Fishing Capacity Management

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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.

A wide array of fishing gears and practices ranging from small-scale artisanal to advanced mechanized systems are used for fish capture. Over the years, traditional fishing gears have been upgraded and newer more efficient fishing systems have been introduced. Most important among these fish harvesting systems are trawls, seines, lines, gillnets and entangling nets and traps. Among the most significant developments which affected the historical evolution of fishing gear and practices are (i) developments in craft technology and mechanization of propulsion, gear and catch handling (ii) introduction of synthetic gear materials (iii) developments in acoustic fish detection and satellite-based remote sensing techniques (iv) advances in electronic navigation and position fixing equipment (v) awareness of the need for responsible fishing to ensure sustainability of the resources, protection of the biodiversity and environmental safety and energy efficiency.

The erstwhile Indo-Norwegian Project which was formed as a result of a tripartite technical co-operation agreement signed in 1952, between India, the USA and the United Nations for fisheries development, has made important contributions in traditional craft motorisation and mechanisation. Central Institute of Fisheries Technology (formerly Central Fisheries Technological Research Station) was established in Cochin in 1957, with the objectives of development of fishing industry in India. The programme for mechanisation of the existing traditional crafts began with the posting of FAO naval Architects to the Research Station. In 1955, experimental shrimp trawling was conducted with 6.6 m LOA, 10 hp open motor boat, off Malabar coast using

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a Gulf of Mexico type flat trawl of 9.6 m head line and consistently impressive catches of shrimp was obtained from the shallow coastal waters of 4-18 m depth (Kristjonsson, 1967). This finding gave a major fillip in commercial shrimp trawling in India and increasing demand for shrimps for the processing industry caused rapid development of the otter trawling in Indian waters. This was soon followed by various technological developments including offshore expansion in the area of operation. At present the focus is to expand the fisheries into even deeper waters and diversification of fishing to areas such as tuna longlining. Major technological changes that have taken place in the capture fisheries of India are:

- Introduction and popularization of synthetic fishing gear materials.
- Introduction of mechanised trawling and purse seining in mid-1950s.
- Expansion in mechanized fleet in terms of numbers, size, installed hp and capacities and introduction of multi-day fishing.
- Improvement in efficiency and diversification of trawls, purse seines, gillnets and lines, for mechanized sector.
- Expansion of fishing grounds for harvesting deep sea fishing for deeps sea prawns, lobsters and cephalopods.
- Adoption of modern technologies such as echo sounder and GPS.
- Chartering and joint venture schemes.
- Motorization of traditional fishing crafts and expansion in fishing grounds.
- Improvement of traditional fishing units, in terms of craft modernization, gear materials, gear efficiency and dimensions.
- Introduction of ring seines in mid-1980s along south-west coast and rapid expansion of ring seine units in terms of size of crafts, horsepower of OBM, craft materials, increase in and overall dimensions of the ring seines and mechanized purse line hauling.

Growing concern is being expressed world-wide about the impact of excess fishing capacity on the sustainability of fishery resources and on the economic viability of fishing operations. The problem of excess capacity has received international and national focus in recent years. Fitzpatrick (1995) has estimated a 270% increase in the average fishing technology coefficient between 1965 and 1995 which indicates large scale increase in technological efficiency and precision in fishing practices. Garcia and Newton estimated that, in 1989, there was a global overcapacity of 25 to 53% with respect to maximum economic yield (MEY), meaning that important economic gains could have been achieved by an appropriate reduction in fleet capacity. A recent study by WWF has indicated that the world fleet was two and a half times in excess of what the world stocks could sustain, which indicates the need for optimizing the fishing capacity. Cunningham and Gréboval (2001) define capacity management as the implementation of a range of policies and technical measures in order to attain a desired balance between fixed fishing inputs and capture fish production, which could be through direct controls, such as limited entry schemes or indirect controls through developing appropriate incentive systems for self regulation.

2.0 Indian capture fisheries

India has a long coastline of 8118 km, an Exclusive Economic Zone of 2.02 million km^2 and continental shelf area of $0.506x10^6$ km^2. The inland water resources of India consist of $1.97x10^5$ kilometers of rivers and canals, $3.15x10^6$ million hectares of minor and major reservoirs, $2.35x10^6$ hectares of ponds and tanks and about $1.3x10^6$ hectares of oxbow lakes and derelict water bodies, $1.24x10^6$ hectares of brackish-waters. Inland capture fishery production of India increased from $0.19x10^6$ t in 1950 to $0.81x10^6$ t in 2004 and marine capture fish production of India increased from $0.5 x10^6$ t to $2.8 x10^6$ t, during the same period (FAO-FIGIS, 2007) (Fig. 1). About 2400 species of finfish have been recorded in India, out of which about 69% are found in marine waters and the rest in inland waters.

Marine fishing fleet in India consists of (i) non-mechanized (artisanal) sector using country craft and traditional gears, (ii) motorised sector using traditional craft with outboard motor(s) (OBMs)

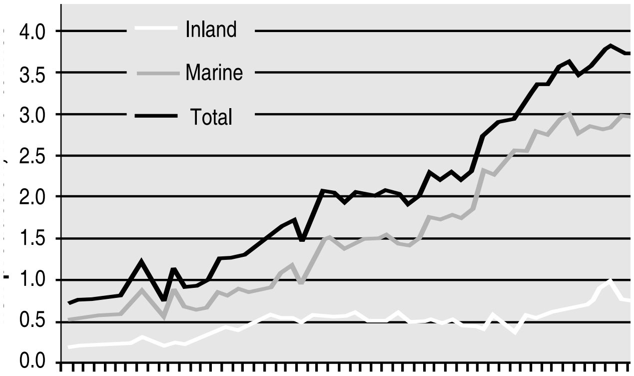

Fig.1 Capture fish production in India (source: FAO-FIGIS)

(9.9-120 hp) and, more recently, inboard engines (IBM) (89-156 hp); (iii) mechanized sector (8.5-16.7 m LOA; 89-156 hp; and (iv) deep sea fishing sector (>16.7m LOA; 156 hp and above). There have been significant structural changes in the fishing fleet over the last few decades. Contribution of the mechanised boats to the total marine fishing fleet increased from 14 to 25% and motorised craft from 4 to 32 %, over the years from 1985 to 2005, while that of non-motorised craft decreased from 83 to 44% (Fig. 2 in ensuing).

Marine fishery potential of the Indian Exclusive Economic Zone (EEZ) is estimated at about $3.93x10^6$ t. About 58 % of the resources is available at a depth of 0-50 m, 35 % at 50-200 m and 7 % from beyond 200 m depth. The present catch of $2.8x10^6$ t forms about 72 % of the estimated fishery

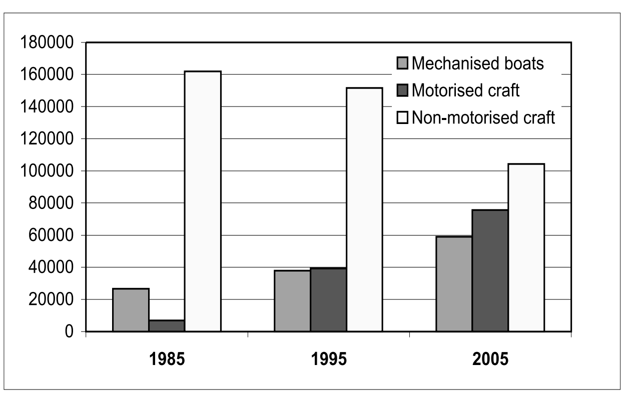

Fig. 2 Structural changes in marine fishing fleet in India, during 1985-2005 (source: CMFRI, 1998; 2006)

potential and is largely derived from the intensively fished shelf waters. About 2,38,772 fishing crafts of various sizes and classes are under operation in marine fisheries, consisting of 58,911 mechanised boats, 75,991 motorised crafts, 104,270 non-mechanised crafts (CMFRI, 2006).

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 to overexploitation (Devaraj and Vivekanandan, 1999). 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 CPUE. Growth overfishing and economic overfishing, at several centres, and inter-sectoral conflicts in the coastal belt have highlighted the need for caution and urgent remedial action.

The time series data of marine capture fisheries illustrates that the catch have increased gradually in 1950s with the rate increase accelerating since 1980s and early 1980s. The increase in catch is limited to mechanized and motorized sector, which were able to expand their fishing ground further offshore. Catches of the non-motorized sector has been decreasing since 1970s (Srinath 2003). Existing intra and inter-fleet competition is the outcome of fisheries overexploitation and Malthusian overfishing (Pauly 1994) in Indian waters. The proliferation of mechanized and motorized fleet increased the catch but had a negative impact leading to growth overfishing, economic overfishing and ecosystem overfishing. A recent analysis of time series data of marine landings by Bhathal (2005) has shown that 'the fishing down marine food webs' effect is visible in Indian fisheries from 1964 onwards with a decline of 3.25 MT L at the rate of 0.0058 per year. There is an immediate need to curb existing overcapacity, redistribute remaining effort across the trophic levels (Pauly et al., 1998; 2002) and adopt responsible fishing techniques and practices.

The Comprehensive Marine Fishing Policy announced by the Government of India in 2004, seeks for the first time, to bring the traditional and coastal fishermen in to the focus together with stakeholders in the deep sea sector so as to achieve harmonized development of marine fisheries in the Indian EEZ (Government of India, 2004). The policy

aims to (i) augment marine fish production of the country up to the sustainable level in a responsible manner so as to boost export of seafood from the country and also to increase per capita fish protein intake of the masses, (ii) to ensure socio-economic security of the artisanal fishermen whose livelihood solely depends on this vocation, and (iii) ensure sustainable development of marine fisheries with due concern for ecological integrity and biodiversity.

3.0 Excess fishing capacity

Fishing capacity is the ability of a stock of inputs (capital) used in fisheries to produce output, measured as either effort (or indicators of effort) or catch, over a period of time (FAO, 1998; 1999a; 2000; 2001). Overcapacity (or excess capacity) may be defined as capacity in excess of the (desired) stock of inputs that will produce a desired level of outputs (e.g., a set of target fishing mortality rates for the species being harvested) and will best achieve the objectives of a fishery management plan. Excessive fishing capacity leads to overfishing and affects long term sustainability of resources, biodiversity and environment and economic viability of fishing as a method of food production.

The FAO Code of Conduct for Responsible Fisheries (FAO, 1995) recognizes that excessive fishing capacity threatens the world's fishery resources and thus their ability to provide sustainable catches and benefits to fishers and consumers. It recommended that "States should prevent overfishing and excess fishing capacity and should implement management measures to ensure that fishing effort is commensurate with the productive capacity of the fishery resources and their sustainable utilization" (Article 6.3).

The International Plan of Action for the Management of Fishing Capacity (IPOA) was elaborated within the framework of the Code of Conduct with the objective of attaining an efficient, equitable and transparent management of fishing capacity for fisheries conservation and sustainable management.It advocates that the States and regional fishery organizations (i) should strive to achieve worldwide, an efficient, equitable and transparent management of fishing capacity, within a scheduled time-frame, in the framework of their respective competencies and consistent with international law; (ii) should endeavour to limit initially at existing level and progressively reduce the fishing capacity applied to affected fisheries, when confronted with an overcapacity problem; and (iii) recognize the need to exercise caution to avoid growth in capacity undermining long-term sustainability objectives. The actions in this direction include assessment and monitoring of fishing capacity, the preparation and implementation of national, regional and international plans of action (FAO, 1999b).

The excess fishing capacity stems essentially from the widespread tendency for overcapitalization and overfishing under free and open-access conditions. Excess harvesting capacity may take the form of any combination of people, fishing gear, fishing vessels and variations in their capacities and efficiencies.

Excess fishing capacity is estimated by a variety of techniques of differing sophistication and data requirements such as (i) bioeconomic analysis, (ii) schocastic production frontier analysis, (iii) fishing power analysis, (iii) data envelopment analysis and (v) peak to peak analysis (FAO, 1998; 1999a; 2000; 2001). Excess capacity is assessed by comparing the existing capacity to an optimal or desired level, using various reference points such as maximum economic yield (MEY) and maximum sustainable yield (MSY).

4.0 Excess fishing capacity in Indian fisheries

A few attempts have been made to estimate optimum fleet size for harvesting of marine fishery resources, in Indian waters (Kalawar, 1985; CMFRI, 1998; MoA, 2000; Kurup and Devaraj, 2000)(Table 1). Estimate of optimum fleet size by Kalawar (1985) was limited to the territorial waters of Kerala.

CMFRI (1998) has estimated the optimum fleet size for marine fishing as 67984 consisting of 20928 mechanised boats, 15998 motorised craft and 31058 non-motorised craft for Indian waters. Estimates of optimum fleet size by Devaraj and Kurup (2000) for Indian shelf waters (excluding islands) were 62748 consisting of 10998 mechanized trawlers, 784 mechanized purse seiners, 3694 mechanized gillnetters, 2014 mechanised bag-netters (dol-netters), 1558 other mechanised boats, 14862 motorized crafts and 28837 non-motorized crafts and was more conservative than CMFRI

Table 1: Estimates of optimum fleet size for Indian waters			
	CMFRI (1998)	MoA (2000)	Kurup and Devaraj (2000)
Mechanised boats	20928	47683	19048
Mechanised trawler	12245		10998
Mechanised purse seiner	835		784
Mechanised gill netter	3972		3694
Mechanised bag netter	2193		2014
Other mechanised boats	1683		1558
Motorised craft	15998	51726	14862
OBM boat seiner	326		304
OBM gill netter	10746		10018
OBM ring seiner	1302		1219
OBM dol netter	159		147
Other OBM boats	3465		3174
Non-motorised craft	31058	159481	28837
Total fleet size	67984	258890	62748

(1998) estimates. According to these estimates, the existing number (CMFRI, 2006) of mechanised trawlers were in excess by a factor of 2.7, mechanised purse seiners 1.3, mechanised gillnetters 3.8, mechanised bag-netters 4.4, other mechanised boats 3.6, motorized vessels 5.1 and non-motorized vessels 3.6 (Fig. 3). National Level Review Committee appointed by Ministry of Agriculture to assess the area-wise requirements of different categories of fishing vessels below 20 m LOA determined the optimum fleet size for India as 258890 consisting of 47683 mechanized crafts, 75591 motorized crafts and 159481 non-motorized crafts, where the focus in apportioning of capacity tended towards mechanised and motorised sectors. According to these estimates, the existing fleet size (CMFRI, 2006) of mechanized vessels is in excess by 35% and motorized crafts by 46%, while non-motorized crafts were 24% less.

These studies indicate that there are significant levels of excess capacity in motorized and mechanized fleet of India. A significant percentage of the mechanized and motorized fleet operates fishing gears which have poor selectivity and high ecological impact such as bottom trawls and small-meshed gillnets, which negatively impact on sustainability of resources. However, the number of non-motorized crafts in the fleet has been diminishing, due to competition from motorized and mechanized segments and depletion of coastal resources within their reach.

The Ministry of Agriculture has recently taken action to induct 110 Tuna Longliners, 18 Purse Seiners, 10 Trap/ Hook & Line vessels, 15 Squid Jiggers, 72 Pelagic/Mid-water Trawlers and 500 Pole & Line vessels for deep sea fishing in the Indian EEZ, as follow up action of implementation of the Comprehensive Marine Fishing Policy – 2004 and on the recommendations of Empowered Committee on Marine Fisheries.

The effective control of fishing capacity needs regular stock assessments and an understanding of fleet dynamics, based on a monitoring of the fleet size and its use and an understanding of its links with related issues, such as the impact of subsidies, fleet mobility and access to fish stocks.

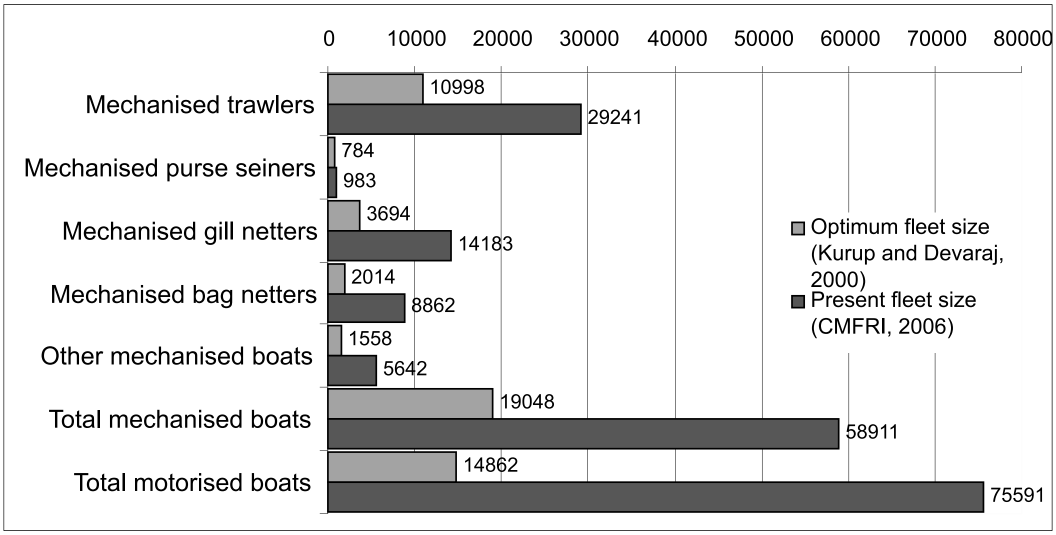

Fig. 3 Present (CMFRI, 2006) and estimated optimum fleet size (Kurup and Devaraj, 2000) for marine fisheries of India

5.0 Approaches to fishing capacity management

The growth of fishing capacity is controlled either by limiting the use of 'inputs' (limited entry schemes) or by placing a limit on 'output' such as an upper limit on the volume of landings.

Directly limiting fishing inputs may facilitate the tendency to expand capacity by improving the elements of fishing effort that have not been restricted. Hence technical developments that effectively increase fishing effort must be compensated by appropriate adjustments made to the restrictions imposed on the fishery.

A consensus is emerging in favour of using individual transferable quotas (ITQs) management to control fishing capacity, particularly in developed countries. This system of capacity regulation generally limits the number of fishing units and allocates a share of the total allowable catch (TAC) to each unit and allows the sale or lease of the right to quotas. This system shifts the incentive structure away from racing to catch fish before others do so, and towards harvesting the fish provided under quota, in the most efficient manner. Making these rights transferable increases the possibility of efficient use of fisheries inputs, reducing fishing capacity to a level that accords with the quantity of fish available for harvesting. However, not all fisheries are amenable to quota management, either for social and cultural reasons or because of the multi-species nature of the fishery, for which complex schemes are usually needed to offset the increased incentive to discard bycatch.

A rights based regulated access system under a co-management regime based on a strong inclusive cooperative movement of stakeholders with built-in transferable quota system and buy-back or rotational right of entry schemes seems to hold potential for capacity management in the shelf fisheries of Indian states, which need to be implemented in collaboration with the Union Government and the neighboring states with confluent ecosystems and shared fishing grounds. A key advantage of the use of rights based approaches for managing fishing capacity is that they provide a mechanism through which stakeholders can more easily and actively participate in the management process.

Major focus need to be given for the sustainability shelf resources, as more than 95% of the landings are derived from this zone of maximum productivity. Restoration and enhancement of fishery resources need to be ensured in shelf waters by all possible resource conservation and enhancement strategies such as area closures, seasonal closures (fishing holidays), mesh regulation, minimum landing size, ban on destructive fishing practices, restructuring and diversification of fishing effort to underexploited areas and resources, ranching and restoration of non-productive fishing grounds, in additional to the removal of excess capacity from the fishing fleet, rights based access control and responsible fishing practices. Vessel Monitoring Systems (VMS) need to be made mandatory for large vessels (>20 m LOA) and newly inducted resource-specific deep sea fleets, to forestall tendency for zonal transgressions. Comprehensive and effective monitoring, control and surveillance (MCS) is essential for managing fishing capacity and to prevent illegal, unregulated and unreported (IUU) fishing in the Indian EEZ.

Since a large number of people depend on fisheries, implementation of any of the measures demands thorough evaluation of social as well as economic factors and incorporation of possible trade-offs among social, economic and ecological objectives of management. Conventional top-down approaches for reducing excess fishing capacity may not be well suited for Indian fisheries, which is predominantly small-scale and is inextricably linked with livelihood issues of large sections of coastal population. The solution may lie in an integrated approach based on co-management, with stake-holder integration in an inclusive cooperative framework with allocation of property rights over different resource segments. Co-management is an approach to management in which responsibility for management of the resource is shared between the resource users and the government.

Fishing effort management is not possible in isolation, as the fishing grounds and accessible fishery resources extends far beyond the jurisdiction of the maritime states (12 nautical mile from the coast line) and hence need to region based and harmonized among the maritime states sharing the same resources, in collaboration with the Union Government who holds responsibility for waters beyond territorial limits of the maritime states.

Capacity management in some form or another is undertaken and integrated into the general fisheries management policies by most fishing nations, including India. The measures adopted include area restrictions, temporal restrictions, gear restrictions, fish size restrictions, access related restrictions, catch restrictions, rights-based approaches and financial incentives, taxes and royalties, etc. (Pascoe and Gréboval, 2005).

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. Significant economic gains could be achieved by eliminating excess capacity, in addition to attaining objectives of resource sustainability.

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"Ten percent of the fishermen catch ninety percent of the fish."

– Fisherman's Saying