

COUNTRY STATUS PAPERS

6. I BANGLADESH

FISHERIES OVERVIEW & FISHERIES MANAGEMENT

Introduction

The total fish production of Bangladesh is 1.264 million mt., of which the freshwater sub-sector provides 72% and the marine sub sector provides 28%. Fisheries accounts for about 80% of the animal protein consumed in the country and is a source of both employment and foreign exchange earnings. But despite a continuous increase in fish production, it has not been able to cope with the fast-growing population.

In 1975-76, the country's fish production from all sources was 640,000 mt. In 1994-95, this figure rose to 1.17 million mt, whereas the per capita fish consumption went down from 33.498 to 20.5g. This is so because fish production increased only in arithmetical progression, whereas the human population increased geometrically.

Bangladesh declared an Exclusive Economic Zone of 200 nautical miles in her sea waters in 1974 (Fig. 1). As a result, an area of more than 1,20,000 sq. km. is now under the economic jurisdiction of the country for exploration, exploitation, conservation and management of living and non-living resources. The development potential of this sector has not been properly exploited. Rather, because of unplanned and irrational increase in fishing effort, many of the marine fish and shrimp stocks have already declined. As a result, coastal fishing has become non-remunerative, fisherfolk are getting poorer and thus putting more and more pressure on the resource - a fruitless quest for survival. But the impression that the potential for marine resource exploitation has got exhausted is incorrect.

Bangladesh is a typical multispecies fishery. A number of species - demersals in particular - are exploited by every single type of fishing operation.

Both freshwater and brackishwater aquaculture are practised in Bangladesh. The Bay of Bengal and adjacent river mouths are characterised by strong waves and wide tidal and salinity fluctuations. Extensive areas of the coastal belt are, however, under shrimp-based brackishwater aquaculture. Fisheries, including aquaculture, constitute a vital source of food, employment, trade and economic well-being.

In recent years, Bangladesh fisheries have become a market-driven sector. Coastal fisheries entrepreneurs have tried hard to take advantage of these opportunities by investing in hatcheries, processing factories and intensive shrimp culture in response to growing international demand for fishery products. As a result, repeated pressure is applied in an unplanned manner on valuable shrimp resources.

Production of fresh water & marine aquaculture

Total fish production during the past decade has been increasing. It has gone up from 8.15 lakh mt in 1986-87 to 12.64 lakh mt in 1995-96. The fish production from different sources during 1990-91 to 1995-96 is indicated in the table below:

Year	Inland Fish Production (MT)	Culture Production (MT)	Marine Production (MT)	Total (MT)
1990-91	4.43	2.11	2.42	8.96
1991-92	4.97	2.27	2.42	9.52
1992-93	5.33	2.28	2.50	10.21
1993-94	5.52	2.75	2.60	10.97
1994-95	5.70	9.30	2.70	11.79
1995-96	5.95	3.90	2.79	12.61

Fish consumption, demand & export

Fisheries accounts for about 4.7% of the GDP and provides about 80% of the animal protein consumed. Despite the growing fish production, per capita consumption has fallen from 33.45 in 1975-76 to 20.5 gm in 1995-96. The recommended per capita fish consumption is 30 gm/day.

The export earnings of fishery products have risen sharply during the past two years, from 903.9 million taka in 1993-94 to 1,340.9 million taka in 1995-96. It accounted for 9.12% of the export earnings in 1995-96. The export earnings from 1990-91 to 1995-96 are given in the table below.

Year	Amount in (MT)	Amount in (Crore Taka)
1990-91	26,109	576.62
1991-92	22,080	524.35
1992-93	26,607	700.29
1993-94	30,639	903.9
1994-95	40,419	1,285.7
1995-96	38,929	1,340.9

Stock assessment results, facilities and present activities

A number of surveys have been conducted since 1958 in the marine waters of Bangladesh. Most of these surveys have been of an exploratory nature and oriented to fishing and feasibility studies. Some surveys have been conducted to assess the standing stocks of marine resources, particularly the demersal stocks. But hardly any survey work has been done to assess pelagic resources in a reasonable manner.

The results of demersal fishery resources assessment vary considerably from those of West (1973). Through a desk study, he estimated the standing stock of demersal fish at 2,64,000 mt. to 3,74,000 mt. and the shrimp standing stock at 9,000 mt. His estimate was questioned by many authors. But recent results – from the surveys conducted by Fridtjof Nansen and Anusandhani before and after 1984 – show similar results. They estimate the standing stock of demersal fish to be within a range of 150,000 mt. to 160,000 mt. During the Dr. Fridtjof Nansen survey (Saetre, 1981), an acoustic study estimated the pelagic stock to be from 90,000 mt. to 160,000 mt. This figure was considered an under-estimate.

Fig I. Marine and Coastal Waters of Bangladesh

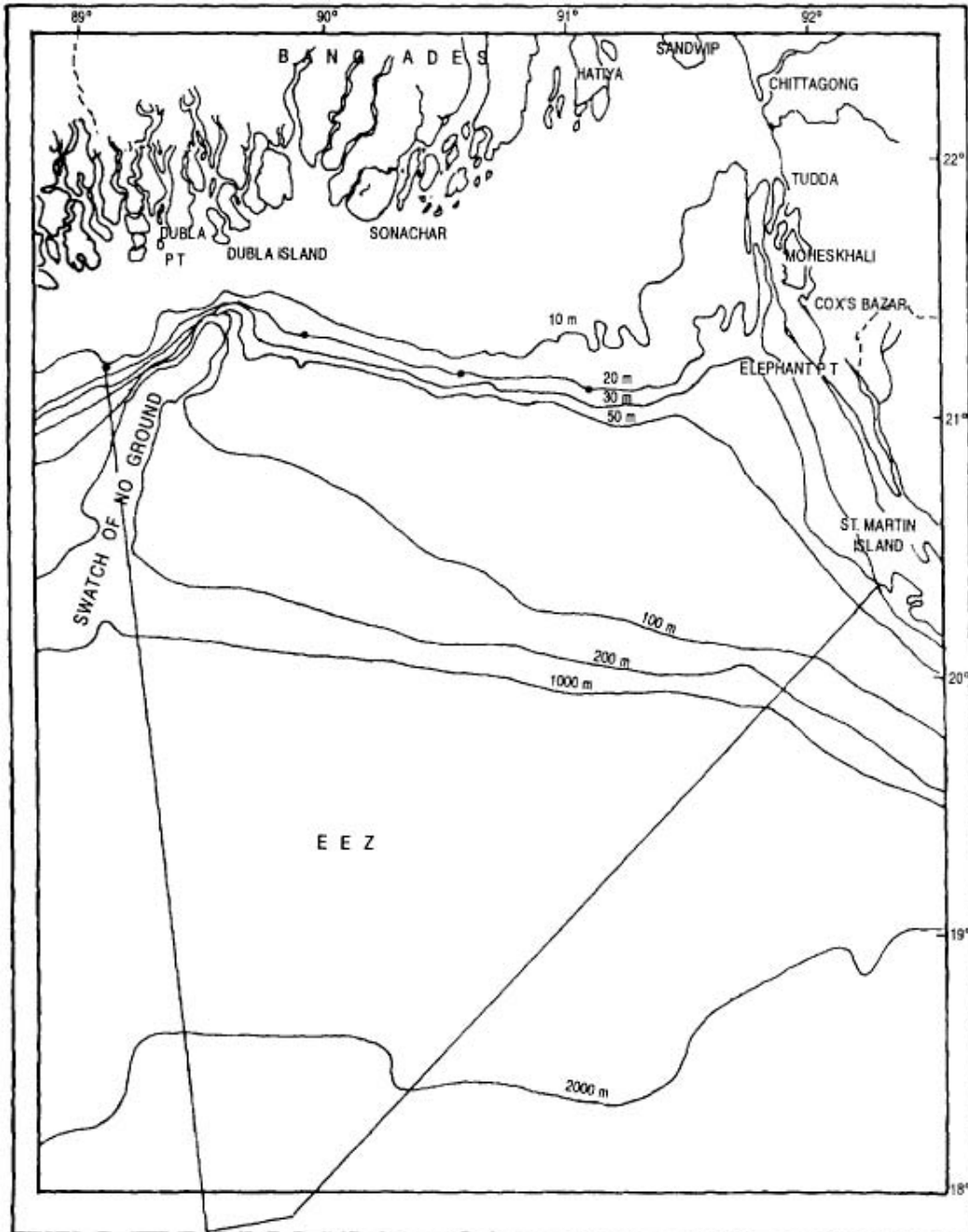


Fig 2. Life Cycle Pattern of Panaeid Shrimp

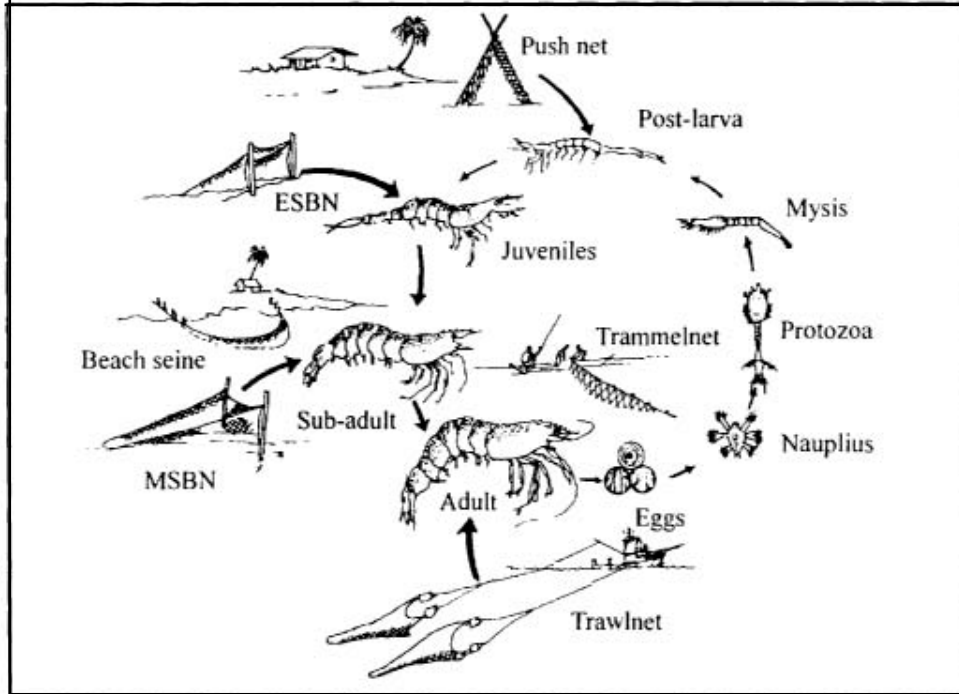
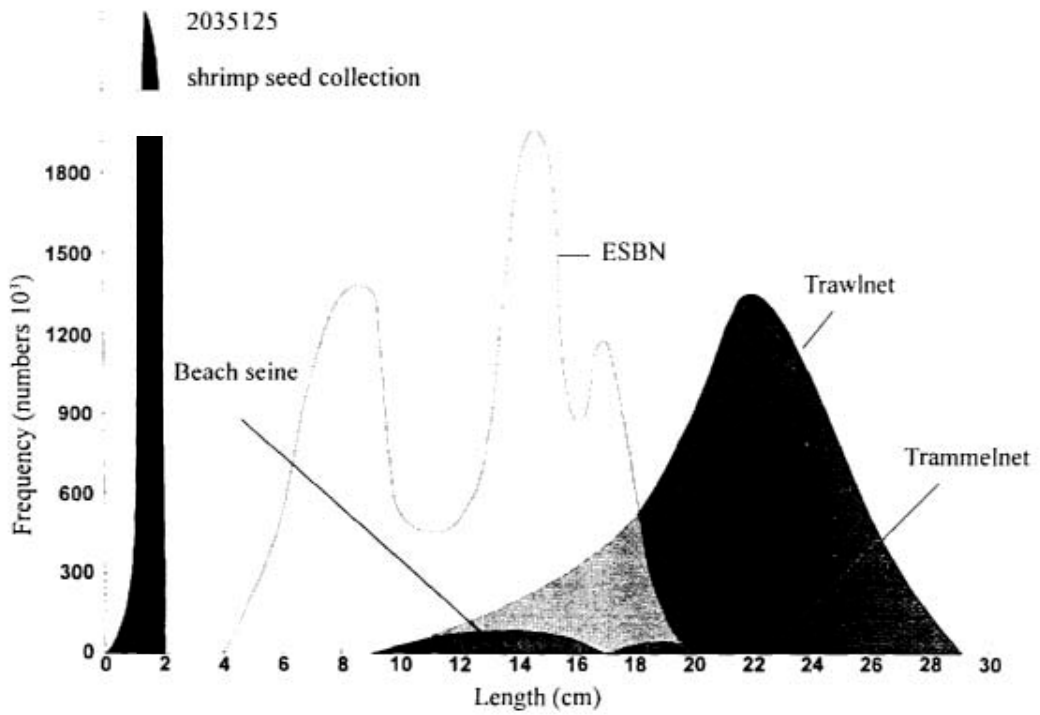


Fig 3. Annual Catch (number) of tiger shrimp (*P. monodon*) by length and gear



Parameters of fish population dynamics for various commercial species of shrimp and finfish were estimated. The results of stock assessment studies so far achieved have been treated with these parameters to find out the fisheries potential for different resources. At this stage, it has been estimated that 40,000 mt to 55,000 mt of demersal finfish can be harvested annually from the offshore fishing grounds lying between the 10 m and 100 m depth zone. The maximum sustainable yield of shrimp has been estimated at 7,000 to 8,000 mt annually; this also includes the resources of the shallow water zone.

in the coastal area, infrastructure and service facilities are inadequate. In the absence of proper landing centres, artisanal fishermen land their catches at scattered places without processing, marketing and transportation facilities. It is only the industrial trawler fleet (public and private) that lands at defined places. Some of the mechanized hilsa boats land at the few landing centers of BFDC. The other private landing places do not have adequate ice, freshwater, berthing and bunkering facilities. The BFDC operates four landing centers in Cox's Bazar, Khulna, Barisal and Patuakhali districts. It has modern fish-landing, preservation, ice, water, berthing and bunkering facilities at Chittagong that are used for its own fleet as well as for extended services to private operators. Such landing centers need to be developed in every coastal district and at other important landing centres.

The DOF marine wing has two establishments one for survey and monitoring another for scientific staff. But this is inadequate, hardly enough to carry out the task of operating two research vessels as well as land-based work for routine collection and processing of industrial, semi-industrial and artisanal, statistical and biological data. At present, the stock assessment survey and monitoring work cannot be continued as per schedule because of the condition of the vessels and the allocation of insufficient funds for maintenance, annual dry docking and procurement of equipment. The scientific staff are few and inadequately trained. Their exposure to programmes for marine and brackishwater research is limited.

Present Fishing System

Marine fishery resources are exploited by

- (i) The Industrial/Trawl Fishery, and
- (ii) The Artisanal Small- Scale Fishery

The Industrial/Trawl Fishery, is a relatively new development in Bangladesh; it began in 1972. At present, 45 shrimp trawlers and 17 white fish trawlers are in operation. Among the shrimp trawlers, five trawlers have a wooden body, the others have a steel body. Among the white fish trawlers, three have wooden bodies, the others have steel bodies. The overall length of shrimp trawlers varies from 20.5 m to 44.5 m, while the white fish trawlers range from 70.5m to 28m. Engine power varies from 350 to 1200 HP, but mostly falls within the 550-850 HP range.

The white fish trawlers use mostly high opening bottom trawls from the stern side. Cod-end mesh size is 60 mm. The shrimp trawlers use outriggers and operate two nets at a time from two sides with booms and use modern shrimp trawl nets with cod-end mesh size ranging 45-50 mm. The headrope length in the trawler fleet varies from 18 m to 32 m. Almost all the vessels are equipped with modern navigation, communication and fish-finding equipment. Trawl fishing is restricted to operate within a 40 meter depth contour.

The Artisanal/ Small-Scale Fishery; Till mid- 1960, only traditional craft operated in estuaries and coastal waters. Two organizations -the Bangladesh Fisheries Development Corporation (BFDC) and

the Bangladesh Jatio Matshyajibi Samabay Samity (BJMSS) – started the process of mechanisation by importing and introducing marine engines.

These fisheries include different types of fishing craft and gear. Some of the gears are operated by mechanized /motorized boats, some others by country boats (row boat, sail boat), some without any boat. These include five different types of gill nets (i. e drift gill net, fixed gill net, large mesh drift net, bottom set gill net and mullet gill net), three types of set bagnet (i. e estuarine set bagnet, marine setbagnet and large mesh set bagnet), trammel net, bottom longline, beach seine, and many others scattered throughout the coast and estuaries which operate up to a depth of 40 meters (Fig 2).

According to the frame survey of traditional and mechanized boats carried out by the FRSS (Fisheries Resources Survey System) of the DOF (Department of Fisheries) during 1984-85, a total of 17,331 boats were in operation in the marine artisanal fishery, of which 3,317 were reported to be mechanized and 14,014 non-mechanised. According to the Marine Wing of the DOF, some 6,000 mechanised boats are currently in operation in the Bay, of which about 4,000 are registered with the MMD (Mercantile Marine Department). According to another estimate (Nuruzzaman, 1991) the number of traditional and motorized boats in the estuaries and coastal waters of Bangladesh is 20,000 and 12,700 respectively.

The following nets are used in marine and coastal waters. They need special mention because of their major contribution in production or their major role from the management standpoint:

a. *Drift Gill Net (DGN)*

Drift gill nets are operated at depths varying from 20 to 40m exclusively for pelagic fish. The principal catch is *Hilsa ilisha*. Skipjack tuna, mackerels and sharks figure as by-catches. The nets are made of nylon twine or tire cord and are operated by motorized boats. The mesh size is around 100 mm. Hilsa drift gill nets operate during March to October, the other gill nets from November to February.

b. *Estuarine set bagnet (ESBN)*

This is a trawl-type bagnet fixed at the bottom in canals and estuaries all around the coastline. It is the most widely operated net in Bangladesh. The depth of water during the operation varies from 3 to 10 meters. The net operates throughout the year. It is very effective for capture of juvenile/undersized species of fish and shrimp of marine origin. The gear is in fact destructive to the stock from the biological sustenance point of view. The cod-end mesh size varies from 5 to 18 mm. These nets are mainly operated by row boats.

c. *Marine set bagnet (MSBN)*

This net is almost similar to the ESBN and follows the same type of operation. But the mesh size is a little bigger. It operates in winter from mid-September through February in the deeper waters from the island base e. g from Dubla island, Sonadia island and Mohipur – at a depth of 10 to 30 m. The net is operated by mechanised boats.

d. *Trammel net (TRN)*

This is a three fold bottom-drifting gill net targeted at penaeid shrimps but also useful for capture of valuable finfish species. The net is comparatively new in Bangladesh and is concentrated along the

Teknaf – Cox's coast, The mesh size at the inner wall is 40-50 mm, and is made of nylon twine. This gear is operated by country rowing boats within a depth of 5 to 15 meters and operates almost right through the year. The sizes of species caught are biologically sustainable. Expansion of operation, both horizontal and vertical, could be encouraged.

e. *Bottom longline (BLL)*

Bottom longlines operate during the period mid-August to mid-February at depths of 20 to 30 meters, i.e. beyond 20 km from the shoreline, mainly from Cox's Bazar. These gears are operated from 6- 14 HP mechanized boats. They target jewfish and croakers, and also catch salmon, cat fish, threadfin bream etc.

f. *Beach Seine (BS)*

Beach seine are semi-encircling nets operated during November to February from the beach and from March to November in the estuary by country boats. They are concentrated in the Teknaf- Cox's Bazar coast but available throughout the country. Since the mesh size is small, i.e 12 mm in the middle, and the area of operation very shallow, the beach seine catch the young and juveniles of jew fish, anchovies, clupeids and small shrimps.

g. *Shrimp-seed collecting gears*

Fine-mesh push nets, fixed bagnets and dragnets are used throughout the coastline in creeks, canals and estuaries for harvesting the larvae of *P. monodon*, the tiger shrimp. These nets are operated seasonally almost throughout the year (such as January to October in Cox's Bazar, February to April in Patuakhali, January to April in Khulna, November to August in Satkhira). The catches contain larvae and juveniles of other shrimps, fin fishes and zooplanktons.

The tiger shrimp larvae constitute less than 1% of the total catch. The remaining 99% which constitute other species, are destroyed by the seed collectors who are interested only in shrimp seed. This practice results in serious damage to the resource and to the ecology. But it cannot be stopped because of the demand for shrimp fry from the shrimp culture industry. Measures for monitoring and control are, however, being taken – including development of hatcheries as a substitute for wild capture of shrimp seed. Fishing by different crafts and gears has an impact on the fish population.

Artisanal Fisheries Sector

Artisanal fisheries includes a number of different type of fishing gears and crafts as listed above. According to recent survey reports, drift gillnetters account for about 55% of the artisanal production (mainly composed of Hilsa), while estuarine set bag nets account for 30%. (Most of the catch consists of juveniles and post-juveniles of animals of marine origin).

a. *Gill net fishery*

These fisheries include drift gill net, fixed gill net, large mesh drift net, bottom set gill net and mullet gill net, These do not by themselves indicate overfishing. But fishing of Hilsa spawner and Jatka in the riverine ecosystem does raise management concerns. Overfishing is noticed, however, in the exploitation

of brooders of Indian Salmon and long jaw fish (Lakhua and Lambu) by large mesh driftnet (LMD) in the shallow waters off Cox's Bazar.

h. *Set bagnet fishery*

Catch assessment and biological information on the pattern of exploitation by this fishery was studied in detail. It is evident that this fishery is the most destructive regular fishery. It was found that species of brackishwater origin i.e *Aceles indicus* (the sergestid shrimp), *Raconda russeliana* and *Setipinna taty* are not over-harvested, they are under-fished to some extent. Almost all species of marine and freshwater origin which visit the brackishwater area for nursery and breeding are seriously overfished (growth overfishing). Fig 3 shows that *P monodon* (tiger shrimp), caught by this gear before the adult stage, are not permitted to join in the spawning process.

C. *Shrimp PL fishery*

The coastal aquaculture industry for penaeid shrimp has developed and remained dependent on the wild seed. So harvesting of the larvae and post larvae of almost all fish and shrimps along with that of tiger shrimp are increasing day by day. According to a recent survey report (Paul et al 1993), more than two billion larvae of *Penaeus monodon* are caught by seed collectors annually throughout the coastline.

These two billion larvae constitute less than two per cent of the total catch of seed collected. The rest (more than 98%) is just killed. These include the larvae of other shrimp fish and zooplankton. On the other hand, out of the total number of *P.monodon* removed from the sea and estuary by different fisheries, the shrimp seed fishery alone takes 99.568 %, while the trawl fishery takes 0.215% only. But if the percentage of harvest is calculated in terms of weight, the impact is just the reverse - i.e the trawl fishery takes 61.27% and the shrimp seed fishery only 3.08%.

A considerable part of the two billion larvae of tiger shrimp (and other fish and shrimp larvae) would have the chance to go back to the sea and grow to adult size and substantially increase the catch and catch rate of shrimp by offshore fishing gears - if it is not caught in the estuaries and the sea coastline. The main solution that can permit this scenario is raising commercial hatcheries for supply of shrimp seed. Controlling the transportation, handling and stocking of seed may also reduce the demand of seed for aquaculture.

Industrial Fisheries

a. *Trawlers*

The effort in the trawl fishery during the past one and a half decades has stayed around 5,000-6,000 standard fishing days to produce 3,500-6,000 mt of shrimp. The MSY of penaeid shrimp is 7,000 mt. The optimum effort for producing the amount is 7,000- 8,000 standard days. Till date the shrimp production is much below the MSY level. White fishes landed by the trawler fleet are in the range of 8,000- 12,000 mt (only 20% of the actual catch), while 80%, equivalent to 35-45,000 mt (White & Khan 1985) are discarded dead in the sea. Even if the discarded amount is considered as production, MSY is not achieved. The MSY is 85,000 mt (Lamboeuf, 1987). Although effort in the trawl fishery is below the optimum and the gear is non-selective, the population of tiger shrimp has become over-exploited.

Present Management System

The present management system largely focuses on the industrial trawl fishery. The other brackishwater and marine fisheries do not see very much of management practices. In 1983, the Government of Bangladesh enacted the Marine Fisheries Rules, 1983, in accordance with the provisions of the Marine Fisheries Ordinance, 1983. The marine fisheries rules amended in 1993 provide for licensing and monitoring of artisanal mechanised fishing boats. The monitoring of fishing vessels is carried out only by the Marine Fisheries Surveillance Checkpost at Patenga, Chittagong.

The main features of the Ordinance are as follows:

1. Every fishing vessel should take a license from the Department of Fisheries
2. Every fishing vessel should supply its catch and effort data regularly to the Fisheries Department.
3. Rules prohibit the following methods:
 - a. fishing with any gear having mesh size smaller than the mesh size mentioned in the rules.
 - b. Fishing with any kind of explosive, poison or noxious substance.
 - c. Fishing marine species of any type with electrolighting.
4. Mesh size: All licensed fishing vessels should use nets of mesh size with the following dimensions:
 - a. for shrimp trawl net (boom) with low opening, the minimum mesh size shall be 45 mm at the cod-end.
 - b. for fish trawl net, mesh size at the cod-end shall be 60 mm
 - c. for large mesh drift net (LMD), the minimum mesh size shall be 200 mm
 - d. for small mesh drift net (LMD) the minimum mesh size shall be 100 mm
 - e. for set bagnet (behundi net) the minimum mesh size at the cod-end shall be 30 mm.
5. Area for fishing

The area upto 40 meter depth is reserved for artisanal fishing gear.
The industrial fishery is allowed to operate beyond 40 meter depth.

Limitations, enforcement, compliance and inadequacies of the present management system

Management of marine fisheries is a very big task. It calls for activities both within and outside fisheries. The following constraints are encountered during management:

1. Limited capabilities:

DOF in respect of marine fishery performs two main functions (a) monitoring of the fishing gears, and vessel and stock assessment for sustainable development of fishery resources (b) implementation and enforcement of rules under the Marine Fisheries Ordinance 1983.

To discharge these two responsibilities, the DOF have two units. But these are managed by, a limited number of scientific staff and legislative officers. So the capabilities of the organizations under MOFL, particularly in respect of marine and brackishwater fisheries, need to be strengthened greatly.

2. *Need for revising the existing Marine Fisheries Ordinance 1983*

The Marine Fisheries Ordinance 1983 and subsequent rules need to be amended to meet current practices and requirements. Existing rules mention a 30 mm codend mesh size for ESBN – which actually use only 8-12 mm mesh. But recent experimentation and investigation reveal that 30mm cod end in ESBN would result virtually in **no** catch, since they target juveniles. It would also be non-remunerative for fisherfolk. So mesh size increase would not help management. This is why complete withdrawal of this gear from the estuarine habitat is necessary. Accordingly, it needs to be included in marine fisheries rules as follows:

ESBN fishery: As an immediate measure to reduce effort, ESBN operations (during the periods July-September and February - April) in the offshore region of Cox's Bazar district, should be totally stopped.

Large mesh drift net: Operation of LMD in shallow waters should be banned

Marine set bagnet: Should use 45 mm cod-end mesh size.

Trammel net fishery: As the trammel net fishery has been proved to be a biologically sustainable fishery. it should be extended up to 40 m depth of water after appropriate biological and technological studies.

Trawl fishery.

- (a) A shrimp trawler that is dying out should be replaced not by a shrimp trawler, but by a fish trawler.
- (b) Existing rules stipulate that white fish should constitute 30% of the total catch. The figure should be 50%, not 30%.
- (c) 20-day fishing trips should be allowed, instead of the 30-day trips mandatory at present.
- (d) To facilitate resource monitoring and management, an enhanced fee should be included in the annual licence fee for fishing vessels.

Registration of mechanised boats: In the MFO'83 and subsequent rules, provision has been made for licensing of artisanal fishing boats with DOF. But it is the Mercantile Marine Department that deals with the registration of these boats. It is evident, however, that all the boats are not registered. Fishermen do not like observing formalities with two different departments for registration and for fishing licence. The DOF has the capability to check the craft's health and safety equipment. These two functions need to be placed under the DOF for an easy monitoring and enforcement system.

Besides, a fishing boat – whether mechanised or non-mechanised – has to face many other departments before it can legally go fishing. This makes registration a complex procedure which is not in fact conducive for the smooth operation of fishing boats. For instance, a boat after construction needs to be registered with the Mercantile Marine Department, and obtain a valid inspection certificate (for hull and safety equipment) from the same authority. After that, the DOF provides a fishing licence for a year, then pays river dues, income tax, forest royalties, local tax for water bodies etc. All these activities should be unified and dealt with by a single authority – this is the demand of fishermen.

Co- ordination among different organizations

The various waters in the coastal districts come under different organizations – the Ministry of Land, the Ministry of Forests, the Ministry of Water Development and Irrigation, the Ministry of Fisheries and

Livestock. A high-power committee co-ordinates with different organizations for sustainable development and integrated management of coastal fisheries zones.

Present departmental strength, facilities and needs

The Department of Fisheries is the key organization responsible for development and management of fisheries. This department has two wings, Inland and Marine, each headed by a Director. The Marine Wing of DOF is located at Chittagong. The Marine Fisheries Ordinance 1983 and the subsequent Marine Fisheries Rules (Amended) 1993 were enacted to serve as a legal base for the conservation and management of marine fisheries. A system of licensing all fishing vessels, together with a provision for providing Identity Cards to fishermen, has come into force from September 1996.

Previously, only deep sea trawlers were provided with a licence. But in spite of a coastline of 480 km and fishing activity in every nook and corner of the coast, the present system of a single office in Chittagong with a meagre staff severely hampers the management and conservation initiatives of the DOF's marine wing. An increase in the strength of infrastructure facilities and personnel has become imperative for proper management of marine fisheries. In this context, a proposal for dividing the entire coastal area into seven zones – Cox's Bazar, Chittagong, Noakhali, Khulna, Barisal, Bhola and Patuakhali – with provision for establishing a marine fisheries office in each zone with appropriate staffing and infrastructure facilities, should be considered.

Fishing Communities

Fishing is traditionally a low-status occupation, and the majority of fishing families belong to socially neglected Jaldas (who are Hindus). With increasing commercialization of marine fisheries and the rise in landlessness due to population pressure on limited agricultural lands, a large number of Muslims began taking up fisheries full time.

The traditional fishing communities live in coastal villages, generally at the very edge of the land mass, where land is least productive and subject to river and sea erosion. Exposure to floods, fires and storms is high. Cyclones are regular annual phenomena in coastal areas. They are often accompanied by tidal bores measuring 10 to 20 feet above the high tide level. The cyclones damage the fishing crafts and gears of fishermen and destroy their livelihood. Examples: the cyclones of November 1970 and April 1991, which led to severe loss of life and material. Government rehabilitation programmes do not compensate sufficiently for these losses.

The living conditions of fishermen, particularly in urban areas, are deplorable. In such areas they live in slum settlements noted for congestion, sub-standard housing, inadequate municipal services e. g. refuse disposal and sanitation. The only facility available for bathing and washing is a small polluted communal pond. Fishermen in rural areas do not face such severe congestion, but battle difficult conditions regarding sanitation, housing and water supply.

Within fishing communities, there are two distinct groups: those who own boats and fishing gears, and those who work only as fishing crew. Most fishermen are landless. Many of them are employed only during the fishing season. A few revert to estuarine fishing when the marine fishing season is over. A majority of fishermen thus rely on money-lenders during the off-fishing season to meet their subsistence needs. Result: most fishermen are chronically indebted to fish traders and money-lenders. The fishermen

are inclined to borrow from money lenders despite the presence of formal credit systems in some areas. Many of the larger mechanised boats and gears are owned by individuals not actively engaged in fishing. They have fishermen as crew on a share or cash basis (or on a wage basis – in a few cases).

Most fishing communities live below the poverty line. Within a community, incomes are uneven and disparities quite high. Since fishing is a seasonal activity, incomes are not evenly spaced through the year. This uneven pattern of earnings, together with spending on non-essentials, inhibits savings and breeds indebtedness. Fishermen do not get the right price for their catches. Middlemen acquire fish from them at hefty discounts because of the loans they have given fishermen. The social structure and the low economic level of fishing communities has made it difficult for fishermen to organize themselves into economic units or into co-operative societies.

The increased effort in the estuarine set bagnet fishery and the shrimp larvae fishery has created severe problems from the conservation and management standpoint. These fisheries have proven to be destructive and are major obstacles to the recruitment of major fish and shrimp species to deep-water areas. A study programme to motivate fishermen and let them participate in the management of marine fisheries is being implemented with the help of BOBP. This programme seeks methods to make fishers more conscious of the fishery resource and the need for management, and to help them find alternative jobs that offer better incomes, leading to better living standards and a brighter future for their children.

Better programmes for community development and social welfare are required to provide basic adult education, primary education for children, health care, and better housing resettlement in a less congested environment and upgrading of hygienic standards. The establishment of close liaison and understanding between the fisheries department and other government departments concerned with health education, rural development, land etc, will be needed to obtain these services for fishing communities.

Fishermen need training for marine sector development

Subsequent to development of a technology for management practices in inland fisheries, the DOF (Directorate of Fisheries) has undertaken elaborate training programmes for its staff. But the DOF does not have an organized training programme to transfer the technology to fishermen and ensure that they protect and manage the marine fishery resource.

Thorough participation: A short-term training programme with active participation by fisherfolk can help enhance fisherfolk knowledge about resource limitations. The programme would consist of the following elements:

1. Different types of fishing gear and their operation.
2. Destructive fishing gear
3. improved gear to reduce juvenile catches without reducing the incomes of fisherfolk.
4. Improving the value of ESN catches
5. How to improve the value of the catch through processing and marketing.
6. Impact of pushnet fishery

7. Transport of shrimp fry
8. Maintenance of crafts and gears.

Suitable, economically viable alternative fishery methods to replace destructive fishing gears can be established with the active participation of fisherfolk.

Through motivation: Before introducing any restrictions on fishing operations, the economic effect on very poor fisherfolk should be assessed. Special social training programmes should be undertaken to motivate the fisherfolk to replace destructive fishing gears with alternative income-generating fishing methods.

Training inputs

For improved marine fisheries management, emphasis should be placed on training target groups in sustainable methodologies. The coastal shrimp culture industry depends solely on the push net fishery for supply of shrimp seed from the wild. More than 2,035 million Bagda 'post larvae are collected annually – this is only one per cent of the total catch of the fishery. The rest of the catch – which is equivalent to about 200 billion PL of the shrimps/fishes and zooplankton – is thrown on the sands to die. This is considered as a serious growth overfishing.

Up to 60% of the PL collected from nature perish during sorting, transportation and stocking. If this mortality could be reduced substantially, 50% of the PL could be left behind in the sea and enhance production. A strong extension and motivation campaign is necessary to address that problem. Alternative sources for seed supply should be developed so that seed collection effort is reduced. The government should help train fry collectors in simple operations like keeping the larval catch in good condition in a large earthen or aluminium pot or bowl, and releasing what is not wanted into the sea. Extensive training of fry catchers and traders is necessary for this purpose.

Recommendations

1. The dependence on natural shrimp seeds by shrimp farms has to be gradually reduced. Supply from shrimp hatcheries has to be increased.
2. Destructive fisheries such as ESN, push net fishery and beach seine fishery have to be gradually eliminated with the help of appropriate rehabilitation programmes.
3. The feasibility of extending the trammel net fishery into deeper waters, also the feasibility of longlining and other viable fishing methods, should be studied in detail with the participation of ESN fisherfolk.
4. Under-exploited and unexploited resources such as tuna and tuna-like fishes, mussels, squids, octopus, lobster etc, have to be assessed through scientific surveys. Initiatives have to be undertaken for their exploitation with strict monitoring and control programmes. A project should be undertaken in this connection.
5. The industrial demersal trawler fleet (particularly shrimp trawlers) should be phased out gradually and replaced by the artisanal fishing fleet in order to overcome discards at high sea. This will also help to reduce capital cost and generate socio-economic benefits. This in turn will enhance optimum exploitation of resources and maximization of benefits from the limited resources.

6. A more comprehensive awareness-building programme is needed among coastal fisherfolk to ensure their participation in government management and conservation initiatives.
7. Regulatory systems including new revenue controls, closed seasons, net mesh limits and stock conservation rules should be established as a matter of urgency by coordination of responsibilities and management within and outside the Sunderban reserve forest between Departments of Fisheries and other related departments.

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6.2 INDIA

“NO EVIDENCE OF OVERFISHING IN INDIA’S EEZ”

India with its large coastline and Exclusive Economic Zone is a major player in marine fisheries in the Indian Ocean. The country has a coastline of 8,129 km, of which 4,568 km is in the Bay of Bengal. The marine fisheries potential of the country was estimated in 1977 at 4.49 million tonnes. However, a revalidation exercise in 1991 came up with an estimate of 3.90 million tonnes, of which 2.21 million tonnes is within 50 metres depth and 1.69 million tonnes in the waters beyond 50 metres depth.

The annual marine fish catch has touched 2.71 million tonnes in 1995 - 1996. Together with inland fish production of 2.24 million tonnes, making a total production of 4.95 million tonnes, India is perhaps the seventh largest producer of fish in the world.

At this level of production, the availability of fish per caput per annum (of the fish eating population estimated at 56% of the population of the country) is about 9 kg. This is substantially below the World Health Organization norm of consumption of 11 kg per caput per annum. One must note that about 0.5 million tonnes of fish are handled/processed for export and substantial quantities of trash fish go into the preparation of fishmeal/feed.

Against this background, the Government have been playing an active role in promoting the development of fisheries, fishing communities and fish production. The objective is to push up fish production to 6.37 million tonnes by 2001 - 2002 AD. This will take availability to 11.24 kg p.c.p.a. The Government of India welcomes the initiatives which led to the finalization of the Code of Conduct for Responsible Fisheries following the World Fisheries Conference at Cancun, the U.N. Conference on Environment and Development of Rio, and the U.N. Conference on Straddling and Highly Migratory Fish Stocks. India had participated actively in the drafting of the Code of Conduct for Responsible Fisheries. India welcome also the initiative of the FAO - BOBP and the host country Indonesia in organizing this workshop on the Precautionary Approach to Fisheries Management.

Throughout its history, India has been conscious of the need for conservation and sustainable use of the world's resources. The ethos of the large number of religions and cultures co-existing in the country is one of harmony with nature. A streak of vegetarianism running through many groups also keeps down demand for meat and fish to manageable levels. In this scenario the precautionary approach to fisheries management should almost be regarded as a part of the ethos of the people!

While overfishing is a problem in many of the world's oceans and seas, there is no evidence of any overfishing in the Indian EEZ - in zones 51 and 57 of the FAO Marine Statistical Areas.

In fact, production is only about 70% of the assessed potential of 3.9 million tonnes. There are reasons to believe that as resources hitherto considered non-commercial are tapped in future, the potential itself will be found to be much higher. The total fleet at present (1994 - 1995) is 238,000 fishing crafts, of which only 46,900 are mechanised vessels. Of these mechanised vessels, only about 25% engaged mainly in trawling or gillnetting - have the capacity to make voyages of 6 - 8 days and fish in depths up to a maximum of 70 - 80 metres. Substantial areas of the continental shelf lying at depths beyond 70 - 80 metres, particularly on the N.West coast and the N.East coast, remain unexploited. These are about 191,000 traditional craft (catamarans, dugouts, plank built boats) of which about 32,000 have

been motorized with outboard motors or small inboard engines. Such craft ply in the in-shore waters, going out on voyages of less than 24 hours.

While Marine Fishing Regulations Acts have been legislated by most of the coastal states of India, and these require registration of vessels with State Fisheries Departments, the reality of large numbers of fishing communities relying only on fishing for a livelihood cannot be ignored. Hence, entry restrictions on traditional craft do not appear feasible. At the same time, the GOI is conscious of the need to regulate the growth of mechanised fishing vessels and channel their growth in directions which would increase production from areas presently untapped.

To further this objective, it is proposed to go in for a new generation of fishing vessels between 1.5 - 20 metres O.A.L, which would be able to tap waters of about 150 - 200 metres depth and go on voyages up to about 15 days. This would also help shift the fishing effort from the inshore/nearshore areas to offshore areas within the EEZ.

6.3 INDONESIA

FISHERIES AND FISHERIES MANAGEMENT OVERVIEW

1. Indonesia

The fisheries sector plays an important role in the national economy of Indonesia and its long-term development. Its share of the Gross Domestic Product is relatively small (about 3%).

Fisheries provides employment to over 4.3 million fishermen/fish farmers especially in coastal and rural areas. Handling, processing and marketing activities employ some more people. In all, the fisheries sector employs about 5% of Indonesia's total productive labour force.

The sector also supplies about 60% of the total animal protein consumed by the population with annual per capita consumption of about 19.4 kg. This is still below the national nutrition requirement level of 26.5 kg/capita/year of fish.

The sector's growth over the last decade has been steady. Total fish production went up from 2.4 million tons (1985) to 4 million tons (1994) with an average annual growth rate of 5.9%.

Table 1. Indonesia: Fisheries Production 1985 and 1994

Sub- sector	<i>(In '000 tonnes)</i>	
	1985	1994
Marine Capture Fisheries	1,821	3,080
Inland Open Waters	269	336
Aquaculture	305	597
Total	2,395	4,013

The BOBP project area is in Tapian Nauli Bay, Sibolga, North Sumatera. It is estimated that almost 20% of the male population is engaged directly in fishing. Many more of the population, both men and women, take part in the processing, transportation and marketing of fish, and the building and servicing of boats and gear.

Three subject areas pose potential problems: mariculture, anchovy lift net fishing, and small-scale fisheries.

The project's goal is to evolve model fishing villages to undertake community - based fisheries management. The project seeks to facilitate and enable improved management of mariculture, anchovy lift net fishery and small-scale fisheries in the Tapian Nauli bay area of North Sumatera, through awareness-building, strengthening the institutional capacity of the agencies concerned and provision of technical assistance.

II. Recent Perspectives and Trends in Fisheries Management (after 1990) in Tapanuli Bay, West Coast, North Sumatera Province, Indonesia

The West Coast of North Sumatera is divided into four district areas: municipality of Sibolga, the districts of Central Tapanuli, West Tapanuli and Nias. However, the BOBP operates during its III Phase only in Central Tapanuli and the Municipality of Sibolga.

The number of fishermen who capture fish in Tapanuli Bay increases year by year. So does the number and size of the gear. But the fishing ground remains the same.

Fish capture technology has developed very rapidly. In comparison with large-scale fisheries, the production from small-scale fisheries which uses simple gear is low.

Devices such as high-intensity light (20,000 watt), echo sounder and GPS determine the position of the boat and the fishing ground and provide navigation aids.

There are more than 440 fishing crafts in Sibolga. It is estimated that 25% of them fish for small pelagics. Besides, there are 519 units of lift net platform and 170 units of moveable lift net. There are also many small-scale fisheries which use canoes, and boats without engines and gillnet monofilament as a fishing gear. The main product is usually small pelagic fish.

Grouper are being reared for live export to Singapore. Grouper farms started to develop in 1989 in Hong Kong and Malaysia after the Regional Fisheries Services (Dinas Perikanan) introduced such technology to the farmer.

Seed are still supplied from the wild. They are caught locally by fishermen. At present there is no grouper hatchery in Tapanuli Bay.

Till 1993, cage-culture production of grouper was very good. But production then fell dramatically due to outbreak of disease. Result: mass mortality of cage culture grouper. The number of cages therefore decreased from 398 in 1993 to 250 in 1996. Some surveys have been carried out but the disease still remains a mystery. So does its prevention.

III Problems

3.1 Fish Capture

Large-scale fisheries using trap, purse seine, and moveable lift net as fishing gear run into conflicts with small-scale fisheries, which generally use hand line, gillnet, and lampara for small pelagics and operate up to three miles from the coast.

Small-scale and large-scale fisheries usually fish round the year without limits to area and season. As a result, fishermen catch small sizes of fish. This may be a problem for the re-generation of certain species in the long term.

The number of fishing crafts increase not only in quantity but also in type of gear, whereas the fishing ground is still the same. The level of exploitation will soon impair carrying capacity.

Fishermen usually fish in areas they are familiar with. Their knowledge of the habits and habitat of fish is limited. Transfer of fishing technology will therefore be very slow. The quality of fish during catch and after landing is very poor.

3.2 Fish Culture

Grouper farming has grown very rapidly in Tapian Nauli bay. Both technology and management are simple and traditional.

The site of the majority of grouper culture cages around the bay has been selected on the basis of security and easy access, rather than the quality of the water in which the cages are set.

In most farms of Tapian Nauli Bay, feed frequency and quantity of feed are not very scientific or systematic because feed supply depends on trash fish stocks.

Grouper seed supply is very limited, both in and quantity and quality. Problems in seed supply may be caused by:

- * Decrease in the quality of the nursery ground
- * Lack of technology in seed capture
- * Lack of technology in transportation
- * No grouper hatchery developed yet
- * No information about grouper seed potency in Tapian Nauli Bay

Grouper farms achieve a higher level of enterprise than small-scale farms because of the higher investment.

There is no government regulation concerning location of grouper farms in North Sumatera. Result: possible conflicts between grouper farms and other users of the water surface.

IV Some suggestions to solve the problems

- Extension, training and education are needed to solve the problems of site selection and culture method. Seed supply problems can be tackled as follows:
 - Identification of seed in Tapian Nauli Bay
 - Research on fishing gears that help grouper seed capture
 - Research on seed transportation methods
 - Research on treatment before the seeds are transferred to the grow-out facility
 - Research on grouper hatchery
- Capital investment can help develop small-scale farms.
- Government regulation is needed in order to manage water usage.
- Management is needed to produce a map of the fishing ground and improve control of resources exploitation.
- Regulations concerning fishing area and number of fishing craft must be strengthened to reduce conflicts between small-scale and large scale fisheries.

Research is needed on optimal light intensity for moveable lift net and purse seine as well as the right distance between the two.

A new technology in fish capture and culture must be introduced that does not damage the fisheries resource.

V Government's Actions in terms of Precautionary Approach

5.1 Capture

- Presidential Decree No 3911980 introduced a nationwide trawler ban in response to protests from fishing communities that large trawlers were destroying their traditional grounds.
- Minister of Agriculture Decree no 123/Kpts/Um/1975 provides for closed seasons, closure of fishing areas, and mesh size regulations.

5.2 Culture

- Presidential Decree No 23/1 982 on Mariculture Development in Indonesia.
- Presidential Decree No 473/Kpts/Um/&/1982: Guidelines on Mariculture Development in Indonesia
- Policies such as ban on broodstock capture, ban on capture of *Napoleon wrasse* (an endangered demersal fish found among coral reefs), ban on fish using chemicals and potassium.

5.3 Supervision of fishermen

Apart from regulations, the government will also improve monitoring and supervision of fishermen and fish farmers. It will strengthen extension and training through workshops for extension officers and meetings among them. Groups of fishermen and fish farmers will be set up to promote an agribusiness approach among them.

6.4 MALAYSIA

MANY MANAGEMENT MEASURES INTRODUCED

1. Description of the fishery setting

Malaysia has a long coastline of about 3,400 km made up of the main land masses of Peninsular Malaysia, Sarawak and Sabah, the EEZ waters in the Andaman sea, the Straits of Malacca, the South China Sea, the Sulu Sea and the Celebes Sea. With the declaration of the EEZ in 1980, the area available for exploitation and management increased from 47,000 to 160,000 square nautical miles. The bulk of the resources exploited come from within the continental shelf.

The main climatic influences that affect the sea conditions are those associated with the North East Monsoon and the South West Monsoon winds. In general terms, Malaysia has a warm water multi-species fishery in relatively calm water; natural phenomena like typhoons just miss Malaysia. The coastal zone includes a number of ecosystem types, of which the more prominent are the mangroves and the extensive mudflats in the intertidal zones where large rivers have their estuaries. These features cast their influence on the bottom areas of the coastal waters and the demersal coastal fisheries.

The mainstay of Malaysia's capture fishery lies the coastal zone, which is also the main aquaculture production area. This picture is both comforting and disconcerting. Comforting because our inshore fishery production from the coastal zone has been giving stable yields for many years, although it has reached the maximum exploitation limit. The manager's task is to ensure sustainable utilisation. It would be satisfying if one can claim that because of management measures already practised (in full earnest since the early '80s), the coastal fisheries has managed to maintain the landings of its coastal resources. The other comfort is to know that in the paper on the National Agriculture Policy (NAP), 1992 - 2010, the growth rate figures for 1991 - 1995 are calculated as 3.5% for agriculture and 11.5% for manufacturing, while that for the fishery sector is 6.2%. It thus averages higher than the overall agriculture growth rate.

The fishery sector is expected to overtake other traditional contributors to the agriculture sector such as rubber and sawlogs. This shows that the fisheries sector has so far managed to hold itself well. Although it is not possible to gauge the success of management measures, there is enough indication of stability of some kind in fishery resources.

Why is this picture disconcerting as well? Because, in a sense, our coastal fishery is vulnerable -being subject to any changes that take place 'upstream'. Malaysia is well aware of the impact of development on the environment. Some form of 'safe zones' must be set aside for aquaculture development. Since the coastal resource is fully exploited, it is imperative that the limited resources of the coastal waters are maintained and do not suffer decline. Aquaculture takes the front stage because it is seen to be a source of fish products for the growing population. Consumption (by an estimated population of 26.3 million) is expected to touch 1,579,800 metric tonnes by the year 2010 (on the basis of an estimated per capita consumption of 60 kg per year). In 1994, the total marine landings exceeded 1,181,763 metric tonnes valued at over RM2.99 billion. Aquaculture and the development of offshore waters should together help meet the estimated demand. Malaysia's experiences in fisheries management relate mainly to coastal fisheries. Starting from coastal fisheries, a management quota has been set of offshore fisheries, based on a comprehensive survey done during 1986 - 87 in the EEZ waters of Malaysia. Although not contributing in a big way to total fishery production, inland fisheries has great potential for development,

because Malaysia is well-endowed with inland water bodies that are both natural and man-made. In terms of legal jurisdiction, inland fisheries are looked after by state governments. Only marine waters are under the Federal Government.

The development of the marine fisheries subsector has long been restricted to the territorial waters. But after the proclamation of an EEZ, the Department of Fisheries has not only got the opportunity to practise resource management (thereby ensuring sustainable exploitation and equitable allocation of her natural marine resources), but also to increase production, and protect the marine environment from pollution and degradation.

2. Industry

2.1. Capture fisheries

The capture fisheries is divided into pelagic and demersal resources; these in turn consist of reef and island fishery, (This classification is based on fish behaviour and methods of catching.) In terms of development, the fishery may be divided into inshore and offshore fisheries. We do not as yet have a far-shore fishery, because of a relatively short history of mechanised fishing (trawlers were introduced in the late '60s) and a relatively small population of about 19 million (1993 estimate), but we hope to have one in the not-distant future. The closest thing to a far-shore fishery are some Taiwanese longliners who used our shore-based facilities for their Indian ocean tuna fishing, and started a minor culture activity on bait (milkfish) rearing. Perhaps some of their ventures can rub off on our local entrepreneurs before too long.

All fishing activity is licensed, and based on the type of fishing gear used. The fishing gears in use include bottom trawl, purse seine, seines of various types, drift/gill net, lift nets, traps, hooks and lines, bagnets, barrier nets and push/scoop nets. The first two gears are designated as commercial gear while the others are referred to as traditional gear. These gears are not designed to catch shellfish. Bottom trawls yielded 54% of the total marine landings at 561,942 tonnes, indicating that they are an important gear and a controlled gear for management purposes.

2.2. Inshore/coastal fishery

The inshore fishery has been arbitrarily defined to include water up to 30 nautical miles from the coast. In practice, this zone lies within the continental shelf. The fishery continues to be the most important subsector; it provides about 86% of the total marine landings at 901,801 mt valued at RM 2.1 billion for 1993. Fishery regulations allow for the use of traditional gear while commercial vessels of less than 70 GRT using all types of gear operate in this zone. In practice, being accessible to some 80% of the labour force means that a large number of boats, many less than 10 GRT with small engines, operate in this fishery. Fishing pressure is therefore high (trash to food fish ratio in the 1986-87 trawl survey for the west coast peninsula was 62:38, while for the east coast it was 33:67). The more or less stable landings over the years point to a fully exploited fishery.

2.3. Offshore/deepsea fishery

The deep sea fishery sub-sector operates beyond the 30 nm zone and includes vessels of 70 GRT and above, operating trawl, purse seine, hooks and line, and drift/gillnets. The fishery yielded catches of

145,549 mt in 1993, constituting about 14% of the total marine landings. Trawlers landed 69.7% while purse seiners landed 30.2% of the catch in this fishery.

By value, the deep sea contributed RM 269 million. The East Coast of Peninsular Malaysia had the greatest share of the landings at 52.2% while Sarawak got only 20%. In contrast, the potential yield from the East Coast and Sarawak was expected to be 43% and 33% respectively. The disparity may indicate that Sarawak is under-utilising its resources, and has further potential for exploitation.

We have good reason to believe that foreign vessels have been tapping our EEZ waters with gear ranging from tongliners to paired bottom trawls. Our survey of potential yield for 1987 shows what is left after their rampant exploitation.

2.4. Aquaculture

The development of aquaculture in Malaysia is relatively recent when one compares its experience **with** that of neighbours. Though it began as early as the turn of the century, sizeable operation began only in the 1950s with the development of cockle semi-culture and the culture of Chinese major carps in mining pools. Significant changes occurred only during the last two decades, especially with the introduction of marine cage culture in the early '70s and more recently, the significant involvement of the corporate sector in commercial marine shrimp culture. Aquaculture in Malaysia is experiencing rapid growth. Total production in 1993 amounted to 105,237 metric tons, valued at RM 292.4 million. These figures show increases of 32% and 4 1% respectively over the corresponding figures of the previous year.

Nonetheless, semi-culture of cockle, *Anadara gramsa*, was still predominant, contributing about 74% of the total aquaculture output. Culture of oyster, *Crassostrea iredalei*, has managed to gain a foothold in the hotel half-shell market, which was formerly supplied by wholly imported species despite limited seed supply. Oyster spat are being hatchery-produced on an experimental scale. The quantum of aquaculture production is still small; it contributes only 7% of the national fish production. Utilisation of labour was also insignificant, involving only about 16,853 fish farmers, over 90% of whom take part in fresh water aquaculture production.

The major culture systems, based on freshwater and brackishwater, comprise the following :

- i) Cockle culture in mudflats
- ii) Freshwater fish and shrimp culture in ponds
- iii) Freshwater fish culture in floating net-cages
- iv) Brackishwater culture of shrimp and marine fish in ponds
- v) Marine fish culture in floating net cages
- vi) Mussel culture in rafts and racks
- vii) Oyster culture in rafts and racks
- viii) Crab culture in cages and ponds
- ix) Aquarium fish breeding and culture in tanks and ponds

The total pond surface area utilised for aquaculture in 1993 was 6,235 ha of which about 68% consisted of freshwater ponds. In addition, a total of 716,953 m² of cage surface area was utilised in the same year,

of which marine fish cages took up 93%. In terms of value, freshwater pond production was the biggest contributor (RM 112.53 million) to the total output, accounting for 38.48%.

In Sarawak, the gill net fishery also targets the *Tenualosa* (locally known as "ikan terubok"). The fish is being exploited primarily for its roe, and the spawning adult is the target, which has resulted in the fishery being threatened by over-exploitation (Cheen, 1994). The landing of this species has also been declining for the past few years.

2.5. *Other Traditional Fisheries*

The other traditional fishing gear employed by coastal fishermen includes hook and line, bagnets, liftnets, seine nets, traps, barrier nets and scoop nets. Together they contributed 132,051 tonnes (1.24%) to the total marine fish landings in 1994. These are very passive fishing gears, which are operated by the smaller fishing crafts in the coastal waters and harvest a large number of demersal as well as pelagic fish species, prawns and cephalopods. In Sarawak, a number of traditional fishing activities is being conducted in the mangrove areas of Kuching, Sarikei and Lawas (Pang 1989).

The description of the industry given above shows that the management of the fisheries in Malaysia covers a wide variety of fishery practices that has to be dealt with, bearing in mind the sensitivity of the different perceptions of the 13 States that make up Malaysia.

3. **Mission, Vision and Objectives of the Department of Fisheries**

The DOF's mission is to bring about changes in the country's fishery sector. It is guided by other Government policies, in particular the National Development Policy together with Vision 2020, and the National Agriculture Policy 1992 - 2010 (new NAP). Malaysia is a relatively young country. In its early years, emphasis on socio-economic development was necessary. With the country increasingly recognised as one of the emerging nations, the new NAP is founded on the vision of a market-led, commercialised, efficient, competitive and dynamic agricultural sector (fisheries included) in the context of sustainable development.

The mission translates into five main Department of Fisheries objectives :

- to increase national fish production
- to rationally manage fishing resources
- to develop the deep sea fishing industry
- to speed up the growth of the aquaculture industry
- to maximise the income of the fishing industry

4. **Management of the Fisheries**

4.1. *Legal Framework*

The 'Fisheries Ordinance 1909' was the initial ordinance that regulated the fishing industry in the early 1900s. The Ordinance was subsequently amended in 1912, 1924, and 1926, presumably to cater to new needs, and was finally repealed in 1951. The Fisheries Rules of 1951 were then enacted on August 1, 1951. During this time there were also seven fisheries ordinances/enactments introduced by the various

states. The fishing industry up to that time consisted mostly of traditional fisheries, and regulation of the industry at that time was at a minimum. It is interesting to note that early fishery laws related to the maritime ordinances made to regulate river and sea transport by all vessels. As an example, the Sea Fishing and Kilongs Ordinance 1963 of the State of Sarawak, and the Fishing Stakes Ordinance of Sabah were both made under the parent law, the Merchant Shipping Ordinance. The implementing agency was the Marine Department because fisheries were not yet significant enough as an industry to warrant the creation of a government department. As such they were more concerned with fishing stakes as obstructions to shipping lanes than with regulation of fisheries from the resource point of view.

4.1.2. However, in the 1960s and 1970s, the introduction of trawling in the coastal waters created several conflicts between traditional fishermen and trawlers, especially when they fished in the same grounds. This led to the enactment of the Fisheries Act 1963 (incidentally the year of independence), which became the legal instrument to manage fisheries in Malaysian waters. The Act sprang more from the practical need to handle conflicts than to provide a fisheries management plan, because conflicts easily got politicised. It served to integrate and strengthen the legal framework relating to marine and inland fisheries; to protect the natural living resources; protect the interests of fishermen; equitably allocate fisheries resources and administrative activities to reduce conflicts among fishing communities.

This Act was repealed when the current Fisheries Act 1985 was enacted. The new enactment can be seen to represent the accumulated experience of over 20 years of fishing practices. During this time, new practices have come in; and more efficient fishing gears have worsened the problem of resource depletion, consequently aggravating conflicts. The Act came into force after the declaration of the EEZ; additional clauses not in the previous Act were necessary to deal with foreign fishermen. The management problem was no longer one of controlling local fishermen; there was the serious problem of encroachment by foreign vessels whom Malaysian fishermen now meet in more open waters.

4.2 Management Measures

The Department of Fisheries has worked out a number of management measures and implemented them within the framework provided by new fisheries laws. New features have been incorporated in the drafting, which allow for great flexibility. One is to recognise that developments in fisheries practices and situations vary at different places and times. Thus the parent Act passed in Parliament contained features that cater to the whole country. Regulations made under the Act could be drafted differently for different situations. Under each set of regulations, the licenses can reflect further differences at local levels within each State and for every fishery. This tier-by-tier drafting allows for changes to be made without having to go back to Parliament. They can therefore be speedily put into effect once they are endorsed by the Minister of Agriculture (Fisheries). There are now many examples of various regulations that Malaysia has enacted in response to internal country demands, also to international conventions. In this way, management policies and measures can be effectively carried out in response to need. The current measures carried out include

4.2.1. Direct Limitation of Fishing Effort

A moratorium has been placed on the issuance of new or additional fishing licenses for vessels to fish in coastal waters. This is to ensure that the current high fishing pressure on the limited coastal fisheries resources will not be increased to prevent or ameliorate over-exploitation.

4.2.2. *Closed Fishing Areas*

Commercial fishing gears like trawlers and fishing purse seiners are prohibited from fishing in waters less than five nautical miles from the shore, which are nursery grounds for juveniles of prawns and fish. This move will serve to reduce fishing pressure. On the other hand, exclusion clauses can be introduced into licensing conditions to allow the same boats to go closer inshore when it is too rough for the boats to go further from the shore, and adult prawns come closer to the shore.

4.2.3. *Management Zones*

Four fishing zones were established through a limited licensing scheme, whereby zones were designated for specific fishing gears, class of vessels and ownership. The four management zones aimed at equitable allocation of resources and at reducing conflicts between traditional and commercial fishermen.

The four zones were :

- Zone A, less than five nautical miles from the shore, reserved solely for small-scale fishermen using traditional fishing gears and operated by owners.
- Zone B, beyond five nautical miles, reserved for owner-operated commercial fishing gears such as trawlers and purse seiners of less than 40 GRT.
- Zone C, beyond 12 nautical miles, reserved for commercial fishing gears which are more than 40 GRT.
- Zone C,, beyond 30 nautical miles, reserved for deep sea fishing vessels of 70 GRT and above.

4.2.4. *Conservation of Resources*

Conservation of marine resources has always been the primary concern of the Department. Marine Parks and Marine Reserves, as well as prohibited areas for fisheries, have been established under the Fisheries Act 1985 as a management measure. This is to protect, conserve and manage in perpetuity special representative portions of the marine environment in order that they remain undamaged for future generations. Public awareness is being promoted of the need to protect the corals and other marine flora and fauna in the waters surrounding the islands off the coast. At present, four Marine Parks in the waters of 35 islands off the west and east coasts of Peninsular Malaysia have been gazetted. The waters of three islands off Labuan have also been gazetted. In Sabah itself, three marine parks have been established, consisting of about 10 islands. The waters around five islands in Terengganu and Sarawak – Palau Nyireh, Pulau Tennggol, Palau Talang-Talang Besar, Pulau Talang-Talang Kecil and Pulau Satang- have also been gazetted as fisheries-protected areas. The collection of shells, molluscs or corals is prohibited. Fishing is also prohibited unless it is licensed. An order has been gazetted to pronounce the waters up to two nautical miles outwards surrounding the island and island groups as out of bounds to all fishing activities.

4.2.5. *Rehabilitation of Resources*

Artificial reefs have been established in Malaysian fisheries waters to enhance marine resources, also to alleviate the problem of depleting fish resources in coastal waters. It is also a possible

fishing management tool to maximise catches, conserve resources, rehabilitate the habitat and mitigate the effects of overfishing. A total of 54 artificial tyre reefs, 10 boat reefs and 10 concrete reefs have been constructed. Some experimental reefs using PVC pipes have also been set up to study the effect of the artificial reef.

4.2.6. *Monitoring, Control, and Surveillance (MCS) in Fisheries Management Programmes*

The collection of information over a wide area covered by stations throughout the country imposes a big demand on resources to communicate, compile, analyse and generate reports. Laws and regulations are effective only if they are enforceable. The MCS refers to the provision of a composite of group teleconference systems, a marine HF communication system, a marine VHF voice-secure communication system and a National Integrated Database Management System (NJDMS) to service just the above functions. It links up all the enforcement bases and stations with the patrol vessels and the headquarters. Foreign fishing in the Malaysian Exclusive Economic Zone has always been a problem, especially in the waters of the East Coast of Peninsular Malaysia and off the coast of Sabah and Sarawak, and their activity widens the coverage. So we are now looking at cost-cutting methods of doing the MCS.

Two approaches are being looked at seriously, one through software, another through hardware. The software approach is the idea of community-based management (CBM). In the past, a tough stand was taken. It yielded results but needed a lot of political will. However, it can be seen to be very costly in terms of human and financial resources. The new management feels that while enforcement will always have its role to play in implementing laws, other ways are now open. CBM is in its infancy and is yet to crystallize in realistic action. But a more educated society is already making itself heard. There is a need to give these people the responsibility to make joint decisions with the government. So NGOs have been invited to the table in the National Advisory Council for Marine Parks, as provided for by the Fishery Act 1985. A Special Area Management Plan (SAMP) project is being undertaken by Malaysia with BOBP support. It is applied to the Pulau Payar Marine Park in Kedah state as an example of CBM. It is intended that SAMP will be applied also to Marine Parks in the rest of the country. A beginning has been made with CBM.

The hardware is the potential application of a Vessel Monitoring System, principally making use of high bandwidth satellite transmission and GPS, allowing for E-mail and updated location of fishing vessels instead of only from patrol vessels. Transmitters/receivers are fitted on to fishing vessels and give their position automatically every 15 minutes. The potential for management information is tremendous, as the information on catch and location is not only for the DOF but also for entrepreneurs of deep-sea vessels who know just where their fishing vessels are at any time. There is the likelihood that the owners of vessels will pay for these transmitters. Then they can also report on foreign encroachments and become part of the enforcement capability. So the whole fleet of offshore patrol vessels and the operational costs incurred can be reduced when the existing MCS is revamped by the VMS.

- 4.2.7. Research monitoring surveys and landing data are regularly carried out and collected to provide usable information for management to take decisions.

5. Implications for the Fishing Industry

- 5.1. A rational fisheries management strategy will help to reduce conflicts between traditional and commercial fishermen. They will also ensure sustainable exploitation of fisheries resources and at the same time increase the productivity of fishermen.
- 5.2. In the case of inshore fisheries, the strategy will be geared towards a reduction of fishing effort in the inshore waters. This is to reduce over-capitalization in the fishing industry, removing excess fishing effort. Alternative employment is more easily available in the present labour market. In the current development plan, funds are allocated for 'buy back schemes' to purchase fishing boats and gear from the fishermen.
- 5.3. Fishermen graduating from the Fisheries Training Institute in Terengganu will be encouraged to venture into deep-sea fisheries. Much emphasis is given to the development of deep-sea fisheries to increase production from offshore areas, especially in the waters off Sarawak and Sabah, as well as in the Indian Ocean.
- 5.4. There will be a focus on Marine Parks and Marine Reserves as one of the conservation measures to ensure sustainability of fish stocks, as well as on their potential for contributing to the leisure and tourism industries. Gazetting of islands as Marine Parks and Reserves is a good example of the precautionary approach, because gazetting does not require a thorough justification study. In any case, there will be not much left for conservation by the time such studies are completed. In fact, gazetting enables a proper study.
- 5.5. Apart from the implementation of all these management strategies and tools, future management policies to be implemented will also include :

3.5.1. *Strengthening and intensification of research into the biology and ecology and assessment of fisheries resources.*

It is recognized that limited access through licensing cannot by itself effectively control the fishing effort. With mechanization, greater use of sophisticated fishing aids and more efficient fishing gears, the fishing effort has actually increased with time. The increase in the landings of trash fish, especially the juveniles of commercial fishes, is a matter of great concern to the Department, and research in the use of selective gears should be developed. Necessary intensive research on biology, population ecology and resource assessment has been implemented. It will be intensified under the Seventh Malaysia Plan to provide comprehensive data and information for formulating management plans for different types of fisheries and fishing gears. This will also include research on selective and environmentally friendly gears, which will contribute towards a reduction in by-catch. Such efforts will be further supplemented by a research monitoring programme, whereby the state of fisheries resources will be monitored to support the management plan. Such research-monitoring programmes will be conducted by research vessels as well as by observers on board deep-sea fishing vessels.

5.5.2. *Provision of more efficient extension services to educate the target group on management needs and benefits derived from such management*

- 5.5.3. In the international arena, the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas was finalized and approved at the 27th Session of the FAO Conference in Rome on 24 November 1993. The agreement will be

enforced up to the 25th instrument of acceptance. As of May 1995, six countries agreed to be party to this agreement. The Agreement calls on all states that fish in the high seas to be responsible for their own vessels, and practise international conservation and management measures, and ensure that their fishing vessels do not engage in any activity that undermines the effectiveness of such measures. Records have to be kept. Information will be freely exchanged through international cooperation. Settlement of disputes is also provided for in the Agreement.

In addition to the above Agreement, the Agreement for implementing the provisions of the United Nations Convention on the Law of the Sea (UNCLOS) of 10 December 1982, relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, was opened for signature in December 1995. The Agreement also deals with mechanisms for international cooperation, duties of flag states, complaints and enforcement by flag states, dispute settlement and the requirements of developing states. With these two Agreements, there are development opportunities for our fishermen to develop further to fish in the high seas as well as in the Indian Ocean. However, there are implications in relation to the existing law as well as in the marine fisheries development of Malaysia.

It is envisaged that if Malaysia wants to set up her own distant water fishing fleet, this will require additional/supplementary national legislation to manage these distant water fishing fleets in accordance with the two international agreements. To safeguard Malaysia's participatory rights to tuna resources in the Indian Ocean, Malaysia should be a founder member of relevant fisheries organizations such as the Indian Ocean Tuna Commission (IOTC) that will be established for the conservation and management of these resources.

6. Conclusions

The fisheries resources, especially in the coastal areas, are depleting fast due to over-exploitation as well as pollution. These degrade the aquatic environment and destroy the aquatic habitat. At this point of time, sound management strategies and measures need to be applied to prevent further decline in fish landings. Efforts to further enhance fisheries resources will be necessary to increase fish stocks. Measures such as better management of the coastal habitat by formulating sound management models, coastal zone management plan, rehabilitation of resources through artificial reefs and also through restocking programmes will help in ensuring that fishery resources are managed effectively and exploited rationally at the maximum sustainable level. With the implementation of the international agreements relating to high seas fisheries and management of the straddling fish stocks and highly migratory fish stocks, our fishermen will be encouraged to exploit the fisheries resources in the high seas - especially in the Indian Ocean IMT-GT and the BIMP-EAGA growth development area.

Such management measures will ensure sustainable and rational exploitation of fishing resources as well as increase the productivity of the fishermen in line with the mission and vision of the Department Fisheries.

Going back to NAP till 2010, it was observed that the share of agriculture in the GDP continued its long-term decline from 22.9% in 1980 to 18.7% in 1990. Even though it was able to sustain a value-added growth of 4.6% per annum over 1986-1990, the manufacturing sector's growth was 13.7% increasing its GDP share to 27% in 1990. This transformation and development of the Malaysian economy marked a milestone as it shifted from an agriculture base to diversify into manufacturing. The implication for fisheries development of an active economy could include the following :

- It is to be expected that fisheries have to compete for labour with other sectors
- Increasing affluence would support the expectation that consumption per capita is likely to increase as greater consciousness on health and nutrition aspects of food consumption favour fish as a source of fat free protein.
- Land will increasingly be scarce and expensive for aquaculture.

However, despite the trend that seemingly works against the fishing industry, the government will not allow a fishery that has maintained itself after so many years of commercial fishing to 'shrink' below a threshold point. Agriculture (including fisheries), assumes strategic importance at this threshold. A Food Policy embodied in the National Agricultural Policy (NAP) (1992-2010) emphasises local availability of such food items as meat (fish included) in household consumption from the food security aspect. Fish constitutes about 60% of the animal protein intake. The NAP suggests that import substitution, domestic demand and the export market present opportunities for increasing output and income. The existing level of technology in the Fisheries Research Institute, although not high, is able to provide the technical support for resource management and the production of fish protein if factors like current species preferences and price are not considerations for viability. In other words, we can meet the strategic requirements of production of protein for food in existing bodies of water.

The production of high market-value items such as exotic species of fish, shrimp, and ornamental fish, suggests that we have components that are money earners and 'cash crops' that bring in foreign exchange from their export. The tourism industry as well as the recreational fishery and the processing and packaging industry are downstream activities that generate incomes many times their value in weight as raw fish meat. Post-harvest technology would ensure better utilisation of existing limited resources and add value to fisheries production.

Malaysia seldom talks these days about providing for poor fishermen through fisheries projects. Since the late SO's, subsidy programmes were no longer proposed as development projects. So-called poor fishermen, if unable to make their living from fisheries, are absorbed into other industries because of the country's general development. Roads and factories with easy access to markets are now found everywhere in rural areas. They often allow the fisherfolk to take part directly in the leisure industry and sell their fish products at their doorstep. There is no longer any social pressure to make higher incomes for fishermen a development objective. The emphasis of the fisheries administrator today is to increase production to meet projection of demand calculated at 1,579,800 tonnes by 2010,

Appendix : Practical problems of fisheries enforcement in Malaysia

The following are the problems in fisheries enforcement.

- *Areas of coverage*

If one observes the sightings of foreign vessels and the areas they cover, one can begin to appreciate the task of enforcement. The EEZ waters cover an area of 160,000 square nautical miles.

- *Apprehension of offenders*

Poachers and illegal trawlers often use fast boats designed for swift escape - they can get into waters too shallow for enforcement boats. Their ability to sight patrol vessels from afar enables them to dump incriminating evidence.

- *Armed fishing vessels*

Possession of arms is an offence that invites severe punishment in Malaysia. So it is foreign vessels rather than local vessels that are likely to carry arms. Apart from the DOF, the Air Force and the Navy also take part in enforcement. The armed forces are more suitable than other institutions for offshore enforcement.

- *Vessels in Custody*

Court procedures in Malaysia and the handing out of sentences take time. A case can drag on for years. Fishing gear and vessels are bulky items, and while a case is on, the vessel in custody deteriorates beyond repair. This is a problem when prosecution fails.

- *Prosecution*

Prosecution is a tough job. After enforcement by the Navy and the police, the DOF has to carry out investigation and prosecution. Failure at any link in the chain results in failure to prosecute. The need to attend court to provide evidence is costly.

Table 1: Arrests of local vessels

<i>Year</i>	<i>DOF</i>	<i>No of Vessels Arrested</i>	<i>Police</i>	<i>Navy</i>	<i>Customs</i>	<i>Total</i>
1993	722	578		16	3	1319
1994	598	650		1	2	1251
1995	495	406		2	1	904
1996	410	406		0	0	816
Total	2225	2040		19	6	4290

Table 2 : Sightings of Infringements/Fishing by Foreign Fishing Vessels in Malaysian Fisheries Waters

Country	1991	1992	1993	1994	1995	<i>Total</i>
Thailand	1746	2290	1242	1102	625	7005
Indonesia	473	276	140	297	284	1470
Vietnam	21	20	76	41	11	169
China	27	24	40	56	160	307
Taiwan	83	25	42	28	24	202
Singapore	6	1	0	2	11	20
Hong Kong	3	4	18	63	6	94
Others	59	56	37	92	59	303
Total	2418	2696	1,595	1681	1180	9570

<i>Year</i>	<i>No. of vessels arrested</i>			<i>Total</i>
	<i>DOF</i>	<i>Police</i>	<i>Navy</i>	
1993	4	64	39	107
1994	62	46	40	148
1995	37	18	71	126
1996	43	22	32	97

6.5 MALDIVES

FISHERIES MANAGEMENT OVERVIEW

by Economic Planning and Co-ordination Section,
Ministry of Fisheries and Agriculture, Male, Republic of Maldives

Introduction

Maldives is an archipelago of nearly 1,200 coral islands grouped into 19 widely dispersed administrative atolls. Marine resources constitute the country's main natural endowment; economic activities concentrate heavily on fishing and tourism. Currently, fisheries account for 1% of GDP, 20.6% of employment, and 75% of the country's export of commodities. (Ministry of Planning, Human Resources and Environment, 1996)

Maldives depended solely on fisheries and fishery-related activities until the development of the tourism industry in the '70s. Major changes then started taking place, as opportunities for alternative income-generating activities increased. The fishery industry too has seen substantial development during recent years -tuna and other fisheries have got bigger and new fisheries have emerged. The reef fish fisheries, which remained at a subsistence level for a long time, has now come into its own, and is a major source of jobs, particularly when tuna fishing is poor.

These developments have many socio-economic implications for fishing communities. Detrimental effects include over-exploitation of fisheries and user conflicts. To overcome these implications and sustain the country's only renewable resource, as well as to develop its key economic base, fisheries management has a vital role to play. Various stakeholders in fisheries must collaborate, and the problems of the current fisheries management system must be reviewed from the resource user standpoint as well as the policymaker's standpoint. A more effective and efficient fisheries management system, in which different stakeholders can carry out tasks and responsibilities, needs to be formulated.

In view of the central role fisheries management has to play, it is important to understand the present fisheries management system and the issues it confronts. Putting this into perspective, this paper will attempt to provide an overview of the fisheries management system, highlighting the problems of enforcement compliance and the violations associated with various types of fisheries.

Overview of the fisheries management system

As Maniku (1995) has stated, the management of marine resources is quite a complex task. The legal framework of the current fisheries management system is found in the Constitution, the official mandate of the ministries concerned and other bodies, as well as in various laws, regulations, decrees and guidelines. The National Development Plan outlines national policies and strategies, including priority to fisheries management and the setting of long-term fisheries development plans. It covers a wide range of specific issues. These plans are developed by various government and government-related agencies, the most important being the President's Office, the Fisheries Advisory Board (FAB) and the Ministry of Fisheries and Agriculture (MOFA).

a) *The President's Office*

The President's Office plays an important role by generating and implementing fisheries policies. It provides policy direction through decisions based on laws relating to the sector, the

recommendations of the FAB, and general policy statements including Presidential decrees and the regulations of relevant Ministries.

b) *Fisheries Advisory Board (FAB)*

The FAB provides a mechanism for high-level consultation among the various ministries and agencies concerned with fisheries development to ensure a more coordinated approach to decision-making. It is chaired by the Minister of Fisheries and Agriculture and is mandated to provide guidance to the President on matters requiring major policy decisions.

c) *Ministry of Fisheries and Agriculture*

The Fisheries law of Maldives (Law no. 5/87,24 August 1987) empowers MOFA to “formulate and administer regulations on matters relating to fisheries.” It has the “obligation . to explore the possibilities for the development of fisheries, to carry out the research needed for such development and to develop fisheries. ” (Gozun, 1992) So the main responsibility for proper and efficient management of the fisheries resources vests on MOFA. It has to provide a basic framework in terms of clear policies and regulations for efficient resource management by collecting and analysing statistical and other information on fisheries necessary for the management and development of the sector.

d) *Surveillance, monitoring and enforcement*

The National Security Service (NSS), coast guard section, provides a credible deterrent to violations of regulations concerning management surveillance, monitoring and enforcement. It ensures that agreed measures for both nationals and foreigners are observed. Other roles: it collects information on fishing effort, catches, and other data needed to negotiate fishing agreements, decide on national policies, and take strategic and tactical decisions about enforcement.

The modes of enforcement are air patrols, sea patrols, special observers on fishing vessels, and harbour inspection. The enforcement modes used depend on the resources available, the nature of the regulations and the characteristics of the fishery. Due to the openness of the seas where traditional fishing for tunas takes place, NSS is well equipped for search and rescue activities as well.

e) *Other responsible bodies*

In addition to the above, various other institutions are involved, either indirectly or directly, in fisheries. They play an important role in their respective areas of responsibility. These institutions are;

1. Maldives Industrial Fisheries Company (MIFCO)
2. Ministry of Trade and Industries (MTI)
3. Ministry of Planning and Human Resources and Environment (MPHRE)
4. Ministry of Atolls Administration (MAA)
5. Ministry of Transport and Shipping (MTS)

6. Ministry of Finance (MOF)
7. Ministry of Education (MOE)
8. Vocational Training Center (VTC)
9. Maldives Monetary Authority (MMA)
10. Ministry of Foreign Affairs (MFA)

Management Issues

The difficult nature of integrated management has given rise to many issues and problems among different interest groups and economic sectors sharing common resources. These problems are inter-related. They relate to institutional weaknesses, the country's geography and lack of awareness among resource users. The main problems identified are:

a) Over-exploitation

As stated in a review of the marine resources (Marine Research Section, Ministry of Fisheries and Agriculture 1997), the most dramatic developments in recent years in the fisheries sector have been in the reef fisheries. Several of the newly developed reef fisheries are being driven by demand from overseas markets. These include the beche-de-mer, live grouper, shark oil, shark fin, giant clam and *Napoleon wrasse* fisheries. As the gap between demand and supply of these fisheries widened, prices continued to rise, putting pressure on the resources and resulting in over-exploitation. Consequently, many of these fisheries – including *Napoleon wrasse*, marine turtles, giant clams, whale shark and whales had to be banned.

Similarly, the condition of skipjack tuna resources is also worth reviewing. According to the review of the Maldivian living marine resources (Marine Research Section, Ministry of Fisheries and Agriculture, 1997), catches in recent years have stagnated, with catch rates as well as the sizes of skipjack declining. The reasons for these changes are still not known though there are many possibilities. For a country that depends almost entirely on marine resources, the economic implications of these problems would be disastrous if proper management actions are not taken in time.

b) User conflicts

The tourist industry in the Maldives contributes 18.4% to the GDP (MPHRE, 1996). It is important to realize that certain reef resources are more valuable as tourist attractions than as export commodities. It is estimated that shark watching, by direct diving alone, generates US \$2.3 million per year. (Marine Research Section, Ministry of Fisheries and Agriculture, 1997). As reef resources gained in economic importance in recent years, user conflicts also emerged. Reef resource utilization involves fisheries, coral mining and tourism. The tourist industry often uses reef resources like diving and snorkeling in a non-extractive manner, while the fisheries and other industries use it mainly in an extractive manner. These contrasting patterns of resource utilization have given rise to user conflicts.

c) Lack of compliance

There are many difficulties in getting management programmes to work effectively. Non-compliance is one of them. A number of factors make for non-compliance. Dual ownership is one

of these factors. Maldives became a republic in 1968. With this change, the system of resource ownership also changed. The modern law which came into force during this time changed the communal system of ownership to the dual legal system. In the former system, each atoll had a major role to play in managing immediate resources, mainly due to transport and telecommunication problems. The atoll chief controls the resources as a common property of that atoll with advice from the elders of the community. In the dual legal system, total control in resource management by the community was in dispute, leading to other management problems such as clashes between traditional and modern laws, and differing interpretations of laws and regulations. (Maniku, 1996).

Lack of information is another major problem encountered by users. Maldives lacks an easy central mechanism by which the user may refer to current regulations. In many cases, users who live in various corners of the country are unaware of the current situation. Not knowing the regulations, they may not follow them. Similarly, misunderstanding and misinterpretation of these laws and regulations also makes for lack of success in implementation.

Another major factor behind non-compliance is insufficient prior consultation among various stakeholders in developing regulations. As the opportunities for different types of fishing increased, new laws and regulations were being implemented without much research and consultation among the various stakeholders, leading to conflicts between government objectives and the profit motives of fishermen.

d) *Inadequate statistics and information*

The fisheries sector has the potential to strengthen its contribution to the GDP and to employment. To achieve this, a number of management measures and policy decisions are required. And to formulate these measures, more realistic data is of paramount importance. To provide a policy framework for development and management, the fisheries sector lacks a scientific database and sufficient technical support as well as the capability and financial support to do economic analysis on resource data and to undertake broad sector-wide analysis.

From a socio-economic point of view, one may observe many changes taking place in the fishing industry due to alternative income-generating opportunities. Private sector participation in new sectors being developed has affected fishermen and members of the island communities. The percentage of active fishermen in the country has been stable since 1980 and the number of fishing vessels has decreased. The reasons and the underlying causes must be studied. The national fishery strategy has to be investigated to ensure efficient management and development of the sector.

e) *Others*

Many other basic difficulties are also encountered in getting management programmes to work effectively. They include

- (i) Lack of funds and lack of manpower to enforce management measures.
- (ii) Inappropriate and inadequate policies and objectives arising from the conflicting interests of stakeholders.
- (iii) Insufficient coordination between the departments concerned with fisheries development and management.

Conclusions

The fisheries management system in the Maldives faces a number of constraints. These call for a collaborative effort by stakeholders. Development and management objectives must be related to resource potential and sustainability, with an active contribution and commitment from fishing communities as well as policy-makers. People's participation in decision-making is a key factor behind successful management.

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6.6 SRI LANKA

FISHERIES MANAGEMENT OVERVIEW

by A A Kulathunga

*Asst Director, Department of Fisheries and Aquatic Resources,
& S Jayasinghe*

Asst. Director, Department of Fisheries & Aquatic Resources

Introduction

Sri Lanka is a coastal state located in the Indian Ocean to the south of India, between latitudes 6 - 10 degrees north and longitudes 80 - 82 degrees east. The fishing industry of the island has a long history. According to the Mahawansa (the historical record of the island), a coastal fishery existed even prior to 190 B.C. The fishery plays an important role in the island's economy because of the following reasons.

1. Contribution to jobs, nutrition, GDP and foreign exchange

According to the Frame survey of the current fisheries census, there are some 82,600 marine fishing households (excluding those from the north), and a total of 110,000 fishermen with a dependent population of 700,000 (Atapattu 1996). In addition, some 25,000 people are employed in fishery-related industries.

Fish account for more than 70% of the animal protein requirement of the island. Sri Lankans prefer fish to meat due to religious and cultural reasons.

The fisheries sector contributes 3% to the Gross Domestic Product (GDP) and employs a quarter of island's labour force.

Fish and fishery products contribute more than 2% of the total value of the exports. In 1996, Rs. 4,125 million was earned by exporting fish and fishery products. The total fish landings in 1995 were 237,000 mt, of which 157,500 mt. was from the coastal sub-sector, 60,000 mt. from offshore and the deep sea and 20,000 mt. from inland fisheries and aquaculture (Atapattu, 1996).

2. Resource Base

The island has a land area of 66,000 sq km, and a coastline 1,700 km long. Since the declaration of the Exclusive Economic Zone (EEZ) in 1978, Sri Lanka has sovereign rights over 233,000 sq km of the area. The marine fishery is seen all around the island, but mainly confined to the continental shelf area which is rather narrow. It rarely exceeds 40 km, and averages around 22 km in width. The total area of the shelf is about 26,000 sq km, which is about 11% of the total area of the EEZ of Sri Lanka (Anon, 1995). The fresh water fishery potential is nearly 12,500 ha, covering large, medium and small tanks, around 100,000 ha of village seasonal tanks and villus (Jayasekara, 1995). The brackish water potential covers 120,000 ha. of lagoons, riverine estuaries, mangrove swamps and salt marshes.

Marine fish production plays an important role in the island's economy and food security. The bulk of the national fish production, particularly the capture fishery, comes from the marine sector, and the major part of the latter from the coastal area. According to the resource survey done by Dr. Fridjof Nansen, 250,000 mt. of fish could be harvested from the coastal sector - about 170,000 mt. from

pelagic resources and 80,000 mt. from coastal demersal resources. The offshore and deep sea resources have been estimated by the same survey to be 70,000 - 90,000 mt.

3. Present Status

The relatively organized artisanal fishery in the latter part of the 19th century evolved from what was once a purely "hunting and gathering" fishery. With the inboard motorization of the famous 28 foot boats in 1958, and the introduction of nylon nets in 1961, the fishery graduated from subsistence level to commercial level.

From 1959 to 1994, four development plans were implemented. They focused mainly on increase of fish production to meet local fish demand. As a result, fish production has increased from 42,633 mt. in 1959 to 172,746 mt. in 1994 (Mahalingam, 1995). This is a nearly 300% increase within four decades. This significant increase in production was mainly due to increased fishing effort through developments in gear and craft technology.

As a result of increased fishing effort aimed merely at maximising output without being part of a resource management plan, many problems and issues related to resource management emerged in the near-shore area. Management of coastal fishery resources is necessary. The government faces the challenge of increasing the per capita availability of fish to meet increasing demand. The new Fisheries and Aquatic Resources Act No.2 of 1996 was enacted with a view to managing the fishery resources effectively and efficiently. This fulfils a long-felt need in fisheries.

4. Management Issues and Problems

4.1 *Open Access*

Certain features make the fishing industry somewhat different from others. Fishery resources are finite and therefore scarce, but they are renewable if properly managed. Economic returns could be attained over the long run. Since the sea represents an open-access resource, there is no resource rent attached to the exploitation of fishery resources, other than the costs incurred to reach the fishing ground for exploitation.

There are certain distortions in the market system, so far as fisheries are concerned. The book "Common property economics: a general theory and land use applications" by Glenn G. Stevenson (1991), clearly shows the disadvantage of open-access resource. It is a depletable resource characterised by rivalry in exploitation. It is subject to use by any person who has the capability and the desire to harvest the fishery.

Barring a few traditional fishing systems which regulate access to the resource through community-based informal institutions (Atapattu, 1992; Kulatunga and Edirisinghe, 1995; Atapattu, 1996), the sea is mainly an open access resource in Sri Lanka. In the 1940s, when total fish production was in the region of 40,000 tons, a major part of it came from traditional fishing gear such as beach seine nets, stake nets etc. These have existed for a long period. Coastal rural communities practised fishing methods which were in harmony with the environment in which they lived. In addition, these systems had important economic features like the distribution of income among fisherfolk communities (equity). There were rotational systems where many had a stake. The income from these operations was distributed among them. These traditional fishing systems continue. They were not devoid of conflict. But many conflicts were resolved by the village leaders through social and economic sanctions imposed on violators.

4.2 *Uncontrolled Demand for Fishing Effort*

These traditional methods could not, of course, meet the needs of an increasing Sri Lankan population. The per capita supply was low, and economically efficient gears and methods based on experiences from developed countries had to be introduced. Motorization of fishing craft commenced in the late '50s (1958) and introduction of nylon nets was done in 1962 (Pieterz, 1995, Atapattu, 1997). These methods brought about a dramatic increase in fish production.

4.3 *Lack of reliable information on fish resources*

The conservation intent of traditional fishing systems is subject to question (Ruddle, 1994). It is important not to assume *a priori* that traditional fishing systems are inherently conservationist. Management measures should have been introduced from the very inception of these schemes. Unfortunately, such a management regime was not considered. This is the main cause of present-day problems in fisheries. Thanks to the incentives given in the form of subsidies on capital goods and institutional credit under an open-access, common property regime, the fishing effort increased substantially in the coastal fishery. The popular 9 metre (28 feet) boat was introduced in 1958 without a proper management plan. A major constraint was the lack of reliable information on available resources. Sustainable exploitation levels could not therefore be determined.

Knowledge about exploitation of fisheries and the rate of fishing effort are as important as stock assessment. The existing data collection systems are somewhat outdated and need to be upgraded for effective resource management. Further, a legal framework was not adequately available to deal with present-day problems and issues, especially of coastal fisheries. All development plans of the past 1959 - 68, 1972 - 76, 1979 - 83 and 1990 - 94 - had concentrated mainly on increasing fish production through increased fishing effort (Mahalingam 1995). During this period, little attention was paid to resource management (Atapattu, 1973). Result: by the mid-1980s, many conflicts among groups of fishermen from coastal waters surfaced. This led to the framing of beach seine regulations in 1984 and purse seine regulations in 1986.

4.4 *Destructive Fishing Gears and Methods*

In view of the open-access free-entry nature of fisheries in Sri Lanka and most other countries, economically wasteful and biologically destructive fishing gears and methods are employed to tap the resource. Such uncontrolled effort depletes resources. The high-value species such as lobster, prawn and crab are particularly vulnerable. Overfishing of resources beyond the carrying capacity or the Maximum Sustainable Yield (MSY) is a natural consequence. It is well known that the national lobster fishery suffers from overfishing (Jayakody, 1991). Coastal fisheries including shrimp and lobster (Joseph, 1993) also suffer from Declining Catch per Unit Effort (CPUE). Suraweera and Jayawickrama (1989) have suggested that the prawn fishery in Portugal Bay of Kalpitiya be managed, since the resource has been over-exploited.

4.5 *Poor Enforcement*

In the past, the authorities concentrated mainly on increasing output by increasing fishing effort. Action was later taken to manage the fishery by framing regulations under several ordinances, such as the Village Communities Ordinance of 1889, the Small-Town Sanitary Ordinance 1892, the Local Board

Ordinance 1898, the Game Protection Ordinance 1909, the Local Government Ordinance 1920, the Pearl Fishery Ordinance 1925 and the Fisheries Ordinance No. 24 of 1940. From 1895 to 1940, nearly 56 regulations were gazetted. Seven regulations applicable to the whole island were added to the statute from 1940 to 1986. In addition, the following amendments for effective fishery management (Fernando, 1997) were made to the Fisheries Ordinance.

- (i) Protection of young fish and fish eggs (1950).
- (ii) Fisheries disputes to be referred to a public inquiry. Enhanced punishments for destructive fishing (1952).
- (iii) Establishment of a fisheries reward fund to pay informants and witnesses about the illegal use of explosives (1952).
- (iv) The possession or use of fish killed by dynamite or poison was made an offence (1956).
- (v) The scope of matters referred for public inquiry was widened (1956)
- (vi) Wider powers were given to the Minister of Fisheries to formulate regulations regarding fishing disputes (1966).
- (vii) The possession, sale and transport of fish taken by explosives within or outside the country's waters was banned (1973).
- (viii) The power given the Director of Fisheries for settlement of fishing disputes was widened (1973).

However, enforcement of these regulations was very poor for various reasons, and the objectives of enforcement could not be met satisfactorily. This has led to a continuous increase in fishing pressure on the coastal resources, and to many social, economic and environmental problems in the coastal fishery (Jayakody, 1991; Atapattu and Dayaratne, 1992; White, 1994; Atapattu, 1994; Kulatunga and Edirisinghe, 1995; Dayaratne, 1996).

4.6 *Habitat Degradation*

During the past few decades, different types of fishing gear have been introduced to the coastal fishery in order to exploit resources and meet increasing consumer demand, not only from the local market but also from foreign markets. These environmentally unfriendly fishing gears badly degrade the coastal habitats which play such a vital role in the coastal fishery by maintaining wild stocks and conserving nurseries for recruitment and juvenile fishes (Kulatunge and Edirisinghe, 1995; Rajasuriya, 1997).

4.7 *Poaching*

Poaching by foreign fishing vessels is a menace faced by Sri Lankan fishermen. Large quantities of resources are being exploited by these fleets; the country loses foreign exchange, employment opportunities and an abundance of animal protein. To minimise this problem, manage the fishery and regulate the activities of foreign boats in Sri Lankan waters, specially the region covered by the declaration of the Exclusive Economic Zone (EEZ) in 1976, a new Act (Regulation of Foreign Fishing Boats Act No. 59 of 1979) was enacted by Parliament in 1979. In the process, amendments were made to the already revised Fisheries Ordinance of 1940. But the problem still exists. An effort is being made to upgrade the existing air sea rescue system into an effective system for monitoring control and surveillance of the EEZ of the island.

5 Lessons Learned and Strategies Pursued

5.1 *Fisheries Policy*

In the past, fisheries policy in Sri Lanka was based on four main objectives viz

- (i) Increase fish production
- (ii) Expand employment opportunities.
- (iii) Improve the social well-being of the fishing community.
- (iv) Earn foreign exchange.

To achieve these objectives, emphasis was laid on increasing output by stepping up fishing effort through the introduction of motorised fishing boats and nets made out of synthetic fibres. The emphasis was on development, without any thought being given to management (Mahalingam, 1995; Atapattu, 1996). Result: resources in the coastal waters got depleted. Conflicts among resource users were aggravated, and incomes fell. Today the fisheries policy has changed. Due consideration has been given to fisheries management in the 1995-2000 fisheries development plan.

5.2 *New Legislation*

Most of the regulations framed in the past (1989-1995) were either location-specific or case-specific. The large number of fisheries regulations that existed then were found to be vague. They were not uniform, since they were framed under the provisions of different ordinances (Fernando, 1996). To overcome these problems and to bring uniformity to the regulations, a new set of laws were drafted in 1940 and gazetted as Fisheries Ordinance No. 24 of 1940. From 1940 to 1973, amendments were made to the Ordinance nine times to deal with the management problems.

During the 1980s and 1990s, conflicts among various resource user groups went up. The Department of Fisheries and Aquatic Resources was convinced of the need to enact a new set of laws to deal with increasing management problems. The new Fisheries and Aquatic Resources Act No. 2 of 1996, enacted in 1996, made provisions for effective and efficient fisheries management.

5.3 *Public Awareness Campaign*

A massive public awareness programme has been planned to enhance knowledge on the importance of fishery resource management. A series of seminars and workshops has been programmed. Under the sponsorship of the Bay of Bengal Programme (BOBP), one national-level and two regional and sector-specific workshops were completed for policy makers, resource managers, administrators, researchers and others. In addition, a series of district and village-level seminars were conducted under the aegis of the FAO/UNDP-supported marine resources management project. A large number of seminars are to be organized under the programme.

5.4 *Fishery* Resource Survey*

Although a few *ad hoc* location-specific or species-specific surveys were done by NARA from time to time, a meaningful resource survey was not carried out until the ADB-funded resource survey which is now in progress.

5.5 *A Set of New Regulations*

As discussed above, the main objective of past development plans until 1996 was to exploit the resource, not manage it. Implementation of this objective under an open-access common property regime has caused the coastal fishery a lot of problems. Environmentally unfriendly gears and destructive fishing methods have increased in number as well as gear types. The increased fishing effort with these destructive gears badly degraded the critical coastal ecosystem. The new Act was enacted with a view to overcome these problems. A number of regulations were framed under the new Act.

5.6 *Monitoring, Control and Surveillance System*

As discussed above, poaching by the foreign fishing fleet is a problem. Donor assistance has been sought to upgrade the existing air-sea rescue system to a monitoring, control and surveillance system (MCS). Such a system is highly capital-intensive and needs donor support.

5.7 *Environmental Impact Assessment (EIA)*

The new National Environmental Act (NEA) was enacted in 1993 to minimise environmental degradation in implementing development projects. It stipulates that all aquaculture projects of more than 4 ha should go through EIA procedures. If the proposed project is within an environmentally sensitive area, the project – irrespective of size – should undergo EIA screening.

5.8 *Fisheries Management Project (UNDP)*

The United National Development Programme has donated US \$ 1.8 million for a project to manage the island's coastal fishery. The following tasks have been completed so far.

- (i) A book “Fishing Gear and Crafts in Sri Lanka” has been published. This will provide the information on fishing craft and gear in Sri Lanka required by decision-makers for sound and effective management.
- (ii) A trilingual fish directory has been published.
- (iii) A Management Plan has been prepared for the Negombo lagoon.
- (iv) A compendium of fisheries legislation in Sri Lanka was prepared in 1996.
- (v) Shrimp and lobster regulations were revised to suit current requirements.

5.9 *Fisheries Development Project (ADB)*

The ADB-funded Fisheries Development project concentrated mainly on fishery harbours and anchorages. To manage coastal fisheries, it is essential to reduce the fishing pressure on coastal resources. The deep sea and off shore fishery has to be developed in order to accommodate fishermen who quit the coastal sub sector. Berthing facilities have to be provided either by constructing new harbours or by expanding existing structures.

5.10 *International Conventions, Treaties and Agreements*

With technological advances and developments in communications that have made the world a global village, no country ought to isolate itself from the rest of the world. There are many conventions,

treaties and agreements, international and regional, which influence the national fishery. The foremost of these are

- (i) The Law of the Sea convention which came into force on 16 November, 1996.
- (ii) The UN General Assembly Resolution 44 /228 of December 22, 1989, which brought about the UN Conference on Environment and Development (UNCED) in Rio in 1992 and adopted Agenda 21.
- (iii) The 1992 Declaration of Cancun.
- (iv) The UN Conference on Straddling and Highly Migratory Fish Stocks which adopted an agreement in 1995.
- (v) The Code of Conduct for Responsible Fisheries and other related legislation.
- (vi) The Ramsar Convention on Conservation and Management of Wetlands (1973).
- (vii) The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) signed in Washington in 1973.

The main effect of such conventions is to further the conservation and management of resources in the EEZ of Sri Lanka and the high seas. The most recent international convention is the Agreement on the Establishment of the Indian Ocean Tuna Commission (IOTC), which will impact substantially on the Sri Lankan fishery.

6. Conclusions

A well-thought out fisheries policy, new legislation and sound strategies will enable a suitable environment for meaningful fishery resources management. Success will mainly depend on implementation and enforcement either by statute or by the community or both. Changing a system that has been in force for nearly half a century is not easy. A massive awareness campaign has to be mounted aimed at policy-makers, administrators, resource managers and other stakeholders, and a sound enforcement and monitoring mechanism has to be developed. Can a developing country accomplish this without assistance from developed countries?

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6.7 THAILAND

COASTAL FISHERIES MANAGEMENT IN THAILAND

By Jate Pimoljinda and Sakul Supongpan

Introduction

Thailand is situated in the Southeast Asia Peninsula, extending from 5° N to 21° N latitude and 95° E to 106° E longitude, with a seabed area of 420,280 sq.km (Gulf of Thailand 304,000 sq.km and Andaman Sea 116,280 sq.km.). The coastline is 2,615 km long (Gulf of Thailand 1,875 km and Andaman Sea 740 km). The Gulf is relatively shallow, with an average depth of approximately 58 m, and 84 m in the deepest area, while the Andaman Sea has a depth of up to 1,000 m. Fishing activities have therefore to be conducted in an area of less than 90 m depth.

During the last three decades, the demand for marine products has increased rapidly as a result of economic and population growth in Thailand. Land has been encroaching into the sea, particularly for setting up new community settlements in the coastal belt, followed by infrastructure construction to support economic development in the communities. There has also been decentralization of industry, which has been moving away from congested areas like Bangkok. Result: degradation of coastal areas, destruction of huge mangrove areas, pollution of sea water along the coast by discharged urban and industrial waste, and expanding tourism. Fisheries resources suffered due to overfishing and illegal and destructive fishing. New recruitment of aquatic resources could not take place, because the main nursery grounds were destroyed and water was polluted. The incomes of traditional coastal populations who make a living through small-scale fisheries, aquaculture and agriculture fell. These populations have recently been overwhelmed by migrant workers who compete with them for scarce jobs and exploited coastal resources in an indiscriminate manner to supplement their low wages. Urban investors have sought land and developed it indiscriminately for shrimp aquaculture which provides a relatively a high return in a short time. Mangrove areas too have been encroached upon for shrimp culture. Basic commodity prices have increased. Growing social conflicts have created problems.

Marine fisheries play an important role in Thailand. People in coastal areas catch fish for their own food. Recorded fish production has increased every year - total marine landings in 1992 and 1993, for example, were 2.74 and 2.75 million metric tons, valued at \$ 1.436 and \$ 1.445 million respectively. But trash fish constituted the bulk of increased catch (Statistical records, 1993).

Thai marine waters harbour more than 1,000 species of fish, representing 135 families of marine fish. These can be divided into three major groups — pelagic fish, demersal fish and invertebrates.

The most abundant commercially important pelagic fish are Indo-Pacific mackerel (*Rastrelliger brachysoma*) Indian mackerel (*R. kanagurta*), scad (*Decapterus maruadsi*, *D. macrosoma*), Spanish mackerel (*Scomberomorus commersoni*), tunas (*Thunnus tonggol*, *Euthynnus affinis*, *Auxis thazard*), sardines (*Sardinella gibbosa*), anchovy (*Stolephorus heterolobus*), carangids (*Selar crumenophthalmus*, *Selaroides leptolepis*, *Atul mate*) etc.

Common high-value demersal fish include snappers (*Lutjanus lineolatus*) groupers (*Ephinephelus* sp), threadfin bream (*Nemipterus japonicus*, *N. hexodon*, *N. mesoprion*, *N. tolu*, *N. peronii*), monocle bream (*Scolopsis taeniopterus*), lizardfish (*Saurida hexodon*, *S. trndosquamis*, *S. elongata*), barracuda (*Sphyrna obtusata*, *S. jello*), bigeyes (*Pricanthus tayenus*) etc.

The invertebrates of high economic value include more than 10 species of shrimps (*Pentreus monodon*, *P semisulcatus*, *P merguensis*, *P latisulcatus*, *P longistylus*, *P japonicus*, *Metapenaeus ensis*, *M. affinis*, *M. intermedius* etc.), cephalopod (*Loligo duvaucelli*, *L. chinensis*, *Sepioteuthis lessoniana*, *Sepia pharaonis*, *S. aculata*, *S. recurvirostra*, etc.), swimming crab (*Portunus pelagicus*, *Charybdis ferriatus*), mud crab (*Scylla serrata*), spiny lobster (*Thynus orientalis*), green mussels (*perna viridis*, *Musculus senhausia*), bloody cockle (*Anadara granosa*), oyster (*Crassostrea cucullata*), shortnecked clam (*Paphia undulata*) etc.

There are 24 coastal provinces in Thailand. According to the Fisheries Statistical Record, the fishing grounds are divided into five zones: Zone 1, Eastern Gulf; Zone 2, inner Gulf; Zone 3, Upper Southern Gulf; Zone 4, Lower Southern Gulf and Zone 5, the Andaman Sea (Fig. 1). The Statistical Data Base and Data Information, 1995, revealed that there were 53,313 full-time fishing household units and 18,934 fishing worker household units - an increase over the last ten years of 3.1% and 6.8 % respectively (Table I).

Table 1 Number of marine fishing households and fishing boats of Thailand, 1995
(classified by fishing zone).

Fishing type	Fishing Zone					
	Total	1	2	3	4	5
Full time households	53,313	6,280	5,923	7,312	16,935	16,863
Worker households	28,934	2,570	3,360	4,424	11,272	7,308
Fishing boats	54,715	6,431	6,633	7,568	16,846	17,237
Outboard engine boats	36,634	3,261	2,362	4,969	12,869	13,446
Inboard engine boats	14,965	2,930	4,076	2,718	2,751	2,254
Boats without engines	3,116	267	225	154	1,226	1,244

Zone 1 : Trad. Chanta Buri and Rayong Province

Zone 2 Chon Buri, Chaeangsaio, Samuth Prakam, Bangkok, Samuth Sakorn, Samuth Songkram and Phet Buri Province

Zone 3 Prachaub Kiri Khan, Chumpom and Surat Thani Province

Zone 4 Nakom Sri Thammarat, Pattalung, Songkhla, Pattani and Narathivat Province

Zone 5 Rangun, Phang-Nga, Phuket, Krabi, Trang and Satun Province

Sources Statistical Data Base and Data Information, 1995

The majority of these households engage in marine capture fisheries, which can be divided into large-scale fisheries and small-scale fisheries. Large-scale fisheries employ powerful fishing gears such as trawlers and purse seiners, while small-scale subsistence fishers use traditional fishing gears such as trammel net, crab gill net, fish net etc. The full-time small-scale fishing households constituted about 87 % of the total fishing households, and produced about 13 % of the country's total fish production (Piumsombun, 1994). A total population of 320,000 is engaged in fisheries or the fisheries-related

sector. They may be classified as 70,000 large-scale fishermen, 180,000 small scale fisherfolk and 70,000 in fisheries-related sectors.

There were 54,751 fishing boats. These included 36,634 boats with outboard (longtail) engines, 14,956 with inboard engines, and 3,116 non-motorized boats (Statistical Data Base and Data Information, 1995 Table 1). In 1983, the number of fishing boats had gone up over 10 years by 1288 – an increase of about 2.4 %.

Prior to the development of marine fisheries, pelagic species were mainly caught near the shore, using non-mechanized boats and traditional fishing gears such as bamboo stake trap and set bag net. The Chinese purse seine was introduced in 1925 and modified into the Thai purse seine for catching pelagic fish, using a mesh size of 2.5 cm. The green purse seine or mackerel encircling net, made of payao coconut leaves and using a mesh size of 4.7 cm, was also introduced. It was anchored for a number of days, and used luring lights produced by simple kerosene, butane lamps, and further developed using electric generators.

In 1964, the fishermen succeeded in developing beam trawls to catch shrimp. This fishing gear became popular along the coastal area of the Gulf. Following an agreement for economic and technical co-operation signed in 1960 between the Thai Government and the Government of the Federal Republic of Germany, otterboard trawlers were introduced to the Gulf of Thailand. The subsequent increase in the number of trawlers in operation, and the fish catches, was remarkable (Table 2).

The marine fishing industry of Thailand was buoyed by the success in otterboard trawling, which rapidly developed and expanded during the late 1960s and the early 1970s. The trawl fisheries are the most productive sector of marine fisheries, accounting for over 58 % of the total marine catch in 1993 (Statistical Records, 1993). The number of registered trawlers of Thailand rose sharply from 99 units to 2,026 units in 1963. Thereafter, the number rose continuously to 9,465 units in 1992. The highest figure was 13,113 units in 1989. The rest of the marine catch (43%) is shared by the pelagic fisheries which is dominated by purse seines, gill nets and small-scale fisheries. Fish meal plants that used trash fish to produce fish meal rose dramatically from 79 units in 1978 to 91-98 units during the years 1979 to 1991. The sharpest rise was in 1990 and 1992 by 104 and 106 units respectively (Statistics of Fisheries Factory, 1992).

Attempts have been made by scientists from Thailand and abroad to assess the potential of demersal, pelagic and invertebrate fisheries resources in the Gulf of Thailand and Andaman Sea. The potential yields of various fish stock, derived from the relationship between catch and effort, were assessed. It is clear that the demersal fish stocks in Thai waters have been overexploited. Catch composition is changing in favour of small and less valuable species. It is estimated that trash fish caught by trawlers ranged from 45 % to 65 %. Eighteen per cent to 32 % of these trash fish are juveniles of food fish species (average from 1989-1993. Stock Assessment Section, Bkk. Marine Fish Development Centre).

The rapid development of the commercial trawling and purse seining fleet has meant extreme economic hardship for small-scale fisherfolk, who can no longer compete for limited resources. Furthermore, trawlers, purse seiners, push netters and clam dredgers damage marine resources through their use of small-mesh cod-end and sieve sizes, which retain juvenile fish, shrimp, swimming crab and clam. Result: reduced recruitment of high-value species and marketable-size fish into the fisheries.

The coastal population have earned a livelihood not only through capture fisheries but also through the culture of shrimp, fish, oyster, mussel, crab etc. The increase in shrimp culture areas is remarkable,

because during the last decade, the culture areas have increased by 93.9 % and shrimp culture households have gone up four-and-a-half times. The total shrimp culture area is 420,724 Rai, whereas the areas for fish culture, mussel and oyster, culture, and crab culture are 1, 15,605 and 6,329 Rai respectively (Statistical Data Base and Data Information, 1995).

Table 2 Number of trawlers registered in 1960 - 1992

Year	OBT	PT	BT	Total
1960				99
1961				201
1962				976
1963				2,026
1964				2,360
1965				2,393
1966				2,695
1967	1,380	176	316	1,872
1968	2,258	244	424	2,926
1969	1,939	243	420	2,602
1970	2,210	442	430	3,082
1971	2,472	522	614	3,608
1972	3,185	702	599	4,486
1973	4,480	824	533	5,837
1974	4,074	854	343	5,271
1975	3,816	852	294	4,962
1976	4,088	832	284	5,204
1977	4,962	906	420	6,288
1978	5,110	854	489	6,453
1979	7,038	1,172	537	8,747
1980	8,131	1,230	1,060	10,421
1981	6,021	1,008	496	7,527
1982	9,358	1,406	711	11,475
1983	7,796	1,266	328	9,390
1984	7,769	1,166	196	9,131
1985	6,968	1,218	139	8,325
1986	6,226	1,084	97	7,407
1987	6,129	1,164	50	7,343
1988	5,766	1,132	52	6,950
1989	10,438	2,193	482	13,113
1990	10,256	2,193	456	12,905
1991	8,117	2,037	144	10,298
1992	7,538	1,876	51	9,465

OBT : Otterboard trawl, PT : Pair trawl, BT : Beam trawl

The remarkable developments mentioned above have intensified the mechanization of fishing craft and the development of land for aquaculture. In the absence of appropriate management measures, they have led to a decline in resource abundance and degradation of the coastal environment. A drastic reduction in catch rates is clearly perceived, so also is the overfishing of demersal resources.

As regards pelagic resources, many economically important species have been fully exploited, while some species may have suffered over-exploitation. Common phenomena at present are a continuing decline in catch rates, the virtual disappearance of certain predominant species, a change in species composition of catches, and a predominance of trash fish of low-value economic species.

The Thai Department of Fisheries recognized that marine capture fisheries had still to extend to the high seas; the potential for proper utilization of deep-sea resources has still to be studied. The DOF also lays greater stress on increasing mariculture production per unit area. Ways to minimize fish waste, and introduce better technologies to utilize fish discards and trash fish either for human consumption or for other uses have been developed. Fishing grounds have been rehabilitated, and conflicts between small-scale and large-scale fishermen have been sought to be minimized. Thailand is willing to share its fishery expertise with neighboring countries both within and outside ASEAN, through joint venture and capital investment (ASEAN, 1994).

Problems to be addressed

The rapid expansion of Thai marine fisheries in the past has exerted great pressure on the available resources. Intensive exploitation of resources, without systematic management and rehabilitation, has led to use conflicts. It is clear that demersal resources and some of the pelagic resources are declining in both size and abundance. Catch composition is changing in favour of smaller and less valuable species. It is estimated that trash fish constitutes over 50 % of the total landings, and more than 30% of the trash fish are juveniles of food fish species. Likewise, coral reef resources have sustained damage through both natural factors and economic development. Both fisheries and tourism have suffered in consequence.

To conserve the marine fisheries resources, the DOF has set up various management measures through the Fisheries Act of 1901. This was revised in 1947 and 1982. These regulations aim to determine the use of certain types of fishing methodology in certain areas; establish spawning and nursing seasons and areas for marine resources; prohibit certain types of fishing gear during these seasons and areas; regulate mesh sizes for purse seining, gill netting and squid lift netting; limit fresh entrants to trawl fisheries by ceasing issue of new trawl licenses. However, these regulations have not been fully enforced. Violations do occur. Illegal fishing operations do go on.

Recently, the DOF set up a project for artificial reef installation to provide habitats for marine resources and their juveniles, allowing more resources to reach marketable and reproductive size. The reefs will physically obstruct nearshore trawling and push netting. Conservation areas are also being established.

The depletion of fisheries resources and the degradation of coastal habitats because of destructive fishing, have affected all living resources. In addition, land-based economic development in some coastal areas has polluted the coastal waters. The major pollutants that undermine coastal habitats are sedimentation, increased nutrient input from domestic discharge, and industrial and mining runoff.

The law should be enforced to prohibit illegal fishing. As various types of fishing gears increase, user conflicts among gears that compete for the same resource will increase. Small-scale fishing gears are

usually damaged by trawlers and mechanized push nets. In resolving user conflicts, the authorities should bear in mind the fact that small-scale fishermen constitute the majority of Thailand's fisher population and that they are a poor and disadvantaged lot.

Policies and Strategies of DOF

The following strategies to ensure better marine fisheries/resources management have been prioritized:

1. Speed up amendments to fisheries laws, rules, regulations and restrictions.
2. Strengthen the enforcement of fisheries management measures.
3. Prevent further degradation of resources by limiting the number of fishing boats and by regulating mesh size.
4. Install artificial reefs in appropriate coastal areas to act as sanctuaries, spawning and seed bed areas. These will also reduce conflicts among fishermen and serve as a management tool.
5. Encourage the formation of associations among small-scale fishermen.
6. Formulate area-based or community-based fisheries resources management at the provincial or district level, as well as setting up a coastal resource information center.
7. Disseminate knowledge to fishermen, fisheries-related operators and the public about the conservation, utilization and management of marine fisheries resources to ensure maximum sustainable benefits.
8. Speed up the demarcation of coastal reef zones including the mapping and rehabilitation of coral reef resources, and formulate criteria for undertaking activities in them, as well as issue rules and restrictions on the possession of corals.
9. Monitor and improve the quality of water resources. Prevent and solve pollution problems that may impact on fisheries resources, aquatic reserve areas, areas of historical importance and touristic areas.
10. Monitor surveys of marine fisheries resources, periodically assessing the status of economically important species, and improving the standard of fisheries statistics information.
11. Encourage better co-operation among researchers, resources managers and fishermen to jointly solve problems.

Strategies and Plans for Coastal Fisheries Resources Management

1. *Bettering the living standards of small-scale fishermen* by improving the infrastructure of fishing communities, increasing their educational and employment opportunities, improving health. Aquaculture, mariculture, and extension services for capture and post-harvest fisheries have been introduced to the communities to raise incomes and strengthen job skills. Efforts have been made to set up fisheries co-operatives to improve financial management.
2. *Awareness-building in marine resources conservation:* Public campaigns for conservation and sustainable resource use are essential on account of resource depletion, the growing numbers of fishermen, and the increasing efficiency in fishing methods. Education programmes concerning resource conservation have been implemented in many communities.

3. Community-based resources management: Management to improve the participation of fishing communities in resources management has been established in several communities of Thailand to reduce over-exploitation of coastal resources and degradation of habitats.
4. Artificial reefs installation: Several artificial reefs have been installed along the coast of Thailand. This is a management device to help reduce confrontation and conflict between trawlers and small-scale fishermen. It will also enhance coastal productivity, which will benefit small-scale fishermen and help rehabilitate coastal habitats.
5. *Establishment of marine reserves*: Marine reserves have been set up to serve as protected areas and as spawning and nursing grounds for aquatic resources which might otherwise be endangered or overfished. Fishing is not permitted in these areas. Many coral reefs areas have been declared as marine reserves.
6. Enforcement of fisheries laws and regulations: Strict and systematic enforcement of the law is essential if resource management is to succeed.

Table 3: Plan for infrastructure facilities and activities allocation under the 8th National Economic and Social Development Scheme for small-scale fisheries development in 22 coastal provinces

Artificial Reef	Unit	Fiscal Year			
		1997	1998	1999	2000
1. Artificial Reef Installation	Site	15	15	15	15
2. Retaining Wall	Site	25	25	25	25
3. Fishing Equipment Repair and Storage	Unit	5	5	5	5
4. Rain Water Stocking Tank	Unit	5	5	5	5
5. Demonstration and Supply of Fishing Gear	Village	30	30	30	30
6. Fishing Pier Construction	Site	25	25	25	25
7. Fish Processing and Nutrition	Unit	12	12	12	12
8. Green Mussel and Bloody Cockle Culture	Village	10	10	10	10
9. Fish Culture	Village	10	10	10	10
10. Seed Release (number)	million	30	30	30	30
11. Infrastructure deepening	Site	10	10	10	10
12. Pilot Project on CBFM	Village	3		3	

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Fig 1: Map illustrating Zonation of Thai Waters

