

Marine Fisheries Policy Brief - 1

KERALA



Central Marine Fisheries Research Institute
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Foreword



Marine fisheries sector in the country is undergoing changes in recent years as the emphasis is shifting from increasing production from coastal fisheries to sustaining the resource-base. The task of sustaining coastal fisheries is assuming challenging proposition with increasing dependent population on fishing, open access and climate change, to name a few. The recent norms stipulated by the European Union on certification and other international mandatory and voluntary codes emphasise sustainable fisheries through fish trade. These developments call for periodic re-visit into the existing fisheries acts and policies in order to make suitable revisions and amendments. Recognising the need to address these concerns through research inputs, the Central Marine Fisheries Research Institute has taken a step forward to regularly assess and update the situation by analyzing and interpreting 50 years of data on marine fish catch and effort. The update will be in the form of a series of publications, “*Marine Fisheries Policy Brief*”, which is the output of various research projects undertaken by the Institute in the field of capture fisheries and mariculture. The Brief is expected to be useful for updating Marine Fisheries Acts and Regulations in the country.

As first in the series, I have great pleasure in releasing the publication ***Marine Fisheries Policy Brief - 1 (Kerala)***. Being in the forefront of marine fisheries development in the country, Kerala is encountering challenges to sustain fisheries resources due to several factors. This Brief has made an attempt to include recent challenges such as climate change and the international obligations such as certification. I take this opportunity to congratulate the scientists of CMFRI who have supported to prepare this document in English and Malayalam. Also I compliment Dr. N.G.K. Pillai, Head, Division of Pelagic Fisheries and Dr. E. Vivekanandan, Head, Division of Demersal Fisheries for their initiative in the preparation of Policy Briefs on behalf of CMFRI Policy Cell. I am confident that publication of this nature will be of immense use to development workers, planners, policy makers and all those concerned with the sustainable development of fisheries.

Kochi-18
August, 2009

Dr. G. Syda Rao
Director

Introduction

Kerala which has a coastline of 590 km ranks first in marine fish production of India, contributing nearly 25% (5.81 lakh tonnes on average) to the total annual production. The export of marine products from the State earns valuable foreign exchange besides affording innumerable job opportunities in the industry. The population depending on fisheries has steadily increased over the years and stood at 6,02,234 in 2005 (Anon., 2005). Kerala has been in the forefront of absorbing innovative and new technologies in fishing practices, which have led the marine fisheries sector to take a complex structure. The 1980s was an important period in the development of marine fisheries in Kerala. In the first half of the period the motorized sector grew rapidly and became the most important sector yielding the maximum catch in 1988. By that time, ringseine became very popular in exploiting the pelagic resources and replaced the boatseines to a very great extent. Huge size of the new net (450 to 1000 m long) and large number of crew (30 to 50) needed for its operation necessitated larger boats with high capacity outboard engines (3 outboard engines of 40 hp each). This facilitated extension of fishing grounds for the motorized sector. The fishing grounds covered by the mechanised sector also extended by increasing the boat size and fishing effort and efficiency through multi-day fishing during the late 90s.

Demographic features (marine)

Coastline (km)	:	590
No. of landing centres	:	178
No. of fishing villages	:	222
No. of fisher families	:	1,20,486
Fisherfolk population	:	6,02,234
Active fishermen	:	1,40,222
Full time	:	1,24,103
Part time	:	10,488
Occasional	:	5,631



Major fish landings centres located along the coast of Kerala

As fisheries are rapidly developing it is important to periodically update suitable fisheries policies which will ensure sustainable development of the fisheries sector, nurturing the resource as well as the fishermen community and related sectors dependant on fisheries for their livelihood.

Development of Marine Fisheries of Kerala – a time line

- 1953 - Establishment of Indo-Norwegian Project (INP)
- Mid 50s - Mechanized fishing started by Indo- Norwegian project
- 1962 - Introduction of shrimp trawling
- 1963 - Exploratory and experimental fishing by INP and introduction of new craft designed by Central Institute of Fisheries Technology (CIFT)
- Late 60s - Entry of Individual entrepreneurs into fishing paving way for fast development of trawl fishery
- Early 70s - Large scale commercial trawling in the inshore waters
- 1974 - Motorization initiated by Marianad Fisheries Co-operative Society in Trivandrum

	Increased Foreign exchange earnings through sea food exports
1979	- Introduction of commercial purse seining
1980	- Motorisation programme adopted by fishermen of Alapuzha, Ernakulam & Kollam districts
	Promulgation of the Kerala Marine Fishing Regulation Act-1980 (KMFRA-1980) by Govt. of Kerala
1985	- Introduction of outboard ringseining
	- Introduction of mini trawling
1988	- Introduction of ban on trawling during the monsoon period
1996	- Introduction of multi- day voyage fishing
1999	- Conversion of small trawlers for deep sea prawn fishing
2003	- Introduction of inboard ringseiners
2007	- Conversion of shrimp trawlers for tuna longlining

Fishery Status

Production trends

During 1997-2008, the total marine fish production from Kerala varied from 5.14 lakh tonnes (2001) to 6.70 lakh tonnes (2008), with an annual average landings of 5.98 lakh t (Srinath *et al.*, 2006; CMFRI, 2009) (Fig. 1). According to the CMFRI census 2005 it is estimated that there are 29,177 marine fishing craft in Kerala, of which 14,151 (49%) and 5,504 (19%) craft belong to the motorised and mechanized sector respectively and 9,522 (22%) constitute the traditional sector. The landings are mainly contributed by the mechanized (56%) and motorized (42 %) sectors (Fig.2).

In the mechanized / motorized sector, ringseines (3.04 lakh tonnes in 2008) is the major contributor to the landings followed by trawls (1.57 lakh tonnes in 2008). Other gears deployed by the fishermen include the gillnets, hooks and line, boat seines and purse seines. Around 800 species are landed along the Kerala coast of which about 200 are commercially important and are classified as pelagics, demersals, crustaceans and cephalopods. The major pelagic resources include the oil sardine and lesser sardines, anchovies, mackerel, tunas, ribbonfishes and carangids. The major demersal fish resources include sharks, rays, threadfin breams, lizardfishes, sciaenids and soles. Penaeid and non-penaeid prawns, crabs, stomatopods and lobsters constitute crustacean resources while squids, cuttlefishes and octopus contribute to the cephalopod landings. Pelagic groups dominate the landings forming 71% followed by demersals (14%), crustaceans (9%) and cephalopods (6%) (Fig 3).

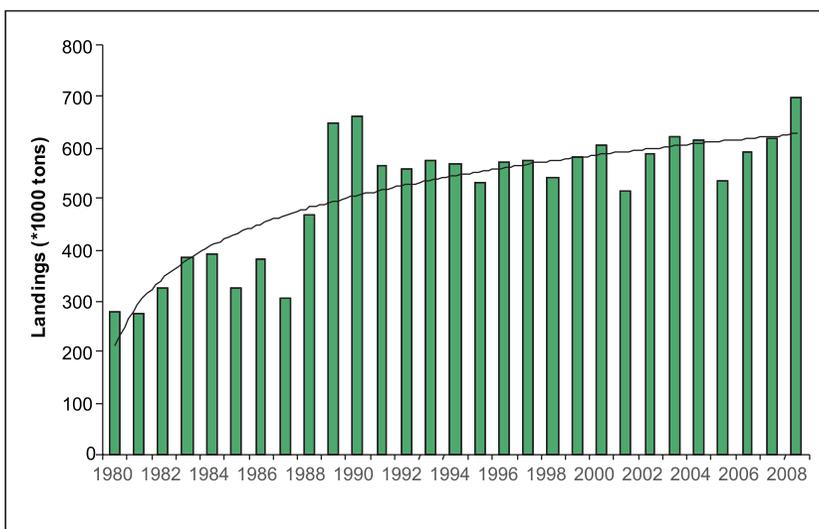


Fig. 1. Trend of marine fish landings in Kerala during 1980-2008

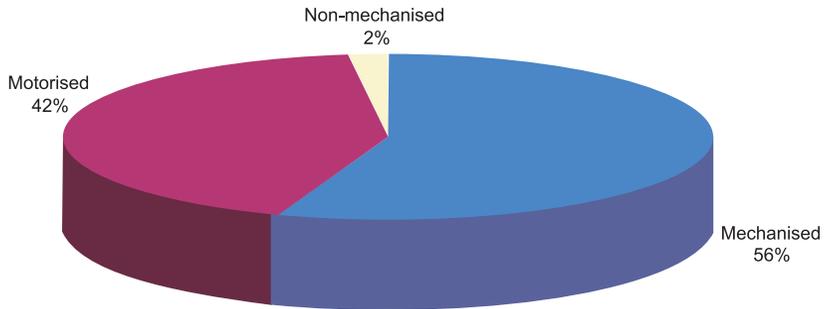


Fig.2. Sector- wise marine fish landings

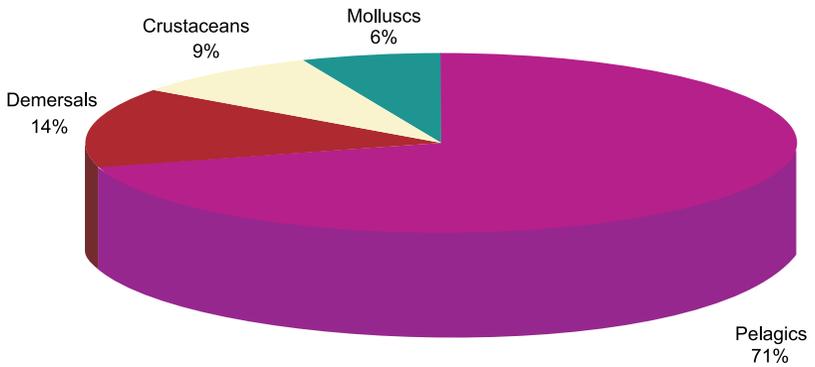


Fig. 3. Components of marine fish landings in Kerala

Table 1. Important craft-gear combinations in marine fisheries of Kerala

Craft	Fishing gear
Mechanised fleet	
1. Mechanised Trawlers Small (8.5-9.7 m LOA; 90 hp) Medium (9.7-16.7 m LOA; 100 -158 hp) Large (16.7-21 m LOA; 177 hp)	Shrimp trawls – 5 types Fish trawls – 3 types Cephalopod trawl – 1 type Gastropod trawl – 1 type
2. Mechanised Gill-netter-liner (9.7 – 21 m LOA; 110-140 hp)	Gillnets; longlines; handlines
3. Mechanised Purse seiner (15.2 – 16.7 m LOA; 110-156 hp)	Large mesh (45 mm) purse seines for tuna, seerfish, mackerel and carangids
Motorised (IBM or OBM) Traditional fleet	
4. Crafts with inboard engine (steel or wood hull; 18.3-25.8 m LOA; 90-140 hp)	Ring seines (18 mm mesh) for sardines and mackerel
5. Crafts with OBM (wood, steel, fibreglass hull); 12.2 to 21.3 m; 22+22 hp, 40+22 hp, 40+22+22 hp, 40+40+22 hp or 40+40+40 hp)	Ring seines (18 mm mesh size) for sardines, mackerel, carangids and prawns
6. Crafts with OBM (wood and fibreglass hull; 9.9-22 hp)	Ring seines (8-12 mm) for anchovies; Mini trawls; Gillnets; Hooks and lines; Encircling nets; Boat seines; Shore seines
Non-motorised traditional fleet	
7. Catamaran Plank canoe Dugout canoe FRP canoes	Encircling nets; Boat seines; Shore seines; Gillnets; Hooks and lines; Cast nets

Marketing and Trade

The average production during 2000-2005 was 5.81 lakh t valued at Rs.2327 crores and Rs.3957 crores at first sales and last sales point respectively (Sathiadhas, 2009). The significant difference in the first and last sales indicates the involvement of intermediaries who are mostly from non-fishermen communities. This shows that there is enough scope for more fisherfolk to involve in fish trade and other micro enterprises in the post-harvest sector. The sectoral revenue generated at first sales is highly skewed in favour of the mechanised category. During 2004 and 2005, mechanised fleet cornered about 72 % of the revenue earned at first sales, against 27% and 1% earned by motorized and non-mechanised segments respectively. The processing, preservation, transportation and handling at various stages and the marketing process have undergone rapid changes in recent years providing ample employment opportunities. In the post-harvest sector, about 50% of the activities are undertaken by women and their involvement is

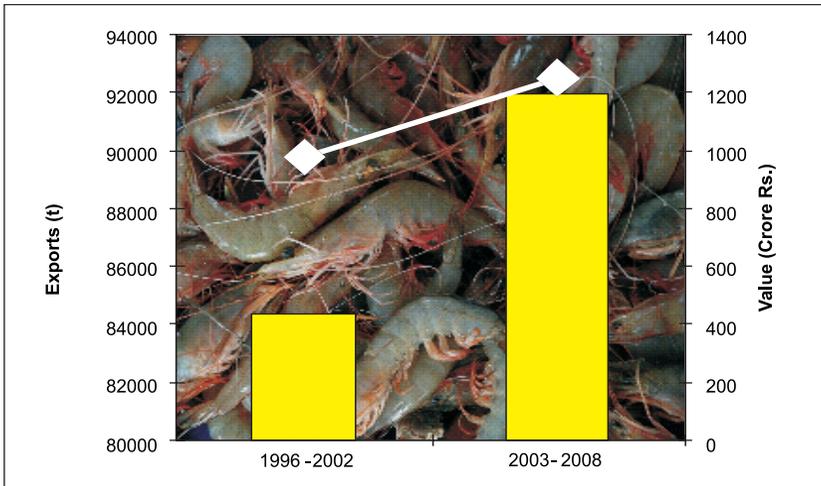


Fig. 4. Export of seafood during 1996-2002 and 2003-2008 (export quantity in histogram and value in white line)

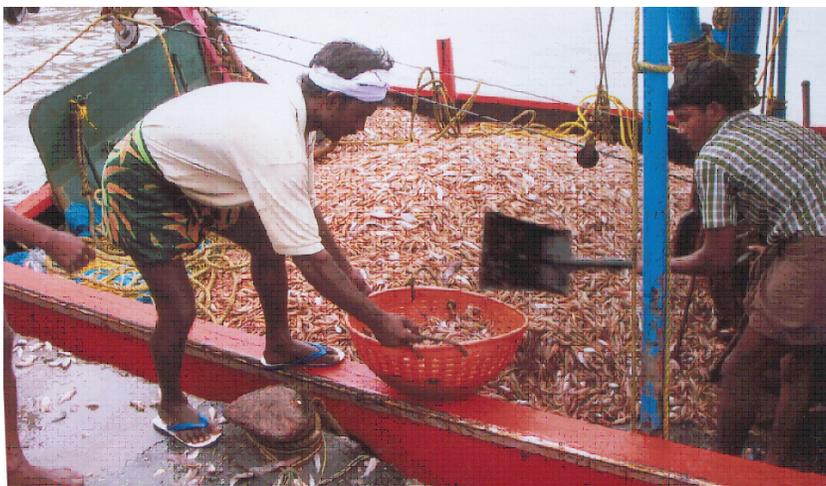
highest in shrimp peeling (95%), curing and processing (85%) and marketing of fish (72%).

The per capita consumption of fish in Kerala is 28 kg per annum which is very high compared to the national average. Seafood products like shrimp, cuttlefish and squid are in great demand in European, Japanese, South Asian as well as Gulf markets and during 2003-2008, export of 91,921 tonnes worth Rs.1252 crores from the state has been reported (Fig. 4). During 2008-09, the export was 99,033 tonnes and value was Rs. 1513 crores.

Trawl fishing ban during monsoon

The catch trend analysis has revealed an increase in catch by 2, 31,923 tonnes (24.8%) during the post-ban period (1988-2008), compared to the pre-ban period (1975-1987).

The increasing fish catch after 1988 may be mainly attributed to the intensification of motorisation of craft resulting in increased operations by the ring-seiners as well as increased fishing effort by trawlers through the



Bumper shrimp catch in a trawler at Neendakara Fisheries Harbour



Ring seine (1000m long) – mass harvesting gear being cleaned after fishing by country craft (length 80 feet) fitted with 120 hp engine

extension of fishing grounds and multi-day fishing (Yohannan *et al.*, 1999). The imposition of ban on bottom trawling has contributed to reduction in annual trawl effort, thereby partially reducing fishing pressure on fish stocks. The trawl ban has the potential to regenerate fish stocks, especially with regard to demersal fish and shrimp resources which are harvested at larger sizes by trawlers immediately following lifting the ban every year (Nandakumar *et al.*, 2001). The costs and earnings of all types of fishing units operating in Kerala revealed that monsoon ban on trawling has benefited all sections in terms of increased catch and revenue net income, labour income and operational efficiency in the succeeding seasons.

The recent trends in production levels indicate that the fishery as a whole has reached an asymptotic level of production while some of the individual resources are exhibiting declining trends. Further, the resource-wise trends indicate that the fate of the fishery will mainly be governed by the success

or otherwise of the production from the pelagic resources assemblage comprising mainly of small pelagics such as sardines, anchovies, mackerels and scads. The abundance of these resources are highly variable and climatic– driven and hence mechanisms for sustainable exploitation of these resources are required.

Potential Yield and Optimum Fleet Size Estimates

Potential yield

Estimation of the marine fisheries resources potential and the optimum fleet size to exploit these resources sustainably are crucial for proper planning and development, but is a challenging task requiring lot of data inputs. The total potential yield estimate for Kerala obtained by the simple high pass filter method was 6.99 lakh tonnes against an annual average (1995-2008) yield of 6.20 lakh tonnes indicating scope for marginal increase from certain resources (Table 2).

Table 2. Estimated annual average landings (2005 - 08) and potential yield of the major resources along Kerala coast (Source: Sathianandan *et al.*, 2008)

Species / Groups	Potential Yield (t)	Annual average landings (t)
Demersals		
Sharks	2301	1983
Skates	510	395
Rays	1522	1314
Lizardfishes	9575	8497
Rock cods	6119	5139
Snappers	1873	1387
Pig-face breams	725	493
Threadfin breams	34555	30750
Other perches	10659	8837
Croakers /Sciaenids	9389	8191

Silverbellies	5765	5349
Big-jawed jumper	1762	1131
Black pomfret	1146	810
Silver pomfret	1030	600
Soles	19798	18804
Penaeid prawns	51823	44209
Non-penaeid prawns	9132	6384
Lobsters	419	274
Crabs	6471	5486
Stomatopods	12968	8426
Bivalves	82	71
Gastropods	890	740
Cephalopods	32207	25835
Pelagics		
King seer	9804	6701
Little tunny	11143	9184
Frigate/Bullet tunas	6847	5801
Skipjack tuna	689	483
Longtail tuna	842	667
Yellowfin tuna	3139	2890
Bill fishes	1235	1003
Barracudas	5164	4730
Wolf herring	745	616
Oil sardine	236922	192492
Other sardines	14641	12117
Whitebaits	24559	22485
Thryssa	4991	4847
Other clupeids	7913	5325
Half beaks & full beaks	1088	828
Ribbonfishes	21678	19931
Horse mackerel	4780	4026
Scads	25021	23523
Leather-jackets	745	519
Carangids	15795	14785
Indian mackerel	56209	50650
Total **	699070	620000

**Includes other resource groups

Optimum fleet size

The estimates of optimum fleet size are based on such premises that will ensure returns in terms of quantity caught, as has been in recent past. If the fishery is near fully exploited these fleet sizes will necessarily mean the maximum permissible under the given circumstance and may not necessarily mean economic windfall to the stakeholders. As per CMFRI Census 2005, there are 3982 trawlers in Kerala and the optimum fleet size of trawlers (single day and multi-day) is 2829 indicating an excess of 1153 boats. Ringseines, which were introduced during the 80s, have become immensely popular. The dimensions of the gear have increased manifold; with length extending to about 1000 m compared to 200 m when it was first introduced. Presently the OBM units are being converted to IBM. The exact number of ringseine units presently in operation are not available, but an estimated 2259 units were reported during 1991 (Anon., 1992). However, only about 1048 units of ring seines are required for the sustainable exploitation of the pelagic resources and the present effort will have to be optimally regulated.

Table 3. Existing fleet and optimum fleet size of various categories of vessels
(Source: Sathianandan *et al.*, 2008)

Fleet	Existing fleet size	Maximum Fleet size
Mechanised multi-day trawlers	3982	1614
Mechanised single-day trawlers		1215
Outboard mini trawlers	NA	549
Mechanised gillnetters/drift netters	428	79
Outboard hooks and line	NA	2135
Other mechanised crafts	NA	3
Mechanised purse seiners/ring seiners	54	232
Outboard ring seiners	NA	816
Other outboard crafts	NA	2480

NA – Not Available

Issues in Marine Fisheries

- Excess fleet
- Unregulated increase in fishing effort and introduction of fishing technologies resulting in inter-sectoral as well as intra-sectoral conflicts
- Large scale capture of juveniles and low value fish which adversely affect bio-diversity and marine food webs as well as the entire ecosystem
- Lack of mesh size regulations likely to cause growth overfishing
- Declining of certain fish stocks
- Impacts of climate change on the marine environment and resources
- Inadequate quality controls and marketing infrastructure
- Impacts of global pressures on trade

Management Options

Government of Kerala has constituted different Committees from time-to-time to evaluate specific needs of marine fisheries including trawl ban, and to suggest suitable management options for sustaining/improving fisheries. The following are few Acts/Committees :

1. Kerala Marine Fishing Regulation Act -1980
2. Babu Paul Committee (1981)
3. Kalawar Committee (1985)
4. Balakrishna Nair Committee-I (1989)
5. Balakrishna Nair Committee-II (1991)
6. Balakrishna Nair Committee-III (2000)
7. Master Plan for sustainable development of fisheries of Kerala (2006)
8. D.K. Singh, Secretary to Govt. of Kerala (Fisheries) – (2007)

To suggest management options, the present paper has taken into consideration the above documents as well as recent changes in the fisheries.

1. Registration of fishing vessels

The present marine fisheries is a free and open access system and consequently there is intense competition for the resources among various sectors. Protecting the interest of artisanal fishers from unequal competition with mechanized vessels and thereby ensuring their socio-economic security is important. To rein in unsustainable increase in fishing effort, the following measures are recommended :

- Mandatory registration and licensing of all motorized and mechanized boats.
- Single agency registration of fishing vessels and a system of marking the fishing vessels with a unique identification code. The database of fishing vessels operating from the State should include all related details such as gear/craft dimensions, engine and fishhold capacities and be accessible to all concerned agencies.
- Review of registration and licensing every five years.
- Upward revision of the registration, licensing fees and berthing charges to discourage new entrants.

2. Reduction of fishing effort and capacity

In their efforts to increase returns and suit specific situations, fishermen adopt new designs of fishing craft and gears. Larger craft and gear, more efficiency in fishing, addition of horsepower and number of OBMs, introduction of IBM fitted large vessels carrying onboard very huge nets, winches and other deck equipments, bypass the KMFR Act. Their unbridled expansion may pose a threat to marine resources in the long run. Hence, controls are required to be imposed in terms of number, size, scale of operation and capacity of craft-gear combinations. In view of the fact that

ringseine is found as the most efficient gear in the exploitation of pelagic resources which contribute nearly 70% to the total fish landings in the State and the fact that fishermen population depending on this type of fishing is very high in the State, ring seines may be employed with due conservation measures.

The following measures are recommended:

- Fixing and capping the size and power of the boats in each sector by imposing upper limits for the craft length and horsepower. The large ring seiners operating in Kerala may be limited to < 22 m OAL and < 120 hp engine capacity.
- Restriction for multi-day fishing by fixing upper limit for absence from the shore.
- Registration for new boats may be permitted only as replacement of craft of the same engine capacity.
- New innovations and modifications of craft in terms of design, operation, mode of propulsion, engine horsepower, fishing methods, types of gears etc. should be carefully scrutinized and vetted by a competent technical authority before giving permission.
- All boat building yards, net making and selling units and private fish landing centres/ fishing harbours may be brought under the purview of KMFR Act and may be made to register under the Act.

3. Mesh size regulations and prevention of discards

At present, minimum mesh size is not prescribed for gears, other than trawl net as a result of which very small and juvenile fishes are regularly caught causing serious threats to the fish stock. Minimum mesh size regulations are required for all major gears like ringseine and gillnets.

The following measures may be adopted :

- Minimum 17 mm mesh size for ring seines.
- Encourage operation of large mesh (>45 mm) purse seines in deeper waters for tunas, pomfrets and barracudas
- Encourage large mesh gillnets (100 – 150 mm) for large oceanic tunas, seer fishes, bill fishes and sharks.
- Encourage use of By-catch Reduction Devices (BRDs) and Juvenile Excluder –Shrimp Sorter Devices in trawls.
- Provision to handle the by-catch / discards generated by trawls for livestock feed manufacture until discards are gradually phased out through strict controls on mesh size and BRDs.

4. Diversification of vessels and targeting specific resources

To ease out fishing pressure in the inshore waters, the existing vessels may be suitably upgraded/modified as multipurpose/combination vessels to harvest the under-tapped resources like tunas, billfishes, pelagic sharks and oceanic squids available in the oceanic and deeper waters. The suggested options are:

- Diversification to passive fishing by large mesh gillnets, squid jigging and hooks & lines
- Promote deep-sea fishing of tuna resources by resource specific craft and gear.
- Provision of institutional support for small scale fishermen especially those fishing for oceanic species of tunas to upgrade their fishing crafts and acquire ice boxes/ fish preservation facilities on their traditional craft.

5. Conservation through Minimum Legal Sizes (MLS) and Minimum Legal Weight (MLW)

Spawners are required to replenish the population and it is also vital to ensure sufficient survival of young ones of fish to grow to maturity when it can breed at least once in its lifetime. However, it is observed that certain

fishing gears/methods destroy spawners and juveniles. It is to be ensured that each species of commercial importance is exploited only above its size at first maturity and for this Minimum Legal Sizes (MLS) are prescribed (Table 4). The following options are recommended here:

- Adherence of Minimum Legal Size (MLS) during landing and marketing.
- Fixing of minimum export size for high value resources such as lobsters, seerfishes, tunas etc.
- Awareness creation on perils of juvenile fishing

Table 4. Recommended Minimum Legal Size (MLS) / Minimum Legal Weight (MLW) of major finfish and shellfish resources

Species	Common name	Vernacular	MLS (cm)*	MLW (gm)
CEPHALOPODS				
<i>Loligo duvaucelii</i>	Squid	Koonthal/Olakkanava	80	25
<i>Sepia pharaonis</i>	Cuttlefish	Kallankanava	115	150
<i>Octopus membranaceus</i>	Octopus	Neerali/Kinavalli	45	15
LOBSTERS				
<i>Panulirus homarus</i>	Rock Lobster	Kadalkonchu		200
<i>P. polyphagus</i>	Rock Lobster	Chittakonchan/Kadalkonchu		300
<i>P. ornatus</i>	Rock Lobster	Kadalkonchu		500
<i>Thenus orientalis</i>	Sand lobster	Adippan		150
FINFISHES				
<i>Sardinella longiceps</i>	Oil sardine	Mathi/Neichala	14	
<i>Rastrelliger kanagartha</i>	Indian mackerel	Aiyala	16	
<i>Euthynnus affinis</i>	Little tuna	Choor/Sooda		
		Kudutha	40	
<i>Auxis thazard</i>	Frigate tuna	Elichoor	30	
<i>Katsuwonus pelamis</i>	Skipjack tuna	Choor	44	
<i>Thunnus albacares</i>	Yellowfin tuna	Kera	70	
<i>Decapterus russelli</i>	Scad	Champan/Kanniyala/ Kozhuchala/Thiriyen	14	
<i>Megalaspis cordyla</i>	Horse mackerel	Kanayan Paravangada/ Kanameen	22	
<i>Trichiurus lepturus</i>	Ribbonfish	Vellithalayan	56	
<i>Scomberomorus commerson</i>	King seer	Neimeen/Varimeen/ Ayakora	75	

<i>Nemipterus japonicus</i>	Threadfin bream	Kilimeen	14
<i>N. mesoprion</i>	Threadfin bream	Kilimeen	12
<i>Cynoglossus macrostomus</i>	Sole	Manthal	11
<i>Lactarius lactarius</i>	Whitefish	Parava	13
<i>Epinephelus tauvina</i>	Grouper	Kalava	72
<i>Parastromateus niger</i>	Black pomfret	Karutha avoili	30
<i>Pampus argenteus</i>	Silver pomfret	Velutha avoili	200

*based on length-at-first maturity

6. Demarcation of fishing grounds and closed season/closed area /Marine Protected Areas (MPAs)

To ensure sustainable yields from the exploited stocks, fishery regulations enabling effort reduction, rebuilding of stocks and ecosystem rejuvenation through closure of fishery for a specified period of time is inevitable. Along Kerala coast, restriction of trawl fishing during monsoon is recommended to protect the spawning stocks from capture by mechanised fishing vessels and allow natural replenishment of fish stocks. The idea is that if the fish are protected from fishing, they live longer, grow larger and produce an exponentially increasing number of eggs. It also affords relief from continuous disturbance of the fishing grounds due to trawling that would otherwise harm the marine ecosystem.

The suggested measures are:

- Continuation of mandatory closed fishing season for a period of 47 days from 15th June to 31st July for mechanised vessels.
- Using consensus approach, suitable areas which act as shrimp/ fish nurseries and ensure recruitment of fishes may be identified and declared as MPAs and no-fishing zones.
- Demarcation of fishing zones for each class of fishing vessels is required. Zone upto 10 metre depth may be earmarked for non-motorized craft (who use < 10 hp engines) and the zone between 10 and 30 metre depth may be

reserved for motorized sector. The area beyond this limit may be earmarked for mechanized sector including craft fitted with inboard engine.

7. Sea safety

Ensuring the safety of the fishermen at sea is an important concern. The suggested options are :

- Carrying life saving appliances and fire fighting equipments may be made compulsory onboard all fishing vessels as well as a pre-requisite for applying for registration of the fishing vessel and annual renewal of fishing licences.
- Fishing vessels should be appropriately marked as per FAO specification for their identification on the basis of the International Telecommunication Union Radio Call Signs (IRCS) to ensure safety of fishermen at sea.
- Vessel Monitoring System for all fishing vessels in the Indian EEZ using satellite tracking may be introduced.

8. Strengthening of management information system

The basic requirement for knowledge-based fisheries management is the availability of reliable and adequate data on the resources and their dynamics including the economics of fishing. As per the KMFR Act every owner of the fishing vessel is expected to furnish various information to the government in the prescribed form. However, this is not sufficiently enforced. But such a provision will enable a database which is crucial for assessment of stock and taking appropriate fisheries management decisions that will ensure sustainable development of fisheries sector. The scientific data acquisition mechanism already in place by research institutes such as CMFRI can be supported by an effective fishing data feedback system with active participation and co-operation of fishing vessel operators. The following measures are suggested :

- Supply of data on fishing effort, catch and species composition (fishing logs) to the Fisheries Department may be made mandatory for all motorised and mechanized fishing craft.
- A Fisheries Information System (Potential Fishing Zone advisories, market information and e-commerce portal, fish identification and biological information *etc.*) integrated with unified fishing Vessel Registration System to facilitate effective control, monitoring and management of fisheries making use of the advances in Information Technology may be developed.

9. Participatory management and strengthening of conservation oriented extension services

Management of fisheries can be made more effective if the principal stakeholders are involved in decision-making and implementation. Fishermen cooperatives may be vested with the responsibility of protecting fisheries resources they harvest. They should be made aware of the biological and environmental basis for sustainability of fish stocks by constant interactions with the scientific community which will make the implementation of the management measures/options smooth and effective. Awareness on benefits of conservation of fish stock is presently minimal and has to be created and strengthened through extension services of Central and State Fisheries institutions/agencies, NGOs with a participatory management approach.

The following measures also may be considered:

- Popularisation of FAO Code of Conduct for Responsible Fisheries (CCRF) among all stakeholders.
- KMFR Act 1980 needs to be thoroughly reviewed and appropriately modified in conformity with the CCRF especially with respect to

destructive fishing gears/fishing materials, harvesting and sale of undersized organisms.

- State/ District/ Panchayat level Scientific Advisory Committees may be set up with experts and other stakeholders to advise the Government on various issues concerned with the exploitation, marketing, management and conservation of the fishery resources.
- Strengthening of Co-operative Societies for benefit of the small scale fisheries sector.
- A model fishing village/harbour may be set up for demonstration of participatory or co-management.

10. Strengthening of domestic fish marketing networks

As fish is a very important component of the diet of the majority of the people in the state, an efficient internal market network has to be established based on the principle of optimum utilisation of the resource, hygienic handling/processing and efficient marketing. The following are the suggested options:

- Encourage involvement of fisherfolk in fish trade and other micro-enterprises in the post-harvest sector
- Strengthening of infrastructure such as ice plants, cold storages, potable water availability and electricity to enable storage, marketing/ processing of the harvested resources with minimal wastage
- Only registered fish stalls with proper hygienic standards may be authorised to vend fishes outside the landing centre. Suitable agencies to check quality of fish sold in the domestic market may be set up. Possibility of enabling a regulated marketing structure may be pursued.

11. Certification

Seafood industry is going to face a major problem with the European Union bringing out a new regulation which intends to prevent, deter and eliminate illegal, unreported and unregulated (IUU) fishing. This regulation demands a 'Catch Certificate' to accompany every health certificate to be signed by a competent authority and a person authorised by the Govt. of India whose signature is approved by the European Commission. In this regard,

- A system may be introduced to certify sustainable fishing methods and to ecolabel fish and fishery products by authorised agencies.
- Stakeholders have to be sensitized with regard to emerging non-tariff barriers (standard, testing, labelling and certification requirements) in global fish trade and need for adoption of sustainable fishing/fish farming activities.

12. Introduction of HACCP and value addition technologies

Following recommended scientific procedures from the time of capture of fish for preserving and storage would add value to the fishery products. Also, a wide array of value added products can be prepared by trained fishermen groups. Wastes generated during the processing can also be used for production of items like fish silage for use as cattle feed/ plant manures. The suggested options are:

- Ensure hygienic conditions and suitable infrastructure in fishing harbours / landing centres and fish markets.
- Training programmes for fishermen groups in on-board fish catch handling, value-addition and utilisation of wastes during processing.

13. Climate change and its impact on marine ecosystem

Climatic aberrations are proved to affect coastal communities by causing cyclones/storms, coastal erosion, loss of man days at sea and availability of fish resources by affecting their abundance and distribution patterns. Hence

conservation of marine ecosystem should be promoted in the society at large and fishermen in particular. The options worth consideration are:

- Sensitisation of all stakeholders on the challenges likely to arise from climate change-induced sea level rise and other impacts on the fisheries sector should be done.
- Evolve weather watch groups for fisheries sector and develop contingency plans for weather related risks to the fishing communities
- Energy efficient and fuel saving fishing technologies (LPG/solar energy sources) to be promoted which will also reduce CO₂ emissions.
- Protection of coastal areas and mangroves to be given priority.

14. Capture based aquaculture technologies and Fish Aggregating Devices (FADs) for the traditional fisherfolk communities

Large scale collection of juveniles of fish such as milkfish, mullets, sea bass, juveniles and brooders of shell fishes such as prawns and crabs, spats of mussels, berried lobsters and ornamental fishes have a direct bearing on the fish stock and should be discouraged. However, many juveniles are caught live by traditional fishermen operating shore seines and other gears in inshore waters which can be effectively used for fattening in floating cages by feeding them trash fish. FADs which are known to aggregate fishes may be deployed for benefit of small coastal fisher communities displaced by the motorised/mechanised sector for inclusive development of the fishermen community. The suggested options are:

- Promotion of capture based aquaculture in floating cages or pens maintained by fishermen communities.
- Limited number of FADs managed by traditional fishermen community with restrictions on all fishing methods except by hooks and line.
- Formulation of a coastal water use policy.

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