

Fishing capacity management: A perspective in Indian context

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Abstract

The committee on fisheries of Food and Agriculture Organization had assessed world scenario and raised the concerns about Worlds' fishing capacity in 1997. A management plan of action on Worlds' fishing capacity was adopted in 1999 to rationalize and reduce excessive fishing capacity. It was expected that by the year 2005, all member nations would achieve the effective, equitable, sustainable and transparent ways of managing fishing capacity in their respective countries. The excessive fishing and excess capacity are being experienced in the Indian Exclusive Economic Zone. Based on theoretical review and practical perspective, this paper examines the trends and dominant issues in Indian marine capture fisheries. Fishing fleet composition of all coastal states and union territories and power engaged in the sector was analyzed and also discuss the practices followed, legislations drawn, challenges being faced and measures taken by the Government of India to achieve sustainable fishing capacity management and to harmonize the socio-economic aspects.

Keywords: marine capture fisheries, fisheries management, fishing capacity, exclusive economic zone, territorial waters

1. Introduction

India has taken impressive strides in marine fisheries in the past decades. Fisheries in India play an important socio-economic role. The aquatic living resources although renewable are not infinite and need to be managed appropriately. The Code of Conduct for Responsible Fisheries (CCRF) prescribed by the FAO in 1995^[1] sets out principles and international standards of behavior for responsible practices with a view to ensure effective conservation, management and development of living aquatic resources with due respect of ecosystem and biodiversity. The recent approach in fisheries management is focused on sustainable utilisation. To achieve this, appropriate policies and practices required in various stages of exploitation, conservation and management. The policy orientation in regard to exploitation has to address the issues like technological upgradation, diversification and resource specific capture techniques, fishing capacity, value addition and utilization of low value resources. Excess fishing capacity has been identified as one of the most pernicious problems affecting long-term sustainability and biodiversity of fishery resources and economic viability of fishing operations^[2]. The management of fishing capacity requires array of policies, several technical measures and stakeholders' consensus to ensure an optimum balance between fish production and fishing inputs in capture fisheries^[3]. The excessive fishing capacity leads to over exploitation and the depletion of many worlds' commercially important fish stocks^[4]. Overfishing and redundant fishing inputs are closely associated with excessive capacity^[5].

In the era of globalization and growing human population, there is a growing demand for fish in developed and developing countries, which contributes to the increase in fishing efforts in the seas^[6]. The Worlds' total catch would have been around 120 million tons^[7]. The real concern would be, how long the world can continue to exert the quantum of excess fishing effort with same level of fishing fleet. The prevailing trends in fisheries would apprehend that the world

would run out of wild capture sea food by the year 2048^[8]. The scientists opined that the decline was due to overfishing worldwide. Since sufficient data are not available, it is difficult to assess economic and social complexities of fisheries management at the global level. Globally, the economic losses in marine fisheries are estimated as ~ 50 billion US\$ per year due to poor management, inefficiencies, and overfishing. According to the figures of past three decades, these losses go to over 2 trillion US\$^[9].

The committee on fisheries constituted by Food and Agriculture Organization (FAO) in 1997 carried out the assessment of the world scenario and raised the concerns about worlds' fishing capacity. They proposed a management plan of action on worlds' fishing capacity, which was adopted in 1999 to rationalize and reduce excessive fishing capacity. It was expected that by the year 2005, all member nations would achieve the effective, equitable, sustainable and transparent ways of managing fishing capacity in their respective countries. There is an urgent need to take steps to curb the losses at the national level and to make attempt to harmonize the fish production and its fishing fleet size to the desired level^[5, 10].

India's marine capture fisheries have reached to a stage that the marine capture fish production for the last few years is almost constant, around 3.2-3.4 million tons^[11-12]. From 1963 to 1997, there was the expansion phase with insufficient management and control, which saw rapid growth in fisheries and over exploitation^[13]. Some of the fish stocks in Indian EEZ are overexploited and have started showing the declining trend. Many of the coastal and inshore fishing grounds have disappeared or moved away either due to marine pollution or overexploitation^[14, 15]. More and more fishing vessels are no longer economically viable. The bottom trawlers are running in profit during few months of the year. To match their profitability, the mesh size is being reduced by the fishers, which is further leading towards non sustainable fishing. The Government of India has initiated several programs to reduce

the pressure of overfishing and has taken several steps towards diversification of its fleet to reduce the excessive pressure of fishing in coastal and territorial waters by promoting the use of modern electronic equipment such as echo sounders, Global Positioning System (GPS), fish finders, Very High Frequency (VHF) communicator, Radio Telephone (RT), Search and Rescue Transponder (SART) etc. To protect the interest of poor fishers who had traditional boats, around 45,000 country boats have been motorized since seventh five-year plan ^[16]. Though, it has created overfishing capacity. There is need to rationalize numbers and types of desired motorized boats. The diversification has taken place in the fishing capacity and in fishing methods. Over the years, the fleet composition has been changed with increase in number of shrimpers, deep sea stern trawlers, tuna long liners etc. At the same time, percentages of traditional boats have reduced. The post tsunami fund support to southern coastal states has added more fishing units in the sector which lead to increased total fishing fleet strength, to around 1,99,141 in Indian waters ^[17]. India has nine coastal states, follows the federal system and the fisheries upto 12 nautical miles come under the jurisdiction of respective state government. This paper overview the Indian Marine Fisheries and discuss various approaches for fishing capacity management as well as approaches towards sustainable marine fisheries. It shall also present India's effort in harmonizing socio-economic aspects of marine fisheries.

2. An overview of Indian marine fisheries

India has a long coastline of 8118 km, a continental shelf of 0.53 million km² and an Exclusive economic zone (EEZ) of 2.02 million km². There are nine coastal states and five coastal Union territories (UT). Around 14.49 million people are engaged either fully or partially in the activities of fisheries sector. There are 3,432 marine fishing villages with 3.99 million fishers and family members, who belongs to 8,74,749 households of which, about 60% fishers' families are below poverty line. India is world's second largest fish producer; it contributes around 3.4 million tons from marine and around 6.1 million tons from the inland fisheries. The total marine fish landing centers is around 1,537 in India. The total fishing crafts in India are 1,99,141 among them, traditional crafts (52,982), motorized crafts (73,410) and mechanized crafts (72,749) are being deployed for fishing in the 9 coastal states and 4 Union Territories ^[18]. The marine capture fish production was increased from 0.5 million tons in 1950 to 3.67 million tons in 2014 ^[11-13]. Estimated contribution from this sector to Indian GDP is around 0.83% ^[18]. The total potential yield revalidated from the pelagic, demersal and oceanic realms was 4.41 million tonnes ^[19]. Of which, upto 100m depth contour, the potential yield estimated was 3.8 million tonnes followed by 100-200m (2.59mt), 200-500m (1.14mt) and oceanic realm (2.16mt). The present potential yield (2011) when compared to the year 2000, is showing increasing trend in the pelagic realm forming 21% and of demersal 2% whereas, oceanic realm is showing decreasing trend (-12%).

According to Devaraj and Vivekanandan (1999), the capture fisheries in India has been progressing in a haphazard way. Three phases could be recognized in the development of fisheries in coastal areas of India viz. i) pre-development phase (1947-1962), without any effective management, ii) growth phase (1963-1988) and full expansion phase (1989-

1997) with insufficient management and control, which has been leading to rapid transition and over-exploitation. The substantial increase in fishing effort since the 1970s has resulted in the decrease in per capita area per active fishermen and per boat in the inshore fishing grounds and also in the catch per unit effort (CPUE). Growth overfishing and economic overfishing, at several centers, and inter-sectoral conflicts in the coastal belt have highlighted the need for caution and urgent remedial action.

Since last decade, it was reported that overfishing has caused reduction in few fish stocks. Fish catches of the non-motorized boats have been decreasing since 1970 ^[20]. The catch composition has been changing with increased effort per unit catch. Overall, excess fishing has started affecting the food web in marine environment of Indian EEZ ^[21], which compelled, Government of India to initiate various steps in managing its marine fishing capacity.

Since Indian fishery is a multi-species fishery, it may be difficult to suggest a single method for its fishing capacity management. However, measures may be considered in two broad groups for the management of fishing capacity as implemented in China.

First method adopted was to create a system to provide economic incentives to fishers for controlling their fishing capacity, without direct intervention of Government of India. This incentive method may be in the form of individual quotas i.e. community based management or in the form of subsidy-or-tax to influence the market and at the same time, collecting rents so as to avoid depletion of resources and economic waste ^[22].

Second method was incentive blocking methods, where government may directly use the mechanisms to manage the fishing capacity levels ^[4]. There are two possible ways: input based measures and output based measures. The input based controls may be used by levying user fees or by reducing the harvesting capacity. By reducing input level of fishing in the field, controlling license, restrictions on gear size etc, the required targets may be achieved. Output based controls are for acquiring the right targets generally by limiting the quantity of landed fish by a particular fishery, at aggregate trips ^[23].

2.1 Legislations related to marine fisheries in India

There are certain legislations drawn for conservation, management and development of marine fishery resources in Territorial Waters, Continental Shelf, Exclusive Economic Zone (EEZ) such as Maritime Zones Act 1976, Marine Fishing Regulation Acts 1979, Merchant Shipping Act 1958, The Coast Guard Act 1978, Major Port Trusts Act 1963, Wildlife Protection Act 1972, Biological Diversity Act 2002 and Environment Protection Act 1986. These legislations addressing sovereign rights for conservation, exploration, exploitation and management of Indian marine fishery resources, protection to the poor fishers who operate unpowered fishing boats, protecting their fishing areas, nets and equipments from large bottom trawlers, providing criteria of competency certificate of officers required for manning the fishing vessels of more than 24 m Over All Length (OAL), protection of maritime of the country, safety of fishermen, protection of islands and offshore structures and preventing poaching in Indian waters, extending infrastructure facilities and services for the large fishing vessels in Indian ports,

protecting specific areas in Indian waters, marine sanctuaries, marine parks etc. like Gulfs of the Mannar and Kachch and also certain identified marine species like ten species of sharks, giant groupers, seahorses, sea cucumbers and molluscs, provides the measures for conservation of biodiversity and sustainable harvest of biological resources as the marine coastal area of India is extremely rich in biodiversity and providing the framework to the Government of India for coordinating the activities of various organizations of Centre and State and has provision for making of laws on various issues, authorizes the government of India to protect and improve environmental quality by taking the measures for reducing pollution from all sources [24-31].

3. Measures towards sustainable marine fisheries

The Government of India announced the Comprehensive Marine Fishing Policy in 2004, for the first time involving all the stakeholders, traditional and coastal fishers together with deep sea sector so as to achieve harmonized sustainable capture fisheries in India. The objective of policy was to augment marine fish production to the sustainable level, to ensure socio-economic security of poor fishers and to ensure sustainable development with due consideration for biodiversity and ecological integrity. The catch compositions since 1950 were driven by economically motivated behaviors of fishers, species fetching

higher profit were caught first and then, the efforts shifted towards less profitable species [32]. Fisheries management efforts of European Union also could not achieve its goal of enhancing the sustainability of fish stocks and improving economic condition of the sector [33]. Diversifications towards the deep sea and distance water fishing (DWF) were adopted by the world’s most fish producing countries like China to reduce pressure on their domestic fishing grounds [34] but the fishing capacity remains on the higher side.

During 1970s, the increase in catch was limited to mechanized and motorized fleet since they could expand their fishing ground towards the larger area. Therefore, Government of India encouraged the conversion of traditional boats to motorized boats. As it was growth period, the catch per unit effort and energy inputs was on increasing rate due to the increased number of boats and mechanization. These proliferations of mechanized and motorized boats had a negative impact leading to overcapacity. Therefore, subsequently Government of India brought control on issuance of licenses and efforts were made for diversification of fishing fleet. Fig.1 indicates marine fish production data from 1980 to 2014. With the total number of fishing fleet of around 0.1 million traditional/non-motorized boats and the same numbers of other mechanized boats, considerably higher marine fish production was achieved during 1996-1997.

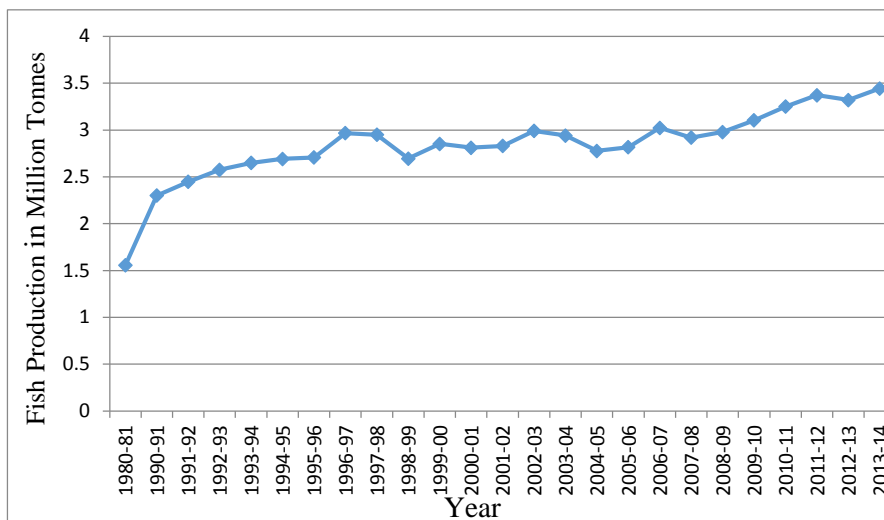


Fig 1: The production of marine capture fisheries. (Source: [17,18])

3.1 Readjustment in the size of fishing fleet

The Indian fishing fleet comprises of Mechanized, Motorized, Traditional/Non-motorized crafts. The mechanized crafts are the combination of Trawlers, Gillnetters, Purse Seiners, Dolnetters, Ring Seiners, Liners and others. The motorized boats comprise of Catamaran, Dugout Canoe, Plank built boats, Fiber Glass boats, Ferro Cement boats, Plywood boats, Carrier boats, Teppa etc. The data for the present study is collected from the fishing census reports of 1980, 2005, 2010, compiled by the fisheries organizations in India [11-13].

As shown in Fig. 2, there was a trend of continuous increase in total fleet size till 2005 and it reached to 2,88,772 crafts. Since then, the reduction in total fleet size has started and in 2014, the fleet size reduced to 199141 crafts. Mainly, the traditional/non-motorized crafts reduced from 1,34,741 in 1980 to 52,982 in 2014. The reduction was mainly due to

overfishing in near shore waters and encouragement of Government agencies for mechanization. On the other hand, distribution of motorized and mechanized boats was increasing in all along the coast line of the country. Motorized boats reached up to 71,313 in 2014 from zero in 1980 [11, 12, 13, 18]. Tamil Nadu has maximum motorized crafts, followed by Kerala and Andhra Pradesh. The readjustment of different types of fishing methods and fishing boats taken place in Indian peninsula show the evolution in race for fish. The continuous increase of mechanized boats from 9,289 in 1980 to 72,749 in 2014 makes this sector more energy intensive thereby the cost involved in fishing operation is more than the revenue relied. Though the increase of mechanised boats reported, the catches of marine fishery resources showing increasing trend upto 1998-99 and thereafter, the catches are almost stagnant.

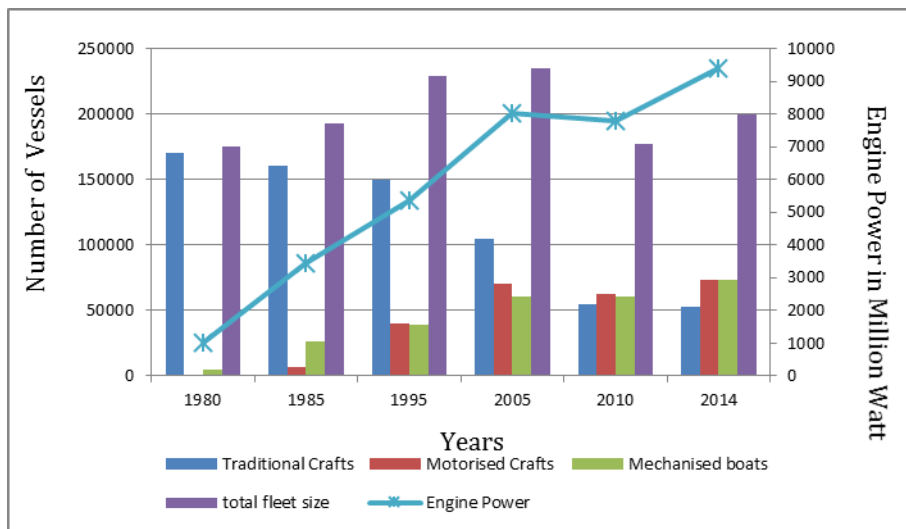


Fig 2: Structural changes in Indian marine fishing fleet (Source: [12-13, 35-36])

The recent scenario of distribution of fishing fleet in all nine coastal states and Union Territories of India is shown in the Fig. 3.

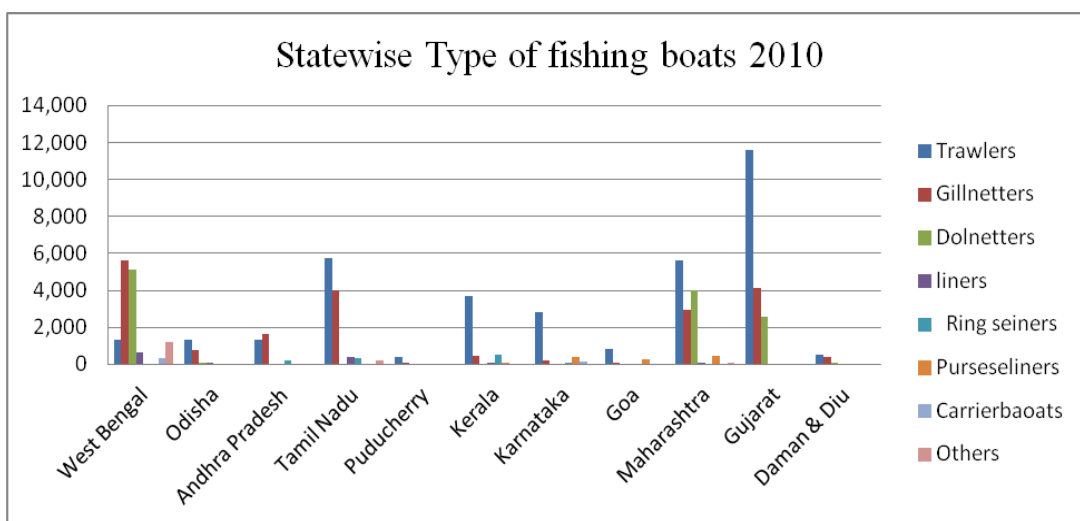


Fig 3: The fleet composition in various states and union territories (source: [12])

For planning and management of fishing capacity all along the coast line, it is important to access the distribution of fleet. The area of continental shelf in the west coast of India is larger than that in the east coast. Accordingly, the numbers of trawlers are more in the west coast. Though, trawl fishing is more energy intensive, it is being preferred for better catch rate. Among the Indian states, Gujarat has longest coastline of 1,600 km and has maximum number of mechanized boats. Government of India had made an attempt to estimate optimum fleet size but various aspects of energy inputs were not taken into account, therefore it may not be called as comprehensive approach. It was mostly based on Maximum Sustainable Yield (MSY) and biomass. However, these estimations give the indication of 35% mechanized boats, 46% motorized crafts and 24% non-motorized crafts being excesses in Indian fishing fleet [20, 21].

As per the last census 2010, the requirement of power was higher as numbers of mechanized boats have increased all time high to 72749. Replacements of decommissioned boats were taking place with the higher powered engines, though the numbers stand the same. Hence, the energy inputs are on rise.

The requirement of total power may be estimated at around 8.5 million kW to propel the entire Indian fishing fleet. Engine power engaged and hydrocarbon burn needs to be considered while estimating optimum fleet size. During developmental phase, emission of CO₂ was increased from 0.30 million tons in the year 1961 to 3.60 million tons in 2010, for every ton of fish catch, emission of CO₂ increased from 0.50 ton to 1.02 ton [35]. Due to overfishing, there is a substantial increase in fishing efforts and also, the increase in conflicts in inter-sectoral areas in the coastal belt. This has invited the need for caution and urgent remedial actions.

3.2 Zonation and other fishing regulations

Identification and monitoring of Marine Protected Areas could be the way forward for place specific management and development which may lead to protect local ecology and economically beneficial fishing to the local fisher [36]. Indian states have taken step forward towards Zonation and earmark area for traditional and for large mechanized vessels under the Marine Fishing Regulation Act 1979 as described in the Table1.

Table 1: Zone regulations promulgated by different states/ union territories of India

State/UT	Guidelines for the fishing boats		
	Non-Mechanized	Motorized	Mechanized
Gujarat	Up to 9 km from the shore are reserved	-	Beyond 9 km, 40 mm mesh size for trawlers and 150 mm mesh size for gill netters (Gujarat Fisheries Act, 2003) [37].
Maharashtra	Up to 9 m and 18 m depth zone in specified areas are reserved	Up to 22 km is earmarked for the boats of less than 6 cylinder engine	Mesh size for trawl fishing is 35mm and purse seine in specific districts within territorial waters is not allowed (Maharashtra Marine Fishing Regulation Act, 1981) [38].
Goa	Up to 5 km from the coast are reserved		Less than 20 mm of mesh size for prawn and 24 mm for fish net are not allowed (Goa Marine Fishing Regulation Act, 1980) [39]
Karnataka	From the shore to 6 km is earmarked for traditional/small boats	Beyond 6 km to 20 km is for mechanized boats of up to the length of 15 meters	Beyond 20 km, it is for all large mechanized vessels (Karnataka Marine Fishing Regulation Act, 1986) [40]
Kerala	Up to 30 m, around 78 km from Kollencode to Paravooris and up to 20 m from Paravoor to Manjeshwar around 512 km is specified zone		The area from 40 m to 70 m depth from Kollencode to Paravooris and from 20 m to 40 m from Paravoor to Manjeshwar is specified for the mechanized vessels of less than 25 Gross Registered Tonnage (GRT) (Kerala Marine Fishing Regulation Act, 1980)[41]
Tamil Nadu	Up to 5 km from the coast are reserved	Beyond 5 km	For trawl net mesh size is specified 40 mm, for shrimp trawl, it is 37 mm and for gill net, it is 25 mm On river mouths, within 100 m, no fishing is allowed (Tamil Nadu Marine Fishing Regulation Rules, 1983) [42]
Andhra Pradesh	Up to 8 km from the shore is earmarked	Beyond 8 km	Vessels of 25 GRT and more are allowed to fish only after 15 km from the shore and mesh size is specified not less than 15 mm. Shrimp trawlers should have Turtle Excluder Device (TED) (Andhra Pradesh Marine Fishing Regulation Act, 1994) [43].
Orissa	Up to 5 km are reserved	Beyond 5 km mechanized vessels of up to 15 m length are permitted	Beyond 10 km from the coast, mechanized vessels of 25 GRT and more are allowed to operate (Orissa Marine Fishing Regulation Act, 1981) [44].
West Bengal	The area from the shore to 18 km is for the traditional boats	The area from the shore to 18 km is for the small craft having less than 30 hp engines onboard.	For bag net, mesh size is specified as 25 mm, for gill net, it is 25 mm and for drag net/purse seine, it is 25 mm. Turtle excluder devices need to be fitted in the trawl nets (West Bengal Marine Fishing Regulation Act, 1993) [45].
Andaman and Nicobar islands		Up to 10 km from the coast is for the vessels fitted with up to 30 hp engines	Beyond 10 km, it is for the large vessels Mesh size is specified for nets is less than 20 mm and for gill net/ shore seiner, it is less than 25 mm. Turtle excluder devices need to be fitted in the trawl nets (Andaman and Nicobar Marine Fishing Regulation Act, 2003) [46].
Lakshadweep Islands			Mesh size specified for pelagic, mid water, purse seine, ring seine and bottom trawl should be more than 20 mm (Lakshadweep Marine Fishing Regulation Act, 2000) [47].

3.3 Deep sea fishing policy

Under the deep sea fishing policy 2014, the Ministry of Agriculture, Government of India has issued fresh regulations [16]. Accordingly, the deep sea fishing vessels are not allowed to fish in the following areas in the Indian EEZ:

- On the coast of Orissa and West Bengal-the area between 19°20'N-85°30'E, 20°N-86°56'E, 20°42' N-88°E', 21°8'N-89°7'E and 21°16'N-89°14'E.
- On Maharashtra and Gujarat Coast-the area between 22°54'N-67°33'E, 21°33'N-68°56'E, 19°2'N-72°E, 18°33'N-72°E and 18°N-72°31'E.
- On Kerala and Tamil Nadu Coast-the area between 7°45'N-77° E, 7°45'N-78°E, 7°30'N-78° E and 7°30'N-77°E.
- Fishing is prohibited in the area of less than 24 nautical miles from Nizampatnam, Andhra Pradesh to Paradeep Port, Orissa.

These vessels are not permitted in the territorial waters and should not fish in the areas earmarked for

mechanized/traditional fishing crafts specified by the Government orders/notifications.

4. Efforts towards harmonizing social aspects of marine fisheries

Considering the challenges of overfishing, marine environmental aspects, IUU fishing activities, depletion of specific stocks in specific area, Government of India has recognized the need to educate people about the scientific steps for management of marine capture fisheries. Government of India is funding awareness programmes on Code of Conduct for Responsible Fisheries (CCRF), evaluation of fishing capacity, diversification of fleet, sustainable fishing, and over capacity. These programmes are implemented through the states, union territories, fishery institutes, NGOs and fisher's organization/ associations/ societies.

The financial incentives to the groups of fishermen were provided for taking up the new generation craft because old

boats having inefficient engines consumed more fuel and provided less speed to the craft. For trawl fishing, it is around 30% of the catch value that goes to fuel cost; in 1981, it was about 300 L/ton, which increased to about 500L/ton in 1994^[48]. Increase in diesel price from Rs. 3.50/L in 1989 to Rs. 60/L in 2016 is contributing to financial difficulty for the fleet owners^[49]. To bring down the operation cost of smaller fishing vessels below 20 m length, some schemes were introduced from 1990-91 onwards. It is in the form of reimbursement of excise duty on diesel. These schemes are to support the smaller crafts and fishers Below Poverty Line (BPL) category to improve their income. Subsidy to the extent of Rs 3 per liter subject to the maximum quantity of 500 L of diesel per boat per month is being provided during active fishing months. Considering the hazardous nature of sea fishing, the subsidy of around 75% is provided to the boat owners for the cost of a kit of electronic equipment, which may consist of GPS, RT, VHF and echo sounders. For distress signals, a search and rescue beacon is also included in the kit. As steps towards reducing pollution in the form of engine exhaust in marine environment, Government of India has introduced the LPG kits for the out board motors during 11th five year plan. Under the scheme, the central finance aid of around 30% of the price of one LPG kit, subject to maximum of 200 US\$ is being given to the boat owner. Agencies like state fisheries, cooperatives and Panchayathi Raj Institutions are being engaged in implementation of these schemes^[50].

Till date, 7 major fishing harbors, 61 minor harbors and 190 fish landing centers have been developed in various coastal states and union territories for the development of infrastructure facility for the deep sea as well as for coastal marine fishery sector. These are providing the facilities for safe landing and berthing of fishing vessels and also contributing to minimizing the post-harvest losses. State fisheries, cooperatives and cooperative federations are being assisted by the Central Government to minimize the post-harvest losses and to strengthen their marketing infrastructures. The scheme was implemented in the 8th five year plan and was, reintroduced during the 10th five year plan. In this scheme, 13 cold storages, 31 refrigerated vehicles for transporting the catch and 45 retail outlets to facilitate marketing were introduced. The financial help amounting to Rs.17.9 million and Rs.18.6 million were released by the central Govt. towards these schemes during the years 2007-08 and 2008-09 respectively. The States of Kerala and Gujarat have provided the maximum number of cold storage and ice factories^[18].

5. Conclusions

In Indian context, the livelihood of large population in coastal states depends on marine capture fishery. Implementation of corrective measures may need thorough evaluation of social, economic and regional aspects that shall work for all fishers and fisheries. Marine capture fish data, deployed horse power and fuel consumption for the last 30 years show that the quantity of fish production has not been increased the way energy inputs in the form of engine power and hours of fishing efforts have increased. Of late, advance technologies and electronic gazettes have also contributed to the increase in fish production. There are several other indicators, which show over capacity in the area of small fishing boats and especially up to 50m depth, the energy utilization per unit catch is

increasing. This indicates that the energy input output ratios are falling. The marine capture fisheries are eventually on the path of reducing profit margins. Although, the measures of conservation such as monsoon ban on fisheries and Government welfare schemes have improved the situation to some extent but the long term strategy is still awaited in view of energy inputs, fishing efforts, integration of technological-scientific advancements, resource specific and area specific effective management of fishing fleets for achieving sustainable harvest.

Considering the complexity of fishing capacity management, there may not be a single mechanism by which the excess capacity can be optimized. At the same time, an integrated approach of temporal and spatial measures is to be taken depending upon input and output control, fish species and area of operation. An adaptive framework is needed for ecologically sustainable and commercially viable marine capture fisheries. The effective control of fishing capacity needs regular assessment of energy inputs, engine power and regulations. Also, required regular stock assessment on the basis of Maximum Sustainable Yield (MSY), fish stock dynamics and Maximum Economic Yield (MEY).

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