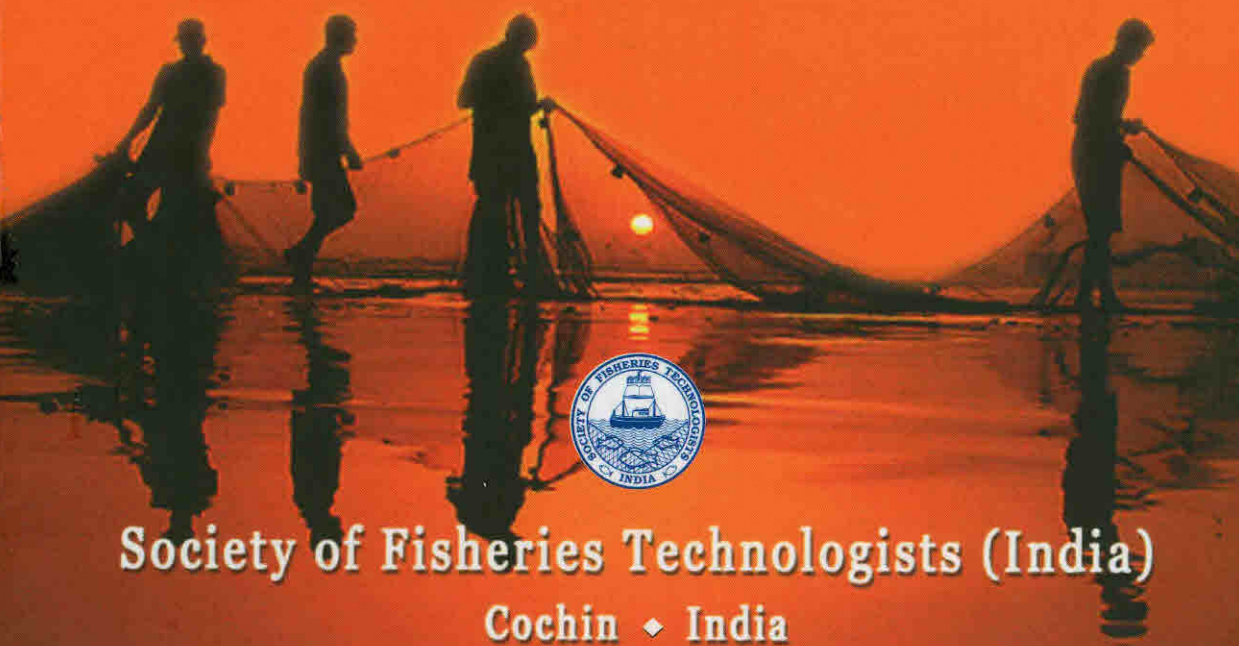
Coastal Fishery Resources of India

Conservation and Sustainable Utilisation



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Extension Education for Conservation and Sustainability of Coastal Resources

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Introduction

Marine fisheries sector forms the source of livelihood for over 7 million traditional fishermen inhabiting in over 3600 coastal fishing villages situated along the country's coastal belt of 8118 km (DAHDF, 2009). Besides, the sector provides direct and indirect employment for several million of coastal population in fishing, processing, trading and ancillary activities. As many as 14.48 million people in the country depend on fisheries sector for their livelihood. There were about 1,04,270 traditional fishing crafts, 75,591 motorised crafts and 58,911 mechanised crafts totaling 2,38,772 fishing crafts operating in Indian waters (CMFRI, 2006). In spite of the significant increase in fishing capacity and introduction of new technologies, there has been a perceptible trend of stagnation in capture fish production in recent years (CIFT, 2007: Bhathal and Pauly, 2008). The stagnation of fish production is a pointer towards the need for not only the use of conservation methods but also the implementation of coastal fishing management programs including adoption of responsible fishing techniques in order to sustain the fishery resources.

In this paper, the general socio-economic profiles and livelihood problems of coastal fisherfolk operating catamarans, FRP boats, plank-built boats and mechanized boats are presented. The extension education areas which could be undertaken by the various government agencies for increasing the awareness as well as the adoption of conservation methods and the major constraints in the management of fishery resources are discussed.

Socio-economic profile of marine fisherfolk

In the micro level studies conducted during 1980s, it was found that in fishing villages studied, even though the fishermen have more or less

a common life style and social background, the ownership pattern of fishing craft and gear, and individual status varied between the geographical regions in a state and also between the states. The general characteristics of traditional fishermen included illiteracy/ low education level, employment in fishing for 200-250 days per year, underemployment due to off-season in fishing, annual income of around Rs.25000, dwelling in huts or semi-pucca houses, poor socio-economic living conditions and amenities, low investment and variation in ownership pattern of fishing craft and gear, use of traditional fishing techniques, less fish catch due to non-availability or depletion of resources in nearby areas, unfavourable weather conditions and seasonal availability of fish.

The socio-economic variables of fishermen operating catamarans among randomly selected sample of respondents in Kerala and Tamil Nadu are given in Table 1 (Balasubramaniam and Ashaletha, 2007). It is seen that the mean scores of the two samples did not vary much on most of

Table 1: Socio-economic variables of fishermen operating catamarans

Variables	Kerala Catamaran respondents (n=31) Mean±SD	Tamil Nadu Catamaran respondents (n=34) Mean±SD
Age, years	41.70±9.42	43.41±10.63
Education, scores	2.19±1.01	2.14±1.07
Experience, years	25.83±10.62	26.85±11.16
No. of fishing days	248.54±50.58	247.64±33.55
Size of craft, m	6.92±1.23	5.75±0.95
Social participation, scores	1.96±1.01	2.35±1.12
Radio and newspaper utilization, scores	4.77±3.26	4.00±2.52
Information need, index	59.13±14.29	54.28±10.49
No. of crew	2.67±0.65	3.00±1.04
No. of family members	5.96±1.32	6.26±2.03
No. of family members in fishing	1.29±0.64	1.55±0.82
Investment on craft, Rs.	4964.51±2449.29	4882.35±3211.95
Investment on nets, Rs.	15080.64±10060.52	15258.82±11354.27
Annual income, Rs.	9529.03±5329.11	13320.58±6574.36

Source: Balasubramaniam and Ashaletha (2007)

the independent variables except the variables such as annual income, social participation and size of craft operated. It is also observed that the fishermen operating catamarans in both samples had used smaller gill nets (91 to 93%) followed by trammel nets (35 to 68%), nylon monofilament nets (32 to 41%) and other types of gears.

The socio-economic variables of fishermen operating FRP crafts in the two fishing centres, *viz.* Quilon (Kerala) and Veraval (Gujarat) are given in Table 2 (Balasubramaniam *et al.*, 2005).

Table 2: Socio-economic variables of fishermen operating FRP crafts

Variables	Quilon (n=31) Mean±SD	Veraval (n=40) Mean±SD	't'
Age, years	44.90±10.17	39.70±9.58	2.96**
Number of fishing days per year.	257.93±41.30	191.29±28.34	3.66**
Experience, years	19.09±9.77	18.38±8.64	0.39
Size of FRP craft, m	8.46±0.38	9.26±1.07	1.06
Investment on craft, Rs. $x10^3$	52.41±18.51	58.90±17.24	2.89**
Investment on nets, Rs. $x10^3$	94.12±43.90	69.32±24.51	5.32**
Investment on engine, Rs. $x10^3$	51.87±6.63	41.03±16.01	14.42**
Maintenance cost of craft and net, Rs. $x10^3$	20.68±9.90	9.25±4.72	1.79
Maintenance cost of engine, Rs. $x10^3$	6.06±6.83	4.51±2.52	1.51
Annual income, Rs. $x10^3$	42.94±21.36	46.12±16.71	0.93
Average quantity of fuel used, litre.day^{-1}	36.93±13.23	46.29±13.15	5.01**
Information source utilization, index	39.67±21.05	20.32±4.81	6.14**
Average fish catch, kg.day^{-1}	155.35±103.89	91.50±64.36	-

** Significant at 1% level

Source: Balasubramaniam *et al.* (2005)

The fishermen respondents at Quilon and Veraval were middle-aged, had about 19 years of experience and operated 8-9 m L_{OA} FRP crafts for fishing. At Quilon, the fishermen had an average of 258 days of fishing in a year while at Veraval, it was about 191 days in a year. The crew size was 5 to 6 with an investment of about Rs. 0.17 to 0.2 million on a fishing unit. They spent about Rs. 500 daily on fuel alone. Annual income was about Rs. 43,000 to Rs. 46,000. The *t*-test revealed that of the 13 variables, the means of eight variables were significantly different between the fishermen at two centres and the other five variables were not significantly different.

Table 3 presents the socio-economic variables of fishermen operating large plank-built crafts in three fishing centres in Kerala (Balasubramaniam *et al.*, 2003). The *F*-values revealed that of the 20 variables, the mean scores of only four variables, *viz.* average operating hours of engine, number of communication channels used, innovation proneness index and adoption index scores were found to vary significantly between the plank built craft operators in three centres. On the remaining 16 variables, there were no significant differences between them.

Table 3: Socio-economic variables of fishermen operating plank-built crafts

Variables	Punnapra Mean±SD	Chethi Mean±SD	Thaikkal Mean±SD	*F*
Age, years	43.90±8.97	38.81±13.09	38.45±8.31	0.88
No. of years of education	5.00±0.81	7.18±4.16	6.90±2.46	1.75
No. of fishing days per year	242.10±38.61	250.90±36.25	254.09±33.07	0.31
Experience, years	24.80±8.39	20.45±14.75	20.63±8.82	0.50
Size of craft, m	15.87±3.22	14.64±2.26	16.72±2.30	1.76
No. of days of operation of craft	222.10±36.90	180.45±57.63	228.63±53.94	2.89
Investment on craft, Rs. $x10^3$	128.50±84.88	81.54±41.43	108.50±43.54	1.68
Investment on nets, Rs. $x10^3$	273.10±97.36	348.86±237.25	325.06±177.05	0.46
Investment on engines, Rs. $x10^3$	181.04±87.72	189.72±105.84	166.97±28.67	0.22
Maintenance cost of craft, Rs. $x10^3$	12.55±8.33	15.96±10.55	14.43±6.15	0.41
Length of nets used, m	422.20±152.36	366.54±148.76	403.09±104.86	0.45
Average depth of fishing, m	49.20±23.10	53.90±23.91	37.36±8.74	2.04
No. of nets used	1.10±0.31	1.45±0.52	1.36±0.50	1.63
Average operating hours of engine per day	9.00±1.82	11.18±2.70	8.72±1.55	4.48*
Total engine hp used	46.89±20.79	44.09±14.96	50.90±4.90	0.58
Annual income, Rs. $x10^3$	36.74±29.58	37.67±13.09	61.08±42.66	2.14
Communication channels used, No.	4.20±0.91	5.72±1.55	3.81±1.77	5.09*
Innovation proneness index	48.00±13.98	61.81±14.01	69.09±13.75	6.16**
Adoption index	66.00±16.46	80.00±	85.45±12.93	4.64*
Overall average catch, $kg.day^{-1}$	553.46±111.12	526.81±	531.53±93.55	0.19

* Significant at 5% level; ** Significant at 1% level
Source: Balasubramaniam *et al.* (2003)

The results revealed that the respondents in three centres were middle-aged (38-44 years), well experienced (20-25 years) and employed in fishing for 242-250 days in a year. It is seen that they had operated 15-17 metre larger plank-built crafts [disco vallam (46.87%), thangu vallam

(43.75%); both types of crafts (9.38%)] and some respondents (15.62%) had also used smaller crafts (mini-vallam) for mini trawling. On an average, the investment in fishing crafts varied from Rs. 81,540 to Rs. 1,28,500 while the investment on fishing nets varied from Rs. 2,73,100 to Rs. 3,48,860. Due to the operation of two or three engines (total hp 44-51), the investment on engines varied from Rs. 1,66,970 to 1,89,720. The results also revealed that the average depth of fishing varied from 37-54 metres and the net average annual income was found to vary from Rs. 37,000-61,000.

The socio-economic variables of fishing boat owners in three fishing centres of Kerala were presented in Table 4 (Balasubramaniam *et al.*, 2000). The results revealed that among the boat owners in the three centres, there were no significant differences on five variables such as age, investment on engine, engine horse power used, experience and risk preference, and in all the other 12 variables, the *F*-values were significant.

Table 4: Socio-economic variables of mechanized boat operators

Variables	Cochin (n=30) Mean±SD	Quilon (n=30) Mean±SD	Kozhikode (n=21) Mean±SD	F
Age, years	39.73±9.68	40.13±9.81	37.04±8.31	0.74
Investment on boat, Rs. $x10^5$	6.08±3.27	3.75±2.32	4.60±2.80	5.13**
Investment on engine, Rs. $x10^5$	2.07±0.73	1.80±0.77	1.98±0.86	0.91
Investment on nets, Rs. $x10^5$	0.71±0.35	0.51±0.15	0.85±0.21	11.25**
Annual income, Rs. $x10^5$	5.73±9.37	0.59±0.30	0.52±0.43	7.70**
Size of boat, m	12.21±1.39	11.31±0.89	11.64±1.48	3.89*
Engine hp	122.80±76.50	95.60±10.71	103.33±8.48	2.59
No. of net units used	7.63±3.35	7.10±1.53	10. 76±3.04	12.31**
Size of crew, No.	6.00±0.45	5.30±0.46	6.04±0.21	28.86**
Experience, years	9.23±8.52	11.23±6.72	6.69±3.38	2.72
No. of fishing days per year	211.66±38.31	190.83±19.69	193.81±30.61	3.96*
Information need quotient	67.16±20.74	49. 00±17.78	65.00±20.06	7.47**
Risk preference index	67.25±10.17	67.50±7.51	72.73±7.15	3.08
Awareness index	69.52±13.90	64.76±8.98	84.35±4.29	23.21**
Size of shrimp trawl, m	24.56±5.13	36.15±5.07	28.02±0.84	53.68**
Operating hours of engine per day	16.21±3.69	11.70±1.36	14.61±1.02	25.83**
Average annual fish catch, t	95.29±94.26	28.90±10.63	39.47±9.28	10.99**

* Significant at 5% level; ** Significant at 1% level
Balasubramaniam *et al.* (2000)

The results also showed that the average size of boat operated in these centres varied from 11.31 to 12.21 m L_{OA}. The size of shrimp trawl ranged from 24 to 36 m, and the horsepower of the engine varied from 95 to 123. The average number of fishing days varied form 190 to 212 per year. It is seen that increase in investment and technology adoption results in increase in the annual fish catches, though overinvestment may not often result in more income due to various operational parameters.

Need for extension interventions to facilitate adoption of CCRF guidelines

By the late 1980s, it became clear that fisheries resources could no longer sustain such rapid and often uncontrolled exploitation and development, and that new approach to fisheries management embracing conservation and environmental considerations were urgently needed. The FAO Code of Conduct for Responsible Fisheries (CCRF) (FAO, 1995) provides the necessary framework for national and international efforts to ensure sustainable exploitation of aquatic living resources in harmony with the environment. In this context, the following aspects of the CCRF require specific attention in fisheries extension interventions so as to promote their voluntary acceptance effective application.

- Usage of improved gear and practices to increase fish catch and at the same time, avoidance of overfishing
- Usage of improved gear and practices to conserve fishery resources
- Usage of method to reduce fuel consumption for responsible fishing and energy optimization
- Observance of fishing holidays like monsoon trawl ban
- Usage of measures to avoid catching non-target fishes
- Usage of measures to avoid catching of juveniles
- Usage of measures to avoid pollution of sea and waste disposal to protect coastal areas
- Observance of Government restrictions on fishing in some selected areas for conservation
- Following regulations or restrictions imposed by local bodies for protecting fishery resources and to minimize the adverse impacts on the environment due to aquaculture
- Promoting the contribution of fisheries to food security and food quality, giving priority to the nutritional needs of local communalities
- Promoting the protection of living aquatic resources, their environments and management for sustainable fisheries

- Ensuring good fishing facilities and equipment assuring safe, healthy and fair working and living conditions
- Conservation of biodiversity of aquatic habitats and ecosystems and protection of endangered species
- The harvesting, handling, processing and distribution of fish and fishery products have to be carried out in a manner which will maintain the nutritional quality and safety of the products, reduce waste and minimize negative impacts on the environment.

Need for coastal fisheries conservation and management programmes

Fisheries development is closely associated with coastal zone management, and increasing fish production and management of coastal fisheries, prevention of environmental pollution, and improvement of socio-economic conditions of fisherfolk are basic issues in coastal zone management. Coastal zones are unique and special resource areas because of their strategic importance and contribution to National economy. The coastal population depends on coastal environment and resources for their livelihood and scientific management of these resources are suggested by the policy planners and administrators for sustainable development and for peaceful co-existence among the various interest groups.

Stobutzki *et al.* (2006) reported that Asian region supplied nearly 60% of global fish production and the simultaneous multidisciplinary assessments conducted in eight Asian countries (Bangladesh, India, Indonesia, Malaysia, Philippines, Sri Lanka, Thailand and Vietnam) had highlighted disturbing regional trends. The coastal fisheries resources were severely depleted and biological and economic overfishing were occurring throughout the region, and these were symptoms of the lack of effective management of fishing capacity in the region. The major contributor to these declines was overfishing and all eight countries showed signs of overfishing in coastal fisheries such as declining catch per unit effort. Licensing systems alone are rarely sufficient to effectively manage fishing capacity, particularly if the enforcement is poor and compliance is low. The delineation of fishing zones has been another approach for managing access within the region. The EEZ of most countries is divided into zones, based on depth or distance from shore, where particular gear and vessels can be used. As both sectors (small scale and industrial) may be competing for the same resource, there is need to regulate the fishing in both the sectors.

An environmental impact assessment (EIA) conducted in Indonesia, indicated that continuous depletion of coastal resources resulted in reduced fish catch and income of fishers, thus contributing to increased poverty in the coastal communities and perpetuation of the cycle (PRIMEX, 1997). In Indonesia, a project was initiated during 1998-2003 at a cost of USD 75 million in four selected locations and the project activities included (i) controlling fishing effort within environmental limits through the establishment of a coastal fisheries licensing system and adoption of community-based coastal resources management measures; (ii) increasing the income of coastal fishers and facilitating their access to alternative livelihood or income-augmenting opportunities; (iii) improving the living conditions of selected coastal communities through the provision of necessary social infrastructure, and (iv) rehabilitating facilities at selected fish landing centres to improve environmental and sanitary conditions as well as product quality.

Vijayan *et al.* (2000) reported that the fishing pressure exerted by the increasing number of crafts using innovative gears in the near-shore regions had resulted in heavy competition leading to inter and intra-sectoral conflicts. Active fishing with synthetic fibres, motorization of crafts and modification of craft and gear had contributed to the overfishing. The Kerala Marine Fishing Regulation Act, 1981 the first of its kind in the country was enacted and this act provides for a regulation of fishing in the territorial seas along the coastline of the state through registration and licensing, mesh size regulation, prohibition of certain fishing methods, delimitation of fishing zones and declaration of closed seasons. In this context, a partial ban on trawling during the monsoon season was introduced in May 1981 (Kalawar *et al.,* 1985; Nair, 1989).

Extension education areas for responsible fisheries and coastal zone management

The key areas identified for extension education, in the context of responsible fisheries and coastal zone management include the following:

- Indiscriminate trawling and use of trawl codends with less than legal mesh size, catch of juveniles and discards at sea.
- Regulating the operation of ring seines and standardisation of ring seine units.
- Regulation of fishing by mini-trawls in inshore areas by artisanal fishermen.
- Area-wise optimization of fleet size and fleet categories.
- Large scale adoption of square mesh codends for the exclusion of juveniles

- Facilitating the adoption of fuel efficient otter boards
- Ban on night trawling
- Reduction of time lag between catching and icing
- Use of Bycatch Reduction Devices (BRD) and Turtle Excluder Devices (TED)
- Facilitating adoption of environment-friendly semi-pelagic trawl systems.
- Sensitization regarding Illegal, Unreported and Unregulated (IUU) fishing.
- Information on potential fishing zones (PFZ)
- Marketing of quality fish, and hygiene and sanitation in marketing
- Production and marketing of value added fish products through self help groups, cooperatives and interested entrepreneurs.
- Prevention of pollution in fisheries environment.
- Creation of awareness on negative effects of unscientific shrimp farming
- Conflicts between mechanized and artisanal fishermen groups regarding the use of different fishing methods and on trawl ban issues
- Extension schemes to increase awareness and for capacity building measures

The major constraints in management of coastal zones are listed below:

- Imbalance among community members, in terms of economic and social inequalities.
- Population growth, poverty and unemployment.
- Scarcity of resources and growing competition for space
- Conflicting needs of residents, over-exploitation of fishery resources and need for alternative employment avenues.
- Lack of coordination among institutions and organizations concerned with various aspects of developmental problems.
- Lack of participation of users in development activities.
- Decline of coastal zone common property resources.
- Ineffective system of governance.
- Lack of broad based resource management approach.
- Environmental problems and inadequate protection measures.
- Inadequate participation of NGOs to deal with local problems and distribution of wealth.
- Natural disasters and unfavourable weather conditions.

Conclusion

The conservation strategies need to be region and fishery-specific, and could facilitate the development of effective access and property rights regimes. The state fisheries policies need to explicitly allocate rights between small-scale and large-scale mechanized fishing sectors, where resources are shared taking into account the economic and social benefits of each sector. Each State fisheries department in the coastal region needs to prepare a policy document to promote responsible harvest and post-harvest operations and should put in place an efficient extension strategy to realise the objectives.

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