Indian Fisheries: The Present Scenario of Resources and Harvesting Methods

B. Meenakumari
Central Institute of Fisheries Technology
Cochin - 682 029

Fisheries sector of India contributes significantly in ensuring the national food security by providing protein rich food and employment to millions of people. Around 6.73 million fishermen and fish farmers, residing in coastal villages, along the major river basins and reservoirs of the country, depend on fisheries and aquaculture for their livelihood. Fisheries sector supports the development of a number of auxiliary industries as well. The sector has also been one of the major contributors to foreign exchange earnings through exports. In 2002 around 5 lakh tonnes of marine products were exported from India and the value could reach 1.45 billion US dollars (MPEDA, 2005). India is the seventh largest fish producer in the world and second in inland fish production (FAO, 2004a). The fisheries sector contributes Rs. 2,22,230 million to national income, which is 1.4 % of the total Gross Domestic Product (GDP).

Resources in nutshell

India is endowed with an Exclusive Economic Zone (EEZ) covering 2.02 million sq.km, with a continental shelf area of about 0.53 million sq. km and having about 8,118 km coastal length with an estimated fishery potential of 3.9 million tonnes. The inland waters of India have enormous potential for riverine fisheries, with Ganga, Brahmaputra, Godavari, Mahanadi, Krishna, Kaveri, Narmada and Tapti contributing to the total 1,91,024 km of rivers and canals. The other inland fishery resources include about 1.4 million hectares of brackish water area, about 23.81 lakh ha of fresh water ponds and tanks, about 7.98 lakh ha lakes and about 20.31 lakh ha of reservoirs. The production of large reservoirs is about 20 kg per ha and several reservoirs generate around 100-150 kg per ha per year (Dwivedi *et al.*, 2005). The estimated fish production from inland water bodies is around 4.5 million tonnes. The total fish production of India in the year 2002-2003 was 6.2 million tonnes with Gujarat being the first in marine landings and West Bengal in inland production. India is considered as one of the mega-biodiversity nations, endowed with 12% of the shellfishes and finfishes of the world. According to figures given by National Bureau of Fish Genetic Resources (NBFGR), Lucknow, 2118 finfish species belonging to 55 suborders and 209 families abound in Indian waters (Kapoor and Sarkar, 2003).

Marine Fisheries

Over the years, this sector has changed from the subsistence level to the high-end commercial ventures. The Blue Revolution of 1960's ushered in an era of mechanization in fishing industry and the marine fish production figures increased from the meager 0.53 million tonnes in 1950-51 to 2.6 million tonnes in 2004-05.

The growth of marine fisheries sector can be divided in three phases:

Phase I (1947-1967): Landings mainly by the non-mechanized indigenous craft and gear

Phase II (1968-1987): Use of improved gear materials, increased mechanization and initiation of motorization of country crafts

Phase III (1987 onwards): Intensification of mechanized fishing, substantial growth in motorization and introduction of multi day fishing

The latest developments include the introduction of electronic equipments in navigation and fish finding.

Fishing is carried out all over the coast by mechanized vessels (68%), motorized vessels (25%) and artisanal vessels (7%). The region-wise share in marine fish landings is Northwest coast 30.6%, Southwest coast 34.8%, Southeast coast 24.0% and Northeast coast 10.6%. The growth rate in marine fish production in recent years has been slow (an average of 2.32% during 1990-91 to 1999-2000) compared to inland fisheries (average of 8.38% during the corresponding period). The declining trend of marine fisheries can be attributed to overfishing through surplus fishing fleet which comprises 1,81,284 traditional crafts, 44,578 motorised traditional craft and 53,684 mechanised boats (ICAR, 2003), generation of enormous bycatch consisting of 40% juveniles and the devastation caused by fishing gears to the ecosystem.

Pelagic fisheries resources

The pelagic fisheries contribute to about 54% of the total landings that amounted to 1.43 lakh tonnes; of which 64% was obtained from the west coast and 36% from the east coast. Stagnation in the pelagic fish catch at around 1.3 mt per annum against an annual potential yield of 2.21 mt from Indian EEZ, was observed in the last 10 years. Among the maritime states, Kerala ranked first contributing 28.7% of the total pelagics, followed by Gujarat 16.8%, Tamil Nadu 16.1%, Maharashtra 11.9%, Andhra Pradesh 8.1%, Karnataka 7.3% and Goa 3.3%. Of the total pelagic finfish landings, the major contributors were oil sardine (27%), mackerel (11%), carangids (9%), ribbonfish (9%), Bombayduck (8%), lesser sardines (6%), anchovies (6%), Hilsa shad (4%), seerfish (3%), and tunas (3%).

The pelagic fisheries resources of India are largely multi-species multi-gear fisheries. There are about 250 species contributing to this fishery, some of which enjoy wide geographical distribution, while others like Bombayduck or shad have got restricted or discontinuous distribution. Out of the 250 species that contribute to the pelagic fisheries along Indian coast, only 60 species belonging to 7 groups, namely, oil sardine, lesser sardines, anchovies, Bombayduck, ribbonfishes, carangids and Indian mackerel form the major fisheries. These groups contribute to around 80% of the total pelagics and the other pelagic groups that comprise of wolf herrings, shads, barracudas, unicorn cod, mullets, seer fishes and coastal tunas form around 20% of the total pelagic finfish landing. The major single species fisheries of the pelagic resources, the oil sardine (*Sardinella longiceps*), the Indian mackerel (*Rastrelliger kanagurta*) and the Bombayduck (*Harpodon nehereus*) showed wide fluctuations in their landing patterns.

In the preceding years, production of pelagics, mostly, oil sardine, mackerel, coastal tunas, seer fishes and Bombayduck, has reached the optimum level of exploitation in the conventional fishing grounds. The present fishing effort directed towards these species has crossed the level of maximum sustainable yield (MSY) and further expansion may jeopardize the sustainability of these species. The groups that can potentially augment to pelagic fish production are whitebaits, carangids, ribbonfishes, tunas, pelagic sharks as well as mesopelagic resources (myctophids like file fishes and lantern fishes). Pilot effort to introduce monofilament long lining system for catching tuna, available stocks of which in the Indian EEZ has been estimated to be about 2,00,000 tonnes from main land and island waters and about the same quantity from oceanic waters, have been found successful. The extension of operational range of crafts and introduction of combination vessels for multi-day fishing will help in exploitation of potential pelagic resources from 50-200m region.

According to the fisheries statistics of CMFRI (2005), a marginal increase is noticed in the landings of Indian mackerel, carangids and lesser sardines while that of oil sardine, Bombayduck, seerfishes, tuna and ribbonfishes registered a decline. The fishery and biological characteristics of pelagic fishes were not found to be altered evidently as a consequence of tsunami.

Demersal resources:

About 700 species of finfishes are recorded from the Indian sea bottom, of which about 250 form regular components in demersal fisheries. The demersal finfish, crustaceans and molluscs together contribute 46% of total landings. In 2004 the demersal finfish landings were 6.7 lakh tonnes, which contributed to 27% of the total marine landings. The diversity of demersal finfishes is much more pronounced in the east coast than west coast. The important demersal finfish groups are elasmobranchs (sharks, skates, rays), eels, catfishes, lizardfishes, perches (rock cods, snappers, pigface breams, threadfin breams, etc.), goatfishes, threadfins, croakers, silverbellies, whitefish, pomfret (black, silver and chinese), flat fishes (halibut, flounders and sole) and other miscellaneous groups. Among the different groups, perches are the most abundant forming 30% of the total demersal fish landings in 2004, followed by croakers (18%). Elasmobranchs contributed to 9% while the proportion of silverbellies and catfishes were 8% each. The states of Gujarat and Maharashtra are the major contributors of the sciaenids in the west coast, whereas Tamil Nadu and Andhra Pradesh dominate in the east coast.

Among the shellfish resources crustaceans (penaeid prawns, non-penaeid prawns, lobsters, crabs and stomatopods) account for about 14% of the total marine production, followed by Molluscs (Cephalopods), 5%. The crustacean landings declined by 15.4% and that of molluscs by 3.85% in 2004.

Penaeid prawns form 47.9% (1.76 lakh t) of the crustacean landings followed by non-penaeid prawns (31.7%), stomatopods (8.8%), crabs (11.2%) and lobsters (0.4%). The west coast accounts for 72% of the total penaeid production. A decline in both penaeid and non-penaeid landings were observed during 2004. Attention is now shifting towards the exploitation of deep-sea prawns *Heterocarpus woodmasoni*,

Heterocarpus gibbosus, *Plesionika spinipes*, *Metapenaeopsis andamanensis* and *Aristeus alcocki*.

Share of lobsters in the total marine landings is about 0.4% and the maximum was from NW coast (45%) followed by SW (33%) and SE (19%) coast of India. Kerala accounts for 32% of total lobster landings followed by Maharashtra, Tamil Nadu and Gujarat. Out of the 8 species of spiny lobsters (Palinuridae) found in Indian waters, four are commercially exploited. Again, out of 8 species of slipper lobsters (Scyllaridae), only one species contributes substantially to the commercial fishery. In the lobster landings of Kerala and Karnataka, deep-sea lobster *Puerulus sewelli* dominated the fishery while *Thenus orientalis*, *Panulirus polyphagus* and *P. ornatus* respectively dominated from Gujarat, Mumbai and Tuticorin.

Landing of crab was highest (49%) along the Southeast coast, followed by NW and SW coasts. Tamil Nadu contributes (36%) to the fishery, followed by Gujarat, Kerala and Andhra Pradesh. The important species contributing to this fishery are *Portunus pelagicus*, *Portunus sanguinolentus*, *Charybdis cruciata*, *Scylla tranquebarica*, *Podophthalmus vigil* and *Charybdis lucifera*. The total landing of crabs by trawlers showed a decrease of 1084 tonnes in 2004 when compared to 2003.

Cephalopods have received increasing importance as a marine fishery resource because of their high export value and account for 4-5% (1.13 lakh tonnes) of the total marine fish landings. Of the total cephalopod production, 82% is from west coast. In 2004 the total cephalopod production decreased by 3.85%. Cephalopods exploited from Indian seas can be broadly divided into 3 categories, squids (Order: Teuthoidea), cuttle fishes (Order: Sepioidea) and octopuses (Order: Octopoda). The cuttlefish and octopus stocks are lightly exploited along both coasts. The neretic Indian squid (*Loligo duvauceli*) forms more than 75% of the catch. In Mandapam and Rameswaram waters, the Palk Bay squid (*Sepioteuthis lessoniana)* is the dominant species. Along the east coast, cuttlefishes are more dominant, of which *Sepia pharaonis* and *Sepia aculeata* form bulk of the catch followed by *Sepiella inermis*, *Sepia prashadi* and *Sepia elliptica*. Among Octopods, *Octopus membranaceous* is the most dominant followed by *Octopus dolfusi*. According to CMFRI (2005) the landings of *L. duvauceli* and *O. membranaceous* showed declining trend while *S. lessoniana* increased after tsunami.

The bivalve and gastropods (comprising of clams, edible oysters and mussels) also form major components of the molluscan fisheries. Among clams, *Villorita cyprinoides*, *Meretrix casta*, *Meretrix meretrix*, *Paphia malabarica*, *Marcia opima* and *Anadara granosa* are the dominant ones. The black clam *Villorita cyprinoides* is the dominant species, followed by *Sunetta scripta*. Among mussels *Perna viridis* contributes 93% of the landings and *Perna indica* a minimal 7%. The pearl oyster fishery that has degraded over the years is restricted to the Gulf of Mannar, Palk Bay, Gulf of Kutch, some coastal stretches of Vizhinjam Bay and Andaman & Nicobar Islands. The edible oysters consist of *Crassostrea madrasensis* and *Saccostrea cucullata*. *Xancus pyrum and Hemifusus pugilinus* contributed to the bulk of the gastropod landings. After tsunami there was increased landings of large, heavy and semi-

fossilized *Xancus pyrum* at Nagapatnam.

Inland Fisheries

During the past 50 years the inland fisheries sector has grown at a faster rate as compared to marine fisheries. Fish production from inland waters has increased from 30% to 50% and contribution of marine fish production to total Indian fish production has come down from 70% to 50% (Dwivedi *et al.*, 2005). Improved aquaculture practices and mixed farming system contributed to the increased fish production. The inland fish production has shown an increasing trend from 0.2 mt (1960-1961) to 3.2 mt (2002-2003) (Vass, 2005). But this sector requires more awareness as there is no regular stock assessment and monitoring as done in the case of marine fisheries. The landings from the major five riverine stretches have gone down to abysmally low levels. The discharge of industrial and domestic effluents to these water bodies has raised the pollution to alarmingly high levels. Further, the series of dams built over these rivers for electricity generation has geographically isolated some of the major migratory species and reduced their population density.

The inland water also supports a wide variety of indigenous ornamental fishes, particularly in North Eastern states, the exploration of which can substantially contribute to the aquarium fish trade.

Harvest Technology

The technological developments and advancements in the technique of fish finding, introduction of synthetic twines, and introduction of powerful and highly efficient harvesting systems are some of the significant developments that have taken place in the fish harvesting technologies in the last few decades. There are a wide variety of harvest technologies both in the inland and marine sector. They range from the simple traditional gears to more sophisticated ones. Fishing gears vary greatly in their structure, materials used, and principles of capture and methods of operation.

Harvesting technologies can be broadly classified as passive (gill nets, entangling nets, hook and line and traps) and active (trawls, seines and troll line) (Brandt, 1984). The traditional gears are generally low energy systems as compared to the modern fish harvesting systems.

Based on the area of operation there are inland fishing gears, which include gears operated in rivers, estuaries, and reservoirs, and marine fishing gears that are operated in the sea. The fishing gears have been classified into fourteen categories by the International Standard Statistical System of Classification adopted by FAO, according to the principles of capture and sub grouped according to the structure of the fishing gear. Fishing techniques include fishing gear and methods. The principal factors determining the selection and methods of fishing gear are the biological features of the fish, the fishing area, environmental factors, economic conditions and social conditions.

Harvesting technologies for the inland sector

Inland fish production increased in the post independence era. At present about 78% of the inland fish produced in India is derived from aquaculture and 22 % from capture fisheries. Fishery activities from these areas were insignificant in the earlier years. However, during the last few decades

the inland water bodies witnessed technological advances and increased efforts.

A wide array of fishing gears is operated throughout the country in the inland sector.

Fishing without gear

Grouping

This is the traditional fishing method from time immemorial. Hand picking is practiced along the shores and lakes, rivers and seas to catch sedentary, stranded or slow moving organisms. Fish living in crevices and amidst rocks in shallow waters are caught by hand. Large groups of people squat together across a shallow water stream thus forming a barricade and move up the river slowly. Fish living among the rocks are disturbed and while trying to escape strike against the human barricade. They are captured by hand. Hand picking of fish or prawns is prevalent in backwaters of Kerala. This is mainly carried out by the womenfolk. They carry out this operation even in neck deep water. Stranding is practiced in shallow ponds. Selected areas of water ponds are cut off from the main water body by erecting low barricade or earthen bunds. The water thus enclosed is removed and the place is allowed to dry partially and the stranded fishes are collected by hand.

Stupefying devices

Certain devices are made use of in stupefying the fish either mechanically, chemically or electrically for the capture of the organism. They are then collected using scoop nets.

Line fishing

Fishes are lured by offering an artificial bait or natural bait. Long lines with small hooks are operated for predatory fishes in estuaries, rivers and reservoirs. It may be surface set or bottom set. Length of the main line ranges up to 1000m with 450 to 500 branch lines and hooks. Small fishes, earthworms, prawns etc. are used as bait. Catfish, thread fins, gobies etc. are the target fishes. Long lines and drop lines are mainly operated by marginal fishermen in areas where other gears cannot be operated.

Hand lines

Hand line is the simplest form of fishing line. A line with a single hook with bait is operated by a single man paying constant attention to the catch.

Set line

Several hooks are set in a fixed position in the case of setlines. This is also operated from a canoe or boat.

Drop lines

It consists of a main line and a number of hooks of same specifications attached to the end. At the upper end of the line a float is attached. The gear is effective during winter for the capture of carps and catfishes.

Fish traps

Fish barrier

In principle this consists of leading the fish by means of bamboo screens and their final capture by lift nets. This method is practiced in Ganga. Screens are fixed prior to the season. The barrier consists of 3 sections. Main section is set in an inclined direction across the river making an angle of 30-40 degree to the shores. The other two sections are set in the form of a "V" with the apex of the V facing the ascending hilsa. Migratory hilsa guided by the screen enters the liftnet striking on the webbing of the

net causing it to vibrate. The man on watch immediately lifts the net and collects the fish.

Buoyed traps

Bamboo screens are operated by net walls and the fishes are captured in the blind pockets of the trap. The leader (net wall) is rectangular, 30-35m in length and 7-9m in depth. The net is laid across the river with mouth of the net facing towards migrating hilsa.

Fish Pot

Fish pots are popular in upper reaches & rivulets. The trap is made of bamboo strips and fastened by cotton twines. Usually it is 60-70 cm in length. The traps are set across the current, number of them in rows. They are set in the evening and lifted in the morning for the capture of prawns and small fishes.

Aerial traps

Raft traps

For the fishery of mullets that are known to take leaps at the sight of an obstacle, rafts are constructed by securing plantain trunks together; they are either moored or drifted. In the former case fishes are driven towards the raft, while in the latter the fishes that come in the way of raft are caught. Twigs spread on the raft prevent further leaping by the fish. This method is practised in Ganga and Yamuna.

Verandah net

It is common in the "Bheels" of West Bengal. It consists of a net wall erected in an oblique manner facing the direction of movement of fish. The fish at the sight of obstruction leaps and is caught in the folds of net wall.

Leading scare line is constructed by fixing leaves of water hyacinth between the twists of rope. The length of each line ranges from 200-300m. The net is formed by securing webbing to bamboo poles driven to the ground in an oblique manner. The upper section of the webbing has a fold towards its lower periphery. When it leaps and hits the upper section the fish falls down into the fold. This is mainly used to catch major carps.

Bagnets

Push net

A typical one consists of a "V" shaped frame to which the webbing is attached. The frame is made of bamboo poles or light wooden poles secured at an angle of 45 degree. The side opposite to the angle is the base. The net is pushed through water by man wading and during operation it scraps the bottom. It is hauled at frequent intervals shifting the catch to the codend. The net is also operated as a lift net from boats as well as stationary bag nets. Catch consists of small fishes and prawns.

Stow net

It is a bag net with cod end and two wings. The mouth of the net is kept open while in operation by bamboo poles. The net is anchored to the ground. Usually two floats are attached in the middle of the wing. The length of the bag varies from 5-6m and codend, 5-7m. The net is also operated with the help of stakes fixed on the bed. It is set against the current prior to the tide and hauled in after the tide. Catches are mainly sciaenids, polynemids and prawns.

Stick held drag net

This net is operated in Orissa, Madhya Pradesh and Andhra Pradesh. Mesh size of

the gear ranges from 10-15mm. Webbing is fixed to bamboo stick of 70m to 90m length at regular intervals to form a pouch. The net is dragged by two persons in shallow areas that are devoid of bottom obstruction. While hauling the net, fishes are driven into the net from both sides by splashing water with one hand.

Beach seines

The net is divided into two wings and the middle landing part or bag. Bag is differentiated from wings by greater fishing height and smaller mesh size. The net is spread in the form of an arc from the shore. Hauling is done in such a way that the foot rope reaches the shore prior to the head rope, but never raising from the bottom. Beach seines with peripheral pockets for collecting fishes are also operated.

Boat seine

In construction it is similar to a bag net and operation is that of a typical boat seine. The warp of one side is fixed to a pole driven in shallow water and the net is put in water from the boat in the form of an arc. On returning towards the starting point one more bamboo pole is driven and the boat in turn is fixed to these poles. The net is then hauled back from the boat. Catches are mainly catfish, gobids and prawns.

Shore seines

Shore seines are operated in the middle and upper reaches of reservoirs to capture all types of fishes. However, due to depletion of the fishery resources these gears are not in vogue nowadays.

Surrounding gear

The net is put around a shoal in a circular fashion in shallow waters, later the area of the circle is reduced and the enclosed fishes are captured.

Drive-in nets

It is similar to a stick held seine net. The net is fixed in the form of "U" and the fishes are driven into the net by scare lines constructed by twisting old nets. In the final stage of operation of the net, two ends are brought together and the confined fishes (mainly *Mystus* spp) are captured.

Falling nets

Cover pots/ plunge basket

These are gears that are cast on the fish and the fishes are taken from above. The material is a bamboo strip secured by coir rope. Catches are mainly *Ophiocephalus* spp.

Lantern nets

They are similar to cover pots. The webbing is held in form by six poles radiating from the apex. The top end of the frame terminates in a cotton rope, which is held tight during shooting and then let loose entangling the enclosed fish.

Cast net

It is a conical type of net operated either from the shore or from a canoe. Cast nets are used both in the sea (near shore) and in the backwaters. Cast nets are generally made of PA multifilament twines. Two types of cast nets are operated along the coast, one with closing strips and the other without peripheral pocket.

In the net with peripheral pockets, main webbing is folded inwards and fixed to the body of the net at regular intervals to form pockets for collecting fishes. "Chakar jal" of Gujarat is with 60-100 meshes attached to a metal ring and the lower end of the gear has 1000-1250 meshes attached to hauling

lines. Small sinkers are attached to the lower end of the net at an interval of 10-60mm. The depth of the net varies from 4-5 m with mesh size ranging from 10-60 mm

Gill nets

Gill nets are long walls of webbing hung vertically in water are either set in one spot or allowed to drift with the current. In inland it is either set in the surface or bottom. Gill nets are the most effective and economical gear for inland waters. They are highly effective and by adopting proper mesh size for the target fishes, undesired fish can be left out, making the nets suitable for conservation of the resources. They can be operated even from a non-mechanised craft.

Gill nets are operated with head rope and with or without foot rope and sinkers. Numerous variations are noticed in the operation of gill nets. In "Gochail jal" of Allahabad, when fishes are gilled, the floats of that particular region sink, giving indication to the fishermen, who immediately remove the fish. In Hoshangabad gill nets are set parallel to the shore while "Thangadi" is spread in the form of "L" with the shorter arm perpendicular to the shoreline. Scaring by beating the sides of boat is practised in the operation of this net. In Orissa, scaring is by beating the water with bamboo poles. In Mettur reservoir nets are set at the bottom in the night and surface in the day. In general river gill nets are small in size with less fishing height and smaller mesh size.

Shore seine/beach seine

"Mahajals" are beach seine. The gear is divided into 3 parts. Middle one is the landing part with two wings. The central bag has the greatest depth and it has the smallest mesh size. Thermocole and stone sinkers are used to keep the net in position.

Net is usually carried to 100-200m away from the shore and is spread in the form of arc. The net is hauled from the shore in such a way that the foot rope is ahead of the head rope and should reach the shore first. 4-5 people are required for the operation.

Harvesting machines

These are sophisticated fish pumps, which are used to mechanically transfer fish attracted and concentrated to one area. They are mostly used in large aquaculture farms. The fish or shrimps are gathered to one end of the pond and the harvesting machine pumps the shrimps or fish along with water from the farm into different boxes. The catch is graded according to size as it passes through the conveyor belt. .

Trawls

Bottom trawl was found to be an effective method for controlling and eradicating catfishes and other uneconomic fishes when operated in the lower and middle reaches of the Hirakud reservoir. Midwater trawls operated at high speed in the carp dominant areas landed major carps and catfishes. Trawling can be used to harvest and eradicate the unwanted fishes from the reservoirs.

Harvesting technologies for the marine sector

Trawls

Trawl is a conical bag shaped gear, which is dragged through water either at the bottom or subsurface water. The opening of the mouth region of the net is maintained with the help of floats on the head rope and sinkers in the foot rope and otterboards to maintain the horizontal opening. It accounts for more than 20 % of world marine catch.

In India trawls are operated by more than 65 % of mechanized boats and they contribute substantially to the total marine catch. Trawl can be operated either from the side or stern. Based on the position in water column where they are operated, trawls are classified into bottom trawl and midwater trawl. Based on the mouth opening of the trawl they are grouped into beam trawl, otter trawl and bull trawl. Based on the number of trawls operated from a single vessel, there are double rig trawl, triple rig trawl and quad rig trawl.

Some of the recent innovations in trawl net designs are use of large mesh trawls in the fore parts of the net, which minimize drag and hence fuel requirements. Ecofriendly trawls have been specially designed and rigged so as to have minimal impact on the trawling ground and non-target organisms. Semi pelagic trawls have been designed which are operated a small distance above the sea bottom for off bottom resources and thus minimise disturbance on the sea bottom.

Seine nets

Seine net is a long wall of netting with or without a bag, supported by floats and sinkers. These are operated by ropes attached to the end of the wings, which are used for hauling and herding the fish. They are usually operated in the coastal or shallow waters where bottom and surface act as natural barriers. Seines operated from a boat are called boat seines (eg. Danish seine). Seines operated from shore are called shore seine or beach seine (eg. *Rampani* nets operated in south west coast of India).

Purse seines

Purse seining is an efficient fishing method for the capture of shoaling fishes. Purse seines evolved from beach seines in 1920s with the incorporation of a purse ring to facilitate closing of the bottom of the net and thus make it possible to operate in deeper waters. They are roughly rectangular walls of netting rigged with floats on the head rope and sinkers in the foot rope. They are the predominant type of surrounding nets. The bottom of the net is closed after encircling the fish shoal by a purse line, which prevents fish from escaping downwards by diving. They are generally classified based on the scale of operations (small scale, medium scale and large scale); based on the number of vessels used (one boat purse seine and two boat purse seine); based on method of operation (surface and sinking purse seine) and based on target species (anchovy, sardine, tuna, mackerel etc).

Fish luring methods like drifting fish aggregating devices (FADs) with powerful lights and underwater lamps are used in high sea purse seining operations for aggregation of fish during night. This helps in concentrating the fish and thus easier to capture them by purse seining.

Gill nets, trammel nets and entangling nets

They are vertical walls of netting kept erect in water column by means of floats and sinkers and set perpendicular to the direction of movement of target fish. Depending on the method of operation gill nets are classified into drift gill nets, set gill nets and encircling gill nets. Based on the structure, there are simple gill nets and multi layered netting called trammel nets. Entangling nets are loosely hung and catch is entangled in the net.

Hooks and lines

Lines are used both by the traditional and modern fisheries sector. Line fishing is basically composed of line and hook. The most important types of hooks and lines are pole and line popular in Lakshadweep islands, jig line for squids using lights, and troll lines for predatory fishes. Hand lines and long lines are also widely used. Tuna long line is a very important example for a long line gear. The fish are enticed to artificial or natural baits on the hooks and are finally caught.

Traps

Traps are impounding devices into which an organism is lured and from which escape is made difficult. The main advantages are energy saving in operation and low capital investment. Traps can be left unattended and animals can be obtained undamaged. Fishing with traps is considered highly selective.

Pound nets

Pound nets are stationary uncovered nets mainly seen in Japan. These are fixed in stakes; a leader net is kept at an appropriate angle to the swimming direction of migrating fish schools so as to guide them to enclosures with retarding devices and closed at the bottom by netting.

Pots

Pots are cages or baskets made from materials like wood, metal rods etc. These are designed to catch fish, crustaceans or cephalopods.

Fyke nets

Fyke nets are used in shallow waters, and it consist of a cone shaped bag of netting with ring shaped rigid structures to maintain cylindrical shape of the net body and are provided with wings to lead the fishes into the bag. They are fixed to the bottom by stakes.

Responsible Fishing Methods

The ever-increasing demand for fish as food has lead to innovations and technological developments in fishing gear design and methods making it possible to harvest the varied resources. This has invariably increased the pressure on the fishery resources. Presently there is an urgent need for responsible harvesting technologies for a long-term sustainability of the fishery resources. Awareness of the need for responsible fishing to ensure sustainability of the resources, protection of the biodiversity, environmental safety and energy efficiency is the need of the day. Development of fishery was supported by intense R&D and operational research input for introducing suitable mechanized fishing vessel designs and fishing gear for small mechanized fleet from Central Institute of Fisheries Technology and Indo-Norwegian Fishery Project (now Integrated Fisheries Project) and exploratory resource surveys and biological investigations on marine fishery resources by Exploratory Fishery Project (now Fishery Survey of India), Central Marine Fisheries Research Institute and Department of Ocean Development, which is continuing (Devadasan, 2005). The need for scientific management of resources to ensure long-term sustainability was introduced by the FAO Code of Conduct for Responsible Fisheries, which was adopted in October 1995. This voluntary code sets out principles of behaviour for responsible practices in the fisheries sector. The initiatives to adopt the code include selective fishing gear and practices,

environment friendly fishing gears, enhancement of resources and energy conservation in harvesting. Recent advances like use of Global Positioning System (GPS), echosounder, sonar, gear monitoring systems and progress in satellite technology to identify potential fishing zones (PFZ) help fishermen in saving search time and fishing time. Putting into practice the FAO Code of conduct of Responsible Fisheries, ensuring sustainability, reducing by-catch, discards and juvenile destruction, eliminating destructive gears, conserving endangered and threatened species and ecosystem conservation, can bring about positive changes in the present crisis in fisheries.

Further Reading

Anon (2003) Tenth Five-Year Plan Document – 2002-2007, Chapter 5.2, Govt. of India, New Delhi: 575-580

Brandt, A.V. (1984) Fish Catching Methods of the World, Fishing News (Books) Ltd., London: 432p

CMFRI (2004) Annual Report 2003-2004, Central Marine Fisheries Research Institute, Cochin: 139 p

CMFRI (2005) Annual Report 2004-2005. Central Marine Fisheries Research Institute, Cochin: 134 p

Devadasan, K. (2005) CIFT Initiatives in responsible fishing operations, Souvenir, Sustain Fish 2005, 16-18 March, 2005, Cochin : 59-65

Dwivedi, S.N, Saxena, A and Bajpai, A. (2005) Inland Fisheries of India and Future Perspectives, Fishing Chimes, 25(1): 47-51

FAO (2004a) FAO yearbook. Fishery Statistics Capture Production. Vol.94/ 2002, FAO Fisheries Series No.66, FAO Statistics Series No.180, FAO, Rome. 642 p

FAO (2004) The state of World Fisheries and Aquaculture, FAO, Rome

George, V.C. (1971) An Account of the Inland Fishing Gear and Methods India, Spl. Bull. No.1, CIFT, Cochin

George, V.C. (1981) Indigenous Marine fishing gear and Methods of India – Part I – Karnataka State, CIFT Special Bulletin, CIFT, Cochin

ICAR (2003) Agricultural Research Data Book, Published by Director, Indian Agricultural Statistics Research Institute, Library Avenue, New Delhi

Kapoor, D and Sarkar, V.K. (2003) Expanding initiatives for conservation and sustainable exploitation of fish genetic biodiversity of India. Fishing Chimes, 23(1): 57-65

MPEDA (2005) Statistics of Marine Products Exports 2002. The Marine Products Export Development Authority, Cochin, India. 592 p

Nedlec, C. (1982) Definition and Classification of Fishing gear Categories, FAO Fish. Tech. Pap. 222: 51p

Vass, K.K. (2005) Future challenge of capture fisheries in India. Fishing Chimes, 25(1): 47-51