contrast, the percentage from the group of miscellaneous, small pelagic and trash fish increased from 23% in 1980 to 52% in 2000. The shift from high to low trophic species is a symptom of fishing impact. Although it is hard to judge what level is tolerable, the great change seen in Table 13 often reflect excessive fishing effect.

Table 13 Observed changes over time in catch composition by major groups in the Myanmar marine capture fisheries

Marine capture fisheries	Percentage of catch		
	1980	1990	2000
Miscellaneous, small pelagic, trash fish	23	42	52
Small demersal species	25	16	17
Demersal species	44	35	22
Large pelagic species	6	5	8
Sharks/rays	1	1	1

3.12 Viet Nam

Viet Nam is located in the South East Asia with a coast of 3 260 km and an exclusive economic zone (EEZ) of more than 1 million km². Viet Nam marine waters have many islands, bays, lagoons and estuaries. Total landing of the marine capture fisheries has increased rapidly since 1980 from around 0.5 million tonnes in 1982 to 2.1 million tonnes in 2007 (Figure 12), with an average growth of about 6.5 percent per year.

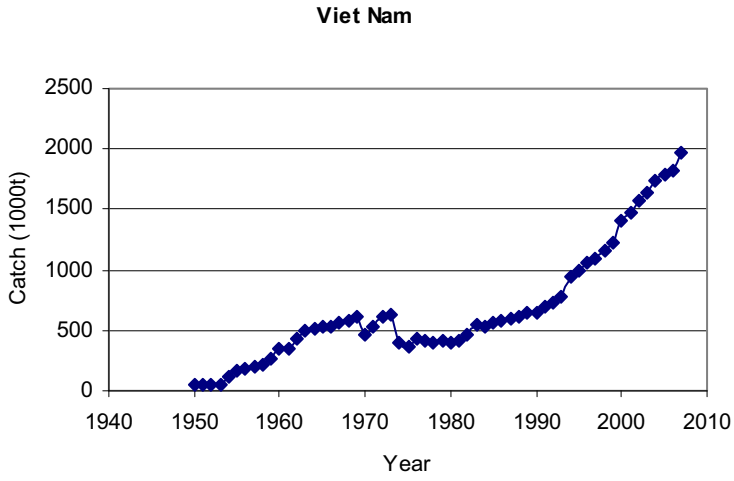


Figure 12: Historical catches from Viet Nam's marine capture fisheries

Fisheries are a large sector in Viet Nam's national economy and play an important role in social and economic development. Recently, fisheries have been developing rapidly and becoming a key economic sector. Fish consumption constitutes about 40 percent of animal protein diet for Vietnamese people and has also directly employed over 4 million people.

Viet Nam's marine capture fisheries are mainly small-scale. In 2008, there were about 104 290 fishing vessels, majority of which are small fishing boats and contribute about 84 percent of the total. There are about 45 666 fishing vessels with a small engine of less than 20 hp or without engine, which mostly operate in the near shore waters.

Workshop exercise report

There was not a participant from Viet Nam at the second workshop and therefore no assessment was carried out using the methodologies agreed on at the first workshop.

Fishery status report

The standing stock of fish resources in the Vietnamese EEZ was estimated at 3.3–3.5 million tonnes in 1997 and potential yield was about 1.5–1.6 million tonnes.

4. PRESENTATIONS OF REGIONAL ISSUES

4.1 Improving fishery statistics in the region (SEAFDEC)

Dr Somboon Siriraksophon delivered a presentation on the trends of neritic tuna (longtail tuna and eastern little tuna) from 1999 to 2005, based on the data collected in collaboration with SEAFDEC member countries. He showed that based on the data, 76–88 percent of longtail tuna and 67–86 percent of eastern little tuna landed in Thailand were harvested outside the Thai EEZ. It was found that many other marine commercial species such as surimi raw material species (Nemipteridae, Synodontidae, Priacanthidae, Mullidae and Sciaenidae) face a similar situation, i.e. caught outside Thai waters, but landed in Thailand. This phenomenon has existed since the 1980s. He also pointed out that the current fishery statistical program

does not separate the fish bought from foreign vessels from the catch caught by the Thai fishermen. Such data will lead to misleading results when used for assessment of fish stock status. He also informed that SEAFDEC will further support and promote the use of fishing logbook systems or catch traceability systems in order to improve fishery statistic data at national level and subsequently improve the assessment of stock status in the region.

4.2 The Bay of Bengal Large Marine Ecosystem (Rudolf Hermes, FAO, BOBLME)

The Bay of Bengal Large Marine Ecosystem project is funded under the GEF umbrella to establish a Strategic Action Programme to protect the health of the ecosystem and manage the living resources of the Bay of Bengal on a sustainable basis to improve the food and livelihood security of the region's coastal population. It consists of five components:

1. Strategic Action Programme;
2. Coastal/Marine Natural Resources Management and Sustainable Use;
3. Improved Understanding and Predictability of the BOBLME Environment;
4. Maintenance of Ecosystem Health and Management of Pollution;
5. Project and Knowledge Management.

The second component, coastal and marine natural resources management and sustainable use is very fishery focused. The project intends to carry out collaborative regional fishery assessment and management plans. The following are the major tasks of the component:

1. Development of a regional fishery management plan for sharks;
2. Development of a subregional fishery management plan for Indian mackerel (Bangladesh, India, Indonesia, Malaysia, Myanmar and Thailand);
3. Development of a subregional fishery management plan for hilsa (Bangladesh, India, Indonesia, Myanmar);
4. Regional statistical working group established;
5. Design and implementation of a common fishery data/information system in the BOBLME.

This stock assessment workshop will certainly benefit the project and in return the completion of the project will help build capacity of the region in data collection, stock assessment and fishery management.

4.3 The inventory of marine resources and fisheries (Marc Taconet, FAO)

The inventory of marine resources and fisheries is part of FAO Strategy-STF and aims to provide a backbone for comprehensive monitoring in support to management. From a process view point, the inventories can serve national needs by encouraging structured approaches in a management framework, and scientists can use them in support of their interactions with managers in an endeavour to identify meaningful resources or fishery units, together with suitable required indicators. The Inventory potentially provides the basis for a comprehensive information management mechanism for the EAF. Not the least, they provide a basis for tackling regional harmonization in particular for transboundary stocks.

Since 2003, the Fishery Resources Information System (FIRMS) Partnership and Fishcode-STF project provided a framework for the development and iterative improvement of guidelines in support to implementation of regional and national inventories, including definitions, reporting templates (for both the resources – biotic concept and Fisheries – reflecting human print on the system), and workflow management until public dissemination. In South East Asia, a first phase of inventory implementation was conducted in 2006–07 and very valuable reports were produced by 4 countries. Resources and fisheries in these inventories are structured according to criteria of jurisdictional areas, ecological groups, and fishing gear-fleets. In comparison with temperate regions, the small-scale and multispecies characteristics of the South and South-East Asian fisheries add complexity and constitute a great challenge for a sound inventory, but in turn the inventory is also proposed as an opportunity for shaping up a useful information management skeleton in support to management needs.

The inventories are disseminated in the form of factsheets, providing a summary description on the status and trend of each stock or fishery. Consolidated views of stock status, by region, species group, or any other grouping criteria can also evolve from inventories, once harmonization across different sources of data in the inventories has been achieved.

4.4 Trawlbase and its use in fishery assessment and management (Len Garces, WorldFish Center)

The TrawlBase is a regional database of trawl surveys in South and Southeast Asia. The presentation focused on how the database can be used for fisheries resource assessment and management, with emphasis on spatial patterns in the assemblage structure in the region, temporal trends in species composition and abundances of fish stocks in the western coast of Peninsular Malaysia.

First, Len provided an overview of the fish assemblage structure of demersal species in South and Southeast Asia. Multivariate techniques (classification/cluster and ordination analysis) were used to analyse the trawl survey data. Results indicate that spatial patterns of demersal assemblages are mainly influenced by depth. Demersal resources in Malaysia, for example, showed assemblage boundaries at around 40 m and 90 m depth. This is consistent with the limited number of assemblage structure studies conducted previously in the region. This spatial structure should be taken into account when designing fisheries management zones. The current spatial fisheries management measures in the region are largely inconsistent with the observed assemblage structure patterns. The delineation of management zones should be based on the spatial patterns of resources to manage the overall impact from different fisheries or sectors.

Second, he examined temporal changes in species composition of the coastal demersal resources in the west coast of Peninsular Malaysia. Regression analysis shows massive declines in resource biomass of most species groups. Multivariate analyses also showed differences between survey periods, e.g. the species composition in the 1970s are different from that in the 1990s. Moreover, the percentage composition data from the west coast of Peninsular Malaysia generally showed that large and more valuable species declined in relative abundance while species of small body sizes increased. This may suggest “fishing down the food web” trend is evident.

It was recommended that: (i) further investigation is needed on the change of species composition in relation to biomass decline trends and commercial catches; (ii) other indicators such as mean size should be investigated to understand temporal changes; (iii) finer scale analysis and taxonomic issues should examined; and (iv) up-to-date survey data should be used in further analyses.

4.5 How could stock assessment in South and Southeast Asia be strengthened? (Purwito Martosubroto)

It is a reality that fisheries in South and Southeast Asia is under open access regime, which is of course being not conducive for stock assessment work for at least four reasons: (i) open access regime will end up with overfishing conditions; (ii) open access regime opens door for IUU fishing activities; (iii) open access regime constraints fish stock assessment undertaking; and (iv) open access regime denies the standard and principles of sustainable fisheries as embodied in the CCRF (1995).

Overfishing has been addressed in many international conferences and global calls. It was voiced during the World Summit on Sustainable Development in Johannesburg in 2002, which set the target that by 2015 overfishing should be eliminated globally. Increased occurrence of overfishing has resulted in attributing this failure to fisheries management authorities and stakeholders within the fishing sub-sector. Trying to curb fishing effort has not produced positive results. New developments are emerging in the downstream part of the sector, namely in the post harvest sub-sector. In fact market forces are demanding products coming from the well managed fisheries and certified through various ecolablelling schemes. The Marine Stewardship Council (MSC) has been a pioneer in introducing the ecolabel scheme in wild capture fisheries and during the past 10 years, 42 fisheries in 14 countries were certified as sustainable on the basis of the MSC criteria. The number of fisheries currently under MSC assessment has also increased in the recent years. This scheme has encouraged policy makers in many countries to improve fisheries management practices in accordance with the principles embodied in the CCRF (1995).

Work priorities in support of strengthening fisheries stock assessment in the years to come include:

Strengthen fish stock assessment through:

- Enhance methodology as what we have learned in the current two workshops.
- Enhance data collection from commercial fishing through logbooks and observer programmes, with logbooks being one of the conditions for licensing.
- Capacity building (training, workshops).

Build awareness among policy-makers on:

- Precautionary principles – management actions should not await until data and information are complete and at the initial stage of fishery development, granting licences should be cautious (conservative), in the meantime data collected from the existing licensed vessels should be used as a basis for developing licence policy.
- Build awareness on the impact and cost of NOT implementing responsible fisheries.
- Promoting close cooperation between scientists and managers.

In addressing the above issues various means could be explored including:

- Strengthen communication among scientists nationally and regionally (revitalize Fishbyte?).
- Communication is basically aiming to reduce differing perception and enhance mutual understanding, in other words communication is a process of education, namely educating two parties to achieve mutual understanding.
- Strengthen communication between scientists and managers through the process of inviting "communication expert" to facilitate discussion in the meeting/workshop.

Conclusions and recommendations:

- Stock assessment is not independent to but closely linked to fisheries management. Improved management requires, among other things, also adequate knowledge on stock status and trends.
- Increased demand for ecolabelling and catch certification schemes will eventually call for better fisheries management and in turn for stock assessment as well.
- There is an urgent need for a workshop specifically addressing communication between scientists and managers.
- Need for a workshop on fisheries governance addressing the need for prioritizing precautionary principle in data poor fisheries (when fisheries are still in an initial stage of development).

Comments regarded the need to utilize data from different sources in the assessment process. Scientific surveys may be biased but catch statistics often have serious problems and could be biased too. Furthermore, in commercial landings many species are not represented. It would be useful to compare experiences with using these two different sources of data.

It was noted that often certification leads to a distortion with regard to the use of resources, preference being given to species that are exported while other resources, perhaps important nationally, being given less attention.

The representative from India indicated that logbooks are not used in his country, but the idea of introducing them was explored. In Thailand logbooks are being introduced because of EU regulations. Experience of introducing logbooks has not been very positive in Sri Lanka. Recently there are new requirements that the volume of landings be checked against what was declared in the logbooks. Concerns have been raised over confidentiality, and there is need for rules.

5. CHARACTERISTICS OF AND OBSERVATIONS ON THE MARINE FISHERIES IN THE SOUTH AND SOUTHEAST ASIA REGION

South and Southeast Asia is the most fishery productive area in the world. The 12 countries that participated in the workshop contributed 25 percent of the world fishery production in 2006. The majority of the fisheries are in tropical or subtropical waters. The multispecies and multigear nature of the fisheries coupled with the unique life history parameters of fish species in the region poses a great challenge not only to stock assessment but also to fishery management. All the countries are developing countries, and they often have insufficient infrastructure for data collection and inadequate human and financial resources for fishery studies and implementation of management strategies. How to maintain the prosperity of fisheries and consequential contribution to national economy and livelihoods of local communities demands a pragmatic and innovative approach in policy formulation, management strategy development and implementation of fishery regulations.

Based on the country reports and discussion at the workshops, the characteristics of and observations on the marine fisheries in the region are summarized below with the hope that they will attract attention from relevant government decision-makers, fishery scientists and regional and international communities and provide necessary information for future policy formulation and development of management strategies.

1. Fisheries make a significant contribution to national economy in the South and Southeast Asian countries, ranging from 1.1 to 11.4 percent (for details see Appendix 5).

2. Increasing fishery production, securing food supply and improving fishermen's livelihood are considered as a top priority in almost all the countries.

3. Total fish production in the region has kept an increasing trend since the 1950s. This increasing trend can be in all the countries, although China and Thailand have experienced a decline over the last five years.

4. Fishing effort has increased continuously in all the countries except Malaysia (Appendix 4), in which the number of vessels has staged or decreased slightly over the last decade, however, if increase in efficiency of fishing vessels through upgrading engines and adding on more electronic equipments is taken into account, fishing effort would has increased in Malaysia as well.

5. Open access still dominates the fisheries of the region. A cap on licences is only seen in the shrimp trawling in Malaysia and generally in the southern South China Sea fisheries of China. Even in these two cases, there is no control over increase in engine power and electronic add-ons, which can have a significant impact on efficiency and power of fishing vessels.

6. Abundance of many commercially important fish stocks has declined continuously over time and overfishing has been a common phenomenon in most countries (see stock coordinate under each country).

7. Species composition has shown a clear shift from high to low trophic levels or from high-value to trash species. This shift may be the reason for the continuous increase in total catch of a water region while many species of high-trophic levels are seen overexploited because production of an ecosystem increases tenfold on average if trophic level of the target species drops by one.

8. All countries have regulations in place to sustain fishery production such as control over licences, seasonal closure, spatial closure and minimum legal size limit. These regulation measures have plaid a positive role in reducing fishing pressure on fish resources. However, the regulatory measures are not tailored to the current stock status and the objectives of management plans and therefore cannot effectively control fishing effort in accordance with the long-term sustainable productivity of the fish stock. For example, licensing is mainly applied to track fishing vessels and collect information on fishing fleets in some country, but does not have a limit over the total number of licences issued. Only in a very few cases, licensing was used as a measure to control the number of vessels in operation. These regulations are often invariant over time and therefore impossible to control fishing effort based on the state of stock abundance. To prevent overfishing, fishing effort must be controlled in accordance with

the sustainable productivity of the stock and the long-term management goal. For example, if a fish stock has been exploited down to an abundance level lower than the one that can produce MSY, a cap over the number of licensed vessels would not stop overfishing the stock and the stock may continue to be depleted. It should also be noted that a target stock abundance level and the time period to reach that target level must be determined when taking decisions on the fishing effort level to be allowed to fish. Most countries in this region do not have the scientific capacity and management skills for this kind of effort control.

9. There is a wide gap between the available scientific information and fishery policy formulation. Fishery regulations are often designed not based on the best scientific information and advice from research. Plenty of research results exist in the region, but are not fully used to formulate government policy and to design fishery regulations. Lack of consultation with the science community seems common and little inputs are sought from scientists for fishery management. These two facts very much compromise the effectiveness of fishery regulations. This gap may have resulted from operational considerations and short-term social and economic consequences of fishery policy and regulations. For example, a tougher control overfishing effort may cause resistance from fishermen and a short-term decline in catch, which may lead to societal concerns. However, it must be pointed out that this gap will hinder the development of effective management and cause a negative impact on the long-term sustainability of fisheries in the region.

10. The need for improving infrastructure seems imminent in most countries for the collection of fishery statistics data. In some countries, fish landing statistics are collected, but often by species group rather than by species, which makes stock assessment difficult and therefore no information available about its stock status and potential productivity. Most countries do not have any information about fishing effort of specific fisheries, which is a great drawback for stock assessment. Although some countries have a licensing system in place, no data has been collection on the total number of licences and the number of licensed vessels that are in operation. This shortage of fishery statistic data certainly has posed obstacles to fishery studies and in return to effective management of fisheries. It is worth noting that fishery policy formulation and design of effective management strategies demand also for other social and economic information besides catch statistics, for example incomes, fleet composition, fishing areas, market prices, etc.

11. High biodiversity is a common nature of the fishery ecosystems in the region. As a result, most fisheries in this region catch multispecies, or a species is fished by multiple gears. The nature of multigear and multispecies poses a great challenge to stock assessment as well as fishery management. Most stock assessment models were developed for temperate fisheries and once applied to tropical fisheries; they may exhibit shortcomings or clear limits. The management of multispecies and gear fisheries is much more complicated than single species and gear fishery as a regulation can only be determined after taking into account all the consequences to all the species and all the types of fishing gear. It seems clear that effective management of multispecies and gear fisheries cannot simply follow suit the temperate fisheries and demands an innovative approach. The complexity of tropical multispecies is coupled with the scarcity and poor quality of data. Probably, because of these reasons, the majority of stock assessment undertaken in this region are based on simplified models such as length-based and yield per recruit analyses. Such models often underestimate the impact of fishing on fish stocks, and this must be taken into account when designing harvest strategies on the basis of such research results.

12. Bycatch is not a common issue for management in most fisheries in the region except trawling in some countries (Appendix 5). There seem two reasons for that: (i) the concept of target species and bycatch is quite vague in the region because of the multispecies nature of fisheries; and (ii) all fish caught are landed and utilized either as food or trash fish. However, the non-selective capture of trawling does cause concerns about its impact on ecosystems in some countries.

13. The biggest threats to marine ecosystems are coastal development, habitat destruction, pollution, and overfishing (Appendix 5). IUU and destructive fishing like mining and capture of juvenile fish were also considered as threats to ecosystems.

14. The awareness of climate change impact on fisheries seems low in the region (Appendix 5). Although most countries know that climate change could have impact on fisheries, they know very little about how fisheries could be impacted and no countries have taken any action or study on this topic except China, which delivered a presentation on the impact of climate change on the fisheries of the northern South China Sea shelf along the Chinese coast. Climate change may pose significant impact on fisheries and the tropical waters may become one of the most influenced regions, especially the tropic Pacific. Although the world knows little at present about the real impact of climate change on fisheries, raising awareness shall benefit the countries in dealing with such impact, adopting themselves to such changes and finding mitigation measures in the future.

6. RECOMMENDATIONS OF THE WORKSHOP

The workshop reviewed the current state of marine fisheries and the practice of fishery management in the region and had a lengthy and comprehensive discussion about the potentials of and concerns about the long-term sustainability of marine fisheries in participating countries. Participants made many recommendations about fishery data collection, information sharing, development of management strategies, coordinated approach to regional issues, national capacity building, etc., which are of practical guidance to improving fishery governance in the region. Below is a summary of the major recommendations from the workshop:

1. Effort should be made to increase the reliability and accuracy of fishery statistics data, particularly landings data. At the workshop, participants voiced their concerns about fishery statistic data. There two aspects of this issues. First, there is insufficient infrastructure to collect fishery statistics properly. In some countries, fish landings data are reported by grass-root government officials, who often best guess the amount of catches landed, rather than by a data collection network based on sampling methods and census. At least, some verification should be carried. At best, a national network should be established in each countries to ensure data quality. Second, double counting should be avoided caused by trading or misreporting. At the workshop, SEAFDEC presented a case study showing 40 percent of the long tuna catch recorded for the Gulf of Thailand actually caught outside the Gulf. This may be caused by trading between countries, for example, Cambodian fishermen often directly sell their catch to Thai fishermen at sea due to the higher price in Thailand. In such cases, both countries count the traded fish as their own catches. National data reporting systems are often not able to separate the catches sold/bought at sea from those landed in domestic ports or there is lack of willingness to separate them.

2. Fishery policy and management strategies should be designed based on stock assessment results with full consultation with and inputs from fishery scientists, managers and fishermen.

3. Management regulations should be designed based on current stock status and management goals. Most countries in the region have regulations on minimum legal size, seasonal closure, spatial closure, gear control, licensing etc. The effectiveness of these regulatory measures in sustainable management can only be materialized once coupled with effective effort control which is consistent with long term sustainable productivity of the stock and the management goals of the fishery.

4. Training in stock assessment and fishery management should be undertaken. Most countries lack or have not stock assessment scientists. The knowledge is limited about fishery production system and how proper management can benefit the country in increasing production and conserving marine ecosystems. A few countries have asked FAO for such training workshops.

5. A stock assessment working group should be established for the region. Such a working group can help countries having lack of stock assessment expertise to develop capacity and to improve stock assessment skills through regular exchange of information and experience. The working group can also carry out coordinated study on stock assessment methodologies and develop innovative ones that are tailored to the unique nature of multigear and multispecies of the tropical fisheries in the region.

6. Availability of human and financial resources should be increased for fishery research and implementation of management strategies. Fishery research seems losing moment and getting less attention from governments in the region. Some countries like Cambodia and Myanmar have no fishery research institutes and fishery management related activities often face insufficient human and financial resources.

7. A regional forum or committee on fisheries should be established. Such a forum is expected to provide a platform for high level government officials, fishery scientists, representatives of fishing industry and fishermen to exchange their viewpoints and experience and for countries to share information and data, learn from each other, deal together with regional issues and act simultaneously in coordinated manners on bilateral and multilateral issues in the region. The forum can also help build capacity in fishery policy formulation and design of fishery management strategies at regional level.

APPENDIX 1

Agenda

Time	Programme	Chairperson
October 5 (Monday)		
09.00–09.30	Registration	
09.30–09.45	Welcome remark by Chumnarn Pongsri	
09. 45–10.00	Scope of the workshop – Gabriella Bianchi	
10.00–10.30	Coffee break and group photo	
10.30–10.45	Overview of the Work Plan agreed on at the first workshop	Duto Nugroho
10.45–11.45	Country report and discussion – Thailand	
11.45–12.45	Country report and discussion – Malaysia	
12.45–13.45	Lunch	
13.45–14.45	Country report and discussion – Cambodia	E. Vivekanandan
14.45–15.45	Country report and discussion – Philippines	
15.45–16.00	Coffee break	
16.00–17.00	Country report and discussion – Bangladesh	
October 6 (Tuesday)		
09.00–10.00	Country report and discussion – China	Abu Talib Bin Ahmad
10.00–11.00	Country report and discussion – Indonesia	
11.00–11.20	Coffee	
11.20–12.20	Country report and discussion – India	
12.20–13.30	Lunch	
13.30–14.30	Country report and discussion – Sri Lanka	Worawit Wanchana
14.30–15.30	Country report and discussion – Myanmar	
15.30–16.00	Coffee	
16.00–17.00	Country report and discussion –Viet Nam	
October 7 (Wednesday)		
09.00–9.30	Australian experience in stock assessment and status reporting	Gabriella Bianchi
9.30–10.00	Regional perspectives of stock assessment and status reporting – FAO RAP	
10.00–10.30	Fishery inventory – Marc Taconet (FAO)	
10.30–10.50	Coffee	
10.50–12.30	Trawlbase and its use in fishery assessment and management – Len Garces (WorldFish Center)	
12.30–13.30	Lunch	
13.30–15.00	Overview of the fishery stock status in the region – discussion	Simon Funge Smith
15.00–15.20	Coffee	
15.20–17.00	Overview of the fishery stock status in the region – discussion	
October 8 (Thursday)		
9.00–10.30	Methodologies of fishery stock status assessment – discussion	Somboon Siriraksophon
10.30–10.50	Coffee	
10.50–12.30	Methodologies of fishery stock status assessment – discussion	
12.30–13.30	Lunch	
13.30–15.00	Integration of stock status from country level to FAO statistical areas – discussion	Marc Taconet
15.00–15.20	Coffee	
15.20–17.00	Integration of stock status from country level to FAO statistical areas – discussion	
October 9 (Friday)		
9.00–10.30	Stock status and local management strategies – discussion	Simon Funge Smith
10.30–10.50	Coffee	
10.50–12.30	Other relevant issues – discussion	Simon Funge Smith
12.30–13.30	Lunch	
13.30–15.00	Adoption of conclusions and recommendations	

APPENDIX 2

List of participants

BANGLADESH

Jalilur RAHMAN
Senior Scientific Officer
Bangladesh Fisheries Research Institute,
Marine Fisheries and Technology Station
Cox's Bazar 4700
Tel.: +880 1711408339
Fax: +880 34163976
E-mail: jrhmn@yahoo.com

CAMBODIA

Suy SERWATH
Director
Marine Fisheries Research and Development Institute
Fisheries Administration
Phnom Penh
Tel./Fax: +855 23215470
Mobile: +855 12710800
E-mail: serywath@gmail.com

CHINA

Yongsong QIU
Chief, Fishery Resources Division
South China Sea Fisheries Research Institute
231, Xingang Road Wet
Guangzhou 510300
Tel.: +86 20 89108329
Fax: +86 20 84451442
E-mail: scfifrd@pub.guangzhou.gd.con
qysgz@163.com

INDIA

E. VIVEKANANDAN
Principal Scientist
Central Marine Fisheries Research Institute
Post Box 1603
Cochin 682018 – Kerala
Tel.: +91 484 2394061
Fax: +91 484 2390225
E-mail: evivekanandan@yahoo.com
evivekanandan@hotmail.com

K. SUNILKUMAR MOHAMED
Head of Division
Central Marine Fisheries research Institute
Post Box 1603
Cochin 682018 Kerala
Tel.: +91 944 7056559 (mobile)
Fax: +91 484 2394909
E-mail: ksmohamed@vsnl.com –
ksmohamed@hotmail.com

INDONESIA

Duto NUGROHO
Researcher
Research Institute for Marine Fisheries (RIMF)
Jalan Muara Baru Ujung, Komplek Pelabuhan Perikanan Samudra
Jakarta 14430
Tel.: +62 21–6602044
Fax: +62 21–6605912
E-mail: dutonugroho@gmail.com
Kanlutmb@indoset.net.id

MALAYSIA

Abu Takib BIN AHMAD
Senior Research Officer
SEAFDEC/Marine Fisheries Resources Development and Management Department
Taman Perikanan, Chendering
21080 Kuala Terengganu
Tel.: +609 6163150
Fax: +609 6175136
E-mail: abutalib@seafdec.org.my

MYANMAR

Myint PE
Assistant Director
Department of Fisheries
Sinim Road, Ahlone Township
Yangon
Tel.: +951 680748
Fax: +951 220597
E-mail: myintpe@myanmar.com.mm

PHILIPPINES

Francisco TORRES Jr.
Aquaculturist1
Bureau of Fisheries and Aquatic Resources
National Fisheries Research and Development Institute
940, Quezon Avenue
Quezon City 1103
Tel.:+632 3725063, 4109192 or
+639 209080833
Fax: +632 3725063
E-mail: Francisco_torresjr@yhahoo.com

SRI LANKA

Champa AMARASIRI
Director
National Aquatic Resources Research and Development Agency (NARA)
Crow Island Mattakkuliya
Colombo 15
Tel.: +94 776365428
Fax: +94 112521914
E-mail: champa@nara.ac.lk

THAILAND

Ratanawalee PHOONSAWAT (Ms)
Fisheries Biologist
Marine Fisheries Research and Development Bureau DOF Thailand
49, Soi Prarachaveriyaporn 16
Bang Pheung, Phra Pradeang
Samut Prakan 10130
Tel.: +662 8167635 to 38; ext. 13
Fax: +662 8167634
E-mail: ratvaree@yahoo.com

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO)
Viale delle Terme di Caracalla
00153 Rome – Italy

Gabriella BIANCHI (Ms)
Senior Fishery Resources Officer
Marine and Inland Fisheries Service
Fisheries and Aquaculture Resources Use and Conservation Division
Fisheries and Aquaculture Department
Tel.: +39 0657053094
Fax: +39 0657053020
E-mail: gabriella.bianchi@fao.org
Web site: http://www.fao.org/fishery/en

Yimin YE
Senior Fishery Resources Officer
Marine and Inland Fisheries Service
Fisheries and Aquaculture Resources Use and Conservation Division
Fisheries and Aquaculture Department
Tel.: +39 0657054592
Fax: +39 0657053020
E-mail: yimin.ye@fao.org
Web site: http://www.fao.org/fishery/en

Marc TACONET
Senior Fisheries Information Officer
Statistics and Information Service
Fisheries and Aquaculture Policy and Economics Division
Fisheries and Aquaculture Department
Tel.: +39 0657053799
Fax: +39 0657052476
E-mail: marc.taconet@fao.org
Web site: http://www.fao.org/fishery/en

Rudolph HERMES
Chief, Technical Advisor
FAO Regional Office for Asia and the Pacific
39 Phra Atit Road
Bangkok 10200
Thailand
Tel.: +6626974149
Fax: +662 6974445
E-mail: simon.fungesmith@fao.org

Simon FUNGE SMITH
Senior Fishery Officer/
APFIC Secretary
FAO Regional Office for Asia and the Pacific
39 Phra Atit Road
Bangkok 10200
Thailand
Tel.: +6626974149
Fax: +662 6974445
E-mail: simon.fungesmith@fao.org

David LYMER
Fishery Data and Information Officer
FAO Regional Office for Asia and the Pacific
39 Phra Atit Road
Bangkok 10200
Thailand
Tel.: +6626974273
Fax: +662 6974445
E-mail: david.lymer@fao.org

Elena BALESTRI
Consultant
Statistics and Information Service
Fisheries and Aquaculture Policy and
Economics Division
Fisheries and Aquaculture Department
Tel.: +39 0657054739
E-mail: Elena.balestri@fao.org

Purwito MARTOSUBROTO
Consultant
Jl.Palapa, XVIII
12, Pasar Minggu
Jakarta–12520
Tel.: +6221 7804255
Fax: +6221 78837808
E-mail: purwitom@gmail.com

SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTRE (SEAFDEC)

Somboon SIRIRAKSOPHON
Policy and Programme Coordinator
SEAFDEC Secretariat
PO Box 1046
Kasetsart Post Office
Bangkok 10903
Thailand
Tel.: +662 9406326
Fax: +662 9406336
E-mail: somboon@seafdec.org

Pouchamarn WONGSANGA (Ms)
Information Programme Coordinator
SEAFDEC Secretariat
P O Box 1046
Kasetsart Post Office
Bangkok 10903
Thailand
E-mail: pouch@seafdec.org

Worawit WNACHANA
Head of Capture Fishery Technology Division
SEAFDEC Training Department
P O Box 97
Phrasamutchedi
Samut Prakan 10290
Thailand
Tel.: +662 4256140
Fax: +662 4256110 – 4256111
E-mail: worawit@seafdec.org

WORLDFISH CENTER

Len R. GARCES
Portfolio Coordinator, East and Southeast
The WorldFish Center
Jalan Batu Maung, Batu Maung 11960
Bayan Lepas – Penang
Tel.: +604 6202134
Fax: +662 6265530
E-mail: lgarces@cgiar.org

OBSERVERS

Magnus TORELL
Senior Advisor
SEAFDEC Secretariat
Tel.: +662 9551557
Fax: +662 9406336
E-mail: magnus@seafdec.org

Tadahiro KAWATA
Technical Coordinator
SEAFDEC Secretariat
Tel.: +662 9406332–8
Fax: +662 9406336
E-mail: kawata@seafdec.org

Nualanong TONGDEE (Ms)
Senior Information Officer
SEAFDEC Secretariat
Tel.: +662 9406326
Fax: +662 9406336
E-mail: nual@seafdec.org

Yusri BIN YUSOF
RFPN of Malaysia
SEAFDEC Secretariat
E-mail: yusof@seafdec.org

Piyawan HUSSADEE (Ms)
RFPN of Thailand
SEAFDEC Secretariat
E-mail: piyawan@seafdec.org

Nyunt WIN
RFPN of Myanmar
SEAFDEC Secretariat
E-mail: nyunt@seafdec.org

AWWALUDDIN
RFPN of Indonesia
E-mail: awwal@seafdec.org

Nipa KULANUJAREE
Fisheries Biologist
Marine Fisheries Research and Development Bureau, DOF Thailand
49, Soi Prarachaveriyaporn 16 Bang Pheung
Phra Pradeang
Samut Prakan 10130
Thailand
Tel.: +662 8167636
Fax: +662 8167634
E-mail: nipadao@hotmail.com

Natinee SUKRAMONGKOL
Fishery Oceanographer
SEAFDEC Training Department
P O Box 97 Phrasamutchedi
Samut Prakan 10290
Thailand
Tel.: +662 4256100
Fax: +662 4256110, 4256111
E-mail: natinee@seafdec.org

Nakaret YASOOK
Fishing Gear Technologist
E-mail: nakaret@seafdec.org

Sayan PROMIJNDA
Fishing Gear Technologist
E-mail: sayan@seafdec.org

SECRETARIAT

Penchan LAONGMANEE (Ms)
Fishing Ground and Fishery Oceanography Section Head
SEAFDEC Training Department
Tel.: +662 4256100
Fax: +662 4256110, 4256111
E-mail: penchant@seafdec.org

Siriporn PANGSORN (Ms)
Fishing Ground Information Scientist
E-mail: psiriporn@seafdec.org

Tanapat SORRAGRITTAYAMATE
Fishing Ground Information Scientist
E-mail: tanapat@seafdec.org

Nathacha SORNVAREE (Ms)
Administrative Officer
E-mail: natha@seafdec.org

APPENDIX 3

Welcome message of Dr Chumnarn Pongsri
Secretary-General of SEAFDEC

Representatives from our collaborating partner, FAO
Representatives from the FAO Regional Office for Asia and the Pacific,
Resource Persons from FIRMS, WorldFish Center;
Representatives from the South Asian countries;
Representatives from the SEAFDEC member countries;
Ladies and Gentlemen,

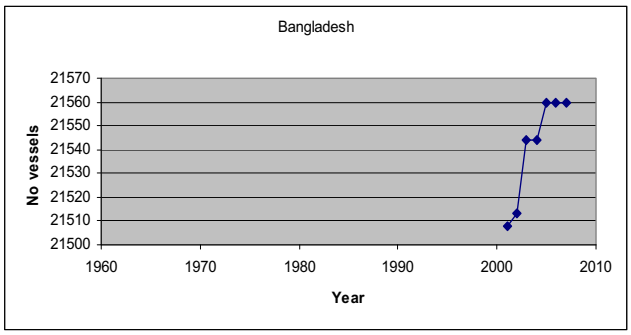
On behalf of SEAFDEC as the co-organizer of this Workshop, I wish to welcome you all to Bangkok and to this Second workshop on the assessment of fishery stock status in South and Southeast Asia. I learned from the report of the first workshop that the capacities of the South and Southeast Asian countries differ in terms of data collection and stock assessment. The establishment and development of appropriate methods that can incorporate auxiliary data and improve the assessment of the status of fishery resources in our countries is therefore a great challenge for all of us.

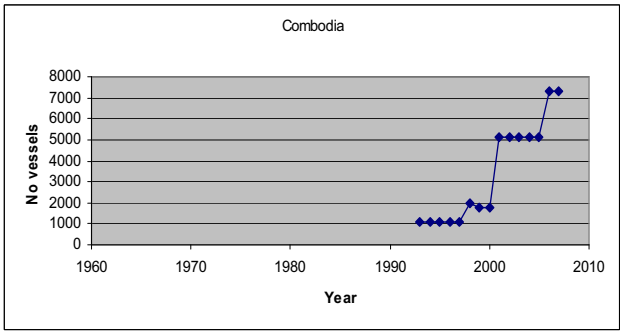
As we are all aware of, the first workshop reviewed the data and information available in our countries, and harmonized the methods of assessing the state of our fishery resources. Using such harmonized assessment methodology, the countries were asked to test its applicability using their respective fisheries data. In this second workshop, country representatives are invited to discuss the results of their testing activities. On behalf of SEAFDEC, I would wish to thank FAO for pursuing this initiative and especially for co-organizing this workshop as it would give the South Asian and the Southeast Asian countries the opportunity to discuss their experiences and exchange information with regards to the assessment of their respective fishery stocks. I would also like to encourage all the participants to take active part in the discussions bearing in mind that such methods could lead to a standardized assessment of the fishery resources in these regions. With your support, I am sure the Workshop would be able to come up with the necessary tangible results.

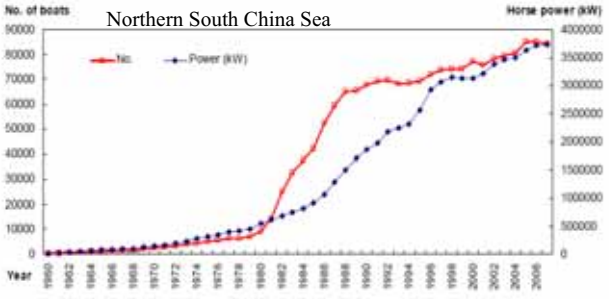
With that ladies and gentlemen, it is my wish and that of SEAFDEC that this Workshop would be successful and that the results could be adaptable by the countries in these regions for assessing the status of our fishery stocks which can support our efforts in managing the resources in a sustainable manner.

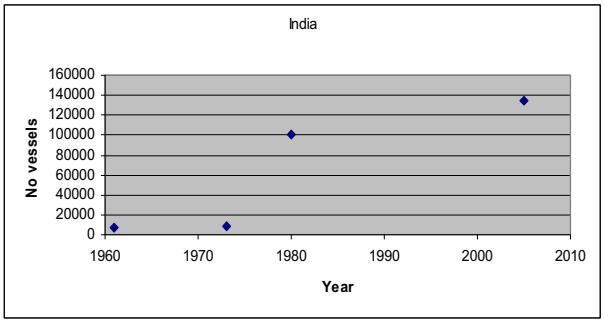
APPENDIX 4

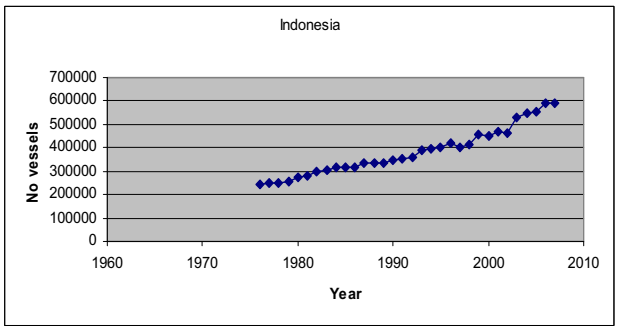
Statistical data of fishing vessels in the South and Southeast Asian countries

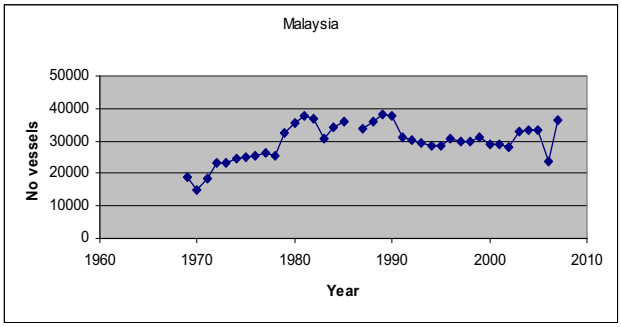


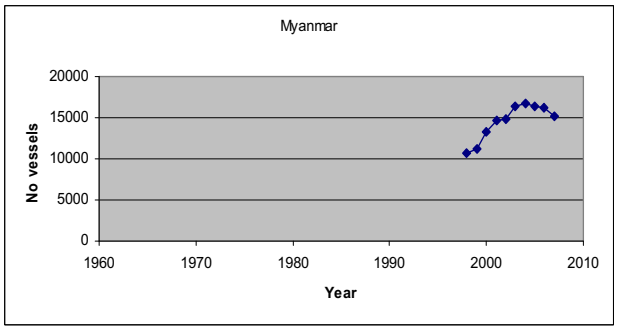


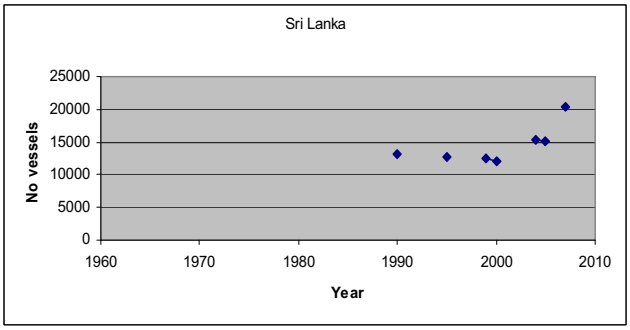


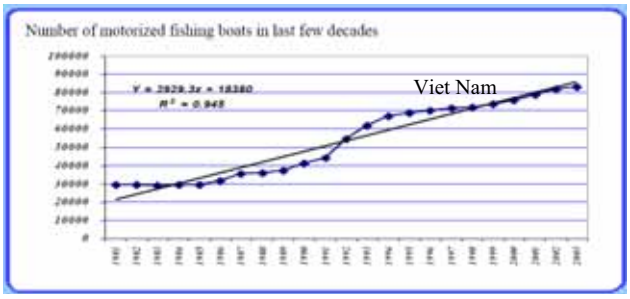












All graphs show numbers of motorized vessels, except Myanmar showing non-motorized vessels as motorized vessels form only a small part of the national fishing fleet. The graph for China shows only the number of vessels in the northern South China Sea rather than the whole country.

APPENDIX 5

Summary table of country reports from the South and Southeast Asia

Country	Total product. (million tonnes)	Marine catch (million tonnes)	Fishery % contribution to GDP	What is government's biggest concern for fishery? (you can list several in order)	Is a fishing licence required to fish?	Are new licences still being issued?	Has overcapacity occurred? If yes, at what percentage (best guess)?	Is stock status assessment done for major species? If yes, how often are they updated?	Is management plan specifically designed based on stock assessment? If yes, how often revised?	What are the major issues to stock assessment?
Bangladesh	2.44	0.49	4.92	(i) Protection of juveniles (ii) Increase marine production (iii) Reduce fishing pressure from shallower region and increase in deeper region (iv) Reduction of pollutants (v) Better fishers livelihood	Yes	Yes, but only capped for shrimp trawlers	Yes for shallower region (20%), but not for deeper region	Only for hilsa shad regularly, but for other marine species grossly done in 1980s	Only for hilsa shad and reviewed time to time, but not for other species	Insufficient & unreliable species wise data/short of human & financial resources
Cambodia	0.83	0.066	11.4(16?)	(i) Increase production and alleviate poverty (ii) Protection of fish habitat & biodiversity	Yes	No	?	No	No	limited and poor data skill shortage short of fund
China	10.4	3.1	2.5	Fishermen's livelihood; Yield	Yes	No	Yes, 60%	Yes, every 5–10 years	Yes, about every 10 years	No reliable landing data since late-1980s; short of human resources
India	7.5	3.2	1.1	(i) Overcapitalization (ii) Juvenile exploitation (iii) Decline in yields of some stocks (iv) Impacts on marine ecology (v) Implementation of effective management measures	Yes, for mechanized and motorized craft; non-motorized craft do not need licence	Yes; in some cases, new licences are issued for mechanized craft as replacement, new licences are issued to motorized craft	Yes , 50–60%	Yes; Major fisheries assessed continuously consolidation every 5 years; major fisheries covers 80% of the total catch	Yes; but not always potential yield estimates are revised every 10 years	Lack of coordination among different agencies

Country	Total product. (million tonnes)	Marine catch (million tonnes)	Fishery % contribution to GDP	What is government's biggest concern for fishery? (you can list several in order)	Is a fishing licence required to fish?	Are new licences still being issued?	Has overcapacity occurred? If yes, at what percentage (best guess)?	Is stock status assessment done for major species? If yes, how often are they updated?	Is management plan specifically designed based on stock assessment? If yes, how often revised?	What are the major issues to stock assessment?
Indonesia	8.2	4.7	2.5	Fishermen livelihood Imbalance fishing effort between Fisheries Management Area	Yes	Yes in some cases for vessel with size of > 5GT	Yes, in some areas for certain group of species.	Yes, for certain main species and updated every 4 years	Conceptually yes, problem in implementation	Lack of coordination; limited institutional capacity; limited human resources
Malaysia	1.56	1.38	1.20	(i) Increase productivity to enhance food security (ii) Declining resources (overcapacity, overfishing issues & habitat degradation) (iii) Conserve and utilize natural resources on a sustainable basis (iv) Create new sources of growth for the sector – Agro-based industry	Yes (for all fishing vessels & gears)	Yes (only for area outside 30nm and vessel >70GRT)	Yes (Particularly for demersal resources)	Yes, coastal demersal finfish – every 2–3-year; offshore demersal fisnfish – every 10 years; shrimp – every 5 years; pelagic fish — every 10 years	No	(i) Lack of trained staff to do the SA (ii) No suitable research vessel
Myanmar	3.17	1.68	7.6	Income Coastal communities livelihood Food security for local consumption	Yes, except fishing for family consumption	Yes, some new fisheries	Yes, 20%	No stock assessment for all kind of fish species after 1980	Yes, but not revised since 1983 and still use the old data for fishery management	Lack of stock assessment expert; No reliable landing data; Insufficient funding

Country	Total product. (million tonnes)	Marine catch (million tonnes)	Fishery % contribution to GDP	What is government's biggest concern for fishery? (you can list several in order)	Is a fishing licence required to fish?	Are new licences still being issued?	Has overcapacity occurred? If yes, at what percentage (best guess)?	Is stock status assessment done for major species? If yes, how often are they updated?	Is management plan specifically designed based on stock assessment? If yes, how often revised?	What are the major issues to stock assessment?
Philippines	4.7	2.3	2.2/4.3	– Food security – Livelihood – Resource conservation – Environmental degradation	Yes for commercial fishers, but for small-scale fishers, none is required	For commercial fishers, a moratorium is in effect, none for artisanal fishers	Previous studies on some groups of species have stated it has occurred	Yes, for a few species groups, especially the large pelagics. Updated yearly if possible	As stated in the Fisheries Code	Insufficient human resources and funds
Sri Lanka	0.319	0.27	2.7	– Increase fish production – Improve livelihood – Increase foreign trade	Yes	Yes and renewed every year	Yes in some fisheries and also just after Tsunami	No. Tunas done through IOTC, export-oriented fisheries are being done	No	Lack of personnel Inadequate fund Inadequate equipments
Thailand	4.1	2.6	1.3	– Overfishing, – Conflict among the beneficial groups that exploit the same resource, high fishing cost (fuel), shortage of labour	Yes	Some fisheries are capped, but others allow new entry	Yes, 50–60%	Yes	Thailand do not have reference points	The multi-gear, multi-species fisheries make Thailand's marine fisheries difficult to manage
Viet Nam	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a

Country	What are the major issues to fishery management?	Is illegal fishing an issue?	Is bycatch an issue?	Is climate change a problem? What is the biggest concern?	Any marine protected areas established? What is the area?	What is the biggest threat to marine ecosystems?	Is there any other issues that need to be flagged?
Bangladesh	Inadequate information on catch & effort Inadequate information on stock, spawning and nursery grounds Lack of tools/ mechanism of implementation Inadequate MCS facilities	Yes, for foreign & unlicensed artisanal fishing	Yes, only for shrimp trawlers	Yes, for coastal aquaculture	Yes, only for spawning ground of hilsa shad in certain period	Indiscriminate juvenile catch from shallower region and pollution	Security at sea due to natural disaster cyclone/tsunami and also from pirates/robbers for the fishers and fishing crafts & gears
Cambodia	Insufficient data Poor implementation of regulations	No	No	No	No	No	
China	Difficult to enforce because of large no of boats	Yes, destructive fishing; fishing without licences	Yes, bycatch of juveniles	Yes, large catch fluctuation because of climate variability	No. There are some conservation zones, but fishing is still allowed	Overfishing; coastal development; pollution	Capture of juveniles
India	Weak implementation of rules and MCS	No	Yes, for trawling	Yes, for pelagic species. Potential abundance of low-value fish and decline of some stocks; sea level rise and safety are major concerns	There are 31 MPAs and two biosphere reserves (6.16% of coastal biogeographic)	Fishing/ degradation of environment, habitat destruction	FMPs formulation, Co-management

Country	What are the major issues to fishery management?	Is illegal fishing an issue?	Is bycatch an issue?	Is climate change a problem? What is the biggest concern?	Any marine protected areas established? What is the area?	What is the biggest threat to marine ecosystems?	Is there any other issues that need to be flagged?
Indonesia	– Strengthening institutional capacity – Lack of commitment – Limited catch and standard effort documentation on semi-industrial fisheries – Lack of controllable access to coastal and shallow water fisheries (<30GT)	Yes, due to lack of common perception on implementing IPOA on IUUF	Yes, mainly on tuna longline for turtle and seabird, trawl for turtle	Yes, changing recruitment pattern on coastal and neritic fisheries	Already declared that the target on MPA at 10 million Ha in 2010	– Coastal and coral reef degradation – Pollution to estuarine and coastal waters in high density population areas	– Controllable access to coastal and shallow water fisheries – protecting the essential fish habitat – controllable market for certain threaten species

Country	What are the major issues to fishery management?	Is illegal fishing an issue?	Is bycatch an issue?	Is climate change a problem? What is the biggest concern?	Any marine protected areas established? What is the area?	What is the biggest threat to marine ecosystems?	Is there any other issues that need to be flagged?
Malaysia	Lack of details scientific advice Lack of human resources at managerial position Lack of political will	Yes – Foreign vessel operating in Malaysia's EEZ. In 2008, there are 61 cases involving 4 countries – Local vessels that operated other than in the allocated fishing zone. In 2008, 1 296 cases with total compound of RM1.7 million and auction of seized catch valued at RM0.2 million.	No, all being utilized	Yes it is a concern but not sure on the effect.	Yes There are about 200 MPA which were gazetted under various legislations and departments. It includes: Marine Parks (42), State Parks (Sabah – 6, Sarawak – 3), Fisheries Protected Area, Mangrove Reserves, Bird Sanctuaries & Wildlife reserves (8) and RAMSAR Sites (6 site = 95 712 ha)	– Impact of coastal development to the sensitive coastal and marine ecosystems and habitats – Coastal erosion – Marine pollution	Overlapping claimed areas
Myanmar	Insufficient staff and facilities for implementation of monitoring, control and surveillance system are the major issues to fishery management	Yes, destructive fishing practices; fishing without licences; poaching from other countries	Yes, bycatch is an issue since some commercially important juveniles fish are included	Yes, large catch fluctuation in pelagic fish especially in hilsa fishery	Yes, one national marine park was established in Myeik archipelago	Overutilization of mangrove forest and dynamite fishing in coral reef areas is the biggest threaten to marine ecosystem	Trawling in forbidden area of nearshore by baby trawl, using small mesh size in cod end of trawl net are other issues that need to be flagged

Country	What are the major issues to fishery management?	Is illegal fishing an issue?	Is bycatch an issue?	Is climate change a problem? What is the biggest concern?	Any marine protected areas established? What is the area?	What is the biggest threat to marine ecosystems?	Is there any other issues that need to be flagged?
Philippines	Hard to enforce legal measures; Insufficient resources	Yes, but slowly being reduced if not outright eradicated	Yes and no	Yes, fish production in general	Quite a substantial number categorized as to the manner established (e.g by national law local ordinance, etc.)	– Uncontrolled population growth; Pollution; – IUU fishing; – Foreshore development and mining among others	Politics?
Sri Lanka	Lack of implementation Lack of legal facilities Inadequate fund	Yes, pouching of foreign vessels in local waters and vice versa	Not at present	Not at present Coast erosion, sea water intrusion Sea level rise	2 Marine parks 4 sanctuaries	Destructive fishing methods, coral mining Solid wastes Coastal development	None
Thailand	Political interferences	Yes, no estimation	Yes such as shark but we are fully exploited. No discarding all catches are landed, if not eatable as trash fish. We assumed that there is no discard in the Gulf of Thailand	Yes, more storms will affect the safety and efficiency of fishing operation. No studies on impact on fisheries	– 21 MPAs (5,685.23 KM2) – Conservation area (79,757.22 km2 about 25.23%)	– Pollution – Excessive fishing activity	None
Viet Nam	n.a	n.a	n.a	n.a	n.a	n.a	n.a

This report covers the main outcomes of the second of two workshops held in Bangkok (Thailand) in May and October 2009 respectively, with the main objective to review the fisheries data and information available in South and Southeast Asia region and identify appropriate methods to update the assessment of the state of the fishery resources in this area.

The workshop was attended by 38 participants from 10 countries, the Southeast Asian Fisheries Development Centre (SEAFDEC), the WorldFish Center and FAO.

Despite the scarcity of data, by using participants expert opinion it was possible to compile summary tables on the state of the main stocks for most countries. Key recommendations included the need for increased reliability and accuracy of fishery statistics; the desirability of fishery policies and management strategies to be designed based on stock assessment results; and undertaking training in stock assessment and fishery management. Establishment of a stock assessment working group was also considered as a priority.

ISBN 978-92-5-106595-2 ISSN 2070-6987

9 789251 065952

I1663E/1/07.10/1