

INTEGRATION OF FISHERY MANAGEMENT INTO COASTAL AREA MANAGEMENT PLANS IN SRI LANKA.

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ABSTRACT

The coastal zone of Sri Lanka has three main components: a relatively narrow continental shelf from 2–20 km wide, a number of shallow coastal lagoons and estuaries, and some coral reefs. These habitats are rich in species and in 1993 70% of the total marine harvest came from the coastal zone. The coastal zone is also important for aquaculture.

The interaction between the fishing community and other components of the coastal zone is two way. Fishing has an impact on fish stocks and increasing numbers of fishermen living along the coast have a direct impact on the coastal vegetation, including mangroves, and this contributes to instability of the coastal zone. Although the erosion and deposition of sand from the coast is primarily linked to natural cycles such as the monsoons, these processes are altered by human activities such as agriculture, forest clearance and construction activities. Landfill in estuaries, sand and coral mining and industrial pollution are all particularly detrimental to fisheries and the livelihoods of fishing communities. It is therefore important that fisheries management is integrated into the general Coastal Zone Management Plan and that the latter must be well defined legally, must be supported by the public, and must be flexible enough to accommodate long-standing rights and privileges exercised by those living along the coast and exploiting the coastal zone resources.

1. INTRODUCTION

In the 1920s the government of Sri Lanka realised the importance of the coast and the problems associated with it. During that period erosion of the coast was a major problem and their efforts were all directed towards its arrest. The agencies responsible were the Departments of Railways, Highways, Irrigation and Public Works. Due to lack of understanding of the fragile and vulnerable nature of the coastal zone and its users, especially the fishermen, no action was taken to arrest the deterioration other than erosion. As a result the problems associated with the coast became acute and complex.

In 1984 an advisory council comprising representatives from a number of Ministries responsible for the resources and the constructions in the coastal areas laid down a set of principles to arrest further destruction of the coastal zone. The Department of Coast Conservation, which was then an arm of the Ministry of Fisheries and Aquatic Resources, played the role of coordinator. At the discussion the Ministry also played a major role as the representative of the fishermen who live in the area and use this resource for their living.

The principles laid down at the discussions were based on the following:

1. The nature of the coast,
2. Its common heritage,
3. The state's responsibility and its limits,

4. The necessity of a plan to manage the coastal resource and its powers,
5. Inter-agency coordination and cooperation,
6. Community understanding and support in management of the coastal resources.

The principles laid down were later used in formulating the coastal management plan. To manage the fisheries activities in the coastal zone, the Department of Fisheries and Aquatic Resources with the help of UNDP is preparing a management plan for the Fisheries Sector. This paper will discuss integration of fishery management into the Coastal Zone Management Plan.

2. FISHERIES RESOURCE IN THE COASTAL ZONE

2.1 Fish Resources in Coastal waters

Coastal waters are defined as the strip of sea over the continental shelf. The continental shelf around Sri Lanka is a narrow platform, having a mean width of 20 km. But at a few points off the east coast it narrows to 1–3 km. To the north and northwest the shelf widens into an extensive shallow bank and forms the floor of the Gulf of Mannar, Palk Bay and the Pedro Bank before merging with the continental shelf of the Indian mainland. Sri Lanka, being a tropical country, has waters which are very rich in species which are very varied in quantity. There are over 500 species of edible fish found in coastal waters. Their sizes range from 4 cm long Sprats (*Anchoviella* spp) to 1–2 meter long Marlins (*Histiophoridae* spp). Closer to the inshore areas the resource is large compared to the resource beyond, the majority being small pelagic species.

In 1993 170,000 t, amounting to more than 70% of the total marine catch, was harvested from the coastal zone. Ninety percent of this catch was pelagic species which move in large shoals and form the dominant group in beach seine landings. Species of fish such as pony fishes (Leiognathidae), Sprats, Sardines (*Amblygasrer* spp) and herring-like fishes (Clupeiformes) contribute greatly to the inshore gillnet and beach seine fisheries. Other pelagic fish found in large numbers in Sri Lankan waters are the Mackerel (*Rastrelliger* spp) Horse mackerel (Carangidae), Flying fish (*Exocoetus* spp), pomfrets (Sphyratnidae), Garfish (Belonidae), Barracuda (Sphyrænidae), Mackerel tuna (*Euthynus affinis*), frigate Mackerel (*Auxis thazard*) and Skipjack (*Katsuwonus pelamis*). Among the valuable bottom living species the brightly coloured fish such as Parrot fish (Scaridae), young groupers (Serranidae), Coral fish (Chaetodontidae), Angel fish (Pomacanthidae) and Wrasses (Labridae) are found mostly in coral reefs. Among the submerged rocky bottoms, common species found are Snappers (Lutianidae) and Bream (Lethrinidae).

2.2 Lagoons and estuaries

The lagoons and estuaries are an interface between marine, freshwater and land. They are important coastal environments which are highly productive and the effects of which extend out into coastal seas. The fauna and flora that live in these areas are able to live over or in muddy substrates and are able to withstand fluctuating salinity. The principal species of fish which feed in estuaries are representatives of a number of families including Sprats, Herrings and Grey Mullet.

2.3 Coral reefs and rock

Coral reefs are regions of high benthic primary producers. They have maximum growth at depths less than 25 meters and at temperatures between 25°C—29°C. They form 2 to 3 percent of the nation's total shore line (Coastal Zone Management Plan, 1990) and provide diverse living opportunities for a multitude of plants and animals. Young stages of many valuable bottom living species of fish are found here. In Sri Lanka nearly 75 species of fish belong to the Wrasses, Demoiselles, Angle fish and Coral fish are found in large numbers in the reefs. The coral reefs are also places of shelter for lobsters. Another aquatic animal of commercial value found in large numbers is the Pearl oyster which grows on large patches of hard sea bed at many points round the coast specially in the Gulf of Mannar.

3. IMPORTANCE OF THE COASTAL ZONE TO THE FISHERY INDUSTRY

Sri Lanka has a population of 17.7 million. To satisfy its fish protein requirements it needs 270,000 t of fish per year, 220,000 t of which is taken from its own waters, the rest is imported. The marine sector contributes 202,000 t to the total fish catch, the balance comes from inland waters. Coastal waters contribute 80% of the marine catch, the balance comes from the deep sea and offshore areas. The deep and offshore catches are mostly tuna, tuna-like fish, bill fishes and sharks the majority of which spend their young days in coastal waters before they move out to the deep sea. The fish stocks in coastal waters rely on the primary production of those waters which may be affected by pollutants that may enter the coastal waters or be destroyed by the destruction of lagoons, estuaries and coral reefs.

3.1 Importance of coastal zone to coastal aquaculture

In 1993 nearly 1500 t of shrimps were exported from Sri Lanka most of them cultured. In the western coastal zone, where most of these prawn farms are located, land suitable for prawn culture is hard to obtain. Further, the egg bearing female prawns and prawn larvae needed for culture have to be obtained from the coastal waters. Degradation of the coastal water reduces the number of larvae and berried prawn resulting in collapse of the industry.

3.2 Coastal areas are important for fishery activities.

The coastal zone is the area where most fishery activities take place. The fishermen not only build houses in the coastal area but also land, dry and process their catch there. In Sri Lanka there are nearly 1000 landing places most of which are scattered along the coast. With the introduction of large motorised boats the number of landing places has reduced. A number of landing places, anchorages and harbours have developed (locations of fishery harbours include Kirinda, Tangalle, Puranawella, Mirissa, Galle, Beruwala, Mutwal, Mannar, Myladdy, Trincomalee and Valachchiheni). The coastal zone is also where fishing boats are built and repaired, the main boat building areas are in Negombo, Jaffna and Beruwala. Repair facilities are available at most of the harbours and anchorages. Vital statistics from the fisheries sector are shown in Table 1.

Table 1.
Statistics of the fisheries sector in Sri Lanka.

1.	Fishing population	marine	412,200
		inland	55,909
Total fishing population			468,109
Projected population of Sri Lanka			17,433,200
Fishing population as percentage of total population			2.78%
2.	Active fishermen (1989)	marine	98,444
		inland	12,891
Total active fishermen			111,335
3.	Fishing households (1989)	marine	87,808
		inland	11,451
Total number of fishing households			99,259
4.	Fleet strength (1989)	marine inboard craft	2357
		outboard craft	9028
		non-mechanised	15,136
		inland non-mechanised	4058
Total fleet			30,579
5.	Number of fishing villages	marine	1050
		inland	1289
Total number of fishing villages			2339
6.	Contribution of fishery to Gross Domestic Product		2.2%

(Source: Fisheries Survey 1989)

4. THE IMPACT OF THE COASTAL ZONE ON FISHERIES

4.1 Coastal erosion and its effect on fishing villages

The interface between water and land is dynamic. Apart from man made causes storms, waves and currents carry sand from place to place, eroding at one place and depositing it in another, changing the shoreline constantly. During calm weather waves deposit sediment and build up the beach. In rough weather the wind energy dissipates on the shore causing erosion of the beach. Coast erosion takes place when removal of sand exceeds deposition and it has been estimated that approximately 175,000—285,000 m² of coastal land is lost each year in the coastal belt extending from Kalpitiya to Yala National Park.

Erosion in the south and west of the Island is high during the beginning of the southwest monsoon and on the North and East coasts at the end of the Northeast monsoon. Unless the eroded sand returns shoreward from offshore areas during the calm season the beach shrinks, resulting in decrease in size of the fishing villages (e.g. Dehiwala, Moratuwa, Ulhitiyawa, Kandakuli) and the areas for fishing operations (e.g. beach seine operations in Colombo District).

Rising sea level is also causing decrease of the shoreline. Recent estimates have shown that over the last century all over the globe there has been 0.5 to 2.0 m rise in sea level causing coastal dwellers, the fishermen, to move landwards.

4.2 Coastal deposition and its effect on the fishing industry

Accretion of sand obstructs rivers and other water outlets, prevents escape of flood water resulting in lowering of salinity (e.g. Koggala lake) and flooding of dwellings, and prevents the escape of industrial effluent resulting in destruction to aquatic life (e.g. Lunawa Lagoon). It also impedes entry of aquatic fauna and oxygenated water from the sea resulting in lowering of fish production (e.g. Mundal lagoon). Deposition of sand on the seabed also causes destruction of fish habitat. In areas north of Talawila sand deposits have destroyed the aquatic environment causing destruction of fishing grounds (e.g. the beach seine fishery in Kandakuli South).

Land fill in estuaries and lagoons is most often carried out for housing construction or for urban expansion (e.g. Negombo, Crow Island, Mattakkuliya). In Negombo the areas adjoining the lagoon were filled in for housing, reducing the area of mangroves. In Trincomalee sections of the bay have been filled for construction of industrial projects. In most coastal areas individuals residing on the banks of lagoons and estuaries encroach on to the estuary or to the lagoon in order to increase their land area, reducing the effective water area of the estuary or the lagoon and leaving little room for fish to breed and grow.

4.3 Sand and coral mining causes destruction to fishing villages and to aquatic life

Sand and sea shells are used for the construction industry. In 1984 approximately one and a half million cubic meters of sand were mined from the coastal region for construction purposes. Removal of sand from river outfalls along the coast leads to coastal erosion and beach retreat causing destruction of large numbers of fishermen's houses. (e.g. Moratuwa, Lunawa)

Corals have been used in Sri Lanka from time immemorial in the building industry. In the southern and western coastal areas corals were used instead of bricks in construction work (e.g. the forts of Kalpitiya and Galle, and houses on the south western coast). Coral in the form of lime is used as binding, plastering and as painting material in the building industry. It is also used to remove acidity in agricultural lands and as a chemical in the ceramic, sugar, steel and fertiliser industries. Corals are extracted by breaking coral reefs, by collecting coral debris and by mining dead corals from inland areas (e.g. Kahawa, Thelwatta, Akurala, Ambalangoda). All these actions cause destruction of the fragile coastal zone where fishermen live.

Coral reefs are places where primary production is said to be as high as $5000 \text{ g C m}^{-2} \text{ y}^{-1}$. They support highly productive filamentous green algae, blue green algae and symbiotic Zooxanthellae, on or in coral skeletons. Juveniles of many economically important demersal fish (e.g. Grouper (Serranidae), Parrot fish (Scaridae) Wrasses, Damoiseselles, Angel fish and Coral fish.) live among corals and feed on algae on the coral and on the coral polyps.

Destruction of corals is caused not only by coral miners but also by persons employed in other trades such as tourism and ornamental fish exporters. Tourists and persons employed by the tourist trade walk over the coral to get a close view of coral beds while others collect pieces of coral as souvenirs. Those who want to see the corals anchor over the reefs damaging the live corals, still others catch multicoloured coral fish for export. All these destroy the fish and fish habitats.

4.4 Discharge of pollutants to the coastal waters reduces marine production

Most of the coastal tourist developments have problems disposing of waste water and sewage due to lack of adequate space for the necessary structures. Most developers use the space for room expansion leaving no room for waste disposal. Most hotels in Hikkaduwa, Negombo and Beruwala allow sewage and waste water to empty on to the beach. In certain instances the waste water pits are located very close to the high water mark. Pollution through these sources affects the coral reefs (e.g. Hikkaduwa) and other biological environments reducing marine production.

5. THE IMPACT OF FISHERIES ON THE COASTAL ZONE

Sri Lanka has a population of 17.5 million of which 0.45 million depend on fisheries for their living (Table 1). They live in 1050 villages distributed along the coastal zone. Almost all live within 2 km of the beach. Unlike in agriculture, the houses of fishermen are built close together, a style that has evolved in order to muster combined effort for bringing the catch to the shore, dragging the craft and gear to the beach and also for security. The majority of fishing villages are sited close to the fishing grounds. Since most of the fishing grounds are situated close to the river or lagoon mouths the fishermen prefer to live closer to the shore where the rivers or the lagoons opens to the sea (Negombo, Chilaw, Kalpitiya, Mutwal, Panadura, Kokilai, Nayaru, Batticaloa, Valachchihenai). These coastal dwellers use not only the land and living resources but also the non-living resource of the coastal zone.

5.1 Fishing settlements exerts pressure on coastal vegetation

The last few centuries have seen a gradual increase in population in the maritime area causing a heavy demand for land and the plants that grow on it, thus causing changes to the coastal zone. In the south west maritime zone the Palmyra tree which was growing profusely has totally disappeared leaving only its name at places where it grew (e.g. Tal Aramba is Palmyra forest, Tal pitiya is Palmyra garden) These trees would have been used by the early settler fishermen to construct their houses and boats (e.g. palm trunks are used for boat building in the Maldives even today). Being a hardy tree it would have resisted the heavy southwest monsoon winds (during May – October) by absorbing its energy. Its bushy roots trap fine sand and soil particles making the top sandy layer erosion resistant. Removal of such vegetation would have been the preliminary step towards coastal erosion.

Rhizophora sp is the dominant mangrove plant in the wet zone. Mangroves were used in building houses making boats, fish traps, brush piles and for staining nets and sails in addition to its use as firewood. The expanding fishing villages which were close to the lagoons or river mouths have used the mangrove vegetation for all these purposes.

5.2 Impact of fishing on the coastal fish resource

The survey carried out by the Norwegian Research Vessel “*Dr. Fridtjof Nansen*” estimated that the total biomass of Sri Lanka’s continental shelf and the area immediately adjacent to it was 750,000 t. The annual sustainable yield (ASY) of this resource is said to be 250,000 t of which 175,000 t is pelagic and 75,000 t is demersal and semi-demersal. The present coastal production from the above resource is 170,000 t of which 159,700 t is pelagic and the balance 11,300 t is

demersal (Fisheries statistics, 1993, Ministry of Fisheries and Aquatic Resources). The coastal pelagic resource is nearing the annual sustainable yield (ASY) but the district based catch analyses show heavy pressure on the resource and at certain times over exploitation.

5.3 Use of wood for craft building exerts pressure on depleting coastal forest cover

Sri Lanka has a fleet of 27800 fishing craft nearly 16500 of which are non-traditional Oru, Vallam, Teppam etc. (Ministry of Fisheries and Aquatic Resources, 1990). Although some are motorised all have wooden or fibre reinforced plastic (FRP) hulls. The hardwood needed for the manufacture of craft was mostly taken from the coastal zone. Due to lack of suitable wood for craft building fishermen are now using the only alternative available the fibre reinforced plastic (FRP) and most of the new craft used in the beach seine fishery today are made out of FRP.

5.4 Built structures cause coastal erosion

Every year during the monsoon period numbers of fishing villages face the danger of getting washed into the sea as a result of the heavy sea erosion. To arrest erosion boulders are piled along the coast as a protective measure. These measures sometimes cause more damage to the village or to the adjoining village. Whenever boulders are laid instead of the beach absorbing the energy of the wave it reflects some of the wave energy back to the next wave, which causes more damage to the coast. Further, heavy swash passes through the spaces between the boulders and removes the material when it recedes causing erosion behind the boulders.

Fishery harbours and anchorages with breakwaters built to supplement the shelter often have negative results. A dramatic example of such failure can be found in Kirinda where the harbour became silted up in a short period of time. Further, such breakwaters have created not only coastal erosion problems but have induced the entry of sand bearing currents in to the harbours causing siltation (e.g. Beruwala Harbour)

5.5 Removal of reefs and boulders for fishery activities result in coast erosion

Reefs that lie close to the surface of the sea acts as breakwaters and create calmer areas between the reef and the beach. These natural breakwaters are blasted with permission from the state agencies to create passages for fishing boats or to help beach seine operations. The waves enter through these breaches and erode the coast causing heavy damage to the shore.

6. INTEGRATION OF FISHERIES MANAGEMENT IN TO THE COASTAL ZONE MANAGEMENT PLAN.

Fisheries management is fundamentally a method of allocating the fisheries resource. In allocating the fisheries resource, a system has to be designed to divide the resource among the different type of fishing activities (e.g.- beach seiners, purse seiners, gillnetters, cast netters etc.). Long before any scientific understanding of fish stocks fishermen were aware of the reduction in abundance caused by over fishing. They knew that over fishing has to be dealt by collective action which later became the written fisheries law. They also knew the value of protecting the females and young animals by means of non-fishing seasons such as the breeding seasons or prohibition of fishing for young fish, and these were added to their laws. When the abundance of the stocks

further declined fishermen prevented outsiders coming to fish in to their area. When it further declined fishing was confined to a privileged few in the village. This situation is common to both rich and poor, developed and underdeveloped countries.

6.1 The common regulations widely used in fisheries management

- i. Closed areas: fishing prohibited in nursery, spawning or rapidly depleting areas.
- ii. Prohibited methods: use of explosives, poison or poison giving material in fishing is banned in any water body of Sri Lanka (e.g. Fisheries Ordinance section 14).
- iii. Protected female fish: female lobsters that carry eggs are protected (e.g. Spiny Lobster and Prawn (Shrimp) Regulation 1973).
- iv. Protected young fish: young lobsters are protected by lobster regulations, In inland water bodies young fish are protected by prohibition of gillnets having a mesh less than three inches.
- v. Protection for species: endangered species are protected by banning or controlling exports. (Fisheries Ordinance Sec. 12).

The above measures have been applied for centuries all over the world and in Sri Lanka during the last few decades. But these laws cannot ensure conservation. To control and protect the fish stock knowledge of the size of the fish stock is required. In Sri Lanka an attempt was made in 1978 —1980 to assess the fish stock in the coastal waters. The report published has been used even today to prevent over fishing in coastal waters. The department of Fisheries and Aquatic Resources, which is responsible for the management of fisheries in Sri Lanka, frames regulations to achieve maximum sustainable yield and for orderly fishing. It collects basic statistics on catch, fishermen, households, boats, methods, areas etc. It also enforces regulations to identify and licence boats (Registration of fishing boats regulation, 1980), levy tax on size and/ or weight of boats (Foreign fishing boat regulation, 1981), issue permits to regulate the catch (e.g. Purse seine regulation). The information gathered is used in the introduction or reduction of boats to achieve the maximum sustainable yield.

6.2 Features that should go into an integrated coastal zone management plan

- The coastal zone management plan must be broad based and well defined.

To integrate a fisheries management plan within the coastal area management plan, the latter must be broad enough to accommodate fisheries. It must also have an institutional and legal framework for such integration. Further, each sector in the coastal area management plan must have a well defined area of action with responsibilities and arrangements for coordination with other sectors of the plan.

In the fisheries sector fish stocks in the coastal waters rely on primary production of that area. The primary production will be affected if the water in the coastal area is polluted. The pollutants discharged from industries and agricultural land (e.g. pesticides and fertiliser run off) reach coastal waters through water ways, estuaries

and lagoons. If the area of action is not well defined and the institutional structure is not strong, prevention of pollutant discharge may be difficult, resulting in resource reduction.

- The coastal zone management plan must have legal power.

The resources of the coastal zone are daily getting scarcer and, as a result, different sectors of the coastal zone may compete for the same resource and this will lead to conflicts. To deal with such conflicts there must be provisions and mechanisms with legal powers in the coastal zone management plan.

- It must be supported by the public.

In integration of fisheries into the coastal zone management plan policies made must be supported by the public, Decisions taken without public support may fail during implementation. Further, awareness has to be created among the public regarding the decisions made. This awareness can be created by having discussions, workshops and seminars for persons who are affected or benefited by the decisions.

- It must be flexible and long-standing rights and the privileges must be honoured.

In Sri Lanka, coastal waters and beaches have been used by the fishermen for centuries without any hindrance although there have been some problems with a few developers from the tourist industry. In preparing policies for integration of fisheries, due care and respect has to be given to ancient rights and privileges (e.g. beaches are common property, every person has the right to approach them and use them). When regulations are framed to control the use of a resource through prohibitions or restrictions it should be made sufficiently flexible to deal with different types of situations.

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