Chapter 2

Indian Marine Fishery: An Overview

2.1. Physical Description of Indian Marine Fishery:

India is located between latitudes 8° 4' and 37° 6' N and longitudes 68° 7' and 97° 25' E with 28 states and 7 union territories covering a total land area of about 3.3 million km^2. Out of these states and union territories, 9 and 4 are maritime respectively. India's Exclusive Economic Zone (EEZ) covers a total area of 2.02 million km^2 of which 0.86 million km^2 on the west coast including the Lakshadweep Islands and 1.16 million km^2 on the east coast including the Andaman and Nicobar Islands. The continental shelf covers half a million km^2.The country has Indian Ocean at the south, the Arabian Sea on the west and the Bay of Bengal on the east. Indian marine fishery region is divided into two coastal zones: West Coast (Malabar Coast) and East Coast (Coromondal Coast).

a) West coast of India (Malabar Coast)

The following states and union territories border the west coast of the country:
Maritime States: Gujarat (GJ); Maharashtra (MR); Goa (GOA); Karnataka (KT); Kerala (KR).
Union Territories: Daman and Diu; Lakshadweep.

It has a broader continental shelf with high fish catches. The seasonal cycles of the waters of the Arabian Sea are well mixed because of strong influence of the northwest monsoon. This causes abundant nutrients such as nitrates and phosphates which lead to higher plankton production. The effect of these factors is a richer fish fauna, both in terms of diversity and in abundance. Over 75 percent of India's total fish landings originate from the west coast. Geographically West Coast is divided into two sub-regions namely, (i) South-West zone, which is consisting of Kerala, Goa & Karnataka and (ii) North-West zone consisting of Maharashtra & Gujarat.

(i) **South-West**: Although this sub-region of the west coast is the largest contributor of India's total marine fish landings, the production is more or less stagnant in the five years ended in 2005. The striking features of the marine fisheries of this region are the predominance of the pelagic resources. That is why the proliferation and enhancement of capacity of ring seine crafts in this zone are observed. The major fishes that are caught in this region are oil sardines, sharks, white baits, carangids, mackerels, ribbon fishes and crustaceans. However, the demersal fish landing has increased steadily with the exception of Kerala

(ii) **North-West**: The growth of marine fish production in North-West was spectacular owing to the rapid development of fishing in the state of Gujarat. In this sub-region, Gujarat is the major resourceful state. During the last fifteen years, this region has emerged as one of the single largest contributors of total marine fish landing in India. Cephalopods and crustaceans are abundantly available both in Maharashtra and Gujarat. In Maharashtra, pomfrets, non-penaeid prawns and stomatopods are major fish variety. On the other hand, in Gujarat major fishes are catfishes, threadfins, croakers, pomfrets, cephalopods, penaeid & non-penaeid prawns.

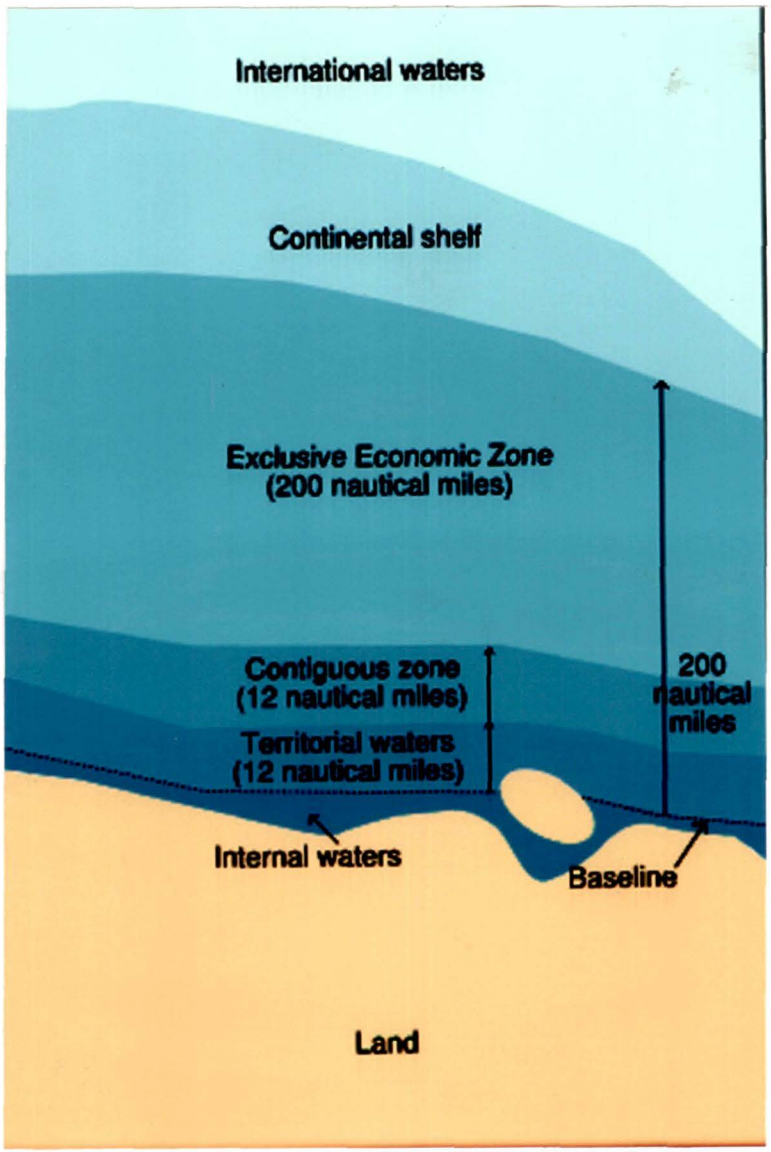
b) East coast of India (Coromandel Coast)

The following states and union territories border the east coast of the country:
Maritime States: Tamil Nadu (TN); Andhra Pradesh (AP); Orissa (OR); West Bengal (WB).
Union Territories: Pondicherry (PC); Andaman and Nicobar Islands.

It has a narrow continental shelf. The northeast monsoon winds, which sweep over the Bay of Bengal are moderate and have short duration. Primary production in the Bay of Bengal is relatively low. Overall, this region produces only 25 percent of total Indian marine landings. East Coast is divided into two sub-regions namely, (i) South-East zone, which is consisting of Andhra & Tamilnadu and (ii) North-East zone consisting of West Bengal and Orissa.

(i) **South-East**: South-East zone consists of two maritime states Andhra Pradesh and Tamilnadu. Oil sardines are one of the most important species captured in this zone. The major fishes that are caught in this sub-region are ribbon fish, seer fish, lizard fish, goatfish, threadfin beams, silver bellies and penaeid prawns etc.

(ii) **North-East**: North-East zone contributes only about 10.7 percent of total all India landing. Hilsa shad, Bombay duck, coilia, seer fishes are mainly landed in West Bengal (WB). Bombay duck & Hilsa shad constitutes 71 percent of total pelagic landing & 51 percent of total marine fish landing in WB. Elasmobranches, sharks, skates, rays and penaeid prawn are also the part of main catch. Catfishes, Croakers, Pomfrets and Penaeid Prawns etc of demersal variety are available in this sub-region.



Photograph of Indian EEZ at different depth and International waters

2.2 Marine Resource & Potential:

In India, about a million people are involved in fishing operations. According to the estimate made by the working group constituted by Ministry of Agriculture, Government of India (GOI), the harvestable potential of marine resources from India's seas is 3.934 million tones. But the level of harvest of Indian marine fish is around 2.8 million tonnes (DAHD, 1998). The harvest data shows that the exploitation from deep sea sector is still very negligible and working group observed the possibility to enhance Indian marine fish production to 3.5 million. An estimation of the depth-wise potential shows that about 58 percent of the resources are available in 0-50 meter depth, 35 percent in 50-200 meter depth and 7 percent in depths beyond 200 meter. Findings of working group regarding potential fishery resources are shown in table-2.1.

Table- 2.1: Potential of fishery resources in the Indian EEZ at different depths: (in million tonnes)

Depth range (m) Fish type	0-50	50-200	> 200	Total
Demersal	1.28	0.625	0.028	1.933
Pelagic	1.00	0.742	0.246	1.988
Total	2.28	1.367	0.374	3.921
percent total	58.1	34.9	7.0	100.0

Source: Working Group Report revalidating potential of fishery resources in the Indian EEZ, DAHD ministry of Agriculture, 1998.

The present marine fishing fleet is estimated to be about 237345 numbers (inclusive of 810 Fiber-glass Reinforced Polymer (FRP) Catamarans and 135 Beach Landing Crafts) consisting of traditional craft (104059 nos.), motorized traditional craft (74937 nos.) and mechanized boats (58349 nos.) which includes about 80 large fishing vessels of 21 meter overall length (OAL) and more (Marine Fisheries Census, CMFRI, 2005). As seen by the number of traditional craft and small-mechanized vessels, the major fishing activities are still concentrated in the areas within 0 to 70 - 80 meter depth zones. Trawling by larger vessels is confined to the northeast coast (Bay of Bengal). As compared to the west coast, concentration of traditional craft (Including motorized crafts) is more on the east coast (about 57 percent of the total). In the case of mechanized vessels, the trend is reverse. The scale of mechanization is also reflected in the total fish landings of the two coasts.

India's EEZ comprises different depth zones: 0-50 meters extending to 0.18 million sq. kms; 50-200 meters extending to 0.27 million sq. kms; and 200 meters and beyond extending up to the limits of the zone, 1.57 million sq. kms. The fishable potential in unit area is considerably low in depths beyond 50 m (0.9 tonnes/km^2) compared to that in the inshore waters (12.2 tonnes/km^2). Also, the deep-sea fishing requires larger vessels (Overall length (OAL) > 17 m) with sophisticated fishing technologies involving high establishment and maintenance costs. Fish production has increased over the years with the motorization of traditional craft and introduction of mechanized boats in the traditional sector, as well as by the diversification of fishing effort beyond 50 meters depth. Exploitation of resources of about 1.64 million tonnes of deep sea fishery can be done through technology intensive joint ventures deploying foreign fishing vessels. It is estimated that 0.5 million of tonnes or about 40 percent of the unexploited stocks in the deep sea are the tunas, which undertake transoceanic migration.

Fishing effort around Andaman & Nicobar Islands and Lakshadweep Islands is negligible. Though these two groups of islands in the Bay of Bengal and Arabian Sea are located strategically to exploit oceanic pelagic fishery resources, no serious attempt has been made so far to develop a strong base for oceanic fishing. The resource potential of these islands in the Indian EEZ is estimated at 250000 metric tonnes and the present harvest is about 40000 metric tonnes.

2.3 Infrastructure & facilities:

Marine fishery output largely depends on infrastructure and facilities available for harvesting. Infrastructure includes post-harvest facilities for processing and marketing of fish and fish products. Fish being perishable product, it could not be harvested to its fullest potential unless backed by proper infrastructure facilities in order to reach the market place with adequate care and within appropriate time. It is clearly indicative that, in India, major efforts have been aimed at creation of landing and berthing facilities for fishing vessels in places along the coastline. Six major fishery harbours, 54 minor fishery harbours and 188 fish landing centres (FLCs) have been sanctioned in the tenth five year plan, of which 6 major, 38 minor and 142 FLCs have been set up within 2004. It is estimated that there are about 378 freezing and 13 canning plants. About 52 Individual Quick Freezing Plants have set up to export seafood in value-added form. Processing of fish into canned and frozen products is

entirely carried out for export market. There are 258 registered freezing units with a capacity of 2,170 million tonnes, 23 canning units with a capacity of 84.5 million tonnes, 24 fish meal units with a capacity of 419 million tonnes, and 297 cold storage units with a capacity of 203,448 million tonnes per annum. Kerala has 112 boat building yards followed by Maharashtra having 32.

As per Marine Products Export Development Authority (MPEDA)[2] sources there are 399 processing plants and 471 cold storage facilities in India. The following table-2.2 gives the state wise summary of list of approved units of European Union (EU).

Table-2.2: State-wise summary of the list of approved units to EU

Maritime state	PP	PPa	A	Total
Gujarat	11	20		31
Maharashtra	5	24	1	29+1
Goa	2	1		3
Karnataka	6	1		7
Kerala	53	17	23	70+23
Tamilnadu	6	24	2	30+2
Andhra Pradesh		42	2	42+2
Orissa		9	1	9+1
West Bengal	1	9		10
Total	**84**	**147**	**29**	**231+29 =260**

PP: Processing Plant; **PPa:** Processing Plant engaged in processing fully or partially farm raised materials; **A:** Exclusive Cold Storage facility for Fish & Fish Products.
Source: MPEDA, Ministry of Commerce & Industry, Govt. of India

India also has some non-EU approved but following Hazard Analysis Critical Control Point (HACCP)[3] standards processing and cold storage units in the country. This sector has attracted a very high amount of investment, to the tune of about Rs.30 billion during the first six years of new millennium, of which 23 percent is foreign investment.

[2] The Marine Product Export Development Authority (MPEDA) was constituted in 1972 under the Marine Product Export Development Authority Act 1972 by the Ministry of Commerce & Industry, Government of India. The role envisaged for the MPEDA is comprehensive – covering fisheries of all kinds, increasing exports, specifying standards, processing, marketing, extension and training in various aspects of the industry.

[3] The Hazard Analysis and Critical Control Point (HACCP) system was introduced approximately 20 years ago as a means to control food-related hazards. It is widely recognized that good hygienic practices (GHPs) form the basis or an integral part of HACCP. HACCP is a systematic preventive approach to food safety and pharmaceutical safety that addresses physical, chemical, and biological hazards as a means of prevention rather than finished product inspection. HACCP is used in the food industry to identify potential food safety hazards. (WHO/FAO, 2006)

2.4 Existing types of vessels in marine fisheries of India

Fishing crafts are most essential for catching the fish in large scale in water bodies. Indian fishers used the age old craft and gear evolved centuries ago. However, with the advent of new technologies, a gradual shift occurred towards the mechanized sector. No doubt, intensive efforts to develop the fisheries started after 1947. Then, in the mid and late 1950s, a few state governments, notably Tamil Nadu and Andhra Pradesh commenced mechanization with the collaboration and assistance of FAO and the Indo-Norwegian project. After that, trawling has become widespread all along the Indian coast and the number and size of trawlers has increased substantially. Trawling has emerged as the most important method for exploiting demersal fisheries resources (especially prawns and shrimps). Trawlers have become the main stay of the fishing sector and 50 percent of the total Indian catch comes from trawlers. Apart from trawlers there exist several other types of vessels in Indian Marine fishery.

2.4.1 Brief Account of development of Indian Marine Fishing Vessels:

Fishermen generally used dug-out canoes until the late 1960s. Because of the extended continental shelf and calmer waters on the west coast dug-out canoes serve the purpose. On the other hand, fishermen used catamarans because of the narrower continental shelf and high surf conditions on the south and south east coast. The crafts grew larger further up the east and west coasts because of the extended continental shelf and marine diversity. Traditionally, large beach seines were in use along most parts of the west coast and south east coast. In most part of the west and south-east coast, a variety of large drift and gill nets are used, which target different species. Hooks and lines were used mainly in the southern areas and these catamaran fishermen of the south west coast have been considered the most skilled on the globe. Until the end of the 60s none of these traditional craft were mechanized and the navigational skills of the small scale Indian fishermen, who in some areas made week long voyages, are acknowledged the world over. Like small scale fishers all over the world, the Indian fishermen over the years adopted fishing techniques that they came across during migration or through contact with foreign traders. Adaptation was always tested over time and the evolution was therefore gradual and calculated. The fishermen used a variety of gear for different species in different seasons. Fish was landed in the home village whence the women took the fish to market, always keeping the best for home consumption. Fiber-glass reinforced polymer (FRP) boats were introduced in India in early 1970s, but did not become very popular due to high cost, lack of maintenance facilities and other problems (Sheshappa, 1998). However, during the late 1970s and 1980s, FRP canoes become very popular and largely replaced the traditional

wooden canoes. Several other major technological transformations were witnessed in the Indian fisheries before the 1980s, all resulting from successive Five Year Plans. One of these transformations was the introduction of purse seines in the late 1970s on the west coast. These sophisticated gears were deployed by mechanized vessels and soon caught the bulk of the total catch, reducing the share of traditional fishers.

As one of the planned objectives of Seventh Five Year Plan, motorization of crafts began in 1980s. India initiated deep sea fishing in 1972 with imported trawlers. By the early 1980s, over 100 chartered vessels and joint venture deep sea fishing vessels were operating, mostly in the inshore grounds up to 50 m and rarely up to 100 m (Devaraj, 1995). This became a serious challenge to the age old traditional sector. In March 1991, the Central Government announced a Deep Sea Fishery Policy (DSFP) in order to make room for using large trawlers. This announcement actually helped foreign companies to enter into the Indian marine. But the large scale protest from the Indian fishing community compelled the government to withdraw the declaration and launched a commission of inquiry in 1994 to review this joint venture.

However, the expansion of fisheries to new areas (i.e., deep sea and offshore) was realized through accelerated mechanization, mainly in the 1980s. Introduction of outboard motors brought about a revolution in traditional fishing. Motorization effectively reduced search time and hence, increased time spent at sea and made accessible previously untapped areas of high fish concentration (Sathiadas et al., 1995; Devaraj and Vivekanandan, 1999). However, it has been proposed that efforts to increase fish catches from deep waters under the help and efforts of the Union Government have not been successful to the expected extent (Mathew, 2003). Deep sea vessels require huge investments and the rate of return are less compared to those of fishing units (both mechanized and artisanal) operating in inshore waters. Even tuna long liners fetch better rates of return than other deep sea vessels, which mainly concentrate on prawns. Now the priority is shifting to sustain deep sea fishing by diversification of fishing effort to other resources and reduction of fishing pressure on the penaeid shrimp (Sathiadas et al., 1995).

2.4.2 Types of Vessels:

The types of fishing crafts of India falls under two general categories. These are non mechanized or artisanal and mechanized fishing crafts. The categories of fishing craft types comes under non mechanized are catamaran, dugout-canoes, plant built canoes, masula boat, built up boats. The mechanized crafts are line boats, trap boats, dol-netter, gill-netter, trawlers.

Fishing vessels and gears used in Indian Marine Fishing sector are not of same types. Marine fisheries in India are characterized by a great diversity of marine resources (fishes, crustaceans, molluscs etc.), exploited by various types of fishing vessels and gears. Indian marine researchers categorized[4] those into three distinct groups[5] (CMFRI, 1980; Sathiadas et al., 1995) with mechanized group divided into two sub-groups. They are

1. **Non-mechanized (artisanal) group using country craft with traditional gears**
2. a) **Mechanized group using traditional crafts with outboard motors (OBM)**
   b) **Mechanized group using inboard motors (IBM)**
3. **Deep sea fishing group**

1. Non-mechanized (artisanal) group using country craft with traditional gears: Owing to different sea conditions, different types of non-mechanized boats have been evolved on the two coasts of India. The most widely used traditional crafts on the east and the west coast are named, as Catamarans, Canoes, Plank built boats etc. The major gears deployed by artisanal vessels without any sort of mechanical device are- Hooks and lines; Gillnets; Seines (from boat and shore); Bag nets; Traps etc. (Mohapatra, 1986; BOBP, 1990; Sathiadas et al., 1995).

(i) Catamarans: The simplest type of fishing crafts used in Indian Marine fishery is the Catamaran. This is created by a few curved logs of wood joined together forming a kind of floating raft, used along the east coast of India. Three variations are named according to the different maritime states: Coromandel type, Orissa or Ganjam type and Andhra or Visakhapatnam type.

[4] Each of these categories (mechanized, motorized and non mechanized) has several subdivisions and numerous local names, specific to the respective states (Chandy, 1970c; BOBP, 1982, 1983b, 1984; CMFRI, 1988; BOBP, 1990; Thirumilu et al., 1994; Chennubhotla et al., 1999; Pillai et al., 2000

[5] We here mention the grouping as suggested by researchers of CMFRI and others. But Mechanized group using traditional crafts with outboard motors (OBM) is practically a motorized craft. At the same time, boats under 2(b) and 3 are mechanized crafts capable of using modern technology in marine fishing.

Photograph of Non-Motorized boat (photograph taken by author at Namkhana, West Bengal)

Photograph of Motorized boat with OBM (photograph taken by author at Kakdwip, West Bengal)

a. Coromandel type - It is made up of 3-5 logs and the accessory pieces and for rowing sails is added. Rowing sails regulate the movement of the raft. A variation of coromandel type with 7 logs is used to capture flying fishes of Nagapatnam called Kolamaram.

b. Orissa or Ganjam type- It is made up of 5 logs which are not tied together by rope, but are pegged with wood. The planks are cut in a way that it takes the shape of a boat. This type is mainly used in the coastal water of Puri and Ganjam district of Orissa.

c. Andhra type or Vishakhapatnam type: It is a variation of Orissa and Ganjam type, but larger (5-7 meters long) and made of heavy wood. The woods used in fitting the sides are strong, median logs, generally used within 50 meters of depth.

(ii) Dug-out canoes: A simple type of fishing craft for fishing within short distances from the coast is dug-out canoe. It is a small-sized canoe made by scooping logs of wood in the form of boat. The "Odams", "Thonies", "Vanchies" etc. of the southeast and south-west coasts of India are included in this category. In calm weather, oars may be enough for propulsion; but if winds and currents prevail, sails may be used.

(iii) Plank-built canoes: This is a larger variety of dug-out canoe and made of planks on the sides, largely used in maritime states such as Kerala.

(iv) Masula boats: Masula boats are made of non rigid planks bind together with coir ropes and generally used along Andhra coast.

(v) Dhinghi: This is a type of boat designed and constructed for variety of purposes including fishing. It is more common in West Bengal.

(vi) Outrigger canoes: This is a plank-built canoe provided with a single outrigger similar to the "rampani" boats. It is used for capturing fish of inshore waters of Bay-of-Bengal or Arabian Sea.

(vii) Built-up boats: These carvel types of boats are built up of planks. The best types of built-up boats are seen in the north-east coast of India. This is the way how most of the boats made now-a-days.

Photograph of Motorized boat with IBM (photograph taken by author at Diamond Harbour, West Bengal)

Photograph of Trawler (photograph taken by author at Sankarpur, near Digha, West Bengal)

2a) Mechanized group using traditional crafts with outboard motors (OBM)[6]: Most traditional crafts mentioned above, operating in different maritime states are modified to accept outboard engines of 5 to 9 hp[7], in order to increase their catching efficiency. The first set of outboards motors introduced was of 3 hp only and subsequently larger OBMs were introduced (Srivastava et al., 1991; Pillai et al., 2000).

2b) Mechanized group using inboard motors (IBM)[8]: These fishing vessels are generally 32 ft to 51 ft OAL with 50-120 hp inboard motors. These are small trawlers (in all maritime states); Pair- trawlers (Gulf of Mannar and Palk Bay regions of Tamil Nadu); Purses seiners (south west i.e., Kerala, Karnataka, Goa & southern Maharashtra); Gillnetters (in all maritime states). The majority of the units exploit inshore waters down to 50 meter depth (Sathiadas et al., 1995; Somvanshi, 2001). With the advent of mechanization of the fishing crafts small and medium sized boats, 10 to 15 m long, are constructed with engines operated by oil for venturing to distant coastal areas in search of fishing grounds.

i) Dol netter: The dol-netters are used for operating the dol nets, which are basically fixed bag nets. The dol-netter varies form 8-14m in length, 1.5m to 3.6m in breadth and 0.8m to 1.8m in height. The carrying capacity of each of such boats varies from 2-14 tonnes. Generally these boats are fitted with 2-4 cylinder diesel engines.

(ii) Gill netter: Vessels of almost any size can undertake gill netting. The numbers of nets used for fishing are adjusted to suit the size of the operating vessel. The vessels vary in length between 25 feet to 55 feet. The deck is so laid out that the gear can be conveniently moved, with a clear passage from bow to stern so that the gear can be passed after hauling. This is a sophisticated type of fishing vessel which is used for fishing in inshore as well as off shore waters.

(iii) Stern trawlers: Stern trawling is the most wide-spread method of fishing in India. The vessels range in size from 32 feet to 55 feet in length and may be fitted with 60 to 120 horsepower engine and above. Vessels above 45 feet in length may also be constructed in steel. The most common deck layout is such that the wheel house is just forward of amidships with working deck aft. The winch powered by the engine is

[6] From now onwards mechanized group using traditional crafts with OBM will be termed as Motorized craft.
[7] hp stands for Horse Power
[8] Now onwards this group will be termed as mechanized crafts.

Photograph of Dol-Netter (photograph taken by author at Frazergunj, West Bengal)

Photograph of Purse-seiner (photograph taken by author at Digha, West Bengal)

located behind the wheel house with the warps leading to the gallows located at the middle or sides of the stern, from which the otter boards hang.

3. Deep sea fishing group: Vessels involved in deep sea fishing are of length (OAL) more than equal to 25m (or OAL $\geq$ 70 ft). Vessels are powered by the engine at least of 120 hp or more. The major types of fishing vessels: deep sea trawler (25 m OAL and used for catching prawns), deep sea tuna long liner (34 m OAL and used for catching tuna), deep sea multipurpose vessels (26 m OAL and used for catching both prawns and other fishes) (Sathiadas et al., 1995).

(i) **Long Liners:** Long liners and long line gear is highly targeted specific, non-destructive and can be operated with low power engines. Sails can be used for propulsion to reduce fuel consumption and environmental pollution. With some modification to their traditional fishing, skilled fishers can use this method. The operation can be semi automated by shooting the gear manually and hauling it back with a mechanical device. It can also be operated in combination with a gill net, making it more cost effective. The use of long liners in Indian Marine Fishery is still very much restricted because of huge amount of operating cost involved.

(ii) Purse Seiners: The purse seiners use excess horsepower for propulsion beyond the actual requirement, and it uses up to four outboard engines of 90 hp which results in high fuel consumption without a commensurate increase in production. An engine power of less than 50 hp is sufficient for effective operations. Selectivity measures can be introduced in purse seines by using large meshed sections and escape windows in the bunt for excluding non-targeted species. The economic viability of smaller units should be highlighted.

Among these three general groups stated above, non-mechanized vessels with gears of traditional design are concentrated in the shallow inshore coastal waters in depth range up to 50 m and mechanized as well as deep sea vessels exploit the resources of deeper off shore waters (Chandy, 1970a; Jhingran, 1991). Each of these categories (mechanized, motorized and non mechanized) has several subdivisions and numerous local names, specific to the respective states (Chandy, 1970b; BOBP, 1982, 1983b, 1984; CMFRI, 1988; BOBP, 1990; Thirumilu et al., 1994; Chennubhotla et al., 1999; Pillai et al., 2000; Bensam 1999a).

As compared to the west coast concentration of traditional crafts including motorized boats is more on east coast (53 percent of total). In the case of mechanized vessel the trend is reversed. Larger vessels (13-15 meters OAL) are replacing the smaller mechanized crafts (8-10 meters OAL) thereby increasing their endurance to fish farther and longer in the sea. Trawlers have become mainstay in the marine sector. Present contribution of mechanized and motorized vessel to total marine fish landing is about 87 percent and the rest is artisanal. North-West -37 percent, South-West-32 percent, North-East- 10 percent, South-East-20 percent and A&N Island & Lakshadeep contributes 1 percent. Presently about 50000 traditional crafts have been motorized in the marine sector which is about 28 percent of total traditional fishing fleet of our country (Yadava, 2006).

2.5. Indian Marine Harvest:

We will now discuss Indian marine harvest situation with respect to different zones and different maritime states. As we have described earlier, Indian EEZ is divided into four sub-regions each having different number of states and union territories. Number of fishermen and boats being different in different zones, effort levels are also different. Hence, harvest level varies with zones as well as states.

The special publication of CMFRI (NO- 89) contained data relating to marine fish landing (actual and estimates) from 1985 to 2004. This publication gave harvest levels of different major catches in each maritime state from 1985 to 2004. We only furnish only a summary table (Table-2.3) below which shows total harvest of each maritime states and respective zones from 1999 to 2004. However, in order to have a detailed discussion on trends of Indian marine harvest for the period 1985 to 2004 we follow the data given in the said special publication. In this discussion we therefore, try to understand the fluctuations in harvest data with respect to fluctuations in major catch of a particular zone, if necessary.

Table-2.3: Marine fish production from 1999 to 2004

Maritime Zones	Maritime states STATE/UT	Marine fish Production 1999-2000	Marine fish Production 2000-2001	Marine fish Production 2001-2002	Marine fish Production 2002-2003	Marine fish Production 2003-2004 *
South-West Zone	KARNATAKA	165650	175906	128415	180161	187000
	GOA	62110	67328	66550	72287	83760
	KERALA	575500	566571	593783	603286	608520
	LAKSHADEEP +	13600	12000	13650	7496	10030
	zonal total (percentage)	**816860 (28.83)**	**821805 (29.24)**	**802398 (28.36)**	**863230 (28.37)**	**889310 (30.23)**
North-West Zone	MAHARASTRA	397900	402838	414268	386860	420010
	GUJRAT	670950	620474	650829	743638	609140
	DAMAN & DIU +	15950	16382	21524	11258	13770
	zonal total (percentage)	**1084800 (38.28)**	**1039694 (36.99)**	**1086621 (38.40)**	**1141756 (38.19)**	**1042920 (35.46)**
South-East Zone	ANDHRA	166480	182502	204940	248495	263930
	TAMILNADU	363000	367855	370998	371500	373000
	A&N ISLAND +	28150	27618	27021	28228	31060
	PONDICHERY	38620	38950	39600	40105	42800
	zonal total (percentage)	**596250 (21.04)**	**616925 (21.95)**	**642559 (22.71)**	**688328 (23.02)**	**710790 (24.16)**
North-East Zone	ORISSA	125940	121086	113893	115006	116880
	WESTBENGAL	180000	181000	184300	181500	181600
	zonal total (percentage)	**305940 (10.80)**	**302086 (10.75)**	**298193 (10.54)**	**296506 (9.92)**	**298480 (10.15)**
TOTAL INDIA		**2833850**	**2810510**	**2829771**	**2989820**	**2941500**

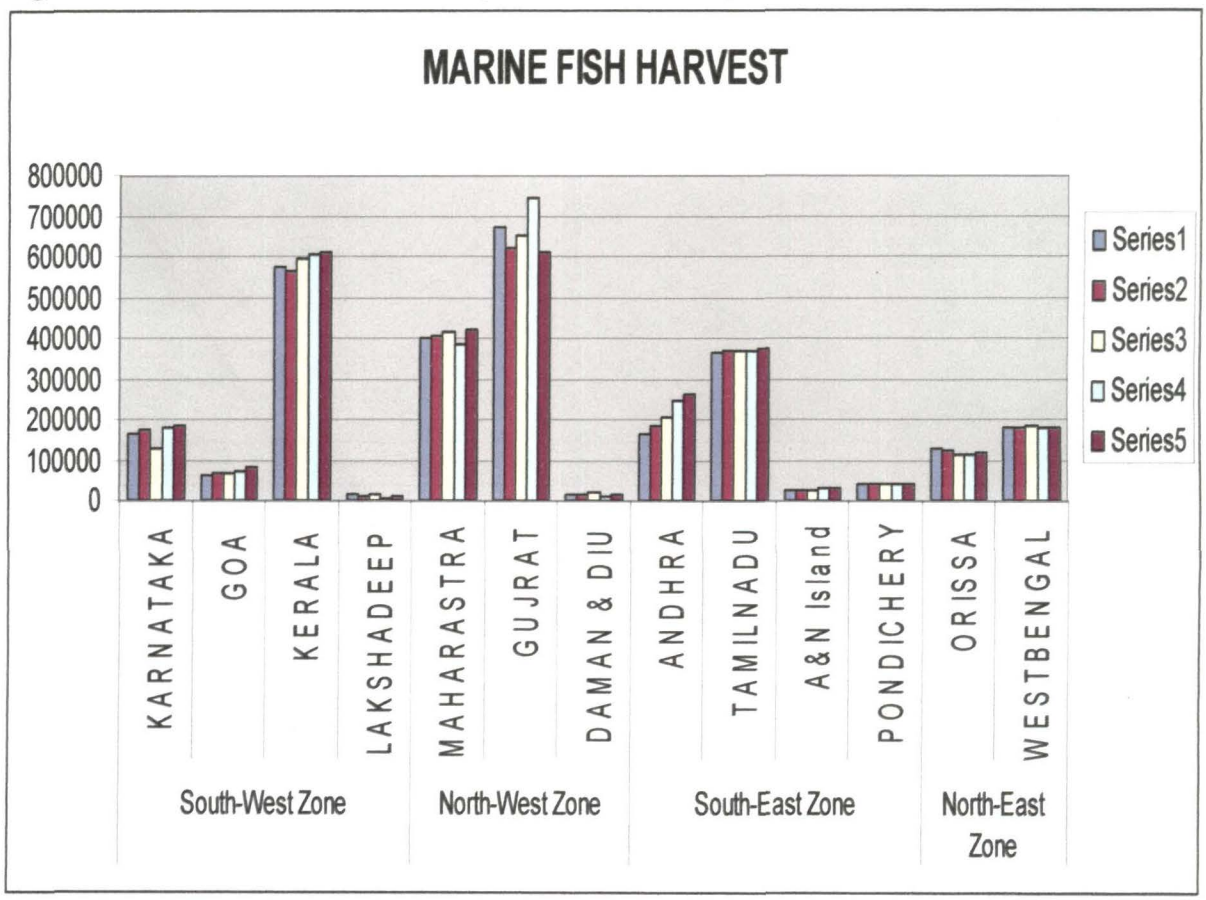
Source: CMFRI, 2005 (*indicates estimated value). Figures shown in parentheses indicate percentage of landing of that zone to Indian total production in respective year. (+ please see discussion in 4.3)

Landing data reported by CMFRI and shown in the above table reveal that total marine fish production of India during 1985 to 2004 has increased from 1.52 million tonnes to 2.58 million tonnes registering a peak of 2.69 million tonnes during 1997. The total landing declined to about 2.3 million tonnes in 2001. This is mainly due to a 32 percent decline in landing of Gujarat. From 2002 production has increased and revolved around 2.55 million tonnes due to increase in landing in WB, OR & AP. Production of pelagic fish (oil sardines, lesser sardines, Bombay Ducks, mackerel, ribbonfish, carangids, seer fishes) resources increased from 7.7 lakh tonnes in 1985 to 13.8 lakh tonnes in 2004 with a peak of 1.39 million tonnes in 2003. In Indian marine fish landing, pelagic fish landing fluctuates with high inter-annual variation. The landings of ribbon fishes and carangids have decreasing trend. Landings of demersal fish (elasmobranches, catfishes, perches, pomfrets, silver bellies, flat fishes, penaeid & non-penaeid prawns, crabs and cephalopods) range from 7.5 lakh tonnes in 1985 to 11.5 lakh tonnes in 2004 with a peak of 13.5 lakh tonnes in 1998. The landing of

elasmobranches, catfishes, silver bellies soles croakers and non-penaeid prawns have shown declining trend (ICAR, 2005).

Marine fish productions in different maritime states are shown graphically in the following bar-chart (Figure-2.1)

Figure-2.1: State-wise marine fish production for the years from 1999 through 2004



Series 1: MARINE HARVEST 1999-2000, Series 2: MARINE HARVEST 2000-2001, Series 3: MARINE HARVEST 2001-2002, Series 4: MARINE HARVEST 2002-2003, Series 5: MARINE HARVEST 2003-2004*.

The south west zone is characterized by sudden jump in production after a period of stabilization. In this zone total landing varied from 4.8 lakh tonnes in 1985 to 8.89 lakh tonnes in 2004 with a maximum of 10.18 lakh tonnes in 1989. Goa shows an increasing trend in production of marine fisheries. This region has a predominance of pelagic resources. Ring seine is mostly used for catching fish in this region. Oil sardine landing reached all time high

of 3.4 lakh tonnes in 2003. Declining trend of catching sharks, white baits, carangids, mackerels and ribbon fishes is also reported.

In the north – west zone, in Maharastra the marine fish production fluctuate around 4 lakh tonnes and maximum in 4.2 lakh tonnes in 2003-04. In Maharastra landing of Bombay duck remained more or less unchanged at 28000 tonnes for the last three years. In Gujarat landing steadily increased upto 7.4 lakh tonnes in 2003 but then it is declined to 6 lakh tonnes in 2004. Pelagic resource landing fluctuated from 2.61 lakh tonnes (1985) to 2.89 lakh tonnes (2004) with maximum as 4.2 lakh tonnes in 1997. In Gujarat the landing of Bombay duck has decreased to 40000 tonnes in 2004. In both states ribbon fish landing registered high growth and reached its peak in 1997. Landing of carangids in Maharastra is between 10000-20000 tonnes. In Gujarat it is still increasing. Same trend can be seen for seer fish. The mackerel landing, the bulk of which was from lower Maharastra coast was quite increasing with oscillating trend and reached a peak of 38000 tonnes in 1996. The landing plummeted to 9600 tonnes in 2004. Demersal fish development is spectacular in this region which registered an eight-fold increase in the landing from 0.85 lakh tonnes to 7.1 lakh tonnes in 1998. This is because of increase in production in Gujarat (ICAR, 2005).

In the south-east region, the single largest contributor for marine fish production of Andhra Pradesh and Tamilnadu are the oil sardines. The trend of catching oil sardines are also increasing in this region. Mackerels, ribbon fishes, and other demersal fishes show a declining trend in Tamilnadu. Also the declining resources of lizard fish, threadfin beams, silverbellies and goat fishes are a cause for concern in this region.

In the north-east region landing increased from 70 thousand tonnes in 1985 to 2.94 lakh tonnes in 2004. This increase is from approximately 4 percent to 10 percent. Total landing in West Bengal increased from 23 thousand tonnes in 1984 to 1.8 lakh tonnes in 2004. The state Orissa also shows an increasing trend with a peak of 1.26 lakh tonnes in '99-2000. Hilsa shad, seerfishes, croakers, pomfrets are the major contributors in this region (ICAR, 2005).

The estimate of region-wise production showed that the north-east region, comprising West Bengal and Orissa coasts contributed 13 percent to the total production. South-east region consisting of Andhra Pradesh, Tamil Nadu and Pondicherry coasts contributed 22 percent. On the west coast, the north-west region comprising Maharashtra and Gujarat coasts contributed

30 percent of the total, whereas, the south-west region comprising Kerala, Karnataka and Goa coasts contributed to the maximum of 35 percent. The estimated marine fish landings of Kerala during 1988-2005 with an average catch of 5.74 lakh tonnes. Among fin-fishes, pelagic resources accounted for 73 percent and demersal 14 percent. Crustacean resources accounted for 9 percent while cephalopods formed 4 percent of total catch in Kerala. Pelagic resources were mainly constituted by oil sardine, mackerel, carangids, tunas, ribbon fishes and seer fishes. Demersal resources were dominated by threadfin breams and soles. Among crustaceans, penaeid prawns were dominant. Cephalopods (mainly squids and cuttlefishes) are also part of the major catch. In Kerala the mechanized sector contributed 44 percent, motorized 54 percent and the rest 2 percent was by the artisanal sector. In the mechanized/motorized sector, among various gears, ring seines contributed 50 percent, trawls 26 percent, gill nets and hooks & line 18 percent and other gears (such as boat seine, purse seine) 4 percent. Trawl landings were dominated by penaeid prawns, cephalopods, threadfin breams, ribbon fishes, lizard fishes, anchovies and elasmobranches. The Long Term Potential Yield (LTPY) and Average Long Term Yield (ALTY) of marine fish landings of Kerala was estimated as 6.63 lakh t while the average yield as 5.74 lakh t indicating scope for increase in landings (ICAR, 2005).

More recently, the annual reports from different zones reveal that the estimated marine fish landing of Tamil Nadu was 4.2 lakh tones during 2005. The catch increased by 14.7 percent from that of 2004. Mechanized trawlers contributed 46 percent to the catch. Pelagics formed 53.9 percent, demersals 29.6 percent, crustaceans 8 percent and molluscs 2.7 percent of the total landings. The landings of pelagics increased by 21.6 percent, while molluscs and crustaceans recorded a fall by 18.8 percent and 6.6 percent respectively. Among the pelagics, sardines dominated the landings followed by carangids. Among the demersals, silverbellies were dominant followed by perches and elasmobranches. Molluscan catch was dominated by cephalopods, whereas prawns and crabs contributed mainly in the crustaceans landings. The marine fish landing for Pondichhery is continually increasing. The catches of sardines, mackerel, ribbonfish, nemipterids, lizardfish and goatfish decreased, while seer fish, sciaenids, pomfrets and elasmobranches increased. The trawls were the major gear contributing 44.8 percent followed by gillnets (33.1 percent), seines (13.3 percent) and the hooks and line (7.0 percent). The major pelagic resources supporting the fishery of Andhra Pradesh were sardines, seer fish, ribbonfish, anchovies mackerel and tunas. In Karnataka, the estimated monthly marine fish landings of the State varied between June and October. The annual catch shows some increase as compared to that recorded in 2004 (MFIS, 2005). Pelagics dominated the

landings with 63.9 percent, followed by demersal finfish (20.4 percent), crustaceans (11.6 percent) and mollusks (3.5 percent). In Goa, the estimated marine fish landings was contributed by pelagics which dominated the landings with 89.4 percent, followed by demersal finfish (9.0 percent), crustaceans (1.5 percent) and mollusks (0.2 percent). in Gujarat, The estimated marine fish landings was increased compared to previous year. The pelagic landings were estimated as 1.66 lakh tonnes forming 36 percent of the total production. The demersal resources contributed 35 percent, followed by crustaceans 22 percent and cephalopods 7 percent (ICAR, 2005).

2.6 Manpower Employment:

The manpower employed in India in active marine fishing (harvesting operation) alone is currently estimated at 1 025 million. The pre- and post-harvest operations in marine fisheries including the internal and external marketing provide employment to another 1.2 million people. On an average, a quantity of 5 kg marine fish produced, gives employment to about 2 persons, one in the harvesting and another in the post-harvest sector. The manpower employed in active fishing in the mechanized sector is estimated at 0.2 million people, which includes the 0.15 million fishermen engaged in the trawl fisheries alone and the remaining 0.05 million in gill-netters, dol-netters, purse seiners and others such as sona boats, and deep-sea fishing vessels. The motorized sector employs 0.17 million people in active fishing, 66 percent of them are engaged in the operation of ring-seines, mini-trawls and gillnets. The motorized dugout canoes, catamarans and plywood boats provide employment to about 58 000 persons in active fishing. The non-mechanized sector provides the maximum employment to 0.655 million people where 0.27 million people are engaged in catamarans, 0.2 million in plank-built boats and the rest in dugout canoes, masula boats and others (Bhattal, 2006). .

There is larger role of women in post-harvest operations in Indian marine fishery. Even though women are not involved in active fishing in marine fisheries, they contribute substantially to the pre- and post-harvest operations. About 25 percent of the labour force in the pre-harvest activities, 60 percent in the export marketing and 40 percent in the internal marketing is women. Altogether, about 0.5 million women are employed in pre- and post-harvest operations in the marine fisheries sector, out of the total work force of 1.2 million persons. It is estimated that for every fishermen engaged in primary fishing activity about four others are getting additional employment by way of post- harvest operations, fish marketing and a host of other allied activities. The per capita consumption of fish in the country is low,

only 5 kg per annum as against the world average of 12 kg per annum and Japan's average of 86 kg/capita. The fishermen's share in the consumer rupee is the best index to measure the efficiency of the fish marketing system. Marketing studies at the all-India level indicate that the fishermen's share in the consumer's rupee ranges from 30 percent to 60 percent for different species/groups of marine fish and marketing cost, including transportation range from 6 percent to 13 percent of the consumer's rupee. The wholesalers receive 5 percent to 32 percent and the retailers from 14 percent to 47 percent of the consumer's rupee for different species/groups of marine fish. In the domestic marketing system, marine fish sales used to be mostly confined to the coastal and adjoining regions in the past. Currently, about 50 percent of fish is consumed fresh in and around the producing centres, 43 per cent in the demand centres located up to a distance of 200 km from the coast and only 5 per cent goes to the centres located beyond 200 km (Bhattal, 2006).

Many studies on man-power employment in marine fisheries suggest that there is enormous scope for improving the distribution process through enhanced private investment in the preservation, processing and transportation sectors of the domestic marketing system under the liberalized economic policies. The quantity of about 30 percent of the total landings, which are processed after they become unsuitable for fresh consumption, suggests good scope for market development of value-added products for domestic consumption. (Srinath, 2003)

2.7 Management of Indian Marine Fishery:

Marine fisheries, as we know, are a renewable natural resource for continuous exploitation. However, this may be done if it is scientifically managed. Sustainability of a renewable resource can be achieved only if the exploitation carried out through a planned and regulated manner. Starting as an avenue for food and livelihood, fisheries now became a full fledged industry. Three most important considerations in fisheries management are

(i) Conservation of fisheries resources,

(ii) Protection of fish habitats and

(iii) Employment and welfare to fisher-folk.

Many researchers observed the absence of constructive legislation, effective fisheries management policies and programmes and concluded that proper remedial measures are yet to be conceived and implemented. It is also said that, given India's marine resources, growing fisher-folk population and fleet size, lack of coordination between maritime states is a major cause for concern. Many opined that sustainable marine fisheries are in the long run the best

protection for coastal communities and for future generations. The present scenario suggests that the current level of marine fish production from the exploited zone has to be sustained by closely monitoring the landings by strictly implementing the scientific management measures.

Following the Indian constitution it can be stated that control and regulation of fishing and fisheries within territorial waters is in the jurisdiction of the state, whereas beyond the territorial waters, it is the exclusive domain of the Union. Therefore, management of fishery exploitation in the Exclusive Economic Zone (EEZ) requires close coordination between the centre and the states. There is still an absence of a legal regime to manage fisheries operated by Indian nationals using vessels of Indian origin in the Indian exclusive economic zone beyond territorial limits. Indian government has established Marine Fishing Regulation Act (MFRA), which is based on a model piece of legislation prepared by the Ministry of Agriculture, Government of India, more than two decades ago to protect the interests of different sections of persons, especially those engaged in fishing with traditional fishing craft, as well as to conserve fish and to regulate fishing on a scientific basis. It is also there to maintain law and order in marine environment. Since fishing resources are there for harnessing, thus the act was drawn up at a time when coastal fisheries were mainly divided into mechanized and non-mechanized fishing units and when there were tremendous conflicts between the two sub-sectors over access to fishing space and resources, sometimes leading to destruction of life and property. The inter-sectoral conflicts were so prevailing that it was important to set up an act to prevent them. There are no legal mechanisms available to address all aspects of fisheries management. Recent trends in both artisanal and small-scale fisheries in the country have been alarming and indicate the need for implementation of rigid management programmes. In fact, such management for the coastal marine fisheries is long overdue.

2.7.1 Present situation: Problems & challenges

At present, Indian fishery is at crossroads. Several studies identified that the main areas of concern in current day Indian marine fisheries are stagnation of total yield, dwindling catches of high value fishes, reduced earning, increased cost of operational resources, depletion and, in case of certain species; overexploitation (Yadava, 2006). These are being compounded with juvenile catches, gradual initiation of destructive fishing gears. Impacts of all these on general fishing activities lead to overall problems relating to inefficiency in marine fishery. There are also issues such as the result of pollution & other anthropogenic interventions, marginalization of small scale fishers, open access system, conflicts of fishing in national and

international waters, problems relating to closed seasons, ban on certain fishing activities and licensing of foreign vessels. Besides, there are problems of shifting from open access to regulated mode of fishing & also the unavailability and paucity of informed management regime.

Many experts suggest that, effective management of the vast fisheries resources and the fishing fleet, a mechanism for Management, Control & Surveillance (MCS) needs to be in place. According to their suggestion, the MCS would incorporate the requirements of a Vessel Monitoring System (VMS) in general and specifically aimed at the fishing vessels above 20 meter OAL. The MFRA enacted by the coastal State Governments and the Maritime Zones of India provides the prohibition of the Foreign Fishing Vessels in the areas earmarked for the traditional and small-motorized fishing crafts. For monitoring the fishing activities to be carried out in different assigned fishing zones by respective fleets, 30 patrol boats were provided to the fisheries department of the different maritime States in 2004. The Coast Guard undertakes surveillance beyond the territorial waters. The resources monitoring surveys conducted by the Fishery Survey of India (FSI), Mumbai are being linked with the management measures to be evolved and applied for sustainable development of marine fisheries. However, at present there is no law to regulate the Indian owned fishing vessels operating in waters beyond the territorial limits.

With regard to the difficulties in development and management of its Marine fishery resources of India, experts indicated a host of reasons (Bhattal, 2006). The Indian subcontinent covers a vast region with long coastlines and different ecosystems, both on land and in the sea. The fishery resources are diverse, as are the fishery technologies and systems. Artisanal and small-scale fishermen operate from thousands of landing places dispersed along the coast and live within socially and culturally disparate communities. Marine fishery management and controls being in the concurrent list, the policies, programmes and approaches regarding management differ with state to state as well as with the union government. Today's Indian marine fisheries face challenges and problems in achieving the kind of sustainability that will assure its long term survival. The marine fisheries of India were not controlled in their initial phase, and insufficiently managed in the subsequent phases. Given this, the transition from the fully exploited to the overexploited phase in certain zones or for few specific species has occurred rapidly. This is something which cannot be accepted for long run sustainable resource management. The existing situation calls for an in-depth evaluation of the current state of

affairs and take immediate measures, in order to avoid further aggravation of the situation. There are additional problems that endangered marine fishery are habitat degradation, water pollution and bioaccumulation of persistent organic pollutants as well as illegal fishing. It is alleged that there is no coordination between different maritime states, although vessels are increasingly migrating into the waters of adjacent states. Many studies observe that, since the pressure of over fishing is felt most acutely within territorial waters, the most important requirement towards conservation and management would be to reform the state-level conservation and management regime. The basic common problems of Indian marine fishery has three different aspects- i) issues related to Open access, ii) issues related to Overcapitalization and Overcapacity and iii) issues related to Over-fishing or Overexploitation. Let us discuss each of these situations in brief.

i) Issues related to Open Access

The most important characteristic of marine capture fisheries is that the resources are a common property, the access to which is free and open. The sustained increase in the demand for seafood and the commensurate rise in prices have increasingly encouraged the induction of more manpower and fishing vessels with improved catching efficiency into the traditional as well as the new fishing grounds over the years. The open access nature of marine capture fisheries is one of the major reasons for depletion of few select species and conflict among user groups. With an open access, no catch limits have been set on effort or the catch. It is already reported by different studies that gear employed for exploitation of demersal resources, particularly the bottom trawl, is being used excessively. The trawl-able biomass appears to be overexploited and a reduction in the trawl effort is necessary to sustain the demersal fishery. On the other hand, the gear employed for the exploitation of pelagic resources is either underused or not used at all. Hence open access regime has created two contradictory situations: a) overexploitation leading to near depletion of certain species in certain inshore areas and b) under achievement of potential yield in off-shore waters (Somvansi, 1999).

ii) Issues related to Overcapitalization and overcapacity

Fishing capacity is the ability of a vessel or fleet of vessels to catch fish. Fishing capacity (capacity output) can be expressed more specifically as the maximum amount of fish catch over a period of time (year, season) that can be produced by a fishing fleet

if fully utilized, given the biomass and age structure of the fish stock and the present state of the technology. Capacity utilization can be defined in this context as the ratio of actual output (catch, landings) to some measure of potential output (capacity output) for a given fleet and biomass level. Fishing capacity can be expressed alternatively in reference to fleet characteristics or as the ability of a fleet to generate fishing effort. Overcapacity can be defined as a situation where capacity output is greater than target output. The maximum potential catch in fisheries is the maximal or expected harvest that fishing effort is capable of producing given the observed capital stock, other vessel characteristics, the state of technology, and the resource stock (Kirkley and Squires, 1999). Fishing capacity is the ability of a vessel or fleet of vessels to catch fish. Specifically, fishing capacity is conceived as the maximum available capital stock in a fishery that is fully utilized at the maximum technical efficiency in a given time period given resource and market conditions. Capacity reduction then becomes reduction of the capital stock in a fishery or fleet. Capital utilization (CU) captures how much of the existing capital stock is being used and capacity utilization provides information about short-run versus long-run equilibrium and economic incentives for investment and disinvestment. Capital utilization has been defined as the ratio of the desired capital stock (given output quantity and input prices) to the actual capital stock (Berndt, 1990; Färe et. al., 1994). An alternative definition of capital utilization is the ratio of capital services to the stock of capital (Schworm, 1977; Hulten, 1990). The discussion of capacity and capacity utilization in the literature is often actually of capital and capital utilization, so that the primaries focus is the optimum utilization of capital. This concept are same as available fishing effort, effort capacity, harvest capacity, maximum effort utilization, maximum potential effort, and potential fishing capacity in the fisheries literature.

Excess capacity creates a number of problems. It generates intense pressure to continue harvesting well beyond the point of sustainability. With revenues spread among many vessels operating under little or no profits, reductions in fleet size become politically and socially more difficult. Vessels are more vulnerable to changes in the resource base and regulations when they are only marginally viable because of excess capacity. Excess capacity encourages inefficient allocation and constitutes a major waste of economic resources. Then over investment occurs and an excessive amount of variable inputs are used. Excess capacity may also complicate the fishery management process, particularly in regulated open access as in India, frequently leading to micro-

regulation. Excess capacity substantially reinforces the increasing tendency for management decisions to become primarily allocation decisions, i.e. decisions about the gainers and losers of wealth and profits (or losses) from alternative management choices over an over-fished or even declining resource stock.

With the advent of new technology and comparatively easy way of livelihood more fishers stepped into the marine fishing industry along with their many more vessels. As a result the current catching capacity of the fishing fleets in Indian waters far exceeds that required for biologically sustainable catches from most commercial stocks at depth down to 100 m (Devaraj and Vivekanandan, 1999). Introduction of mechanized boats and motorization of traditional boats have caused extended fishing operations. This has also increased the fishing pressure beyond recovery of certain standing stocks and depletion of resources is noticed in many fisheries. It is therefore of grave concern that there is an ongoing policy to still expanding the fisheries sector. Although the expansion plans are for deep sea sector (i.e., waters beyond 200 m) and sustainability is emphasized (GOI, 1997, 2002), but no firm steps were purposed by the government to reduce the existing overcapacity.

iii) Issues related to Overexploitation

Overexploitation in Marine fishery is a common phenomenon all over the world. Many international agencies expressed their concern and recommended strong monitoring policy. India is not an exception in this regard. Studies of FAO and other Indian agencies like CMFRI reveal many such facts of overexploitation in Indian marine fishery. According to such studies, active fishing with synthetic fibers, propulsion with outboard motors and modification of craft and gears including indigenization of fishing techniques such as mini purse seine and mini trawling have contributed to over fishing. Landings have considerably eroded over the years. Several fish stocks are being over-fished. The fish production from near-shore waters (up to about 90 meter) has reached its optimum yield levels and has been stagnant for some years leading to pressure on the coastal fin and shellfish resources and regular conflicts between traditional and mechanized sectors. Increase in fishing by the mechanized sector which has led to large scale destruction of egg bearing and juvenile fishes. The loss in terms of harvest of juveniles is very substantial. Trawlers and Ring seiners cause

maximum destruction of juvenile population followed by mini trawlers and purse seiners (Yadava, 2005).

Existing intra and inter fleet competition have driven the resources to over exploitation. Overexploitation/ over-fishing imply excess effort to catch more fish. This 'excess' can be done in three ways (i) growth over-fishing, (ii) recruitment over-fishing and (iii) economic over-fishing.

Different sectors of fisheries in order to take advantage of their catches use smaller meshes. Thus, small fishes dominate catches and lots of juveniles and eggs are damaged. This is called growth over-fishing because fish are caught before they had a chance to grow (Pauly, 1994c). One of the reasons for juvenile exploitation is that commercially exploitable quantities of prawns/shrimps occur in habitats that are also utilized by large number of juvenile fish. For example, the area covered by trawl nets for prawns in coastal waters of western India usually yield only nearly 16 percent of prawns, while the rest of catch comprise fin-fishes or benthic organisms, with significant amounts of juveniles fish and fish eggs (Menon, 1996). Besides, there is a considerable price difference between fin-fishes and shrimps, which bring far more revenue than other resources. This continues to retain a strong fishing pressure on the overall stocks. So, in order to hang on to as much as possible, mesh sizes are further reduced. So, in this form of growth over-fishing destabilizes multi-species resources and causes massive changes in species composition (Pauly, 1994a). Moreover, smaller mesh sizes catch larger numbers of small sized fishes. For the duration of long trip, these fishes are often rejected because of shortage of space or ice, which are preferably dedicated to shrimps.

Similarly, recruitment over-fishing occurs when a fishery is impaired because very few adults are left. It has been also observed in many fisheries of India. Such over-fishing occurs when the collective productiveness of exploited stocks is low. Economic over fishing, occurs when fishing effort surpasses than needed to maximize the economic payment from the fishery (Clark, 1990; Pauly, 1994b, c). It has also been stated in various reports from the coastal fisheries of India.

2.7.2 Present Marine Fishing Policies:

Present marine fishing policies are formulated on the basis of mainly two acts, namely, Indian Fisheries Act (1897) and Marine Fisheries Regulation Act (MFRA) (1978). While the several provisions of the first one help to formulate the policies related to protection of fisheries against explosives, the second one provides guidelines to maritime states to enact laws for regulating fishing in the territorial waters. This MFRA (1978) stipulates regulations on mesh size, gear reservation of zones for various fishing sectors, declaration of closed seasons etc. This act empowered maritime states to frame or to amend laws time to time. However, the Indian marine fishing policies can not be structured only on the basis of the guidelines provided by these two acts. Other relating acts on environment protection, preservation & conservation of water and its pollution, port & shipping, wild life protection, forest conservation etc. have direct implications on marine policy. Therefore, all such related acts and statutory obligations are also considered while declaring the marine fishing policy. Thus, Indian Marine Fishery Policies are seriously influenced by several enactments under four major ministerial jurisdictions of shipping, agriculture, environment and forest. Even the enactments like coast guard and maritime zones which are under the ministerial jurisdiction of defense are highly relevant with regard to policy framing of present marine fishing of India. In fact, *the territorial waters, continental shelf, exclusive economic zone and other maritime zones act, 1976* which falls under the Ministry of Defense has paramount importance in India's marine fishing policies.

Present maritime fishing policies took its final shape following the recommendations of Murari Committee (1993) which was constructed at the time of agitation of fishers'. Government had accepted all the recommendations of the said committee in September, 1997. Since then renewal, extension or issuance of new licenses and permits for fishing jointly with foreign chartered vessels were stopped. It is now the declared policy that all licenses or permits for fishing should be made public and copy must be available in the office of the registered authority so that it can be accessible for inspection. The existing government policies also debarred any vessel above 20 meter length within the areas being exploited by fishermen with traditional craft or mechanized vessel below 20 meter length. On the West Coast, the distance from the shore upto 150 m depth line or 100 nautical miles, whichever be further is restricted for all vessels of more than 20 m length except few mentioned specifically in the guidelines. On the east coast, however, Indian vessels below 20 m size would have exclusive access up to

100 m depth or 50 nautical miles from the shore whichever is farther except few relaxations. The authority to define depth zone and also to determine the distance is rested on National Hydrographic Office or Coast Guard or Fishery Survey of India.

In the area open to the vessels above 20 m length, resource specific vessels for tuna and tuna like fishes, squids and cuttle fish, deep sea fin-fish in mid-water or pelagic regions and oceanic tuna may be allowed for exploitation by tuna long lining, tuna purse seining, squid jigging and mid-water trawling, provided these are defacto Indian[9] owned registered vessels.

The fleet size for different fishing grounds may be fixed taking into account of the maximum sustainable yield and the need for conservation of resources.

[9] The Indian owners should account for at least 51% debt as well as equity.