

4. SALIENT RESEARCH ACHIEVEMENTS

4.1 Achievements in brief

CIFT has developed and introduced twelve standard designs of mechanized wooden fishing boats in the size range of 7.67 to 15.2 m LOA for coastal and intermediate range. It is estimated that over 80% of the nearly 54,000 mechanised wooden fishing crafts in the Indian fishing fleet conform to the popular CIFT designs or its later adaptations.

- ➔ Hull maintenance of the fishing vessels is important for increasing its service life. CIFT has developed a package of technologies for protection against biodeterioration, fouling and corrosion for increasing the life span, substantially reducing maintenance cost of fishing vessels.
- ➔ Aluminium-magnesium alloy sheathing with cathodic protection and prescribed coating system was developed as a cost-effective substitute for copper sheathing for wooden hulls as protection against marine borers. This technology is widely used in the small-scale mechanized vessels.
- ➔ Epoxy resin based coating developed has improved the life span of cast iron propeller, making it a cost-effective substitute for bronze propeller in fishing boats.
- ➔ Spheroidal graphite cast iron with nickel (21-24%) material was recommended as substitute for conventional manganese-bronze for propellers of fishing boats, resulting in cost savings of 25-30%.
- ➔ Superior cost-effective antifouling paint formulations incorporating Cuprous oxide and modified indigenous resins were developed for protection against fouling in fishing boats.
- ➔ CIFT has developed technologies for the chemical preservation and upgradation of low cost timbers to make them more durable. These have extended the service life of fishing crafts and contributed towards the efforts against deforestation.
- ➔ Technology was evolved for upgradation of cheaper secondary species of wood as substitutes for boat scantling, by impregnation with styrene-polyester monomers, fortification with Creosote/Tributyl tin oxide (TBTO) and polymerization with gamma irradiation.
- ➔ CIFT has made immense contribution towards the standardization of the netting, netting yarn and netting twine used for fishery purposes. These developments have led to an increase in the productivity of the fishing gear and increase in net profits due to low maintenance and long service life of the nets.
- ➔ CIFT has made significant contributions in the development of fishing gear and methods for the traditional sector, traditional motorized sector, small-scale mechanized sector and large-scale industrial sector in Indian fisheries, which is reflected in the increase in fish production.
- ➔ Improvements were made in the design and durability of lobster traps as substitute for traditional traps of short life span and low efficiency, for harvesting of spiny lobster.
- ➔ A mini-trawl for operation from traditional crafts powered by outboard motors of 8-15 hp, for shallow water shrimp trawling was introduced.
- ➔ A purse seine was introduced and popularised for operation from traditional plank built canoes (*Thangu vallom*) powered by outboard motors, for efficient harvesting of pelagic shoaling fishes. Since its introduction, the mini-purse seine has become very popular among the fishermen of motorized sector along the coast line of Kerala, significantly contributing to the landings of pelagic coastal resources such as sardines, mackerel and anchovies.

- Specially designed trawl for shrimp trawling with low vertical opening and extra long wings on either side was found effective for sweeping of wider horizontal area along the sea bed resulting in increased shrimp catch.
- Bulged belly trawl with relatively high vertical opening was designed to improve the catch of fin fishes without compromising on shrimp catch.
- In high opening trawls, vertical opening of the trawl is increased by innovative design improvements, facilitating capture of demersal as well as off-bottom resources.
- Large mesh trawl with relatively large meshes in the front portion resulted in significant reduction in trawl resistance, making use of the herding effect of large meshes on fin fishes. The reduced drag permits greater trawling speed and operation of a larger trawl with the available installed engine power. These designs have been well accepted by the trawler fishermen of Gujarat, Karnataka and Kerala.
- In rope trawl the front trawl sections are replaced by ropes which, as in the case of large mesh demersal trawl, resulting in reduction of trawl resistance. Fin fishes are retained due to the herding effect of ropes. The reduced drag permits greater trawling speed and operation of a larger trawl with the available installed engine power.
- Otter boards are sheer devices used in trawls for keeping the trawl mouth horizontally open. Different sizes of flat rectangular boards of wood and steel construction, V-form steel otter boards, oval steel otter boards and vertically cambered otter boards have been introduced by CIFT for the benefit of small-scale mechanized fleet, during the course of its development. V-form otter boards with high stability, better hydrodynamic efficiency, low maintenance cost and longer service life is now replacing the flat rectangular boards in the small-scale mechanized sector. Overall savings by adoption of V-form otter boards in place of flat rectangular boards is about 15%.
- Purse seines were introduced for catching pelagic shoaling fishes such as sardine and mackerel, from small mechanized vessels.
- Long lines for sharks using indigenous hooks has been developed as a low energy resource-specific alternative to energy intensive less selective fishing methods such as trawling.
- Troll lines were developed for predatory fishes such as Spanish mackerel and barracuda, using buffalo horn, stainless steel, spoon and fish head jigs.
- Marine gill nets optimized for catching sardine, mackerel, Spanish mackerel, pomfret and hilsa, in terms of material and mesh size were introduced for the benefit of non-motorised, motorised and mechanized segments of the industry.
- Gear systems have improved the capture fishery production from the inland open water resources significantly over the years. Trammel nets and monolines were also introduced in reservoir systems.
- Technology for extraction of chitin from shrimp shell and conversion to chitosan has successfully addressed a very serious environmental threat due to the careless disposal of the waste. Eight parties have already taken this technology and started production and marketing. Nearly 20% of the available shell waste is being used by these industries for conversion to chitin and chitosan. In addition to creating employment this has become a highly remunerative industry.
- Ready-to-serve fish curry products in retortable pouches can be stored at ambient temperature.

The technology has been already given to more than a dozen parties who have already started production and marketing. This technology has long-term impact in terms of value addition.

- Isinglass is a product that has got application as a clarifying agent in breweries, mainly the beer industry. The technology was transferred to an industry for commercialization.
- The technology for extraction of polyunsaturated fatty acids (PUFA) from fish oil is a very important contribution towards nutritional security by providing a vital nutritional component. Many multinational companies are importing PUFA-enriched products and this technology will lead to import substitution.
- Collagen-chitosan film has wide applications as a wound dressing and in dental surgery. It replaces the imported Teflon membrane used in dental surgery and the cost will be only a small fraction of that of the imported material. The raw material is fish air bladder, which does not find any use now.
- Database on biochemical composition of fish serves as the major source of data on biochemical composition of fish for product formulation and nutrition labelling.
- A single step microbiological assay was perfected for detecting residues of 8 antibiotics in seafood, viz. Chloramphenicol, Oxolinic acid, Tetracycline, Oxytetracycline, Furazolidine, Nalidixic acid, Neomycin and Trimethoprim which are commonly used in aquaculture farms in India. The method can detect these antibiotic residues to a level of 0.1 ppm. About 65 seafood factories in Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Maharashtra and Gujarat exporting seafood to EU and US are direct beneficiaries of this technology.
- A two step nested PCR method for the detection of White Spot Syndrome Virus in shrimps was developed, standardised, assessed and introduced for commercial use. This method will detect the presence of as small as 10 virions per post larvae. The technology is being used for regular testing of post larvae (PL) before introduction to the farms.
- A RT-PCR method to test for the devastating yellow head virus (YHV) in shrimp farms was developed, assessed and commercialised. This is the only test method for yellow head virus now available in India. The method is being currently used for screening frozen shrimp for YHV, being exported to the US, to meet the phytosanitary regulation of the WTO.
- An improved ELISA method for detection of residues of chloramphenicol, a 'zero tolerant' antibiotic, in processed seafood for export to EU, US and Japan was evolved. This improved method was assessed and commercialised in 2003. It is now regularly used to monitor chloramphenicol level in farmed and processed shrimps.
- The 'Cloritest paper' developed for detection of ppm levels of chlorine in process water, an essential requirement to implement sanitation and hygiene practice in food processing industry, was transferred to M/s. Glaxo Laboratories. This has resulted in significant reduction of the rejection of seafood items on the basis of contamination with pathogens.
- Suitable programmes were organised for implementation of HACCP in the seafood industry. A software was also developed for HACCP.
- Throughout India the effluent treatment system attached to seafood processing units is a neglected area resulting in serious environmental problems. To alleviate this problem of pollution by the seafood industry, an efficient effluent treatment plant was designed to treat the effluents conforming to the Pollution Control Board standards.

- The following engineering equipment have been developed by CIFT for use in fishing and fish processing:
 - 15.5m fuel efficient steel fishing vessel
 - Fibreglass canoes
 - S.S Tilting Kettle
 - Oil fryer for battered and breaded products
 - Tunnel Dryer
 - Environmental data acquisition system
 - Temperature- Salinity meter
 - Ship borne data acquisition system
 - Speed and distance log
 - Trawl depth meter.

- The following aspects having management and policy level implications in fisheries have been studied by the Institute:
 - Idle capacity in fish processing plants in India
 - Price analysis of Indian seafood in the export market
 - Economics of artisanal fisheries
 - Economics of operation of fishing vessels on both West and East coast of India
 - Price spread in domestic fish markets of Kerala and Gujarat
 - Fuel utilisation pattern by the fishing industry in India
 - Assessment of harvest and post harvest losses in fisheries
 - Estimation of inland fish landings in reservoirs

- The Institute also undertakes research studies which provide feedback to technology development and transfer. The following are some of the works undertaken:
 - Socio-economic profile of fisherfolk in different parts of the country and development of socio-economic status scale
 - The areas and extent of participation of women in fisheries related activities
 - The types and activities of cooperatives and other organisations in fisheries and the role played by them in small scale fisheries
 - Adoption behaviour including extent of adoption, communication, decision making, response to technological changes, innovativeness, differential adoption and technological gaps of fishermen in traditional, mechanized and motorized sectors and fish curers in relation to technologies transfer by the institute
 - Evaluation of the training and extension programmes taken up by the institute in terms of gain in knowledge, awareness, practice and constraints
 - Evaluation of HRD activities in fisheries to understand the impact and constraints
 - Studies on ban on monsoon trawling, coastal zone management and socio-legal issues

The research activities carried out by the institute has benefited various sections of the society directly and indirectly. Some of the notable programmes carried out are listed below:

4.2 Programmes for Women & Weaker Sections

Ever since its inception, the Institute has been making every effort to strengthen the weaker section of society including the fishermen, fisherwomen, the rural poor and the financially backward community. Training programmes and demonstrations have been organised both at the institute and other locations towards achieving this goal. Some of the trainings conducted have been on trawl net square mesh codend fabrication, fish processing and quality control, maintenance and repair of outboard motors, fish handling and processing, production of value added fish products and waste utilisation. The beneficiaries have been those nominated by Fisheries organisations, Societies, Self-Help Groups etc.

4.3 Programmes for NEH Region

Development of the backward North Eastern Hilly regions is a top priority item in Govt. of India's agenda and ICAR has been taking up programmes for this purpose. Programmes for technology transfer to the NEH region aims at development of agriculture, animal husbandry and fisheries in the region through implementation of need based technologies. The programmes were initiated in 2000 as a part of the Five Year Plan of the Indian Council of Agricultural Research. As a part of this, the CIFT has been conducting systematic programmes for transferring technologies developed by the Institute for harvest and post-harvest processing of fish. All eight states of the NEH region including Sikkim and the 'Seven Sisters' namely, Assam, Meghalaya, Arunachal Pradesh, Mizoram, Manipur, Nagaland and Tripura have been covered by CIFT under this programme. The Institute has been, since its inception, focusing on technology development for inland and fresh water bodies. The NEH states are blessed with a number of rivers, lakes and reservoirs including the great Brahmaputra.

During the period 2000-2004 thirteen teams comprising scientific and technical staff visited the above states and identified technologies suitable for each state through field visits, interaction with stake holders at community level and discussion with officials of Fisheries Department and other agencies. Major resources, production and marketing channels etc. have been identified and appropriate technologies are being finalized and implemented. Some of the technologies transferred are briefly outlined below:

Construction of fibreglass fishing canoes

Fibreglass as an alternative material for the fabrication of fishing canoes was introduced for the first time in the North East Hill Region. A 40 day long training-cum-demonstration programme was carried out in March 20004 at Amranga in Assam under which 16 participants and the Engineers of the fisheries department were provided hands-on training in the fabrication of FRP canoes. Three different types of canoes which are commonly used in Assam, particularly in beel fishing, were fabricated after taking out a mould of the original wooden canoes. This breakthrough has attracted the attention of other state governments in the region and similar demonstrations are proposed in which officials from other NEH states also can take part.

Rubber wood canoes

Rubber plantation is fast becoming an important activity in the state of Tripura. Following the success in fabrication and demonstration of rubber wood canoes for fishing, the Institute has demonstrated the technology for the benefit of the state government and the fishing community at Tripura. Rubber wood logs have been procured and subjected to chemical treatment which will be transported to Agartala in Tripura and construction carried out. This will ensure better price for the

otherwise wasted rubber wood, spare costly wood and forests, and make inexpensive canoes available to fishermen.

Weed harvester

Weed infestation in the water bodies has been a major problem in fisheries in the North Eastern states. The Institute is currently looking into the possibilities of developing suitable device to uproot the weeds from beels and lakes.

Quality improvement of fish

The study conducted by the Institute on the quality and marketing system of fresh and dry fish has thrown light on the need to give more emphasis on food safety aspects in fishery products. The Institute conducted training programmes in Meghalaya, Assam and Arunachal Pradesh to create awareness among the stakeholders on the need for hygiene and sanitation in fish handling and demonstrated simple techniques like use of detergents and methods of personal hygiene.

Fish ensilage

Disposal of waste originating from fresh fish markets is a very major environment problem faced in all the North Eastern states. The Institute has developed and demonstrated the technology for preparation of fish ensilage from fish waste. This product has proved its efficacy as a valuable nutritional supplement in livestock feeds. Piggery, poultry and cattle rearing are found to be important homestead activities in the NEH states. The Institute has taken up demonstration of this technology in Meghalaya and will be implementing the same in Manipur, Nagaland and Assam. The Manipur Government has come forward to take it up as a Self Help Group activity.

Fish maws

The air bladder of fresh water fish is the basic raw material for preparation of fish maws (Isinglass) used in clarification of wine. Collection of air bladder, cleaning and drying them can be taken up as a Self Help Group activity and the same will be implemented in Assam, Meghalaya and Manipur. This will ensure economic utilization of the hitherto wasted fish air bladders.

Improved fish curing methods

NEH states are the major consumers of dry fish produced in Andhra Pradesh, West Bengal, Gujarat and other parts of the country. Besides, states like Assam also carry out fish drying as a community activity. The intervention in quality improvement of dry fish will be taken up in two stages namely at the production centres and the marketing centres. Training and demonstration were also held at West Bengal and Assam in improved handling, curing and packing of dry fish.

Fish freshness testing

Quality deterioration during long distance transport from far off places like Andhra Pradesh is an important problem in fresh fish. There is no proper mechanism for the state government or the consumers to determine the extent of spoilage. The Institute has developed fish freshness tester and this tester was demonstrated and supplied to some of the states.

FRP ice box

Fish produced in small water bodies in the interior regions of states like Assam do not get profitable prices due to difficulty in transport. The use of ice box is not known in some of the states including Assam. The Institute has demonstrated the fabrication of FRP ice boxes in the NEH region.

Burla model smoke kiln

Smoked fish is a locally cherished ethnic product in NEH states. In order to overcome the quality problems of traditional way of smoking, the Institute has demonstrated the Burla model smoke kiln in Arunachal Pradesh and it has been installed in Assam, Manipur, Nagaland and Arunachal Pradesh.

Value added fish products

In states like Manipur and Nagaland, stocks of canned fish like oil sardine supplied from nearby countries like Burma and Thailand could be seen in the market which indicates the people's taste for value added fish products of good shelf life. The Institute proposes to give training in the preparation of value added products like pickle and wafers. Demonstration of such items has already been carried out in Assam and Meghalaya. Preparation of value added products will be promoted as a Self Help Group activity with the help of the state governments. Training has already been imparted in Arunachal Pradesh, Assam and Meghalaya.

Operation and maintenance of cold storages and ice plants

A survey was conducted of the ice plants and cold storages in Aizwal (Mizoram) and necessary technical know-how imparted on their operation and maintenance.

Trainees Training

Under the Trainers' Training Programme, the Institute has conducted training programmes for state fisheries officials of Assam, Arunachal Pradesh and Tripura as well as students of Fisheries College, Agartala.

4.4 Programmes for Islands

Various programmes have been carried out in the Lakshadweep and Andaman & Nicobar islands. In Lakshadweep expertise available with the institute was made use of for providing necessary training in new fishing techniques, fishing methods, repair and maintenance of engines etc. Training was imparted in fabrication, rigging, mounting and field operation of monolines. New design of bottom set long lines was rigged with 200 hooks for exploring the reef. Practical training on board was also given. Collapsible lobster traps were operated with different baits. The fishing gears were made available to the interested fishermen for commercial operations.

Several training programmes were conducted in different islands of Lakshadweep in collaboration with Lakshadweep Social Welfare Board. These included training imparted to entrepreneurs on the preparation of quality upgraded tuna 'Mas'. 'Mas' based convenience products, dried and cured fish, production of pickles, processing of shark fins, isolation and purification of fin rays, cleaning and decolouration of shark cartilage and preparation of diversified value added products like fish flakes, wafers, cutlets, soup powder, fish fingers etc. Conversion of low value fish and processing waste into fish meal, isolation of shark liver oil and body oil were the other items included in the training. Training was also imparted on the adoption of hygiene and sanitation in processing, packaging and storage of products.

In the Andaman & Nicobar islands programmes included the development of a new design of craft depending on the conditions of the islands for commercial operation. The model is a beach landing craft made of steel with 7.5 m LOA, 16hp, 1800 rpm engine. A sketch of a modern boat building-cum-repair yard has also been finalized.

4.5 Wealth from Waste

- Chitin / chitosan from shellfish waste
- Collagen-chitosan film from fishery wastes
- Fish silage from cephalopod waste
- Surgical sutures from fish gut collagen
- Isinglass from fish maws
- Shark fin rays from shark fins
- Processed shark cartilage
- Poultry feed from miscellaneous fish

4.6 Patents

Patents obtained

- Antifouling paints for ship bottom
- Production of absorbable fine grade surgical sutures from fish gut collagen

Application for patents filed with Patent Authority

- Development of collagen based membrane for periodontal application
- Fibreglass sheathed rubber wood canoe
- Fishing canoes form treated rubber wood
- Shelf stable fish sausages in indigenous synthetic casings
- Ready-to-serve pearl spot moilee in retortable pouches
- Process for production of high bulk density Chitosan
- Mesh gauges: a device for easy measurement of fishing net mesh size
- A package of practices for improving the bacterial quality and food safety of farmed fresh water scampi (*Macrobrachium rosenbergii*)
- Production of edible fish powder from small bony fish by thermal processing using perforated Aluminium trays

Application for patents under filing

- Rapid test kit for identification of white spot disease and stress in shrimp
- A process for the production of high purity Glucosamine hydrochloride from shrimp shell waste
- Isolation of squalene from shark liver oil
- A shell bead nucleus production system
- A molluscan shell cutting system
- Micro algae concentration monitor
- A tunnel fish drier
- Water activity meter

- Effluent treatment system for seafood processing plants
- Package of practices for pathogen free chilled fish for export
- Collapsible fish trap
- Collapsible lobster trap

5. IMPACT ASSESSMENT

5.1 Growth

- Modernisation of fishing vessels and development of designs of fuel efficient vessels have been attempted and newer craft materials have been introduced to reduce the cost of operation and increase the income of fishermen.
- Research has also focused on conservation and long term sustainability of resources as well as improvement in productivity in the fisheries sector through design and development of eco-friendly, cost effective gear systems and by-catch reduction devices.
- The seafood processing industry has been efficiently guided and supported by evolving suitable technologies for quality assurance and also by providing state-of-the-art laboratories for testing of mandatory parameters, to aid production and export of over Rs. 7000 crore worth seafood products from India.
- Technologies for fishery byproducts and waste utilization have been developed to minimize environmental pollution resulting from processing of fish and to convert waste into wealth.
- Suitable technology has been developed and transferred to the industry on production of value added products and by-products, waste utilization and effluent treatment for the overall development in the fisheries sector.
- Packaging technologies for ready-to-eat products has had a positive impact on the market with entrepreneurs taking up the technology on consultancy basis.
- The technology transfer programmes of CIFT 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.

5.2 Input/output assessment

HARVEST SECTOR

- Introduction of newer materials for construction of crafts and fabrication of gear has been successfully attempted and popularized.
- The first steel vessel in the Saurashtra coast was introduced during the period 2001-05.
- FRP, treated rubber wood and FRP sheathed rubber wood are some of the materials introduced for the first time in the sector. This has also been extended to the NEH regions of Assam, Meghalaya, Tripura and Manipur.

- The first 15.5 m LOA split level deck trawler-cum-gill netter-cum-liner was introduced off the Visakhapatnam coast.
- Diversification of fishing craft, gear and methods was taken up for the Lakshadweep and Andaman & Nicobar islands.
- Synthetic gill nets and monolines were introduced in Lakshadweep for improving and diversifying the traditional fishing methods.
- Eco friendly and responsible fishing devices like turtle excluder device and other by-catch reduction devices were popularized in different parts of the country with a view to meet international requirements of responsible fishing and resource conservation.
- Monoline fishing was introduced for the first time in Hirakud reservoir.
- Mesh measurement device for easy measurement of mesh size was developed which is presently being used for implementation of mesh size regulation.

POST HARVEST SECTOR

- CIFT has helped the seafood processing industry attain world class quality standards.
- CIFT is the appellate body for quality assessment and control of fishery products for export and acts through Supervisory Audit Team (SAT) and as member of Inter Departmental Panel (IDP) as per requirement by the Ministry of Commerce (Govt. of India), European Union and other importing countries.
- CIFT serves the seafood export industry by testing and certification of process water, ice and products for heavy metals, antibiotic residues etc. on both the East and West coasts.
- Innovative, cost effective effluent treatment plant for the seafood industry was developed.
- Guidance by the Institute helped the seafood industry achieve EU standards and HACCP compliance.
- Innovative and newer products from low value fish were introduced.
- Retort pouch packaging was standardized for different ready-to-eat products and have been successfully commercialized.
- Palm impression technique, a simple tool for popularization of hygiene and sanitation among primary fish handlers, was demonstrated.
- Extensive technology transfer programmes in post harvest technologies was carried out in NEH region covering all the states.
- Wealth creation by utilization of fishery waste for production of ensilage was successfully demonstrated and commercialized.

TECHNOLOGY DISSEMINATION

| S.No. | Technology dissemination programmes (in the last 5 years) | Number of programmes |
|-------|---|----------------------|
| 1. | Training courses | 337* |
| 2. | Technical consultancies | 23 |
| 3. | Supply of designs of craft and gear | 390 |
| 4. | Publications distributed | 6041 |
| 5. | Testing and certification services | 12981 |
| 6. | Exhibitions/ film shows | 68 |
| 7. | Radio talks | 39 |
| 8. | TV programmes | 5 |
| 9. | Technical queries answered | 1700 |

* (5481 persons participated in the training programmes)

5.3 Shortcomings

- Manpower: Acute shortage of manpower with respect to technical and scientific staff is a major constraint. Retirement of experienced staff and lack of recruitment has affected the quality of research programmes due to lack of continuity and inadequacy in taking up diversified areas of research.
- Inland centres: Many programmes have been proposed and are being carried out for the development of the inland sector. However, the Hoshangabad Centre of CIFT was closed down and the activities which were being conducted there with respect to reservoirs has slowed down.
- Research in deep sea fisheries technology could not progress due to lack on vessel that could be operated in the deep sea.
- The land on which the headquarters stands is still leased from the Cochin Port Trust and this, coupled with lack of space, is hampering critical expansion.

5.4 Lessons learnt, suggestions and options for the future

- Focus also on inland sector and aquaculture
- Eco-friendly fishing techniques for reservoir and riverine systems
- Suitable gear development for aquaculture system
- Development of engineering equipments for culture ponds
- Processing techniques for cold water fishes, especially trouts
- Design of fish ladder for NEH region
- Improved weed harvester for NEH region
- Modern packaging and transportation technique in the inland sector