

BRACKISHWATER AQUACULTURE AND MANAGEMENT

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ABSTRACT

Sri Lanka has extensive areas of estuaries and coastal lagoons. Since the late 1950s many have seen the (largely unplanned) development of shrimp fishing and prawn culture. The most valuable of the 31 shrimp species found in Sri Lanka is the black tiger prawn *Penaeus monodon* which is cultured in earthen or concrete ponds. They are stocked with post-larvae from six hatcheries and their products form an increasing proportion of the total marine exports (in 1992 60% by value, 50% by volume). The shrimp farms and associated processing industry are an important source of employment. The outlook is of continued expansion but the existing farms are subject to several current constraints: the hatcheries are still dependent on wild spawners for the production of fry and these are in short supply; dependence on imported feed which is a large proportion of total costs; lack of expertise on the diseases which occur in intensive and semi-intensive culture; inadequate infra-structure including water and electricity supplies; lack of planned development; poaching.

The shrimp farm industry in Sri Lanka is regulated by the Ministry of Fisheries and Aquatic Resources Development which now demands an environmental impact assessment before the development of large new projects. However, the initial rapid development has led to a number of environmental and management issues, the most prominent of which are the need to control pollution and to rehabilitate the Dutch Canal, the need to halt the destruction of mangroves, the displacement of villagers from land, the salination of drinking water supplies, the need for more employment on the farms for people living locally rather than those from outside the area, the need to identify areas for shrimp farm development outside the Northwestern Province where suitable locations are already almost saturated.

1. INTRODUCTION

The brackish water area in Sri Lanka is estimated at about 120,000 ha of which 80,000 ha are estuaries and large deep lagoons and the rest comprises shallow lagoons, tidal flats and mangrove swamps. The smaller lagoons especially in the South Western, South and Southeastern regions are mostly closed by sand bars. Some have connections with the sea for a short duration during the rainy season. Some of the larger estuaries which are called lagoons such as Puttalam, Jaffna and Negombo maintain their connection with the sea throughout the year. Large expanses of tidal flats and mangrove areas exist in the Kalpitiya and Mannar regions. Most of these brackishwater bodies have been used as traditional fishing grounds by small scale fishermen for generations.

Government patronage to the brackishwater fishery industry began with the establishment of the brackishwater research station in Negombo in the latter part of the 1950s and a second one in Chilaw in the 1970s. These two stations initially concentrated on the promotion of milkfish (*Chanos chanos*) culture by collecting the fry from the northern province and nursing them up to the fingerling stage. Under the Government pond subsidy programme, pond farmers were given their fingerling requirements from these two stations. At a later stage these two stations were geared to produce post-larvae of freshwater prawn, *Macrobrachium rosenbergii* instead of milkfish for distribution among farmers. Withdrawal of government patronage to inland fisheries resulted in the closure of these stations in 1990.

Table 1.
The extent of areas suitable for shrimp culture
in Sri Lanka

District	Extent (ha)
Puttalam	1,200
Hambantota	400
Galle	200
Batticaloa	1,600
Mannar	800
JaiTha	400
Trincomalee	600
Mullaitivu	800
Total	6000

Source: Sainaranayake, 1986.

At present brackish water aquaculture in Sri Lanka is mainly confined to the shrimp culture industry due to its high profitability over the other cultured fish species. Culture of bivalve molluscs (*Crassostrea* and *Perna* sp.), seaweed (*Gracilaria* sp.) and mud crab (*Scylla serrata*) are still at the experimental stage.

1. SHRIMP CULTURE AND DISTRIBUTION OF FARMS

Thirty one species of shrimps have been recorded from Sri Lanka waters. Of these only the penaeid shrimps have commercial value. *Metapenaeus dobsonii* is the most abundant among those species that are found in both estuarine and marine waters. Being one of the smallest in size it is however not as commercially important as less abundant species such as *P. indicus* and *P. semisulcatus*. Due to faster growth, large size attained and export potential, the black tiger prawn *Penaeus monodon* has been almost exclusively used in brackishwater shrimp culture (Joseph, 1993). Out of the 120,000 ha of total brackishwater areas in the island, about 6000 ha have been identified as potentially suitable for aquaculture (Samaranayake, 1986) (Table 1).

Since the beginning of the 1980's rearing techniques for shrimps have made great progress and shrimp farming is now reaching an industrial dimension especially along the coast of the Northwestern Province of Sri Lanka. Although the first prawn farm started in Batticaloa in the late 1970s, civil disturbances in the North and East diverted this industry to Northwestern Province (Fig. 1). Recently a few project proponents have submitted their proposals to start farms in the Southern Province and these are still under consideration of the Inter-Ministerial Scoping Committee headed by the Ministry of Fisheries and Aquatic Resources Development. As at the end of 1993, a total of 91 prawn farms have been approved by the Ministry of Fisheries and Aquatic Resources and the Provincial Ministry of Fisheries of the Northwestern Province. Out of the approved land area of 1633 ha about 498 ha of pond area have been developed. Table 2 gives the details of the area developed by size and land ownership. Lands owned by the Government are leased out to the developers for 33 years at a nominal lease rent of Rs. 500 per acre.

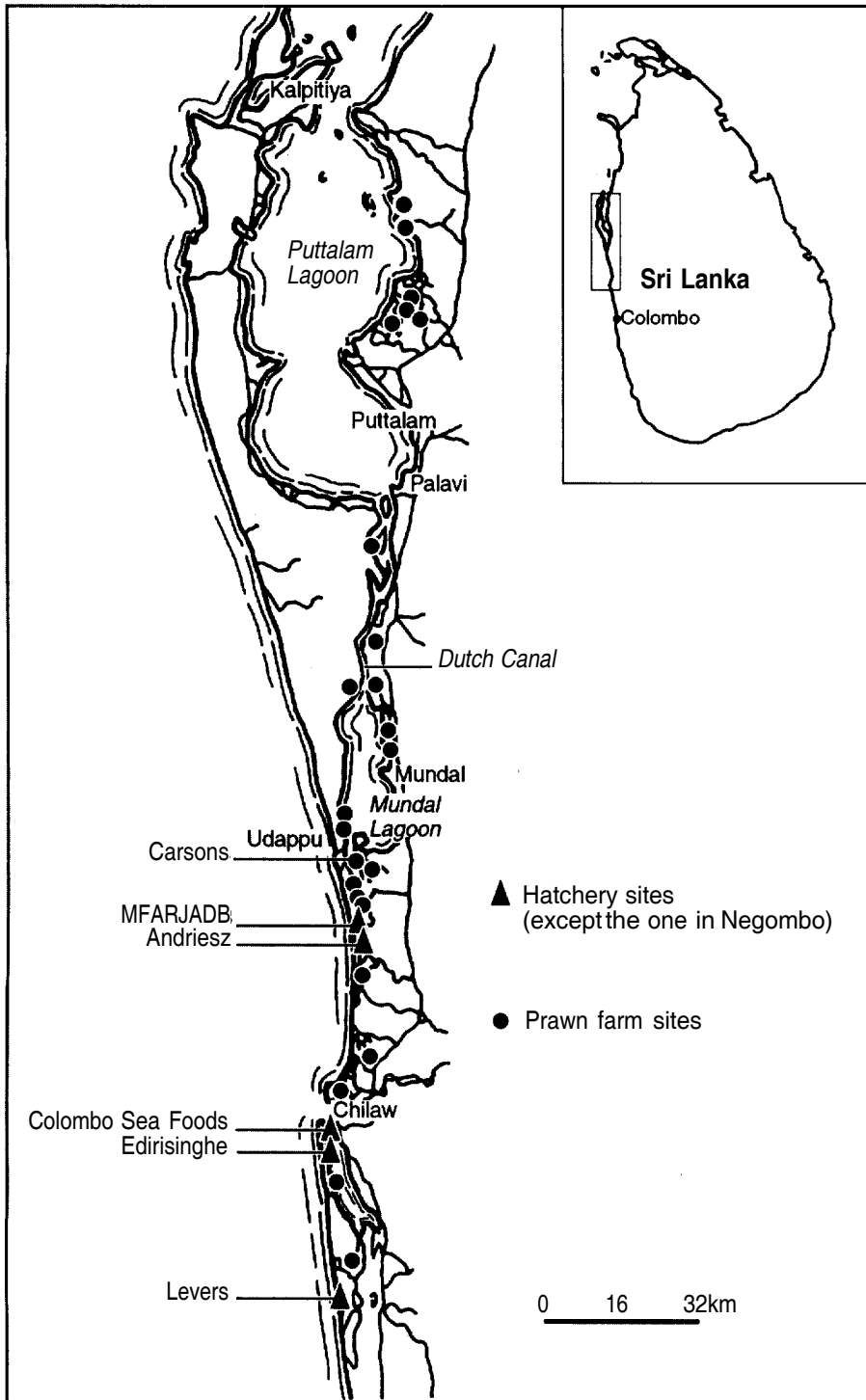


Fig. 1 The distribution of shrimp farms and hatcheries in Sri Lanka. Source: Joseph, 1993.

3. CULTURE SYSTEM

Most of the large scale prawn farm developers adopted intensive culture practices at the beginning of the commercial prawn culture industry in Sri Lanka except for the small scale farmers, who adopted extensive culture practices. The intensive culture operation is more sophisticated, requiring very high financial and technical inputs. This culture practice mainly depends on hatchery-bred fry, high stocking density, use of formulated feeds, application of aeration to increase dissolved oxygen levels in the pond water and intensive water management. The rearing facilities are either earthen or concrete ponds. Due to the outbreak of diseases in intensive culture in the 1980s, the majority of the farmers have changed from the intensive system to semi-intensive systems where the stocking density is 15–20 PL (post-larvae)/m². A few small farms still maintain extensive systems where the stocking density is 5–10 PL/m². The common stocking practice is monostocking under which all the ponds are stocked once and harvested at the end of the growth cycle. A small number of large farms follow a staggered stocking and harvesting schedule.

Post-larvae for these farms are obtained from 6 hatcheries located in the Northwestern Province and one in Negombo. All these hatcheries produce *P. monodon* post-larvae and their total production capacity is about 160 million PL per year. Although this is higher than the total demand of 120 million PL, it has been reported that some farmers do not get their requirements in time.

4. EXPORT EARNINGS AND POTENTIAL

Frozen sea food products from Sri Lanka first entered the world market in 1972. Since then, the export industry of marine products has established itself as one of the most dynamic agro-based industries in the island. There have been ups and downs in the world trade in shrimps in recent times but Sri Lankan exports have enjoyed a good market over the past few years and there is no reason to believe that this trend will change in the near future. Japan and the USA are the most important markets for Sri Lankan prawns. Exports to the European market are growing rapidly. The volume and value of shrimp exports from 1984 to 1992 are shown in Table 3. Among the sea food exports, shrimp accounts for more than 60% of the total value and more than 50% of the total volume. Although the available data does not reveal the proportion of cultured shrimp exports, it can be assumed that less and less wild (captured) shrimp and prawns are being exported in recent years (Joseph, 1993a)

Out of the 29 registered seafood exporters in Sri Lanka, nine are involved in shrimp exports and five of them also possess processing facilities. Exported shrimp comprises 75 per cent frozen/head-less/shell-on, 10–15 per cent frozen/head-on/shell-on and 10–15 per cent frozen/head-less/peeled and de-veined. Generation of huge amounts of foreign exchange, provision of employment to a large number of people in the farms and in processing factories as aquaculturists, technicians, executives and labourers (both skilled and unskilled), cultivation of areas previously unused for shrimp farming are the basic features of the shrimp industry today. The economics of shrimp farming are very attractive. The production cost of one kg of shrimps of 35–40 g average weight is Rs.200–250, of which 50–60 per cent is spent on feed. The current sale price is 350–400

Table 3.
Export earnings from shrimps

Year	Total exports of marine products		Shrimp exports	
	Volume (t)	Value (Rs.m)	Volume (t)	Value (Rs.m) —
1985	3240	453	1648	303
1986	3410	608	1973	427
1987	2376	575	1231	339
1988	3476	824	1826	526
1989	39821	137	2598	767
1990	3162	883	1855	472
1991	1827	855	942	454
1992	3734	303	1246	613
1993	5895	2144	1426	808

Source: Data Management Unit DOFARD, 1993.

Rs/kg. Most farms achieve a production of 2.5 – 3 t/ha in one culture cycle. The total cost of developing a one hectare pond (land, pond construction, equipment/machinery, seed and feed, labour etc.) up to the completion of the first culture cycle is estimated at Rs. 1 million. Such projects start to pay off from the first year.

In addition to the income generated from the exports, developers are entitled to the following tax incentives provided by the Board of Investments (BOI) of Sri Lanka.

- i. Exemption from income tax,
- ii. Partial tax-credit after the expiry of the above tax exemption period,
- iii. Exemption from customs duties and turnover tax, on the import of plant, machinery, equipment, raw materials and other project related goods, including one passenger car,
- iv. Funding and credit facilities,
- v. Exemption of duties and customs levies on the import of one motor vehicle.

World trade in prawns has gained considerable momentum in recent years. About 50% of the world shrimp catch enters the international market. Developing countries are the major suppliers of shrimps while the developed nations are the major buyers. Imports to countries such as the USA, Japan and Western Europe have increased rapidly since the last decade. Japan and the USA are the most important markets for tropical shrimps. There is a growing market for the shrimps also in Hongkong, Singapore, Australia and Canada. Therefore, the longer term outlook for world trade in shrimp is for continued growth during the next two decades. According to the projections

Table 4.
Targets for exports in fisheries sector (value in Rs.million)

	1994	1995	1996
Shrimps	1942	2094	2366
Lobsters	144	151	158
Crabs	27	27	27
Ornamental fish	172	213	264
Others	124	124	124
Total	2409	2609	2939

Source : Export Development Plan -MOFARD, 1992.

of the MOFARD, it is expected to earn Rs. 2,094 million and Rs. 2,366 million in foreign exchange in 1995 and 1996 respectively from the export of shrimp. This is more than 80% of the projected export earnings from the fisheries sector (Table 4).

5. REGULATION AND MANAGEMENT

The development of the shrimp farm industry in Sri Lanka is managed by the Ministry of Fisheries and Aquatic Resources Development, which is the Project Approving Agency under the National Environmental Act No. 47 of 1980, as amended by Act no. 56 of 1988. This Act is the basic national charter for protection and management of the environment.

Under the provision of the Act, regulations have been framed to follow an Environment Impact Assessment (EIA) procedure before approving new projects for shrimp culture over 4 ha in extent. The EIA practices and procedures should ensure that high quality environmental information is available to public officials and citizens before decisions are made and before the government makes any significant commitment of environmental resources. It is better to anticipate problems than to cope with them after they occur. Therefore it is now common practice to require that before any major development, an environmental impact assessment should be prepared that will clearly set out what the effects could be and how it is proposed to compensate them. This kind of requirement may demand extensive investigations which may still leave much in doubt. MOFARD, as the project approving agency, calls for an Initial Environmental Examination (TEE) for projects over 4 ha and below 20 ha.

In the case of projects over 20 ha an Environmental Impact Assessment (EIA) is necessary. MOFARD is assisted by a scoping committee made up of 10–12 representatives from various concerned Agencies. Scoping committee approval is granted only after a thorough examination of the IEE or EIA reports which may include a public hearing process. Though there is no legal requirement to adopt the same procedure for projects below 4 ha in extent, MOFARD has requested the Provincial Councils to process and approve project proposals below 4 ha in order to avoid any environmental degradation and unplanned development of the industry. Northwestern Provincial Council has set up a similar Scoping Committee for this purpose.

6. CONSTRAINTS ON THE EXISTING FARMS

A number of technological, social and environmental constraints encountered by the shrimp farmers have been identified.

- i. The inadequate supply of wild spawners remains a major problem for the industry, particularly that of Tiger prawns (*P. monodon*) as all hatcheries depend on wild spawners for the production of fry. The actual production of the hatcheries is insufficient to meet the demand. Techniques have to be developed for rearing brood stock in captivity.
- ii. The shrimp farming industry in Sri Lanka is almost entirely dependent on imported feeds that are expensive and sometimes in short supply. Feed represents about 40 —60 per cent of the total operational cost. Local feed production is still in its infancy.
- iii. Diseases such as black/brown gill syndrome, bacterial infection (*Vibrio*), viral MBV infection and ectoparasitic infections are common in hatcheries and grow out ponds. These diseases are occurring in most semi-intensive and intensive culture systems. Insufficient numbers of personnel are trained in disease control and other techniques and this has prevented successful technology transfer to small scale shrimp farmers.
- iv. Lack of proper water management systems, inadequate infrastructure facilities such as supply of electricity, road networks etc., have caused concern among the shrimp farmers.
- v. Start of unauthorised and unplanned shrimp culture projects by various farmers both on private and government lands, causing serious threats to the existing farms authorised or approved by the scoping committee.
- vi. There are complaints of organised poaching at some farms.

7. MANAGEMENT ISSUES

- i. The majority of existing shrimp culture projects are along the northwestern coastal belt and depend on the Dutch Canal as the common water source. Any further expansion of the shrimp farm industry in this area has to depend on the availability of water from the same canal. This will be detrimental to the entire industry since there is already concern that pollution in the canal system is beyond optimal levels. Lack of a proper monitoring system to assess the impact of effluent discharge and the sedimentation in the water source has aggravated this situation. It is essential to rehabilitate the Dutch Canal early to avoid any water quality deterioration which may damage the existing shrimp farms and to explore the possibility of increasing the carrying capacity of the canal in order to develop the industry.
- ii. Destruction of large expanses of mangroves to construct new shrimp ponds is going on along the Northwestern coast especially close to Puttalam Lagoon and Mundal lake. Most developers do not consider the importance of mangrove forests because it is not immediately apparent. Mangrove forests provide essential nursery grounds for a large number of fish and shellfish species upon which the lagoon fishermen are totally dependent. If the mangrove ecosystem is damaged or reduced, there will be a reduction of fish catches of the lagoon

fishermen. In addition, this will destroy the nesting grounds for a number of migratory bird species who are coming from distance parts of Asia. For these reasons, mangrove forests need to be managed very carefully. Selection of alternative potential sites in the Southern and Eastern part of Sri Lanka will be a good solution to this issue. The experience gained and the lessons learned from the Northwestern coast can be used for a sustainable development of the shrimp industry in these areas.

- iii. Due to the capital intensive nature of brackishwater shrimp culture, participation of the villagers in the industry has been restricted to a large extent. At the same time the livelihood of most of the villagers who are engaged in paddy cultivation and fisheries are affected by the development of shrimp farms which cause salt water intrusion and loss of aquatic life and mooring facilities for fishing craft. Local communities are concerned that expansion of shrimp farming will lead to salination of drinking water supplies and a threat of flood during rainy seasons. This situation has created a series of public protests and conflicts between developers and villagers.
- iv. Growing unemployment among the local communities has created a number of socio-economic problems. Large farms almost always employ labour from outside the community for reasons of security. Employment opportunities for the members of the local community in shrimp farms are therefore negligible or non-existent. Provision of employment for the local communities in the projects would provide them with the opportunity to train themselves in prawn culture and in the long run they would be able to have community shrimp ponds or a cluster of farms in the area to obtain income as a compensation for the loss of agriculture lands, grazing lands and fishing.
- v. The concentration of shrimp culture projects in the Northwestern Province has almost reached saturation point. With the improvement in the conditions of the North and East, large areas of land suitable for shrimp farming would be made available in addition to those in the Southern part of Sri Lanka. Identification of these lands and provision of relevant information on water quality and soil conditions etc., may help to ease the stress on the land in Northwestern Province and thereby ensure the sustainable development of the shrimp industry in Sri Lanka.

8. CONCLUSION

Brackishwater aquaculture is dominated by shrimp farming which is presently concentrated along the Northwest coast. Though most of the farms have the approval of the Inter-ministerial Scoping Committee, the development has been unplanned. Management measures which are laid down as conditions for approval are not adhered to, due to the non-availability of follow up actions and monitoring activities by the authorities concerned. Unauthorised farms have aggravated the problem bringing into focus several technological, social and environmental issues and constraints. The experience and lessons learned from the Northwestern coast can be put into use when the potential lands for shrimp culture in the South, North and East are developed. Management measures for a sustainable development should be implemented vigorously by introducing an effective monitoring mechanism.

9. REFERENCES

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