Building Sustainable Governance

An overview of fisheries management and marine ecosystem health in Tamil Nadu, India

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Paper prepared for ESPA Workshop 1
4th April 2009, Institute for Ocean Management, Chennai, India
Project: Building Capacity for Sustainable Governance in South Asian Fisheries: Poverty, Wellbeing and Deliberative Policy Networks

Building Sustainable Governance

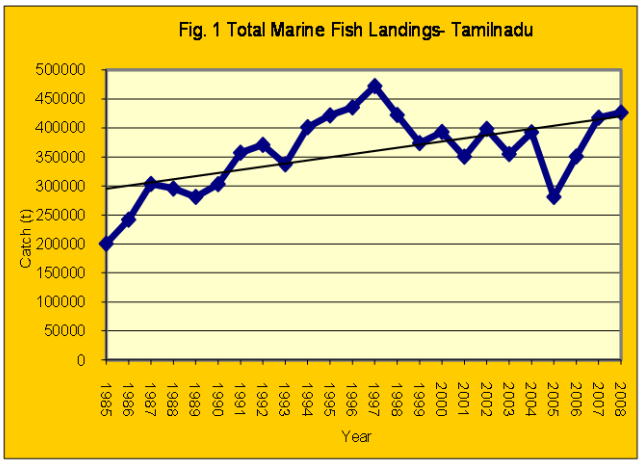
1. Introduction

Tamil Nadu is bestowed with the bountiful riches of three major seas, the Arabian Sea on the west coast, the Indian Ocean, and the Bay of Bengal on the east coast, and has the benefit of both the South-West and the North-East monsoons. With a 1,076 km long coast line, 35,000 sq km of continental shelf and an estimated 2.2 lakh[1] hectares of offshore area, this state is considered as a pioneer in the exploitation of marine fisheries resources. Characteristically, three types of coastal ecosystems exist along the Tamil Nadu coast: the northern Coromandel coast from Aranganku ppam in Pulicat near Chennai to the north end of Nagapattinam, the middle Palk Strait from Kodiakarai on the south of Nagapattinam to Rameswaram and the southern Gulf of Mannar, from Thanuskodi to Kanyakumari in the south.

Starting from pioneering researchers like James Hornell, Chidambaram and Chacko, till recent times, the marine fisheries of Tamil Nadu has been extensively studied by many fishery scientists. It has undergone a perceptible change due to sustained increase in fishing activities involving introduction of different advanced fishing technologies, gears and fishing fleets. Coastal water pollution due to increase in industrialization coupled with the climate change have had profound impact on biological resources especially the fishery resources, prompting critical evaluation of the status of the marine fisheries in order to come out with a road map for proper management of fishing activities through appropriate conservation and mitigation measures. This study attempts to critically analyze the marine fisheries of Tamil Nadu with an aim to explore appropriate interventions and management options for better conservation and sustainable utilization of the resources through appropriate resource management for ensuring better livelihoods.

2. History and development of fisheries:

Marine fisheries development in Tamil Nadu is similar to that of the all-Indian scenario. The period up until 1965 may be termed as a pre-development phase where fishing was still largely dominated by small indigenous craft like catamarans, plank built boats, canoes without any engine power to propel or conduct fishing and the gears were of mostly cotton made and primitive, like the cast net, gillnets, shore seine, boat seine, hooks & line etc. Mechanization was in the very early stages in this phase. The period from 1965 to 1986 may be referred to as the developing phase; there was a major expansion in the use of modern technology in craft and gear. Synthetic gears made of nylon, HDPE, monofilament etc. were introduced. There was an increase in the number of large mechanized trawlers, with an aim to boost export of fish and prawn products. The Government invested in new fishing harbours and encouraged introduction of the purse seine. Motorization of smaller, artisanal boats was taken up and this extended their fishing capability further into offshore areas. The subsequent period (1986-2000), which may be called as the developed phase, witnessed a rapid growth in motorization of the artisanal fleet leading to further extension of fishing offshore. Since mechanized vessels (especially trawlers) also adopted voyage fishing, this lead to intersectoral conflict between mechanized and motorized sectors. This phase witnessed the introduction of seasonal closures of selected fisheries as concerns developed over fish stocks. Finally, the fourth phase or present phase (post-2000) is characterized by declining fish catches, depleted fish stocks, increasing conflict over fishery



[1] 1 Lakh = 100,000

resources, mounting investment needs, and export market fluctuations coinciding with major changes in the global and domestic macro-economic environment.

As per the 2000 census data of Tamil Nadu Fisheries Department the total number of mechanized crafts was 8,009 (trawlers 6,903, gill netters 647 and long liners 442). Non-mechanised crafts were 41,770 of which 27,272 were catamarans and 14,498 were boats and canoes (Table 1). Now, after tsunami devastation the mechanized crafts are enumerated to be 11,969, vallams 23,020 and catamarans 31,965. According to CMFRI 2005 census data, the mechanized boats declined to 7711, canoes increased to 26,627 and the catamarans declined 20,082. The increase in canoes may be attributed to the post-tsunami rehabilitation programme extended by Central, State Governments and Non-Government Organisations (Table I).

Table 1. Chronological increase in the marine fishing craft, villages, fishermen population and fish production during 1948-2000

Year	Crafts			Villages	Population	Fish production
	Catamarans	Canoes	Mechanised Boats			
1948-49*	11262	1942	---	233	95,735	27,135
1957***	23161	4716	---	242	2,36,653	67,542
1961-62	29661			363	2,14,868	1,16,245
1973-77**	30501		1533	374	2,88,586	2,05,735
1978***	29744	7340	2919	403	3,37,713	2,12,899
1980**	31851	11492	2627	422	3,95,903	2,17,394
1986***	28132+ 656(OBM)	8439+742 (With engine)	2432+ 82(FRP)	442	4,63,800	2,44,759
2000***	27272	14498	8009	591	6,79,971	3,93,332

Source: * Govt. of India, ** C.M.F.R.Institute, and Tamil Nadu Fisheries Dept.

The number of coastal districts has increased, due to bifurcation, from 9 during 1980's to thirteen owing to the increase in population. Similarly the fishing villages have also increased from 233 in 1940's to 442 in 1980's and further to 591 (as per Tamil Nadu Fisheries Department which include 10 estuarine fishermen villages also, and as per CMFRI census data collected in 2005) at present, mainly due to increase in population and also due to constant migration of labour force from inland to coastal areas in search of employment. The landing centres have also increased to 364 indicating expansion in fishing activities along the coast. The fishermen population was a meagre 0.96 lakh during 1940's and in 2005 it is estimated to be 7,90,408 (Table 1). The number of households has been estimated to be 192,152. Infrastructural facilities include 9 fishing harbours, a number of landing jetties, 55 freezing and ice plants, 2 canning plants, 3 fish meal plants and 2 seaweed processing plants. There are 14 boat building yards of which only 3 are in the public sector. There are 15 net making plants in the private sector and one net making factory belongs to the government. Co-operative movement is well established with 315 fishermen co-operative societies. Also, two co-operatives have been started for promoting fish farming ventures. In Tamil Nadu almost all the fishing villages are connected by good roads and have facilities like schools, primary health centres, banks, post-offices, electricity and drinking water. There are 428 fisherwomen self help groups with 8,161 women as members engaged in ornamental fish culture, freshwater prawn culture, sea weed culture and spiny lobster and crab fattening.

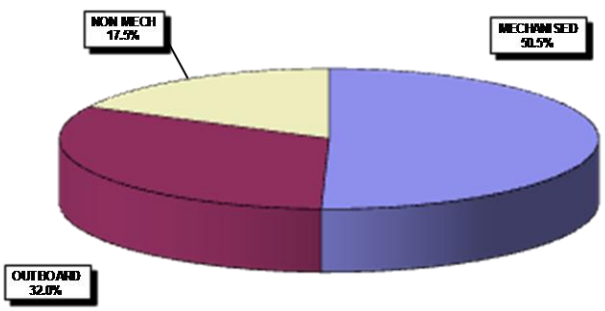
3. Marine and Coastal Ecosystem Health

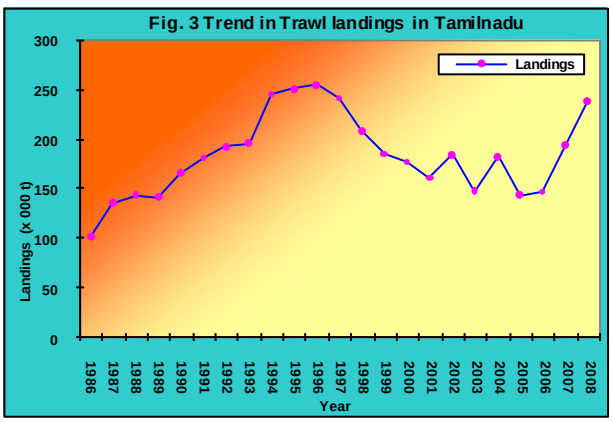
Composition of the flora and fauna of the three coastal ecosystems differ characteristically from each other. The Coramandal coast is an open sea ecosystem, surf beaten, most of the time rough, often exposed to cyclones and now even tsunami-prone, with intermittent rocky terrain on the north, sandy even floor in the middle with deep canyon like ridges running parallel to the shore, studded with deltaic mangrove forests, with estuaries of major and minor rivers. The fishing area is wide and fishery resources are also abundant with ample scope for deep sea fishing for resources like oceanic tunas, pelagic sharks, squids, deepwater shrimps and lobsters. The mechanized trawlers of north Tamil Nadu, particularly from Chennai base, always migrate north into Andhra Pradesh, Orissa and West Bengal waters. The north Chennai, Pondicherry, and Cuddalore coasts are exposed to various intensities of pollution by industrial wastes and effluent discharges affecting water quality of the near shore waters. The fishermen attribute this as a valid reason for the decline and non availability of fish in and around these areas. Dwindling resources in inshore waters have forced the traditional fishermen and mechanized trawl operators to venture into the deep sea for yellowfin tuna and other deep sea resources by converting wooden trawlers for long lining.

The Palk Strait is an almost closed, calm, quiet, shallow sprawling lake with three openings, one on the north into Bay of Bengal, the second on the east near Thanuskodi and the third on the west near Pamban into Gulf of Mannar. The fishing ground is shared by the mechanized and traditional fishermen for fishing 3 and 4 days a week, respectively. It is highly suitable for mariculture activities like sea weed culture, mussel culture, cage culture and raft culture etc., and can be developed as "Mariculture Park" in the future. Mechanized trawl operators seldom migrate, whereas, the traditional gillnet fishermen migrate to Gulf of Mannar for tuna fishing in and around the Wadge Bank area with base at Thiruchendur, Veerapandianpattinam and Kayalpattinam.

The Gulf of Mannar has a lengthy east and a small portion of rocky west coast in Kanyakumari district. It is a highly sensitive Bioreserve and National Marine Park, with 21 coral islands between Rameswaram and Tuticorin, bestowed with a highly productive Wadge Bank with openings into Palk Strait, Indian Ocean and Arabian Sea, with unique biological resources like soft and hard corals, sea cow, gorgonids, sponges, ascidians etc., with prominent fisheries of perch, tuna, seerfish, billfishes, sailfishes, sharks, ribbonfishes, balistids, sea cucumber, ornamental fishes, turtles, mammals etc., Dugong, turtles, sea cucumbers, sea horses, pipe fishes, soft and hard corals and gorgonids are the few endangered species included in the schedule I of the Wild Life (Protection) Act of 1972. The indiscriminate onslaught on the coral islands by the illegal miners by resorting to blasting the live coral beds with dynamite has ended due to stringent patrolling by the forest department for conserving these islands. All activities including fishing are banned in the vicinity of 500 m of all the coral islands. The Kurusadai Island, a popular site for rich marine biodiversity is now banned for tourists, education excursions and specimen collection for research and other investigations. Now, the highest conservation activities are in force in this ecosystem.

Fig. 2 Percentage composition of marine fish landings in Tamil Nadu by Mechnised, Motorised and Non mechanised sectors during 2000-2008





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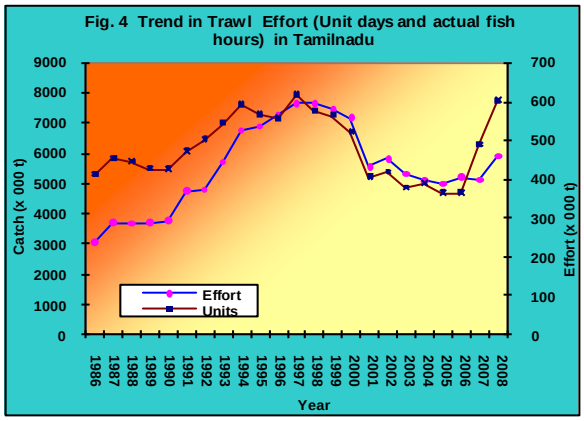
3.1 Current status of fisheries health:

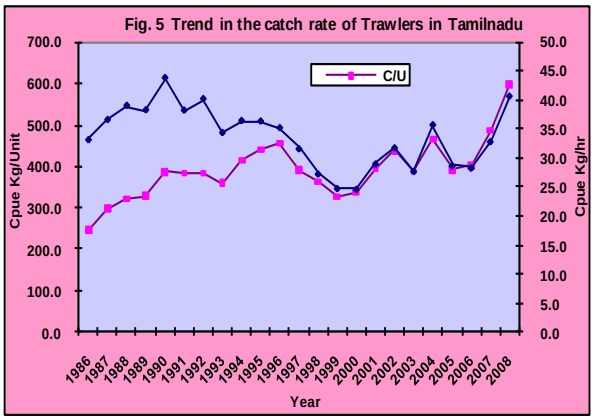
Marine fishery resources are comprised of all the following four major groups: pelagic, demersal, crustacean and molluscan. Total marine fish landing in Tamil Nadu during 1985-2008 (Figure 1) indicates that the catch varied from 2 lakh t in 1985 to 4.72 lakh t in 1997 and in 2008 it was 4.27 lakh t. Mechanised vessels landed almost 50.5% of the total catch, vessels fitted with out-board engines 32% and non-mechanised vessels accounted for 17.5% (Figure 2). During 2000-08 the production varied between 2.81 lakh t in 2004 and 4.28 lakh t in 2008 with an average of 3.76 lakh t (Table 2) indicating a very limited scope for any perceptible increase in the landings in future. The potential yield for Tamil Nadu within 50 m depth is estimated to be 3.69 lakh t, beyond 50 m depth it is 3.5 lakh t and the total is around 7.19 lakh t per annum and the present level of exploitation is just above half of this estimate.

Table 2. Groupwise landings of demersal, pelagic, crustacean and molluscan fishery resources of Tamil Nadu during 2000-08

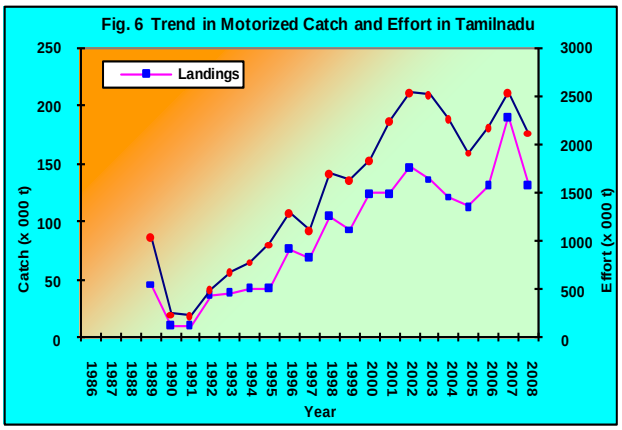
Name of fish	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average	%
DEMERSAL RESOURCES											
ELASMOBRANCHS	16808	12686	15674	16372	21424	10689	10850	9914	9876	13810	3.7
Eels	527	317	598	790	338	1030	320	680	322	547	0.1
Catfishes	4942	2511	3111	2647	3793	2570	4435	5550	5931	3943	1.1
LIZARD FISHES	3325	3294	5653	4221	4561	4271	3811	2360	8689	4465	1.2
PERCHES	28186	33296	31263	34329	32207	28570	31855	29320	35388	31602	8.4
GOATFISHES	6835	5814	5415	4626	5885	8121	5992	5437	7385	6168	1.6
THREADFINS	572	444	635	312	486	196	186	712	419	440	0.1
CROAKERS	10605	8567	9944	8502	7859	6626	6924	8674	6597	8255	2.2
SILVERBELLIES	33569	31495	37460	26914	32789	38663	45942	50804	46884	38280	10.2
BIG-JAWED JUMPER	304	401	601	84	245	1065	463	70	179	379	0.1
POMFRETS	2744	3375	3337	2167	2621	3252	2177	2689	1885	2694	0.7
MULLETS	965	882	591	790	525	494	855	739	3492	1037	0.3
UNICORN COD	7	0	0	0	0	0	0	0	0	1	0.0
FLAT FISHES	2475	1743	2585	2219	1804	1549	1755	1074	3067	2030	0.5
Sub Total	111864	104825	116867	103973	114537	107096	115565	118023	130114	113652	30.3
PELAGIC RESOURCES											
CLUPEIDS	128293	115146	123172	123941	107641	69958	111767	154843	134042	118756	31.6
BOMBAYDUCK	2	32	0	0	28	8	15	0	2	10	0.0
HALF BEAKS & FULL BEAKS	5152	2533	2845	1964	1714	1331	1978	2696	3910	2680	0.7
FLYING FISHES	1918	5447	5438	4705	2392	761	802	1275	640	2598	0.7
RIBBON FISHES	4507	3594	5311	5218	3941	2160	5310	2039	6997	4342	1.2
CARANGIDS	19557	22335	26556	23450	26315	20746	23944	24965	28781	24072	6.4
MACKERELS	10799	12107	19616	10404	20058	17406	23152	16516	12012	15786	4.2
SEER FISHES	13056	6400	8206	7351	6804	3988	5750	6699	5437	7077	1.9
TUNNIES	8435	5218	6473	5774	6826	5507	10750	14167	15316	8718	2.3
BILL FISHES	254	1455	717	646	1068	249	763	597	662	712	0.2
BARRACUDAS	8035	5617	8669	5065	4546	8078	6008	7402	6978	6711	1.8
Sub Total	200008	179884	207003	188518	181333	130192	190239	231199	214777	191461	51.0
CRUSTACEANS	38157	32808	40038	34723	32395	27761	35789	33382	35470	34503	9.2
MOLLUSCS	9653	8174	15080	14368	16415	10477	13911	11392	19265	13193	3.5
Seacow	0	0	0	0	0	3	9	20	0	4	0.0
Whale	0	0	0	0	0	0	0	0	0	0	0.0
SEAWEEDS	0	0	0	0	0	1	0	0	0	0	0.0
MISCELLANEOUS	33650	25018	19678	13581	48073	5738	7046	23947	27175	22656	6.0
TOTAL	**393332**	**350709**	**398666**	**355163**	**392753**	**281268**	**362559**	**417963**	**426801**	**375468**	

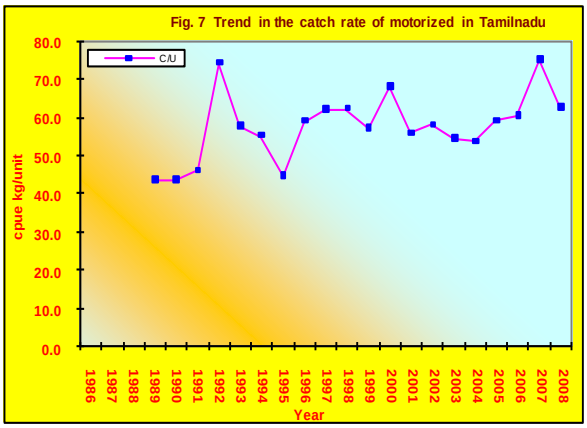
3.1.1 Mechanised sector: Among the mechanized units, the trawl nets landed 92.1% of the total catch followed by mechanized gillnets (4.2%), mechanized bottom set nets (1.3%), mechanized hooks & line (1.2%) and mechanized purse seine (0.5%). The catch per hour of the purse seine was the highest 1272 kg/hr followed by the bottom set net 469 kg/hr, hooks & line 94 kg/hr, gillnet 59 kg/hr, trawlnet 51kg/hr, and lastly the bottom set gillnet 3 kg/hr (Table 3). The trend in trawl landings in Tamilnadu during 1986-2008 given in Figure 3 shows that the catch continued to increase form 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. The trend in the trawl effort in units and actual fishing hours shown in Figure 4 and the catch rates given in Figure 5 also reflect similar trend as that of the trawl landings.





3.1.2 Motorised sector: The motorized units were comprised of out-board and inboard vessels of different types operating mainly drift/set gillnets, hooks & line, bottom set nets, trammel net, purse seine, ring seine, boat seine and other gears. 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 depicted in Figure 6 reflects a spectacular increase from 1991to 2001 and then gradually declined till 2004 with a revival in later years. The catch rate by motorized units has also been observed to increase gradually with fluctuations as witnessed in Figure 7.





3.1.3 Non Mechanised sector: The more common gear used in the traditional sector were drift/set gillnets, hook and line, traps, boat seines, shore seines and scoop nets. Non-mechanized landings comprised 10.8% of the total catch by traditional units. The catch per hour indicates that the catch rate of ring seine (small purse seine) was the highest 735 kg/hr, followed by out- board purse seine (373 kg/hr), small shore seine (Olaivalai) (247 kg/hr), bottom set net (62 kg/hr), hooks & line 12 kg/hr, drift gillnet (11 kg.hr), and boat seine (1 kg/hr) (Table 4). In contrast to both mechanized and motorized sectors, the non-motorized, the catch and effort of traditional sector given in Figure 8

continued to decline from 1989 to 2008 with violent fluctuation in landings and minor variations in the effort input. The catch per unit of non mechanized tradition units shown in Figure 9 registered a marginal increase from 1989 onwards with a decline during early 2000 and a revival after 2005.

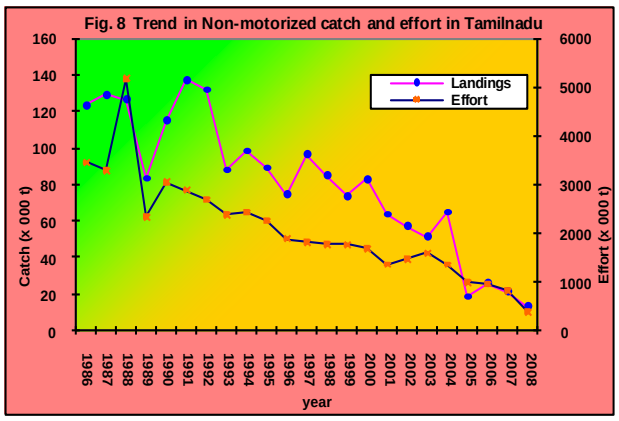
Table 3. Average catch (t), catch per unit (kg), catch per hour (kg) and percentage composition of mechanized trawlnet, gillnet, hooks & line, bottom set nets and purse seines along Tamil Nadu coast during 2000-08

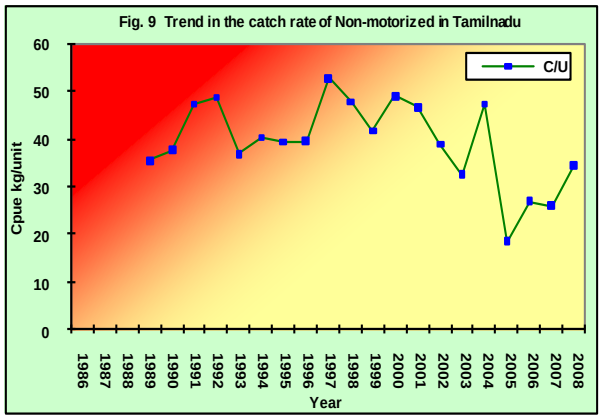
	MTN	MDTN	MGN	MHL	MBN	MPS	MBSGN	MDGN	TOTAL
AVR. CATCH	139024	72206	9696	2708	2898	1126	115	1670	229441
CPU (kg)	577	518	487	1013	3187	5199	15	1225	12220
CPH (kg)	51	26	59	94	469	1272	3	54	2028
PERCENTAGE	60.6	31.5	4.2	1.2	1.3	0.5	0.1	0.7	

Table 4. Average catch (t), CPU (kg), CPH (kg) and percentage composition of fish landings by different type of unit operated along Tamil Nadu coast during 2000-08.

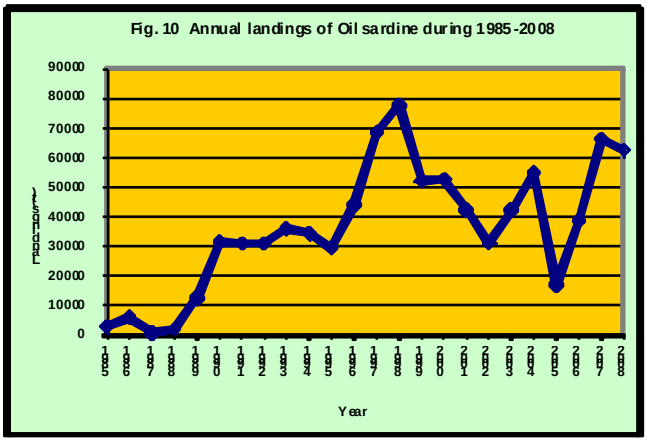
	IBGN	IBHL	IBOTHS	OBGN	OBHL	OBRS	OBTN	OBSS	OBBN	OBPS	OBOTHS	OBBS	OBTRAP	NMGN	NMOTHS	TOTAL
AVR. CATCH	33259	715	7957	87357	14600	14513	1228	1281	5812	2397	12457	634	133	12672	9494	204506
CPU (kg)	124	33	111	51	76	1216	13	464	565	676	72	67	64	26	24	3582
CPH (kg)	15	5	13	11	12	735	2	247	62	373	16	1	0	3	4	1499
%	16.3	0.3	3.9	42.7	7.1	7.1	0.6	0.6	2.8	1.2	6.1	0.3	0.1	6.2	4.6	

3.1.4 Composition of fishery resources: During 1980's demersal fish resources dominated (54.6%) over pelagic resources (45.4%) in the total landings. However, the average percentage composition of different groups at present indicates the dominance of pelagic fishery resources (51%), followed by demersal fishery resources (30.3%), crustaceans (9.2%), molluscs (3.5%) and miscellaneous groups (6%).





3.1.5 Pelagic fishery resource: Major pelagic fishery resources included the clupeids, mackerel, seerfish, tuna and billfishes, barracudas, ribbon fishes and carangids. During 2000-08 the pelagic fishery resource landings varied from 1,79,884 t in 2001 to 2,31,199 t in 2007 with an average of 1,91,461 t which formed 51% of the total marine fish production in Tamil Nadu and were comprised of clupeids, carangids, mackerel, seerfish, tunnies, barracudas, ribbon fishes, flying fishes, half and full beaks, billfishes and others.



Clupeids: The clupeid group was constituted by oil sardine, other sardines, Stolephorus, Thryssa, wolf herring, hilsa shad, other shads and other clupeids and this group formed 31.9% of the total fish catch. The oil sardine *Sardinella longiceps* has emerged as the single most dominant species among the sardines with a maximum production of 77,715 t in 1998. Probably due to the impact of tsunami the catch drastically declined to a mere 17,131 t in 2005 which revived back to 66,304 in 2007 (Figure 10), the average catch during 2000-08 was 45,323 t which constituted 12.2% of the total catch and 38.2% of the clupeid catch. The catch of other sardines, comprised of *S. albella, S. dussumieri, S. sirm, S. gibbosa* and other species, showed an increasing trend from 1976 to 1984 and formed 12.2% of the total catch. During 2000-08 the resource formed 11.4% of the total catch and 35.7% of the clupeid catch. In the 1980's and 1990's, whitebaits (*Stolephorus* spp.) ranked second to other sardines in the pelagic varieties and contributed 7 to 8 % to the total catch, while during 2000-08 the catch declined to as low the resource formed only 2.3% of the total catch and 7.2% of the clupeid catch (Figure 14). *Stolephorus commersoni, S. indica,* and *S. bataviensis* contributed to the bulk of the whitebait landing.

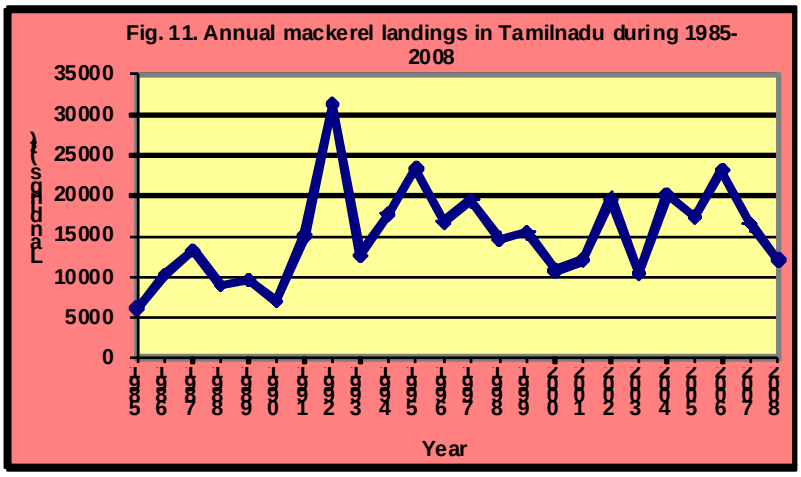
Table 5. Different groups of clupeid landed during 2000-08 with average catch (t) and percentage composition in the total marine fish catch

Groups	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average	% in Resource	% in All fish
Wolf herring	2278	2580	3220	2545	2673	1828	2625	2481	4436	2741	2.3	0.7
Oil sardine	52694	42407	30922	42143	54948	17131	38866	66304	62488	45323	38.2	12.2
Other sardines	38346	36656	53848	55889	29400	34129	43585	48035	41508	42377	35.7	11.4
Hilsa shad	84	23	109	0	12	61	1339	357	4061	672	0.6	0.2
Other shads	3107	374	428	754	564	457	835	3733	2319	1397	1.2	0.4
Anchovies						1	11	0	0	3	0.0	0.0
Coilia	1315	222	227	306	394	44	57	538	60	351	0.3	0.1
Setipinna	291	9	14	33	73	0	0	404	2	92	0.1	0.0
Stolephorus	9671	13958	11083	8025	8669	5168	4645	10142	5622	8554	7.2	2.3
Thrissina	22	0	0	0	0	0	0	12	0	4	0.0	0.0
Thryssa	7016	6098	10124	6577	4113	4628	9326	10074	5419	7042	5.9	1.9
Other clupeids	13469	12819	13197	7669	6795	6511	10478	12763	8127	10203	8.6	2.7
TOTAL	**128293**	**115146**	**123172**	**123941**	**107641**	**69958**	**111767**	**154843**	**134042**	**118756**		**31.9**

Table 6. Groupwise landings of carangids during 2000-08 with average catch (t) and percentage composition in the total fish catch.

Groups	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average	% in Resource	% in All fish
Horse Mackerel	716	864	599	472	480	331	334	1268	976	671	2.7	0.2
Scads	1060	2390	5312	3256	3107	3752	4609	3047	5599	3570	14.3	1.0
Leather-jackets	1053	858	1180	2645	2963	1152	925	1728	1309	1535	6.1	0.4
Other carangids	16728	18223	19465	17077	19765	15511	18076	18922	20897	18296	73.3	4.9
Total	**19557**	**22335**	**26556**	**23450**	**26315**	**22751**	**25950**	**26972**	**30789**	**24964**		**6.7**

Carangids: The catch ranged between 4,587 t in 1978 and 14,617 t in 1984 representing a share of the total fish catch of 4.2%, exhibiting an upward trend from 1975 to 1984. This progressive trend continued further during 2000-08 as the catch fluctuated between 19,557 t in 2000 and 30,789 t in 2008 with an average catch of 24,964 t constituting 6.7% of the total catch of the state (Table 6). The scads were the dominant group constituting 14.3% of the carangid catch. The leather jackets *Chorinemus lyson, C. toll* and other species formed 0.4% of the total catch and 6.1% of the total carangid catch. The horse mackerel *Megalaspis cordyla* formed 0.2% of the total catch and 2.7% of the carangid catch. The catch of other carangids belonging to the genera *Selar, Carangoides* and *Caranx,* grouped as other carangids, formed 4.9% of the total catch and 73.3% of the carangid landings.

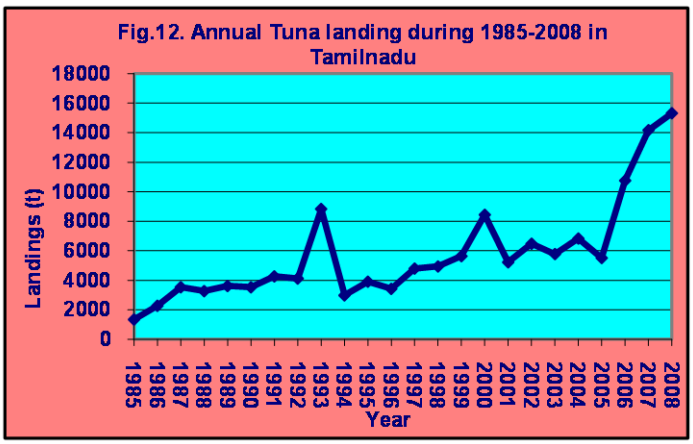


Mackerel: The third dominant pelagic resource is the Indian mackerel and the dominant species is *Rastrelliger kanagurta,* constituting 4.0% of the total fish catch. The landing was 6000 t in 1985 and the peak landing of this species (23,264 t) was observed in 1992. During 2000-08, the catch has been fluctuation between 10,799 t in 2000 and 23,152 t in 2006 with annual average of 12,012 t (Figure 11).

Table 7. Species composition of seerfish landings in t in Tamil Nadu during 2004-08

Species	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average	% in Resource	% in All fish
Other seerfish	788	27	12	0	0	0	0	0	0	92	1.3	0.02
S. commerson	12047	6216	7923	7136	6671	3794	5637	6431	5206	6785	95.9	1.82
S. guttatus	168	117	258	208	113	166	94	84	174	154	2.2	0.04
S. lineolatus	51	33	0	0	1	0	0	0	4	10	0.1	0.00
Acanthocybium spp.	2	7	13	7	19	28	19	184	53	37	0.5	0.01
TOTAL	**13056**	**6400**	**8206**	**7351**	**6804**	**3988**	**5750**	**6699**	**5437**	**7077**		**1.90**

Seerfish: The seerfish is a commercially and economically very important resource and this formed 1.9% of the total catch. The catch drastically declined from 13,056 t in 2000 to a mere 3,988 t in 2005 with a marginal revival thereafter to 6,699 t and 5,437 t in 2007 and 2008 respectively with an average of 7,077 t (Table 7). Four species, the king seer *Scomberomorus commerson* (95.9%), the spotted seer *S. guttatus* (2.2%), the streaked seer *S. lineolatus* (0.1%) and the wahoo *Acathnocybium solandri* (0.5%) occur in the fishery.

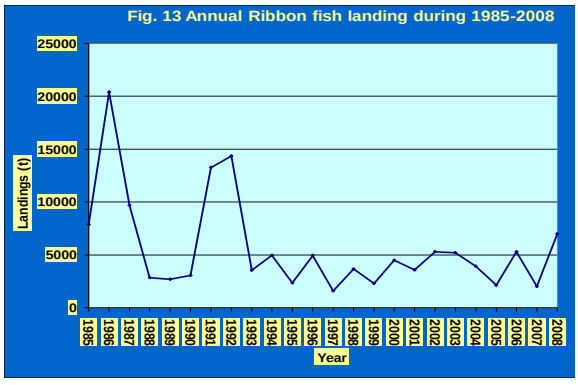


Tuna: The tuna catch increased from 1,336 t in 1985 to 8,831 t in 1993 and it further increased to 15,316 t in 2008 with an average catch of 8,718 t (Table 8). The trend in the tuna landings during 1985-2008 is shown in Figure 12. The dominant species of tuna were the little tuna *Euthynnus affinis* (49.9%), the skipjack *Katsuwonus pelamis* (9.2%), the long tail *T. tonggol* (4%), the frigate tuna *Auxis thazard*, the bullet tuna *A. rochei* (11.6%), the yellowfin *Thunnus albacares*, and other species (25.2%).

Table 8. Species composition of tuna landings in Tamil Nadu during 2000-08

Species	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average	% in Resource	% in All fish
E. affinis	4110	3422	3611	2498	3787	3264	7388	7025	4083	4354	49.9	1.2
Auxis. spp	902	505	934	784	500	815	1641	2045	984	1012	11.6	0.3
K. pelamis	1817	379	342	438	464	457	528	1186	1643	806	9.2	0.2
T. tonggol	109	534	1161	301	667	204	53	95	0	347	4.0	0.1
Other tunnies	1497	378	425	1753	1408	767	1140	3816	8606	2199	25.2	0.6
TOTAL	**8435**	**5218**	**6473**	**5774**	**6826**	**5507**	**10750**	**14167**	**15316**	**8718**		**2.3**

Ribbon fishes: The catches ranged from 4,594 t in 1977 to 28,664 t in 1978 with an average of 13,022 t and this group constituted 5.6% of the total landings (Figure 13). A downward trend was witnessed during 1978-1984 and this was witnessed in recent times also as the catch varied between 1612 t in 1997 and 5311 t in 2002 with an average annual catch of 4,514 t (1.2%) during 2000-2004. More than 90% of the catch was constituted by single species *Trichiurus savala* and the rest by other species like *T. haumela.*



Barracudas: The barracuda fishery is supported by *Sphyraena obstusata, S. forsteri, S. jello* and *S. picuda* and the last two large sized species are often caught by drift gillnet and hooks & line and are commercially very important. During 2000-08 the barracuda catch varied between 4,546 t in 2004 and 8,669 t in 2002 with an average catch of 6,978 t, which formed 1.8% of the total catch.

Table 9. Catch composition in t of half & full beaks, flying fishes and bill fishes during 2000-08

GROUPS	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average	% in All fish
HALF BEAKS & FULL BEAKS	5152	2533	2845	1964	1714	1331	1978	2696	3910	2680	0.7
FLYING FISHES	1918	5447	5438	4705	2392	761	802	1275	640	2598	0.7
BILL FISHES	254	1455	717	646	1068	249	763	597	662	712	0.2

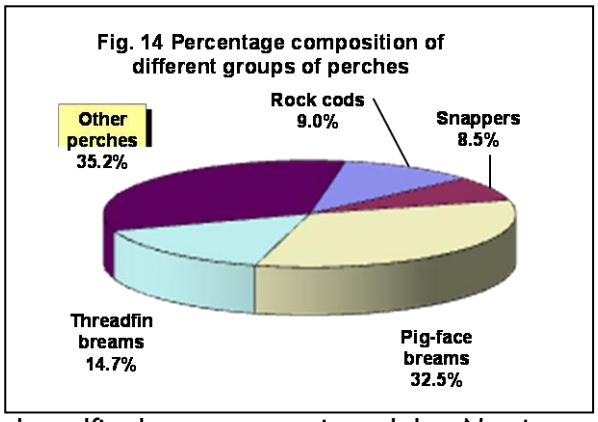
Half beaks & full beaks: The half beaks, *Hemirhamphus georgii* and *H. marginatus,* full beaks *Strongylura crocodilus, S. strongylurus* and *Ablennes hians* also form a considerable fishery along the coast and the catch during 2000-08 varied between 1,331 t in 2005 and 5,152 t in 2000 with an average of 2,680 t forming 0,7% of the total catch (Table 9).

Flying fish: The flying fishes *Exocoetus spp.* form a good fishery along the Palk strait and Gulf of Mannar coast and the catch continued to decline from 1,918 t in 2000 to a mere 640 t in 2008 with an average catch of 2,598 t forming about 0.7% of the total catch (Table 9).

Bill fishes: The billfish *Istiophorus platypterus* and *Makira india* are caught along with the tuna during May-September and the catch increased from 254 t in 2000 to 1,455 t in 2001 and then declined to 249 t in 2005 with marginal revival thereafter and the average catch was 828 t and this formed 0.2% of the total catch (Table 9).

3.1.6 Demersal fishery resources:

The demersal groups were constituted by perches 28%, croakers 20%, elasmobranchs 9%, silverbellies 8%, catfish 9%, flatfish 8%, pomfrets 6%, lizardfishes 5%, threadfin breams 2%, goatfishes 2%, eels 2%, and big jawed jumper (1%).



Perches: This group contributed 8.4% to the total marine fish catch and 28% of the demersal catch. There was a decreasing trend during 1975-1977 and a steady increase afterwards with little fluctuations. In the later years, the catch showed an increasing trend and varied between 28,211 t in 1999 and 37,589 t in 1995 with an average catch of 32,362 t, forming 7.9% of the total catch. Similar trend was observed during 2000 -2008 also, with the annual average catch being 31,602 t (Table 10). The pig-face breams, comprised of *Lethrinus nebulosus, L undulosus* and other lethrinids formed 33.3% of the perch catch, followed by the threadfin breams constituted by *Nemipterus japonicus, N. mesoprion* and other species (15.6%), rock cods *Epinephelus tauvina, E. fario, E. merra, E. malabaricus* (10.7%), snappers *Lutianus lutianus, L. malabaricus, L. sebae, L.lineolatus* (7.5%). The rest of the catch was constituted by other perches like balistids, therapons etc., (Figure 14).

Table 10. Catch composition of different groups of perches during 2000-08

GROUPS	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average	% in Resource	% in All fish
Rock cods	3310	4108	2373	3897	3337	1713	2517	2317	2130	2856	9.0	0.8
Snappers	2355	1276	1073	3049	4155	3635	2003	2112	4591	2694	8.5	0.7
Pig-face breams	9939	12482	10627	9884	10111	8948	10414	9312	10738	10273	32.5	2.8
Threadfin breams	3250	5548	6287	5000	4728	4610	4727	3629	4079	4651	14.7	1.2
Other perches	9331	9880	10903	12499	9876	9664	12194	11950	13850	11127	35.2	3.0
Total	**28186**	**33296**	**31263**	**34329**	**32207**	**28570**	**31855**	**29320**	**35388**	**31602**		**8.5**

Table 11. Catch composition (t) of sharks, skates and rays during 2000-08

ELASMOBRANCHS	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average	% in Resource	% in All fish
Sharks	5731	3969	4946	3425	9822	2274	2335	1504	1210	3913	28.3	1.1
Skates	181	160	749	414	768	1123	546	581	699	580	4.2	0.2
Rays	10896	8557	9979	12533	10834	7292	7969	7829	7967	9317	67.5	2.5
Total	**16808**	**12686**	**15674**	**16372**	**21424**	**10689**	**10850**	**9914**	**9876**	**13810**		**3.7**

Silverbellies: They formed on an average 16.6% of the catch and ranged between 17,837 t in 1977 and 62,109 t in 1983 with an average of 38,492 t. An increasing trend was discernible from 1975 to 1983. The catch declined to 26,914 in 2003 with a spectacular revival to 50,804 t in 2007. The annual average catch during 2000-08 was 38,280 t. The important component species were *Secutor insidiator, Leiognathus splendens, L. dussumieri, L. jonesi, L. bindus, L.equulus* etc.

Elasmobranchs: The share of this group in total was 6.9% ranging from 12,393 t in 1979 to 20,614 t in 1975 with an average of 15,980 t. The trend took a downward turn from 1975 to 1981 and showed an increase thereafter. During 2000-08 the landings varied between 9,876 t in 2008 and 21,424 t in 2004 and the average catch declined further to 13,810 t forming 3.7% of the total catch (Table 11). Rays comprised of *Rhynchobatus djiddensis, Rhinobatus granulatus, Himantura bleekeri, H. uarnak, Aetobatus narinari, Rhinoptera javanica, Amphotistius kuhli, A. imbricatus, ,Mobula diabotus* etc., were the dominant group (67.5% of elasmobranch catch), followed by sharks (28.3%), *Scoliodon laticaudus, Rhizoprionodon acutus, Carcharhinus sorrah, C. limbatus, C. carcharhinus, Pristic cuspidatus, Sphyrna blochii, S. zygaena, S. tudes* etc., and the skates comprised of mostly guitar fishes (4.2%).

Croakers: A minimum of 10.096 t in 1975 and a maximum of 22,029 t in 1982 were landed with an average of 14,815 t and this formed 6.4% of the total catch. An increasing trend was observed from 1975 to 1980 and then it took a downward turn from 1981-1984. The catch has declined to 6,597 t in 2008 with an average of 8,255 t, forming 2.4% of the total catch. The important species were *Otolithus ruber, O. brunneus, O. maculates, Johnius diacanthus, J. dussumieri, J. carutta, Sciaena russelli, S. macropterus,* etc.

Pomfrets: This group is commercially very important among the demersals and formed 0.75% of the total catch. The catch fluctuated between 1,885 t in 2008 and 3,375 t in 2001 with an average catch of 2,694 t (Table 12). There are three species silver pomfret *Pampus argenteus,* Chinese pomfret *P. chinensis* and the black pomfret *Formio niger.* Silver pomfret is the most dominant species comprising 59.8% of the total pomfret catch, followed by the black pomfrets (38.3%) and then the Chinese pomfrets (1.9%).

Table 12. Species composition of pomfrets during 2000-2008 along Tamil Nadu coast

POMFRETS	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average	% in Resource	% in All fish
Black pomfret	1343	2066	1109	677	817	2009	713	311	240	1032	38.3	0.3
Silver pomfret	1374	1297	2166	1397	1698	1216	1381	2372	1603	1612	59.8	0.4
Chinese pomfret	27	12	62	93	106	27	83	6	42	51	1.9	0.0
Total	**2744**	**3375**	**3337**	**2167**	**2621**	**3252**	**2177**	**2689**	**1885**	**2694**		**0.7**

Flat fishes: The flat fish catch fluctuated between 1,074 t in 2007 and 3,067 t in 2008 with an average of 2,031 t forming 0.58% of the total catch (Table 13). Soles comprised of *Solea elongata, Cynoglossus bilineatus, C. lingua, C. bilineatus* etc., are the most dominant group forming 83.4% of the total flat fish catch, followed by halibut *Pleuronectes erumei* (16.0%) and flounders *Pseudorhombus javanicus, P. arsius* etc., (0.6%).

Table 13. Catch composition of different groups of flat fishes during 2000-2008												
FLAT FISHES	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average	% in Resource	% in All fish
Halibut	230	274	592	496	228	332	371	215	185	325	16.0	0.1
Flounders	39	28	35	5	2	2	1	0	1	13	0.6	0.0
Soles	2206	1439	1958	1718	1574	1215	1383	859	2881	1693	83.4	0.5
Total	**2475**	**1741**	**2585**	**2219**	**1804**	**1549**	**1755**	**1074**	**3067**	**2031**		**0.5**

Goatfishes: The goatfishes comprised of *Upeneus vittatus, U. sulphureus, U. sundaicus* and other species have emerged as an important fishery and the catch varied between 4,626 t in 2003 and 8,121 t in 2005 with an average catch of 6,168 t, which formed 1.7% of the total catch (Table 14).

Lizard fishes: The lizard fish catch exhibited an increasing trend though the catch varied between 2,360 t in 2007 and 8,689 t in 2008 with an average of 4,465 t, forming 1.2% of the total catch (Table 14). *Saurida tumbil,* and *S. undosquamis* were the most dominant species.

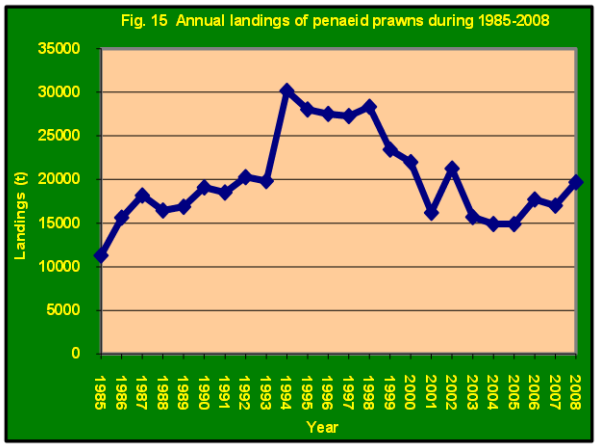
Catfish: The catfish catch showed generally a declining trend as it declined from 4,942 t in 2000 to 2,511 t in 2001 with a marginal revival in the fishery as the catch increased to 5,550 t in 2007 and further to 5,931 t in 2008 with an average of 3,943 t, forming 1.1% of the total catch (Table 14). The important species were *Tachysurus thalassinus, T. coelatus, T. dussumieri, T.tenuispinis* and *Osteogeneiosus militaris.*

In addition to the above mentioned important demersal fishery resources, mullets, eels, threadfins, big-jawed jumper and unicorn cod were also caught in considerable quantity, as seen in Table 14.

Table 14. Catch composition of eels, catfish, lizardfishes, goatfishes, threadfins, big-jawed jumper, mullets and unicorn cod during 2000-2008											
Name of fish	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average	% in All fish
Goatfishes	6835	5814	5415	4626	5885	8121	5992	5437	7385	6168	1.7
Lizard fishes	3325	3294	5653	4221	4561	4271	3811	2360	8689	4465	1.2
Catfishes	4942	2511	3111	2647	3793	2570	4435	5550	5931	3943	1.1
Mullets	965	882	591	790	525	494	855	739	3492	1037	0.3
Eels	527	317	598	790	338	1030	320	680	322	547	0.1
Threadfins	572	444	635	312	486	196	186	712	419	440	0.1
Big-jawed Jumper	304	401	601	84	245	1065	463	70	179	379	0.1
Unicorn cod	7	0	0	0	0	0	0	0	0	1	0.0

3.1.7 Crustacean resources

The crustacean fishery is supported mainly by penaeid and non-penaeid shrimps, crabs, lobsters and stomatopods, forming 9.3 % of the total fish catch. Penaeid shrimps formed 4.8% of the total catch and 51.3% of the crustacean catch, followed by crabs (3.4% of total catch and 37.1% of crustacean catch), non-penaeid shrimps (0.7% of total catch and 8% of crustacean catch), stomatopods (0.3% of total catch and 2.9% of crustacean catch) and lobsters (0.1% of total catch and 0.7% of crustacean catch) (Table 15).



Penaeid shrimps: Shrimps have shown an increasing trend during 1975-1984. The group's contribution to the total catch was 5.1%, with an average of 11,741 t (Figure 15). The catch continued to increase owing to the increase in effort during nineties with a peak production of 30,176 t in 1994. In the succeeding years the catch declined to 16,202 t in 2001, which formed 6.1% of the total catch of the state. During 2000-2008 the annnual average catch was 17,716 t, forming 4.8% of the total catch (Table 15). Important species are *Penaeus indicus, P. monodon, P. semisulcatus, P. japonicus, P. merguiensis, Parapenaeopsis stylifera, Metapenaeus dobsoni, M. affinis, M. brevicornis, M. monoceros, Metapenaeopsis stridulans, Solenocera crassicornis, S. hextii, S. choprai,* and other species.

Non-penaeids: During 2000-08 the catch increased from 2,002 t in 2000 to 5,546 t in 2001 and then exhibited a declining trend as the catch declined to 1,081 t in 2005 with an average of 2,750 t, forming 0.7% of the total catch (Table 15). The important species are *Exhippolismata ensirostris, Nematopalaemon tenuipes, Exopalaemon styliferus, Acetes indicus, A. japonicus,* and *Parapandalus spinipes.*

Crabs: The landings ranged from between 5,883 t in 1979 and 16,413 t in 1976 with an average of 10,359 t and this formed 4.4% of the total catch. A decreasing trend was noticed during 1977-1981 and then an upward turn in 1984. During 2000-2008 the crab landing showed an improvement and formed on an average 3.4% of the total catch and the landings fluctuated between 10,386 t in 2005 and 15,455 t in 2003 with an average of 12,786 t (Table 15). Mainly three species, *Portunus pelagicus, P. sanguinolentus* and *Charybdis cruciata* support the crab fishery along the Tamil Nadu coast and the other species formed the non-edible portion of the catch suitable for reduction as fish meal.

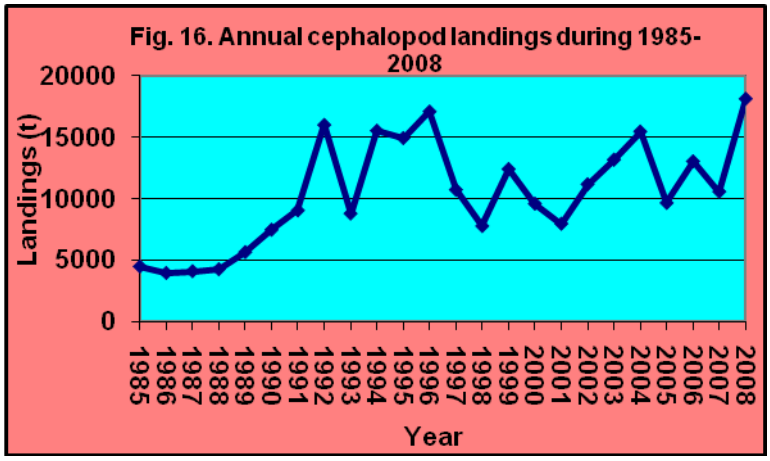
Lobsters: This is one of the most economically important export commodities, although it forms only 0.1% of the total catch. Five species of spiny lobsters, *Panulirus homarus, P. polyghagus, P. ornatus, P. pencillatus* and *P. verisicolor,* the sand lobster *Thenus orientalis* and the deepsea yellow lobster *P. sewelli* occur in the commercial landings. The lobster catch continued to increase from 142 t in 2000 to 226 t in 2004 and further to 430 t in 2008 with an average catch 257 t (Table 15). Though there is size restriction for exploitation and marketing, the fishermen and traders continue to harvest the young ones weighing lesser than 100g, as there is a clandestine market for under-sized lobsters also. In a few places like Tharuvaikulam in Tuticorin district, lobster fattening is carried out by the fishermen in iron net cages in the intertidal waters.

Stomatopods: The stomatopod, *Oratosquilla nepa* is the most dominant species forming 0.3% of the total catch. During 2000-08 the catch progressively increased from 327 t in 2000 to 1,453 t in 2008 with an average catch of 994 t indicating an increasing trend in the landings as there is an increase in the demand for this species in the market (Table 15).

3.1.8 Molluscan fishery resources: The molluscan catch was comprised of cephalopods (87.1%), and to some extent, gastropods (7.7%) and bivalves (5.2%). Though there appears to be an increasing trend in the total molluscan catch during the early 2000, the catch drastically declined during 2005-08 after tsunami. The catch increased initially from 8,174 t in 2001 to 16,415 t in 2004 and then declined to 3,137 t in 2008 with an average catch of 8,730 t, forming about 2.3% of the total marine fish catch (Table 16).

Table 15. Catch composition of different groups of crustaceans during 2000-2008												
CRUSTACEANS	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average	% in Resource	% in All fish
Penaeid shrimps	22004	16202	21266	15711	14912	14902	17726	17020	19698	17716	51.3	4.8
Non-penaeid shrimps	2002	5546	3537	1940	2871	1081	4355	2234	1187	2750	8.0	0.7
Crabs	13682	10435	14242	15455	13332	10386	12079	12760	12702	12786	37.1	3.4
Lobsters	142	160	195	202	226	308	421	227	430	257	0.7	0.1
Stomatopods	327	465	798	1415	1054	1084	1208	1141	1453	994	2.9	0.3
Total	**38157**	**32808**	**40038**	**34723**	**32395**	**27761**	**35789**	**33382**	**35470**	**34503**		**9.3**

Table 16. Catch composition of different groups of molluscs during 2000-200.												
MOLLUSCS	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average	% in Resource	% in All fish
Bivalves	62	0	2910	307	141	215	352	52	52	455	5.2	0.1
Gastropods	22	241	1017	898	810	634	532	791	1077	669	7.7	0.2
Cephalopods	9569	7927	11153	13163	15464	9628	1504	51	0	7607	87.1	2.0
Total	**9653**	**8174**	**15080**	**14368**	**16415**	**12482**	**4394**	**2901**	**3137**	**8730**		**2.3**



The cephalopod landing during 1985-2008 is shown in Figure 16. The cephalopods were comprised of squids, cuttlefishes and octopus in which the squids were the most dominant group constituted mostly by *Loligo duvaucelii, Sepioteuthis lessoniana* and other species belonging to the genus *Symplectoteuthis* and *Doryteuthis*. The cuttlefishes were comprised of *Sepiella inermis, Sepia aculeata, S. pharaonis, S. prashadi* and *S. elliptica* and the octopuses *Octopus dollfusi, O. globosus* and *O. herdmani*.

3.2 Status of marine/coastal ecosystem health

The rich demersal fishery resource of the Coramandal Coast has drastically declined due to intensive and extensive mechanised trawl fishing. Initially single day trawling was carried out during day time during 1960s and 70s in the vicinity of the fisheries harbours located at Kasimedu in Chennai, Pudumanikuppam in Cuddalore, Pondicherry, Nagapattinam, Mandapam, Rameswaram, Turicorin and Muttom. Gradually when the fishing ground located near the fisheries harbours started to yield poor catch due to intensive fishing, the trawling was extended on north and south along the coast and this paved the way for multiday fishing initially for 3 days and later more than a week all along the coast. Expansion of fishing area and adoption voyage fishing in search of better fishing grounds indicate decline in the demersal fishery resources year after year. This was mainly due to the degradation of the environment and the ecosystem as a whole. Constant continued sweeping of the sea bottom by the mechanized trawlers severely affect the bottom fauna especially the sedentary invertebrates and the sea bottom of the near shore waters have become barren almost like a desert.

Construction of a series of big dams and smaller check dams on the upper reaches of most of the mighty perennial rivers and some of the seasonal rivers, coupled by the reduction in rainfall during the subsequent later years due to change in the climate, have resulted in drastic reduction in the quantum of freshwater discharge into the Bay of Bengal, Palk Bay and Gulf of Mannar. This has resulted in short supply of valuable nutrients in the near shore waters which in turn has critically affected the primary production of the region concerned. The short supply of freshwater in the mangrove ecosystem has resulted in a decline in the number of component species of the mangrove ecosystem and reduction in the mangrove spread area leading to considerable reduction in the fishery resources especially crustaceans. A very fast increase in the area of coastal aquaculture for prawn by reclaiming the wetland ecosystem and by deforesting the mangrove ecosystem along the coast has also resulted in a drastic decline in the mangrove forest area. This has resulted in further reduction in the nursery grounds of the marine fishery resources and in turn this has resulted in a decline in the recruitment of important fishery resources mostly crustaceans.

Selective fishing for commercially important species especially the apex predators like sharks, billfishes, sailfishes, seerfishes, barracudas, large croakers like koth, ghol and dhara has lead to not only a drastic reduction in the population of the component species of these resources, but this has resulted in increase in the population size of the prey fishes of these predators. There is a change in the species composition and emergence of commercially less important species like oil sardine, resulting in an increase in small pelagic fishery resources. This phenomenon is now referred to as "fishing down the food web".

4- Development of legislation

Marine Fisheries management practices in Tamil Nadu are largely based on conventional approaches around biological criteria. Tamil Nadu Marine fishing regulation legislation is almost based on a model bill prepared by the central Government in 1979 and it is managed by five major legal instruments including TMFR Act 1983 and several other related pieces of legislation from the Central Government. Tamil Nadu provides only a primary and often incomplete regulatory and licensing regime for fisheries management, augmented by seasonal fishing bans including the uniform ban on fishing by mechanised boat for 45 days from 15th April to 29th May along the East coast and from 15th June to 29th July along the West coast, regulating mesh size, and zoning within the 22 km limit of the inshore waters. Lack of proper patrol vessels makes the enforcement of even these basic kinds of regulations quite weak. The increase in conflict between the smaller inshore vessels and larger offshore mechanized trawlers in exploiting the fish on both the sides of the 22 km boundary has not been effectively dealt with. Although there has been an attempt to limit fishing vessels, entry into the sub-sector by new vessels is not restricted in practice.

This weak legal framework never leads to a sound basis for fisheries development either in terms of meeting the demands of the 2004 CMFP or in meeting the requirements of international law. The policy and legal implementation is weak with no effective administrative systems in place to support improved fisheries management performance. There is an ineffective coordination between state laws and authority within the 22 km boundary (Territorial waters) and national laws and authority which deals with area outside the 22 km territorial boundary (EEZ waters). Lack of political and social will to observe and practice even the preliminary regulatory measures like spatial restriction of mechanised trawlnet operation in shallow waters within the territorial waters meant for the operation of traditional boats, operation of pair trawling and ring seine has led to an increase in the conflict between the sectoral fishing and the biological resources have also become more vulnerable. This is a pertinent issue that needs critical consideration to find out ways to improve the marine fisheries management practices through active participation of all the stakeholders whose livelihood depends either directly or indirectly on marine fishing and fishery resource utilization.

5 Conclusions

5.1 Key threats to sustaining marine ecosystem health

Marine fish production in Tamil Nadu is almost stagnating with limited scope for increase in production as nearly 90% of the fishing fleet are operating within the near shore waters only and only a very few are venturing into the deep sea. As the present marine fish production is just above 50% of estimated marine fishery potential, there appears to be further scope to increase the production mainly by exploiting the oceanic resource like tuna, squids, sharks and barracudas by mechanized deep sea fishing vessels. Already the traditional fishermen have started harvesting the yellowfin tuna from the deep waters off Nagapattinam and a few mechanised trawlers are converted for long lining. Some new vessels are also fabricated for long lining. There is a keen competition among different fishery sectors in harvesting the available resources in the inshore waters. Traditional units are marginalized and are forced to operate in the shallow inshore waters owing to their inability to venture into the oceanic waters. Infringement of mechanized trawlers into the shallow waters of traditional fishing units is still a pain in the neck. The increase in the number of traditional units after tsunami has added further fuel to this conflict and these units are forced to share the available resources within the shallow inshore waters. Intensive and extensive fishing has led to a phenomenon called fishing down the food web, wherein the large predators have been systematically fished out leading to an increase in the abundance of less valuable small sized species. Sustained indiscriminate fishing and environmental changes have led to decline of certain fishery resources and emergence of different other resources. Long living, predatory large species with slow growth rate with low

fecundity, occupying the top slot in the food web have either dwindled or vanished. Conversely smaller, short lived species with faster growth rate and prolific breeding and high fecundity have started emerging as dominant fishery.

Owing to the constant sweeping of the sea bottom by mechanized trawlers and traditional "Thallumadi" (bag net) the benthic fauna have been severely affected and there is no sufficient scope for the proper revival of the bottom living fauna and flora. Inappropriate and illegal fishing like pair trawling, ring seining and dynamite fishing have lead to reduction in the benefit sharing of the fishery resources, as only a very few fishermen are being benefited more and many are deprived of the access to the resource.

Emerging economic growth in India and increasing global market demand for fish have led to an unprecedented expansion of fishing intensity and perceptible changes in the species composition of fish being harvested. Simultaneously as fishing intensity has been increasing the catch levels are stagnating and fish stock health is showing some alarming signs. Stock assessment studies reveal that over 61 %t of fish stocks are already over-exploited, and most of the remaining stocks are fully exploited, leaving very little scope for further expansion in the catch from the inshore waters. Due to reduction in catch, exports have also declined by 18 % in the ten month period up to January 2008. Illegal, unreported and unregulated fishing in the Exclusive Economic Zone (EEZs) of the Eastern Indian Ocean is roughly assessed to be 32 % of the total annual fish harvest. Another contributing factor to declining fish stocks may be growing coastal development and pollution.

Massive modernization processes and feeble management measures have led to the current situation of declining catches, reduced profits and incomes, and increasing conflicts, particularly for smaller boat owners and crew, who are neither able to assert their right to access the fishery resource effectively, nor shift to newer fishing grounds. The rapid growth of mechanized trawler fleet, often with the benefit of public subsidies, has led to an increased keen competition for fish with smaller inshore vessels in almost all the fishing areas. The benefit sharing in mechanised trawl sector is estimated to be 20 percent of the fishing labor force enjoys the 60 percent of the catch. This scenario has led the poor fisher into a cycle of perpetual debt, low profits, and difficulty in accumulating cash surpluses. Added to this increase in fuel prices will be likely to further aggravate pressure on the viability of motorized vessels and may lead to demand for further subsidies from government.

5.2 Gaps and needs for fisheries and ecosystem policy and legislation

Tamil Nadu Government has proposed 1) to encourage fishermen to exploit under-utilized fishery resources to reduce fishing pressure in inshore areas 2) To augment aquatic resource production in inshore areas by conservation measures, stock enhancement and establishing of artificial reefs etc., along the coast 3) To promote sustainable eco-friendly coastal aquaculture 4) To strengthen the infrastructure facility for fish landing and marketing 5) To uplift the socio-economic condition of the fisher folk through welfare measures and by generating employment opportunities for fisher folk 6) To modify the present fisheries legislation to suit to the present condition.

Accordingly Tamil Nadu Government has resolved to implement the Tamil Nadu Marine Fishery Regulation Act 1983 in letter and spirit. Uniform ban on fishing by mechanised boats for 45 days along the East Coast during 15th April to 29th May and along the West Coast during 15th June to 29th July. Established 14 artificial reefs and initiated steps to establish 4 more in selected inshore areas. About 28.5 million shrimp seeds were reared and ranched under Sea Ranching Programme. Chennai and Thoothukudi Fishing Harbour will be upgraded under ASIDE scheme. Construction of Fishing Harbours in 7 places under Tsunami Emergency Reconstruction Project and in 2 places under BOOT system is in progress. Several other relief and promotional measures are being implemented time and again for the socioeconomic benefit of fishermen.

Building Sustainable Governance

In addition to these the marine fisheries policy initiatives of Government of Tamil Nadu are:

1. To encourage offshore deep sea and high sea fishing to reduce fishing pressure in the inshore waters.
2. Introduction of intermediary vessel (or) equipping the existing vessel for offshore fishing by providing credit and incentive support to the fishers.
3. Introduction of multi day fishing vessel and carrier / collector vessels.
4. Joint venture for fishing in EEZ and international waters shall be promoted.
5. Introduction of resource specific fishing vessels for tuna and squid fishing.
6. The central institutions like CMFRI, FSI, NRSI may provide information to the state fisheries department on fish stock and optimal exploitation level, fish availability on regular basis.
7. Implementing sea ranching programme at least for selected commercially targeted fishes and shrimps.
8. Conducting regular awareness campaigns to educate the fishers on responsible fishing.
9. Strengthening the communication facilities through establishing well equipped fishers service centres / village knowledge centres.
10. The Government shall identify fishing centres for creating infrastructure facilities such as construction of fishing harbours, landing, berthing, bunkering, post harvest handling facilities on priority basis.
11. Centralised facilities shall be created for fish processing, fish dressing centres, solar dryers etc.,
12. Marketing net work to be strengthened by providing cold chains facilities from the point of fish catch to retail outlets / export.
13. Educate fishers on hygienic handling of fish harvested to realize more money for their catches.
14. Ecosystem based fishery management shall be undertaken (eg.) Fishing holidays during breeding season, Declaring sanctuaries, marine national park etc.,
15. Facilities to be created to utilize by catch for value addition.
16. Plan for voluntary decommission and diversification of fishing effort to offshore region.
17. Effective steps to be taken to curb the excess fishing effort
18. Sea farming, coastal aquaculture shall be encouraged.
19. Destructive fishing practices such as dynamite / cyanide poisoning, pair trawling, purse seine operation, illegal poaching of banned species, fishing in restricted area, pollution which affect the natural ecosystem shall be curbed through effective enforcement laws.
20. The Government shall promote participatory management in fisheries sharing the responsibilities with fishers and Non-Governmental organizations.
21. Sea ranching, setting up of Artificial reef / fish aggregating device shall be undertaken for resource enhancement.
22. Integrated coastal zone management plan shall include both capture and culture fisheries as a vital programme.
23. Juvenile kill or catching of undersized fishes to be avoided.

24. Disaster preparedness and management to be given top priority.
25. Overexploitation of resources despite high market demand shall not be allowed.
26. International guidelines for sea safety measures to be adopted strictly.

Though the above mentioned policy initiatives of Tamil Nadu covers almost all the aspects of marine fisheries management through appropriate developmental activities envisaging the participation of all stakeholders, it is well known that achieving the desired result is very difficult. As per the critical analysis by researchers the existing policy and management focus is on the physical weight of fish caught and this is a production oriented policy that can contribute to overexploitation. Mostly the fishing is typically understood only in its biological dimension. Fishing benefits are often seen in terms of employment and livelihoods for the poor, which can lead to policies that encourage overcapacity. Strategies often focus on improving technology (boats, gear, etc) to enable fishers to increase harvests, even where stocks are at risk. Fishers have poorly defined and un-enforced use-rights for fish, often contributing to an open access, common property situation that provides high incentives for immediate exploitation. In the absence of effective management, fish stocks are usually overexploited and potential resource is dissipated.

5.3 Possibilities of expansion of innovative methods to wider areas

It is important that in the beginning, a process be established for extensive stakeholder participation, education and awareness building, especially at the community level; this will help break down resistance to change and overcome vested interests. In addition, it is critical that the planning and early implementation of programs aim to minimize any impacts of change on people in the sub-sector, particularly smaller operators, and to facilitate development of expanded livelihood opportunities. This is critical to help shift the expectations and capacities of new generations living in coastal fishing communities, that viable economic alternatives beyond fishing are possible. We may consider the salient features of the traditional governance already existing in the fishermen villages and also explore the traditional strong panchayat system of Patnavar in north Tamil Nadu for achieving better success of this aim. This initial phase could then be followed by implementation of an agreed program of adaptive and flexible reforms.

All fishermen belonging to different sector should have equal rights, access and definite roll to play in optimum sustained utilization of the biological resources of the region concerned. Allocation of the fishery resources between different sectors such as artisanal, motorised and mechanised may be thought of as an effective tool to resolve conflict and rational utilization of the dwindling resource with amicable settlement or practices, as in the case of sharing the fishing days among the traditional and mechanised sectors in Palk Bay. It is high time that all the stake holders sit together and find the right process of implementation or observation of various tangible and useful regulatory measures which are in still in paper only in the form of Acts and Rules and have never seen the light implementation. For example the mesh size regulation, spatial restriction for the operation of mechanised trawlers within the inshore waters, operation of right seine etc., Most of the regulations are based on biological entities, often without due consideration to other related measures such as environment, ecosystem, community, social and political and the agency either to exercise or supervise the implementation is the Government evolved as a top down model and Tamil Nadu has never exercised the option bottom up process of shifting the management through community-based initiatives and adopting new participatory co-management approaches involving all the stakeholders, where the marine fishery management is considered as a wholesome process with serious considerations on various fishery regulatory measures pertaining to fishing and fishery resources, resource enhancement, ecosystem reconstruction, stock building, coastal aquaculture, mariculture, inshore water utilization for fishery related activities including ecotourism.

Building Sustainable Governance

Various marine fisheries activities like Research, HRD, Development, Conservation and Trade are administered through different Institutions coming under three different Central Ministries. The Ministry of Agriculture and its Institutions are IFP, CIFNET, FSI & CICEF, the DARE and the Eight ICAR Research Institutes. The Ministry of Science and Technology has the following Earth Sciences, with the DST, DOD, DBT, the CSIR with NIO, the Ministry of Environment and Forests with the wildlife Institute, and the Ministry of Commerce with the MPEDA. At the state level the SAU fisheries colleges, some academic universities and the Fisheries and Forest departments also administer the R&D of marine fisheries sector. The latest addition to these is the National Fisheries Development Board. All these organizations implement their programmes as per their respective mandates. Naturally this kind of widely distributed activities in marine fisheries may cause huddles in the process of effectively implementation of the overall objective of Development, Sustainable Utilization and Conservation of the resources, and addressing the socio-economic issues of the communities and the HRD needs. The mandatory provisions for decision making jointly, if in existence, are not either strictly implemented or only given a casual attention. To strengthen the mandatory provisions for effective joint decision making and implementation of the various programmes, it is necessary that "A Marine Fisheries Research and Development Authority" (MFRDA) consisting the representatives of ICAR (Fy), MOA, MOC, MST (DOD, DBT), MOEF and all maritime state governments including the UTs, should be set up to oversee all the activities related to marine fisheries. Separate Working Groups from among the concerned Ministries and Departments should be constituted to address the Research, Development, HRD, Trade and Management needs of the Marine Fisheries Sector and report to the Authority. It is imperative to ensure that all activities of marine fisheries are placed under the jurisdiction of this Authority

Though there are many regulatory measures like limited entry, temporal restrictions, spatial restrictions, mesh size regulation etc. all these are seldom implemented for obvious reasons for want of an effective implementing agency and lack of political and social will to observe these regulations. The only effective regulation is the 45 day fishing holidays during the middle of April to end of May. Some of the enlightened fishermen from the Ramnad district demand for another fishing holiday of equal period during the north east monsoon in November and December, as most of the southern Tamil Nadu fishery resources are more prolific breeders during this monsoon than during the southwest monsoon. All these years we have been concentrating on the fishery and fishery infrastructure development and now the time has come to equally pay attention to biological resource enhancement and reconstruction of the ecosystem health. An attempt in this regard by the Tamil Nadu Government through the deployment of artificial reef and sea ranching has paid rich dividend in the form of biological resource enhancement and marginal increase in the fish production by the traditional fishing units in the region concerned.

While we encourage the deep sea fishing, we should also concentrate on the transfer of various mariculture techniques put forward by different Research Organisation like CMFRI, Fisheries College and other University Departments among the fishermen and coastal community. Other livelihood activities like marketing and value addition shall be taught to the younger educated generations of the fishermen and coastal community to enhance their income generation and employment opportunities.

Fishermen are always exposed to very rough and hostile climatic conditions. In addition to cyclones now we have tsunami also. In order to mitigate the effects of natural disasters in coastal area, it is necessary to understand the dynamics of the process involved and give accurate and timely early warnings. Over 70% of the natural disasters are climate related and hence management of these disasters will need the integration of weather and climate monitoring in the process. Capacity building in areas of observing the ocean and the atmosphere for accurate and timely forecast of

extreme climate event is utmost necessity. Cross-sectoral multi-hazard approach and co-ordination between various agencies is necessary in the effective management of coastal disasters.

Global experience reveals that considerable time, may be two decades or more and commitments will be required by major stakeholders, government, coastal fishers and processors, to successfully engage in a transformation process. The action plan also needs to be innovative, adaptive and responsive; they must build appropriate capacities and provide the necessary tools and information about best practices. It is important that in the beginning, a process be established for extensive stakeholder participation, education and awareness building, especially at the community level; this will help break down resistance to change and overcome vested interests. In addition, it is critical that the planning and early implementation of programs aim to minimize any impacts of change on people in the sub-sector, particularly smaller operators, and to facilitate development of expanded livelihood opportunities. This is critical to help shift the expectations and capacities of new generations living in coastal fishing communities, that viable economic alternatives beyond fishing are possible. This initial phase could then be followed by implementation of an agreed program of adaptive and flexible reforms.

An effective management system can reduce investments in excess capacity, lower operating costs, increase productivity and unit prices because of larger stocks and better quality fish. With an effective management system, the resource benefit can either be capitalized into the value of defined fishing use rights, or can be extracted by the public management agency to support new economic activities in coastal communities. With a holistic approach to fisheries management, collective decisions are taken about how to generate wellbeing of the ecosystem, how to share the benefits without any damage to the health of the ecosystem and the resource and how to sustain it in the long run. Developing a fisheries management approach to construct the healthiness of the ecosystem and its benefit sharing is a long-term and challenging goal with many intermediate steps required to lay the groundwork - better stakeholder participation, education and awareness, research and analysis, policy and legal reform, and improved fisheries management practices.