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# SUSTAINABLE EXPLOITATION OF BRACKISHWATER FISHERY RESOURCES OF SRI LANKA

by

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## Introduction

Brackishwater environments have been identified to be among the most productive ecosystems in the biosphere. In Sri Lanka, these include lagoons, estuaries, tidal flats and salt marshes (Anon. 1991). Pillai (1965) has estimated that there are about 320,000 ha of brackishwater environments in Sri Lanka. However, it has been revealed that many lagoons and estuaries have gradually decreased in size in the recent past, for example the surface area of the Negombo estuary has been estimated to have decreased by about 800 ha during the last three decades (Anon. 1991). The total area of brackishwater environments in Sri Lanka today is therefore considerably less than that recorded by Pillai (1965).

There are two types of estuaries in Sri Lanka, the basin estuaries and riverine estuaries (Anon. 1991). Basin estuaries are brackishwater environments consisting of shallow basins connected to the sea. One or more rivers discharge into basin estuaries. Riverine estuaries are brackishwater environments where rivers flow directly into the sea through relatively narrow channels. Negombo, Chilaw and Puttlam estuaries are examples of basin estuaries while Kelani and Kalu Ganga estuaries are example of riverine estuaries. There are about 45 basin and riverine estuaries in Sri Lanka. The total area of basin estuaries has been estimated to be around 40,000 ha (Kotagama *et al.* 1989). However, the total extent of riverine estuaries has yet to be estimated. Lagoons on the other hand are brackishwater bodies which are separated from the sea at least during some parts of the year. There are about 40 lagoons in Sri Lanka covering an area of about 20,000 ha (Kotagama *et al.* 1989).

As far as fishery resources are concerned, the lagoons and estuaries are the most important among the brackishwater environments. They serve as nutrient traps and therefore are highly productive. A large number of coastal residents depend on the fisheries of lagoons and estuaries for their livelihood. In developing countries, fisheries of brackishwater environments have received little attention compared to marine fisheries mainly because of their small scale nature (Kapetsky 1981). However, from a sociobiological view point, they play a significant role in mitigating the problem of unemployment at least to some extent. It has been estimated that in Negombo, about 3000 fishermen are dependent on the estuarine fishery for their livelihood (Samarakoon and van Zon 1991).

In the recent past, there has been an increased interest in studying the fisheries of brackishwater environments in Sri Lanka mainly because of their biological, ecological, economic and social significance (Schuster 1951, Pillai 1965, De Silva and Silva 1979, Senanayake 1981, Chitravadivelu and Arudpragasam 1983, Jayanth and Jinadasa 1983, Perera and Jinadasa 1983, Jayasuriya 1984, Siddeek and Jayasinghe 1985, Chitravadivelu and Paranthaman 1987, Wijeyaratne and Costa 1987a 1987b).

### Fishery Resources

Lagoons and estuaries in the tropics harbour a rich ichthyological biomass consisting of autochthonous fauna living in the brackishwater environment and allochthonous fauna coming from the marine and freshwater environments. Pillai (1965) recorded 125 fish species in the brackishwater environments in Sri Lanka. In a recent study carried out in Negombo estuary, 3 more species of fin fish which were not recorded by Pillai (1965) have been observed in the catches (Perera 1990). With time and using more sophisticated equipment more species are bound to be added to the existing list of fishes from the brackishwater environments of Sri Lanka.

Of the fish species inhabiting these environments, about 80% are edible (Pillai 1965).

Small scale commercial and subsistence level fisheries exist in the brackishwater environments of Sri Lanka. Fishing is carried out for fin fish and shell fish (prawns, crabs and molluscs) using a number of gear.

The most important edible fish species in the brackishwater environments of Sri Lanka are sea bass (*Lates calcarifer*), gray mullets (*Mugil* and *Liza* spp.), rabbit fishes (*Siganus* spp.), milk fish (*Chanos chanos*), green chromide (*Etroplus suratensis*), estuarine catfishes (*Tachysurus* spp.), pony fishes (*Leiognathus* spp) and spotted butter fish (*Scatophagus argus*) (Wijeyaratna and Costa 1987a, 1987b, Samarakoon and van Zon 1991).

In addition to food fishes, juveniles of some fin fish species are exploited live from the brackishwater environments as aquaculture seed and ornamental fish. These species are *Monodactylus argenteus*, *Scatophagus argus*, *Lates calcarifer*, *Epinephelus* spp., *Etroplus maculatus* and *Aplocheilichthys dayi*.

Penaeid and palaemonid prawns also play an important role in the fisheries of brackishwater environments. Nine species of penaeid prawns have been observed to be important (Pillai 1965, De Bruin 1965, 1971, Chitravadivelu and Arudpragasam 1983, Perera and Jinadasa 1983, Siddeek and Jayasinghe 1985). The most abundant species are *Penaeus indicus*, *P. monodon*, *P. semisulcatus*, *Metapenaeus dobsoni*, *M. elegans* and *M. ensis* (De Bruin 1965, 1971, Siddeek and Jayasinghe 1985). *Macrobrachium rosenbergii* is also caught in large numbers from brackishwater environments of Sri Lanka (Costa 1979).

The estuarine crab (*Scylla serrata*) and the blue sea crab (*Portunus pelagicus*) are also important in the fisheries of brackishwater environments of Sri Lanka (Punchihewa and Pinto 1987, Pillai 1965). Bivalve molluscs such as clams, cockles, mussels and *Pinna* sp are also harvested on a commercial basis in some lagoons and estuaries.

### Fishing gear and crafts

Several types of gear are used in the exploitation of fishery resources of brackishwater environments. These include gill nets, trammel nets, stake set nets, seines (encircling nets), kraals, drag nets, trawls, push nets, brush piles, cast nets and pole and line. The morphology, operation procedure and catch of these gear have been described by several authors (Senanayake, 1981, Chitravadivelu and Paranthaman 1987, Wijeyaratne 1986, Samarakoon and van Zon 1991).

Traditional non mechanised fishing crafts such as outrigger canoes and log rafts are used in the fisheries of most of the lagoons and estuaries. Outrigger canoes may sometimes contain sails. Gear such as push nets, drag nets, seines, brush piles, trawls, kraals and pole and line are operated on foot. However, the crafts may be used to go to the fishing grounds in the lagoon or estuary. The cast nets and gill nets are operated from the crafts.

### Yield

The yield from fisheries of brackishwater environments of Sri Lanka was estimated by Pillai (1965) to be around  $25 \text{ kg ha}^{-1} \text{ year}^{-1}$ . However, recent studies indicate that the annual yield from these brackishwater environments is much higher than this figure. The yield of fin fish from the Negombo estuary in 1980- 83 period has been estimated to be around  $20 \text{ kg ha}^{-1} \text{ year}^{-1}$  (Wijeyaratne and Costa 1987a). However, if the catch of prawns and crabs was also considered, the yield would have been much higher. It should also be noted that these estimates were made during an unusually severe drought period. Drought conditions result in lesser inflow of nutrients into the estuarine systems.

A recent survey has indicated that the yield of edible fin fish and shell fish from the Negombo estuary is around  $150 \text{ kg ha}^{-1} \text{ year}^{-1}$  (Samarakoon and van Zon 1991). This figure appears to be questionable as the mean production for highly productive brackishwater environments in other parts of the world has been estimated to be around  $100 \text{ kg ha}^{-1} \text{ year}^{-1}$  (Kapetsky 1981). The maximum sustainable yield from shallow lagoons and estuaries in the tropics has been found to be around  $120 - 150 \text{ kg ha}^{-1} \text{ year}^{-1}$  (Saila 1975).

It appears that fishery resources in other lagoons and estuaries in Sri Lanka are not exploited to the same extent as those of the Negombo estuary. The annual yield of fin fish and shell fish from the Puttalam estuary has been estimated to be around  $49 \text{ kg ha}^{-1} \text{ year}^{-1}$  (Jayasuriya 1984).

### Resource Management

For sustainable exploitation of fishery resources in brackishwater environments, it is necessary to have a knowledge on the levels of maximum sustainable yield and optimum fishing effort. It will also be useful to identify the harmful trends of the system and the ways of mitigating their impacts. In the management of fisheries in developing countries, in addition to biological factors, social interactions and economic factors should also be taken into consideration (Panayotou, 1982).

In the recent past, it has been observed that the mean size of fish caught in the Negombo estuary has decreased gradually (Samarakoon and van Zon 1991). This may have resulted from the increased fishing pressure over the past few years. It appears that the present level of fishing effort should not be allowed to increase further in this highly productive ecosystem.

However, restrictive management measures may not be suitable for the fisheries of developing countries because these may increase the problem of unemployment. Therefore, when restrictions are made on access to the fisheries, alternate measures should be taken to utilize the available excess labour properly. It has been reported that the off-shore fishery resources of Sri Lanka can be further exploited (Anon 1991). Therefore, it is necessary to take steps to exploit these underexploited marine resources; the labour available in areas where fishing effort has reached the optimum level could be utilized to exploit these fisheries.

Experimental studies carried out in the Negombo estuary have shown that brush pile cum pen aquaculture can provide a better yield (Samarakoon and van Zon 1991). It will be useful to take steps to carry out such programmes in lagoons and estuaries in Sri Lanka without adversely affecting the existing capture fisheries and the ecosystem.

Sea grass beds play an important role in the productivity of brackishwater environments of Sri Lanka (Punchihewa and Pinto 1989). However, it has been shown that some of the gear such as push nets and drags nets used in sea grass beds of lagoons and estuaries can be heavily destructive to these habitats. Operation of such gear will cause heavy disturbances to these highly productive habitats and will adversely affect the overall productivity of the entire ecosystem.

Exploitation of ornamental fish and aquaculture seed has heavily augmented the income of some fishermen. The value of ornamental fish and aquaculture seed collected annually from the Negombo estuary in the recent past has been estimated to be around Rs:  $50 \times 10^6$  (Samarakoon and van Zon 1991). These resources have to be harvested at the maximum sustainable level so that the exploitation does not adversely affect the existing fish populations and the environment. Overexploitation of young individuals of a community will result in recruitment overfishing which will be detrimental to the fish stocks. Therefore, scientific studies have to be carried out to estimate the optimum level of exploitation of these juvenile fish. In addition, it is necessary to carry out studies on artificial breeding of these organisms so that collection from the wild could be minimized in order to reduce the damage caused to natural populations. Furthermore, artificial breeding will help to select better varieties which will undoubtedly fetch a higher market price.

Some of the gear used in commercial fisheries of brackishwater habitats have been found to be harmful to the fish populations and the environment. For example, sometimes ropes with attached tender coconut leaves are dragged in the water to chase fish towards a gill net, trammel net or seine. These procedures can cause heavy mortalities to juveniles and undersized fish.

Operation of trawls in lagoons and estuaries should also be given serious consideration by fishery biologists and economists. Since this type of gear catches a large quantity of fish, such operations will result in an uneven distribution of income among the fisherfolk. In addition, this gear will destroy the productive habitats such as sea grass beds and also cause heavy mortalities to juveniles and undersized fish.

Brush piles, although extensively used in the Negombo estuary, are rare in other brackishwater environments of Sri Lanka. The advantages and disadvantages of this gear have been described in detail by Kapetsky (1981). One of the main disadvantages in the use of brush piles is the requirement of large amount of mangrove branches and twigs for their construction and maintenance. The use of brush piles has therefore been identified as one of the major causes for the denudation of mangrove forests in brackishwater environments. Mangroves, besides directly contributing to increase the productivity of the ecosystem, also provide the microenvironment required by the juveniles of commercially important prawns and fish. Thus the denudation of mangrove forests in the shores of lagoons and estuaries will affect the fisheries of these species. It is vital therefore to conserve these critical habitats for the sustainable exploitation of fishery resources in these environments. To obtain wood required for brush piles and other purposes, it has been recommended to grow mangrove forests in lands adjoining brackishwater bodies just as tree plantations are established to obtain fire wood (Costa and Wijeyaratne 1992). It has been found that the brush piles constructed with mangroves such as *Avicennia marina* and non-mangrove *Syzygium cumini* give a higher yield than those constructed with other species of mangroves (Costa and Wijeyaratne 1992). The use of certain types of mangroves as brush wood will reduce the indiscriminate destruction of mangrove forests. Therefore, when establishing mangrove plantations to obtain the wood required for brush piles, species such as *Avicennia marina* could be used as they attract more fish and give better yields.

Fisheries of brackishwater environments depend on allochthonous fauna from the marine and freshwater environments and autochthonous fauna. It has been recorded that about 70% of the fin fish and shell fish species observed in brackishwater environments are allochthonous (Pillai 1965). Use of kraals with long wings will adversely affect the migration of diadromous fish and prawns. Therefore it is necessary to determine the optimum amount of kraals that can be accommodated in a given water body. These should also be operated in such a way that they do not block the major migratory routes of diadromous fish and prawns.

Presently most of the brackishwater environments in Sri Lanka are polluted with industrial effluents, domestic waste, sewage and oil (Anon 1991). These pollutants may affect the fisheries by increasing the mortality rates of fish and prawns and making them unsuitable for human consumption. A successfully managed aquatic environment is absolutely necessary therefore for the sustainable exploitation of our fishery resources.

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