

# **UN Global Marine Assessment – Food Security- India**

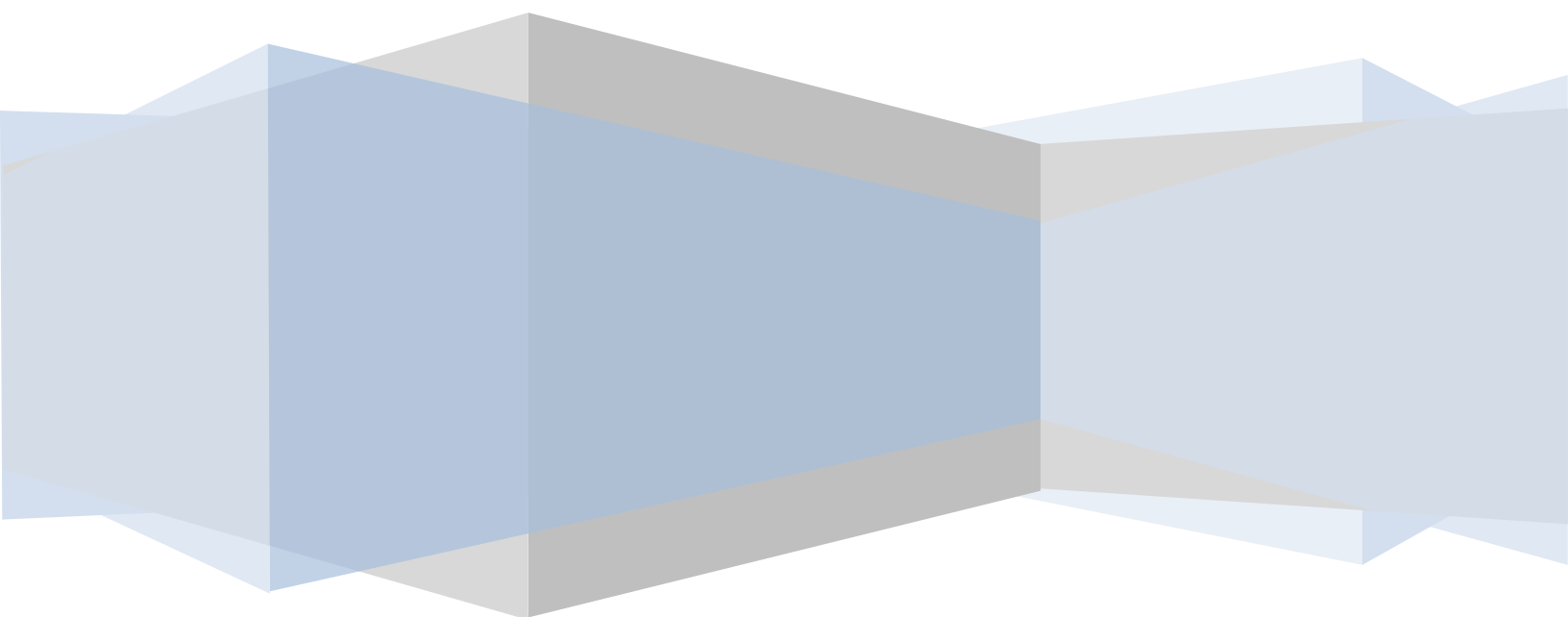
**Report for the Workshop –January 2014, Chennai,  
India**

**Submitted by**

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# **Report on the Assessments made under the theme Marine Food Security for the UN Global Marine Assessment Northern Indian Ocean Region**

**Country: India**

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## **Executive summary of the major assessments made in India under the theme : Food Security**

**Marine Fishery Catch Assessment:** A regular assessment of the Indian marine fishery landings from 9 maritime states and 2 UTs made through daily field observations in 1511 landing centres. The national estimate is based on stratified multistage random sampling design made on spatio-temporal basis. The observations cover about 25 craft-gear combinations and resources are recorded as per a code. There are 1155 coded species in the database. The database from 1959 is in digital format

**National census of marine fishers, crafts and gears .** A national level enumeration of the marine fishermen households were carried out in 1980, 2005 and 2010. The details on marine fishing villages, fish landing centers and fishermen population, infrastructure available, the number of fishing craft and gear with individual fishermen and other details are collected through trained enumerators. Database of marine fisheries census 2005 and 2010 are in digital format. Assessment is made every 5-year .

**Stock assessments** of all major pelagic (29 stocks); demersal (32 stocks); crustacean (6 stocks) and mollusc (5 stocks) stocks on regional and maritime state platform have been made. Length Based Micro Models are used for these assessments.

**Status of fished stocks :** On a national basis the fish stocks have been classified into abundant , less abundant and collapsed) of different resource groups based on last three years (2008-10) average landings and maximum annual landings observed during the period 1950-2010.

**The trawl catch and by catch** was estimated and an analysis made in 2011 has shown that the edible portion of trawl catch was 62%, landed low value by-catch as 25% and discarded by catch as 13%. Assessments of Low value by catch is made at a national level.

**Fisheries Ecosystem Assessments :**The Gulf of Mannar, Northwest Coast (NWC) and the Arabian Sea off Karnataka have been modeled using trophic interactions(Ecopath Models).

**Environment & Habitat Assessments:** Habitat degradation due to anthropogenic activities assessed. Coding of marine litter as per UNEP guidelines started. Mercury and arsenic in the tissue of 68 species of marine finfishes/shellfishes covering all trophic levels were analyzed and were found to be safe for consumption.

**Oceanic Resource Assessment: Fishery for oceanic resources** not established. The potential of oceanic resources including tuna, billfishes and allied species, was estimated as 208,000 t. This comprises of yellow fin tuna (80,000 t), skipjack tuna (99000 t), big eye tuna (500 t), billfishes (5900 t), pelagic sharks (20800 t) and other species (1800 t).

**Mariculture Assessments** The ecological and environmental impacts of commercial and experimental mariculture activities are assessed through planned projects or opportunistically. Socio-economic impacts are also assessed.

**Socio-economic Assessments.** Craft/gear economic efficiency assessments are made annually at a regional level. Other assessments include-the income analysis, Market network surveys, price analysis fish consumption assessment and factor productivity analysis for assessment of sectorial investment

**Climate Change Impact Assessments :** Vulnerability of coastal states ,fish phenology and fish distribution have been made based on past biological data and fishery observations. Estimates of carbon foot print of fishing industries ad estimates of carbon sequestration potential of seaweeds have also been made

**Other one-off Assessments :** As and d hen required specific assessments have been made such as -impact assessment of seasonal fishing/trawling bans, Impact assessment of destructive fishing practices and manmade mishaps (eg oil pollution)/ natural disasters (tsunami)

## PART -1

### Outline of Marine Assessments carried out in the India

#### Background information on the assessments made in the Marine Sector

*Prepared by Central Marine Fisheries Research Institute (CMFRI) under the Indian Council of Agricultural Research (ICAR), Ministry of Agriculture (MoA), for the United Nations workshop in support of the Regular Process for Global Reporting and Assessment of state of the Marine Environment including Socio-economic aspects.*

#### Introduction

The marine environment and the resources thereof have provided food and livelihood security to millions of coastal villagers for several decades. Technological developments made in fishing harvesting, post harvest processing, market chains and mariculture have supported the growth of food production in the fisheries sector. The marine fisheries catch has increased from 0.5 million tonnes in 1950 to an estimated 3.9 million tonnes in 2012.

The CMFRI is mandated to assesses the fishery landing all along the east and west coast and in the Lakshadweep Islands. Realizing the importance of a reliable database in fish stock

#### Box -1

##### Regional Assessment of

**Fisheries :** CMFRI was an active participant in a Regional program. The “Fisheries Resource Information System and Tools” (FiRST) was developed through a regional collaborative effort across eight South and Southeast Asian counties to meet these needs.. A regional database was developed. ‘TrawlBase’, which contains more than 20,000 hauls or stations from scientific trawl surveys in 10 countries conducted between 1926 and 1995.

assessment and fisheries management, the Institute initiated the process of collection of data on catch and effort along with other biological parameters based on scientific principles in 1947.

Since its formation, the CMFRI has conducted dedicated Research and Development programs to understand and assess the fishery and biological aspects of the major resources in the Seas around the country.

Concurrently, focused evaluations on the marine pollution, habitat degradations, socio-economics and the impacts of climate change on the marine environment and the resources has also been made. To increase food production, suitable mariculture technologies have been developed and the annual productions from commercial farms are estimated. To safeguard the ecosystem, periodically environment impact assessments of farming sites have also been made.

#### **Box 2**

#### **Regional Capacity Building**

**Program :** The CMFRI has also organized capacity building programs on Fisheries Data collection and in basics of stock assessment for members of neighbouring countries under the Bay of Bengal Large Marine Ecosystem (BOBLME) program in 2011

A brief outline of the assessments made in the marine sector for food security are given below.

### **1. Marine Fishery Catch Assessment**

- 9 maritime states and 2 union territories divided into 140 zones covering 1511 landing centres
- Estimate based on stratified multistage random sampling design. Detail of methodology available at <http://eprints.cmfri.org.in/4053/>
- Estimates are made based on spatio-temporal basis
- Reporting
  - Time



- Daily (see <http://cmfri.org.in/fishwatch.html> )
- Weekly
- Monthly
- Quarterly
- Annually (see <http://cmfri.org.in/annual-data.html> )
- Space
  - Zone
  - District
  - State / UT
  - Region (NW, SW, NE, SE)
  - National
- Craft & Gear
  - About 25 craft-gear combinations
- Taxonomic Resolution
  - Phylum: Class: Order: Family: Genus: Species (1155 coded species in database)
- Database from 1959 in digital format

### **Salient Inferences from Marine Fishery Catch Assessments**

Distributed along the 8129 km coastline of the Indian Sub continent are 3,288 fishing villages with a population of 3.9 million fishers of which 0.9 million are active fishers. India today has  $2.02 \times 10^6$  sq. km sea area, comprising  $0.86 \times 10^6$  sq.km on the west coast (including the Lakshadweep Sea),  $0.56 \times 10^6$  sq. km on the east coast and  $0.60 \times 10^6$  sq. km around the Andaman and Nicobar Islands.

- The Indian marine fisheries have witnessed a phenomenal growth during the last six decades. The annual landings during the early 50's was estimated as 0.5 million tonnes annually which increased in the subsequent decades and fluctuated between 2.3 to 3.3 million tones during the period 1990-2010 and reached an all time peak of 3.9 million t by 2012.
- The potential yield of the Indian EEZ has been revalidated as 4.42 million tonnes in 2012.
- Some salient points of Indian Marine Fisheries Sector is given below

- Gross value of Indian Marine Fisheries is estimated as US\$ 2.8 billion
  - The Export Value is US\$ 1.6 billion
  - Contributes to 3% total exports
  - Domestic markets- 81% fresh; 5% frozen, 6% dry; 5% fish meal
  - Per capita fish consumption is 2.58 kg (range 39 – 0.3)
  - Share in GDP is 1% ; Share in agricultural GDP is 4%
  - 1million active fishers
- There are 1511 fish landing centers in the country apart from the 26 major fishing harbours and 38 nos of minor fishing harbours
  - The catch landed by different types of fishing vessels such as mechanized vessels (72,559 nos), motorised vessels (71,313 nos) and non-motorised vessels (50,618 nos) are monitored and assessed. Sector wise contribution to all India marine landings of 2012 indicate dominance of mechanized vessels catching 30.8 lakh tonnes (78%) followed by motorized vessels with a catch contribution of 7.8 lakh tonnes (20%) and non-motorized vessels contributing a meager 0.8 lakh tones(2.2%)
  - Important resources that contributed to the total landings of 2012 are oil sardine (18.2%), perches (8.6%), penaeid prawns (6.4%), ribbon fishes and (6%) and perches (5.5).
  - In a recent analysis done by CMFRI, it was observed that among 667 species landed in the country in 2012 only 16 species were landed in all states/Union Territories and 248 species landed in only one of the states/UTs during 2012. Tamil Nadu had the highest diversity fished 404 species followed by Kerala with 366 species.

## **2. Census of marine fishers, crafts and gears – quinquennial/ national**

Complete enumeration of the marine fishermen households covering nine maritime states and 2 Union territories were carried out in 1980, 2005 and 2010.

- Details on marine fishing villages, fish landing centers and fishermen population
- Information on fishermen family, education, occupation and ownership of crafts and gears.

- Infrastructure facilities available in different marine fishing villages and it had sub categories for collecting details of fishing harbour, boat building/repairing yards, ice factories, cold storages, freezing plants , canning plants, curing yards, peeling sheds, oil extraction plants and fish meal plants.
- Fishing crafts and gears existing in the fishery.

#### Reports

- MFIS No.3 in 1978 (<http://eprints.cmfri.org.in/4726/>)
- MFIS No.30, in 1981( <http://eprints.cmfri.org.in/3685/>)
- <http://eprints.cmfri.org.in/5522/>
- <http://eprints.cmfri.org.in/8998/>

Database of marine fisheries census 2005 and 2010 in digital format

### **Salient Inferences from Census of marine fishers, crafts and gears**

An increase of around one lakh fishermen families was noticed in 2010 as compared to 2005.

- Around 6.4 lakh fisher families do not possess any kind of craft, 5.21 lakhs were without any fishing gear and around 5.0 lakhs had neither. These are increments to the tune of 13%, 12% and 11% over the respective fishermen census 2005 figures.
- The number of fisher families wherein only women were involved in fishing and allied activities was 41,000 which was a 17% increase over corresponding 2005 figures. However, the percentage of such families to the total fishermen families remained the same at 5%.
- There are about 864,550 marine fishermen households in the country; 91.3% were traditional fishermen families.
- Nearly 61% of the marine fishermen families in the country (523,691) were Below Poverty Line (BPL).
- About 57.8% of the fisherfolk were educated with different levels of education.
- Among the fishers nearly 15.0% of the males and 13.9% of the females had primary level of education.

- Women were actively involved in allied fishing activities ; Nearly 57.4% of the fisher folk engaged in fish seed collection were females;
- Nearly 81.8% of the fishers engaged in marketing of fish were women
- About 88.1% of the fishers engaged in curing and processing were women and they also formed 89.6% of the fishers engaged in peeling.

### **3. Marine Fish Stock Assessments**

Annual reporting of stock assessments for all major fish stocks in annual reports based on below formats and methods. Long-term assessments published in journals and books

- Stock assessments of all major pelagic (29 stocks); demersal (32 stocks); crustacean (6 stocks) and mollusc (5 stocks) stocks on regional and maritime state platform.
- Macro Models
  - Rapid stock status assessment- Details of methodology available at <http://eprints.cmfri.org.in/7855/>
  - Production models
  - Non-equilibrium production models
  - Potential yield assessments jointly with FSI
- Length Based Micro Models – single species and multi-species
  - Beverton & Holt YPR model
  - Thompson & Bell Predictive model

#### **Salient Inferences from Marine Fish Stock Assessments**

The “Fisheries Resource Information System and Tools” (FiRST) was developed through a regional collaborative effort across eight South and Southeast Asian countries to meet these needs.

- The FiRST software has also facilitated the establishment of a regional database, ‘TrawlBase’, which contains more than 20,000 hauls or stations from scientific trawl surveys in 10 countries conducted between 1926 and 1995.

- The results showed serious decline of resource biomass to an average of 22% of pre-exploitation levels, with cases as low <4%. These results clearly demonstrate the strong impact of fishing on coastal resource biomass and diversity
- Bio-base was developed; All the biological data units from 1985 onwards are in electronic form and are amenable to various type of analysis which result in assessment of stock health at various regions of the country
- Stock assessments of all major pelagic (29 stocks); demersal (32 stocks); crustacean (6 stocks) and mollusc (5 stocks) stocks on regional and maritime state platform have been made.
- General nature of Indian fish stocks which allows high exploitation rates
  - High fecundity ( $\approx 500$  eggs per g body weight),
  - Continuous spawning with extended spawning season with pulses
  - Fast growth rate (K often exceeds 1.0),
  - Abundant spawning stock biomass (more than 50% of standing stock biomass),
  - Quick turnover of generations (1 to 2 years) and
  - Short life span ( $\approx 3$  years)
  -
- Present status some major groups
  - **Clupeids** have reached a peak in landings in the last decade
  - **Mackerel** showed negative growth in the past decade
  - **Catfishes along southwest coast** once declared as collapsed, have shown **signs of revival** in the recent past
  - **Elasmobranchs**, although showed increasing trend couple of decades back have of late started declining
  - **Unicorn cod**, which is a special fishery off North West coast of India, have shown distinct trends of collapse
- On a national basis, classification (abundant , less abundant and collapsed) of different resource groups based on last three years (2008-10) average landings and maximum annual landings observed during the period 1950-2010 showed that:
  - 18 major fishery resources (groups/species) were evaluated as “**Abundant**” ( eels , catfishes, clupeids, Bombay duck, lizard fishes , half and full beaks, perches, goatfishes, croakers, carangids, silver bellies, pomfrets ,mackerels , seer fishes, tunnies, barracudas, crustaceans and molluscs)

- 5 major resources groups/species were classed as **less abundant** (Flat fishes , ribbon fishes, threadfins, mullets and elasmobranchs)
- Flying fish fishery can be considered as ‘Depleting’ and Unicorn fishery as ‘collapsed’
- An estimate of the optimum fleet size based on the best available model indicated that the current fishing fleet is more than the required for the sustainable exploitation of the resources of the Indian EEZ.
- The trawl catch and by catch was estimated and an analysis made in 2011 has shown that the edible portion of trawl catch was 62%, landed low value by-catch as 25% and discarded by catch as 13%.
- Overall analysis of the trawl landing at different centres of Indian coast showed that the Low Value By- catch (LVB) percentage in the total landed fish was 16% in 2008 which has increased to 27% in 2011 and discard percentage is coming down considerably. The low value by catch /discards consists mostly of juveniles of silver bellies, lizard fishes, crabs, stomatopods, ribbon fishes etc.
- State wise (9 maritime states) advisories / plans for management of marine fisheries have been developed.

#### **4. Fisheries Ecosystem Assessments**

- Trophic mass balance (ECOPATH) of major fisheries ecosystems indicating state and well-being of the ecosystem
- Fishery effort and yield simulations (ECOSIM)

#### **Salient Inferences from Environment & Habitat Assessments**

The Gulf of Mannar, Northwest Coast (NWC) and the Arabian Sea off Karnataka have been modeled using trophic interactions. All ecosystems were in the processes of being mature with high degree of overhead. Simulations have been done to look into yields in an increasing effort scenario for the Karnataka model and in an increasing oil sardine biomass scenario in the NWC ecosystem.

#### **5. Environment & Habitat Assessments**

- 5.1. Marine debris & litter – annually/selected areas
- 5.2. Heavy metal pollution - annually/selected areas
- 5.3. Dashboard analysis of habitats - annually/selected areas
- 5.4. Ecologically sensitive habitat assessments – occasional/selected areas

## 5.5 Recruitment strength assessment using DEPM (under development)

### **Salient Inferences from Environment & Habitat Assessments**

Coding of marine litter as per UNEP guidelines started. Observations on micro-plastics in the environment and in the food chain initiated since 2007 and microplastics were observed in the gut of small (eg. Mackerel and Anchovies) and large pelagic (Corypheana and tuna).

- The quantity of litter entering the open coastal waters through a main bar mouth in Kerala was estimated as 2.4 tonnes per annum . Quantity of beach litter was low (less than 100 g per sqm) in Kerala and high (more than 750 g per sqm) is Maharashtra, Tamil Nadu and Andhra Pradesh.
- Mercury and arsenic in the tissue of 68 species of marine finfishes/shellfishes covering all trophic levels were analyzed and were found to be safe for consumption. It was observed that only the apex , migratory and oceanic predator like tuna had slightly higher levels of the these heavy metals because of trophic bioaccumulation.

## **6 Marine Biodiversity Assessments**

The fish diversity of Gulf of Mannar, Enayam (southwest coast), Malvan and Nethrani have been assessed. Also the biodiversity of corals and their health has been assessed through targeted one-off surveys.

Detailed diversity of fishes of the family Carangidae which form a major part of the fished taxa in both the coasts has been studied and pictorially documented.

### 6.1 Iconic/keystone species assessments

- Marine mammals by planned sighting surveys
- Seabirds by planned sighting surveys
- Coral reef diversity using line transect surveys
  - Assessment of coral reef health - annually/selected areas

### 6.2 Taxonomic assessment of major fish families - annually/selected groups

### **Salient Inferences from Biodiversity Assessments**

The fish diversity of Gulf of Mannar, Enayam (southwest coast), Malvan and Nethrani have been assessed. Also the biodiversity of corals and their health has been assessed through targeted one-off surveys.

Detailed diversity of fishes of the family Carangidae which form a major part of the fished taxa in both the coasts has been studied and pictorially documented.

## **7 Oceanic Resource Assessment**

These are not regular programmes, but carried out as intense periodic assessments based on project funding.

- 7.1. Myctophid fish abundance survey
- 7.2. Oceanic squid abundance survey – completed one 3-year assessment recently in the Arabian Sea with output of abundance maps over space and time
- 7.3. Other deepsea fish/shrimp surveys – occasional/ opportunistic

### **Salient Inferences from Oceanic Resource Assessment**

The potential of oceanic resources including tuna, billfishes and allied species, was estimated as 208,000 t. This comprises of yellow fin tuna (80,000 t), skipjack tuna (99000 t), big eye tuna (500 t), billfishes (5900 t), pelagic sharks (20800 t) and other species (1800 t).

Globally, the stock of oceanic squid has been assessed as 3-4 million t and about 1.0 to 1.5 million t of this resource is in central Arabian Sea. Since about 10% of the area of abundance lies within the Indian EEZ, the potential yield from the Indian EEZ has been fixed as 0.1 million t.

Excepting the oceanic resources, the resources beyond 200 m zone are generally of low value and their density is also lower compared to near-shore regions.

## **8 Mariculture Assessments**

The ecological and environmental impacts of commercial and experimental mariculture activities are assessed through planned projects or opportunistically. Socio-economic impacts are also assessed.

- 8.1. Bivalve farming impacts
  - Ecological impacts – benthos, carrying capacity
  - Beneficial socio-economic impacts



- Value chain assessments
- 8.2. Fish culture in cages
  - Fouling community assessments
- 8.3 Natural Seed Abundance Assessments
  - Bivalves – quadrat method in inter and sub-tidal beds
  - Fish/shrimp – net sampler surveys

### **Salient Inferences from Mariculture Assessments**

- Mariculture production assessments showed that mussel and oyster farm production peaked at more than 20,000 t in 2010 and thereafter there has been a decline in mussel production
- The biggest social impact outcome of mussel farming in Kerala was the empowerment of women with 87% of the SHG farms owned by women. The overall impact was improvement in leadership and managerial skills of women and emergence of team spirit within villages.
- Several small business enterprises which supply other inputs for mussel farming were established in mussel farming villages. Approximately 600 tonnes of coir rope worth \$US66,000, cotton cloth worth \$US68,000, and nylon thread worth \$US71,000 were used as inputs in the industry.
- It is estimated that for transportation of seed to farm sites, 368 labor-days were used and for transporting harvested mussel from farm sites to the 14 nearby mussel markets, 2432 labor-days (valued at \$US13,000) were used.
- Environmental Impact assessment of bivalve farming has been done. Though there were variations in the sediment texture and organic carbon content between the farm and the reference sites the impact due to short term oyster farming on these parameters was not significant.
- Among the marine fishermen households 15,674 families were engaged in different aquaculture practices. Among those practicing aquaculture 45.2% were engaged in fish culture, 42.0% in prawn culture, 5.9% in crab culture and 2.0% in mussel culture.
- Fishers engaged in fish culture were maximum in West Bengal (55.7%) and Odisha (31.0%). Fishermen families engaged in prawn culture were maximum in Andhra Pradesh (57.1%), Maharashtra (19.2%) and Odisha (18.7%). Fishermen

families engaged in mussel culture were restricted to Kerala (98.4%) and Karnataka (1.6%).

## **9 Socio-economic Assessments**

- 9.1. Craft/gear economic efficiency assessments – annually
  - Regional
  - State-wise
- 9.2. Socio-economic status of fishers
  - Education/ literacy surveys
  - Income analysis
- 9.3. Market network surveys
  - Price analysis
  - Fish consumption assessment
- 9.4. Factor productivity analysis for assessment of sectorial investment

### **Salient Inferences from Socio-economic Assessments**

- Valuation of marine fish landings at landing centre and retail levels has been done. The estimated value of marine fish landings increased from 14,721 crores in 2007 to Rs.24,890 crores in 2012, registering an annual increase of 11.51% per annum.
- At the point of last sales or the retail market, the gross earnings increased from Rs.24,934 crores to Rs.38,562 recording an increase of 9.11% per annum during the same period.
- The marine fish landings are contributed by many species and a few of them significantly. The analysis of the average contribution of different species over the last six years indicated that penaeid prawns shared about 35 per cent both in the point of first sales and last sales followed by other cluepieds species.
- The capital productivity of all the fishing methods on an average are from 0.60-0.65, which indicates that the fishers are getting about 35 to 40 % above the net operating income to meet the fixed cost and other unforeseen expenses.
- There was structural shift in the capital investment in fishing units from traditional to mechanized units during the period 1997-98 to 2009-10. The private capital investment in fishing equipments increased from 4,117 crores in 1997-98 to 15,163 crores in 2009-10, an increase of about 22% per annum.

- On an average, varieties like non penaeid prawns (97.14% of the consumer rupee), pomfrets (96.42%) and penaeid prawns (90.32 %) gave more than 90% of the consumer rupee to the fishermen indicating an efficient marketing system existing for these premium varieties.

## 10 . Climate Change Impact Assessments

10.1. Vulnerability of coastal states

10.2 Impacts on fish phenology

10.3. Impact of climate change on fish distribution

10.4. Estimates of carbon foot print of fishing industries

10.5 Assessment of perception of fishermen to climate change

10.6 Assessment of ocean acidification on meroplankton

10.7 Estimates of carbon sequestration potential of seaweeds

### Salient Inferences from Climate Change Impact Assessments

- The surface waters of the Indian seas are warming by 0.04 °c per decade, and the warmer tongue (27-28.5 oC) of the surface waters is expanding to latitudes north of 14°N, enabling the oil sardine to ecome more abundant in northern latitudes
- Until the mid 1980s, the oil sardine did not form fishery along the southeast coast. In the 1990s, oil sardine emerged as a major fishery along the southeast coast, with the annual catch recording more than 1 lakh tones
- The Indian mackerel, in addition to extension of northern and boundaries, are found to descend to deeper waters in the last two decades. Analysis of catch from different gears has shown that the distribution of mackerel in the subsurface has increased, and there may be a vertical extension of distribution, and not a distributional shift.
- The threadfin breams *Nemipterus japonicus* and *N. mesoprion* are distributed along the entire Indian coast at depths ranging from 10 to 100 m. Analysis of the female spawners from 1981 to 2004 shows that the percent occurrence of spawners of the two species decreased during the warm months of April-September, but increased in the relatively

cooler months of October-March indicating a shift in spawning period.

- In Indian marine fisheries, the enhanced fishing effort and efficiency in the last five decades has resulted in substantial increase in diesel consumption, equivalent to CO<sub>2</sub> emission of 0.30 million tonnes (mt) in the year 1961 to 3.60 mt in 2010. For every tonne of fish caught, the CO<sub>2</sub> emission has increased from 0.50 to 1.02 t during the period.
- Large differences in CO<sub>2</sub> emission between craft types were observed. In 2010, the larger mechanized boats (with inboard engine) emitted 1.18 t CO<sub>2</sub>/t of fish caught, and the smaller motorized boats (with outboard motor) 0.59 t CO<sub>2</sub>/t of fish caught.
- Among the mechanized craft, the trawlers emitted more CO<sub>2</sub> (1.43 t CO<sub>2</sub>/t of fish) than the gillnetters, bagnetters, seiners, liners and dolnetters (0.56–1.07 t CO<sub>2</sub>/t of fish).
- CO<sub>2</sub> sequestration by the marine planktonic microalgae *Nannochloropsis salina* and *Isochrysis galbana* as well as macroforms *Gracilaria corticata*, *Sargassum polycystum* and *Ulva lactuca* were estimated.

## 11 Other one-off Assessments

- Impact assessment of seasonal fishing/trawling bans
- Impact assessment of destructive fishing practices
- Manmade mishaps (eg oil pollution)/ natural disasters (tsunami)

### Salient Inferences from other one-off Assessments

Based on geographic features, the Tamil Nadu coast along the southeast coast of India can be divided into three systems, namely the Coromandel Coast, Palk Bay and Gulf of Mannar. An assessment was done to evaluate the differences in species composition and numbers between the three regions and, specifically, for detectable effects of the Asian Tsunami of 2004. Nonmetric multi-dimensional scaling (MDS) ordinations displayed differences in species composition among the three regions and also some change in the years after the Tsunami. The latter was confirmed by analysis of similarities (ANOSIM) tests, with the clearest and strongest effects seen on the Coromandel Coast. It is inferred that the Sri Lankan land mass on the eastern side of the Gulf of Mannar and Palk Bay may have offered these regions a degree of protection from the Tsunami impacts.

**PART –II**  
**Information on types of assessment as per format**

<b>Type of Assessment : Marine Fishery Catch Assessment (Section 1)</b>		
	<b>Question</b>	<b>Answer</b>
a.	Agency conducting the specific assessment	CMFRI
b.	Major intended users of the assessment, and the uses for which it was intended	National and State level Fishery Planners and researchers To provide scientific background for policy decisions on fishery management and conservation
c.	Spatial and temporal scale of the assessment, and frequency of assessment cycle	Catch of all fishery resources within Indian EEZ Daily data collection, continuous since 1959
d.	Issues covered by the assessment	Species-wise catch landed by different crafts-gear combinations Magnitude of catch Covering 140 zones and 1511 landing centres Effort expended in fishing hours and boats
e.	Types of data, experimental knowledge, indicators and the reasons for their selection and other information sources contributing to the assessment	Data on catch of different groups of marine resources such as pelagic, demersal, crustacean, molluscan
f.	Where trends of component information sets have been deduced, the methods employed	Sector wise variation in catch (NW, SW, SE, NE) and comparison between catch landed by different gears during seasons deduced. Database in Access format
g.	Where an effort has been made to integrate different types of information, particularly social, economic and ecological information, the extent of, and methods for, such integration	Data integrated with fishery biology data for stock assessment. Data integrated for socio economic analysis by CMFRI Researchers The methodology adopted enables error estimates and CI estimates

h.	Sources of any evaluation benchmarks, reference levels or ecotoxicological assessment criteria used in the assessment	Not applicable
i.	Extent and sources of any forecasts, projections, and scenarios used in the assessment	Potential Yield Estimates
j.	If data-assessment limitations (such as data-extrapolation errors, uncertainties and/or information gaps) were addressed in the assessment, a description of how this was done.	Not applicable
(a)	What types of relevant data or information are known to be collected and managed, and by what State(s) and agencies (this is expected to be the case for some key social and economic data)? What information can be provided about the spatial and temporal coverage and technical content of such data or information?	The fishery data collected for each maritime state is used by the respective state for its fisheries policy planning.
(b)	Where key types of information are not known to exist, can expert knowledge be mobilized to fill the gap and, if so, how can the experts be accessed?	
(c')	Contact details of focal points for the States and intergovernmental organizations to be represented at the workshop	
(d)	Advance notice of identified capacity-building needs	Training on fishery potential estimates through remote sensing or ocean colour indicators

<b>Type of Assessment : Census of fishers, crafts and gears (Section 2)</b>		
	<b>Question</b>	<b>Answer</b>
a.	Agency conducting the specific assessment	CMFRI
b.	Major intended users of the assessment, and the uses for which it was intended	National and State level Fishery Planners and researchers  To provide background for policy decisions on developmental programmes for fisherfolk
c.	Spatial and temporal scale of the assessment, and frequency of assessment cycle	Information on marine fisherfolk, fishing villages, infrastructure facilities available and craft and gear in the fishery along the mainland of Indian EEZ Conducted during 1977, 1980 and five yearly data collection since 2005
d.	Issues covered by the assessment	Socio-economic and occupational status of fisherfolk, infrastructure facilities in the fishing villages, craft and gear used in the fishery
e.	Types of data, experimental knowledge, indicators and the reasons for their selection and other information sources contributing to the assessment	Data on marine fishermen family, education, occupation, ownership of crafts and gears.  Details on marine fishing villages, fish landing centers and infrastructure facilities available in different marine fishing villages.
f.	Where trends of component information sets have been deduced, the methods employed	Principal component analysis and clustering techniques were used for comparison.
g.	Where an effort has been made to integrate different types of information, particularly social, economic and ecological information, the extent of, and methods for, such integration	Prepared detailed reports Accessible in print and on line
h.	Sources of any evaluation benchmarks, reference levels or ecotoxicological	Not applicable

	assessment criteria used in the assessment	
i.	Extent and sources of any forecasts, projections, and scenarios used in the assessment	Not applicable
j.	If data-assessment limitations (such as data-extrapolation errors, uncertainties and/or information gaps) were addressed in the assessment, a description of how this was done.	Not applicable
(a)	What types of relevant data or information are known to be collected and managed, and by what State(s) and agencies (this is expected to be the case for some key social and economic data)? What information can be provided about the spatial and temporal coverage and technical content of such data or information?	The information gathered for each maritime state is used by the respective state for its developmental plans
(b)	Where key types of information are not known to exist, can expert knowledge be mobilized to fill the gap and, if so, how can the experts be accessed?	
(c)	Contact details of focal points for the States and intergovernmental organizations to be represented at the workshop	
(d)	Advance notice of identified capacity-building needs	



<b>Type of assessment : Assessment of stocks biomass of commercially exploited marine resources (Section 3)</b>		
	<b>Question</b>	<b>Answer</b>
a.	Agency conducting the specific assessment	CMFRI
b.	Major intended users of the assessment, and the uses for which it was intended	National and State level Fishery Planners  To provide scientific background for policy decisions on fishery management and conservation
c.	Spatial and temporal scale of the assessment, and frequency of assessment cycle	The stock assessments are at sub national level, usually pertaining to each maritime state  Usually Annual .
d.	Issues covered by the assessment	Estimates of growth and mortality (Fishing mortality, Natural Mortality), Maximum Sustainable Yield, $F_{MSY}$ , $B_{MSY}$
e.	Types of data, experimental knowledge, indicators and the reasons for their selection and other information sources contributing to the assessment	Length based fishery data since the methodology is usually length based population assessment models
f.	Where trends of component information sets have been deduced, the methods employed	In some instances the stocks are categorized into abundant, less exploited, overexploited and depleted.
g.	Where an effort has been made to integrate different types of information, particularly social, economic and ecological information, the extent of, and methods for, such integration	The data generated herein are used in ecological modeling
h.	Sources of any evaluation benchmarks, reference levels or ecotoxicological assessment criteria used in the assessment	Biological Reference Points (BPRs) used
i.	Extent and sources of any forecasts,	In some resources, forecasts are

	projections, and scenarios used in the assessment	made
j.	If data-assessment limitations (such as data-extrapolation errors, uncertainties and/or information gaps) were addressed in the assessment, a description of how this was done.	Uncertainties in estimates and assessment data is addressed by taking a precautionary approach while formulating management plans.
(a)	What types of relevant data or information are known to be collected and managed, and by what State(s) and agencies (this is expected to be the case for some key social and economic data)? What information can be provided about the spatial and temporal coverage and technical content of such data or information?	The data especially those related to spawning and recruitment are used for planning fishing ban period
(b)	Where key types of information are not known to exist, can expert knowledge be mobilized to fill the gap and, if so, how can the experts be accessed?	
(c')	Contact details of focal points for the States and intergovernmental organizations to be represented at the workshop	
(d)	Advance notice of identified capacity-building needs	

<b>Type of assessment : Fisheries Ecosystem Assessments</b>		
<b>4.Ecological Models</b>		
	<b>Question</b>	<b>Answer</b>
a.	Agency conducting the specific assessment	CMFRI,
b.	Major intended users of the assessment, and the uses for which it was intended	Fishers, Central and State level Planning Commissions and Policy formulation bodies
c.	Spatial and temporal scale of the assessment, and frequency of assessment cycle	National Sub national One time assessment during 2004 to 2012
d.	Issues covered by the assessment	Ecological model of the fisheries ecosystem
e.	Types of data, experimental knowledge, indicators and the reasons for their selection and other information sources contributing to the assessment	Fisheries and ecological data
f.	Where trends of component information sets have been deduced, the methods employed	ECOPATH modeling using differential equations
g.	Where an effort has been made to integrate different types of information, particularly social, economic and ecological information, the extent of, and methods for, such integration	Takes into account all living organisms in the ecosystem integrated over time and linked through diets
h.	Sources of any evaluation benchmarks, reference levels or ecotoxicological assessment criteria used in the assessment	Pedigree index based on how much model is rooted in original data
i.	Extent and sources of any forecasts, projections, and scenarios used in the assessment	Simulations with ECOSIM results in predictions over time with different scenarios
j.	If data-assessment limitations (such as data-extrapolation errors, uncertainties and/or information gaps) were addressed in the assessment, a description of how this was done.	In data deficient situations, ecological data from other similar situations
(a)	What types of relevant data or information are known to be collected and managed, and by what State(s) and	Estimated of fleet operations taken into account

	agencies (this is expected to be the case for some key social and economic data)? What information can be provided about the spatial and temporal coverage and technical content of such data or information?	
(b)	Where key types of information are not known to exist, can expert knowledge be mobilized to fill the gap and, if so, how can the experts be accessed?	Simulations are advanced in developed countries
(c')	Contact details of focal points for the States and intergovernmental organizations to be represented at the workshop	
(d)	Advance notice of identified capacity-building needs	

<b>Type of assessment : Environment and habitat Assessment) (Section5 : 5.1 Marine Litter)</b>		
	<b>Question</b>	<b>Answer</b>
a.	Agency conducting the specific assessment	CMFRI
b.	Major intended users of the assessment, and the uses for which it was intended	Planners, Environment and Conservation agencies
c.	Spatial and temporal scale of the assessment, and frequency of assessment cycle	National Sub national Continuous since 2007
d.	Issues covered by the assessment	Quantitative assessment of litter in the coastal waters
e.	Types of data, experimental knowledge, indicators and the reasons for their selection and other information sources contributing to the assessment	Qualitative information (different types of litter) Quantity per unit areas
f.	Where trends of component information sets have been deduced, the methods employed	
g.	Where an effort has been made to integrate different types of information, particularly social, economic and ecological information, the extent of, and methods for, such integration	Yes, Through planned surveys
h.	Sources of any evaluation benchmarks, reference levels or ecotoxicological assessment criteria used in the assessment	WHO standerds
i.	Extent and sources of any forecasts, projections, and scenarios used in the assessment	Indicative assessment of waste regulating by civic bodies being developed.
j.	If data-assessment limitations (such as data-extrapolation errors, uncertainties and/or information gaps) were addressed in the assessment, a description of how this was done.	
(a)	What types of relevant data or information are known to be collected and managed, and by what State(s) and	

	agencies (this is expected to be the case for some key social and economic data)? What information can be provided about the spatial and temporal coverage and technical content of such data or information?	
(b)	Where key types of information are not known to exist, can expert knowledge be mobilized to fill the gap and, if so, how can the experts be accessed?	
(c')	Contact details of focal points for the States and intergovernmental organizations to be represented at the workshop	
(d)	Advance notice of identified capacity-building needs	

<b>Type of assessment : Environment and habitat Assessments (Section 5.2 to 5.5 Heavy metal pollution, dash board analysis, ecologically sensitive habitats)</b>		
	<b>Question</b>	<b>Answer</b>
a.	Agency conducting the specific assessment	CMFRI,
b.	Major intended users of the assessment, and the uses for which it was intended	Planners, Environment and Conservation agencies
c.	Spatial and temporal scale of the assessment, and frequency of assessment cycle	National Sub national Continuous since 2007
d.	Issues covered by the assessment	Whether the Indian seafood is safe with respect to mercury and arsenic What is the water quality of coastal habitats? What is the primary and secondary productivity of coastal waters
e.	Types of data, experimental knowledge, indicators and the reasons for their selection and other information sources contributing to the assessment	Levels of mercury and arsenic in different species of marine fin fishes and shellfishes Levels of mercury and arsenic in the sediment and water Levels of nutrients, TSS, chlorophyll, dissolved oxygen and ammonia. Whether water quality is good or bad based on WHO standards. Qualitative and quantitative information on the phytoplankton and zooplankton Ecologically sensitive habitat (Mangrove, Sea grass beds etc) assessments
f.	Where trends of component information sets have been deduced, the methods employed	Awareness publications of interim results
g.	Where an effort has been made to integrate different types of information, particularly social, economic and ecological information, the extent of, and methods for, such integration	

h.	Sources of any evaluation benchmarks, reference levels or ecotoxicological assessment criteria used in the assessment	Levels set of heavy metal pollution by WHO
i.	Extent and sources of any forecasts, projections, and scenarios used in the assessment	
j.	If data-assessment limitations (such as data-extrapolation errors, uncertainties and/or information gaps) were addressed in the assessment, a description of how this was done.	
(a)	What types of relevant data or information are known to be collected and managed, and by what State(s) and agencies (this is expected to be the case for some key social and economic data)? What information can be provided about the spatial and temporal coverage and technical content of such data or information?	
(b)	Where key types of information are not known to exist, can expert knowledge be mobilized to fill the gap and, if so, how can the experts be accessed?	
(c')	Contact details of focal points for the States and intergovernmental organizations to be represented at the workshop	
(d)	Advance notice of identified capacity-building needs	



**Type of Assessment : Marine Biodiversity  
(Section 6.1 Iconic keystone species assessments)**

	<b>Question</b>	<b>Answer</b>
a.	Agency conducting the specific assessment	CMFRI
b.	Major intended users of the assessment, and the uses for which it was intended	Ministry of Environment and Forests Planners
c.	Spatial and temporal scale of the assessment, and frequency of assessment cycle	National and sub national
d.	Issues covered by the assessment	Marine mammals of the Arabian Sea and Bay of Bengal Sea birds occurring in this region Types of corals
e.	Types of data, experimental knowledge, indicators and the reasons for their selection and other information sources contributing to the assessment	Data on marine mammal / sea bird sighting, Stranding of marine mammal  Time and number
f.	Where trends of component information sets have been deduced, the methods employed	
g.	Where an effort has been made to integrate different types of information, particularly social, economic and ecological information, the extent of, and methods for, such integration	Yes
h.	Sources of any evaluation benchmarks, reference levels or ecotoxicological assessment criteria used in the assessment	No
i.	Extent and sources of any forecasts, projections, and scenarios used in the assessment	
j.	If data-assessment limitations (such as data-extrapolation errors, uncertainties and/or information gaps) were addressed in the assessment, a description of how this was done.	

(a)	What types of relevant data or information are known to be collected and managed, and by what State(s) and agencies (this is expected to be the case for some key social and economic data)? What information can be provided about the spatial and temporal coverage and technical content of such data or information?	
(b)	Where key types of information are not known to exist, can expert knowledge be mobilized to fill the gap and, if so, how can the experts be accessed?	Marine mammal/sea bird abundance estimates are not known. Expertise available in USA
(c')	Contact details of focal points for the States and intergovernmental organizations to be represented at the workshop	NOAA
(d)	Advance notice of identified capacity-building needs	Collaboration with USA

**Type of Assessment : Marine Biodiversity  
(Section 6.2 Taxonomic assessments of major finfish families)**

	<b>Question</b>	<b>Answer</b>
a.	Agency conducting the specific assessment	CMFRI
b.	Major intended users of the assessment, and the uses for which it was intended	Researchers /Academicians
c.	Spatial and temporal scale of the assessment, and frequency of assessment cycle	National 2007 to 2012
d.	Issues covered by the assessment	Species in the family Carangidae
e.	Types of data, experimental knowledge, indicators and the reasons for their selection and other information sources contributing to the assessment	Description of species Morphometric and meristic characters Geographic distribution
f.	Where trends of component information sets have been deduced, the methods employed	Not applicable
g.	Where an effort has been made to integrate different types of information, particularly social, economic and ecological information, the extent of, and methods for, such integration	
h.	Sources of any evaluation benchmarks, reference levels or ecotoxicological assessment criteria used in the assessment	
i.	Extent and sources of any forecasts, projections, and scenarios used in the assessment	
j.	If data-assessment limitations (such as data-extrapolation errors, uncertainties and/or information gaps) were addressed in the assessment, a description of how this was done.	
(a)	What types of relevant data or information are known to be collected and managed, and by what State(s) and agencies (this is expected to be the case for some key social and economic data)?	

	What information can be provided about the spatial and temporal coverage and technical content of such data or information?	
(b)	Where key types of information are not known to exist, can expert knowledge be mobilized to fill the gap and, if so, how can the experts be accessed?	Species status according to IUCN guidelines
(c')	Contact details of focal points for the States and intergovernmental organizations to be represented at the workshop	IUCN
(d)	Advance notice of identified capacity-building needs	Collaboration with IUCN

<b>Type of assessment : Oceanic Fishery Resources</b>		
<b>7.1 and 7.3 - Myctophid Resources, deep sea shrimps/ fishes</b>		
	<b>Question</b>	<b>Answer</b>
a.	Agency conducting the specific assessment	CMFRI
b.	Major intended users of the assessment, and the uses for which it was intended	Fishers and planners
c.	Spatial and temporal scale of the assessment, and frequency of assessment cycle	Since 2000 No fixed cruise plans
d.	Issues covered by the assessment	Areas of occurrence Biology of important resources
e.	Types of data, experimental knowledge, indicators and the reasons for their selection and other information sources contributing to the assessment	Depthwise data (upto 1000m) Biology data Food and prey organisms
f.	Where trends of component information sets have been deduced, the methods employed	No
g.	Where an effort has been made to integrate different types of information, particularly social, economic and ecological information, the extent of, and methods for, such integration	
h.	Sources of any evaluation benchmarks, reference levels or ecotoxicological assessment criteria used in the assessment	
i.	Extent and sources of any forecasts, projections, and scenarios used in the assessment	
j.	If data-assessment limitations (such as data-extrapolation errors, uncertainties and/or information gaps) were addressed in the assessment, a description of how this was done.	Insufficient cruise time resulting in scanty data
(a)	What types of relevant data or information are known to be collected and managed, and by what State(s) and agencies (this is expected to be the case	

	for some key social and economic data)? What information can be provided about the spatial and temporal coverage and technical content of such data or information?	
(b)	Where key types of information are not known to exist, can expert knowledge be mobilized to fill the gap and, if so, how can the experts be accessed?	Abundance estimates Appropriate fishing methods Techno –economic feasibility
(c')	Contact details of focal points for the States and intergovernmental organizations to be represented at the workshop	SEAFDEC
(d)	Advance notice of identified capacity-building needs	

<b>Type of assessment : Oceanic Fishery Resources</b>		
<b>7.2 - Oceanic Squid Resources Assessment</b>		
	<b>Question</b>	<b>Answer</b>
a.	Agency conducting the specific assessment	CMFRI,FSI
b.	Major intended users of the assessment, and the uses for which it was intended	Fishers and planners
c.	Spatial and temporal scale of the assessment, and frequency of assessment cycle	Central Arabian Sea 2009 to 2012 Non monsoon period
d.	Issues covered by the assessment	Biomass and abundance of oceanic squid Areas of occurrence Biology of the resource Plankton of the area
e.	Types of data, experimental knowledge, indicators and the reasons for their selection and other information sources contributing to the assessment	Biology of the oceanic squid Biomass of the resources Experimental squid jigging Fishing technique which will give maximum CPUE
f.	Where trends of component information sets have been deduced, the methods employed	Final project report in preparation
g.	Where an effort has been made to integrate different types of information, particularly social, economic and ecological information, the extent of, and methods for, such integration	Ecological information of the experimental fishing area has been collected
h.	Sources of any evaluation benchmarks, reference levels or ecotoxicological assessment criteria used in the assessment	Baseline surveys were conducted prior to project initiation
i.	Extent and sources of any forecasts, projections, and scenarios used in the assessment	Created abundance maps Appropriate gear for exploitation has been identified
j.	If data-assessment limitations (such as data-extrapolation errors, uncertainties and/or information gaps) were addressed	NA

	in the assessment, a description of how this was done.	
(a)	What types of relevant data or information are known to be collected and managed, and by what State(s) and agencies (this is expected to be the case for some key social and economic data)? What information can be provided about the spatial and temporal coverage and technical content of such data or information?	. Assessment by Russian /Chinese are available in scientific publications
(b)	Where key types of information are not known to exist, can expert knowledge be mobilized to fill the gap and, if so, how can the experts be accessed?	This is a new fishery development issue with appropriate Government schemes
(c')	Contact details of focal points for the States and intergovernmental organizations to be represented at the workshop	
(d)	Advance notice of identified capacity-building needs	



**Type of assessment : Mariculture Assessments****Section 8.1 Impact Bivalve farming on environment, society and women empowerment**

	<b>Question</b>	<b>Answer</b>
a.	Agency conducting the specific assessment	CMFRI
b.	Major intended users of the assessment, and the uses for which it was intended	Planners
c.	Spatial and temporal scale of the assessment, and frequency of assessment cycle	Sub national One- off assessments (as and when the need arises)
d.	Issues covered by the assessment	Impact of suspended bivalve farming on hydrology, sediment texture, benthic community Carrying capacity in farming areas Development of ancillary industries Utilization of profit by women farmers How women are empowered
e.	Types of data, experimental knowledge, indicators and the reasons for their selection and other information sources contributing to the assessment	EIA data based on planned sampling in commercial and experimental farms  Socio-economic data
f.	Where trends of component information sets have been deduced, the methods employed	
g.	Where an effort has been made to integrate different types of information, particularly social, economic and ecological information, the extent of, and methods for, such integration	Frame surveys were conducted covering social and economic criteria Integrated with productivity data
h.	Sources of any evaluation benchmarks, reference levels or ecotoxicological assessment criteria used in the assessment	Benchmark socio-economic survey carried out prior to implementation of one World Bank project in 2009
i.	Extent and sources of any forecasts, projections, and scenarios used in the	

	assessment	
j.	If data-assessment limitations (such as data-extrapolation errors, uncertainties and/or information gaps) were addressed in the assessment, a description of how this was done.	
(a)	What types of relevant data or information are known to be collected and managed, and by what State(s) and agencies (this is expected to be the case for some key social and economic data)? What information can be provided about the spatial and temporal coverage and technical content of such data or information?	
(b)	Where key types of information are not known to exist, can expert knowledge be mobilized to fill the gap and, if so, how can the experts be accessed	
(c')	Contact details of focal points for the States and intergovernmental organizations to be represented at the workshop	
(d)	Advance notice of identified capacity-building needs	

**Type of assessment : Mariculture Assessments**

**(Section 8.2 Assessment of feasibility of cage farming coastal water)**

	<b>Question</b>	<b>Answer</b>
a.	Agency conducting the specific assessment	CMFRI
b.	Major intended users of the assessment, and the uses for which it was intended	Planners and farmers
c.	Spatial and temporal scale of the assessment, and frequency of assessment cycle	Sub national Different inshore areas
d.	Issues covered by the assessment	Survival and growth of farmed species Production rates Input estimates
e.	Types of data, experimental knowledge, indicators and the reasons for their selection and other information sources contributing to the assessment	Growth rates FCR Production Mortality rates
f.	Where trends of component information sets have been deduced, the methods employed	
g.	Where an effort has been made to integrate different types of information, particularly social, economic and ecological information, the extent of, and methods for, such integration	
h.	Sources of any evaluation benchmarks, reference levels or ecotoxicological assessment criteria used in the assessment	
i.	Extent and sources of any forecasts, projections, and scenarios used in the assessment	
j.	If data-assessment limitations (such as data-extrapolation errors, uncertainties and/or information gaps) were addressed in the assessment, a description of how this was done.	
(a)	What types of relevant data or information are known to be collected	

	and managed, and by what State(s) and agencies (this is expected to be the case for some key social and economic data)? What information can be provided about the spatial and temporal coverage and technical content of such data or information?	
(b)	Where key types of information are not known to exist, can expert knowledge be mobilized to fill the gap and, if so, how can the experts be accessed?	
(c')	Contact details of focal points for the States and intergovernmental organizations to be represented at the workshop	
(d)	Advance notice of identified capacity-building needs	

<b>Type of assessment : Socio economics of marine fisheries (Section.9 )</b>		
	<b>Question</b>	<b>Answer</b>
a.	Agency conducting the specific assessment	CMFRI
b.	Major intended users of the assessment, and the uses for which it was intended	Fishers, Central and State level Planning Commissions and Policy formulation bodies
c.	Spatial and temporal scale of the assessment, and frequency of assessment cycle	sub national Periodic Detailed assessment once in 5 years
d.	Issues covered by the assessment	Socio Economic - age, literacy, occupation, income status, ownership status, consumption and expenditure Impact assessment like change in the standard of living before and after the introduction of an innovation, technology or any other new management measure
e.	Types of data, experimental knowledge, indicators and the reasons for their selection and other information sources contributing to the assessment	Cross section data on the socio economic parameters State Planning Boards and State Department of Statistics provide the secondary information on the demographical, geographical and related features.
f.	Where trends of component information sets have been deduced, the methods employed	
g.	Where an effort has been made to integrate different types of information, particularly social, economic and ecological information, the extent of, and methods for, such integration	Serves as the base upon which the studies are developed. For e-g, the extent of damage helps to demarcate low, medium and highly affected areas
h.	Sources of any evaluation benchmarks, reference levels or ecotoxicological assessment criteria used in the assessment	The information available for a particular year, fixed as a benchmark is traced from the available

		source of data or studies. In some cases, we conduct the bench mark study first project year and evaluate at the end of the project period.
i.	Extent and sources of any forecasts, projections, and scenarios used in the assessment	We create a few scenarios in the assessment like with our without a particular technology or advancement.
j.	If data-assessment limitations (such as data-extrapolation errors, uncertainties and/or information gaps) were addressed in the assessment, a description of how this was done.	The limitations in data, if it is time series, by using numerical analysis like interpolation and extrapolation. In some cases, we use the ratio or index developed by the earlier researcher as a co-efficient in our present analysis model.
(a)	What types of relevant data or information are known to be collected and managed, and by what State(s) and agencies (this is expected to be the case for some key social and economic data)? What information can be provided about the spatial and temporal coverage and technical content of such data or information?	The available compiled information at national level (collected during the census 1980, 2005, 2010) can be provided.
(b)	Where key types of information are not known to exist, can expert knowledge be mobilized to fill the gap and, if so, how can the experts be accessed?	
(c')	Contact details of focal points for the States and intergovernmental organizations to be represented at the workshop	
(d)	Advance notice of identified capacity-building needs	Advanced Impact Assessment methodologies

<b>Type of Assessment : Climate Change (Section 10 )</b>		
	<b>Question</b>	<b>Answer</b>
a.	Agency conducting the specific assessment	CMFRI
b.	Major intended users of the assessment, and the uses for which it was intended	Planners, Disaster management Departments, Sub national and national
c.	Spatial and temporal scale of the assessment, and frequency of assessment cycle	Sub national One time
d.	Issues covered by the assessment	Vulnerability of coastal villages to sea level rise How SST variation has affected fish distribution and biology Carbon emissions from fishing vessels Perception of fishermen to climate change
e.	Types of data, experimental knowledge, indicators and the reasons for their selection and other information sources contributing to the assessment	Methods mentioned in Climate change studies Social and biological type of data
f.	Where trends of component information sets have been deduced, the methods employed	
g.	Where an effort has been made to integrate different types of information, particularly social, economic and ecological information, the extent of, and methods for, such integration	Information based on social aspects and fish catch and biology were used  Special proformas were designed to collect data related to perception on climate change
h.	Sources of any evaluation benchmarks, reference levels or ecotoxicological assessment criteria used in the assessment	Census data was used
i.	Extent and sources of any forecasts, projections, and scenarios used in the assessment	
j.	If data-assessment limitations (such as	

	data-extrapolation errors, uncertainties and/or information gaps) were addressed in the assessment, a description of how this was done.	
(a)	What types of relevant data or information are known to be collected and managed, and by what State(s) and agencies (this is expected to be the case for some key social and economic data)? What information can be provided about the spatial and temporal coverage and technical content of such data or information?	
(b)	Where key types of information are not known to exist, can expert knowledge be mobilized to fill the gap and, if so, how can the experts be accessed?	
(c')	Contact details of focal points for the States and intergovernmental organizations to be represented at the workshop	
(d)	Advance notice of identified capacity-building needs	



**Type of assessment : One time Assessment**  
**Section 11.1 Impact Assessment of seasonal fishing/trawling**

	<b>Question</b>	<b>Answer</b>
a.	Agency conducting the specific assessment	CMFRI
b.	Major intended users of the assessment, and the uses for which it was intended	Fishers, Central and State level Planning Commissions and Policy formulation bodies
c.	Spatial and temporal scale of the assessment, and frequency of assessment cycle	National/ Sub national
d.	Issues covered by the assessment	Impact of fisheries management policies on resources and various stakeholders
e.	Types of data, experimental knowledge, indicators and the reasons for their selection and other information sources contributing to the assessment	Fish catch data Fishery biology data CPUE data
f.	Where trends of component information sets have been deduced, the methods employed	Yes, statistical models including ARIMA
g.	Where an effort has been made to integrate different types of information, particularly social, economic and ecological information, the extent of, and methods for, such integration	Yes, stakeholder view analysis
h.	Sources of any evaluation benchmarks, reference levels or ecotoxicological assessment criteria used in the assessment	Biological Reference Points
i.	Extent and sources of any forecasts, projections, and scenarios used in the assessment	CPUE trends Overcapacity analysis
j.	If data-assessment limitations (such as data-extrapolation errors, uncertainties and/or information gaps) were addressed in the assessment, a description of how this was done.	
(a)	What types of relevant data or information are known to be collected	Socio-economic data from State planning boards

	and managed, and by what State(s) and agencies (this is expected to be the case for some key social and economic data)? What information can be provided about the spatial and temporal coverage and technical content of such data or information?	
(b)	Where key types of information are not known to exist, can expert knowledge be mobilized to fill the gap and, if so, how can the experts be accessed?	
(c')	Contact details of focal points for the States and intergovernmental organizations to be represented at the workshop	
(d)	Advance notice of identified capacity-building needs	

**Type of Assessment :****11.2 Impact Assessment of destructive fishing**

	<b>Question</b>	<b>Answer</b>
a.	Agency conducting the specific assessment	CMFRI
b.	Major intended users of the assessment, and the uses for which it was intended	Fishers
c.	Spatial and temporal scale of the assessment, and frequency of assessment cycle	Sub national Random, as per need
d.	Issues covered by the assessment	Damage to stock Biodiversity /Ecosystem
e.	Types of data, experimental knowledge, indicators and the reasons for their selection and other information sources contributing to the assessment	Fishery catches Fishery Biology CPUE trends
f.	Where trends of component information sets have been deduced, the methods employed	
g.	Where an effort has been made to integrate different types of information, particularly social, economic and ecological information, the extent of, and methods for, such integration	
h.	Sources of any evaluation benchmarks, reference levels or ecotoxicological assessment criteria used in the assessment	Biological Reference Points
i.	Extent and sources of any forecasts, projections, and scenarios used in the assessment	
j.	If data-assessment limitations (such as data-extrapolation errors, uncertainties and/or information gaps) were addressed in the assessment, a description of how this was done.	
(a)	What types of relevant data or information are known to be collected and managed, and by what State(s) and agencies (this is expected to be the case for some key social and economic data)? What information can be provided about	

	the spatial and temporal coverage and technical content of such data or information?	
(b)	Where key types of information are not known to exist, can expert knowledge be mobilized to fill the gap and, if so, how can the experts be accessed?	
(c')	Contact details of focal points for the States and intergovernmental organizations to be represented at the workshop	
(d)	Advance notice of identified capacity-building needs	

<b>Type of assessment : Assessments of manmade mishaps/ natural disasters Section -11.3</b>		
	<b>Question</b>	<b>Answer</b>
a.	Agency conducting the specific assessment	CMFRI
b.	Major intended users of the assessment, and the uses for which it was intended	Fishers, Central and State level Planning Commissions and Policy formulation bodies
c.	Spatial and temporal scale of the assessment, and frequency of assessment cycle	Opportunistic / Random
d.	Issues covered by the assessment	Oil spills Coastal HAB blooms Tsunami Cyclones Chemical spills
e.	Types of data, experimental knowledge, indicators and the reasons for their selection and other information sources contributing to the assessment	One off survey post occurrence
f.	Where trends of component information sets have been deduced, the methods employed	
g.	Where an effort has been made to integrate different types of information, particularly social, economic and ecological information, the extent of, and methods for, such integration	Yes, socio-economic surveys
h.	Sources of any evaluation benchmarks, reference levels or ecotoxicological assessment criteria used in the assessment	
i.	Extent and sources of any forecasts, projections, and scenarios used in the assessment	
j.	If data-assessment limitations (such as data-extrapolation errors, uncertainties and/or information gaps) were addressed in the assessment, a description of how this was done.	From state agencies

(a)	<p>What types of relevant data or information are known to be collected and managed, and by what State(s) and agencies (this is expected to be the case for some key social and economic data)? What information can be provided about the spatial and temporal coverage and technical content of such data or information?</p>	
(b)	<p>Where key types of information are not known to exist, can expert knowledge be mobilized to fill the gap and, if so, how can the experts be accessed?</p>	
(c')	<p>Contact details of focal points for the States and intergovernmental organizations to be represented at the workshop</p>	
(d)	<p>Advance notice of identified capacity-building needs</p>	

### Abbreviations and technical terms Used (incomplete)

ARIMA	Intervention Model
BRP	Biological Reference Point
B <sub>MSY</sub>	Limit Reference Points
CI	Confidence Interval
CMFRI	Central Marine Fisheries Research Institute
CMLRE	Centre for Marine Living Resources and Ecology
CPUE	Catch per unit effort
DEPM	Daily Egg Production Model
ECOPATH	Ecological Model
ECOSIM	Ecological Simulations
EIA	Environmental Impact Assessment
FCA	Food Conversion Efficiency
F <sub>MSY</sub>	Limit Reference Points
FSI	Fishery Survey of India
HAB	Harmful Algal Bloom
ICAR	Indian Council of Agricultural Research
IUCN	International Union for Conservation of Nature
LCA	Life Cycle Assessment
MoA	Ministry of Agriculture
MoEF	Ministry of Environment and Forests
NE	North East Region of Indian Coast
NOAA	National Oceanic and Atmospheric Administration
NW	North West Region of Indian Coast
SE	South east Region of Indian Coast
SEAFDEC	South East Asian Fisheries Development Center
SW	South West Region of Indian Coast
TSS	Total Suspended Solids
UT	Union Territory
WHO	World Health Organisation

## ANNEXURE

**Table 1. Temporal and Spatial range of Marine Assessments of India**

	Type of Assessment	Area		Time					
		Sub national (Narrow)	National (Broad)	Daily	Monthly	Annual	Quinquennial	Random	Opportunistic
<b>1</b>	<b>Marine Fishery Catch Assessment</b>	√	√	√	√	√			
<b>2</b>	<b>Census of Marine fishers, crafts and gears</b>	√	√				√		
<b>3</b>	<b>Marine Fish Stock Assessments</b>	√	√			√			
<b>4</b>	<b>Fisheries Ecosystem Assessments</b>							√	
<b>5</b>	<b>Environment &amp; Habitat Assessments</b>								
5.1	Marine debris & litter	√			√	√			
5.2	Heavy metal pollution	√			√	√			
5.3	Dashboard analysis of habitats	√						√	
5.4	Ecologically sensitive habitat assessments –	√						√	
5.5	Recruitment strength assessment	√				√			
<b>6</b>	<b>Marine Biodiversity Assessments</b>								
6.1	Iconic/keystone species assessments								
6.1.1	Marine mammals by planned sighting surveys		√		√	√			
6.1.2	Seabirds by planned sighting surveys	√			√	√			
6.1.3	Coral reef diversity using line transect surveys	√				√			
6.2	Taxonomic assessment of major fish families		√			√			
<b>7</b>	<b>Oceanic Resource Assessment</b>								
7.1	Myctophid fish abundance survey	√	√					√	
7.2	Oceanic squid abundance survey	√						√	
7.3	Other deepsea fish/shrimp surveys	√	√					√	
<b>8</b>	<b>Mariculture Assessments</b>								



8.1	Bivalve farming impacts	√						√	
8.2	Fish culture in cages	√						√	
8.3	Natural Seed Abundance Assessments	√						√	
<b>9</b>	<b>Socio-economic Assessments</b>							√	
9.1	Craft/gear economic efficiency assessments	√	√			√			
9.2	Socio-economic status of fishers	√	√			√			
9.3	Market network surveys	√	√			√			
9.4	Factor productivity analysis	√	√			√			
<b>10</b>	<b>Climate Change Impact Assessments</b>								
10.1	Vulnerability of coastal states	√						√	
10.2	Impacts on fish phenology	√	√					√	
10.3	Impact of climate change on fish distribution	√	√					√	
10.4	Estimates of carbon foot print of fishing industries	√	√					√	
10..5	Assessment of perception of fishermen to climate change	√						√	
10.6	Assessment of ocean acidification on meroplankton	√						√	
<b>11</b>	<b>Other one-off Assessments</b>								
11.1	Impact assessment of seasonal fishing/trawling bans	√	√						√
11.2	Impact assessment of destructive fishing practices	√	√						√
11.3	Manmade mishaps/ natural disasters (tsunami)	√	√						√

**Table.2. Details of gaps in Assessments and capacity building needs**

	Type of Assessment	Gaps in Assessment	Whether Capacity building is required Yes/ No
1	Marine Fishery Catch Assessment	Information on catch from deep sea not recorded	N
2	Census of Marine fishers, crafts and gears	-	N
3	Marine Fish Stock Assessments	Moving fisheries management advise into management rules and regulations  Multi-species models	Y
4	Fisheries Ecosystem Assessments	Fisheries Simulations	Y
5	Environment & Habitat Assessments		
5.1	Marine debris & litter	Assessment area covered is narrow Needs larger coverage	N
5.2	Heavy metal pollution	Benthic infauna not covered	N
5.3	Dashboard analysis of habitats	Area covered is narrow	N
5.4	Ecologically sensitive habitat assessments –	Ecosystem service evaluations not complete	N
5.5	Recruitment strength assessment	DEPM models not done	Y
6	Marine Biodiversity Assessments		
6.1	Iconic/keystone species assessments		
6.1.1	Marine mammals by planned sighting surveys	Reasons for stranding not known Resident population assessments not made Migratory movements not known	Y
6.1.2	Seabird assessment by planned sighting surveys	Population assessments narrow Assessment of migration not made	Y
6.1.3	Coral reef diversity using line transect surveys	Limited coverage	N
6.2	Taxonomic assessment of major fish families	Not complete	N
7	Oceanic Resource Assessment		
7.1	Myctophid fish abundance survey	Potential Fishable biomass not estimated	N
7.2	Oceanic squid abundance survey		
7.3	Other deepsea fish/shrimp surveys	Potential Fishable biomass not	N

		estimated Deep sea /sea mount diversity not assessed	
8	Mariculture Assessments		
8.1	Bivalve farming impacts	Mesocosm assessments of suspended oyster /mussel farming not made	Y
8.2	Fish culture in cages		N
8.3	Natural Seed Abundance Assessments	National level Assessments not made	N
<b>9</b>	<b>Socio-economic Assessments</b>		
9.1	Craft/gear economic efficiency assessments	-	N
9.2	Socio-economic status of fishers	-	N
9.3	Market network surveys	-	N
9.4	Factor productivity analysis	-	N
<b>10</b>	<b>Climate Change Impact Assessments</b>		
10.1	Vulnerability of coastal states	National level asst. not made	N
10.2	Impacts on fish phenology	Impacts on major fishes and biological parameters not complete	N
10.3	Impact of climate change on fish distribution	Narrow : Has to be extended to different species	N
10.4	Estimates of carbon foot print of fishing industries	Complete LCA not made	Y
10.5	Assessment of perception of fishermen to climate change	National level study not made	
10.6	Assessment of ocean acidification on meroplankton	Impacts on different plankton groups yet to be made	Y
<b>11</b>	<b>Other one-off Assessments</b>		
11.1	Impact assessment of seasonal fishing/trawling bans	-	N
11.2	Impact assessment of destructive fishing practices	-	N
11.3	Manmade mishaps/ natural disasters (tsunami)	-	N

Table.3. Details of areas where capacity building programs **can be organized** by CMFRI, India under the theme Food security

	Type of Assessment	Areas where capacity building programs can be organized	Two weeks	One month
1	Marine Fishery Catch Assessment	Short term training in catch Assessment / monitoring Methodology	√	
2	Census of Marine fishers, crafts and gears	Short term training - Census Methodology / Socio-economic analysis	√	
3	Marine Fish Stock Assessments	Length based stock assessment methodologies. Biomass dynamic models		√
4	Fisheries Ecosystem Assessments	Trophic modeling of marine ecosystems		√
5	Environment & Habitat Assessments	Litter assessment and grading , Instrumentation,  taxonomy to corals and fishes	√	√
6	Marine Biodiversity	Taxonomy of corals and fishes		√
7	Fisheries Management Policies	Impact of fisheries management plans from fish stocks /destructive fishing practices		√
8	Socio-economic Assessments	Factor productivity analysis	√	
		Craft/gear economic efficiency assessments	√	