FISHTECH REPORTER

Vol. 06 No. 01

January – June 2020

भा कृ अनु प - केंद्रीय मात्स्यिकी प्रौद्योगिकी संस्थान

ICAR – CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY

विल्लिंगडन आईलेंड, मत्स्यपुरी पी.ओ., कोचिन, केरल, भारत

Willingdon Island, Matsyapuri P.O., Cochin – 682029, Kerala India.

FISHTECH
REPORTER

Cover designed by
Mr. Lijin Nambiar M.M.

Printed by
PrintExpress, Kochi

PUBLISHED BY

The Director
ICAR-CIFT

From the Editorial Board.....

COVID-19 has its impact in different sectors at different magnitude and the confinement protocols slowed down arrival of this issue of the Reporter. The current issue of Fishtech Reporter features 10 articles covering the research developments in the institute.

ICAR-CIFT plays a key role in ensuring responsible harvesting of fishery resources. Surveys conducted on assessing the mechanism of fishing gear marking in India point out the lack of proper gear marking mechanisms in various gears operated along the south and west coast of India. The article describes relevance of fishing gear marking and makes suggestions to implement the same in India. An article detailing CIFT's initiative to introduce responsible trawl fishing using BRDs targeting flower shrimp fishery along Palk bay region of South Eastern Tamil Nadu provides interesting results. Species diversity and the menace of jelly fish in stake nets operated in Cochin backwaters and the design and operation of unique crab ring trap used in the Mahul village of Mumbai coast are also reported in this issue.

In the light of improved utilization of seaweed, results of a preliminary experiment conducted to evaluate the bioremediation effect of *Ulva* sp. are featured. The results of a novel study confirming the keratinolytic activity of bacterial isolates collected from the water, soil and gut samples of fish with possible application in waste management in aqua farms and the article on a new convenient fish snack product-fish bars to meet the growing demand for functional snack products adds value the issue. The issue also covers the CIFT interventions to develop a mini clam processing facility in Perumbalam village of Alappuzha District with fishmen participation and a sample technique for assessing the fish consumption pattern among tribal populations of Wayand district in addressing the malnutrition among tribal population.

This issue is the cross section of the research activities in the institute and contribute to improvements in setting research goals for the benefit of the stake holders in future.

Stay safe. Stay healthy.

Contents

Fishing Gear Marking: A technique for traceability of lost gears

Leela Edwin, Antony V. T., Dhiju Das P. H., Rithin Joseph and Prajith K. K.

ICAR- Central Institute of Fisheries Technology, Cochin-29

Gear marking is an important mechanism for regulating legal and illegal fisheries. If a gear is well marked and has sufficient identification and it can be linked to vessel or gear registers. This is evidently a useful tool for enforcement agencies checking on gear set in certain areas (FAO, 2016). There are at present no effective regulations, guidelines or common systems for marking gear in India. The basic purpose of gear marking is to determine ownership and to trace back information regarding the gear. It also enables the state to take effective action against defaulters in case of Abandoned, Lost and Discarded Fishing Gear (ALDFG).

A study was conducted by ICAR-CIFT, to assess the extent of gear losses in different sectors, and ascertain the presence of any indigenous or institutional mechanism for gear marking prevalent. Three locations were selected for the study from the west and east coasts of India i.e., Veraval, Cochin and Visakhapatnam and data collected from trawl, gillnet and purse seine sectors. The respondents identified for the study were fishers/ net makers, net manufacturing units, monitoring, control and surveillance (MCS) authorities and research institutions. A total of 350 questionnaires were given to the respondents of which only 195 contained details sought for and were taken as valid.

Gear marking in the trawl sector

The survey conducted in the three major trawl fishing centers viz. Veraval, Cochin and Visakhapatnam showed that no marking system is followed in trawl fisheries. However, colours or special knotting are used on the webbing part to identify the nets for convenience of sorting and selecting a gear from a group. The colouring is mainly done with paints on the head ropes and sometimes the knotting made on the webbing is specific to the individual fishers. The webbing pieces with contrasting colours are also used to mark and differentiate gears. The pattern of replacement of old webbing with new webbing is also taken as an identification mark by some fishers in Cochin. However, no set pattern for marking was observed and it differed from fisher to fisher, if used at all. Fishers estimate an average loss of 500 – 1200 kg of webbing for each vessel per year. In addition, accessories like floats, sinkers, iron chain and otter boards also are abandoned in case of emergencies like rough weather. Unserviceable webbings are sold to agents who collect it either from beaches, landing centers or households. The fishers also dispose the old webbings through scrap dealers that purchase old nets. The old trawl nets are sometimes used by fishers themselves for fabrication of Fish Aggregating Devices (FADs). 90% fishers reported loss of parts of trawl nets during operation.

Fig 1. Discarded trawl on the shore

Gear marking in the gillnet sector

It was observed that in the gillnet sector of Veraval there are numbering and special markings on thermocole floats attached to the head rope. In Cochin area, there was no marking system for gillnets. In Vishakhapatnam float colour, shape and arrangement in head rope were used for differentiation. Special knotting on the head rope and float line is also practised, but no marking is seen on the webbing portion. Cement sinkers were marked by carving letters, symbols and numbers. The artisanal fishermen of Kerala operating small gillnets in back-waters use small plastic bottle/piece of polyurethane foam (PUF) sheet as identification marks.

Fig. 2 Gear identification mark in gillnet floats and discarded monofilament gillnets

It is reported that that 25% of fishers are forced to abandon gillnets every year. Main parts abandoned include webbing, floats and sinkers. The webbing that gets caught in obstacles under water like wrecked ship, sunken fishing boats, rocks, debris of wartime wreckages etc. are usually abandoned. It is estimated that an average of 500-900 kg webbing are discarded per vessel per year. All gillnetters surveyed from the study area reported 38% loss of parts of gillnets per year. Main reason for the loss is due to passage of ships and bad weather. Fishers also reported that 37% of the webbing were discarded in the sea.

Gear marking in purse seine sector

There is no gear marking system in the purse/ring seine sector in Cochin region. The gear is stored onboard the vessel even after operation and it was felt by the fishermen that a system for gear marking is not required and practicable. The nets that get entangled in obstacles like drowned boats and rocky bottom are abandoned. The webbings are mostly lost and accessories retrieved. About 100-300 kg of nets are being replaced each year from a single vessel. The chance of losing the net is rare in the case of seines but when the sea is rough due to water currents, portions or whole nets are lost. From 50 respondents, it was found that all vessels are forced to abandon net at least once in a year. About 50% of the discarded net were used for recycling, 22% for aquaculture purpose and roofing support of the houses, 10% for other household activities, 8% to protect vegetation and fencing, 6% for net mending and 4% for fish drying purposes.

Fishing nets are manufactured by the private and government sectors. According to the textile manufacturers, gear marking is not done during production for webbings, twines sold in the domestic market. The ropes produced by large manufacturing houses sometimes have an inlaid marking and logo for identification. However for gears (readymade) exported such markings/tags are provided on customer request. These is no practice of registration of gears separately. The officials of the department of fisheries confirmed that there are no guidelines on marking of fishing gears and they were unaware of any indigenous system followed for the same in any part of the country. Kerala is the first state in the country to have implemented gear marking through the amendment of the Kerala Marine Fisheries Regulation Act in 2017 (Gazette notification No. 16838/Leg.11/2017/Law. dated 18th September 2017). ICAR - Central Institute of Fisheries Technology (CIFT) is the only nodal center in the country dealing with research, development and standardisation in fishing gear technology and have not come across with any system to mark gears/ gear materials and accessories in gear materials.

Key issues and challenges in gear marking in India

The challenges with regard to gear marking, as mentioned above, is because of the vast diversity in the gears used. Also there has been no clear cut policy on gear marking. Some of the reasons for this issue being given less priority so far, may be due to India being a characteristic multi species, multi gear tropical fisheries, long coastline with multiplicity of harbours/ landing centers (>1500). A rough estimate shows that 0.5 - 0.6 million fishing gears are operated in the marine sector. Fabrication of gears are done by artisans locally and there is no system of registration of gears. The fisheries departments of the various states in the country have multiple functions from registering vessels to implementing social schemes and the manpower is fairly stretched with work to be given additional responsibilities.

Suggestions for introduction of gear marking in India

A Unique Identification Code that can be machine read for each gear being operated from registered fishing vessels can be used for gear marking which provides the encrypted information on the gear used. The implementation of same in India would require the creation of awareness among fishermen on the international requirements and the use of gear marking system, providing gear manufacturers with clear guidelines on marking of gear, making mandatory that all registered fishing vessels should operate only marked gear, documenting the specification details of each gear available onboard a vessel and details of operation. At the same time, considering the large section of artisanal fishers of India factoring the costs of marking into the cost of gear will be difficult for the fishers to bear and it would be difficult to prevent defaulters without stringent monitoring.

Encouraging Results of Bycatch Reduction Devices (BRDs) in shrimp trawls – A Preliminary analysis

Madhu V. R.[1], Renjith R. K.[1], Nobi P. S.[1], Raghu Prakash R.[2], Velvizhi S.[3], Yosuva Mariasingarayan[3] and Sakthivel A.[3]

[1]ICAR- Central Institute of Fisheries Technology, Cochin-29

[2] ICAR- Central Institute of Fisheries Technology, Visakhapatnam-03

[3]*MS Swaminathan Research Foundation, Nagapattinam - 05*

The flower shrimp (*Penaeus semisulcatus*), fishery is restricted to the Gulf of Mannar and Palk Bay region of south eastern Tamil Nadu. Gillnets contribute about 12% of the landings along northern Palk-bay (Josileen et al. 2019) and the rest by indigenous sail assisted fishing (*Thallu valai*) (Sampson et al., 1987). The rest of the landings is contributed by mechanized trawl sector. The landings of this species are reported to reach about 80% in trawl fishery during peak seasons (Kumar et al., 2017) but considering the average yearly landing, *P. semisulcatus* may contribute 3-5% of total shrimp landing (Siva et al., 2012). The fishery is seasonal and starts from the month of July and extending till February each year. The most common mesh size used in the codend is 20-25 mm and a chaffing gear made of HDPE twine of 2.5 mm dia. is used by all the vessels, to prevent damage to the codend. The depth of operation varies from 15-25m and beyond 3 nautical miles from the shore. There are a total of 2262 mechanized trawlers of sizes varying from 12-14 meter in length fitted with inboard engine with horsepower varying from 68-193 (Kasim, 2015).

Recent stock assessment based on catch and effort data shows that the flower shrimp stocks fluctuate around the MSY level, however stock assessment based on length frequency data has indicated overfishing during the early 90's (CMFRI, 2003).

Bottom trawl is a non-selective gear and there are reports of high incidence of non-targeted catches from trawlers in this area (Lobo, 2007). There are no technical measures used in the fishery, except for the seasonal monsoon ban implemented uniformly along the east coast. Being an especially important and ecologically sensitive area along the Indian coast, works related to the use responsible trawl systems are scarce from the region.

This study reports the results of an experimental study carried out onboard commercial trawlers with three different BRDs developed by ICAR-CIFT to gauge their efficacy. Square mesh codend, Juvenile Fish Excluder cum Shrimp Sorting Device (JFE-SSD) and CIFT-Turtle Excluder Device (CIFT-TED were rigged in traditional trawl nets for experimental trials. The size of the vessels and the installed engine power used, were similar to the ones used by the commercial trawlers. Three major harbours along the Palk Bay *viz.*, Kottaipattanam, Mandapam and Rameshwaram fishing harbours were selected for the experimental trials (Figure :1).

Fig. 1 Location of Experimental trawling operations

The experimental trawling operations were conducted in the three fishing harbours during the month of February 2020. Two on-board observers were employed for supervising the fishing operations and to collect representative samples from the fishing vessels after each haul. Each haul was of 45 minutes duration and standard procedures were followed for setting and retrieval procedure in all fishing locations. A representative sample of the catches before sorting and the samples from discards were also collected, preserved and brought to the laboratory for identification, quantification and measurements.

Catch and discards: The catch from the different gears during the entire fishing operations, were 1001.2 kg and the total discards were 316.6 kg, which worked out to be about 31.6%, for all the fishing gears combined. Catch and discard from each BRD type varied significantly revealing highest percentage of discard from control net followed by TED, JFE-SSD and square mesh codend (Fig. 2). CPUE in kilogram was found highest for TED followed by square mesh codend, control and JFE-SSD (Fig.3).

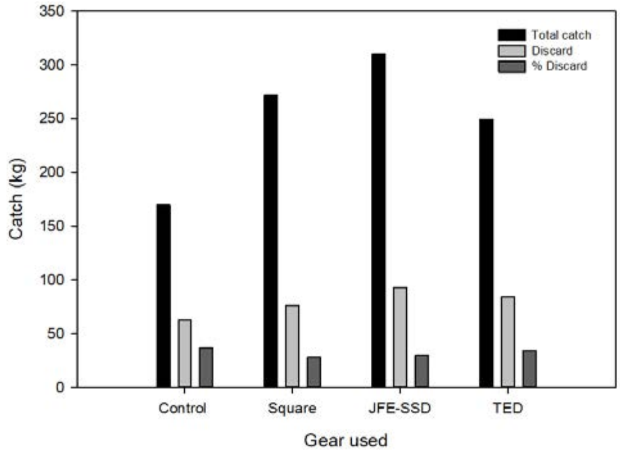


Fig. 2 Total catch (kg) from the different gears used during the experiments

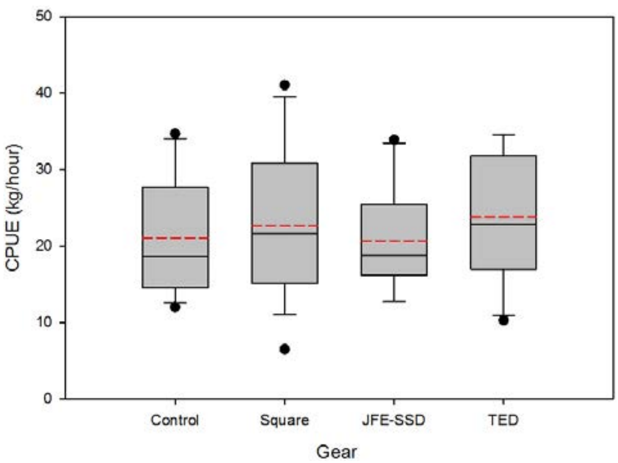


Fig.3. The catch in the different gears expressed as CPUE (kg/hour). The continuous black line is the median and the dashed red line indicates mean.

The total discards from different fishing systems were analyzed and it was observed that highest discards in terms of CPUE (kg/h) was observed in the control vessels (6.9kg/h) and the lowest discards were in the trawlnets fitted with the square mesh and JFE-SSD, with mean CPUE of 4.8 kg/h and 4.7 kg/h respectively. The discards generated were at the rate of 6.1 kg/h in case of nets fitted with the TED.

Length frequency: The length frequencies in the different fishing systems studied, showed that there is an improvement in the selection properties, in case of square mesh and the JFE-SSD rigged trawls. An improvement of about 10-20% in the length frequencies are observed when diamond meshes are replaced by square meshes in the codend. No significant reduction in the catches and discards and difference in length frequency indicated very less escapement through the opening of the TEDs, which is often a problem which fishers raise during the trials.

Economic loss incurred by BRDs: The average reduction in the CPUE noticed were 2.17 kg, 2.31 kg, and 0.92 kg per hour of trawling for the nets installed with square mesh, JFE-SSD and TED, respectively. The cost of bycatch discards varies considerably and an average price of Rs. 20 per kilogram was used for the quantification of loss. Based on the above assumptions, the average loss to the fishermen in monetary terms using different BRDs will account to Rs. 44, Rs. 46 and Rs. 18, per hour of operation when square mesh, JFE-SSD and TED are used, respectively.

It is assumed that the discards/bycatch are sold after they are landed and the loss is due to the reduction in the quantity thus sold, due to juveniles escaping from the BRDs. The loss in terms of per hour of trawling, is shown in figure 4.

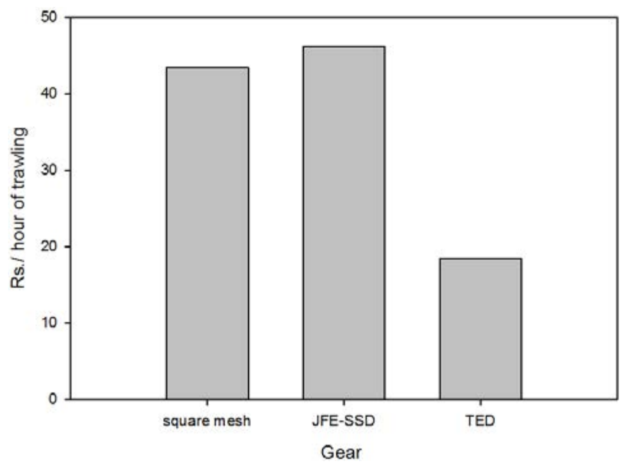


Fig. 4. Loss in terms of rupees per hour of trawling, when different BRD were used in the traditional trawl nets

It was noticed that the escapement in terms of value was higher in the TED installed nets followed by JFE-SSD and square mesh codends. The length frequency analysis of the catches was also carried out, which showed improvement of about 10-12% depending on the species, for the square mesh codends.

The values wise analysis carried out showed an average escapement of about Rs. 30-45 per hour of operation, due to the loss of juvenile fishes from the codend. However, this value is very meager considering the value, if allowed to grow. It has been observed that the fuel consumption of square mesh codend are less compared to traditional diamond mesh codend, due to the lower drag offered by these codends. However, the savings in fuel due to the use of square mesh codends would negate the short-term loss caused due to the release of juveniles. The experiments were the first of its kind that have reported BRDs rigged trawls in the region and would be a baseline for future studies related to implementation of gear based technical measures in trawling sector.

The study was experimental in and for a short duration. Any gear modification would require several trials, for the gear to get stabilized and for the fishers to get used to the new technology. Hence the results may not be the same as in commercial operations, however the overall profile of the species catches observed in this study shows the positive benefits of using these BRDs in Palk Bay. Technical modifications to the gear are a complex process, since it involves many operational parameters that work in tandem and includes the non-technical factor of operational profit. Therefore, more trials would be required in different seasons and at different harbours to further substantiate the results of this preliminary fishing experiments along Palk Bay.

Reference

Aaron Savio Lobo, 2007. The Bycatch Problem - Effects of Commercial Fisheries on Non-Target Species in India. Resonance, Vol. 12(5): 60-70.

CMFRI 2013. Handbook of Marine Prawns of India. Central Marine Fisheries Research

Institute, Ernakulam North Po. PB No. 1603, Cochin-682 018, Kerala, India.

Jose Josileen., G. Maheswarudu, Shelton Padua, Geetha Sasikumar, Eldho Varghese and K. S. Mohamed. 2019. Fishery Management Plan for Palk Bay Blue Swimming Crab. ICAR-CMFRI Mar. Fish. Policy Series No.15. ICAR-Central Marine Fisheries Research Institute, Kochi, Kerala, India, 100pp.

Kasim H M, 2015. Resources and livelihoods of the Palk Bay: Information from India & Sri Lanka. Conference: International Academic Workshop Resources Conservation and Alternate Livelihood Opportunities in Coastal Tamil Nadu (ReCAL'15), 28pp.

Siva, T.V., Krishnan, R., Rajesh, S., & Patterson, J. (2012). Trawl Fishing of Penaeid Prawn in the Northern Mandapam Coast of Palk Bay. World Journal of Fish and Marine Sciences 4 (3): 278-283, 2012.

Jellyfish menace in estuarine Stake nets operated off Kochi, Kerala

Sandhya K. M. [1], Archana G. [1], Chinnadurai S. [1], & Saravanan, R. [2]

[1]ICAR-Central Institute of Fisheries Technology, Cochin-29

[2]ICAR-Central Marine Fisheries Research Institute, Mandapam Regional Centre, Mandapam-20

Jellyfish are distributed around the world oceans and estuaries, living from surface to greatest depths. These gelatinous zooplankton, belonging to Phylum Cnidaria, an ancient phylum of organisms having about 10,000 species include jellyfish, corals and sea anemones. Jellyfish swarms are widespread and frequent in coastal areas worldwide and considered as menace due to their ecological and socio economic consequences (Stabili *et al.*, 2020). Several studies have reported increased influx in recent years with massive blooms appearing in estuaries and backwaters and adversely affecting inland fishing. Invasion of jellyfish are often seen in coastal areas of India. Stake nets locally called as *Oonnivala* are extensively operated in all coastal districts of Kerala as the most important gear for backwater prawn fishing (Thomas *et al.*, 2007). The stake net fishery has already been impacted by accumulation of large quantities of plastic wastes in the nets (Kripa *et al.*, 2012). The problem is further aggravated by jellyfish invasion especially near the estuarine areas during summer months. Out of the 17724 stake nets operated in the state, maximum concentration is in Ernakulam 51.6% (Vijayan *et al.*, 2000).

Survey conducted among twenty fishermen in estuarine areas of stake net operation near Aroor and Arookutty, off Kochi have shown these stake nets choked with large scale influx of jellyfish during the months of March to May 2019. The weight of individual jellyfish varied from 250g to 6kg which was constituted mainly by species such as *Lychnorhiza malayensis* and *Acromitus flagellatus* sp. The weight of the whole biomass of jellyfish varied from 50-100 kg per net per day as reported by the fishers. These jellyfish are a great menace to fishers as their nets get clogged which in turn reduces the filtering capacity of nets. Usually the duration of operation of stake nets varies from 5-7hrs, because of jellyfish clogging, fishers have to lift up the nets intermittently (1-2hrs) to remove them whereby the soaking time of nets was also considerably reduced. For stake nets the highest catches were usually obtained during January-May, with catch rates ranging from 11-13kg per stake net per day (Ramesan, 2017) whereas due to jellyfish menace catches have even declined to 4-6kg per stake net per day. In addition, more efforts also required in sorting the catch which consumes much time and labour of fishermen. Some of these jellyfish cause skin irritation. Fishers have to sometimes discard the catches especially small shrimps like *Metapenaeus dobsoni* due to difficulty in sorting them from jellyfish and also due to skin irritation. Nets get damaged due to the weights of jellyfish which comes along with waterflow which necessitates repair of the nets and also loss of fishing days of fishers.

Stake net catches with jellyfish

Acromitus flagellatus

Global warming, decline in the population of predatory fish species due to overfishing and eutrophication are said to be the factors causing the proliferation of jellyfishes. During premonsoon months, increase in temperature along with salinity rise, causes influx of jellyfish from the seas into in the estuarine and backwaters areas. These jellyfish choke the stake nets and even causes damages to other nets like Chinese dipnets and seine nets. The possible interventions may be excluder devices at the mouth or cod end of stake nets to segregate jellyfish (Manojkumar *et al.*, 2015) or converting the jellyfish to some valuable products which will be an additional income to the stake net fishers.

Reference

Kripa, V., Prema, D., Anilkumar, P. S., Jenni, B. and Sharma, R. 2012 .Habitat destruction: a case study on the evaluation of litter in the marine zone of north Vembanad Lake, Kerala. Marine Fisheries Information Service Technical & Extension Series, 212: 1-3

Manojkumar, B., Rakesh, C.G. and Devika, P. 2017. Development of jellyfish excluder device (JFED) for stake nets. 11th IFAF, November 21-24, 2017, Book of Abstracts, pp.97-98.

Ramesan, V. 2017. Study of traditional stake net fishing practices in Aroor panchayat of Alappuzha, Kerala. MSc Thesis, pp. 33-34, Tata Institute of Social Sciences, Mumbai

Sanjeevaghosh, D. 1993. Backwater Fishery Resources of Kerala, In: Proc. National Workshop on Low Energy Fishing, 8-9 August 1991, Cochin, Fishery Technology (special issue), pp 63-67.

Stabili L., Rizzo L., Basso L., Marzano M., Fosso B., Pesole, G. and Piraino, S. 2019. The microbial community associated with Rhizostoma pulmo: Ecological significance and potential consequences for marine organisms and human health. Marine Drugs 18, 437:1-24.

Thomas, S. N., Edwin, L. and Meenakumari, B. 2007. Stake Nets of Kerala, CIFT Golden Jubilee Series, 25 p, Central Institute of Fisheries Technology, Cochin.

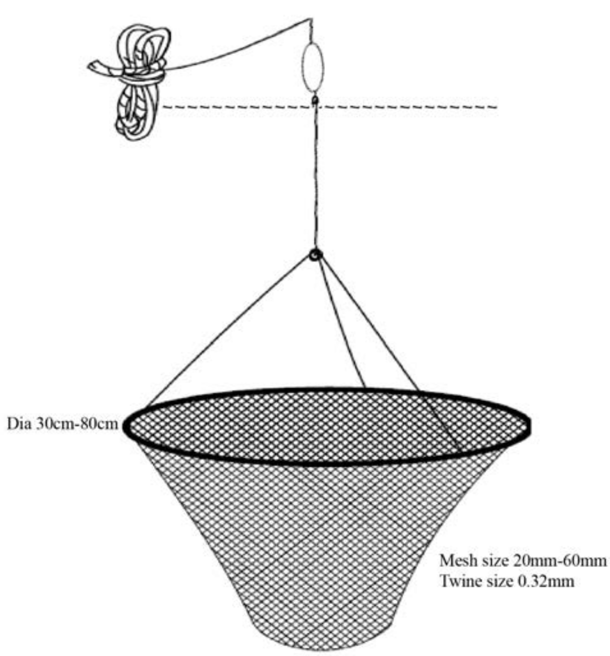
Crab Ring Trap: A commercial fishing activity and a source of livelihood in Mahul, Maharashtra

Manju Lekshmi N. and Harsha K.

ICAR-Central Institute of Fisheries Technology, Cochin-29

Traps are passive fishing gears designed in such a way that the fish enters freely into the trap, and get trapped. Traps are selective, low energy and environment friendly fishing gear. Different types of indigenous fish traps and pots are operated along the coastal waters of India. Most of the traditional traps are made of bamboo and related materials with short life. Currently many modified traps with different shape, size and design are available in the local markets. Most of the fishermen in India consider trap fishing as an option for secondary livelihood, besides the major fishing operations.

Mahul fishing jetty in Mahul village is one of the major fishing centres in Mumbai, which is densely covered with mangroves. It is an intertidal undulated area, where crab fishing using ring traps is a commercial activity. Crab ring traps are locally known as *Fug/pug*. The design of the trap is simple with a bag of mesh/webbing with polyamide/polyethylene monofilament/ multifilament on a circular metal ring made of steel plate/iron rod attached by a bridle to a pulling cord. The metallic ring is 30- 80 cm in diameter with a webbing (0.32 mm) of mesh size of 20-60 mm. Floats made of thermocole are attached with ring having dimension ranging from 8x4x2 – 15x13x6 cm. The traps are operated in the creek mouth within a kilometer from the jetty and peak season for the operation of these traps are during the post monsoon period. Each fisherman carries 80- 100 traps and the average traps used per trip is 30-45 in number. Average soaking time for these traps is 30-60 minutes. The targeted crab species are *Scylla serrata and Portunus pelagicus*. Average size of the crab ranging from 300-1800 g, which fetches Rs. 800-1200/dozen in the local market for live crab (catch per trip 25-30 number) with an average earning of around Rs.1600-2400/trip. If juvenile crabs are trapped, the fishers' generally releases it back to the water because of its low price. Fish waste and poultry waste are used as bait which is attached at the centre of these traps.



Non motorized wooden fishing vessel of 4.6 – 5.0 m size are used for operation with one or two crew members.

Since the design of the crab ring trap is simple, the fabrication costs is around Rs. 200-300/. Life span of a trap is 4-5 years. Fishermen usually fabricates the crab rings by using the webbings from abandoned nets (mostly gillnet), which reduces the chance of ghost fishing.

Crab fishing in Mahul is a primary livelihood activity during the lean season. Coastal fishers can be encouraged for trap fishing in the context of resource conservation and energy saving. These traps are selective, cheaper, eco-friendly and easy to fabricate and has the potential for sustainable exploitation of fishery resources and it can be adopted by fishers of similar ecological niches.

Fish bars: A convenient ready to eat fish snack

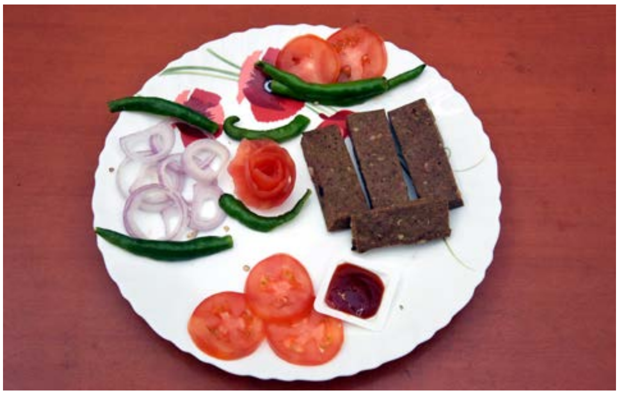
Sarika K., Binsi P. K., Anupama T. K. and Sreelakshmi K. R.

ICAR- Central Institute of Fisheries Technology, Cochin-29

Fish bars are very convenient, pre-portioned, individually-wrapped, ready-to-eat healthy snacks which can be fortified with vitamins, minerals and other nutrients. These are much more nutritious choice than a candy bar, cookies, chips or other snack food. Globally nutritious bars have gained importance and popularity during the recent years and perceptibly in India, it is an emerging product. Fortification of fish protein (60-65%) in such convenient foods offers high quality digestible protein with fewer calories than similar sized portion of meat. So, the growing demand for exploring new and fortified bars needs to be filled by developing such products that conform to emerging trends of nutraceutical and functional foods.

Fish bars are protein enriched snacks of good nutritional value developed from fish meat blended with a standardized formulation of ingredients, processed under conventional steam cooking. The steam cooking causes heat induced gelation in the salt solubilized fish protein, which imparts a proper texture to the product.

The gelation induced during steam cooking, provides a typical meat texture with a good



gel strength (212 g.cm) which is acceptable in non-homogenous types of bars. The non-homogenous texture was contributed by nuts, almonds and raisins giving adequate hardness (30 N) and elasticity to the bars. Fish bars having a moisture content of 60% and water activity of 0.9, requires low temperature preservation. The bars developed were stored under chilled (2°C) and frozen (-18°C) conditions in two different packaging materials (Metalized poly ester (MPE) and Polyester polyethylene (PPE) films) and were subjected to storage studies for 16 weeks and 12 months, respectively.

The chilled stored bars showed an initial pH of 5.96 which increased to 6.29 in MPE packs and 6.23 in PPE packs after 16 weeks of storage. Slightly higher total volatile base nitrogen (TVB-N) and trimethylamine (TMA) values were noticed in PPE packed (22.4 and 11.2 mg N2/100g) than MPE packed samples (19.6 and 9.6 mg N2/100g) but both TVB-N and TMA levels were well below the maximum level of acceptability. The oxidative indices like peroxide value (PV) and free fatty acids (FFA) increased during storage period. Even after 16 weeks of storage, the Thiobarbituric acid reactive substances (TBARs) value was observed to be in range of 0.36-0.39 mg malondialdehyde (MDA)/Kg (Fig 1). The meat bar having an L* 39.35, a* 7.83 and b* 21.07 initially, showed a slight increase in the colour attributes after 16 weeks with L* 43.49, a* 6.68 and b* 19.69 in MPE and L*42.17, a*6.91 and b*21.62 in PPE stored samples. Microbiologically, bars packed in MPE and PPE were safe throughout the storage period under chilled conditions. So, the products were acceptable up to 16 weeks under chilled storage conditions.

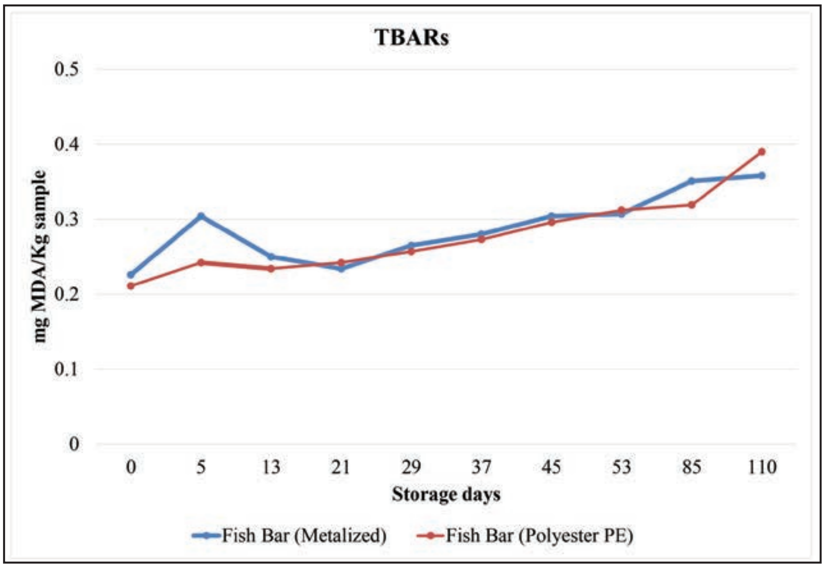


Fig 1 Changes in the TBARs value of fish bars during chilled storage

Consequently, fish bars stored under frozen conditions were analysed for a period of 12 months. During the frozen storage, all the physico chemical parameters were within acceptable range. A slight change in pH was observed from an initial pH of 5.96 which increased to 6.07 in MPE and 6.18 in PPE packed bars after 12 months. On storage, maximum TVB-N and TMA values observed were 18.2 and 9.8 mg N2/100g and 19.6 and 9.8 mg N2/100g in MPE and PPE respectively. Similarly, the oxidative indices were also found to be within the limit. After 12 months of storage PV, FFA and TBA values were observed to be in the range of 9.5 meq/Kg fat, 7.15 % and 1.3 mg MDA/Kg in MPE packs and 3.3 meq/Kg, 2.78% and 1.24 m MDA/kg in PPE stored samples. Even though a slight flavour and colour loss was observed, microbiologically bars were acceptable throughout the frozen storage. So, the fish bars under frozen condition had a good shelf life of one year and no significant variations were observed bet-ween samples stored in selected packaging materials.

Seaweed: An excellent agent of bioremediation in aquatic environment

Rehana Raj, R. Anandan and Suseela Mathew

ICAR- Central Institute of Fisheries Technology, Cochin-29

Globalization and population growth in urban area, along with wild expansion of agricultural and industrial activities had led to the increase in the generation of waste water which ultimately reaches the aquatic environment and thereby impacting the entire food chain of the system (Akpor *et al*., 2014). The untreated waste water which is released to the natural water bodies accounts to around 60% of that produced, which is highly alarming.

The bioremediation practices were started very early by Romans employing microorganisms for

Fig:1 Ulva lactuca

removing contaminants from water bodies. They employed various organisms under controlled conditions to deteriorate, negate, and/or eliminate hazardous contaminants from polluted waterbodies. Research is being carried out even today using microorganisms especially bacteria and macroalgae to mitigate the contaminants present in aquaculture effluents, oil spills and coastal waters and sediments.

Bioremediation is described as the treatment that uses naturally occurring organisms to break down hazardous substances into less toxic or nontoxic substances and uses naturally occurring entity (*biostimulation*) or added indigenous or exogenous organisms (*bio augmentation*) to breakdown or absorb various pollutants. It is also an economically viable technique which can be employed *in situ* or *ex situ* with much public recognition. The success of bioremediation depends on the metabolic activity of the organisms selected for the purpose and the conditions for the organism to thrive well. The targeted organisms acting as agents for bioremediation are usually locally available which use these contaminants as their limiting food source for example, macronutrients such as nitrogen (N), phosphorus (P) etc.

Ulva is a seaweed known to be grown in fish culture ponds as a propitious species because of its affinity towards ammonium uptake from the ponds which is then employed for its metabolic activities (Neori *et al*., 1996; Lehnberg & Schramm 1984). Yamasaki *et al*. (1997) studied on the kuruma prawn, *Penaeus japonicus* larvae cum seaweed *Ulva lactuca*, together exhibited better growth and survival rate of prawn larvae in seaweed. Bat *et al.* (2001) stated that *Ulva* has an excellent bio-indicators potential in the water column as it exhibits excellent property to accumulate the surrounding nutrients rapidly.

There are reports indicating the use of green seaweed *Ulva lactuca* as fish biofilters with minimum maintenance (Vandermeulen and Gordin, 1990; Cohen and Neori, 1991; Neori *et al*., 1991). The nutrients released from the fish pond is reported to support the yield of *U. lactuca*-78-kg m^2 $year^1$and efficient 80% ammonia filtration. The donor acceptor interactions and hydrophobicity has induced the bio-sorption capability of phenolic compounds. It is reported that brown algae, Sargassum had shown high efficiency in eliminating the heavy metals from the water bodies (Sheng *et al*., 2004; Vijayaraghavan *et al*., 2005). The adsorption of dyes by seaweed, is achieved due to the presence of active functional groups, such as hydroxyl, carboxyl, carbonyl, amine, and sulfate. Kinetic reaction studies revealed that the chemisorption phenomenon had led in the removal of dyes from contaminated water bodies.

Application of seaweed for the removal of pesticide from contaminated water

In a preliminary experiment conducted at ICAR-CIFT Cochin, seaweed *Ulva lactuca* was treated with water contaminated with pesticides for 35 days and the treated water was periodically tested for residual pesticide. o,p- Dichlorodiphenyl trichloro ethane (o,p-DDT) and Heptachlor isomer-Epoxide were completely removed from the water by the seaweed by 4^{th} week of treatment. It was observed that the concentration of pesticide significantly reduced and become below detectable limit by the end

Standard	Initial conc. (ppm)	7th day (ppm)	14th day (ppm)	21st day (ppm)	28th day (ppm)	35th day (ppm)
α-BHC	0.3560	0.0126	0.0046	0.0076	0.0031	0.0000
Hepta Epox.	0.4492	0.0046	0.0039	0.0024	0.0000	0.0000
o,p-DDT	0.3421	0.0000	0.0000	0.0000	0.0000	0.0000

of treatment period. Thus, seaweeds have the potential to remove contaminants from polluted seawater, through bioremediation process.

Fig 2: Seaweed based bioremediation unit

References

Akpor, O.B., Otohinoyi, D.A., Olaolu, D.T. and Aderiye, B.I., 2014. Pollutants in wastewater effluents: impacts and remediation processes. International Journal of Environmental Research and Earth Science, 3(3), pp.050-059.

Bat, L., Akbulut, M., Sezgin, M. and Çulha, M., 2001. Effects of sewage pollution the structure of the community of Ulva lactuca, Enteremorphalinza and rocky macrofauna in Dışliman of Sinop. Turkish Journal of Biology, 25(1), pp.93-102

Cohen, I. and Neori, A., 1991. Ulva lactuca biofilters for marine fishpond effluents. I. Ammonia uptake kinetics and nitrogen content. Botanica Marina, 34(6), pp.475-482.

Lehnberg, W. and Schramm, W., 1984. Mass culture of brackish-water-adapted seaweeds in sewage-enriched seawater. I: Productivity and nutrient accumulation. In Eleventh International Seaweed Symposium (pp. 276-281). Springer, Dordrecht.

Neori, A., Cohen, I. and Gordin, H., 1991. Ulva lactuca biofilters for marine fishpond effluents. II. Growth rate, yield and C: N ratio. Botanica Marina, 34(6), pp.483-490.

Neori, A., Krom, M.D., Ellner, S.P., Boyd, C.E., Popper, D., Rabinovitch, R., Davison, P.J., Dvir, O., Zuber, D., Ucko, M. and Angel, D., 1996. Seaweed biofilters as regulators of water quality in integrated fish-seaweed culture units. Aquaculture, 141(3-4), pp.183-199.

Sheng, P.S, Ting, Y.P., Chen, J.P. and Hong, L. "Sorption of lead, copper, zinc and nickel by marine algal biomass; Characterization of biosorptive capacity and investigation of mechanisms," Journal of Colloid Interface Science, 275, pp. 131-141, 2004.

Vandermeulen, H. and Gordin, H., 1990. Ammonium uptake usingUlva (Chlorophyta) in intensive fishpond systems: mass culture and treatment of effluent. Journal of Applied Phycology, 2(4), pp.363-374.

Vijayaraghavan, K., Jegan, J., Palanivelu, K. and Velan, M., 2005. Biosorption of copper, cobalt and nickel by marine green alga Ulva reticulata in a packed column. Chemosphere, 60(3), pp.419-426.

Yamasaki, S., Ali, F. and Hirata, H., 1997. Low water pollution rearing by means of polyculture of larvae of Kuruma prawn Penaeus japonicus with a sea lettuce Ulva pertusa. Fisheries science, 63(6), pp.1046-1

Microbial degradation of feather waste using Keratinolytic bacteria from aquatic environment

Greeshma S. S., Murugadas V., Merlin Mathew and Prasad M. M.

ICAR- Central Institute of Fisheries Technology, Cochin-29

Indian fisheries are witnessing the emergence of inland aquaculture as a promising bio industry and a viable alternative to depleting marine catches for the past few decades. Even though many candidate finfish species were considered for intensive and extensive aquaculture, Pangasius *(Pangasianodon hypophthalmus)* draws global attention due to its sturdy nature and remarkable growth rate (Singh and Lakra, 2012). In general, the supplementary feed cost accounts for more than 50% of the operational cost of aqua farming and has nearly doubled within a decade (Rana et al., 2009). All these factors prompted farmers to adopt poultry waste fed pangasius farming as a cost-effective way of aquaculture, since poultry waste acts as a nutrient rich low-cost protein source with local availability. But, dumping of poultry waste in to aqua-farms on a continuous basis is an unhygienic practice that creates an adverse impact on the environment, water bodies as well as candidate culture species. Non-degradable chicken feathers which contain insoluble keratin with extensively cross-linked disulphide bonds remains intact in nature for long period of time and magnifies the risk of pollution by increasing the nitrogen and carbon content as well as disease transmission between farms. Keratin is often regarded as "biological plastics and is only degraded by a special group of metalloprotease enzyme called keratinase. Keratinase is naturally produced by a variety of microorganisms like fungi, actinomycetes, bacteria *etc.*, (Riffel and Brandelli, 2006) that can degrade feather waste.

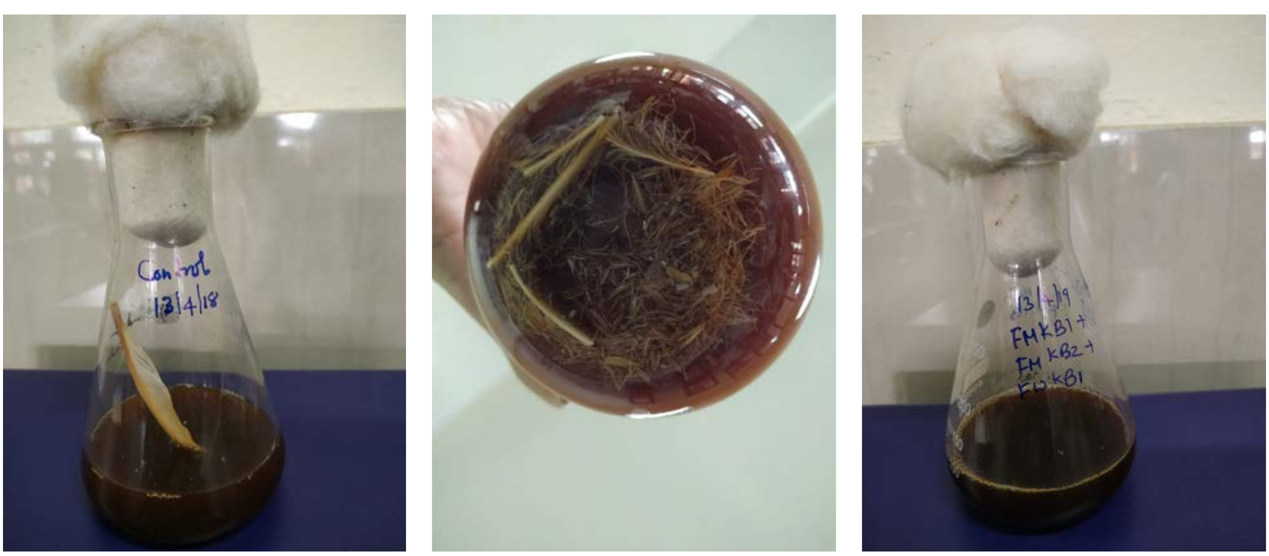
Ten Pangasius farms fed with poultry waste in Palakkad and Ernakulam Districts of Kerala were selected and soil, water, fish *etc.*, were screened for keratinolytic bacteria. The samples were enriched in minimal media containing feather powder (1%) (Govinden *et al.*, 2012) and incubated for 48 hours at 120 rpm under room temperature. Further, the enriched samples were serially diluted in sterile phosphate buffered saline (PBS) and plated over skim milk agar with 10% skim milk powder for screening of protease producers. Bacterial colonies that produced zones on skim milk agar were selected and further checked for keratinase production on feather meal agar containing feather powder (1%) and incubated at 37°C for 1 week to confirm the keratinolytic activity (Sekar *et al.*, 2016). Potential zone producers were purified and identified by 16S r-DNA sequencing analysis with PCR using 27F:5′-GAGTRTGATCMTYGCTWAC-3′ and 1544R: 5′-CGYT AMCTTWTTACGRCT-3′ primers (Phukon *et al.*, 2014) under the following conditions; initial denaturation at 94°C for 5 min, followed by 30 cycles of 94°C for 30 seconds, 52°C for 30 seconds, 68°C for 1min 30 seconds and final extension 7 minutes at 68°C. The amplified PCR product was further purified with gel extraction kit (Bangalore Genei India Private Limited, India) and sequenced at Agri Genome Labs Pvt Ltd, Cochin, Kerala. The nucleotide sequence of two isolates were determined and identified as *Bacillus subtilis* and one as *Exiguobacterium profundum*. The sequences were submitted to the GenBank database of the National Centre for Biotechnology information (NCBI) under accession numbers MN340035.1, MN340032.1 and MN340033.1 respectively.

A total of 6.9% of the 116 proteolytic bacterial isolates obtained from soil, water and fish gut samples of Palakkad and Alappuzha districts of Kerala were found to possess keratinolytic activity. Assessment of direct degradation of feather by combination of keratinolytic bacterial isolates (FMKB1 and FMKB2) showed that the raw feather was partially degraded within two weeks of time and was completely utilised within 45 days at 37°C. (Figure No: 1).

Microbial degradation of feather is a cheap, effective and environmental friendly method for bioconversion of feather waste into value added products such as fish feed, biofertilizer, and keratinases. These bacterial isolates can be proposed as potential candidates for environmentally safe biofertilizer as well as probiotics after proper *in-vitro* and *in-vivo* evaluation.

References

1. Govinden, G., & Puchooa, D. (2012). Isolation and characterization of feather degrading bacteria from Mauritian soil. *African Journal of Biotechnology*, *11*(71), 13591-13600
2. Phukon, P., Phukan, M. M., Phukan, S., & Konwar, B. K. (2014). Polyhydroxyalkanoate production by indigenously isolated *Pseudomonas aeruginosa* using glycerol by-product of KCDL biodiesel as an inexpensive carbon source. *Annals of microbiology*, *64*(4), 1567-1574.
3. Rana, K. J., Siriwardena, S., & Hasan, M. R. (2009). *Impact of rising feed ingredient prices on aquafeeds and aquaculture production* (No. 541). Food and Agriculture Organization of the United Nations (FAO).
4. Riffel, A., & Brandelli, A. (2006). Keratinolytic bacteria isolated from feather waste. *Brazilian Journal of Microbiology*, *37*(3), 395-399
5. Sekar, V., Kannan, M., Ganesan, R., Dheeba, B., Sivakumar, N., & Kannan, K. (2016). Isolation and screening of keratinolytic bacteria from feather dumping soil in and around Cuddalore and Villupuram, Tamil Nadu. *Proceedings of the National Academy of Sciences, India Section B: Biological Sciences*, *86*(3), 567-575.
6. Singh, A. K., & Lakra, W. S. (2012). Culture of Pangasianodon hypophthalmus into India: impacts and present scenario. *Pakistan Journal of Biological Sciences*, *15*(1), 19.



(a) (b) (c)

Figure 1: a). Control raw feather b). Partially degraded raw feather by FMKB1 and FMKB2 within one-month c). Completely dissolved raw feather by FMKB1 and FMKB2 within 45 days

Incidence of coagulase negative Staphylococci and its AMR (antimicrobial resistance) level in seafood, Veraval, Gujarat

G. K. Sivaraman, Visnuvinayagam and M. M. Prasad

ICAR-Central Institute of Fisheries Technology, Cochin-29

The isolation of coagulase negative Staphylococci (CoNS) from 22 number of seafood samples consisting of lobster (3), squid (3), shrimps (2), octopus (3), ribbon fish (4), tuna (2), surimi (3) and cobia (2), Veraval region, Gujarat, was done on the basis of colony morphology on Baird Parker Agar (Oxoid) supplemented with 5% egg yolk emulsion and 1% potassium tellurite solution with 48 h incubation at 35°C ± 2°C as per the ISO 6888, 2003. Well isolated colonies were streaked on to Tryptic Soy Agar (TSA) for further purification and identification. Thirty one isolates of CoNS were identified as *S. haemolyticus (6), S. saprophyticus (3), S. hominis (4), S. simulans (3), S. warneri (12) and S. xylosus (3)* by Staph Biomerieux identification system. The distribution of CoNS from the collected fish samples were *S. haemolyticus* (2), *S. warneri* (3) *and S. saprophyticus* in lobsters;, *S. simulans, S. warneri* and *S. xylosus* in squids; *S. haemolyticus, S. saprophyticus* and *S. warneri (3)* in shrimps; *S. hominis* and *S. simulans* in octopus; *S. haemolyticus (2), S. saprophyticus, S. warneri* (2) and *S. xylosus* in ribbon fish; *S. hominis, S. simulans* and *S. warneri* in surimi, *and S. hominis and S. warneri* in the cobia samples. The antimicrobial sensitivity test to 24 antibiotics viz., Penicllin-G (P) 10 µg Azithromycin (AZM) 15µg, Erythromycin (E) 15µg, Clarithromycin (CLR) 15µg, Linezolid (LZ) 30µg, Co-Trimoxazole (COT) 25µg, Vancomycin (VA) 30µg, Cefoxitin (CX) 30µg, Ciprofloxacin (CIP) 5µg, Gatifloxacin (GAT) 5µg Ofloxacin (OF) 5µg, Clindamycin (CD) 2µg, Tigecycline (TGC) 15µg, Moxifloxacin (MO)5µg, Gentamicin (GEN)10µg, Rifampicin (RIF)5µg, Lomefloxacin (LOM)10µg, Norfloxacin (NX)10µg, Novobiocin (NV)30µg, Teicoplanin (TEI) 30µg, Nitrofurantoin (NIT) 300µg, Pristinomycin (RP) 15µg Ampicillin/Sulbactam (A/S) 10/10µg, Piperacillin/Tazobactam (PIT) 100/10µg (Dodeca Staphylococci-1 and 2, HiMedia, Mumbai) were carried out by disc diffusion method (Kirby-Bauer, 1966) on Mueller Hinton agar with 4% NaCl and incubated at 37°C for 18- 24 h. The inhibition zones were measured and evidenced as sensitive, intermediate and resistant as per CLSI breakpoints (2015) and all of antibiotics concentrations used were as per the CLSI recommendations. The MIC levels were determined with MIC detection strip for the antibiotics such as Methicillin A (0.01-240 µg/ml), Methicillin B (0.001-4 µg/ml), Penicillin (0.002-32 µg/ml), Oxacillin (0.016-256 µg/ml) Vancomycin (0.016-256 µg/ml), Gentamicin (0.016-256 µg/ml) and Ciprofloxacin (0.002-32). CoNS isolates showed higher level of resistance against gentamicin (70.9%), azithromycin (64.5%), vancomycin (45.1%), tigecycline (32.2%), and nitrofurantoin (19.3%). Intermediate level of resistance was also found with vancomycin (41.9%), nitrofurantoin (35.4%) and erythromycin (22.5%). Maximum CoNS isolates were susceptible to novobiocin (100%) followed by ciprofloxacin (96.7%), ampicillin/ sulbactum (96.7%) and fluoroquinolones (83-90%)(Table). The MIC levels was found highest with oxacillin (51.61%), ciprofloxacin (38.71%), amoxyclav (35.48%) followed by erythromycin (6.45%) and clindamycin (3.23%) and methicillin

(3.23%). The intermediate resistant were also found among these isolates with vancomycin (38.71%), erythromycin (12.9%) and tetracycline (3.23%). The average MIC values for oxacillin, amoxyclav, clindamycin, gentamycin, methicillin, tetracycline, ciprofloxacin, erythromycin and vancomycin were 12.84, 7.12, 0.41, 1.16, 5.11, 0.21, 3.83, 16.24 and 2.48 µg/ml, respectively. The presence of antimicrobial resistance in CoNS is mainly due to the commonly used antimicrobial agents such as oxacillin, ciprofloxacin, erythromycin, clindamycin and methicillin for the treatment of Gram's positive bacteria.This could pose public health threat and it may act as a reservoir for the horizontal transfer of antimicrobial resistance.

Table:Antimicrobial resistance patterne of CoNS from the seafood samples.

Sl. No	Name of the antibiotic	Antibiotic group	Resistant (%)	Intermediate susceptibility (%)	Susce- ptible
1	Penicillin (P)	Penicillin	19.3	0	80.6
2	Erythromycin (E)	Macrolides	9.6	22.5	67.7
3	Clarythromycin(CLR)		9.6	3.2	87.09
4	Linezolid (LZ)	Oxazolidinones	9.6	0	90.3
5	Co-Trimoxazole (Trimethoprim/Sulphamethaxole (COT)	Sulfonamides	9.6	0	90.3
6	Azithromycin (AZM)	Azalides	64.5	0	35.4
7	Ciprofloxacin (CIP)	Floroquinolones	3.2	0	96.7
8	Gatifloxacin (GAT)		6.4	9.6	83.8
9	Ofloxacin (OF)		6.4	0	93.5
10	Lomefloxacin (LOM)		3.2	9.6	87.09
11	Moxifloxacin (MO)		9.6	0	90.3
12	Norfloxacin (NX)		9.6	0	90.3
13	Clindamycin (CD)	Lincosamide	6.4	3.2	90.3
14	Cefoxitin (CX)	Cephems	16.1	0	83.8
15	Vancomycin (VA)	Aminoglycosides	45.1	41.9	12.9
16	Gentamicin (GEN)		70.9	0	29.03
17	Nitrofurantoin (NIT)		19.3	35.4	45.1
18	Rifampicin (RIF)	Rifamycin	9.6	3.2	87.09
19	Tigecycline (TGC)	Glycylcyclines	32.2	0	67.7
20	Teicoplanin (TEI)	Glycopeptides	3.2	16.1	80.6
21	Novobiocin (NV)	Aminocoumarin	0	0	100
22	Pristinamycin (RP)	Streptogramin	19.3	6.4	74.1
23	Ampicillin/Sulbactum (A/S)	Beta-lactam& Beta-lactamase inhibitors	3.2	0	96.7
24	Piperacillin/Tazobactum (PIT)		9.6	0	90.3

Development of Sampling Technique for the Study on Fish Consumption Pattern among Tribal Communities in Wayanad District, Kerala

Joshy C. G[1]., Sajeev M.V[1]., Aparna R[2]., A.K. Mohanty [1] and Suseela Mathew[1]

[1]ICAR- Central Institute of Fisheries Technology, Cochin-29

[2]K VK, Amabalavayal, Wyanad, KAU

Fish and fishery products are one of the most preferred diet supplements of majority of population in Kerala. The consistency in consumption trend might be due to abundance of fishery resources along 580 km of vast coastline; in addition to that, fish is regarded as the most affordable source of animal protein blended with a wide range of essential micronutrients and fatty acids. According to the latest census (GoI, 2011), in Kerala, the average fish consumption per month is 2.1 kg in rural areas and 1.9 kg in urban areas, compared with a dismal national average 0.269 kg and 0.238 kg of fish consumption per month in rural and urban India, respectively. Furthermore, as per national average, only 282 in 1000 households in rural and 209 in 1000 households in urban India consume fish. Conversely, Kerala has comparatively higher fish consumption, as 884 rural and 817 urban households in 1000 households consume fish. In terms of the rate of fish consumption, Kerala is almost 5-6 times higher than the national average, much higher than the Indian council of medical research (ICMR) recommended level of 12 kg per capita fish consumption of per annum.

Despite the trend in general fish consumption pattern in Kerala, still there is inconsistency in fish consumption patterns in the state, as evidenced by varying patterns of dietary diversity across coastal, plane and hill regions. Dietary diversity is influenced by different quantitative and qualitative attributes such as income, purchasing power, product price, market availability, supply-demand elasticity, food preference, variation in product quality, cultural diversity, subjective norms, beliefs, attitudes as well as various geographical, environmental, social and economic factors. Hence, the present study was undertaken by ICAR-Central Institute of Fisheries Technology (ICAR- CIFT), Cochin to assess the fish consumption pattern of tribal population in Wayanad district under the project, *"Value chain and Nutritional Research Outputs: Fish for nutrition and health of women and children"* to understand the dynamics of fish consumption behavior, and to ensure sustainable food and nutritional security through establishment of nutrition value chain in fisheries. The study is a prerequisite to implement and scale-up the value-added fish product interventions aimed at guaranteeing access to nutritious foods and breaking the intergenerational cycle of malnourishment among tribes. Currently, there are no real time qualitative or quantitative data available to explain the fish consumption pattern. Given this background, this research will delineate results, which explain the baseline status of fish consumption disaggregated by age, sex and location, level (quantity & frequency) of consumption in different areas, the preferences for fish and fish based products over other animal sourced foods, resource availability and the cultural acceptability for the fish based products. The location of the study has been selected on the basis of four criteria: (a) Prevalence of malnutrition, (b) Presence of fish eating population, (c) Existing extension mechanism suitable for product intervention and (d) Extent of access for easy coordination.

Wayanad is one of the fourteen districts of Kerala situated in the North-East region of the state. The total area under Wayanad district is 2132 km^2, out of which 885.92 km^2 is coming under forest area. As per the 2011 census, the population of district is 817,420 constituting 2.45 % of state population with a population density of 383 per km^2. The district has three municipalities Kalpetta, Mananthavady and Sulthan Bathery with Kalpetta as its administrative headquarters. The entire population including indigenous tribal population is confined to these three municipalities. Wayanad district is inhabited by 11 different indigenous tribal groups (2011 Census) namely, Paniya, Kurichyan, Kuruman, Kattunaykkan, Adiyan, Vettakuruman, Thachanadanmoopan, Wayanadkadar, Mala arayan, Karimballan and Ulladan. The district Wayanad, one of the study locations, has been selected due to the reported prevalence of malnutrition as indicated by anemia in children under five years (54.6 %), anaemic pregnant women (15.5%), underweight children (27.2 %), stunted children (27.7 %), and wasted children (10.7 %) besides fulfilling other the three criteria.

The most critical component of any research programme is the generalization of research findings to a large population in real life situations. Hence, in quantitative research, it is imperative to select an appropriate sampling technique and sample size to represent the targeted population.

As part of developing a suitable sampling technique to study the fish consumption pattern in the tribal population, the secondary data (GoI, 2011) on tribal groups, tribal population and tribal colonies and number of households under each tribal group were collected from the District Collectorate, Wayanad. It was observed that a total of 151,443 tribal people settled in 3,169 colonies containing 36,136 households (HH) distributed among different tribal communities as shown in Table 1.

The study mainly concentrated on major populous of tribal communities due to accessibility, budget

Table 1. Community wise distribution of tribal population in Wayanad District, Kerala

Sr.No.	Tribal Community	Population	Number of Households (HH)
1.	Paniya	68516	15876
2.	Kurichyan	25006	5812
3.	Kuruman	20083	5139
4.	Kattunaykkan	17051	4369
5.	Adiyan	11196	2570
6.	Vettakuruman	6467	1700
7.	Thachanadanmoopan	1646	390
8.	Wayanadkadar	673	174
9.	Mala arayan	166	44
10.	Karimbalan	145	39
11.	Ulladan	94	23
	Total	**151443**	**36136**

Source: GoI (2011)

and other administrative reasons. The core part of the study was to conduct a survey among the households of different communities by using a structured, pre-tested questionnaire developed by ICAR- CIFT. To conduct smooth survey and to get an efficient estimate of different response variables, Stratified Probability Proportional sampling technique was used. Six different tribal communities with highest population were considered as six different strata or groups. Probability proportional to population size was computed from each stratum to calculate the number of households (HH) to be selected from each stratum as given in Table 2.

Let N be the population total of number of households from six tribal communities, that is 35466. Let Nj (j= 1,2, ----,N_i) be the population households in each of the six (i^{th}) tribal communities. This can be mathematically represented as

$$N= N_1+N_2+N_3+N_4+N_5+N_6$$

The assigned probability proportional to the j^{th} unit in the i^{th} tribal community is P_{ij}, which is obtained as

and

Let 'n' be the total number of sample households selected from the entire study population 'N'. In the present study n was fixed as 200 households by considering the feasibility of sampling and budget. Let 'n_j, (j=1,2,---,n_i)' be the sample size of households selected from the i^{th} tribal community.

This can be obtained as $n_{ij} = (N_{ij} / N) * n = P_{ij} * n = P_{ij} * 200$

The probability 'P_{ij}" and number of households selected from six different tribal communities are given in Table 2. As per the sampling plan, 88, 32, 28, 26, 16, and 8 numbers of households has to be selected from Paniya, Kurichyan, Kuruman, Kattunaykkan, Adiyan and Vettakuruman tribal communities.

Let y_{ij} be the j^{th} sample selected from i^{th} tribal community. The sample mean of i^{th} tribal community of proposed sampling technique is given in the equation below.

The unbiased estimator of population mean is obtained as

The sample variance of i^{th} tribal community is obtained as

and unbiased estimator of is obtained as

Thus in the present study, Stratified Probability Proportional Sampling technique has been aptly designed to estimate the fish consumption pattern of tribal communities in the Wayanad district of Kerala. This technique is based on the principle

Table 2. Sampling plan among tribal communities

Sr.No.	Tribal Groups	No. of HH (N_{ij})	Probability (P_{ij})	No. of HH (n_{ij})
1.	Paniya	15876	0.44	88
2.	Kurichyan	5812	0.16	32
3.	Kuruman	5139	0.14	28
4.	Kattunaykkan	4369	0.12	24
5.	Adiyan	2570	0.07	14
6.	Vettakuruman	1700	0.04	8
	Total	**N= 35466**	**1.00**	**n = 200**

that the sampling elements are homogeneous within the stratum and heterogeneous among the strata. Again the households were randomly selected from each of the strata with adequate representation of study population (Ackoff, 1953). The sampling frame of study population is given in Figure 1.

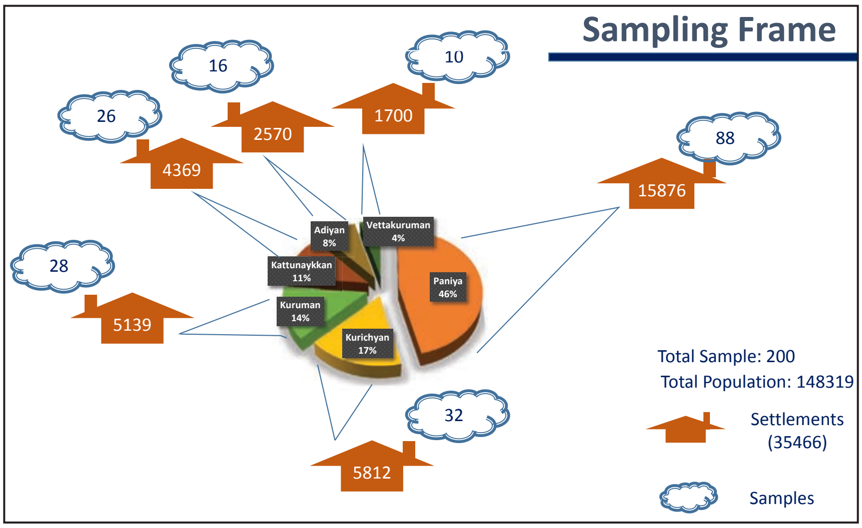


Figure 1. Sampling frame of the study population

The tribal communities with highest number of households were considered as different stratum on the basis of their socio-economic status, food habits, social customs and culture. The number households from each stratum was computed by Stratified Probability Proportional Sampling method. The proposed sampling technique facilitates the smooth survey of the sampling in the selected tribal communities and provides efficient estimates of fish consumption pattern in the tribal population of the district.

References

Aamir Omair (2014). Sample size estimation and sampling techniques for selecting a representative sample, *Journal of Health Specialties* / October 2014 / Vol 2 | Issue 4. Pp. 142-147.

Ackoff, R. L. 1953. The Design of Social Research, Chicago, University of Chicago Press.

GoI (2011), Census of India. (2011) www. censusindia.gov.in

Easton VJ, McColl JH. Statistics Glossary. Available from: http://www.stats.gla.ac.uk/ steps/glossary/sampling.html.

Kumar G.A. K. and Mohanty, A.K. (2013). Extension Research methodology : Basics to Advances. Agrotech Publishing Academy, Udaipur (ISBN : 978-81-8321-297-7), pp. 1-229.

Ray, G.L. and Mondal, S. (2004). Research Methods in Social Sciences and Extension Education, Kalyani Publishers, (ISBN 81-272-1463-9), pp. 1-321.

Sukhatme, P.V., Sukhatme, S., Sukhatme, B.V. and Asko. C. (1997). Sampling theory of surveys with applications. *Indian society of agricultural statistics*, New Delhi. P-529.

Trochim WM. (2008). Research Methods Knowledge Base: Sampling Terminology, [Oct 28th, 2008]. Available from: http://www. socialresearchmethods.net/kb/sampterm. php.

Yaqin Hu1, Chunhong Yuan, Kefeng Yu, Yinghong Qu, Shunsheng Chen, Xichang Wang and Ikuo Kimura. (2014). An Online Survey Study of Consumer Preferences on Aquatic Products in China: Current Seafood Consumption Patterns and Trends. *Fisheries and Aquaculture Journal*, 2014, 5:2. DOI: 10.4172/2150-3508.1000094.

Acknowledgement

This work was undertaken as part of the ongoing ICAR-CGIAR W3 collaboration in India between ICAR-CIFT, Cochin and WorldFish, Malaysia. Technical inputs and reviews provided by researchers from WorldFish under the CGIAR Research Program on Fish Agri-Food Systems (FISH) is acknowledged.

Clam Processing Facility at Perumbalam village, Alappuzha district, Kerala: An ICAR-CIFT initiative with people's participation

Nikita Gopal, Sethulakshmi C. S., Anju A. V., Sreejith S. and Bindu J.

ICAR- Central Institute of Fisheries Technology, Cochin-29

The clam fishing activity in Perumbalam village, an island in the Vembanad estuarine system in Alappuzha District, is completely family-based. About 200 families are engaged in clam collection, processing and marketing for their livelihood, with fishermen looking after harvesting, processing and marketing being taken care of by the fisherwomen. The households involved in clam picking are spread across eight wards along the coast. The ICAR-Central Institute of Fisheries Technology, Cochin intervened in this venture with the intention of transforming this family-centric activity into a centralized clam production, processing and marketing activity with people's participation. CIFT conducted a diagnostic study to explore the feasibility of establishing a clam cluster in the village and for channelizing the clam harvesting, processing and marketing activities through a consultancy agreement with Haritha Farmer's Club, Perumbalam during 2011. Through a DST-SEED funded project, this was implemented with the participation of local partners, the Perumbalam Grama Panchayat and Haritha Farmer's Club, and by mobilizing the clam fishers and processors of the village. Eight of the thirteen wards of the island were surveyed with the collaboration of local project partners and the possibility of forming 14 clusters, each having about 10-15 members in this region were identified and five clusters formed. Standardized protocols for processing clam meat was developed, value added products were developed and demonstrated; customized machinery required

Formal inauguration of the clam processing facility for the processing facility were designed and fabricated; capacities of the local people were built; and a fully operational clam processing facility was established. The facility includes depuration tanks system for depurating clams; processing hall equipped with tables, flake ice machine, chill room; a cooking-cum-boiler unit for cooking and shucking the clams; and a meat-shell separator for mechanically separating the meat from the shell. The cleaned, packed clam product is expected to be safe and can fetch a premium price in the market. Product diversification that was demonstrated can be an added income generating activity which can be taken up by the cluster members. The anticipated increase in sale price of clam meat after processing is about 119% which will directly go to the families involved in clam harvesting and processing clam meat.

Value added clam products

FISHTECH Reporter, published half yearly by the Central Institute of Fisheries Technology present the Institute's recent research outcomes related to fish harvest & post-harvest technology and allied sectors. The information disseminated is intended to reach fishers, fish processors, planner and extension personnel for overall development of the fisheries sector.

ICAR - CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY

Willingdon Island, Matsyapuri P.O., Cochin - 682029, Kerala, India