

# Marine Fisheries Information Service

Technical and Extension Series



Indian Council of Agricultural Research  
**CENTRAL MARINE FISHERIES RESEARCH INSTITUTE**  
P.B. No. 1603, Ernakulam North P.O., Kochi - 682 018, Kerala, India



## *From the Editorial Board.....*

Warm greetings to all

In the present issue of MFIS, the efforts of ICAR-CMFRI to extend the results of R & D to better serve the fishermen and farmers through services such as mKRISHI® Fisheries, the small scale open water cage culture technologies available, surveys conducted for marine fish seeds for stocking in culture sites and mapping of potential mariculture sites are highlighted. The Action Plan incorporating various recommendations for development of useful products from seaweed resources and related technologies, finalised through a National Consultation is also included. In addition, articles evaluating the economic aspects of marine fisheries, coastal ecology, fish disease monitoring and marine biodiversity observed are also included.

# Marine Fisheries Information Service

No. 230, October-December 2016

Abbreviation - Mar. Fish. Infor. Serv., T & E Ser.

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## mKRISHI® Fisheries - A Blue Ocean Innovation

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### Why Blue Ocean is becoming Red?

India is blessed with a vast coastline of around 8110 km. Every day around one million fishermen from 3,202 fishing villages venture into the sea to catch fishes. The allied sector of fish processing and marketing build their hope on this catch. While everyone is hoping for a good catch, climate change impacts and over-fishing has led to declining catch.

Fish catch is uncertain and each trip is expensive, especially the costs for diesel. It was estimated that for each tonne of fish catch, approximately 1.06 t of CO<sub>2</sub> gas is emitted. (Vivekanandan, *et al.*, 2013 *Current Science*, 105 (3):361-366) This is mainly because engines are not very optimized and consume 12-15 litre of fuel in an hour and may cover only 10-12 km (while not dragging the net). Hence, there is a need to optimize each fish trip.

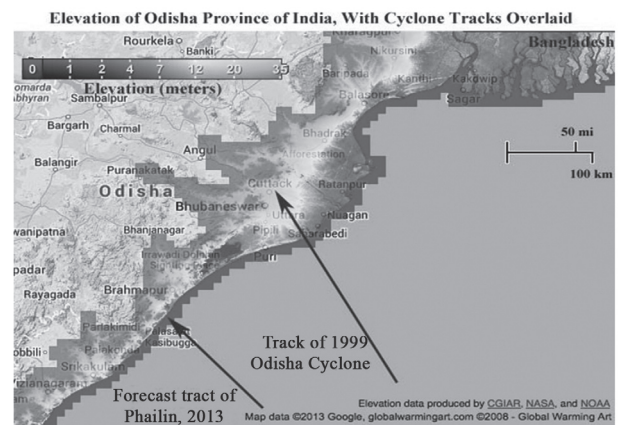
Fishing in the seas is one of the riskiest profession as unpredictable sea conditions due to high wind speed and wave height, makes navigation very difficult, especially boats laden with fish catch. In an actual fishing scenario at sea, with more than 2 meter height waves (or swell) and wind speed more than 20 km per hour, a fishing boat can be tossed around like a toy. During 1891 to 2000, 308 cyclones have hit the Indian coast endangering the lives of 370 million within the 100 km belt off the coast. An Early Warning System (EWS) helps prevent such dangerous situations.

### Technology as a Tool

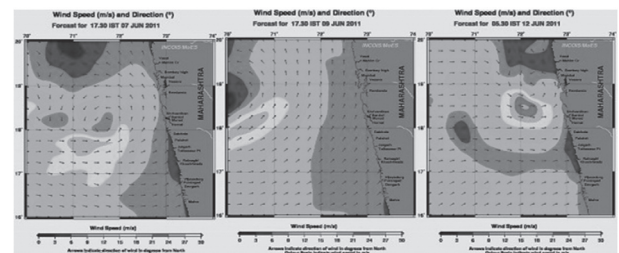
Indian National Centre for Ocean Information Services (INCOIS) generates Potential Fishing Zone



Fishermen preparing for a fishing trip



Cyclone vulnerable East coast



(PFZ) and Ocean State Forecast (OSF) Advisories for Indian coastal region. It processes the Chlorophyll and TSM images received from Oceansat-2 and Sea Surface Temperature (SST) images from NOAA-18/19 and MetOp-A/B satellites. These images are further processed for geometric correction, filtering and are geo-coded. Availability of the PFZ information addresses livelihood needs of the fishermen while wind speed, wind-direction and wave height information addresses their safety concerns.

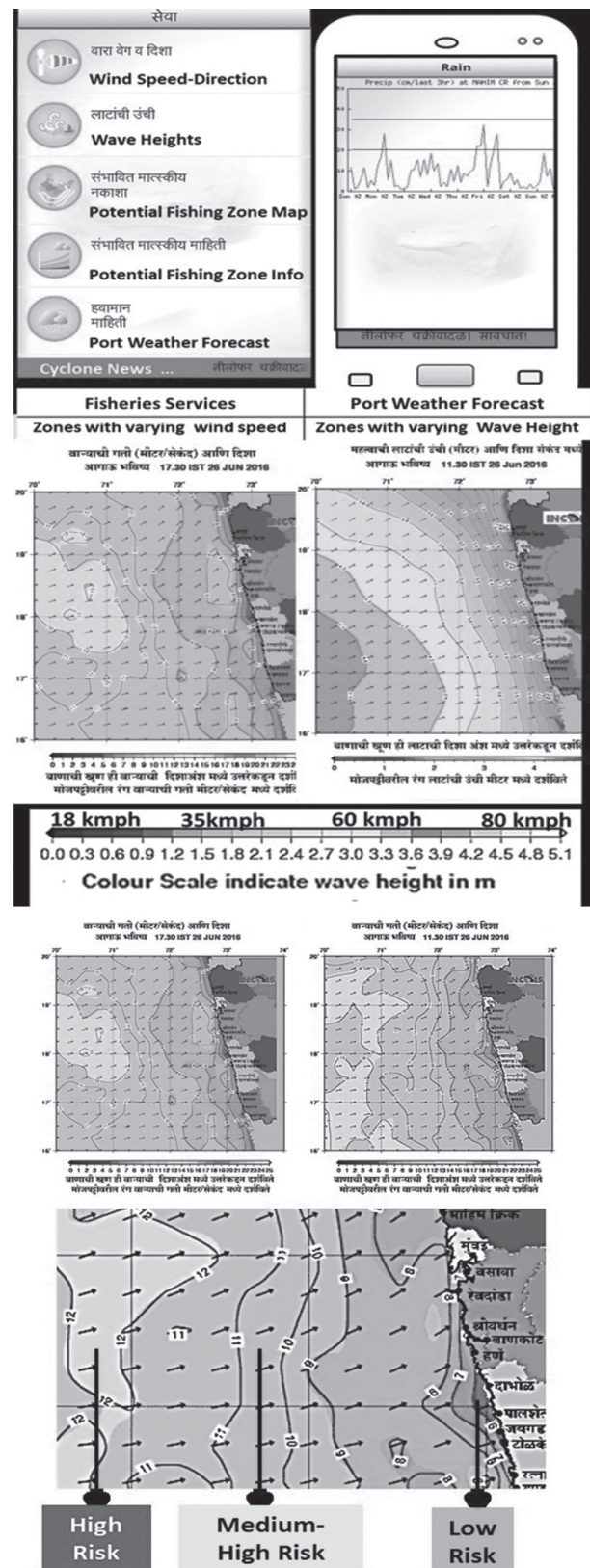
### mKRISHI® Fisheries for fishermen

Mumbai Research Centre of ICAR-CMFRI and TCS Innovation Lab - Mumbai compiled the results of various surveys and fishermen feedback sessions, and created a simple to use mobile application in local language which can work on almost all the existing GPRS enabled mobile devices. Concepts such as Human Computer Interaction (HCI) helped to simplify the services and make it work during no/low mobile network (offline).

Collaborators included public and private partners like ICAR-CMFRI, INCOIS, Tata Consultancy Series (TCS), Tata Teleservices and various NGOs. mKRISHI® Fisheries with application of existing technologies thus became successful involving Design thinking, Simplification, Human Computer Interaction Service Design, GPS, Data Connection and Content personalization. For the mobile signal extension in deep sea, it required antenna design, tower configuration and device side amplification.

Following services were offered to the fishermen going out to sea.

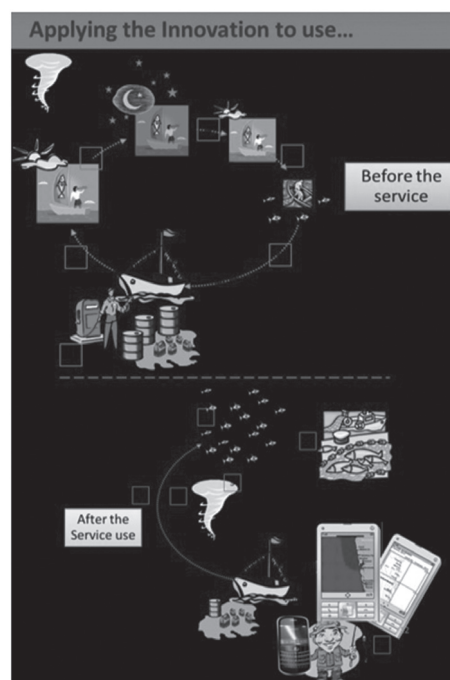
- Potential Fishing Zone
- Wind Speed and Direction
- Wave Height
- Weather Forecast
- Cyclone and *Tsunami* related warning
- Other news



mKRISHI® Fisheries Service incorporating HCI

Fishermen can now have information on their own mobiles and access whatever information is required for planning their fishing trips or navigation. Some used the information very early in the morning to see if PFZ was within the vicinity of their port (say 30-50 km) or far off. They check the wind speed or wave height forecast for next 3-5 days and when they find the sea conditions favourable, they would venture into the sea or else postpone the fishing trip. This selective fishing brought a disciplined approach, which not only led to less expenditure but also less diesel consumption and carbon emissions. While at the sea, the wind direction helps in planning to avoid 'drag' of the fishing vessel and hence further saving in diesel costs. The Information available thus made decision making simpler. Simplified information display method was also developed. Instead of putting the numerical value of the wind speed on the map, a "color code" for each wind speed range was coded and accordingly the respective regions on the maps were drawn in different colours. For a calm sea (wind speed less than 10-12 km per hour) shades of blue were used. For rough sea (wind speed 20 km per hour) light green was used. Anything in the shades of yellow, orange, red or white was considered very rough sea. White was the maximum with the wind speed ranging beyond 100 kmph, generally indicating cyclones. This information was available four times a day, for the next 5 days.

By avoiding unnecessary trips, savings in diesel, ice and labour costs accrued to the fishermen. They also planned their sailing time to get assistance of wind speed, direction, further reducing the diesel consumption. Information collected from Raigad district (Maharashtra) indicated a 30-40% increase in catch and 30% reduction in diesel consumption. Wind, Wave and cyclone information also helps them as an Early Warning System (EWS) to ensure safety of their lives and their investment in boat, fishing gears, etc.



Scenarios before and after use of mKRISHI® Fisheries Service

### Mobile Signal Extension in Deep sea

A pilot study was conducted to expand the mobile signal in sea upto 30 km to help establish a "digital coastal highway", which would also pave the way for tracking, security cover and also aid marine businesses.

### Revenue model

Initially a ₹ 30 per month per fisherman model was tried, but after realization of its positive societal impact it was decided it should be a free service. Thus it acquired a Google like Service model i.e. free for "common people" like fishermen, with no charge for life saving Early Warning System service (Wind/Wave/Cyclone information) etc. and charges for other stakeholders like business enterprises using this service. Other value added services like Catch Traceability which will be charged and operate through a share of subsidy or sale transaction from the buyers is under consideration. Mobile signal extension will be a pay

per use model where government must invest partly to subsidise initial cost. Later, telecom operators will continue as routine business. The beneficiaries would be the coastal fishermen, state governments, Ice industry, fish processing units, exporters and cage culture enterprises within 12 nautical miles.

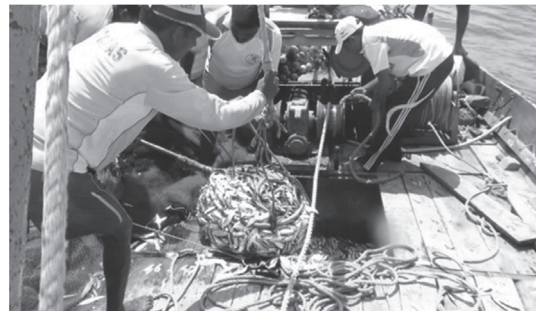
This technology has the potential to directly impact 900,000 fishermen and another 3 million in allied sectors. Based on the survey conducted in Raigad by Mumbai Research Center of ICAR-CMFRI during 2013-14, it was observed that at 15% adoption level, fishermen can save upto 9,00,000 of litres (@30% less consumption). This translates to savings of ₹ 468 lakhs. (@₹ 52/litre), Diesel subsidy saving of ₹ 107.64 lakhs and lesser Green House Gas (GHG) emission of approximately 2412 tonnes. During December 2016, Ministry of External Affairs (MEA), Govt. of India and National Institution for Transforming India (NITI Aayog) held a National level contest on Social Innovation in which mKRISHI® Fisheries was selected as one of the Top 20 innovations. Winners were asked to exhibit their innovations at the *Pravasi Bhartiya Divas* held during 7 - 9<sup>th</sup> January 2017 at Bengaluru and the team setup a model which illustrated the Potential Fishing Zone (PFZ) and its impact in diesel reduction, an Early Warning System (EWS) created by the Wind Speed and Direction Forecast, Mobile Signal Extension to alert and monitor the crossing of the International border and promotion of cage culture based sustainable fisheries. mKRISHI® Fisheries app which presents advisories in local language, with easy to use icons on Java and Android mobile phones can be download from [http://](http://www.tcsmkrisi.com/app/mfish/)



PFZ validation cruise



Mobile signal extension testing



Catch by fishermen from a PFZ at Raigad

[www.tcsmkrisi.com/app/mfish/](http://www.tcsmkrisi.com/app/mfish/) and is now available on google play store also. Upscaling of the service is also being planned.

## Site suitability evaluation for bivalve mariculture in Maharashtra

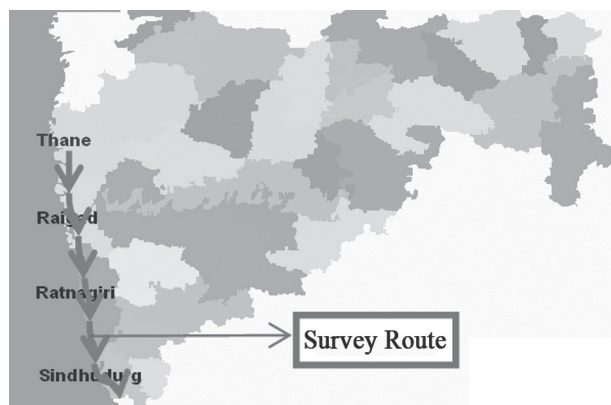
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The coastal stretch of Konkan Maharashtra is endowed with large number of west flowing rivers forming productive estuaries and creeks fringed by mangrove vegetation. The coastline stretching across the districts of Raigad, Ratnagiri and Sindhudurg are marked by the presence of narrow creeks offering sheltered areas for aquaculture activities. Considering the potential for expanding bivalve farming in Maharashtra, surveys for selecting suitable sites for coastal farming were conducted from 5<sup>th</sup> to 8<sup>th</sup> October, 2013 covering Thane, Raigad, Ratnagiri and Sindhudurg districts.



The species that contribute to the fishery are clams such as *Meretrix meretrix*, *Marcia opima*, *Paphia malabarica*; oysters such as *Saccostrea cucullata*, *Crassostrea madrasensis* and the green mussel, *Perna viridis*. The areas harbouring natural bivalve beds offers conducive environmental condition for bivalve farming. Therefore, the survey included the most productive bivalve fishing areas such as the Kalbadevi Estuary and Bhatia Creek in Ratnagiri.

Site selection criteria for bivalve farming were the following

- The primary selection criteria was salinity. Marine mussels prefer salinity of 27-35 psu while oysters of the genus *Crassostrea* are highly euryhaline tolerating low salinity ranges and oysters of the genus *Saccostrea* are typically marine. Water salinity above 22-35 psu was considered as the criteria
- Sheltered areas with moderate water current
- Potential pollution problems in the locality
- Water depth ranging from 2 to 6 m during low tide.
- Water temperature between 21-31°C.
- Good phytoplankton production

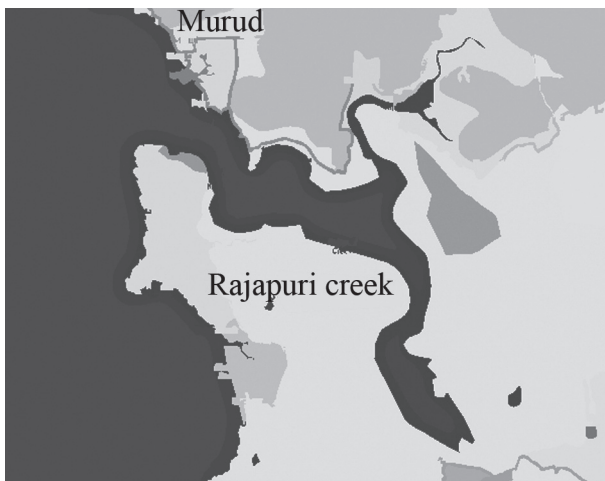
### Survey Results

1. **Revdanda** The whole stretch southward of Revdanda up to Korlai beach and Kundalika creek



were surveyed. Shore-front area of Revdanda including part of Kundalika creek was observed to be inappropriate for bivalve farming due to industrialization.

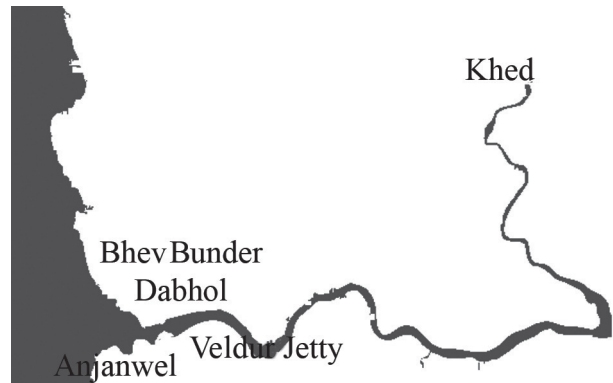
2. Murud coastal stretches in Raigad District and Rajapuri Creek near its bar mouth were surveyed. Natural population of rock oyster *S. cucullata* were observed along the creek. Due to industrialization the area was not suitable for bivalve farming.



3. Dabhol, in the Ratnagiri District was surveyed. Vashishti River flowing from Chiplun merges into the sea at Dabhol as Dabhol Creek. Natural population of the rock oyster, *S. cucullata* were observed. Green mussel, *Perna viridis* is reportedly present in coastal stretches adjoining Bhiv Bunder. Discharges of thermal effluent from Dabhol Power Station and from industries located upstream in Khed exist at this site. However both oyster and mussel farming may be considered here because of the abundance of these bivalve resources in the creek. Further a number of fishermen undertake a sustenance fishery for these resources.

The local fishermen society who evinced immense interest to undertake oyster and mussel farming were sensitised on the various aspects of bivalve farming during the survey. Suitable areas were demarcated near Veldur Jetty for

farming activities with the fishers of Anjanvel Village.



4. Jaigad, a major fishing village in Ratnagiri, located on the banks of Shastri River was surveyed. The stretch adjoining the coast comprises of slightly undulating plains at elevation ranging from 30-60m MSL. Due to the presence of a coal based thermal power plant the site was unsuitable for aquaculture.



5. Kalbadevi Estuary is an important bivalve fishing area in Ratnagiri. Edible oysters (*Saccostrea cucullata* and *Crassostrea* sp.), clams and green mussels are fished within Kalbadevi Creek as well as in rocky inshore regions regularly. This area was found suitable for setting bivalve farms for oysters and mussels. Mussel seeds are available in subtidal mussel beds. A meeting organised with the fishermen community resulted in developing interest for undertaking bivalve farming in the area.



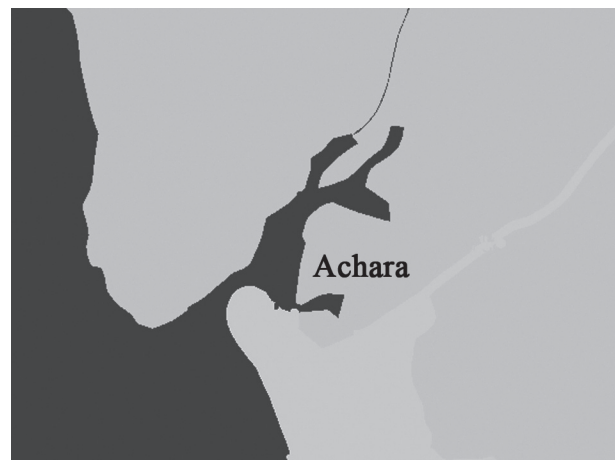
6. **Wadatar** creek in Sindhudurg District is an important edible oyster fishing area. The edible oysters, *Crassostrea madrasensis*, *C. gryphoides* and *S. cucullata* beds are spread near the bar mouth. The local communities harvest the oysters for consumption and marketing. The area near the Wadatar Bridge, which joins Vijayadurg to Devgad was surveyed and demarcated for farming bivalves.



7. **Taramumbari** near Devgad is an important bivalve fishing area. The salinity of the creek recorded 31 psu during low-tide period. Green mussels were fished earlier from the area during low tide. However, at present the mussel populations in the bar mouth is smothered by sediments from the ongoing construction of Taramumbari - Mithmumbari bridge. Therefore, this site may be considered later for carrying out mussel farming after the re-establishment of natural mussel population.



8. **Achara** situated at a distance of 15 km from Malvan is an important coastal village. Farming sites were identified near the Pirawadi Beach. This appears to be a potential farming site for rock oyster.



9. **Devbagh** area was surveyed along Tarkarli Beach and estuarine areas of Karli River. Natural population of rock oyster and green mussels are



reported from Devbagh area. This region holds potential for combining the already developed aquatourism with bivalve farming.



**10. Vengrula** area was surveyed along Mochamad estuarine area. This region holds potential for farming edible oysters.

### Conclusions

Oyster farming was initiated in Ratnagiri and Sindhudurg Districts of Maharashtra with local 'Mahila Sahakari Sanstha' in Kalbadevi Estuary, Wadatar, Taramumbari, Vengrula and Devbagh. In Wadatar, the farming initiated by a ten women group during March 2014, yielded 6,000 t oysters in June 2015. Good settlement of *Crassostrea madrasensis* seeds was observed in Devbagh and Wadatar, followed by Vengrula and Taramumbari. In 2016 the oyster farming programme has scaled-up on a commercial scale with 16 established commercial farms in Wadatar.

## Transforming rural livelihoods through cage farming

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Many fishing/fish farming communities in Kerala are benefitting from the cage culture technologies introduced by ICAR-Central Marine Fisheries Research Institute (CMFRI). In the current year, members of at least 20 families from Pizhala, in Kadamakudy Panchayat of Ernakulam district have done cage farming and about 40 cages (of 4 x 4 m, 6 x 6 m and 8 x 6 m dimensions) were harvested in December 2016. Similarly farmers at Panampukad, Pooyappilly, Chendamangalam etc. have also harvested cage farmed fishes. Fish cages are simple, cost-effective, environmentally sustainable technology that has been introduced in several villages including Pizhala by ICAR-CMFRI through participatory demonstration programmes that started in 2007. "Traditionally we farm fishes in ponds and catch them by setting nets of different

types, but we're never sure how much we'll catch. However in the fish cage culture, we know exactly how many fish we will harvest, and how much we will earn" explains a farmer involved in the venture. Apart from this, the involvement of women who came forward to start cage culture after awareness classes is noteworthy.

### Technology Intervention

Cage aquaculture is nothing but fish production using a relatively new technological system. Thus, many of the issues related to fish biology, pathology, feeding, etc. are similar to other fish production systems. In 2015, after a farmer approached ICAR-CMFRI for inputs in installing a cage in Pizhala, two cages of 4 m x 4 m were installed in September. All physical inputs were met by the farmer, except the

cage nets, which was provided by ICAR-CMFRI. The farmer stocked the cages with Asian sea bass and pearl spot, the most sought after fishes in Ernakulam district. This was the first commercial open water cage culture, in Kadamakudy Panchayat. Earlier the same farmer was using 2 m x 2 m PVC floating cages for fish culture inside shrimp ponds which was not successful. The new cage design created enthusiasm in the farmer and he started cage culture of fish in the open waters in the village where the major activity was fishing and agriculture. This inspired the neighbours and more families residing near the river fabricated cages and stocked fishes. The fish harvest during Easter time was also good and the farmers earned well. The farming is continuing with the village becoming a hub for cage culture. Certain problems identified by farmers during the farming process is given below.

**Constraint in seed availability:** For 50 cages of dimensions varying from 4 m x 4 m to 8 m x 6 m, they need 100,000 numbers of 30 g size Asian sea bass/or 100,000 numbers of 10-20 g pearl spot/ or 200,000 numbers of tilapia seed for each cycle. Since farming is going on round the year, the seed supply should be continuous and according to the farmer's requirements. The supply of adequate number of indigenous fish seed is the need of the hour.

**Lack of cost-effective pellet feed:** At present the farmers procure pellet feed at comparatively higher price of ₹ 35 to 110 per kg. By-catch or low value fish are also used as feed for seabass. As for most of the farmed fishes, cost-effective, species specific feeds are not available. This remains a constraint for many farmers.

**Lack of alternative feeds for fish:** At present a few cage farmers are using different natural resources such as vegetable wastes, food waste, weeds, kitchen left overs etc. for omnivores like pearl spot and tilapia. However, the availability of any item is not as much as to sustain the feeding for total culture period.

**Unexpected discharge of industrial pollutants:** The cage sites get unexpected inflow of pollutants from various industrial sources in the district, especially during sudden rains. It often results in fish mortality in the cages. However, during the current year this was very rare. The fish farmers constantly look out for such instances and report them to authorities for immediate remedial action. However, they are not aware of the pollutant levels, type or nutrient dynamics of the sites etc. Now, scientists of ICAR-CMFRI are continuously monitoring the water quality of the cage farming sites.

**Fish mortality due to attack of parasites / disease:** Occasional encounters with diseases or parasites has been observed in cages. However, freshwater dip of infected fish or change of nets was enough to overcome the problem. Farmers are also using probiotics available with local suppliers.

**Variation of production in cages:** High variation in fish production in the cages was observed by the farmers. According to them, water depth, closeness to other cages and feed are responsible for such variations and these require further standardisation.

### **Success of cage farming in Pizhala**

Popularization of cage farming in the village took hardly a year after its first introduction in 2015. The main reasons for this was the lack of private ponds or other types of fish farming techniques for the villagers. The co-operation of the local panchayat in issuing permission to set up cages, scientific, technology support by ICAR-CMFRI and involvement of Krishi Vigyan Kendra in promoting entrepreneurship and creating awareness among the farmers to new farming methods have paved the way for the success of cage farming in Pizhala. In the long run, for sustainability of the cage farming, the carrying capacity of the system has to be worked out which has been initiated. Diversification of species is also on the cards.

The case study at Pizhala showed that women are more empowered in management of cage farms

like, nursery rearing, feed scheduling, feeding, cage maintenance, marketing etc. Women have been found to be directly involved in fabrication of cages and its maintenance, procuring good quality fish seeds and its stocking. They are also selling the produce directly at farm-gate and in local markets avoiding middlemen. The most significant and positive aspect of involvement of women in cage farming is that since their family income has increased, it is being used for food, health care and

education of the family members. Women's participation can ensure social and economic empowerment in the rural societies with significant societal development. In Pizhala village located close to Ernakulam city, due to the poor financial status of the people development is meagre. However, with popularization of cage farming in the village, opportunities for social upliftment through the development of aquaculture ventures has opened up.

## Bull trawl operation banned along Karnataka coast to reduce indiscriminate exploitation of juvenile fishes

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Mangalore Fisheries Harbour is one of the major marine fish landing centres of Karnataka, contributing more than 40 % of the total marine fish landed in the state. Bull trawling or pair trawling is done along the coastal districts of Karnataka with peak operations during the post-monsoon (September to November) period. The pair trawls target pelagic and semi-pelagic schooling fishes, like carangids, scombroids, clupeids, pomfrets, squids, etc. and the catch mainly consist of juveniles, including those of high value fishes.

During the post monsoon phase of 2016 landings by the bull trawl continued showing the same trend. On 2nd November 2016, nearly 15 tonnes of juveniles of carangids, comprising mainly of *Atule* sp. was captured off Mangalore by 24 bull trawlers. These trawlers had operated off shore (36-40m depth) for a duration of 24 - 48 hours. The total length (TL) of the individual carangids landed ranged from 46 to 102 mm. The modal class (60-70 mm) as well as the mean size (71.16 mm) of the *Atule* sp. was much lower than the length at First Maturity



bull trawl landings

(Lm = 173 mm) reported (Reuben *et al.*, 1992, *Indian Journal of Fisheries* 39(3,4): 195 -234). The fish locally known as 'Chemmann' is consumed fresh as well as after being dried in the sun. As the size of fishes in this huge catch was too small for favour of domestic consumption, the entire catch was taken by fish meal plants for a meagre amount of ₹ 3 per kilogram, whereas the adult fishes of the same species fetch ₹ 35 - 60 per kilogram. The bulk catch

made by the bull trawls result in insufficient preservation leading to poor quality of the catch on reaching the harbour which fetches lower prices in the market as compared to catch made by regular trawlers.

The indiscriminate capture of juveniles by bull trawls leads to growth overfishing and will have an adverse effect on the fishery. Operation of bull trawl in Karnataka was not prohibited till recently and this type of fishing was carried out regularly along the coast. The Mangalore Research Centre of ICAR-CMFRRI during its regular Stake Holders Meet, has created awareness among the trawl net operators, especially those practicing pair trawling on the harmful effects of large scale exploitation of juveniles and have urged the fishermen to refrain from such type of destructive fishing activities.

Several fisher groups too started expressing concerns on such unsustainable fishing practices and some members of the Trawl Boat Owners Association voluntarily decided to stop this kind of fishing in the near shore waters as well as tried to convince other operators to stop such activities. However, this movement by a few fishers did not achieve much success and concerned stakeholders from several quarters urged the Department of Fisheries, Government of Karnataka to take up some actions to control bull/pair trawling activities. After several deliberations, the order (No: AHF 158 Dep. of Fish. Sch. 2016, Bengaluru dated 15-11-2016) to ban bull trawling within 12 nautical miles (territorial waters) zone of Karnataka Coast from 16<sup>th</sup> November 2016 under the Karnataka Marine Fisheries Act, was issued by the Fisheries Department.

## Hydrodynamics of coastal wetlands in Dakshina Kannada and their importance for avian fauna

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Coastal wetlands, which act as buffer zones between the marine and upstream land area, are increasingly under pressure due to an array of activities by multiple users. The wetlands are under the influence of both fresh and saline water. Many bird species including migratory seabirds and resident coastal birds use wetlands as resting place, for breeding or feeding purposes or to take cover from predators. The Ramsar Convention on Wetlands, of which India is a signatory, uses a broad definition of wetlands which includes all lakes and rivers, underground aquifers, swamps, marshes, wet grasslands, peatlands, oases, estuaries, deltas, tidal flats, mangroves, other coastal areas, coral reefs,

all human-made sites such as fish ponds, rice paddies, reservoirs and salt pans. The contracting parties are committed to (a) work towards the wise use of all their wetlands; (b) designate suitable wetlands for the list of Wetlands of International Importance (the "Ramsar List") and ensure their effective management; (c) cooperate internationally on transboundary wetlands, shared wetland systems and shared species.

The coastal plain of Dakshina Kannada District in Karnataka is narrow and thickly populated. Though the district receives more than 3000 mm rainfall annually, problems such as flooding, coastal erosion, and salinity ingress in coastal aquifers and

along river course exist and proper water management strategies are required. The salinity ingress of coastal aquifers is mainly during the summer months when river flow decreases. Over the years the percentage area of creeks, lagoon and wetlands in Dakshina Kannada has decreased due to increasing urbanization resulting in loss of habitat to the multiple users of these wetland areas. The motion or path of the water flow and the forces which act on the type of soil in the area determines the wetland formed. The most common feature of all wetlands is that the water table (the ground water level) is very near to the soil surface or shallow water covers for at least part of the year. The main characteristics of a wetland are determined by the combination of the salinity of the water in the wetland, the soil type and the plants and animals living in the wetland (Fig. 1). The coastal buffer zones of sandy beaches and marsh lands help prevent saline water intrusion. The textural variation of a sandy shore with higher pore size helps in retention of fresh water during monsoon which in turn helps bind the grains together and aids in the growth of sand dune plants. The marsh lands on the upstream have higher percentage of clay, contain Kaolinite minerals joined by strong hydrogen bonds, and thus capable of retaining fresh

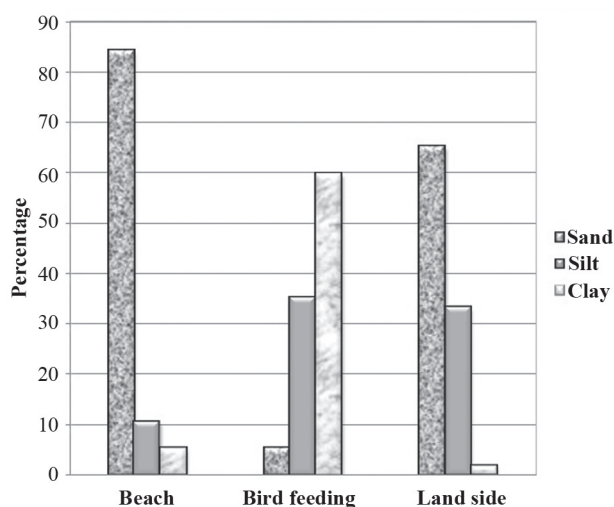


Fig. 1. Soil types in a wetland

water for longer duration even during dry weather period.

The coastal area between Baikampady (Fig. 2) and Chithrapur in Dakshina Kannada district of Karnataka is a typical example of a coastal buffer zone. This wetland is a 'Fern type' and characterized by peaty soil, with dominance of grass like plants, grasses, sedges and reeds. Peat soil is formed in wetland areas when plant material is inhibited from decaying fully due to anaerobic conditions. The 'Ferns type' wetlands are alkaline, receiving water mostly from surface and subsurface flow. It receives sea water from the Arabian Sea during high tide and drains rainwater into the sea during monsoon. The subsurface flow is from upper Chithrapur area where marsh lands are present. However during the process of urbanization and development of cities most of these channels are converted into city waste water drainages. Unfortunately, the precious nutrient rich storm water mixes with waste water and drains into the sea. In the natural course when rainfall is less, there is an inflow of saline water into the region. The higher the ground water table along the adjacent landmass, the less will be the saline water intrusion due to hydrostatic pressure difference in the system. However, during unplanned development activities, more of these precious and natural marsh lands are filled with debris, hence disturbing the natural balance of water flow in these

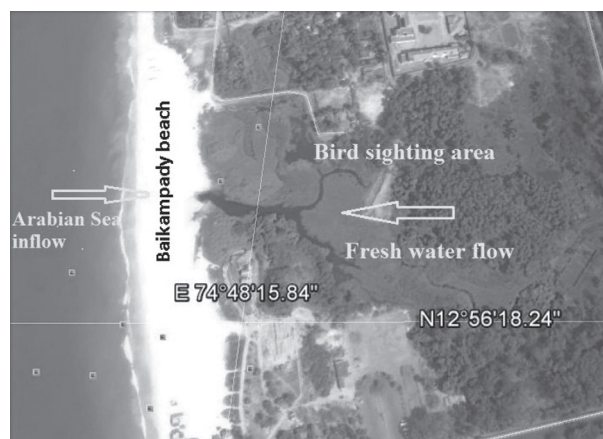
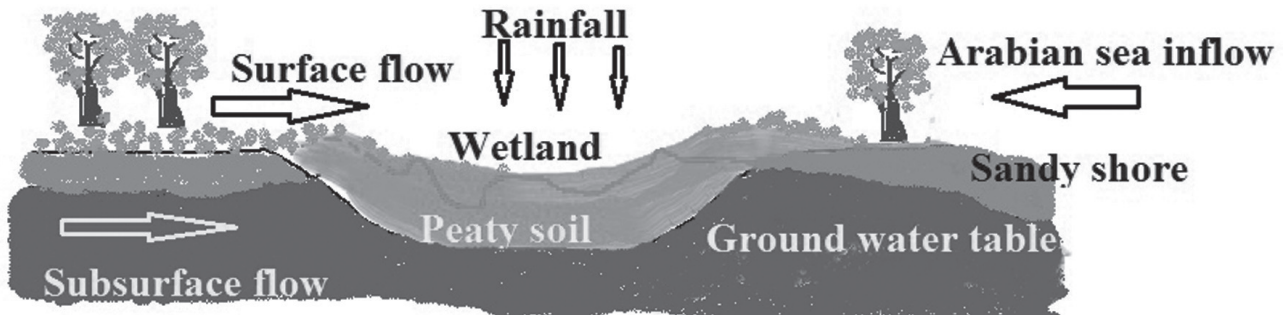


Fig. 2. Coastal wetland and bird sighting area



Schematic diagram of the hydrodynamics and soil type of a wetland

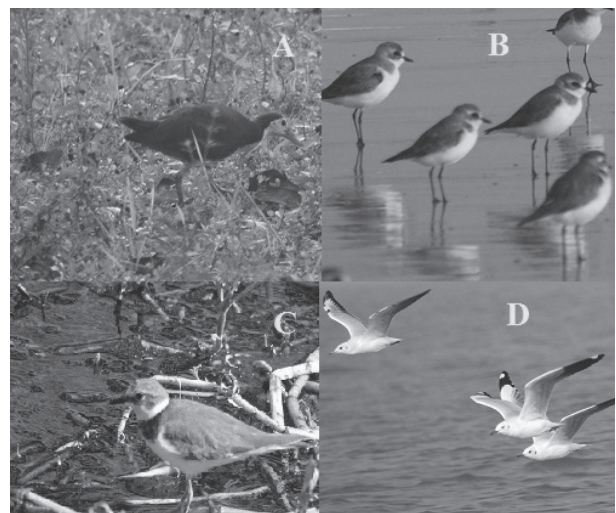
ecosystems. The marsh lands on the upstream area of Chithrapur, act as hydrologic sponge, temporarily storing flood waters and releasing them slowly, thus reducing flood peaks and protecting downstream areas. These functions are all the more important in urban areas where development has increased the rate and volume of runoff.

Wetlands generally host a number of avian fauna and the value of a wetland to a specific bird species is dependent on the moisture present in the soil and the duration and timing of flooding. At times, the water may not be present at the surface, but be close enough to support growth of vegetation and organisms that are needed as food by birds. Birds generally use wetlands formed as depressions in an otherwise dry landscape. These generally occur along streams or in tidally influenced areas near shorelines. The coastal birds especially the shanks and the sandpipers, feed on the beaches during early morning and late evening and take shelter in the inland areas as the beach sand heats up during the day time. The red-wattled lapwing *Vanellus indicus* another bird sighted in this area scrape the ground



Red-wattled lapwing *Vanellus indicus*

and make small depressions on which they lay their eggs. Breeding season is during March to August. The need for lapwings to be near a wetland is that the adult soak their belly feathers to provide water to their chicks as well as to cool the eggs during hot weather. On the other hand the water hens prefer to nest in the marsh lands and ponds in the upstream areas. The decrease in number of sightings of the water hens is an indicator of reduction in wetland areas and stress on the ecosystem. The white breasted water hen *Amaurornis phoenicurus* is an omnivorous species preferring insects, molluscs, grains, shoots of paddy and marsh plants available in its foraging area, which include grass land, mud and shallow water. They usually nest during June



(A) White breasted waterhen *Amaurornis phoenicurus* (B) Kentish plover *Charadrius alexandrinus* (C) Little ringed plover *Charadrius dubius* (D) Black headed gull *Larus ridibundus* and Brown headed gull *Larus brunicephalus*

to October. The nests are a shallow cup of twigs, creeper stems which is positioned in bushes in proximity to the water bodies. The other birds sighted in this area were cattle egret *Bubulcus ibis*, which chiefly feeds on grass hopper, other insects, frogs, lizards, fish etc., Kentish plover *Charadrius alexandrinus* which nests in sandy bed above the high tide mark in seashore or in dry river bed, Little ringed plover *Charadrius dubius*, Brown headed gull *Larus brunnicephalus*, black headed gull *Larus ridibundus* and the Eurasian oyster catcher *Haematopus ostralegus*, which is a winter visitor to India.

Conservation of these coastal buffer zones is of prime importance for the preservation of many diverse species of flora and fauna. Urbanization in these coastal buffer zones has led to people disposing off litter in these empty spaces which obstructs the natural hydrodynamic flow and leads to stagnation of water, eutrophication and breeding of mosquitoes. When more sand dune in the beaches are transported elsewhere and less of marsh lands are available for the retention of rainfall, the recharge capacity of the ground water table is



Eurasian oyster catcher *Haematopus ostralegus*

reduced, which in turn can lead to saline water intrusion. Population increase compels more people to depend on ground water for their daily need. These zones could be cleared of debris and maintained as protected sites with a limited tourist access. The study of the ecology of wetland birds by identifying the patterns of use of habitat, breeding site and resources such as food will be useful for designing strategies to conserve our wetlands.

## Abundance of natural fish seed resources prioritized for mariculture in the Kali estuary

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Mariculture is a promising fish producing industry in India with cage farming of marine finfish and shellfish becoming popular along the entire coast. Fish seed availability is the need of the hour for sustaining and supporting expansion of cage farming of fishes in India. Capture Based Aquaculture (CBA), can be considered as an economic activity for

fishermen communities to practise where by accessing natural fish seed resources for culture, it enhances the fish production, yield and market value. To undertake CBA as one of the mariculture activity in India, it is necessary to understand the availability of commercially important fish seed resources of Indian coast. Hence, a study was

undertaken along Kali estuary in Karnataka to understand the availability and abundance of fish seed resources, which are prioritized for mariculture in India.

Kali river has its origin near the village of Kushavali of Joida Taluka and drains into the Karwar Bay ( $14^{\circ} 50' 21''$  N and  $74^{\circ} 10' 05''$  E) with a total water spread area of 4850 sq.km. The total low lying area in the lower reaches of the river is about 1217 acres. The deepest part of the estuary is found be at about 18 km upstream near Halga, where the depth on an average is 15 metres. Estuaries are dynamic in nature with a wide range of salinities. Moderate saline waters prevail in pre-monsoon (February-May), almost freshwater during monsoon (June-September) and high saline waters occur in post-monsoon (October-January) season. The pre-monsoon season is identified by high temperature and salinity conditions, the monsoon season by heavy rainfall with greater riverine discharge and land run off and the post-monsoon season for stable environmental conditions with a high biological productivity rate. The Kali River is considered as unpolluted because of lack of any industries on its banks and is a lifeline for both agriculturists and fish farmers from a very long time. Some areas of Kali estuary are known for exclusively rich bivalve resources and its brackishwater finfish resources.

### Material and Methods

Seven stations were selected for the present study including Sunkeri, Kadwad, Nandangadda, Siddar, Kinner, Halga and Songeri (Fig.1).

Fish seed samples were collected using cast nets (5 m length, 17 m circumference and 11 mm mesh size) during the lowest low tide at weekly intervals in all the seven stations of Kali estuary for a period of one year (February 2016 to January 2017). 10 hauls were made in each station for each sampling and the net covered area was 4 m per haul. Finfish and shellfish seeds were identified up to species level following FAO species identification sheets.



Fig. 1. Stations for collection of natural fish seed resources

Water quality parameters such as temperature, salinity, pH and dissolved oxygen were monitored at weekly intervals.

### Results

In the present study 9 species were recorded out of 24 species prioritized for mariculture by ICAR-CMFRI, in Kali estuary (Table 1). These were *Caranx ignobilis*, *Mugil cephalus*, *Lutjanus argentimaculatus*, *L. johnii*, *Sillago sihama*, *Siganus javus*, *Lethrinus lentjan*, *Gnathanodon speciosus* and *Psettodes erumei*. *Caranx ignobilis* (35.6%) was found to be the most dominant species followed by *M.cephalus* and *L.argentimaculatus*. A significant variation ( $p < 0.05$ ) was observed in species occurrence and abundance among different stations and seasons.

*C.ignobilis* was the most dominant species in all the stations with a maximum abundance of 23.4% at Songeri followed by Sunkeri with 19.7% of abundance. Minimum was recorded in Nandangadda with 6.9%. *M.cephalus* was dominant in Sunkeri with a maximum abundance of 30.2 % followed by Kadwad (22.9%). The seed of *M.cephalus* was not recorded in Halga during the present study. *L.argentimaculatus* and *L.johnii* were recorded in all the stations except Nandangadda with a maximum abundance of 25.65% at Halga and Songeri (33.34%) respectively. *Sillago sihama* was recorded in three stations viz., Sunkeri, Kadwad and Nandangadda with 38.1% of abundance at Kadwad.

Table 1. Availability of prioritised natural seed resources along the Kali estuary

Prioritized species	Nandangadda	Sunkeri	Kadwad	Kinner	Siddar	Songeri	Halga
<i>Lutjanus argentimaculatus</i>	x	√	√	√	√	√	√
<i>Lutjanus johnii</i>	X	√	√	√	√	√	√
<i>Caranx ignobilis</i>	√	√	√	v	√	√	√
<i>Gnathanodon speciosus</i>	X	√	√	X	X	X	X
<i>Mugil cephalus</i>	√	√	√	√	√	√	X
<i>Lethrinus lentjan</i>	X	v	√	X	X	X	√
<i>Psettodes erumei</i>	√	√	X	√	√	√	X
<i>Sillago sihama</i>	√	√	√	X	X	X	X
<i>S. javus</i>	X	√	√	X	X	X	X

*P.erumei* was recorded in all the stations except Kadwad and Halga. Whereas, *G. speciosus* and *S.javus* were recorded in only two stations viz., Sunkeri and Kadwad *L.lentjan* was recorded in three stations (Sunkeri, Kinner and Halga).

Seasonal variations indicated that out of nine species recorded during the present study, five species such as *Caranx ignobilis*, *M.cephalus*, *L.argentimaculatus*, *L. johnii* and *S.sihama* were recorded in all the three seasons. Seeds of *C. ignobilis*, *M.cephalus* and *L.argentimaculatus* were found more abundant during monsoon season whereas, *L.johnii* was found more abundant during post monsoon and *S.sihama* during premonsoon seasons. *S.javus* is more abundant in pre-monsoon and completely absent throughout the monsoon season. *G. speciosus* was recorded only during the pre-monsoon season. *L.lentjan* is completely absent in pre-monsoon but recorded during the other two seasons. *P.erumei* was recorded during monsoon only.

Water quality parameters of Kali estuary indicated water temperature varied between 28°C -32.3°C, whereas, salinity, pH and dissolved oxygen were 3-21 ppt, 7.8-8.4 and 4.0 to 5.0 mg/l respectively.

The study indicated that *Caranx ignobilis* is the most predominant species of Kali estuary. It was

also recorded that the four species namely *C.ignobilis*, *M.cephalus*, *L.argentimaculatus* and *L.johnii* were recorded in all the three seasons (Table 2).

Table 2. Seasonal variation in abundance of natural seed resources

Species	Pre monsoon	Monsoon	Post monsoon
<i>C.ignobilis</i>	35.4	35.6	29.5
<i>M. cephalus</i>	16.6	19.06	18.4
<i>L.argentimaculatus</i>	2.1	18.64	16.84
<i>L.johnii</i>	4.2	12.7	18.42
<i>G.speciosus</i>	10.4	0	0
<i>L.lentjan</i>	0	5.1	4.7
<i>S.javus</i>	10.4	0	3.2
<i>S.sihama</i>	20.8	2.11	8.94
<i>P.erumei</i>	0	6.8	0

Based on the availability and abundance of prioritized fish species at different stations of Kali estuary, potential sites for different fish seed were identified. Songeri was identified as the most potential site for seeds of *C.ignobilis*. Sunkeri is the most potential site for seed collection of *M.cephalus*. Potential sites for *L.argentimaculatus* and *L.johnii* were Halga and Songeri respectively. It is concluded that Kali is one of the most potential estuary for natural seed resources of fish species prioritized for mariculture.

## An economic analysis of loss in fishing days due to fishermen strike: A case study in Rameswaram fish landing centre

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### Introduction

Ramanathapuram district in Tamil Nadu has 237 km coastline and accounts for about 22% of the state fisher population. The district has 1,707 (29.2 % of total fishing unit) mechanised boats, 3,140 (53.7%) motorised and 1,002 (17.1%) non-mechanised fishing units (State Fisheries Department, Government of Tamil Nadu, 2014-15). During the fishing season two types of trawl nets are used namely shrimp nets and fish nets. Apart from this, gillnet, driftnet, hooks & lines are operated in country craft with inboard engine and plank built boats with outboard engine.

The fishing area available in Palk Bay is limited due to the close proximity of Sri Lanka. The Sri Lankan Navy confiscate vessels that trespass into their territory and capture the Indian fishers who can be kept in remand for many months/years and

such events occur frequently. As a consequence the fishers in India go on frequent strikes demanding the release of Indian fishermen. During the year 2014 and 2015, there were fishing strikes almost every month except during fishing ban period (15<sup>th</sup> April to 29<sup>th</sup> May). The present study documents the loss of fishing days in Rameswaram landing centre and estimates the loss in catch and revenue.

### Methodology

Among the various landing centres in Ramanathapuram district, Rameswaram landing centre was purposely selected for the present study. The length of the mechanised boats in Rameswaram ranges from 30 to 60 feet with engine capacity of 70 to 170/193 bhp. The largest boats now constitute five per cent of the total fleet, offering greater speed, storage and stability. Boats from

Table 1 Total and actual fishing days at Rameswaram during the year 2014 and 2015

Month	Total fishing days		Actual fishing days		Loss in fishing days	
	2014	2015	2014	2015	2014	2015
January	13	13	08	10	05	03
February	12	12	07	12	05	00
March	13	14	10	11	03	03
April	06	06	06	04	00	02
May	00	00	00	00	00	00
June	13	13	10	08	03	05
July	13	13	10	09	03	04
August	13	13	00	12	13	01
September	13	13	09	09	04	04
October	13	13	10	11	03	02
November	13	13	06	09	07	04
December	13	14	06	09	07	05
<b>Total</b>	<b>135</b>	<b>137</b>	<b>82</b>	<b>104</b>	<b>53</b>	<b>33</b>

Rameswaram cannot go for fishing in Gulf of Mannar side, since it has to cross either through Pamban Bridge or Dhanuskodi which is very difficult, whereas boats from Mandapam and Pamban can fish in both Palk Bay and Gulf of Mannar Region.

The data on operating cost and returns from 20 mechanized fishing units in Rameswaram landing centre were collected every month for the years 2014 and 2015 using comprehensive and pre-tested interview schedule. During this process the actual fishing days and loss in fishing days were also documented. From the collected data, the economic indicators like operating cost per trip, gross revenue per trip, net operating income, capital and labour productivities were worked out for the respective years. Based on this information, the total loss in catch and revenue due to strike was worked out.

It was found that in Rameswaram landing centre during the year 2014, out of 135 total fishing days, there was only 82 days of fishing leading to a loss of 53 fishing days and in 2015, there was a loss of 33 fishing days (Table 1). In 2014, 30 % (41 days) were due to strikes demanding the release of Indian fishermen arrested by Sri Lankan Navy. In 2015, 21 days loss in fishing due to strike was recorded. In 2014, the loss in fishing days was more in August

(13 fishing days), whereas in 2015, it was less than five days in almost all the months. Apart from strike other reasons for loss of fishing days were cyclone warnings and festivals.

#### Estimation of economic loss due to strike

##### (a) Average cost and returns per trip in mechanised single-day trawl (fish) net fishing - SDF (fish)

The average operating cost per trip of mechanized single-day trawl (fish) net fishing for the year 2014 was worked out to be ₹ 26,744 per trip with a gross revenue of ₹ 44,139 per trip (Table 2). The net operating income worked out to ₹ 17,395 per trip. There was slight reduction in gross revenue (6.3%) in 2015, compared to 2014.

##### (b) Average cost and returns per trip in mechanised single-day trawl (shrimp) net fishing - SDF (shrimp)

The average operating cost per trip of mechanised single-day trawl (shrimp) net fishing for the year 2014 was worked out to ₹ 25,965 per trip with a gross revenue of ₹ 43,084 per trip (Table 2). The net operating income worked out to ₹ 17,119 per trip. In comparison to the year 2014, there was 12% reduction in gross revenue in 2015.

Table 2 Economic loss due to strike

Indicators	SDF (Fish)		SDF (Shrimp)	
	2014	2015	2014	2015
1. Avg. Catch (in kg)	979	830	433	387
2. Avg. Operating Costs (in ₹)	26,744	26,350	25,965	25,000
3. Avg. Gross Revenue (in ₹)	44,139	41,350	43,084	37,800
4. Avg. Net Operating Income (in ₹)	17,395	15,000	17,119	12,800
5. Loss in fishing days	41	21	41	21
6. Loss in catch (in tonnes) (1) × (5)	40.14	17.43	17.75	8.13
7. Loss in revenue (in lakhs) (3) × (5)	18.09	8.68	17.66	7.93
8. What could have been the catch if there was no strike (in tonnes)	120.42	103.75	53.26	48.38
9. What could have been the revenue if there was no strike (in lakhs)	54.29	51.69	52.99	47.25

**Table 3 Macro level economic loss**

Indicators	SDF (Fish)		SDF (Shrimp)	
	2014	2015	2014	2015
Loss in revenue per boat (in lakhs)	18.09	8.68	17.66	7.93
Total number of trawlers operated	380	330	380	440
Total loss in revenue (crores)	68.74	28.64	67.11	34.89

It was estimated that due to loss in 41 fishing days in the year 2014, nearly 40.14 tonnes of fish which could have landed in Rameswaram was not caught. Hence the estimated gross revenue loss was ₹ 18.09 lakhs. In the year 2015, around 17.43 tonnes of fish which could have landed in Rameswaram was not caught due to 21 fishing days cost. Hence there was a gross revenue loss of ₹ 8.68 lakhs.

It was estimated that due to loss in 41 fishing days in the year 2014, nearly 17.75 tonnes of shrimp and other resources which could have landed in Rameswaram was not caught. Hence there was a gross revenue loss of ₹ 17.66 lakhs. In the year 2015, around 8.13 tonnes of fish which could have landed in Rameswaram was not caught and a gross revenue loss was ₹ 7.93 lakhs.

If there was no strike, there would have been 123 and 125 fishing days in 2014 and 2015 respectively. Hence total revenue of ₹ 54.29 lakhs and 51.69 lakhs - SDF (fish) could have been obtained for 2014 and 2015 respectively. Similarly for shrimp resources, total revenue of ₹ 52.99 lakhs and 47.25 lakhs could have been obtained for 2014 and 2015

respectively. It is evident that the magnitude of revenue loss due to fishing strike is very high (Table 3).

### Conclusion

It is evident from the study that loss in fishing days led to reduction in marine fish landings, which in turn resulted in revenue loss to fishermen. Most of the loss in fishing days was due to fishing strike organized by the fishermen associations/groups. Hence it is the responsibility of the fishers to avoid such strikes as far as possible for the betterment of fishermen livelihood. Further Government can evolve a mechanism to find a permanent solution to this perpetual problem and also facilitate the movement of fishers from Palk Bay to Gulf of Mannar region for fishing activity. This mechanism will reduce the fishing pressure at Palk Bay side and prevent the inadvertent crossing of International Maritime Boundary Line (IMBL) by our trawlers. Besides, to reduce the fishing pressure it is also suggested to promote economically viable alternate livelihood options like seaweed farming and cobia farming, which are gaining momentum in this region.

## Impact of Cyclone Vardha on fishers and their livelihoods

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The Vardah Cyclone struck Chennai, Kanchipuram and Thiruvallur coastal districts of Tamil Nadu on 12<sup>th</sup> December 2016 and impacted nearly 25000

fisher families. Wind speed of 140 km/hour and tidal waves inundated the low lying areas of coastal villages causing very heavy damage. In badly hit

Table 1. Estimation of economic loss due to loss in fishing days

District	Mechanised			Motorised		
	Number of crafts	Loss in Fishing days	Economic loss (₹ Crores)	Number of crafts	Loss in Fishing days	Economic loss (₹ Crores)
Chennai	832	4	8.32	1185	7	1.08
Kanchipuram	-	-	-	1985	5	1.49
Thiruvallur	-	-	-	1211	12	2.47
<b>Total</b>			<b>8.32</b>			<b>5.04</b>

mechanised and motorised fishing boats, gears, engines and catamarans in coastal villages and landing centres. Majority of them could not go for fishing and allied activities which resulted in loss of their regular daily income. Thousands of fishing boats were damaged beyond repair in several coastal villages. With this backdrop, the loss in fishing days, damage to property, crafts, gears and household appliances were estimated based on report developed by Department of Fisheries, Tamil Nadu. Average fishing income per day was estimated based on cost and earnings data routinely collected from the fish landing centres by Socio-economic Evaluation & Technology Transfer (SETT) Division of ICAR- CMFRI. Economic loss was calculated by estimating number of loss in fishing days and average fishing income per day.

In Chennai 21 mechanised boats were wrecked and 807 mechanised boats were partially damaged. 191 motorised boats were damaged. Total physical loss was worked out based on data provided by Fisheries Department, Tamil Nadu and estimated to be ₹ 6.57 crores. (Fig. 1) Economic loss was estimated to be ₹ 9.4 crores (Table 1). Nearly 1243 FRP boats and 728 catamarans were partially damaged in Thiruvallur district. Damage value was assessed as ₹ 9.6 crores and economic loss as ₹ 2.5 crores. Total economic loss in Thiruvallur district was estimated at ₹ 12 crores. Damage to fishing crafts and gears was estimated at ₹ 19 crores in Chennai, Kanchipuram and Thiruvallur districts of

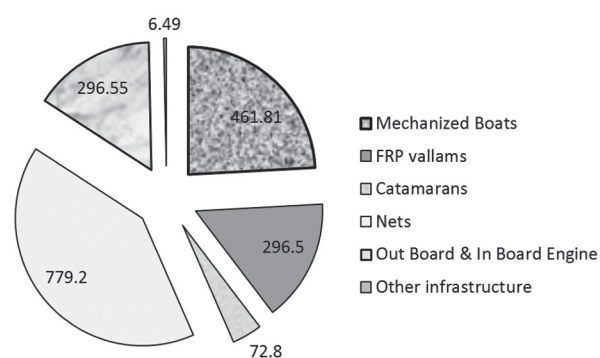


Fig. 1. Estimated cost of Physical damage (in lakhs ) caused by Cyclone Vardah to fishing crafts and gears in Chennai, Kanchipuram and Thiruvallur coastal districts (Source: Fisheries Department, Tamil Nadu)

Tamil Nadu and the economic loss due to loss in fishing days was estimated to be 13.4 crores (Table 1). Chennai coastal district was more impacted than other districts in terms of total economic loss whereas physical damage to boats and nets was higher in Thiruvallur district.

Total economic loss due to Vardha Cyclone in Chennai, Kanchipuram and Thiruvallur coastal districts worked out to be ₹ 32.5 crores. Fisheries Department worked round the clock and paid relief amount to the fishers based on the assessment of physical damages during January, 2017. As per the NDRF (National Disaster Response Fund) norms, Fisheries Department of Tamil Nadu assessed the damage of crafts and gears by Vardah Cyclone and disbursed relief amount to the fishers.

## Impulse effect of demonetisation on the fishing operations, trade and fish consumption in Ernakulam, Kerala

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A rapid survey was conducted during 24-26 November 2016 in order to assess the effect of demonetisation of the ₹ 1000 and ₹ 500 currency bills on the marine fishing operations, trade and fish consumption in Ernakulam district, Kerala across different landing centres and markets. A structured schedule eliciting information on the details related to the total number of fishing operations, crew size, landings, price realised, etc. was used (Annexure 1). The traders (exporters, wholesalers and retailers) were queried on the changes in the quantum of transaction and prices (paid and demonstration realised) during the pre and past periods. The study analysed the extent of different fishing operations by mechanised, motorised and non-mechanised sector in the landing centres / harbours of Munambam, Chellanam, Fort Cochin, Cochin Fisheries harbour and Kalamukku during the pre-demonetised (prior to 8th November) and post demonetised (9-23 November 2016) period covering a fortnight. The fishing operations include the number of trips, days of fishing, depth of fishing, crew size, crew share, operating cost etc. The traders from the Broadway, Thevara, Thoppumpady, Chambakkara and Kaloore fish markets were interviewed for assessing the status of the business during these days. In addition, consumers were interviewed on their pattern of fish consumption during the period. The study covered 200 respondents who were mainly boat owners/ representatives (n=35), labourers (crew / harbour

labourers) (n=40), traders (exporters/ wholesalers) (n= 20), commission agents (n=20), retailers (n=25) and consumers (n=60). The study on the effect of demonetization across the operations / stakeholders revealed the following:

### Fishing operations

The analyses on the fishing operations indicate that there weren't any considerable reduction in fishing operations consequent to demonetisation process. The available supply of money (in denominations of ₹ 500 and 1000) and its usage till December 15 towards the purchase of fuel (diesel) by the pump owners and facilitation by the commission agents ensured that there was no decline in the major fishing activities. However, there was a marginal decrease in the multi day fishing operations during this period. During this season the landings were low mainly due to fishing reasons (slack season, non-availability of crew who were planning to go home for Christmas etc) rather than the demonetisation. Most of the fishing operations from mechanised, motorised and non-mechanised crafts continued amidst these reform shifts. Crew remunerations includes two components viz., crew wages and crew *bata*. The crew share varies depending on the crew size and the different craft gear combinations. Crew wages are normally given on the basis of the revenue generated post sharing the cost of operation and could range from 40-50% among the trawl workers

mainly in Cochin Fisheries Harbour. Crew *bata* is an incentive given to the crew members who are engaged in fishing operations in the sea, irrespective of the catch. It is a fixed amount paid as daily wages to the crew irrespective of the catch based on the duration of the fishing trip and normally ranges between ₹ 150-200 per day and along with this they are also paid for provisions /food expenses. The study revealed that for the realisation of the labour involved, the crew *bata* alone was provided by the commission agents as subsistence and the crew share of the fishermen on account of the catches was delayed for a future payment.

The average revenue losses per trip in landings for the different craft and gear combinations are indicated in Table 1. The results indicate that reduction in the revenue earned from the landings ranged between 8 -16 % ranging from 8.28 % in the case of single day trawlers to 15.79% in the case of inboard ringseine. The gillnetters weren't included

as most of them operate for more than 30-40 days.

### Price realisation

There was a 15-20 % reduction in the landing centre price of major species due to inconsistent demand. However there were no significant changes in the procurement / purchase prices of the export species / high value fishes. The retail prices of the fish species was reduced by 30-40% on account of lower demand from the consumers. There was a marginal reduction in wholesale prices of the fishes which led to an increase in the procurement of fishes by the traders for the production of value added fish products. The prices of the important commercially traded fishes in the retail markets of Kaloor, Broadway and Thevara are given in Table 2.

### Traders

Normally trading in landing centres/ harbour is facilitated by three different supply chain agents - the exporters, wholesalers and the retailers. The

Table 1. Average revenue losses during the period

Sector	Pre demonetisation*	Post demonetisation#	Per cent losses
Trawler (SD)	85,000	78,500	8.28
Trawler (MD)	520,050	475,500	9.37
Ringseine (Inboard)	165000	142500	15.79
Ringseine (Outboard)	8800	7700	14.29
Non mechanised	1050	950	10.53

\*Pre demonetisation (7<sup>th</sup> October - 7<sup>th</sup> November), #Post demonetisation (9<sup>th</sup> Nov- 26<sup>th</sup> November)

Table 2. Average Price differentials of major commercially traded fish species

Species	Pre demonetisation(₹/kg)*	Post demonetisation (₹/kg)#
Sardine	141.67	110.83
Mackerel	161.67	132.92
Thread fin breams	160.00	125.00
Black pomfret	355.67	315.00
Red snapper	246.67	216.67
Anchovy	150.00	120.00

\*Pre demonetisation (23<sup>rd</sup> October - 7<sup>th</sup> November 2016), # Post demonetisation (9<sup>th</sup> November - 23<sup>rd</sup> November 2016)

fishing industry which depends on cash transactions was in a shock for a few days. However it was observed that the November - December period, being the peak export sourcing period and the prevalent increased exchange rates, the exporters found an opportunity to procure more fish during this period of study. As the export payments are normally done with a lag, the transaction were not affected and the export procurement increased by 10-20%. Wholesalers were marginally affected as the delay in payments had led to lower liquid transactions and the unavailability of liquid cash to facilitate new procurements which necessitated the need for credit / cheques for large transactions. The small retailers who purchased 5 -10 boxes of fish were affected because of lower demand of fish from the consumers and the unavailability of the lower denominations of money for giving change to the customers. The retailers also opined the need for longer selling hours to dispose the fish and sometime even resorting to distress sales.

### Consumers

The consumption of fish came down by 30-40 % during the above period. The consumer perception on low fish consumption is depicted in Figure 1. 70% of the polled consumers expressed that they reduced their consumption on account of the non-availability of the lower tenders while purchasing fish. 58% of the respondents reduced their consumption as it was necessary to reallocate and

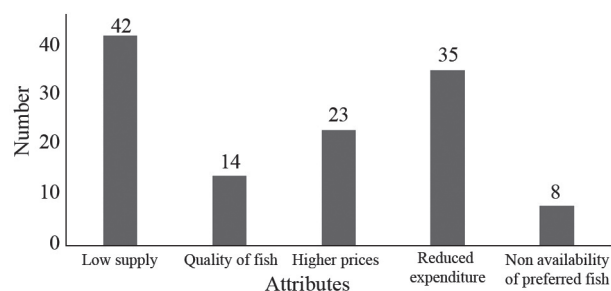


Fig. 1. Consumer perception on low fish consumption

prioritise the consumption expenditure within the limited legal tenders available in hand leading to lower fish demand. The prices of fish had an impact on the consumption pattern which was mainly the differences in the price during their purchases. 23 % of them have reduced their consumption due to quality reasons and 13% of them account to non-availability of preferred fishes.

The most unique thing which was noticed consequent to the demonetisation reform in the fisheries sector was the continued “trust” among the different stakeholders (boat owners, commission agents, labourers and traders) in ensuring that the fishing operations and trade weren’t affected. The stakeholders facilitated smooth fishing operations as well as business transactions during this period. The fishing operations continued undeterred because the major operation costs are incurred for diesel and the crew share (which is a combination of crew wages and profit share). The commission agents provided for the *bata* and food provisions to the crew and since the diesel required was made available, the operations continued undeterred and the crew share was provided with a lag by the commission agents. The fisheries sector rallied behind the commission agents who became key player in building the trust in the sector.

The short study indicated that ‘Trust’ - rules the roost in the fishing sector and the commission agents played a pivotal role in facilitating fishing operations. The sector is slowly embarking on a transparent, cashless and identified banking system. The bottom players in the value chain viz., the retailers and consumers were mainly affected due to non-cash transactions and non-availability of smaller denominations. However their expectations were that the slowdown will only be short-lived and that the fishing economy will rebound once the systems adjust to the new normal.

## Annexure -I

**Socio-Economic Evaluation and Technology Transfer Division  
Central Marine Fisheries Research Institute Kochi - 682 018**

**Study on the effect of demonetization of currency in fisheries sector**

Landing Centre:	District:	State:	Date of observation:	
Sector		Craft / Gear		
OAL / Engine HP				
Particulars		Pre demonetization	Post demonetization	
Average number of trips				
Days of fishing (Single / Multi day.....)				
Depth of fishing				
Operating cost (diesel / ice / bata)				
Crew size (Number of fishermen)				
Average wage rate (Amount in ₹ / Share)				
<b>Landings per trip (kg)</b>				
Average fish landings (Name of the species)	Qty (kg)	Price (₹) / box (wt of box)	Qty (kg)	Price (₹)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
<b>Revenue per trip</b>	<b>Quantity X Price</b>			

## Market Structure Analysis of fish markets in Sindhudurg, Maharashtra

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Maharashtra is one of the major coastal states in India contributing to 11.55% (4630 crores) worth of marine fish landings at the landing centre. The marine landings in Maharashtra during 2015 was estimated at 2.65 lakh tonnes registering a decrease of 23% compared to 2014. Greater Mumbai district ranked first with 50.4% followed by Raigad (17%),

Ratnagiri (12.4%), Thane (10.6%) and Sindhudurg (9.6%). Sindhudurg district of Maharashtra accounts for 25,440 tonnes of fish production from marine sector (Table 1).

### Market structure analysis

Sindhudurg district has three major fish markets at Devgad, ChambarBhati and Jamsande that offers

**Table 1. Marine fisheries profile of Maharashtra & Sindhudurg district**

	Maharashtra	Sindhudurg district
Length of the coastline (km)	720	121
Number of landing centres	152	34
Number of fishing villages	456	83
Number of fishermen families	81,492	7277
Total fisher folk population	386259	33178
Number of fish markets	280	42
Number of wholesale markets	30	4
Number of retail markets	50	8
Number of terminal markets	200	30
Number of export units	39	2
Total fishing crafts	17,362	1940
Mechanised fishing crafts	13,016 (75%)	929 (48%)
Motorised fishing crafts	1563 (9%)	606 (31%)
Non mechanised fishing crafts	2783 (16%)	405 (21%)
Number of boat building yards	5	0
Marine Fish landings (2015-16)	2.65 lakh tonnes (t)	25440 t

significant marketing functionaries and trade (Table 2). Due to the nearness of roads and railways, market arrivals and disposals are done within a very short span of time and all are well structured markets.

Around 20-25 marine and inland species are marketed in these markets with the most common fish species being sardine, mackerel, seer fish, catfish, croakers, pomfrets, anchovies, shrimps etc. Price discrimination exists for high valued fish species (Table 3).

**Table 2. Market structure analysis of fish markets in Sindhudurg District**

Market Dimension	Devgad	ChambarBhati	Jamsande
<b>A. Location</b>			
Year of establishment	1988	2013 (Old market but reconstructed in 2013)	2000
Type of Market	Wholesale & Retail	Wholesale & Retail	Retail
Area of the market (sq feet)	1500	2500	80
Lat/Long Position	16° 37' 54"N 73° 38' 86"E	16° 37' 54"N 73° 38' 86"E	16° 38' 78"N 73° 41' 44"E
Market control	Co-operative societies	Co-operative societies	Private
<b>B. Market access</b>			
Nearest landing Centre	Chambar Bhati (700m)	Devgad (700 m)	Chambar Bhati (7 km)
Nearest railway station (km)	Nandgaon (50)	Nandgaon (49)	Nandgaon (45)
Nearest bus station	Devgad (500 m)	Devgad (1 km)	Devgad (6 km)
Nearest airport (Km)	Goa (Panaji) (150)	Goa (Panaji) (150)	Goa (Panaji) (145)
Nearest seaport	Goa	Goa	Goa
<b>C. Market Timing</b>			
	0800-1200 hrs	0400-0800 hrs	0400-800 hrs
<b>D. Market conduct</b>			
Wholesalers	10-15	10-15	Nil
Retailers	60-90	100-120	40-60
Middlemen	10-20	10-20	2-3
Commission agents	8-12	8-12	2-3
1) Brokers	8-12	8-12	2-3
Entry fee for operation in market	₹ 25/day collected by co-operative societies from retailers	No charge	₹ 20/day collected by market owners

Table 3. Major Species traded in the selected fish markets and its prices

Species	Devgad		ChambarBhati		Jamsande	
	Qty (kg)	Average Price (₹)	Qty (kg)	Average Price (₹)	Qty (kg)	Average Price (₹)
Cat fishes	250	100	200	120	30	135
Croakers	500	120	600	130	25	130
Mackerel	1000	100	600	70	35	115
Pomfrets	500	300	300	325	10	400
Sardine	750	60	1200	40	40	65
Seer fish	500	450	650	450	15	500
Shrimps	1000	250	600	200	30	300
Anchovy ( <i>Thryssa</i> )	500	40	1200	50	60	60
Puffer fish	150	15	200	20	-	-
Tuna	200	85	200	90	20	120
Ribbon fish ( Small)	200	55	250	65	20	100
Ribbon fish ( Big)	200	120	250	140	15	180
Squid	250	90	200	110	20	175
Cuttle fish	250	200	300	160	20	225
Mullet	100	300	300	320	25	350
Lizard fish	250	220	300	210	30	260
Thread fin breams	150	80	200	100	40	115
White fish	150	100	300	90	30	120
Barracudas	150	80	200	90	20	130

### Market arrivals and disposals

The market study indicates that in Devgad market fish arrivals are mostly from Chambar Bhati and Jamsande. The Devgad market often sends fishes to different local markets Taramumbari, Vengurla and Malvan. In Chambar Bhati market major fish arrivals are from Devgad, Jamsande and Ratnagiri, and the market trades marine fishes to Ratnagiri and the neighbouring states of Goa and Karnataka. Mostly the fish arrivals of retail market in Jamsande are from Devgad and ChambarBhati.

### Constraint analysis

The following constraints as perceived by traders were ranked using Garette ranking technique (Table 4). It indicated that lack of infrastructure and allied amenities in markets including waste management facilities, parking areas, freezers, better drinking water etc. besides inadequate supply of fish across the fish markets were found to be the major constraints in the fish markets in Sindhudurg district. Lack of access to facilities was found to be the second constraint with the traders.

Table 4. Constraints perceived by the market traders

Species	Devgad		ChambarBhati		Jamsande	
	Score	Rank	Score	Rank	Score	Rank
High marketing cost	III	72.22	IV	61.11	IV	61.11
Lack of infrastructure and amenities	I	94.44	I	94.44	I	94.44
Price discrimination	IX	5.56	V	50.00	VIII	16.67
High transportation cost	VI	38.89	III	72.22	VI	38.89
Lack of access to facilities	II	83.33	II	83.33	II	83.33
Lesser number of buyers	IV	61.11	VI	38.89	III	72.22
Cut-throat competition among traders	VIII	16.67	IX	5.56	IX	5.56
Low product diversity	VII	27.78	VIII	16.67	VII	27.78
Inadequate supply of fish	V	50.00	VII	27.78	V	50.00

## Action Plan on seaweed exploitation, mariculture and utilization in India

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All macroscopic algae occurring in the marine, coastal and brackish water habitats are termed as seaweeds. They are valued commercially for their polysaccharides deposited in the cell wall besides, minerals, metabolites and nutraceuticals that can be developed from them. Along the Indian coast, 844 species of marine algae comprising 216 species of Chlorophyta, 191 species of Phaeophyta, 434 species of Rhodophyta and 3 species of Xanthophyta are estimated. The seaweed resources surveys carried out so far by the ICAR- CMFRI, Kochi; CSMCRI, Bhavnagar and NIO, Goa in the intertidal and shallow water areas of east and west coasts and Lakshadweep and Andamans, estimated a total standing crop of all the seaweeds in Indian waters as more than 2,60,876 tonnes (wet weight).

Acute shortage of agar yielding red seaweeds all over the world can jeopardize the research programmes in the fields of biology and medicine for want of agar and agarose. In India too reduction in the quantity of wild collected native seaweeds like species of *Gracilaria* and *Gelidiella* is being observed. Red seaweeds are now imported from Sri Lanka, Morocco and SAARC countries with import duty varying between 4-37%. Most of the agar producing units in India remain shut due to lack of raw material and high import duty. This acute shortage in raw material supply is mainly due to indiscriminate exploitation of seaweeds over the years from Tamil Nadu coast (3700-4500 tonnes dry wt/ year) coupled with habitat destruction.

In December 2003 the National Academy of Agricultural Sciences organised a Round Table on 'Seaweed Cultivation and Utilisation' to discuss various aspects of seaweed cultivation and

utilisation in India pertaining to their resources and diversity, biomass estimation, sustainable exploitation, commercial cultivation and processing, herbaria and algal cryopreservation, introduction of exotics and problems faced by the industries. The recommendations that emerged out of the Round Table was brought out in the form of a policy document (*Seaweed Culture and Utilization*, No 22(2003) NAAS, New Delhi). During February 2016, the ICAR-Central Marine Fisheries Research Institute with the support of Department of Biotechnology, New Delhi organized a 'National Consultation on mariculture, utilization and value addition of seaweeds for the livelihood security of coastal population' and an Action Plan was prepared as detailed below.

### A. Seaweed resources and exploitation

1. Undertake study to revise seaweed biomass estimates for commercially important seaweed resources since most records available are out dated (more than 30 years back).
2. A GIS map indicating the biomass for harvest along the Indian coast is very much essential.
3. Encourage proper scientific and improved seaweed collection methods for profitability and for sustainability, while avoiding over harvest, destruction of habitat and harvest of immature seaweeds.
4. Develop seaweed harvest calendar for each region.
5. Annual data on seaweed resources exploited, edible products and other products to be maintained and documented.

6. Identify reasons for decline and methods for repopulation.
7. Identify stress resistant strains from natural environment and also develop stress resistant strains of cultivable species.
8. The large scale exploitation of seaweeds for almost entire industrial units of our nation is from the south east coast and hence this exploitation and processing sector along the Gulf of Mannar and Palk Bay shall be certified by the Marine Stewardship Council or Aquaculture Stewardship Council.

#### B. Seaweed Farming

1. Identify ideal sites exclusive for seaweed farming for each State/ UTs towards socio-economic upliftment of the coastal community.
2. Improve seaweed farming methods- reduce recurring expenditure, develop off- shore farming methods.
3. Promote horizontal expansion of seaweed farming- Pilot studies to be conducted and development to be made only in areas where the coastal villagers are interested to take up farming.
4. Against the indiscriminate exploitation of seaweeds for commerce, seaweed mariculture is the only alternative towards steady supply of raw material and for sustainability, while the natural beds will be conserved. This has to be addressed through the Integrated Multitrophic Aquaculture (IMTA) programme along the Indian coast.
5. To ensure steady supply of raw materials, high priority to be accorded for large scale mariculture.
6. Explore import/ introduction of planting material both to reinvigorate and diversify the cultivars following all legal formalities.
7. In the context of Climate Change and its resultant sea level rise, estuaries are expected to be inundated with seawater and more and more protected bays and estuaries can be brought under seaweed cultivation. Brackishwater species of seaweeds if any can be considered for large scale cultivation.
8. Large scale cultivation of seaweeds for industrial requirements can be encouraged for mitigating ocean acidification and can offer livelihood support to many coastal fisherfolks. Creating awareness through socioeconomic interventions can bring in more benefits.
9. Carrying capacity has to be carried out in the seaweed farming sites to optimize the yield and to avoid crashing of crops as happened recently at Palk Bay in the case of *Kappaphycus alvarezii*.
10. Availability of seed stock is the major deciding factor for making commercial cultivation more viable. Hence the stock improvement and seed production technology can be attempted through biotechnological interventions in collaboration with the Department of Biotechnology, New Delhi. Natural seed banks can also be created either in ponds or in suitable sub-tidal regions.
11. Commercial farming of unconventional agarophytes such as *Gracilaria dura* and *G. debilis* (Gracilariaceae, Rhodophyta) and their value addition through linkage with industrial partners.
12. Introduction of new strains of *Kappaphycus* and other commercially important seaweeds such as *Gracilaria* NBr-10, a fast growing red seaweed from subtropical climatic zones.

#### C. Utilization

1. Utilization of seaweed and seaweed products, their value addition and postharvest technology are to be addressed with major thrust.

2. Programmes on utilization of spent biomass of seaweed industries for manure, biodiesel production etc should be strengthened.
3. Seaweeds are regarded as highly potential biomass sources for quality biofuel production due to their rapid multiplication and growth rate (8-10 times faster) compared to terrestrial and aquatic higher plants. Farming of marine algae is a green technology without the involvement of energy, fertilizers and chemical inputs and is not a labour intensive avocation.
4. Large scale mariculture of marine algae can definitely check ocean acidification considerably. It is estimated that 3% of world's coastal waters with seaweeds grown would produce 230 billion litres of ethanol.
5. As majority of seaweeds lack lignin and pectin on their cell walls, their breakdown and fermentation can be hastened and enhanced by the involvement of suitable microbes (*Bacillus* spp; *Vibrio splendidus* etc). The bioethanol thus produced from seaweeds can be blended with petrol. The energy content of algal biomass is roughly 4700 k cal/kg compared to the energy value of coal (3600-4200 k cal/kg).
6. For functional foods and bioactive secondary metabolites search for new seaweed species are to be strengthened.

#### D. Policy:

1. Seaweed based bio-stimulants for use in agriculture should be duly notified as agricultural inputs by the Ministry of Agriculture and Farmers' welfare.
2. Food Safety and Standards Authority of India (FSSAI) may be requested to harmonize Indian Standards for use of carrageenan as a food additive in line with the CODEX standards.
3. Adopt single window system in the form of a Nodal Cell for seaweed cultivation, processing and marketing to be set up under the Ministry of Agriculture and Farmers' welfare similar to the Bureau of Aquatic Products as in China, Philippines and Indonesia.
4. Explore the possibilities of lifting restriction on export of farmed red seaweeds. Anomaly in classification of agar, algin and carrageenan under the Central Excise and Customs tariff requires to be rectified.
5. Clearance for use of specific coastal waters should be obtained for seaweed farming from Coastal Zone Management Authorities.
6. Cultivation of seaweeds and the harvested (wet/dry) seaweeds shall be treated respectively as agricultural cultivation and agricultural produces for the purpose of fiscal levies.
7. Seaweed cultivation should be encouraged and undertaken all over the Indian coasts as seaweed cultivation is ecologically safe and green technology helps sequester CO<sub>2</sub> levels and thus check ocean acidification.
8. For the production and marketing of value added products raw material exploitation from the natural beds should not be encouraged and the raw material requirement should be met from mariculture at least in a phased manner or limited the cast ashore materials.
9. Harvesting of seaweeds from natural beds to be regulated by fixing quota system and restricted during post reproductive stage (after completing the spore liberation) to ensure and enhance natural stock.
10. Harvesting seaweeds from the natural beds should be regulated in such a way that this process should not spoil the habitat.

#### E. Researchable areas

1. Integrated Multi Trophic Aquaculture (IMTA) - further refining for areas with high tidal amplitudes and horizontal expansion.

2. Integrated taxonomic approaches for documenting the seaweed resources of India.
3. Development of stress resistant and genetically improved high yielding strains of commercially important seaweeds for improving livelihood options of coastal communities.
4. Bio prospecting of novel molecules from marine

algae of native origin for industrial and health applications.

For more livelihood opportunities, better utilization of seaweeds and to increase national production, linkages between researchers, farmers and industries must be strengthened through an All India Coordinated Research Project on Seaweeds.

## Observations on the epifaunal assemblage of micro-mollusc *Electroma vexillum* on the seagrass beds of Tuticorin coast

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Seagrass habitats form a highly productive fragile ecosystem, which offers food, shelter, and essential nursery areas of many fish and benthic invertebrates like crustaceans, bivalves, echinoderms and other groups that are produced within, or migrate to that habitats.

During our regular visit to the seagrass beds of the erstwhile Pandian island of Tuticorin coast, in connection with the assessment of the population characteristics of seagrass beds, small forms of bivalve species were noticed to heavily infest the blades of three resident species of seagrass like *Cymodocea serrulata*, *Halophila ovalis* and *Syringodium isoetifolium*. The bivalves were having inequable, fragile, translucent, obliquely wedge-shaped shell valves which were mostly greenish to brown in colour with narrow dark brown zigzag lines on the dorsal shell valves (Fig. 1).

The shell length of the collected specimens was measured using a digital calliper and total weight by using an electronic balance after drying in blotting papers. The specimens were camouflaging the available seagrass habitat showing distinct colour patterns and significant preference or

zonation in their distribution. Larger specimens of size ranging from 5.9 - 10.4mm with a mean  $\pm$  SE of  $8.08 \pm 0.43$  mm and a corresponding weight ranging from 0.043 to 0.08g ( $0.06 \pm 0.004$ g) and with the mean length to height proportion of  $1.5 \pm 0.16$  were noticed adhering on leaf blades of seagrass species with broad leaves like *Halophila ovalis* and *Cymodocea serrulata*, (Fig. 2), whereas spat of the same species having a length ranging



Fig.1 Close-up view of *Electroma vexillum*



Fig. 2. *Electroma vexillum* attached on seagrass leaf blade from 0.84 - 2.51mm ( $1.38 \pm 0.20$  mm) were found attached to the seagrass species with narrow leaf blades like *Syringodium isoetifolium*. This zonation

in distribution proved the ability of this species to utilize seagrass leaves as settlement surface selectively as the growth advances. 68.9% of the total biomass of *Halophila ovalis* beds and 72.6% of *Cymodocea serrulata* beds were constituted by this bivalve, which indicated gregarious nature of this species.

In the first instances, the bivalve was erroneously identified as the spat of invasive *Modiolus* sp. Later after detailed morphometric studies and consulting with experts, the specimens were identified as *Electroma vexillum* (Recve, 1857), which is very common in the Indo-Pacific region and has earlier been reported from Indian waters. In general, this species attains a maximum length of 10 mm and is normally found in seagrass fields, probably attached by a byssus to the seagrass leaves or hard substrate. Similar small species of bivalves and gastropods which are abundantly distributed in Indian waters are often misidentified or remain unnoticed and hence research focussed on their ecological significance is merited.

## Jellyfish as an export commodity

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Recently, jellyfish blooms have been reported with increased frequency from several parts of the world and it has been suggested that this phenomenon might be related to over-fishing and other human activities that are driving marine ecosystems off balance. It has contributed to the formulation of the “fishing down the food chain” hypothesis, which is based on the assumption that the reduction in large species marine predator

populations is promoting the growth of organisms from lower levels of the food chain. Rising sea temperature is also considered as a reason for the occurrence of jellyfish fishery.

### Fishery & Processing

Unusual landings of jellyfish (*Crambionella* sp.) were recorded along the Kakinada coast of Andhra Pradesh during 2013, where it is locally called as

*Muntha kaya / Neeti kaya* (Telugu). Gill nets (*jogavala / naravala*) of the dimensions, length 107 m and width 20 m with mesh size 12 mm are used for catching of jellyfishes. Fishers travel about 3 km from shore for fishing at a depth of 10-30 m. March to July is the fishing season. Mechanised boats landed about 540 t of jellyfishes worth ₹ 50 lakhs while non mechanised boat landed about 1345 t of jellyfishes worth ₹ 98 lakhs at Kakinada Fisheries Harbour during 2013.

Processing is carried out within 8 hours of jelly fish being caught as otherwise it will be spoiled. After landing, the jellyfishes are washed and cleaned with sea water and soaked for upto 3 hours in salt water. For 100 kg of fish, 30 litres (l) of salt



Soaking of jellyfish with salt and alum



Processed jellyfish ready for packing

water (25 ppt) was added, this process is called as salt mixing. After this for 1 ton of jellyfish, 5 kg of alum was added. After soaking, jellyfishes were collected in separate plastic tubs and then pressed to remove the unwanted mucus and sand particles. This was followed by second cleaning (in salt and alum water) where it is kept soaked for 5-10 days before packing.

Processing reduces liquefaction, odour, the growth of spoilage organisms and makes the jellyfish drier and more acidic, producing a crunchy and crispy texture. After processing jellyfish retains 7-10% of their original weight and the processed product contains approximately 6% protein. Freshly processed jellyfish has a white, creamy color and turns yellow or brown during prolonged storage. Plastic buckets are used for packing of jelly fishes. After completion of processing, jelly fishes are filled in 25 litre buckets and each bucket can be filled with 18 kg jellyfish and 7 l saltwater. Processed jellyfishes have good demand and are exported to countries like Vietnam, Japan, Thailand, China and Indonesia. One kilogram of jellyfish costs about ₹ 30 depending on the size grade. Raw material of unprocessed jelly fishes was sold for ₹ 700 to 800 per crate and was an alternate source of income to the fishermen during the fishing ban period.



Ready to transport jellyfishes packed in plastic buckets

## Mud bank fisheries at Chettuva

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A survey was conducted at Chettuva, Thrissur District, Kerala to observe the mud bank fishery in July 2016. Very low fish catch was recorded at Chettuva Fisheries harbour prior to the formation of mud bank. A sudden increase in catch after onset of mud bank formation prompted many fishers from nearby fishing villages such as Kalamukku (Ernakulam district); Chettuva, Azhikode and Thalikulam (Thrissur district) and Ponnani (Malappuram district) to temporarily migrate to these fishing grounds during the period reported. Ring seiners, motorised mini trawlers and non-motorised crafts were operated. Motorised wooden mini trawlers with either double or single outboard motor, with each boat having 9.9 hp power were also employed for fishing. Since mini trawl was operated with two attached crafts, it was locally known as double net. 50 fishing crafts were recorded during the survey which comprised 45 *Thanguvala*, 1 *Choodavala* (ring seine nets) and 4 double net (mini trawl) units. Fishermen went to fish in the early morning by 0430 hours and were involved in fishing about 4-5 hours daily. The fishing ground was reported at 2 km west of Chettuva Fisheries harbour with a depth range of 5-6 m. Landing of catch started from 0830 hours and continued up to noon. Catch was dominated by

shrimps, mainly *Metapenaeus dobsoni* whose size ranged from 200-300 numbers per kg. Pelagic fin fish was second largest component including *Rastrelliger kanagurta*, *Stolephorus* spp., *Opisthopterus tardoore*, *Dussumieria acuta*, *Tripauchen vagina*, *Thryssa* spp., *Megalaspis cordyla* and *Scomberoides* spp. Minor catch of *Johnius* spp., *Otolithes* spp., *Alepes* spp., *Ambassis* spp., *Lactarius lactarius*, *Alutera monoceros*, *Arius* spp. and *Lagocephalus* spp. was also recorded during the survey. Molluscan catch was absent, except small volumes of *Photololigo duvaucelii* with a size range of 5-6 cm. *Metapenaeus dobsoni*, *Opisthopterus tardoore* and *Escualosa thoracata* were the major catch of double net. The price of *Metapenaeus dobsoni* of 250-300 count varied from ₹ 190-200 per kg while *Rastrelliger kanagurta* was sold at ₹ 110 per kg. It was observed that price for all catches was higher than that of other seasons in same year.

Catch was less compared to previous mud bank fisheries. The heavy by-catch of jelly fish was a troublesome issue in net operation and affected time used for sorting and size grading of the fish catches in the harbour. All jelly fish were discarded after sorting the catch as it lacked local market demand, and caused hardship to the fishers.

## Mortality of olive ridley turtles during nesting season along Chennai coast

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Sporadic nesting activities of olive ridley turtle (*Lepidochelys olivacea*) are often reported along the Chennai coast in northern Tamil Nadu. These turtles approach the beaches for nesting in the Tamil month of Panguni and have thus derived the local name "Panguni aamai". As in every year, with the onset of

annual nesting season in early 2017, mortality of turtles along the Chennai coast was recorded. From 02.01.2017 to 07.01.2017, a total of seven adult turtle carcasses were observed in 20km stretch of beach between Marina beach and Kanathur Reddykuppam. The first specimen was observed in Nadukuppam

### Morphometric measurements of olive ridley turtles

Morphometric parameters (cm)	Odaikuppam		Kanathur Reddykuppam	
Carapace length (Straight)	72	67	66	64
Carapace length (Curved)	75	71.5	69.5	67
Carapace width	65	63	61	54
Plastron length	48	44.5	38	34
Plastron width	47	38		
Head length	26	22	23	16
Head width	13	11	13	09
Forelimb length	39	36	31.5	28
Forelimb width	9.5	7	7	7.5
Hind flipper length	19	19	-	-
Hind flipper width	8	8	-	-
Tail length	17	-	-	-

(13°02.46'N, 80°14.55'E), Marina beach in central Chennai on 02.01.2017. Subsequently, carcasses of two turtles, were found on the beach of Odaikuppam fishing village (12°59.23'N, 80°16'16'E) and four turtles in Kanathur Reddykuppam (12°50'51 N, 80°14.55' E) located in south Chennai. The carcasses, which were partially decomposed, were identified as olive ridley from the intact scute pattern on carapace. Carapace length of specimens ranged from 64 cm to 72 cm and weight approximately ranged from 30 to 35 kg. Morphometric characteristics measured to possible extent are detailed. In the present study, only one turtle found in Odaikuppam and 3 in Kanathur Reddykuppam had injury markings in hind flipper and lost tails while rest had no marks. The specimen recorded from Nadukuppam was found entangled in pieces of gillnet.

Globally, various laws and agreements are in force to protect this migratory species. In India, this species is protected under Schedule II of Indian Wild Life (Protection) Act, 1972. The demarcated Coastal

Regulation Zone (CRZ) under the Environment (Protection) Act, 1986 in 2011 regulates the human activities in Indian coast to ensure safe passage to turtles that come to the beach for nesting. In accordance with direction of a bench of Madras High Court, under the Tamil Nadu Fishing Regulation Act, 1983 a ban on fishing activities either by mechanised or motorised boats within 5 nautical miles (nmi) in the coastal waters from January to April was imposed in September 2016. Following protests from the artisanal fishing community, whose fishing activities are usually confined to this zone, the Tamil Nadu government made certain relaxations which permits artisanal fishery with limited speed of 10 knots. Mechanised sector also raised their concern that since this ban precedes the annual trawl fishing ban from April to May, prolonged halt of fishing adversely affects their livelihoods. In this context, close monitoring of turtle stranding and mortality along the coast during the peak nesting season is required to ensure appropriate conservation measures.



olive ridley turtles washed ashore on A. Odaikuppam and B. Kanathur Reddykuppam beaches



**M F I S**