

## CIFT for futuristic research in responsible fishing and fish processing

The Central Institute of Fisheries Technology (CIFT), initially known as the Central Fisheries Technological Research Station, was established at Cochin of Ernakulam district in Kerala on 29th April 1957. The station was upgraded to the status of an Institute in 1962 and its administrative control transferred to the Indian Council of Agricultural Research (ICAR) on 1st October 1967. With headquarters at Ernakulam, it has Research Centres at Mumbai (Maharashtra) and Veraval (Gujarat) on the west coast and at Visakhapatnam (Andhra Pradesh) on the east coast for solving regional and location specific problems. The institute is the only national centre in the country where research in all disciplines relating to fishing and fish processing is undertaken.

The current mission of the institute is to ensure responsible harvesting of fishery resources through eco-friendly, energy efficient and economical means; ensure total utilization of the harvested fish through appropriate processing,

value addition, packaging and waste utilization; ensure food safety and nutritional security to the consumer and minimize carbon and water footprint per unit volume; and to ensure equitable benefits to the stakeholders, across the value chain.

The research work of the institute is carried out in the research divisions viz., Fishing Technology Division, Fish Processing Division, Quality Assurance & Management Division, Biochemistry & Nutrition Division, Microbiology, Fermentation & Biotechnology Division, Engineering Division and Extension, Information & Statistics Division.

CIFT maintains close linkages with other fisheries institutes of Department of Animal Husbandry, Dairying & Fisheries and state fisheries departments, National Fisheries Development Board, CSIR Institutes, Department of Science and Technology, Department of Biotechnology, Marine Products Export Development Authority (MPEDA), Export Inspection Agency (EIA),

Bureau of Indian Standards (BIS) and research organizations of Ministry of Earth Sciences and Ministry of Environment and Forests.



**Dr. C N Ravishankar**  
Director

The Business Planning and Development (BPD) Unit set up established at the institute in 2011-12 caters to the needs of entrepreneurs who wish to start up new technology-based business. The unit provides physical workspace, management and technical assistance, access to financing and other supporting services to entrepreneurs and young firms to help them survive and grow the start up stage. The set up provides a congenial environment between ICAR scientists and entrepreneurs for commercialization of technologies.

The technical matters including those connected with research

projects handled by the institute as also the prioritization, monitoring and evaluation of the projects are carried out by the Prioritization, Monitoring and Evaluation (PME) Cell. The PME Cell of the institute also coordinates and synthesizes recommendations of the RAC, QRT, IRC documents for listing priority research, problems and monitors ongoing projects and its outputs. The Intellectual Property Rights and Patents are taken care by the Technology Management Unit of the institute. Official Language Implementation Section is headed by the Assistant Director (Official Language).

The technology development transfer programmes of CIFT and adoption in the fisheries sector have greatly contributed to the development of infrastructure and human resource as well as improvement in quality of products and have helped the country achieve a coveted position in the global fisheries scenario. CIFT has worked for both the high technology needs of the industry and the needs of the traditional fishing sector to improve the socio-

economic upliftment of the weaker sections. The institute is being looked upon for guidance, leadership and for technology innovation by both governmental agencies as well as private entrepreneurs.

CIFT, Cochin was awarded ISO 9001: 2008 Certificate and is also has a NABL accredited laboratory. The institute is the proud recipient of the Sardar Patel Outstanding ICAR Institution Award twice, in the year 2000 and 2006.

The technologies for responsible harvesting and sustainable utilization of fishery resources that have been developed, assessed and transferred can be summarized as below:

- ▶ Eco-friendly energy efficient fishing craft and gear systems (fuel efficient fishing vessel of 15.5 m LOA, canoes from rubber wood, different types of pelagic, demersal and semi pelagic gears, bycatch reduction devices, etc.)
- ▶ Advanced technologies like retort pouch processing, high pressure processing, active

packaging etc. for fish preservation and development of value added products from low value fish.

- ▶ Formulation of standards for fish and fishery products for domestic and export markets: biological and chemical standards, code of practices for handling, traceability standards etc.
- ▶ Development of nutraceutical products (PUFA, peptides etc.) and pharmaceutical products (fine grade absorbable sutures, hydroxyl apatite, calcium tablets etc.)
- ▶ Rapid methods for detection of seafood pathogens. Recent success stories

**Succinyl Chitosan based hydro-alcohol hand sanitizer**

Market available hand sanitizers containing synthetic antibacterial compounds (mostly containing Triclosan) cannot be used by workers in fish processing plants due to regulatory reasons. Again, such hand sanitizers mostly contain synthetic acrylogel polymers. Succinyl chitosan is a semi synthetic biopolymer with



*Succinyl chitosan based hand sanitizer*



*Release of hand sanitizer*

excellent biocompatibility and moisture retention capacity. CIFT optimized the synthesis of an amphiphilic Succinyl Chitosan polymer and developed a hydro-alcohol hand sanitizer based on this. The hand sanitizer contains 67% ethanol. Coumaric acid was used as an ionic crosslinker of the hand gel, as well as a natural antibacterial agent. The efficacy of the hand sanitizer was evaluated by ASTM Glove Juice method with positive results. The product was released in ICAR Foundation Day ceremony and under test marketing with M/s. Perma Chemicals, New Delhi.

#### **Hydrogel - composite incorporated with micro-encapsulated curcumin**

A biocompatible and biodegradable hydrogel formulation composed of microencapsulated curcumin and hydrogel composite (chitosan derivative-fish collagen-poly ethylene glycol) was developed. Curcumin is known to be a traditional medicine in India, China and South Asian countries for treating healing impaired wounds and inflammatory conditions. Due to its high hydrophobicity and rapid metabolism, Curcumin was encapsulated in succinyl chitosan micelles with high encapsulation efficiency ( $48 \pm 1.5\%$ ). Average particle size of the curcumin loaded particles was 829 nm. The smallest particle observed was 265.3 nm and the biggest particle observed was 5100 nm in size. AFM image of the micro particles showed that the particles are round to oval in shape with smooth surface. A simple one pot gelation of

encapsulated curcumin containing composite hydrogel was achieved by a novel crosslinking technique. Developed hydrogel was evaluated for its wound healing efficacy in subcutaneous circular incision wound model on albino rats. The hydrogel significantly enhanced the collagen deposition ( $599.466 \pm 16.99$  g/gm) and hydroxyproline content ( $74.93 \pm 2.21$  ?g/gm) in wound tissue on 14th day of post wounding as compared to control and standard. The results suggest that combined bioactivity of curcumin and composite hydrogel promotes tissue reconstruction process during wound healing and might have potential application in wound healing. The hydrogel may have other potential application in cosmetics also.

#### **Collagen peptide from fish skin collagen**

Fish skin collagen was prepared following an in-house method. For hydrolysate preparation, the

extracted fish skin collagen in double distilled water was preheated and then hydrolysed using multiple enzymes. For hydrolysis three different proteolytic enzymes were used. The hydrolysis conditions of time, temperature, Enzyme/Substrate ratio and pH were optimized for the three enzymes by RSM. After hydrolysis, supernatant collected and spray dried to get fish collagen hydrolysate in powder form. Animal studies and cell line studies were done to confirm the anti-arthritis potential of the hydrolysate. Peptide in the hydrolysate was sequenced using LC-QTOF.

#### **PUFA enriched poultry eggs**

Extraction of PUFA from sardine oil was perfected in a reflux/ distillation equipment. The yield of omega-3 concentrate ranged between 18-25% and concentrations up to 70% could be obtained. The extracted oil was encapsulated. It was demonstrated that PUFA can be

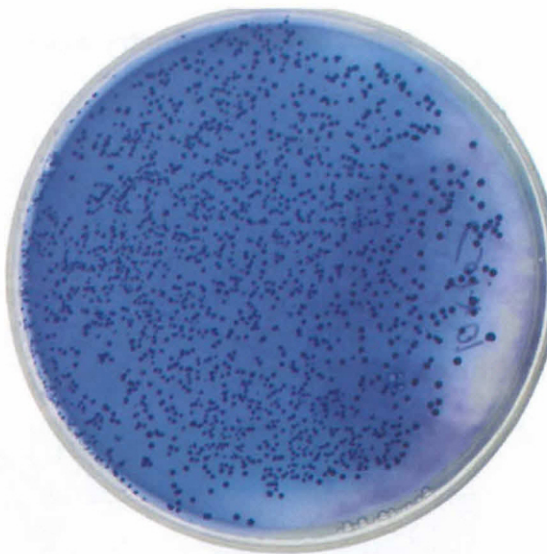


*PUFA enriched poultry eggs*

incorporated in poultry feed for better growth and for PUFA enriched meat and eggs. The technology has been given to a progressive poultry farmer and encouraging results have been reported.

**Methicillin - resistant - Staphylococcus aureus from seafood**

Studies on prevalence of Methicillin - resistant - Staphylococcus aureus in the fish/shellfish and aquatic environment revealed occurrence of this pathogenic organism in fish samples. Molecular typing of the



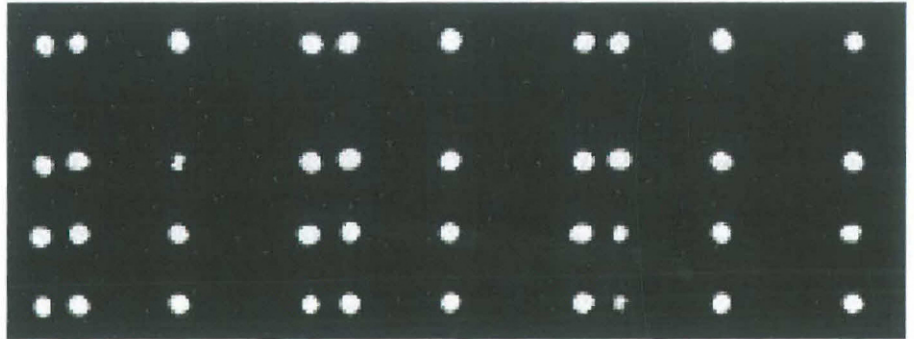
*ORSAB agar showing deep blue*

isolates recovered from fish using Staphylococcus aureus protein typing (SPA) and Multi-locus Sequence typing (MLST) showed that the MRSA clones isolated from fish belonged to the "Bay of Bengal Clone-Community Associated MRSA (CA-MRSA) with Pvl gene". The result implicates the spread of these MRSA clones from hospital to community and now to food and environment.

**Development of a low-cost diagnostic microarray platform for the detection of shrimp viruses**

Shrimp viral pathogens possess serious threat to the viability and

discriminate between the perfectly matched probe and all the mismatch probes. This work demonstrates that an indigenous low-cost epoxide-modified glass slide is a viable and attractive



*Scanned image of dual-labelled capture probes on the indigenously developed microarray after washing*

economics of shrimp cultivation and there is a growing need of test methods for detection of multiple shrimp pathogens in a single test. A microarray-based method for detection of shrimp viruses using glass slides modified with epoxy-functional groups was developed. Epoxy-modified slides were then evaluated for their spotting consistency using dual labeled

oligonucleotide capture probes containing 5'-aminoethyl group and 3'-Cy3 group. The spotting efficiency was found to be steady showing the usefulness of such slide as a substrate for microarray. The sensitivity of the array through hybridization of Cy3'-labelled perfect match and mismatch probes to the Hepatopancreatic parvo virus (HPV) probe printed on the array was also investigated. The microarray was able to

substrate for the fabrication of microarrays to be used in diagnosis of shrimp viral infection. The method developed was rapid, sensitive and can be scaled up for high-throughput applications.

**Draft genome sequence of Mangrovibacter spp. MFB070 - a Nitrogen-fixing bacterium isolated from an aquaculture farm**

The genome of Mangrovibacter spp. MFB070, a facultatively anaerobic, nitrogen-fixing bacterium representing a novel genus and species of the family Enterobacteriaceae, associated with the rhizosphere of mangrove-associated plants was sequenced and annotated. The draft genome sequence of Mangrovibacter spp. is 5,361,682 bp, with a G+C content of ~64.8 % and 5297 predicted coding sequences, and 36 tRNA genes for all of the amino acids. The organism encodes for mdtABCD, the multidrug resistance cluster that increase resistance to

Novobiocin and Deoxycholate. The bacteria also encodes for genes for heavy metal resistance to cobalt, cadmium, zinc, arsenic and copper based on metal resistance determinants that contain genes for RND (resistance, nodulation, and cell division protein family) protein. Several phage proteins were also identified indicating the

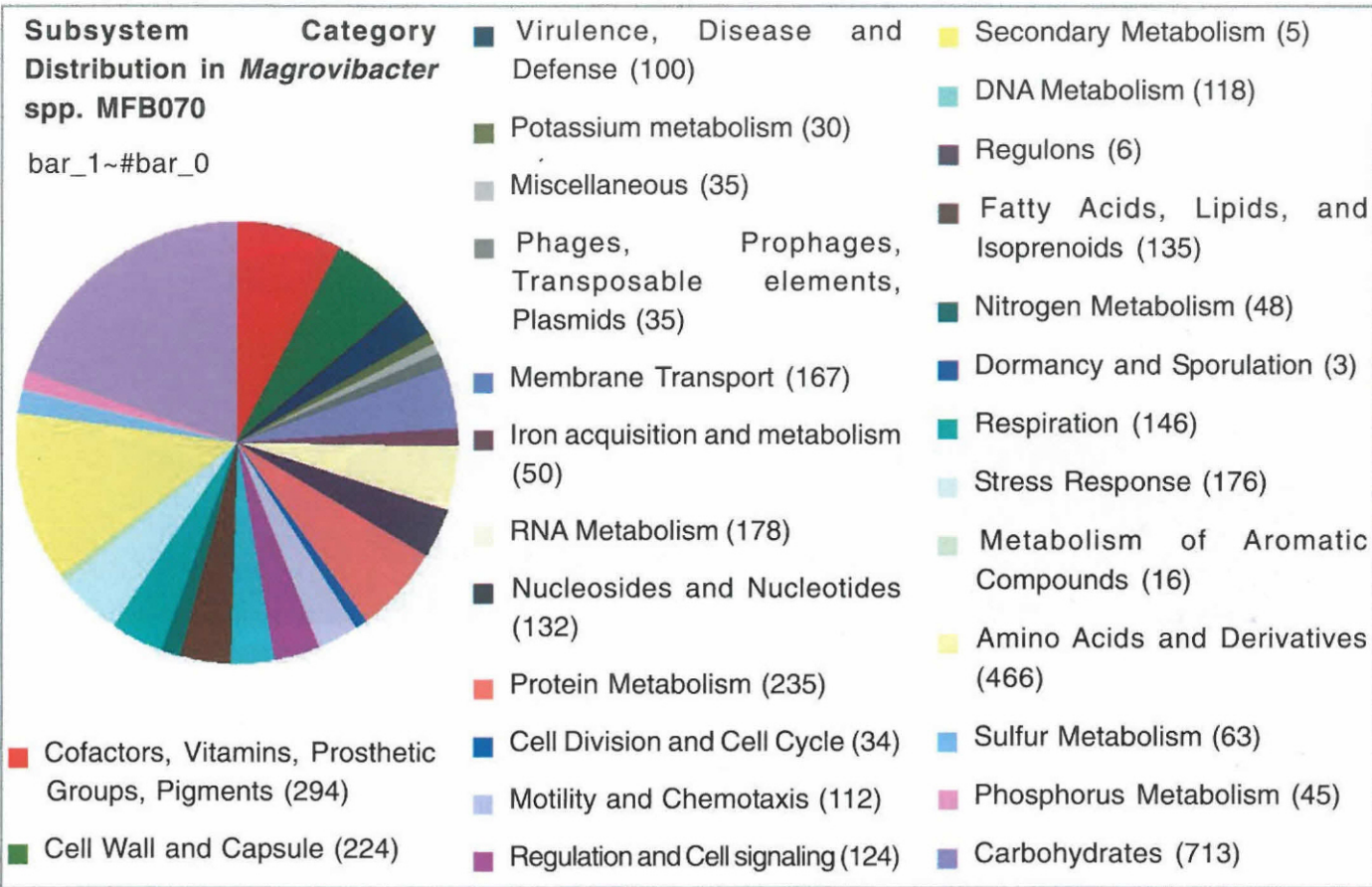
submitted to GenBank and has been assigned accession No. JJMI00000000.1.

**Development of solar boat**

Annual fuel consumption by the mechanized and motorized fishing fleet of India has been estimated at 1220 million litres which formed about 1% of the total fossil fuel

SUNBOAT, which is driven by solar power and was launched at Matsyafed Njarakkal Fish farm, Kerala, by Mr. K Babu, Honourable Minister for Fisheries, Port and Excise, Government of Kerala on 23<sup>rd</sup> February, 2014.

The boat is capable of running for 2.5 to 3.0 hours after complete charging and attains a speed of



presence of phages in the bacteria. Genes involved in iron acquisition and metabolism including siderophores was also identified in the bacteria. The genome also contains ~35 ORFs that match various phages. Set of genes involved in nitrogen fixation, nitrosative stress, nitrate and nitrite ammonification and ammonia assimilation are also found in the genome. The genome of *Mangrovibacter* MFB070 was

consumption in the country in 2000 releasing an estimated 3.17 million tonnes of CO<sub>2</sub> in to the atmosphere at an average rate of 1.13 tonnes of CO<sub>2</sub> per tonne of live weight of marine fish landed. A four-fold increase has taken place in the price of diesel compared to the year 2000. Thus a renewable and non-polluting energy resource for propulsion is the need of the hour. CIFT has developed a solar powered boat christened

nearly 4.0 knots in calm waters. The battery is placed in a separate compartment to protect it from getting wet. The awning protects the fishermen/passengers from sun and rain and is made of Aluminium alloy which does not require any maintenance and painting. The twin hull construction gives high stability during the fishing activities and the deck area is wider compared to a similar sized conventional boat. The

navigational lights are also run by the solar power produced which is an additional feature compared to traditional boats and this facilitates safe fishing during early morning and late night. The propellers of the boat are made of plastic composite and do not corrode. One of the propellers is steerable and manoeuvring is done using this. The height of the propellers can be changed as per requirement.

ADVANTAGES	SPECIFICATIONS
<ul style="list-style-type: none"> <li>▶ No fuel cost</li> <li>▶ No pollution from the burning of fuel</li> <li>▶ Less carbon footprint</li> <li>▶ No sound pollution</li> <li>▶ Clean FRP surface for fish handling</li> <li>▶ Twin hull with low rolling</li> <li>▶ More deck area</li> <li>▶ Suitable for shallow waters</li> <li>▶ Canopy for protection from rain and sun</li> </ul>	<p>L<sub>OA</sub> : 3.63 m                      Breadth : 1.75 m                      Depth : 0.60 m                      Power : 500 W                      Propulsion : 2 x 0.6 kW                      Battery : 12 V                      Number of persons: 4(Max)                      Type of activities: Aquaculture purposes, gill netting, lining, transportation, aqua-tourism etc.</p>



Mr. K Babu, Minister of Fisheries, Ports and Excise launches the solar boat



Dr. B Meenakumari, DDG (Fy.), ICAR in solar boat

**All India fishing craft and gear survey**

As part of the National Fund for Basic, Strategic and

Frontier Application Research in Agriculture (NFBSFARA) funded project 'Green Fishing Systems for Tropical Seas', an all India baseline

survey of fishing craft and gear and energy efficiency benchmarking was successfully completed, for the development of



Field survey in progress

a database of existing fishing crafts and gears operating in the marine sector. This is the second such comprehensive survey on the technical details of the craft and gear being used in the Indian

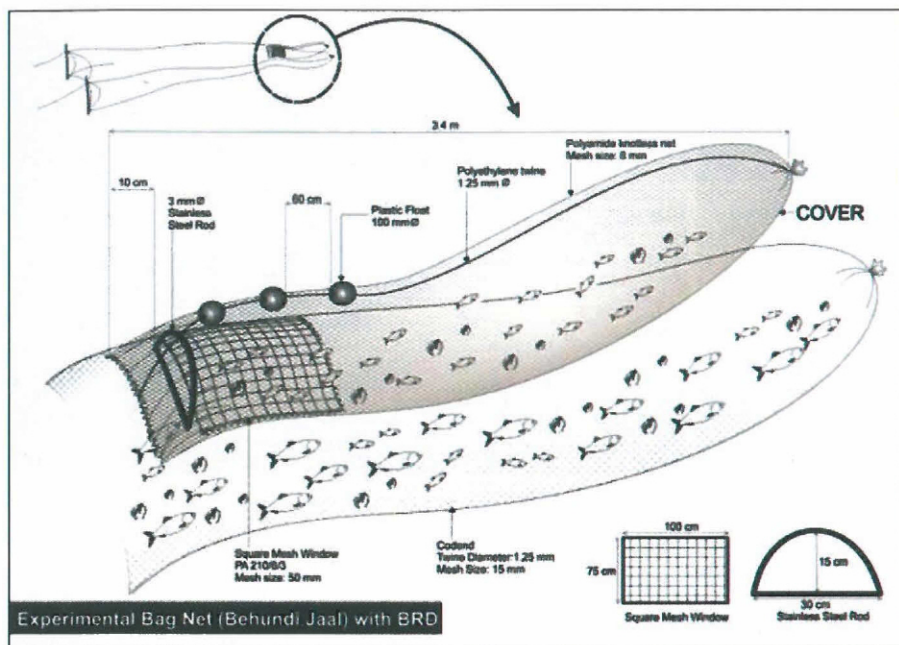
marine sector after the FAO surveys in the 1950's. Structure pre-tested questionnaires were used for collecting information from different stake holders and a total of 37 important landing centres and

160 fishing villages were covered and detailed information of 218 representative gear samples and 66 fishing crafts operated along the Indian coast were collected during the survey.

**Bycatch Reduction Devices (BRDs) in bag nets for reducing the capture of juvenile Hilsa**

monofilament gillnets with mesh size ranging from 100-150 mm. There is targeted fishery for Hilsa sub-adults in the all the estuaries using gillnets with smaller mesh

size, which is adversely affecting the stock. Besides on an average about 85 tonnes of juveniles of Hilsa are being caught in the bagnets used along the major Hilsa migrating grounds. To reduce the capture of Hilsa juveniles in the stationary bag nets a BRD consisting of a square mesh window of size *Square mesh panel BRD* 1m x 0.75m made of 50 mm mesh has been introduced near the codend. These experimental bagnets are under operation in Hooghly river, West Bengal and Narmada river in Gujarat. A total of 41 species were found to escape through the BRD and the mean escapement of juveniles of Hilsa were 11.60% of the total catch excluded from the BRD. The experiments trials are being continued in both the estuaries.



Square mesh panel BRD

**Risk Assessment of emerging pathogens and chemicals in seafood**

Risk assessment of emerging pathogens in fish and fishery products available in southern India revealed that the enterohaemorrhagic *Escherichia coli* O157 had the highest prevalence of 12.9%, followed by *Salmonella* (11.3%), *Vibrio parahaemolyticus* (4.8%) and *Yersinia enterocolitica* (3.2%). Increased incidence of *E coli* O157

and *Yersinia enterocolitica* in marketed seafood indicated altered pathogen profile and possible cross contamination from other animal meat products. Adulteration of fishes with ammonia and formaldehyde was observed during cross-state distribution and transport of fishery products. Source tracking of major pathogens like *Salmonella* indicated use of contaminated ice and unhygienic handling in fish market as the principal entry points for this pathogen.

Potential use of emerging additives like lactic acid in fish sausage production was evaluated in terms of growth retardation of major pathogens like *Escherichia coli*, *Staphylococcus aureus* and inhibition of spoilage flora. Using response surface methodology (RSM) an optimized treatment regime of 1.5% concentration and 2 h soaking time was established, which could maximize shelf life and inhibit growth of pathogenic microflora in Pink Perch (*Nemipterus japonicus*) sausages

during chilled storage.

**Quality Index scheme for Indian fishes**

Quality index scheme for Indian mackerel (*Rastrelliger kanagurta*)

was completed correlating demerit scale with chemical, microbiological hazards and texture profile analysis. A Quality Index Method (QIM) scheme for sensory grading of chilled Indian Mackerel was

finalized with 14 sensory descriptors and total demerit score of 33. Principal component analysis indicated retention of prime quality of fish for initial five days of chilled storage.

**Hud hud crippled seafood sector in Vizag**

The fury of recent cyclone *Hud hud* that entered the shore at Visakahpatanam in Andhra Pradesh packing winds around

by the cyclone. There were severe damages to the civil structure as well as other utensils and facilities. The power outrages affected the

to the cyclonic weather with lack of electricity and loss of brooder shrimps. The processing units and hatcheries could not be operated



*Damages from the fury of Hud hud*

200 km per hour has badly affected the seafood processing units, cold storage premises, fishing vessels and fishing harbours of the port city. Of the 12 seafood processing units in Visakhapatnam, 11 were affected

frozen storages spoiling the cargo worth millions. Reports indicate that about 400 boats have been damaged in the cyclone fury and 72 sunk without a trace affecting the fishermen and their families. Hatcheries were also affected due

for weeks due to power and material shortage. Fishermen as well as processing workers lost their livelihood means and dwellings.

To have an assessment on the



*Ms. Leena Nair, Chairman, MPEDA, visiting fishing harbour area*