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Fisheries Management for Sustainable Livelihoods (FIMSUL)

Work Package 5
Report - WP5AR2

Marine Fish Production in Tamil Nadu & Puducherry

A report based on a detailed analysis of Central Marine Fisheries Research Institute Data

Government of Tamil Nadu

Government of Puducherry

Food and Agriculture Organization of the United Nations

The World Bank

Cover photograph : Landed catch in the Cuddalore fishing harbour. Photo by Philip Townsley

FISHERIES MANAGEMENT FOR SUSTAINABLE LIVELIHOODS (FIMSUL) PROJECT IN TAMIL NADU AND PUDUCHERRY, INDIA (FAO/UTF/IND/180/IND)

Work-Package 5

Fisheries Management Systems

MARINE FISH PRODUCTION IN TAMIL NADU & PUDUCHERRY

A Report based on a detailed analysis of
Central Marine Fisheries Research Institute Data

Authors

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December 2011

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PREFACE

Fisheries Management for Sustainable Livelihoods (FIMSUL), is a project implemented by the Food and Agriculture Organization of the United Nations (FAO) with the Government of Tamil Nadu and Puducherry in India under the World Bank Trust Fund.

The project aims at establishing frameworks, processes and building capacities of various stakeholders especially the Government, to facilitate the planning, design and implementation of appropriate fisheries development and management policies.

The project includes a series of stakeholder consultations and consensus building apart from detailed review and analysis in the areas of stakeholders, livelihoods, policy, legal and institutional frame work, fisheries management and knowledge management. Based on this, the project comes up with various options.

Work Package 5 deals with Fisheries Management. The work package includes a detailed review of the marine fisheries management systems and practices in Tamil Nadu and Puducherry, detailed analysis of the marine fisheries data to help decision making, case studies on different fisheries management unit approaches and finally based on all these, to suggest different fisheries management options. This report is a detailed analysis of the marine fisheries catch data from the Central Marine Fisheries Research Institute. The report emphasises the importance of scientific data and its analysis for arriving at decisions on appropriate strategies in fisheries management and fisheries policy.

The FIMSUL team thanks the successive Secretaries and Director/ Commissioners of Fisheries in Tamil Nadu and Puducherry during the project period for all the support provided. The support of the Department of Fisheries officers from Tamil Nadu and Puducherry is acknowledged with thanks. Thanks to Dr. Ahana Lakshmi for editing the report. We thank the Central Marine Fisheries Research Institute, Kochi for providing the marine fisheries data.

Our thanks are due to Mr. Rolf Willmann, Senior Fisheries Planning officer, FAO, Rome, the lead technical officer for the project, for his constant guidance and support. The team thanks Dr. Gavin Wall, FAO representative for India, Ms. Renuka Taimni and other officers from FAOR office New Delhi for all support.

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EXECUTIVE SUMMARY

Continuous growth in TN marine fisheries is observed in the form of introduction of new fishing vessels, fishing methods, new fishing gears and development of different infrastructure since 1950 leading to a five-fold increase in catch and three-fold increase in active fishers. There is a continuous expansion of fishing operation to deeper and distant waters. There has been a continuous discovery of new fishing grounds, new fishery resources and new fishing methods. The entire shelf area off Tamil Nadu (TN) coast is covered by TN fishing fleet and there is no scope for additional catch from the shelf area.

The landings grew continuously till 1997, witnessed a sharp fall during 1998-2004 and then a sharp increase in the following years 2006-09 hitting the new peak of 5.39 lakh tonnes well beyond the potential yield estimate of 4.25 lakh tonnes by CMFRI. A section of the TN fishing fleet depend heavily on fishing in neighbouring waters and nearly 20% of the catch comes from South Andhra and Sri Lankan waters. Deep sea fishing is already in vogue in TN as Kanyakumari's Thoothoor fishers with a fleet of approximately 500 long-liners cum gillnetters reigning all over the west coast and landing their catch at Kochi. Chennai gillnetters and a tiny fleet of long-liners in Puducherry have already started fishing beyond the shelf on the east coast.

There has been a continuous change in catch composition of dominant species. Pelagic resources have become more dominant over demersal and other resources. This has led to the emergence of the low value oil sardine as the number one species contributing to over 20% of the total TN production. The higher price increase of fish and fishery products over other food products in our country has led to an unprecedented increase in demand and supply. This has prompted the fishers to bring more catch at the cost of increased investment and operating cost which in turn has led to over capitalization of the fishery sector. Lack of entry barriers and capacity controls has led to an intense competition between sub-sectors and between units within each sub-sector. This also adds up to higher investments to increase scale and shift towards more efficient gears like ring seine and pair trawling.

Keen competition has also led to an unfavourable distribution of fish catch among sub-sectors. The mechanised sector with just 25% of the workforce has increased its share from less than 50% a decade ago to over 69.7% in 2010. Inter-sectoral conflicts and adoption of banned gears by both mechanised and motorised sectors are considerable. All these imply that there is an urgent need for improved and efficient management systems addressing over-capacity, ecosystem degradation, sectoral conflicts, fisher rights, limited access, fleet reduction, , gear controls, deep sea fishing, transboundary issues, conflict resolution, among others. This should be done by exploring the existing management practices and traditional management systems, and should come out with practicable management options involving co-management practices with active participation of the fishers.

CONTENTS

1. Introduction

Marine fishing in Tamil Nadu and Puducherry is an age old avocation and the fishermen venture all along the Indian coastline, even beyond the shelf into the deep sea.

Table 1 : Basic details about Tamil Nadu and Puducherry

	Tamil Nadu	Puducherry
Coastline	1076	45
Coastal Districts	13	2
Continental Shelf	44,412 km^2	900 km^2
Offshore area	2.2 x 10^5 hectares	
Number of fishing villages	591 (includes 10 estuarine fishing villages)	25
Total fisher population	0.861 million	36,905
Active fishers	0.26 million	8,813
Production	5.34 lakh tonnes (2009)	30,502 tonnes
Value of export	Rs. 17,722 million (2008-09)	

Tamil Nadu ranks third in Marine fish production and has the potential to emerge as a major exporter of marine products, as 68,397 mt of marine products valued at Rs.1,77,220 lakhs were exported during 2008-09 (Policy Note 2010-2011 of Tamil Nadu).

Out of 24,618 species of fishes occurring globally, about 2500 species (10.1%) have been reported to occur in Indian waters of which 1570 the marine species are reported to be in Tamil Nadu waters. The table below gives a list of commercially important species.

Table 2 : Commercially important species found off Tamil Nadu

Pelagic Resources	Demersal Resources	Crustaceans	Molluscs	Others
Clupeids : Wolf herring, Oil sardine, Other sardines, Hilsa shad, Other shads, Anchovies *(Coilia sp., Setipinna sp, Stolephorus sp, Thrissina sp., Thryssa sp)*	**Elasmobranchs :** Sharks, Skates and Rays	**Prawns :** Penaeid prawns, Non-Penaeid prawns	**Cephalopods :** Squids, Cuttlefish, Octopus	Seaweeds
Half Beaks & Full Beaks	Eels	**Lobsters :** Spiny lobsters, Sand lobster	**Chanks :** Sacred chanks, other chanks	
Flying Fish	Catfish	Crabs	**Bivalves :** Mussels, clams, cockles, edible oysters	
Ribbon Fishes	Lizard Fishes	Squilla		
Carangids : Horse mackerel, Scads, Leather-jackets	Perches: Rock cods, Snappers, Pig-face breams, Threadfin breams, Sweetlip breams	Stomatopods		
Mackerels	Goatfish			

Table 2 : Commercially important species found off Tamil Nadu				
Pelagic Resources	**Demersal Resources**	**Crustaceans**	**Molluscs**	**Others**
Seer Fish: King seer, Spotted seer and Wahoo	Croakers			
Tunnies	Silverbellies			
Bill Fish	Big-Jawed Jumper			
Barracudas	**Pomfrets**: Black pomfret, Silver pomfret and Chinese pomfret			
Sailfish	Mullets			
	Unicorn Cod			
	Flat Fish: Halibut, Flounders, Soles			

1.1 Objective

In this paper, we analyse the data on the marine fish production in Tamil Nadu and Puducherry from 1956 onwards. The data for this analysis have been gathered from published research papers, technical reports, annual reports and other publications for the period before 2000. For the recent period from 2001 to 2010, the data have been obtained from Central Marine Fisheries Research Institute through payment for data mining.

The data obtained through secondary and primary sources have been segregated into species-wise/group-wise, district-wise, sector-wise and the species dominance in the catch, to study various aspects of the fishery. For speedy processing and data mining, the primary data obtained from CMFRI for the period from 2001 to 2010 were subjected to further processing and a series of four PIVOT Tables have been created. These Pivot Tables are available for download from the FIMSUL website https://sites.google.com/site/fimsul/.

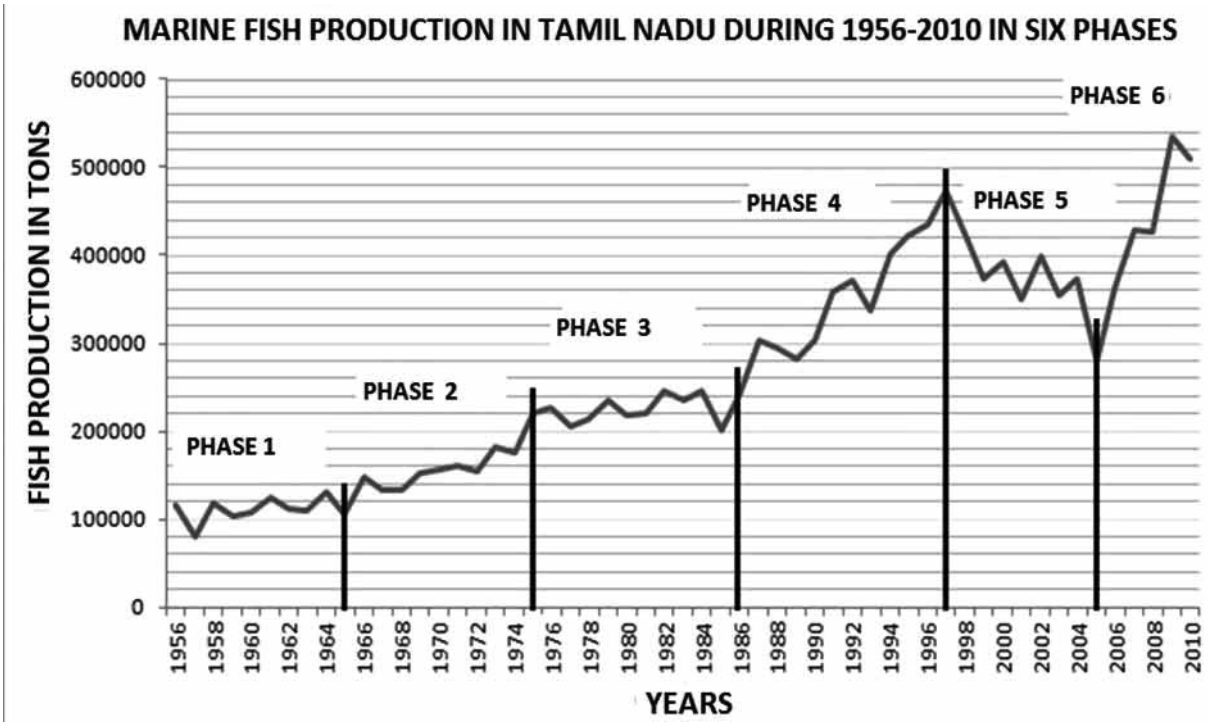
1.2 Historical Developments in Marine Fisheries of Tamil Nadu and Puducherry

The total annual marine fish production in Tamil Nadu during 1956-2010 is divided into six phases as given in Table 3 and Figure 1 shows the production graphic.

Table 3 : The six phases of marine fishing in Tamil Nadu	
PHASE	**YEARS**
Phase 1	1956-1965
Phase 2	1966-1975
Phase 3	1977-1986
Phase 4	1987-1997
Phase 5	1998-2005
Phase 6	2006-2010

The data reveal that from 1956 to 1997, there was a sustained increase, and thereafter a decline for the first time in the history of Tamil Nadu marine fish production till 2004 when tsunami struck. From 2005 onwards there has been a sharp increase in production reaching an all-time high of 5.39 lakh tonnes in 2009 and has continued to remain above 5 lakh tonnes in 2010 also.

Fig.1. Historical developments in marine fish production in Tamil Nadu during 1956-2010



Annual marine fish production in Tamil Nadu during 1956-2010 may be divided into 6 important phases of developments. The first phase during 1956-1965 may be considered as the pre-development phase, where only the traditional non-motorised catamarans, vallams and canoes harvested the marine fishery resources in the near-shore waters up to a depth of 50 m. There was a gradual increase in fish production and change in fish catch due to the introduction of nylon nets. There was no mechanised fishing.The production trends of different species/groups during the first phase are given in table 4.

Table 4 Change in fish caught during Phase 1

Increasing Trend	Decreasing Trend	No Change in Production
Barracudas, Carangids, Cephalopods Cupeids, Elasmobranchs, Half & full beaks, Hilsa & shad, Lizard fishes, Mackerel, Molluscs, Mullets, Oil sardine, Other sardines, Penaeid prawns, Scads, Soles, Threadfins, Tunnies, Wolf herring.	Anchovies, Big jawed jumper, Bombay duck, Catfishes, Croakers, Crustaceans, Eels, Goatfishes, Horse mackerel, Leatherjackets, Non-penaeid prawns, Other carangids, Other clupeids, Pomfrets, Ribbonfishes, Seerfishes, Silverbellies, Thryssa.	Flying fishes, Perches.

The second phase during 1966-1975, may be called as the developing phase, when the beginning of the period was dominated by the introduction of mechanised fishing by bottom trawling for prawns. The rate of fish production gained momentum and the fish production increased rapidly.

Table 5 : Change in fish caught during Phase 2		
Increasing Trend	**Decreasing Trend**	**No Change in Production**
Barracudas, Bombay duck, Catfishes, Cephalopods, Clupeids, Crabs, Croakers, Crustaceans, Eels, Elasmobranchs, Goatfishes, Half & Full beaks, Hilsa Shad, Horse mackerel, Lizardfishes, Mackerel, Molluscs, Mullets, Non-penaeid prawns, Other carangids, Other clupeids, Other sardines, Other Shads, Penaeid prawns, Perches, Ribbonfishes, Seerfishes, Soles, Threadfins, Thryssa, Tunnies	Anchovies, Big jawed jumper, Carangids, Flying fishes, Leather jacket, Oil sardine, Pomfrets, Wolf herring.	Silverbellies.

The third phase during 1976-1985 may be called as the maturing phase, marked by the expansion of the traditional boats and initiation of motorization of the traditional boats and catamarans. This period witnessed expansion of fishing area by mechanized fishing.

Table 6 : Change in fish caught during Phase 3		
Increasing Trend	**Decreasing Trend**	**No Change in Production**
Anchovies, Carangids, Cephalopods, Clupeids, Coilia, Flounders, Flyingfishes, Goatfishes, Hilsa shad, *K. pelamis,* Leather jackets, Lizardfishes, Lobsters, Mackerel, Molluscs, Oil sardine, Other carangids, Other perches, Other tunas, Penaeid prawns, Perches, Pomfrets, Rockcods, Setipinna, Silverbellies, Soles, Stolephorus, Wolf herring.	*Auxis sp.,* Big jawed jumper, Billfishes, Black pomfret, Bombay duck, Catfishes, Chinese pomfret, Crabs, Croakers, *E. affinis,* Eels, Elasmobranchs, Half & Full beaks, Halibut, Horse mackerel, Kingseer, Mullets, Skates, Non-penaeid prawns, Other clupeids, Other sardines, Other shads, Pig face breams, Rays, Ribbonfishes, Scads, Seerfishes, Sharks, Silver pomfret, Snappers, Spotted seer, Stomatopods, Streaked seer, *T. tonggol,* Threadfin breams, Threadfins, Tunnies, Wahoo	Barracudas, Crustaceans, Lobsters, Thryssa.

The fourth phase during 1986-1997 is the fully matured period witnessing the expansion of motorization of the traditional boats and diversification of mechanised fishing. It is marked by the emergence of oil sardine as one of the top 10 species though it was yet to be noticed. Fish production during this period attained the peak of 4.72 lakh t with rapid rate of production.

Table 7 : Change in fish caught during Phase 4		
Increasing Trend	**Decreasing Trend**	**No Change In Production**
Auxis spp., Barracudas, Billfishes, Black pomfret, Carangids, Catfishes, Cephalopods, Clupeids, Crabs, Croakers, Crustaceans, Eels, Elamobranchs, Flounders, Half & Full beaks, Hilsa shad, Horse mackerel, *K. pelamis,* Leather jackets, Lizardishes, Mackerel, Molluscs, Mullets, Non-penaeid prawns, Gastropods, Oil sardine, Other carangids, *Acanthocybium sp.,* Other perches, Other sardines, Penaeid prawns, Perches, Pig face breams, Pomfrets, Rays, Rockcods, *S. commersonii, S. guttatus, S. lineolatus,* Seerfishes, Sharks, Silver pomfret, Siverbellies, Skates, Snappers, Soles, Stomatopods, *T. Tonggol,* Threadfin breams, Threadfins, Thryssa, Tunnies.	Anchovies, Bivalves, Bombayduck, Chinese pomfret, Coilia, Flyingfishes, Goatfishes, Halibuts, Other shads, Other tunnies, Ribbonfishes, Scads, Stolephorus, Thrissina, Wolfherring.	Big jawed jumper, *E. affinis,* Lobsters, Setipinna.

Fifty two species/groups were found to exhibit an increasing trend in production and only 15 species/groups were observed to exhibit a declining trend. Four species were observed to exhibit neither increase nor decrease in production during this phase.

The fifth phase during 1998-2004 was a period of decline in the catch from 4.72 lakh t to 2.8 lakh t and this period may be called as the pre-tsunami period. This period witnessed the impact of overcapacity and intensive capitalisation in the mechanised and motorised sectors. Despite an increase in the fishing capacity, there is a decline in the fish production. This was mainly due to the decline in oil sardines and clupeids.

Table 8 : Change in fish caught during Phase 5

Increasing Trend	Decreasing Trend	No Change in Production
Barracudas, Big jawed jumper, Billfishes, Bivalves, Black pomfret, Bombay duck, Carangids, Cephalopods, Chinese pomfret, Crabs, Flounders, Flying fishes, Halibuts, Hilsa shad, Horse mackerel, *K. pelamis,* Leatherjackets, Lizardfishes, Mackerel, Molluscs, Non-penaeid prawns, Gastropods, Other perches, Other sardines, Other tunnies, Perches, Pig face breams, Pomfrets, Ribbonfishes, Scads, Sharks, Silver pomfret, Skates, Stomatopods, *T. Tonggol,* Threadfin breams, Threadfins, Thrissina, Thryssa, Tunnies.	*Acanthocybium spp.,* Anchovies, *Auxis spp.,* Catfishes, Clupeids, Coilia, Croakers, Crustaceans, *E. affinis,* Eels, Elasmobranchs, Goatfishes, Half & Full beaks, Lobsters, Mullets, Oil sardine, Other clupeids, Other shads, Penaeid prawns, Rays, *S. commersoni, S. guttatus, S. lineolatus,* Seerfishes, Setipinna Silverbellies, Snappers, Soles, Stolephorus.	Rockrod, Wolf herring

Forty species/groups exhibited an increasing trend and 29 species/groups exhibited a declining trend. Two species were observed to have neither increase nor decrease in production.

The sixth phase is the post-tsunami period from 2006-2010, which saw a change in the fishery resource and an adaptive fishing pattern to exploit the emerging and existing deep sea fishery resources through further diversification in fishing methods with an aim to catch the pelagic resource such as the oil sardine in the near shore waters and tuna in the deep sea. This led to an all-time high production of above 5.39 lakh t from 2009 onwards. The unexpected growth in oil sardine production was due to targeted fishing for oil sardine. Oil sardine has emerged as No.1 resource and this formed 20% of Tamil Nadu total production.

Table 9 : Change in fish caught during Phase 5

Increasing Trend	Decreasing Trend
Acanthocybium sp., Anchovies, *Auxis sp.,* Barracudas, Carangids, Catfishes, Clupeids, Crabs, Croakers, Crustaceans, Cuttlefishes, *E. affinis,* Gastropods, Goatfishes, Half & Full beaks, Hilsa shad, Horse mackerel, Lizardfishes, Molluscs, Mullets, Oil sardine, Other carangids, Other clupeids, Other perches, Other shads, Other tunnies, Penaeid prawns, Perches, Scads, Silver pomfret, Silverbellies, Skates, Soles, Squids, Stolephorus, Threadfins, Thryssa Tunnies, Wolf herring.	Big jawed jumper, Bivalves, Black pomfret, Bombay duck, Coilia Eels, Elasmobranchs, Flounders, Halibuts, Mackerel, Non-penaeid prawns, Pomfrets, Rockcods, *S. commersonii, S. lineolatus,* Seerfishes, Sharks, Snappers, Stomatopods, *T. Tonggol,* Thrissina.

Thirty nine species/groups exhibited an increasing trend and 21 species/groups were observed to exhibit a declining trend in production.

2. Fish Production in Tamil Nadu

Tamil Nadu marine fish production almost reflects the all India marine fish production which has increased from a meager 0.38 million t in 1950 to 3.2 million t in 2008 which declined marginally to 3.16 million t in 2010 (CMFRI Annual Reports) (Fig.2).

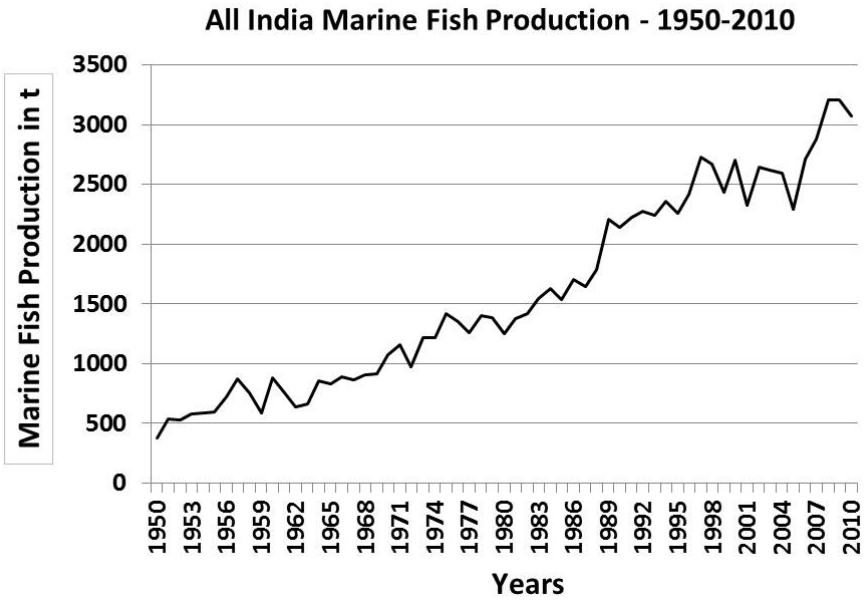


Figure 2 : All India marine fish production

2.1 Fish Production by sector

Three major sectors, namely the **mechanised** comprised of trawl fleet, gillnetters, purse seiners and ring seiners etc., **motorised** such as the gillnetters of different types, long liners, boat seiners, mini trawlers and bottom set netters and the traditional **non-motorised** sector comprised of catamarans, plank built boats, canoes and vallams contribute to the marine fish landings along the Tamil Nadu coasts.

2.1.1 Mechanised sector

Among the mechanized units, trawlers landed 92.1% of the total catch followed by mechanized gillnets (4.2%), mechanized bottom-set nets (1.3%), mechanized hooks & line (1.2%) and mechanized purse seine (0.5%).

The catch per hour of the purse seine was the highest 1272kg/hr followed by the bottom-set net at 469 kg/hr, hooks & line at 94 kg/hr, gillnet at 59 kg/hr, trawlnet at 51kg/hr, and lastly the bottom set gillnet at 3 kg/hr.

The trend in trawl landings in Tamil Nadu during 1985-2008 shows that the catch continued to increase from 1 lakh t in 1985 to 2.54 lakh t in 1995, then it declined to 1.42 lakh t in 2004 and revived back to 2.38 lakh t in 2008 (Kasim, 2009). The catch per actual fishing hours (AFH) of mechanised sector during 2001-10 indicates that the catch rate was better in all the districts except the three districts of Thanjavur, Pudukottai and Ramanathapuram bordering the Palk Bay.

2.1.2 Motorised sector

The motorized units are comprised of out-board units of gillnet, hooks & line, bottom set nets, trammel net, purse seine, traps and other gears, in which the gillnets landed the bulk of the total catch (59.0%) followed by hooks & line (7.4%), ring seine (7.1%), bottom set nets (2.8%) and all other gears put together contributed the balance

6.1%. The trend in the catch and effort of motorized sector during 1986-2008 reflects a spectacular increase from 1991to 2001 and then a gradual decline till 2004 with a revival in later years. The catch rate by motorized units indicates that the out board ring seine was the highest 735 kg/hr, followed by outboard purse seine (373 kg/hr) and has also been observed to increase gradually with fluctuations.

The more commonly used gears in the motorized sector were drift/set gillnets, hooks and line, ring seine, boat seines and shore seines (Kasim, 2009). As observed in the mechanised sector, the catch per AFH by motorised sector in the 3 districts of Thanjavur, Pudukottai and Ramanathapuram is also the lowest when compared to other districts. The poor catch rates by almost all the three sectors in the Palk Bay districts indicates the poor availability of the fishery resources in Palk Bay as it is almost like a shallow salt water lake with a maximum depth of only 13 m. In spite of the 3 and 4 day fishing agreement by the mechanised and traditional sectors which has reduced the total fishing days to 120 and 140 days in a year for these two sectors respectively, the availability of the fishery resources is comparatively the lowest. This shows that the fishery resources of Palk Bay have been exposed to severe overfishing by all the fishing sectors which may be one of the main reasons for the cross boundary fishing problem in Palk Bay.

2.1.3 Non-Motorised sector

Non mechanized landings comprised 10.8% of the total catch by traditional units. The catch per hour indicates that the catch rate of small shore seine (Olaivalai) is 247 kg/hr, bottom set net is 62 kg/hr, hooks & line is 12 kg/hr, drift gillnet is 11 kg.hr, and boat seine is 1 kg/hr.

In contrast to both mechanized and motorized sectors, the catch and effort of traditional (non-motorized) sector continued to decline from 1985 to 2008 with violent fluctuation in landings and minor variations in the effort input. The catch per unit of non-mechanized traditional units registered a marginal increase from 1989 onwards with a decline during early 2000 and a revival after 2005. The more common gears used in the traditional sector were drift/set gillnets, hook and line, traps, boat seines, shore seines and scoop nets.

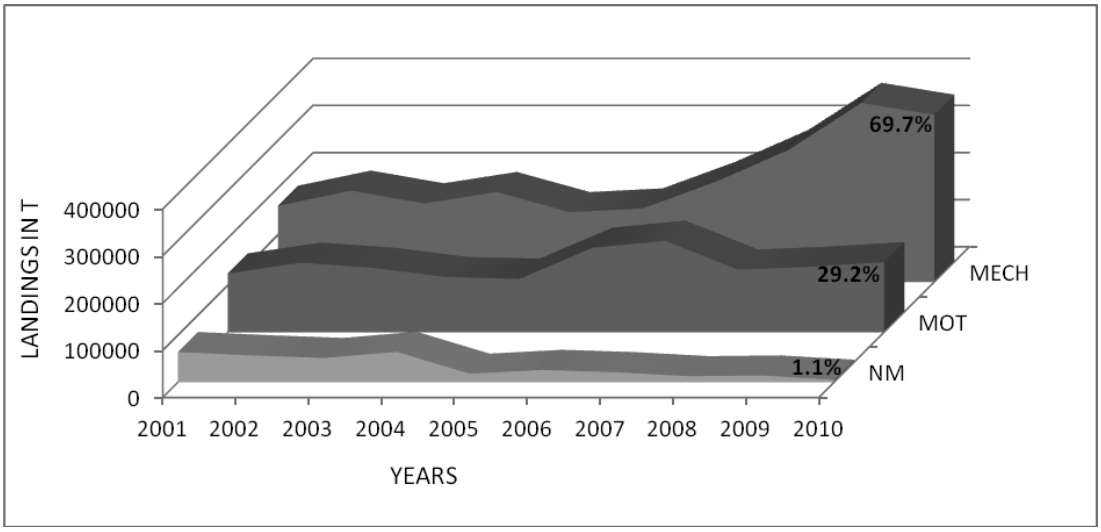


Figure3 : Sectorwise Total Marine Fish Landings in Tamil Nadu During 2001-2010

Total marine fish production by different sectors indicates that mechanised sector contributed the maximum catch during 2001-2010. The percentage contribution by the three sectors is given in Fig 3, in which the contribution by mechanised sector varied from 43.1% in 2006 to as high as 71.2% in 2009 with a decadal average of 56%.The contribution by motorised sector varied from 26.1% in 2009 to 49.5% in 2006 with decadal average of 35.6%. The contribution by the non-motorised sector continued to decline steadily and its percentage contribution to the total catch varied from 18.4% in 2001 to 1.1% in 2010 with an average of 8.4%. The percentage contribution in 2010 by mechanised sector was 69.7%, motorised sector was 29.2% and non-motorised sector was a meagre 1.1% (Fig.3).

Table 10 : Annual Average Production by three Different Sectors in Tamil Nadu during 2001-2010								
Sl No.	MECHANISED		MOTORISED		NON-MOTORISED		TOTAL	
	Species	Catch t	Species	Catch t	Species	Catch t	Species	Catch t
1	Silverbellies	35982	Other sardines	27479	Oil sardine	9914	Oil sardine	61006
2	Oil sardine	24818	Oil sardine	26274	Stolephorus	3755	Other sardines	42970
3	Penaeid prawns	15086	Indian mackerel	12586	Other sardines	3432	Silverbellies	39973
4	Other sardines	12059	Other carangids	7668	Crabs	2630	Other carangids	18368
5	Other carangids	9488	Pig-face breams	6557	Other carangids	1212	Penaeid prawns	17371
6	Other perches	8581	Crabs	4605	Indian mackerel	1098	Indian mackerel	16651
7	Rays	6086	S. commersoni	4070	Other perches	926	Crabs	12496
8	Goat fishes	5625	Thryssa	4020	Thryssa	772	Other perches	11989
9	Croakers	5573	Other clupeids	3928	Silverbellies	708	Pig-face breams	10565
10	Other clupeids	5304	Silverbellies	3283	Penaeid prawns	664	Other clupeids	9877
11	Threadfin breams	5300	E. affinis	3188	Other clupeids	645	Rays	9083
12	Crabs	5261	Stolephorus	3073	Cephalopods	554	Stolephorus	9026
13	Lizard fishes	4974	Other perches	2482	Rays	538	Croakers	8053
14	Cephalopods	4752	Rays	2459	Half & Full beaks	446	Thryssa	7190
15	Barracudas	4576	Barracudas	2282	Hilsa shad	381	Barracudas	7140
16	Scads	4402	Flying fishes	2150	Croakers	366	Goat fishes	6668
17	Ribbon fishes	4068	Croakers	2114	Sharks	338	S. commersoni	6029
18	Pig-face breams	3697	Wolf herring	1918	Pig-face breams	311	Cephalopods	5632
19	Squids	3652	Half & Full beaks	1915	Catfishes	299	Threadfin breams	5602
20	Cuttlefish	3077	Penaeid prawns	1621	Bivalves	284	Lizard fishes	5390
21	Indian mackerel	2967	Catfishes	1243	Barracudas	282	Ribbon fishes	5233
22	Non-penaeid prawns	2791	Sharks	1202	Goat fishes	259	Scads	5088
23	Catfishes	2550	Rock cods	1156	Scads	237	E. affinis	4627
24	Thryssa	2398	Snappers	1155	Cuttlefish	223	Squids	4284
25	Stolephorus	2198	Ribbon fishes	996	Wolf herring	193	Catfishes	4092
26	S. commersoni	1779	Other tunnies	927	Other shads	188	Cuttlefish	4035
27	Sharks	1750	Goat fishes	784	Squids	188	Sharks	3290

Table 10 : Annual Average Production by three Different Sectors in Tamil Nadu during 2001-2010								
Sl No.	MECHANISED		MOTORISED		NON-MOTORISED		TOTAL	
	Species	Catch t	Species	Catch t	Species	Catch t	Species	Catch t
28	Snappers	1577	Cuttlefish	735	S. commersoni	180	Non-penaeid prawns	3040
29	Other tunnies	1471	Auxis. spp	718	Horse Mackerel	171	Snappers	2815
30	E. affinis	1299	Other shads	700	Ribbon fishes	169	Wolf herring	2803
31	Rock cods	1254	Leather-jackets	696	Leather-jackets	158	Half & Full beaks	2549
32	Silver pomfret	1162	Soles	651	E. affinis	140	Rock cods	2546
33	Stomatopods	1096	Bill fishes	623	Rock cods	136	Other tunnies	2424
34	Soles	808	Mullets	454	Mullets	116	Flying fishes	2223
35	Mullets	780	Scads	449	Snappers	83	Other shads	1637
36	Leather-jackets	772	Squids	444	Silver pomfret	80	Leather-jackets	1626
37	Other shads	749	Lizard fishes	404	Threadfins	67	Silver pomfret	1551
38	Wolf herring	692	Gastropods	372	Soles	65	Soles	1524
39	K. pelamis	624	Skates	361	Auxis. Spp	53	Mullets	1350
40	Black pomfret	472	Cephalopods	326	Big-jawed jumper	46	Auxis. spp	1160
41	Gastropods	423	Threadfins	318	Threadfin breams	35	Stomatopods	1110
42	Auxis spp	389	Silver pomfret	309	Flying fishes	28	Bill fishes	1000
43	Bill fishes	372	K. pelamis	276	Black pomfret	27	K. pelamis	901
44	Octopus	371	Black pomfret	273	Other tunnies	26	Gastropods	813
45	Skates	359	Threadfin breams	267	T. tonggol	19	Hilsa shad	792
46	Eels	347	Big-jawed jumper	233	Gastropods	18	Black pomfret	772
47	Halibut	252	Non-penaeid prawns	232	Non-penaeid prawns	17	Skates	726
48	Horse Mackerel	210	Horse Mackerel	225	Lizard fishes	12	Horse Mackerel	606
49	Threadfins	209	Hilsa shad	218	Coilia	9	Threadfins	594
50	Hilsa shad	193	Eels	178	S. guttatus	8	Eels	532
51	Half & Full beaks	188	T. tonggol	173	Eels	7	Big-jawed jumper	460
52	Big-jawed jumper	181	Other mackerels	142	Skates	6	Bivalves	412
53	Lobsters	181	Lobsters	95	Thrissina	5	Octopus	408
54	Coilia	155	S. guttatus	68	Bill fishes	5	T. tonggol	319

Table 10 : Annual Average Production by three Different Sectors in Tamil Nadu during 2001-2010								
Sl No.	MECHANISED		MOTORISED		NON-MOTORISED		TOTAL	
	Species	Catch t	Species	Catch t	Species	Catch t	Species	Catch t
55	T. tonggol	127	Halibut	62	Lobsters	5	Halibut	315
56	Bivalves	124	Coilia	53	Chinese pomfret	3	Lobsters	281
57	Carangids	110	Setipinna	38	Setipinna	2	Coilia	217
58	S. guttatus	108	Octopus	37	Seer fishes	2	S. guttatus	184
59	Chinese pomfret	76	Bombayduck	33	Stomatopods	2	Other mackerels	148
60	Bombayduck	45	Perches	16	Bombayduck	1	Carangids	110
61	Flying fishes	45	Unicorn cod	12	Other mackerels	1	Chinese pomfret	84
62	Thrissina	39	Stomatopods	12	K. pelamis	1	Bombayduck	79
63	Acanthocybium spp.	23	Acanthocybium spp.	8	Halibut	1	Setipinna	57
64	Flounders	19	Anchovies	5	Molluscs	1	Thrissina	44
65	Setipinna	17	Chinese pomfret	5	Clupeids	0	Acanthocybium spp.	31
66	Clupeids	7	S. lineolatus	4	Anchovies	0	Flounders	20
67	S. lineolatus	6	Bivalves	4	Perches	0	Perches	16
68	Crustaceans	6	Seer fishes	2	Carangids	0	Unicorn cod	12
69	Other mackerels	5	Clupeids	1	Pomfrets	0	S. lineolatus	10
70	Molluscs	2	Flounders	1	Mackerels	0	Clupeids	8
71	Anchovies	0	Crustaceans	1	S. lineolatus	0	Crustaceans	7
72	Perches	0	Thrissina	0	Acanthocybium spp.	0	Anchovies	5
73	Pomfrets	0	Carangids	0	Tunnies	0	Seer fishes	4
74	Mackerels	0	Pomfrets	0	Unicorn cod	0	Molluscs	3
79	Miscellaneous	19824	Miscellaneous	2323	Miscellaneous	1359	Miscellaneous	23506
	TOTAL	**224480**	**TOTAL**	**143248**	**TOTAL**	**33900**	**TOTAL**	**401628**
	Percentage	**55.9**	**Percentage**	**35.7**	**Percentage**	**8.4**	**Percentage**	

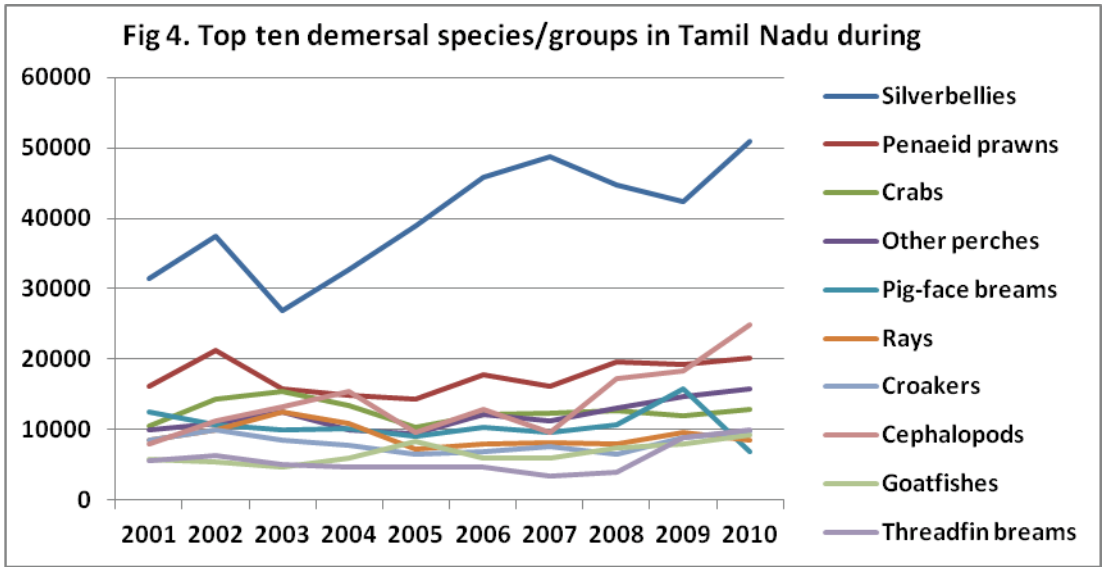
Average annual marine fish production by the three sectors in Tamil Nadu during 2001-2010 is given in Table 10. On an average 4.01 lakh t are landed in which the mechanised sector landed 55.9%, motorised sector 35.7% and the non-motorised sector 8.4%.

2.2. Fish production in Tamil Nadu by Species

Among the top ten demersal species/groups in the marine fish landings in Tamil Nadu during 2001-2010, silverbellies were the most dominant followed by penaeid prawns, cephalopods, crabs, other perches and pig face breams, as these groups contributed above 10000 t and the rays, croakers, goatfishes and threadfin breams contributed less than 10000 t. Among the top ten pelagic species /groups in the marine fish landings in Tamil Nadu during 2001-10, oil sardine was the most dominant species followed by other sardines, other carangids, Indian Mackerel and other clupeids as these groups contributed above 10000 t and the rest, Stolephorus, Thryssa, Barracudas, S. commersoni and ribbonfishes, contributed lesser than 10000 t. Oil sardine formed nearly 25% of total Tamil Nadu landings and has crossed 1 lakh t mark in 2009.

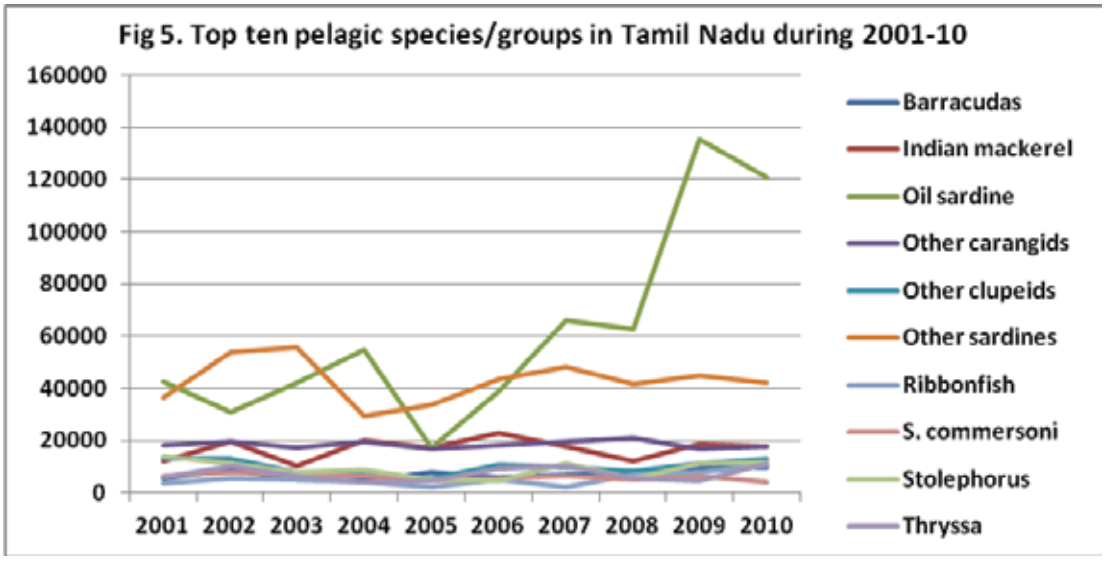
Table 11 : Top ten demersal and pelagic fishery resource obtained from the average catch during 2001-2010 in Tamil Nadu

Demersal Species	Average	Pelagic Species	Average
Silverbellies	40032	Oil sardine	61155
Penaeid prawns	17550	Other sardines	43356
Cephalopods	14044	Other carangids	18433
Crabs	12579	Indian mackerel	16833
Other perches	11948	Other clupeids	10191
Pig-face breams	10558	Stolephorus	9076
Rays	9124	Thryssa	7221
Croakers	8116	Barracudas	7170
Goatfishes	6654	S. commersoni	6084
Threadfin breams	5712	Ribbonfishes	5280



Annual production of the top ten demersal resources is shown in Fig 4 in the form of trend lines. Among the top ten demersal species/groups silverbellies alone contribute the bulk of the landings and exhibit a fast increase in the production trend. Though the remaining nine species/groups seem to have a moderate increase in the production trend, penaeid prawns and cephalopods appear to be much higher.

The production trend lines of the top ten pelagic fishery resources landed during 2001-2010 are shown in Fig 5. Oil sardine and other sardines were the two dominant groups followed by the Indian mackerel and other carangids. Oil sardine was competing closely with the other sardines during the pre-tsunami period and was lower than the other sardines in 2005. However, during the post tsunami period, especially since 2006, there was a sharp increase in the production of oil sardine and the catch crossed 1 lakh t mark in 2009 and 2010. Except oil sardine and other sardine, the rest of the pelagic species / groups seem to show neither an increasing nor a decreasing trend in production.



2.2.1 Dominant resources

The important species/groups exploited by the mechanised sector are elasmobranchs, eels, catfish, lizardfish, perches, snappers, threadfin breams, other perches, goatfishes, croakers, ribbonfishes, carangids, scads, silverbellies, pomfrets, silver pomfret, chineese pomfret, *S. guttatus, K. pelamis,* other tunnies, barracudas, halibut, crustaceans, penaeid prawns, non-penaeid prawns, lobsters, stomatopods, molluscs, cephalopods, squid, cuttlefishes and octopuses.

The important species/groups exploited by the motorised sector are other clupeids, wolf herrings, other sardines, thryssa, half & full beaks, flying fishes, pigface breams, leather jackets, big-jawed jumpers, mackerel, seerfish, *S. commersoni,* tunnies, *Euthynnusaffinis, Auxis spp* and billfishes.

2.3 District-wise marine fish production

There are thirteen coastal districts in Tamil Nadu. The percentage composition marine fish production by the three sectors in the 12 Districts is given in Table 12 (Tiruvarur district's marine fish catch is almost negligible). Tiruvallur, Tirunelveli and Viluppuram districts do not have any contribution by mechanised vessels at all and Kanchipuram district has a meagre 1.2% contribution by mechanised vessels. Districts with predominant contributions by mechanised vessels are Ramanathapuram, Chennai, Pudukottai, Cuddalore, Nagapattinam, Thanjavur and Kanyakumari. Tuticorin district has got almost equal contribution by mechanised and motorised vessels.

Table 12 : Percentage contribution by the three sectors Tamil Nadu in 2010			
Districts	**Mechanised**	**Motorised**	**Non-Motorised**
Thiruvallur	0.0	100.0	0.0
Chennai	86.6	13.1	0.3
Kancheepuram	1.2	98.3	0.5
Villupuram	0.0	99.9	0.1
Cuddalore	77.2	22.8	0.0
Nagapattinam	63.0	37.0	0.0
Thanjavur	60.2	39.8	0.0
Pudukkottai	82.6	17.4	0.0
Ramanathapuram	93.2	4.8	2.0
Tuticorin	51.1	48.8	0.1
Tirunelveli	0.0	100.0	0.0
Kanyakumari	61.0	35.9	3.0
Total	**69.1**	**29.8**	**1.1**

Marine fish landings in 2001 and 2010 in all the 12 districts are given in Table 13 with the difference between these two years to give an abstract status of change in fish production. Tiruvallur, Kanchipuram, Nagapattinam and Pudukottai registered a decline of 5.8, 3.1, 17.6 and 1.4% in the landings in 2010 when compared with 2001 data. Ramanathapuram, Cuddalore and Kanyakumari registered a whopping 52.1, 31.9 and 25.2% increase respectively in the landings followed by Villupuram, Chennai, Thanjavur, Tinunelveli and Tuticorin by 6.2, 6.0, 4.1, 2.0 and 0.2% respectively.

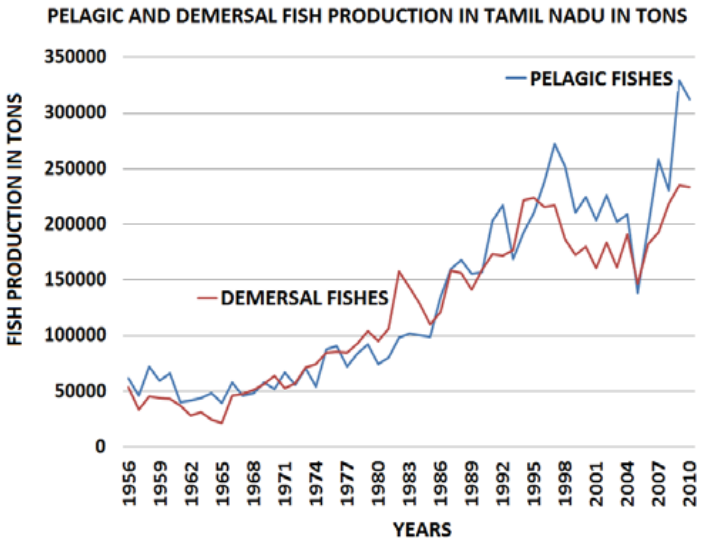
Table 13 : Marine fish production in different Districts during 2001 and 2010 with difference				
District	**2001**	**2010**	**Difference**	**Percent gain/ decline in the overall catch**
Tiruvallur	12310	3190	-9120	-5.8
Chennai	28412	37989	9577	6.0
Kanchipuram	9102	4256	-4846	-3.1
Villupuram	7283	17262	9979	6.3
Cuddalore	26450	76938	50488	31.9
Nagai	53303	25459	-27844	-17.6
Thanjavur	12974	19434	6460	4.1
Pudukottai	23682	21478	-2204	-1.4
Ramanathapuram	51432	133940	82508	52.1
Tuticorin	66527	66772	245	0.2
Tirunelveli	9221	12382	3161	2.0
Kanyakumari	50013	89925	39912	25.2
Total	**350709**	**509025**	**158316**	

2.3.1 Composition of pelagic and demersal resources

The composition of pelagic and demersal fishery resources in the landings during 1956-2010 reveals the apparent developmental changes in the marine fisheries of Tamil Nadu during this period. The preliminary phase during 1956-69 indicates the dominance of clupeids in the pelagic resources as the fishing was restricted to the near shore waters by non-motorised traditional crafts with nets made of cotton and hemp yarns. From 1970 onwards, the demersal fishery resources emerged as the dominant group in the landings possibly owing to the introduction of bottom trawling and expansion in the trawling grounds. Again from 1989 onwards the pelagic resources regained their position as the dominant fishery resource owing to the motorisation of the traditional boats and introduction of efficient gears made of nylon and mono filaments as these gears are efficient in tapping the pelagic fishery resources. A decline in the landings of demersal resources is also apparent probably owing to over exploitation of the demersal fishery resources in the trawling grounds of Tamil Nadu and limited scope for further expansion of the trawling grounds (Please see Fig 6).

Table 14 : Composition of pelagic and demersal fishery resources in Tamil Nadu: 2001-2010

YEAR	DEMERSAL	%	PELAGIC	%	TOTAL
2001	160818	45.9	189865	54.1	350683
2002	183792	46.1	214874	53.9	398666
2003	161213	45.4	193950	54.6	355163
2004	192191	48.9	200562	51.1	392753
2005	146846	52.5	133118	47.5	279964
2006	168976	46.7	192797	53.3	361773
2007	182338	42.6	245891	57.4	428229
2008	200606	47.1	225251	52.9	425857
2009	228156	41.1	326805	58.9	554961
2010	208164	40.9	300861	59.1	509025
Average	182674	45.1	222397	54.9	405071



During 2001-2010, pelagic fishery resources were dominant constituting always more than 50% in all the years except in 2005 when the demersal fishery resources comprised 52.5% of the catch. (Table 14).

2.3.2 Emergence of oil sardine as No.1 resource

Oil sardine, *Sardinella longiceps,* popularly called as 'maththi' in Tamil was unknown as a fishery resource prior to late 1980s and has been recognised as a fishery only in 1988. Now, this single species has emerged as the number one resource, contributing more than one lakh t during 2009 and 2010. Marine fish landing during 1956-2010 in Tamil Nadu with and without oil sardine is shown below, where the red line indicate the total fish catch including oil sardine and the blue line total catch without oil sardine. There appear to be of no oil sardine landings till 1988 and later there has been a steady increase in oil sardines constituting almost 20% of the total marine fish catch in Tamil Nadu during 2009 and 2010. The bulk of the catch comes from Ramanathapuram and Cuddalore districts landed by pair trawlers and ring seines in the former and ring seine in the latter (Fig 7).

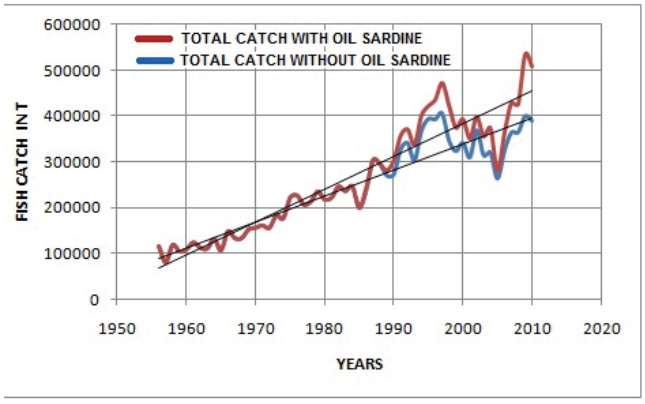


Fig 7 : Total marine fish production with and without oil sardine

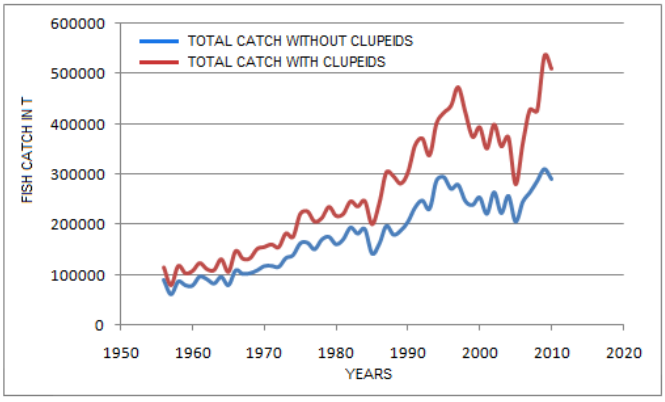


Figure 8 : Role of Clupeids in total fish production

2.3.3 Influence of clupeids

Group-wise analysis of the data reveal that the clupeids including oil sardines have had a major contribution to the total fish catch in Tamil Nadu since 1956 (figure 8). This shows that the success and failure of the marine fisheries mainly depended on the quantum of landings of clupeids. On an average 1,35,632 t of clupeids are landed. The mechanised sector landed 48,629 t forming 35.9% and exhibit an increasing trend. The motorised sector landed 67,707 t forming 49.9% and exhibit an increasing trend. The non-motorised sector landed 19,296 t forming 14.2% and the production continued to decline year after year.

Table 15 : Species/group composition of clupeids in the marine fish landings of Tamil Nadu during 2001-2010

Species	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
Coilia	222	227	306	394	47	57	583	60	149	126	**217**
Hilsa shad	23	109	0	12	44	191	1096	4067	1038	515	**710**
Oil sardine	42407	30922	42143	54948	17444	38839	65824	62491	135918	120619	**61155**
Other clupeids	12819	13197	7669	6795	5588	10696	9664	8140	14107	13240	**10191**
Other sardines	36656	53848	55889	29400	33831	43484	48007	41506	48992	41949	**43356**
Other shads	374	428	754	564	487	1976	3087	2314	1700	4690	**1637**
Setipinna	9	14	33	73	0	0	445	2	0	0	**58**

Table 15 : Species/group composition of clupeids in the marine fish landings of Tamil Nadu during 2001-2010

Species	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
Stolephorus	13958	11083	8025	8669	5066	4573	11006	5615	11060	11709	**9076**
Thryssa	6098	10124	6577	4113	4645	9318	10137	5427	4822	10950	**7221**
Wolf herring	2580	3220	2545	2673	1812	2621	2513	4435	2602	3202	**2820**
Grand Total	**115146**	**123172**	**123941**	**107641**	**68964**	**111755**	**152364**	**134057**	**220388**	**207000**	**136443**

The details of species/group composition of the clupeids in marine fish landings in Tamil Nadu during 2001-2010 is given in Table 15 and it is evident that the dominant species/groups are oil sardine, other sardines, other clupeids, Stolephorus and Thryssa.

2.4 Production trend among the species/groups

The production trends exhibited by different species and groups of fishery resources have been analysed during the six phases for the period from 1956-2010 and summarised in Table 16. There seems to be no correlation between the number of species which increased or decreased during these phases and it is the quantum of landing by individual specie or group that influenced the biomass decline or increase in production.

Table 16 : Number Species/Groups Exhibiting Increasing and Decreasing Trend during the Six Phases from 1956-2010

INCREASING					
1956-65	1966-77	1978-86	1987-97	1998-04	2005-10
19	31	28	52	40	39
DECREASING					
1956-65	1966-77	1978-86	1987-97	1998-04	2005-10
18	8	38	15	29	21

3. Puducherry

The Union Territory of Puducherry with a 45 km coastline and a combined continental shelf of 100 sq. km which support a rich marine fishery potential exhibits close similarity in almost all aspects of Tamil Nadu in marine fisheries and other related activities. The mechanised, motorised and non-motorised crafts and gear are similar to the adjoining Tamil Nadu state, though the types of gear employed are much restricted. Among the traditional gear, gill nets predominate in number followed by hooks & line and encircling bag net especially *Edavalai.* The operations of shore seines and boat seines have been considerably reduced in recent years but more efficient gill nets like *Pannuvalai* and *Mani valai* have made their appearance. Catamaran seems to be the main artisanal craft. Purushothaman (1981) has given a vivid account on the status of small-scale fisheries in Puducherry covering the developmental programmes during the plan period, fishery resources and fishing seasons, craft and gear, infrastructures, and socio-economics.

3.1 Overview of the sector in Puducherry

Puducherry and Karaikal have 25 fishing villages and 24 landing centres of which 15 villages and landing centres are in Puducherry district and the remaining 10 villages and 9 landing centres are in Karaikal. One of the landing centres is a fisheries harbour located at Puducherry. As per CMFRI 2005 census, there are 7,513 fisher families in Puducherry with a population of 27,047 and 2,858 families in Karaikal with a population of 9,858. There are 5,888 and 2,925 active fishermen in Puducherry and Karaikal respectively and 15,349 and 5,048 engaged in fishery related activities in these two districts respectively. The Status Report of the Puducherry Government states that the fishermen population is 1,50,000 of which 28,750 are active from 27 marine fishing villages including one each located in Yanam (located in Andhra Pradesh state) and Mahe (located in Kerala state).

The UT has a total of 4,457 fishing crafts in which 2,957 and 1,199 are spread over Puducherry and Karaikal respectively. There are 86 trawlers, and 68 gillnetters among mechanised vessels and 305 motorised and 1000 non-motorised vessels. The Karaikal fishermen own 195 trawlers and 86 other crafts among mechanised vessels and 756 motorised and 308 non-motorised crafts and the rest are owned by people other than the fishermen. Total number of gears are estimated to be 20,549 of which 674 are trawlnets, 1,355 drift nets, 16,966 gillnet pieces, 913 hooks & lines, 416 long lines, 6 ring seines, 16 shore seines, 30 scoop nets, 3 troll lines, 14 fixed bag nets, 1 boat seine and the rest 155 are other gears. Karaikal has 15,041 gears comprised of 744 trawlnets, 14,276 gillnet pieces, 13 troll lines, 5 hooks & lines and 3 long lines.

Out of 35 Cooperative Societies functioning in the UT, 10 are in Puducherry, 8 are in Karaikal and the rest 17 are located in Mahe. There are 8 ice factories in the UT of which 2 are in Puducherry and 1 in Karaikal and the balance 5 are in Mahe and there is a cold storage in Puducherry. There is no boat building yard, freezing plant, canning plant, curing yard, peeling shed or fishmeal plant.

3.2 Marine fish production in Puducherry

The annual marine fish production with effort for Puducherry during 1956-1968 is merged with Tamil Nadu production. The annual landings including Tamil Nadu varied from 0.8 lakh t in 1957 to 1.33 lakh t in 1968 and the annual total catch from 1969 to 2010 is available independently for Puducherry. In Puducherry there was a continuous increase in effort input from 2.6 lakh units in 1981 to 4.0 lakh units in 1984-85 and the marine fish production was 10,637 t in 1969 which declined to 6,462 in 1978, then gradually increased to attain the all-time maximum of 21,274 t in 1997 and during the latter period, upto 2009, it fluctuated between 12,013 t in 2001 and 19,459 t in 2002.

The effort expended during 1984-85 and from 2005-2009 indicates that effort of almost all the gears exhibited an increasing trend over a period of time except in the case of the non-mechanised sector which showed a declining trend as in Tamil Nadu. The increase in the trawl effort in Puducherry may be owing to various subsidies and welfare measures extended by the Department of Fisheries and Fishermen Welfare. In spite of an apparent increase in the

effort input, the marine fish production does not seem to show a similar increasing trend, as the catch fluctuated between 10,775 t in 1981 and 14,941 t in 1984-85 and 2008 except a conspicuous low landing of 5,512 t in 2005, the year after the tsunami, when the effort input was higher than that of 1981.

3.2.1 Composition of demersal and pelagic resources

The total annual catch of demersal and pelagic fishery resources in the marine fish landings of Puducherry and their percentage composition are given in Table 17. Unlike in Tamil Nadu, the pelagic resources were observed to be more dominant than the demersal resources as the percentage composition of demersal varied between 15.1 in 2005 and 47.6 in 2006 and the percentage composition of pelagics varied from 52.4 in 2006 to 84.9 in 2005 (Table 17).

Table 17. Composition of total annual catch of demersal and pelegic fishery resources in Puducherry during 2001-2010

Year	Demersal Total	%	Pelagic Total	%	Total
2001	4733	39.4	7280	60.6	12013
2002	8584	44.1	10875	55.9	19459
2003	4449	29.7	10519	70.3	14968
2004	4648	25.2	13768	74.8	18416
2005	1636	15.1	9183	84.9	10819
2006	5940	47.6	6538	52.4	12478
2007	3055	20.8	11651	79.2	14706
2008	6573	44.1	8348	55.9	14921
2009	5628	44.5	7009	55.5	12637
2010	3395	31.3	7469	68.8	10864
Average	4865	34.4	9264	65.6	14129

3.2.2 Species dominance in top ten species/groups

The top ten species/groups in the marine fish landings in Puducherry during 1980s, 1990s and 2000s given in Table 18 indicate that other sardines, oil sardine, and Indian mackerel were the dominant species during 1980s in Puducherry, silverbellies (the most dominant species in Tamil Nadu during the same period) is ranked fourth and penaeid prawns, eighth. During 1990s the order of dominance was oil sardine, Indian mackerel, other sardines, other carangids, penaeid prawns and silverbellies. Surprisingly during 2000s, cephalopods which never appeared in the top ten dominant species/groups of fish during 1980s and 1990s, emerged as one of the dominant groups in fourth position following oil sardine, Indian mackerel, other sardines; and were followed by silverbellies, other carangids, penaeid prawns etc. In contrast to Tamil Nadu, among the dominant ten species/groups, pelagics were dominant, forming 78.9, 89.2 and 70.7% during the successive decades respectively and the demersals formed a meagre 15.1, 3.8 and 10.3% respectively. There has been a consistent increase in the crustacean composition from 6% to 7% and further to 9% during 2000s and the molluscans (cephalopods) formed 10.1% during 2000s (Table 18).

Table 18. Top ten dominant species/groups of marine fishes landed in Puducherry & Karaikal during 1980s, 1990s and 2000s

Sl.No	1985-1989	Average	1990-1999	Average	2000-2010	Average
1	Other Sardine	1868	Oil Sardine	4481	Oil Sardine	3045
2	Oil Sardine	1391	Indian Mackerel	2275	Indian Mackerel	1724
3	Indian Mackerel	1338	Other Sardines	1470	Other Sardines	974
4	Silverbellies	829	Other Carangids	585	Cephalopods	969
5	Other Carangids	635	Penaeid Prawns	489	Silverbellies	664
6	Other Clupeids	627	Silverbellies	418	Other Carangids	619
7	Flying Fishes	583	Thryssa	399	Penaeid Prawns	459
8	Penaeid Prawns	528	Other Clupeids	335	Flying Fishes	441
9	Ribbon Fishes	490	Crabs	280	Crabs	404
10	Thryssa	453	Stolephorus	279	Threadfin Breams	330
	Pelagic : 78.9%, Demersal : 15.1%, Crustaceans : 6.0%		Pelagic : 89.2%, Demersal : 3.8%, Crustaceans : 7.0%		Pelagic : 70.7%, Demersal : 10.3%, Crustaceans : 9.0%, Demersal Molluscs : 10.1%	

The details of species/group composition in the clupeid landings in Puducherry are given in Table 10 where it is clearly seen that oil sardine is the most dominant species.

Table 19. Details of species/group composition of clupeids in the marine fish landings of Puducherry during 2001-2010

Species	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
Oil sardine	1425	1212	5779	6879	5027	2348	4194	2900	2634	3463	3586
Other sardines	1319	1472	1161	2081	920	343	1509	301	514	7	963
Thryssa	106	54	112	178	114	122	220	525	554	1218	320
Other clupeids	327	430	248	272	102	190	227	178	107	32	211
Stolephorus	52	303	171	42	2	143	172	209	106	99	130
Wolf herring	129	23	31	100	16	94	44	17	43	40	54
Coilia	1	1	0	3	1	2	0	0	0	0	1
Other shads	2	2	2	0	0	0	0	0	0	0	1
Grand Total	**3361**	**3497**	**7504**	**9555**	**6182**	**3242**	**6366**	**4130**	**3958**	**4859**	**5265**

4. Potential Yield and Annual Fish Production

Potential yield within 200 nautical miles in Tamil Nadu has been estimated to be 4.25 lakh t. On the other hand the marine fish production in 2009 was 5.34 lakh t and 2010 it was 5.09 lakh t. It is well known that the Chennai and Palk Bay trawlers fish in Andhra Pradesh and Sri Lankan waters respectively. The catch over and above 4.25 lakh t may be assumed to have been from the waters of Andhra Pradesh and Sri Lanka, plus a nominal portion from the deep sea of Tamil Nadu and Andhra Pradesh. It is clear that the Tamil Nadu fishers have already crossed the potential yield of the region and therefore, there is no scope for increasing the fish production from Tamil Nadu waters.

4.1 Overfishing

It is understood from detailed studies on various fishery resources by the scientists of CMFRI that in Tamil Nadu waters 65% of the commercially important varieties are overfished. Approximately 20% of the resources have been fished at the optimum level and the remaining 15% of the resources alone are being fished close to optimum levels.

4.2 Over exploitation

Critical analysis of the data on 53 exploited species/groups for the period 1950-2002 on the annual mean trophic level (TrL) of marine fish landings along the Indian coast by Vivekanandan et al., (2009) indicated a backward-bending signature in the landings versus TrL plot for the SE coast in the last 6 years. This indicates fisheries-induced changes in the ecosystem owing to low productivity of the coastal waters and high density of fishing craft. The landings of most of the large predators increased along the Indian coast, but higher removals appear to have helped proliferation of their prey - the mid-level carnivores. Fishing down the food web has been influenced by environmental fluctuations, advanced fishing technologies, and market-driven, deliberate fishing on low-trophic level (TL) invertebrates such as the penaeid prawns.

4.3 Over capacity

The number of mechanised and motorised vessels went on increasing due to the increase in demand for seafood and consequent price appreciation. Various developmental programmes of Central and State Governments such as subsidies for diesel engines, new gears and gear materials, vessels and financial assistance to fishermen and co-operative societies (Srivastava et al., 1991) speeded up the mechanisation and motorisation process. Present estimated number of fishing vessels of almost all the types seem to be far excess than the actual number required to produce the sustainable yield (E.Vivekanandan, CMFRI Scientist, Personal communication). So far no concrete steps have been initiated to control and reduce the number of fishing vessels and there is not even an effort to put a cap on the number of fishing vessels at the present level. Only the fishermen themselves have resolved in a few places such as at Kasimedu in Chennai and Rameswaram not to introduce new mechanised trawlers and to only allow replacement of the obsolete condemned trawlers. Post tsunami study by the United Nations Team for Recovery Support (UNTRS) has revealed that some of the Palk Bay fishermen are willing to come out of fishing provided that there is an attractive buyback offer by the State or Central Government for their existing fishing vessels and fishing implements, and also there is a provision for an alternative livelihood. Orissa is the only state that has determined the optimum number of mechanised vessels of various categories for different fishing ports in their Marine Fishing Regulation Act (James, 1992), though it has not been followed.

4.4 Growth in the number of fishing fleets

Marine fishing sector in India has metamorphosed from a humble subsistence level to the status of a multi-crore industry during the last six decades. The contribution of this sector is estimated to be 1.07 percent to the country's GDP and 5.03 percent to the Agriculture GDP of the country. Steady increase in the number of trawl units during 1981-2009 (Table 20) and in other fishing vessels also with fluctuations have been seen, whereas, the effort of non-motorised sector has been declining continuously. The progressive increase between 1960 and 1990 in the artisanal

crafts was by 110% whereas the increase in mechanized crafts was an astounding 570% thus resulting in overcapacity of the fleet operating in the inshore waters. This uninterrupted increase in the strength of fishing fleet has led to a decline in catch per unit effort and increase in the cost of operation, which has resulted in uneconomical operation of the fishing fleet, even forcing a few fishers out of the business (Srinath and Pillai, 2006).

Table 20 : Effort in units expended in Puducherry during 1981-85 and 2005-2009

Year	Mechanised				Non Motorised	Total Effort	Total Catch
	Trawl	Gillnet	H & L	Others			
1981	33,766			1,120	2,23,897	2,58,783	10,755
1982-83	33,285	2,636	120		2,60,833	2,96,874	12,058
1983-84	35,949			2,830	3,50,368	3,89,147	14,902
1984-85	29,301			4,892	3,69,646	4,03,839	14,941
2005	19,185	1,71,889	37,986		74,411	3,03,471	10,819
2006	88,344	4,21,494	30,186	5,945	53,208	5,99,177	12,477
2007	91,591	3,37,872	1,10,361	8,920	76,293	6,25,037	14,721
2008	71,383	4,07,421	31,670	5,270	2,900	5,18,644	14,941
2009	75,216	2,59,359	1,09,357	3,319	19,165	4,66,416	13,240

Source : CMFRI's Marine Fisheries Information Service No.41,52,67 and 91

4.5 Conversion of excess fleet

The conversion of the mechanised wooden trawlers by modifying the super structure so as to make use of them for the operation of gill nets and hooks & line for tuna, billfishes, pelagic sharks and other scomberoids is reported by Balasubramanian (2000) with details on the estimated catch of tuna and the species composition along the Tuticorin coast. This kind of transformation may help reduce the excess effort of mechanised boats and reduce the adverse impact on the bottom fauna and flora.

4.6 Fishing down the food web

Vivekanandan et al., (2009) have analysed the trophic level (TrL) of 707 species of exploited finfishes, crustaceans and cephalopods along the Indian coast. The maximum exploitation was at the TrL of 3.01-3.50 which constituted midlevel carnivores constituting 43.0%. At basal TrL of 2.00-3.00 the exploited resources were herbivores, detritrivores and omnivores forming 27.3% and at higher TrL of 3.51-4.52, the high level carnivores and top predators were exploited at 29.7%. Overfishing at the bottom of the food web would lead to shortage of food up in the food web. On the other hand, overfishing at the top of the food web, which is demonstrated to occur in almost all fished areas around the globe (Pauly *et al.*, 1998; Vivekanandan *et al.*, 2005), would lead to increase in the biomass of fish groups lower in the food web thereby resulting in severe competition for food at that level.

4.7 Resource Crunch

The marine fish production continued to increase year after year owing to the increase in the number of fishing effort and introduction of different advanced fishing technologies leading to the depletion of the marine fishery resources due to overfishing. The catch rate obtained since 1956 till 2009 indicates that the catch per man hour increased steadily from a meagre 1.08 kg/hr in 1957 to 2.93 kg/hr in 1967. There is lack of information on the effort up to 1981, when the catch rate was 17.65 kg/AFH (Actual Fishing Hours). During 1981-2009 the catch rate declined from 17.88 kg/hr in 1982-83 to a mere 6.20 kg/AFH indicating a steady regressive reduction in the availability of marine fishery resources. This clearly indicates that the sustained increase in the fishing effort in mechanised and motorised sector has led to overfishing of many component species and consequent reduction in the benefit sharing among the fishing units.

4.8 Conservation

Extensive and indiscriminate exploitation of marine natural resources, during the last three decades is leading to a situation where no more commercial fish stocks may be left in the sea by year 2050 unless ecosystems are protected and the biodiversity is revived, warns a new study cataloguing the global collapse of marine ecosystems (Worm et al., 2006). Marine fisheries is basically harnessing a natural resource and therefore its management must be anchored on knowledge- based interventions generated through close monitoring of their distribution, abundance, exploitation, population dynamics and fluctuations of fish stocks in relation to natural factors and anthropogenic interventions (Pillai et al., 2007)

4.9 Better fishing practices

A shift from monofilament nylon to plastic nets by increasing the mesh size from 85 to 130 mm along the Kayalpattinam coast in Gulf of Mannar yielded better and larger sized lobsters during 2004 as reported by Manickaraja (2004) and this type of report on better fishing practice will encourage other fishers also to adopt such tactics in other fisheries also.

Another better fishing method is the trap fishery of Gulf of Mannar and Palk Bay. Lal Mohan (1985) has described the methods of fabrication of different types of traps with one, two and three mouth openings, out of the split sticks of 'Odai' tree (*Acacia planifrons),* 'Eecha' (palmyrah) tree's sticks, roots, leaves and polypropylene tapes, locally known as 'wire', employed in the trap fishery of Gulf of Mannar at Rameswaram, Keelakarai, Ervadi and Mandapam. This could help in promoting trap fishing elsewhere with similar habitat for harvesting live food fish and ornamental fish for export and captive breeding, albeit following strict self-regulation. Marine ornamental fish trade is a lucrative small scale commercial venture and the fishermen will be able to get better economic return out trap fishing if introduced in other areas also (Molly et al., 2008).

Inshore waters earmarked for the traditional fishers' all along the TN coast have been severely impacted by the adverse effect of bottom trawling by the mechanised trawlers for prawns and finfish. Recent experiences have revealed that deployment of artificial reefs at 15 different locations along the TN coast by TN Fisheries Department have been very effective in improving the inshore water ecosystems biologically with enrichment of biodiversity and enhancement of fishery resources. It is reported that these artificial reefs have served as fishing areas for traditional fishers, who could save fuel expenditure as they need not go in search of fish as the fishing grounds are closer to their fishing villages. They could land the fish catch in fresh condition and realise better price, as the voyage time after fishing is less than an hour from the fishing ground. High quality fish were available throughout the year and this has improved the livelihoods of the traditional fishers. Almost all the artificial reefs have been observed to serve as the micro Marine Protected Areas (MPA) since bottom trawling in these areas have been totally prevented. All these beneficial proactive results have prompted the traditional fishers to demand for more artificial reefs at different places of TN coast. Now the TN Fisheries Department has entered into an MoU with CMFRI for the deployment of 19 more artificial reefs at different locations along the TN coast. Tamil Nadu may become the leading coastal state in the conservation of coastal fisheries of India and this experience may be replicated in other sites wherever suitable for the deployment of artificial reefs for ecosystem reconstruction and enhancement of fishery resources with an aim to improve the livelihoods of coastal fishers.

4.10. Conclusion

All these imply that there is an urgent need for a better and more efficient marine fisheries management system addressing over capacity, ecosystem degradation, sectoral conflicts, fisher's rights, limited access, fleet reduction, gear controls, deep sea fishing, transboundary issues, conflict resolving etc. This should be done by exploring the existing management practices, traditional management systems and should come out with practicable management options involving co-management practices with active participation of the fishers.

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