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वार्षिक रिपोर्ट
Annual Report
2000 -2001

भाकृअनुप
ICAR

केन्द्रीय मात्स्यकी प्रौद्योगिकी संस्थान
CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY
(Indian Council of Agricultural Research)

वार्षिक रिपोर्ट

ANNUAL REPORT

2000-2001

केन्द्रीय मात्स्यकी प्रौद्योगिकी संस्थान

Central Institute of Fisheries Technology

(Indian Council of Agricultural Research)

Matsyapuri P.O., Cochin - 682 029

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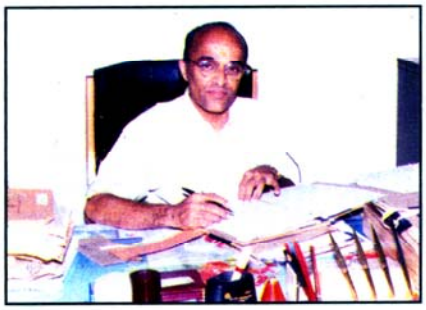
Preface



I am presenting the Institute's annual report for the year 2000-2001 with great pride and pleasure. The Central Institute of Fisheries Technology has received the ***Sardar Patel Outstanding ICAR Institution Award for the year 2000****. I consider this as a recognition of the excellent team work and substantial contributions made by the scientists and staff of the Institute. I congratulate them and thank the ICAR for conferring this award on the Institute.*

It has been a year of significant achievements for the Institute, details of which are presented elsewhere in this report. I would however like to highlight some of the salient and significant achievements here.

On the harvest side, the Institute achieved spectacular success in the popularisation of responsible fishing methods such as by-catch reduction devices, nets with square mesh cod ends for resource conservation and V-form otter boards in small mechanised vessels for ecofriendly fishing. The turtle excluder device designed, developed and fabricated by the Institute was successfully field tested and popularised in Orissa and West Bengal. Design packages were also developed for the construction of 18 m deep sea trawler and 18 m gillnetter-cum-longliner.

In post-harvest technology, emphasis was laid on development of technologies for processing of freshwater fish. Development of value added products including prawn powder from thelly (a tiny variety of shrimp), shelf-stable, dried and smoked fillets from freshwater fish, synthetic collagen based edible casing for fish sausage, thermoformed PVC and polystyrene containers, needle assembly for removal of pin bones from freshwater fish meat and methods for reducing the colour and improving the appearance of PUFA concentrate were some other important achievements during the year.

Development of an improved semi-nested polymerase chain reaction (PCR) technique for early detection of white spot disease virus in farmed prawn and seedlings in hatcheries and coliphage test for detection of faecal pollution of drinking water, water bodies and food products were two other significant achievements. An HACCP based package of practices was developed to facilitate export of chilled fresh fish. This technology was also transferred to the industry in addition to a software - 'CIFT Pinnacle HACCP and Record Keeping' for effective implementation of HACCP in seafood industry.

During the year, greater emphasis was given to human resource development, both at the industry and at the grass root level, and a number of training and extension programmes were conducted. The Institute also acquired several sophisticated analytical equipment in the year under report. The scientists of the Institute continued to serve in the Supervisory Audit Team and Inter Departmental Panel for inspection and certification of food processing establishments as per EU standards. Analytical services to the industry were continued and 2583 samples were analysed during the year. Ministry of Health availed the expertise of the Institute to train their officers in analysis of mineral water. CIFT was also accredited by NABL New Delhi as nodal laboratory for conducting proficiency testing of testing laboratories.

Projects were taken up on value added fishery products, biochemistry, engineering and harvest and post-harvest losses under the NATP. An Agricultural Technology Information Centre was also sanctioned for the Institute.

I hope this report will serve as a source of information on the Institute to individuals, researchers and the industry.

(Dr. K. DEVADASAN)
DIRECTOR

CIFT

bags

Sardar Patel Outstanding ICAR Institution Award, 2000

Dr. K. Devadasan, Director CIFT, receiving the Sardar Patel Outstanding ICAR Institution Award - 2000 at Vigyan Bhavan, New Delhi from Shri. Nitish Kumar, Union Minister of Agriculture

The Central Institute of Fisheries Technology Headquarters at Cochin

Dr. K. Gopakumar, Deputy Director General (Fisheries) ICAR and former Director, CIFT receiving the coveted 14th Khwarizmi International Award instituted by the Islamic Republic of Iran from H.E. Hojjatoleslam Seyed Mohammed Khatarni, President of the Iranian Republic for his outstanding efforts in improving the effectiveness of science

Dr. Krishna Srinath, Head, Division of Extension, Information & Statistics receiving the National Award for Development of women through science and technology instituted by the Department of Science and Technology from Prof. Murli Manohar Joshi, Union Minister for HRD, at Vigyan Bhavan, New Delhi

Dr. Leela Edwin, Scientist (Sr. Scale) receives the Jawaharlal Nehru Award for P.G. Agricultural Research - 2000.

A gist of progress in the R & D activities is given below:

- Designs of six different types of ecofriendly and resource specific demersal trawls were developed.
- Box trawl – a new concept in trawl design requiring lesser amount of webbings – was introduced.
- V-form steel otter boards have replaced more than 95 % conventional wooden otter boards in Munambam.
- Prawn powder produced from the tiny shrimp 'thelly chemmeen' (*M. dobsoni)* as a flavouring agent has been adopted by M/s. Nestle, Mumbai.
- Attractive and shelf-stable smoked and dried fillets were prepared from freshwater fish *Ophiocephalus striatus*.
- Method of preparation of fish curry from milk fish *Chanos chanos* was standardised.
- The frying time for rohu fillets in curry in retort pouch was optimised.
- Synthetic edible casings made of collagen for fish sausages were standardised.
- Indigenously available thermoformed containers made of PVC and polystyrene were found to be as good as imported HDPE containers for packing frozen battered and breaded products.
- A simple needle assembly was developed for removing the bones from fillets of freshwater carp .
- A method was developed for improving the colour of PUFA concentrate in order to ensure better consumer appeal.
- An improved semi-nested Polymerase Chain Reaction (PCR) technique was perfected for early detection of White Spot Disease Virus (WSSV) causing the devastating white spot disease in farmed penaeid prawns.
- A coliphage - based method for detection of faecal pollution of drinking water, water bodies and food products was developed and successful field trials carried out.
- A HACCP based package of practices was developed for export of chilled fresh fish from India.
- A software 'CIFT Pinnacle HACCP and Record Keeping' for implementation and management of HACCP in fish processing industries was developed in association with a private company.
- A spot test for rapid qualitative determination of metabisulphite and phosphate residues in prawns was developed.
- An elephant draft power monitor was developed for measuring the draft power of an elephant (up to 1000 Kg) at the time of traction and carrying loads at different situations as per request from Veterinary College, KAU, Mannuthy.
- Design packages were developed for construction of 18 m deep sea trawler and 18m. gill-netter-cum-longliner.

The Central Institute of Fisheries Technology (named at the time of its inception as Central Fisheries Technological Research Station) was set up in 1954 following the recommendations of a high power committee constituted by the Ministry of Food and Agriculture, Government of India. It started functioning at Cochin in 1957 under the Department of Agriculture of the then Ministry of Food and Agriculture with a small nucleus of staff for research work in fishing craft and gear. The Processing Division of the Institute was started in 1958 and the Extension, Information and Statistics Division in 1961. The Institute was given its present name in 1962. The administrative control of the Institute was brought under the Indian Council of Agricultural Research from 1 October, 1967.

The Institute is the only national centre in the country where research in all disciplines relating to fishing and fish processing is undertaken. Research Centres function at Veraval (Gujarat), Visakhapatnam (Andhra Pradesh), Burla (Orissa), Mumbai (Maharashtra), Calicut (Kerala) and Hoshangabad (Madhya Pradesh).

MANDATE

The Institute functions with the following mandate:

- To evolve innovative and cost-effective technologies for fish harvest
- To develop and standardise various aspects of post-harvest technologies
- To develop technologies for extraction of biomedical, pharmaceutical and industrial products from aquatic organisms
- To act as a repository of information on harvest and post-harvest technologies with a systematic data base
- To conduct transfer of technology through training, education and extension education programmes
- To provide consultancy services and to popularise the innovations for overall development of the fishery industry

ORGANISATION AND STRUCTURE

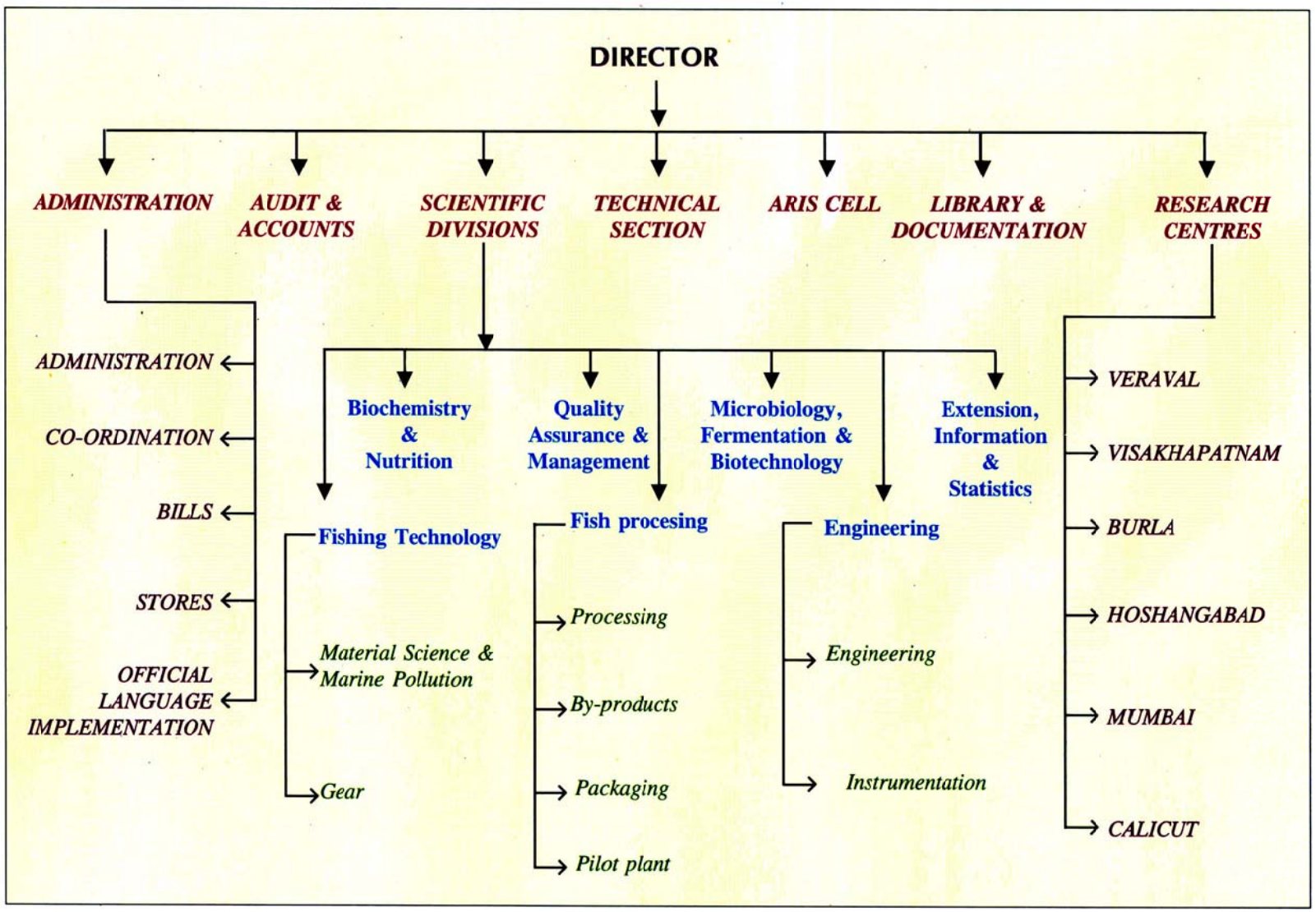
The Institute is headed by a Director with whom all administrative and financial powers are vested. He is assisted by a Senior Administrative Officer and five Asst. Administrative Officers for dealing with matters relating to general administration and two Assistant Finance and Account Officers for looking after the financial accounting aspects as also internal audit of the Institute. One Technical Officer attends to the technical matters including those connected with research projects handled by the Institute. Official Language Implementation Section is headed by the Assistant Director.

The research work is carried out by the following Research Divisions.

1. Fishing Technology Division
2. Fish Processing Division
3. Biochemistry and Nutrition Division
4. Quality Assurance and Management Division
5. Microbiology, Fermentation and Biotechnology Division
6. Engineering Division
7. Extension, Information and Statistics Division

Central Institute of Fisheries Technology

Organogram



Place	Address	Telephone No.	Fax / Telex / E-Mail	Telegram
Headquarters COCHIN	Matsyapuri P.O., Cochin - 682029, **Kerala**	0484-666845 (14 lines)	Fax : 091-484-668212 E-mai : ciftaris@md5.vsnl.net.in root@cift.ker.nic.in	FISHTECH/ MATSYAOUDYOGIKI
VERAVAL	Research Centre of CIFT, Matsya Bhavan, BhidiaPlot, Veraval- 362269. **Gujarat**	02876-31297	Fax : 02876-31576 E-mail : ciftvrc@ad1.vsnl.net.in	FISHTECH/ MATSYAOUDYOGIKI
VISAKHA-PATNAM	Research Centre of CIFT, Ocean View Layout, Pandurangapuram, Andhra university P.O. Visakhapatnam-530003 **Andhra Pradesh**	0891-567040 / 567856	Fax : 0891-567040 E-mail : cift@itpvis.ap.nic.in	FISHTECH/ MATSYAOUDYOGIKI
BURLA	Research Centre of CIFT, Burla-768017, Sambalpur, **Orissa**	0663-430419	Fax : 0663-430419	FISHTECH/ MATSYAOUDYOGIKI
MUMBAI	Research Centre of CIFT, CIDCO Administrative Building (Ground Floor), Sector-I, Vashi, New Mumbai-400703 **Maharashtra**	022-7826017	E-mail : ciftmum@bom.nic.in	FISHTECH/ MATSYAOUDYOGIKI
CALICUT	Research Centre of CIFT, Beach Road, West Hill, Calicut - 673005, **Kerala.**	0495-380627	E-mail : rcofcift@vsnl.com ciftkoz@ker.nic.in	FISHTECH/ MATSYAOUDYOGIKI
HOSHAN-GABAD	Research Centre of CIFT, Near Harijan Chatravas, Ananda Nagar, Hoshangabad - 461001 **Madhya Pradesh**			FISHTECH/ MATSYAOUDYOGIKI

A quick glance at past achievements

Sustainable utilization of the marine and inland resources has been one of the main aims of the activities of the Institute. Surveys have been conducted by the Institute on-board the research vessel *Sagar Sampada* owned by the Department of Ocean Development of the Government of India for exploring both demersal and semi-pelagic fishery resources. The entire area from the North-West to North-East coast was covered under the survey. Specialized nets including high speed demersal trawl, hybrid trawl, high opening trawl and semi-pelagic trawl, to name a few – have been designed to replace the imported nets presently being operated from this vessel. A large number of designs of various types of gear such as gill nets, purse seines, lines and traps have also been developed for exploitation of fishery resources. Development of a combination wire rope for deep sea fishing, which is an import substitution, is another notable achievement of the Institute.

Designs of mechanised wooden fishing vessels in the size range 7.67 – 15.25 m OAL have been developed. The CIFT has also embarked upon designing large resource – specific vessels of 20 m OAL and above, in order to meet the ever increasing demand for exploiting the deep sea waters of the country. Painting schedules and methods have been developed for protection of fishing crafts. Designs of fuel efficient steel fishing vessels were also developed and commercialised.

The Institute also developed a number of electronic equipment for monitoring in commercial fisheries, research as well as environmental studies. Some of them were trawl depth meter, solar processing monitor, environmental data acquisition system, freezer temperature monitor, warp load meter and salinity temperature meter.

Chlorination of water using sodium hypochlorite is normally practised to reduce bacterial contamination. CIFT has developed a chlorine level indicator paper called 'cloritest' for instant reading of chlorine level in process water. This paper has been commercialised by M/s Glaxo Laboratories, Mumbai. Other products developed for the fish processing industry are antiseptic ointment for use by prawn handlers and deodorant for masking the foul odour emanating from processing plants.

To meet the new demands for products and processing techniques, emphasis was shifted from block freezing of fish and shellfish to the development of individual quick frozen products like battered and breaded products, including fish fingers, fish cutlet and fish sticks. A number of packagings for various types of fish products as well as technologies for transportation of live fish and shellfish have also been developed at the Institute.

The important value-added products developed by CIFT which are in demand at present within the country and abroad are fish wafers, fish soup powder, fish pickles and hygienically dried fish. Shark fins and fin rays are very expensive commodities, process for extraction of which has been developed at the Institute. Another value added product developed is fish curry processed in flexible pouches which can remain at room temperature without any change for over a year. Other items developed include masmin prepared by repeated smoking of tuna fillets and squalene obtained from oils of certain species of sharks. Process has also been developed and commercialised for processing shark cartilage.

Suitable media for culture of different types of bacteria and methods for their enumeration and isolation have been developed.

Fine grade absorbable surgical sutures are presently imported involving considerable expenditure for the country. The CIFT has successfully developed pharmacological products from fish waste, a noteworthy one being absorbable surgical sutures from fish gut collagen. Field trials with the product have been very encouraging. Two other important products from fish waste developed by the Institute are chitin and chitosan which have been adopted both in the national and international levels. Six national agencies and three international agencies have so far adopted this technology. Collagen-chitosan membrane is another product which has found a place in periodontal applications.

Transfer of technology through technical consultancy programmes is a major activity of the Institute. Many entrepreneurs have benefited by the services rendered by the Institute leading to establishment of a number of processing units for fish waste utilization and improvement in fish catch. Outreach programmes such as conduct of training courses and field level extension programmes targeting the weaker sections of the community and rural women were also organised.

Staff position as on 31 December, 2000

DIRECTOR

HEADQUARTERS - COCHIN

Scientific	
Head of Division/Section	4
Principal Scientist	5
Senior Scientist	33
Scientist (Selection Grade)	1
Scientist (Senior Scale)	7
Scientist	11
Technical	
T-9 (Technical Officer)	1
T-8 (Technical Officer)	1
T-7 (Technical Officer)	3
T-6 (Technical Officer)	4
T-5 (Technical Officer)	14
T-4	23
T-3	20
T-II-3	10
T-I-3	4
T-2	7
T-1	24
Administrative	
Sr. Admn. Officer	-
Admn. Officer	-
Asst. Admn. Officer	5
Asst. Fin. & Accts. Officer	2
Asst. Director (OL)	1
Private Secretary	1
Assistant	21
Stenographer	8
Junior Stenographer	2
Senior Clerk	22
Lower Division Clerk	13
Cook	1
Auxiliary	4
Supporting	
Supporting Staff Gr.IV	5
Supporting Staff Gr.III	11
Supporting Staff Gr.II	17
Supporting Staff Gr.I	6

VERAVAL RESEARCH CENTRE

Scientific	
Principal Scientist	1
Senior Scientist	1
Scientist	5
Technical	
T-5 (Technical Officer)	3
T-4	1
T-3	3
T-I-3	1
T-2	1
T-1	1
Administrative	
Asst. Admn. Officer	1
Assistant	1
Senior Clerk	2
Lower Division Clerk	1
Auxiliary	***2***
Supporting	
Supporting Staff Gr.IV	1
Supporting Staff G. IV	1
Supporting Staff Gr.II	8
Supporting Staff Gr. I	6

VISAKHAPATNAM RESEARCH CENTRE

Scientific	
Senior Scientist	4
Scientist	3
Technical	
T-5 (Technical Officer)	4
T-4	1
T-3	4

T-2	1
Administrative	
Assistant	1
Stenographer	1
Senior Clerk	3
Supporting	
Supporting Staff Gr. IV	2
Supporting Staff Gr.III	7
Supporting Staff Gr.II	4
Supporting Staff Gr.I	1

BURLA RESEARCH CENTRE

Scientific	
Senior Scientist	1
Scientist (Sr. Scale)	1
Scientist	1
Technical	
T-5 (Technical Officer)	2
T-4	2
T-II-3	1
T-3	3
T-I-3	1
T-2	1
T-1	1
Administrative	
Assistant	1
Senior Clerk	1
Lower Division Clerk	1
Supporting	
Supporting Staff Gr.IV	4
Supporting Staff Gr.III	2
Supporting Staff Gr.II	6
Supporting Staff Gr.I	6

MUMBAI RESEARCH CENTRE

Scientific	
Senior Scientist	2
Technical	
T-5	2
T-1	2
Administrative	
Assistant	2
Lower Division Clerk	1
Supporting	
Supporting Staff Gr.III	2
Supporting Staff Gr.II	2
Supporting Staff Gr.I	1

HOSHANGABAD RESEARCH CENTRE

Scientific	
Scientist	-
Technical	
T-6 (Technical Officer)	1
Administrative	
Senior Clerk	1
Supporting	
Supporting Staff Gr.IV	1

CALICUT RESEARCH CENTRE

Scientific	
Senior Scientist	1
Scientist	1
Technical	
T-7	1
T-4	2
T-3	1
T-1	2
Administrative	
Assistant	1
Senior Clerk	1
Supporting	
Supporting Staff Gr.II	1
Supporting Staff Gr.I	1

Budget expenditure statement for the year 2000-2001

(Rs. in lakhs)

Particulars	Non Plan			Plan		
	Sanctioned Budget	Revised Expenditure	Expen-diture	Sanctioned Budget	Revised Expenditure	Expen-diture
Establishment charges	816.40	670.40	637.10	3.00	-	-
Travelling allowances	7.00	7.00	7.00	10.00	10.00	10.00
Other charges including equipment	26.60	76.60	76.60	439.00	284.00	284.00
Works ongoing	-	-	-	50.00	30.00	30.00
Total	**850.00**	**754.00**	**720.70**	**502.00**	**324.00**	**324.00**

HEADQUARTERS, COCHIN
FISHING TECHNOLOGY DIVISION

Research Projects handled

1. Title of Project	:	Development of ecofriendly demersal trawls and resource specific trawls for demersal fishing
Principal Investigator	:	Shri K.K. Kunjipalu
Location of project	:	Cochin, Visakhapatnam and Veraval
Co-investigators at Cochin	:	Dr. B. Meenakumari, Shri P. George Mathai and Shri R.S. Manoharadoss
2. Title of Project	:	Development of gear, accessories and instrumentation for responsible and resource specific variable depth trawling.
Principal Investigator	:	Shri V. Vijayan
Location of project	:	Cochin
Co-investigators	:	Dr. M.D. Varghese, Shri Percy Dawson, Shri R.S. Manoharadoss and Shri K. Ramakrishnan
3. Title of Project	:	Performance evaluation of suitable selective devices for elimination of fish by-catch (BRD) and turtles (TED) in shrimp trawling.
Principal Investigator	:	Shri Percy Dawson
Location of project	:	Cochin and Visakhapatnam
Co-investigator at Cochin	:	Dr. M.D. Varghese, Shri V. Vijayan and Shri N. Subramonia Pillai
4. Title of Project	:	Studies on traditional fishing gear and methods
Principal Investigator	:	Shri P. George Mathai
Location of project	:	Cochin
Co-investigators	:	Shri V. Vijayan and Shri Percy Dawson
5. Title of Project	:	Studies on material protection and pollution
Principal Investigator	:	Dr. Leela Edwin
Location of project	:	Cochin and Veraval
Co-investigators at Cochin	:	Dr. A.G. Gopalakrishna Pillai and Shri P. Muhamed Ashraf
6. Title of Project	:	Development of fishing gears and techniques for harvesting reservoir fishery resources
Principal Investigator	:	Dr. B. Meenakumari
Location of project	:	Burla
7. Title of Project	:	Harvest technology and catch composition of deep sea fishery resources off Indian EEZ on-board FORV *Sagar Sampada*
Principal Investigator	:	Dr. B. Meenakumari
Location of project	:	Cochin
Co-investigator	:	Smt. Sally Simon, Smt.Sherine Sonia Cubelio and Smt.Latha Unnikrishnan

Chief findings

- Dual preservative treated panels of rubber wood *(Hevea brasiliensis)* exposed to marine condition for 33 months showed a reduction of 6.2% in compressive stress.
- The eutrophication studies in terms of sediment chemistry conducted at two prawn culture systems, suggest an urgent need for formulation of an efficient drainage system in Vypeen Island.
- Six different types of ecofriendly and resource specific demersal trawls were designed and developed.
- 22 m balloon trawl was found suitable for catching prawns and 33 m balloon trawl and 32 m demersal trawl were found suitable for landing fin fish such as pomfrets and squid.
- 25 m box trawl is a new concept in trawl design requiring lesser amount of webbings.
- V-form steel otter boards of CIFT design have replaced more than 95% of conventional wooden otter boards in Munambam. The boards have been introduced in Cochin Fisheries Harbour also.
- Mesh regulation and use of square mesh cod ends have been enforced under the Fishing Regulations Act of Gujarat State.
- Experiments with 18 m large mesh semi pelagic trawl with 400 mm mesh in the forepart, in combination with 140.0 kg High Aspect ratio suber krub otter boards have established its target specificity.

Report of work done

Fishing craft

Rubber wood samples of size 50 mm x 50 mm x 200 mm treated with arsenical creosote, copper creosote and dual treatment were subjected to compression parallel to grain test and compared with the compressive stress of untreated rubber wood. An average increase of 18.80% in strength was noticed. This is inferred to be due to the slight increase in sp. gravity caused due to incorporation of the creosote in the panels. The maximum increase in strength was noticed in dual treated panels ie. 20.73%.

The treated panels were exposed to marine conditions for 33 months. Visual rating of the exposed panels showed them to be in 'sound condition'. This was further confirmed through mechanical strength studies conducted in the UTM. An average reduction of 12.39% was noticed in the compressive stress. There was 18.5%, 12.5% and 6.2% reduction for arsenical creosote, copper creosote and dual treatment respectively. The least reduction was for dual preservative treatment indicating least intensity of internal attack.

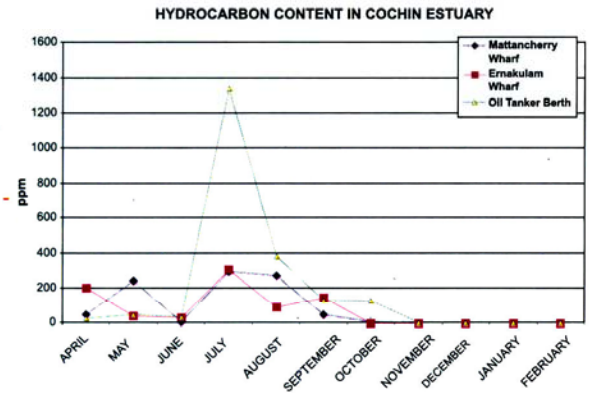
In another study, rubber wood cylinders (2.5 cm dia x 10 mm) treated with pentachloro phenol,

Treated and untreated rubber wood samples

a solvent type preservative, were exposed to artificial seawater and subjected to accelerated leaching tests. The results show that maximum leaching occurs during the first hour (8.9×10^{-3} g/ml) and then gradually decreases.

Attempts were made to characterise 15 species of wood suitable for marine purposes using Fourier Transform Infrared Spectrometer (FTIR).

In order to study the oil pollution in estuarine and marine waters, water samples were collected from Mattancherry, Ernakulam and Oil Tanker Berth every week and analysed for hydrocarbons by FTIR as per ASTM D 3921/85. The variation in hydrocarbons in ppm is given below.



Eutrophication studies in terms of sediment chemistry were carried out in two prawn culture systems viz. Pond 1 (Narakkal) and Pond 2 (Kumbalangi). Pond 2 was found to be affected by severe white spot disease and pollution. The results show that pond 2 is highly eutrophic when compared to pond 1. The unusually high amount of total N and available and exchangeable nutrients like K, Cr and Mg in pond 2 may enhance eutrophication thereby disturbing the quality of water and sediment. There is an urgent need for formulation of an efficient drainage system in the Vypeen island which has got about 1600 km drainage canals with 11 lakh population as proper discharge of effluent water from the farms does not take place here.

Laboratory and field (marine exposure) studies were conducted to evaluate the corrosion inhibition by lanthanides viz. Ce, Gd and Dy chlorides. Laboratory studies with a treatment of 1000 ppm Ce, Gd and Dy chlorides revealed that Dy and Gd inhibited the corrosion of aluminium M57 S by about 50% and Ce by 73%.

A study was initiated to evaluate the seasonal variation of pollutants in the marine environments of Cochin. Seven stations were identified and fixed by GPS. Hydrographical parameters revealed that dissolved oxygen (range 5.2 – 7.4 mg/l), pH (7.93 – 8.33) turbidity (0 – 3.5 NTU) P (0.07 – 0.103 ppm) and NO_2 – N (0 – 0.035 ppm) were highest off Narakkal at 10 m depth. This may be due to the anthropogenic discharges into the sea through the water channels of the Vypeen island.

The analysis of sediment characteristics revealed that off Narakkal, pH ranged from 8.03 – 8.90 and organic carbon content from 2.76 – 5.12%. The phosphate fraction analysis revealed that there are large amounts of loosely bound P in areas of 10 m depth in all the stations. This suggests that it is readily available to the phytoplankton and temporarily adsorbed from grains mainly from anthropogenic discharges like detergents, food materials, wastes etc. The results of other fractions like Al bound P, Fe bound P, Ca bound P, inorganic P and total P were comparatively higher off Narakal and Malipuram especially at 10 m depth.

Fishing gear

Six new designs of eco-friendly and resource specific demersal trawls were developed, viz. 22m balloon trawl (Shrimp), 33m balloon trawl (Fish), 33m balloon trawl (Shrimp), 32m demersal trawl (Fish), 25m box trawl and 25 m balloon trawl (Fish).

Trials carried out with these new designs revealed that all were eco-friendly and with proper rigging did not drag bottom debris and benthos. All types of additional weights on the foot rope like rigging chains besides lead sinkers are bound to have harmful effects of destroying bottom ecology and benthos in the trawling grounds.

The 22 m balloon trawl was found suitable for catching prawns, while the 33 m balloon trawl and 32 m demersal trawl were found suitable for landing fin fish such as pomfrets and squid. The 25 m box trawl is a new concept in trawl design

requiring lesser quantity of webbings for its fabrication.

As a result of popularisation of proven designs/technologies, more than 95% of trawlers operating from Munambam Fishing Harbour are operating V-form steel otter boards, based on the designs supplied by CIFT. V-form otter boards are also being used in Cochin Fishing Harbour.

Mesh regulation and introduction of square mesh cod ends have been enforced under the Fishing Regulations Act of Gujarat State.

Square mesh cod ends and V-form steel otter boards are being popularised in Cochin.

18.0 m large mesh semi - pelagic trawl, with 400 mm mesh in the fore part, in combination with 140.0 kg (1350 x 1000 mm) High Aspect ratio suber krub otter boards was experimented during the year. Forty eight hauls made with this gear system established its target specificity. More than 50% of the total catch comprised quality off-bottom fishes like *Polynemus* sp. and *Pampus* sp. Predominance of other semi-pelagic resources like *Leiognathus* sp, lesser sardines and *Caranx para* could also be observed thus indicating the reduction of non-target fishery resources.

Long base jib semi-pelagic trawl (23.0 m) in combination with 20.0 m double bridles and High Aspect ratio vertically curved doors was found equally effective in the capture of *Pampus* sp. Thirty six per cent of the catch of one experimental voyage consisted of this target species.

Mega mesh trawl (33.0 m) with 800 mm mesh size in the fore part, operated in combination with 1.5 tonne V-form doors and 40.0 m double bridles, could develop a vertical opening of 7.3 m (more than 20% of the HR length of the trawl gear). The distance between the otter boards was found to reach 82.0 m, establishing the functional efficiency of the gear system.

The 33.0 m high opening trawl, commonly found in operation around Vypeen and Azhikode areas, was incorporated with research results such as large mesh in the fore part, forked wing ends and thinner twine materials. The re-designed fishing gear is proposed for operation commercially along with 1350 x 1000 mm High Aspect ratio suber krub doors and 20.0 m double bridles in an effort to identify an optimum, fuel efficient gear system for effective semi-pelagic trawling.

Design details of a warp load meter using strain gauge sensors have been finalised.

Fishing trials with 50 mm and 80 mm square mesh panels were tried in deeper waters from FORV *Sagar Sampada*. Square mesh panels were attached to the cod end to study the escapement of juveniles. A total of 16 hauls were made. The fishes that escaped through the 50 mm panel were only juveniles while from the 80 mm panel, both juveniles and sub-adults escaped.

A 32 m fish trawl was fitted with a single grid in the cod end to study the escapement of fish. Escaped fish was collected in the cod end cover and the percentage of escapement and retention estimated. *Caranx* sp. and mullets were found predominantly escaping through the fish eye. Only 15% of the total weight of fish caught in the cod end proper were found to escape through the BRD.

Gill nets for deep sea fishing were fabricated using PE and PA twines in mesh sizes ranging from 110 mm to 140 mm. Field trips were made to the landing centres and details collected from high sea gill net operators based at Cochin. The total length of the net ranged from 2000-2500 m and the gear was operated as surface drift. The catch consisted mainly of seer, tuna, barracuda and sharks.

Two numbers of Turtle Excluder Device (TED) were fabricated using stainless steel rods of size 12 mm and 8 mm. Gap between the 8 mm rods was kept at 15 cm. Size of TED was 1000 mm x 800 mm. The TED was fixed in a trawl net and a number of operations were carried out. The device was tested and found to be working satisfactorily with regard to the escapement percentage of demersal fishes.Training and demonstration were conducted for popularisation of the TED, especially in Orissa where turtle mortality is reported to be high.

Turtles that escaped from the trawl retained in the cover on deck before being released

Information was collected on the existing long lines from Azheecode which is an important center for long line operation. Mono lines and hooks were procured and arrangements were made to operate the same through traditional fishermen.

Important fishing villages in Thiruvananthapuram and Kanyakumari districts where FADs have been installed were visited and details collected on the fishing practices. The FADs are mainly utilized for subsistence fishing during the months of November, December and January. Hooks Nos.4, 5, 6, 8 and 10 are in use along with 14, 15, 16 and 18 for small pelagics. Squid jigs are also used for cuttle fish capture. Catamaran is the craft deployed for fishing. The fishery consists mainly of perches, carangids and cuttle fish. Hand lines with Limerick and circle hooks were introduced at Poovar and operated through traditional fishermen. Limerick hooks were found to be effective for hand lines.

Harvesting reservoir fishery resources

Studies on fishing gears and techniques for harvesting reservoir fishery resources were continued. Material for fabrication of trammel nets was procured and fabrication initiated.

Long lines with different sizes of hooks were operated for 22 days. Hooks No.15 and 17 were found superior to others. Catch composed mainly of catfish followed by carps.

Nylon monofilament gill nets were operated for 36 days. Mesh size of 30 mm bar showed good performance. Catch composition recorded was catfish, 77%, carps, 8% and miscellaneous, 15%.

Three exclusive cruises were undertaken under the project Harvest technology and catch composition of deep sea fishery resources in the Indian EEZ on-board FORV *Sagar Sampada* during the period under report covering the entire west coast. The programmes undertaken were selectivity studies using square mesh cod end of 30 mm and 40 mm in comparison with conventional diamond mesh. Preliminary studies were carried out using square mesh window panels of 4 x 2 m attached to the cod ends of 38 m HSDT-II fish and 40 m HSDT-II crustacean version. Length, weight and maturity stages of the escaped fishes were noted. Results showed that 75% of the escaped fishes were juveniles. An unusual landing of bulls eye, *Priacanthus hamrur* weighing a total around 1.6 tonnes has been recorded from NW coast of India from a depth of 69 m at 20° 08′ 792″ to 20° 10′ 836″ N and 70° 19′ 832″ E to 70° 22′ 070″E.

Juvenile prawns that escaped from 30mm square mesh cod end on-board FORV Sagar Sampada

FISH PROCESSING DIVISION

Research Projects handled

1. Title of Project	:	Development of diversified fishery by-products and their applications
Principal Investigator	:	Dr. K.G. Ramachandran Nair
Location of project	:	Cochin
Co-investigators	:	Shri P. Madhavan, Dr. Chinnamma George, Dr. P.T. Mathew, Dr. T.K. Thankappan, Dr. T.K. Srinivasa Gopal, Smt. R. Thankamma and Dr. C.N. Ravi Shankar.
2. Title of Project	:	Development of environmental friendly feed for ornamental fishes, carps, *Chanos chanos* and *Mugil cephalus*
Principal Investigator	:	Dr. P.T. Mathew
Location of project	:	Cochin
Co-investigators	:	Dr. K.G. Ramachandran Nair, Dr. Suseela Jose* and Dr. M.M. Jose **
3. Title of Project	:	Development of value added culinary, fortified and functional fish products, their processing and storage.
Principal Investigator	:	Dr. Jose Joseph
Location of project	:	Cochin and Mumbai
Co-investigators at Cochin	:	Shri K.K. Balachandran, Shri T.S. Unnikrishnan Nair, Shri A.C. Joseph, Shri P.K Vijayan and Shri A.V. Shenoy
4. Title of Project	:	Development of suitable packaging materials for value added and ready-to-serve fish and fishery products
Principal Investigator	:	Dr. T.K. Srinivasa Gopal
Location of project	:	Cochin and Calicut
Co-investigators	:	Shri K.K. Balachandran, Shri V.N. Nambiar, Shri P. Madhavan, Shri T.S. Unnikrishnan Nair, Dr. C.N. Ravi Shankar, Shri P.K. Vijayan, Shri P.Ravindranathan Nair and Shri A.V. Shenoy

* *Associate Professor, College of Fisheries, Panangad*

** *Associate Professor, Research Station of College of Fisheries, Puthuvype*

Chief findings

- Technology for the production of isinglass was developed and transferred to a private agency which has started commercial production and marketing.
- Silage produced from prawn shell has a protein content of 6.0% and calcium content of 1.0% and can be directly fed to poultry and cattle.
- Chitosan films of average thickness 0.1 mm had tensle strength 300 kg/cm2 and elongation 10 – 20% at breaking strength.

- Powder made from the tiny shrimp, 'thelly chemmeen' as flavouring agent was adopted by M/s. Nestle, Mumbai for commercial production.
- Shelf life of oil sardine was extended by treatment in chitosan solution before freezing. The quality of the treated fish was better than the control throughout the two month period of storage studies.
- Technology for production of chitin/chitosan was transferred to a commercial agency.
- A formulated feed with 25% protein resulted in better growth rate of *Mugil cephalus* compared to other groups.
- Standardised the preparation of ordinary fish curry using *Chanos chanos*. The product remained in excellent condition for twelve months.
- Formulation for chilly fish using seer fish was standardized and its frozen storage characteristics and shelf life evaluated.
- Chilly fish was fortified with celery leaves and cutlet with coriander leaves and mint without affecting the sensory and storage characteristics.
- The formulation of battered and breaded products from cuttle fish fillets, both in raw and cooked condition, and crab claw was standardized.
- Standardised the optimum frying time for rohu fillets in curry in retort pouch. Rohu curry processed to a F_0 value of 8.5 had a shelf life of 18 months at room temperature.
- Synthetic edible casings for fish sausages made of collagen were standardised.
- Fried mussels with a water activity of 0.54 can be kept for a period of 10 months under vacuum at room temperature in 12 micron polyester laminated with 118 micron LD-HD co-extruded films compared to six months storage in air packed sample.
- Indigenously available thermoformed containers made of PVC and Polystyrene (PS) were suitable for packing frozen battered and breaded products, which gave a shelf life of 18 months. They were as good as imported HDPE containers.
- Vacuum packed dry shark could be kept for a period of more than 225 days in 12 micron plain polyester laminated with 300 gauge low density polyethylene. Air packed samples developed yellow colour.

Report of work done

Fish products and by-products

The isinglass developed from dry air bladders of catfish with high nitrogen content and almost complete solubility in water at 0.5 level was found to meet the requirement of brewers. The technology was transferred on consultancy to M/s. Brewers Nest, Chennai at a cost Rs.1.0 lakh. Scientists from the Institute visited their factory at Chennai and gave guidance for commercial production and marketing.

Isinglass, isinglass flakes and fish maws

Chitin was deacetylated with 45% sodium hydroxide solution at low temperature repeatedly using fresh alkali each time. A 100% deacetylated product with high viscosity was produced by this process. A product with viscosity 1000 cp (1% solution) with deacetylation more than 80% and useful as polymer flocculent could also be produced.

Chitosan of very low viscosity (10 cp) was dissolved in acetic acid and the clear solution was extruded and precipitated in NaOH using the pilot extruder of Travancore Rayons, Perumbavoor. The required tensile strength could not be achieved in the first trial as the process was exactly reverse to that of rayon fibre production.

Dry prawn shell contains more than 30% protein, which is wasted during the process of extraction of chitin. Even though the protein can be recovered by neutralization of the alkali extract, during alkali extraction, the protein undergoes deterioration of nutritive value. The pigments also get destroyed during the process. To isolate the protein and pigments with minimum deterioration, a process was tried for the extraction of protein from the shell. By adding formic acid, pH of the minced shell was adjusted to 4 and kept for two days at ambient temperature. Most of the protein was isolated by this process. The liquid extract had 6.0% protein and 1.0% calcium. There is scope for application of the product directly in animal and fish feeds.

Chitosan films were tested for their physical properties. A chitosan film of thickness 0.1 mm had tensile strength 300 kg/cm^2 and elongation 10-20% at breaking point.

Tiny shrimps available from the backwater fetch only very low price. Investigation was undertaken to develop a flavouring agent from this shrimp and a product with good colour and flavour was developed. This product was approved by M/s Nestle, Mumbai.

Chitosan, chitosan gelatin and chitosan – isinglass films were prepared and transplanted in albino rats without any adverse reaction and are being tested for orthodontic applications.

Sardines were dipped in chitosan solution of different concentrations and their frozen shelf life studied. Chitosan treatment was found to increase the storage life and retain the characteristics of fresh sardines. Further studies are required for fixing the minimum concentration of chitosan.

A feed containing 25% protein was formulated with soya flour as the main source of protein. This was tried for *Mugil cephalus* in the instructional ponds of the Fisheries College, at Puthuvype. The experiments were conducted with 50% feed with traditional manuring, 100% manuring only and 100% feed only. After one year, the survival rate was 90% in all the three groups. The final weight was 150% in group 1 and 170% in group 3 compared to group 2 showing that supplementary feed can give reasonable production in the case of *Mugil cephalus*. The fish were also found to reach marketable size during the period.

Fish curry prepared from *Chanos chanos* using an indigenous recipe could be stored for one year at –20°C without significant change in texture, flavour and appearance. After nine months, crystal formation in the air pockets of the package and slight dried appearance on the surface were noticed. These did not affect the flavour. The texture became firmer or slightly tough but it did not significantly affect the sensory characteristics. No significant changes were noticed in chemical parameters such as NPN, TVBN, PV, FFA etc. during one year of storage. No water separation was observed on thawing and the thawed product retained almost all the original characteristics.

The formulation of a typical local fish curry using tamarind, salt and chilly was standardized to suit the freezing and frozen storage requirements. The product was stored at –20°C and the chemical, physical and sensory changes studied. The product

was in acceptable condition for more than nine months. Though the product retained the flavour and appearance, the texture showed significant changes. It became tough and firm. These changes could be attributed to the low pH of the product due to tamarind.

Chilly fish was prepared using seer fish by modifying the recipe for preparation of chilly chicken. The procedure was standardized and the product was packed in polythene sheets and stored at –20°C and –35°C for one year. Both the products were found to be in very good/excellent condition even after one year of storage. Appearance, flavour and texture were very good and the thawed product showed almost the same original characteristics. The frozen product showed slight dehydrated appearance, which was not observed in the thawed product. The products stored at –20°C were slightly tough after one year storage

Based on the above, chilly fish was prepared using minced red snapper and surimi incorporating 1% salt, 1%sodium tripolyphosphate, 0.1% glycerophosphate and 0.1% MSG. Chilly fish was also prepared by icorporating a paste of celery leaves. Chilly fish from surimi was the best in flavour and appearance. Chilly fish prepared after incorporating celery leaves was better in taste than that prepared from minced fish alone. No appreciable change was noticed in any of the chemical, physical and sensory characteristics after four months of storage. Further studies are needed to prepare new products using fish fillets and mince.

Cutlet was prepared by incorporating coriander leaves, mint leaves and mixture of coriander leaves and mint leaves respectively after making them into a paste. Addition of small amounts of the above ingredients having pharmaceutical value improved the flavour characteristics without affecting colour, appearance and texture. The storage of the products incorporated with coriander and mint leaves at –20°C did not show any changes in characteristics compared to the control.

Method of preparation of battered and breaded products from cuttle fish fillets was standardized with respect to batter composition, bread crumb size, etc. Two types of battered and breaded cuttle fish fillets viz. raw and cooked, were prepared and stored at –20°C. Both the samples were acceptable up to 15 months of storage. The samples prepared from pre-cooked fillets were more rubbery, compared to that from raw fillets. However, bacterial quality of the samples from pre-cooked fillets was better than that from raw fillets

Coated crab claw balls from mud crab remained in acceptable condition for 14 months of storage at –20°C.

Frying conditions for rohu fillets in fish curry medium was standardised. It was noted that frying for three minutes gave best results with regard to the retention of firm texture in the curry medium. About 170 g of fish curry was packed along with 90 g of fried fish in retort pouches and processed to F_0 value of 8.17 and cook value of 82 min. The total process time was calculated by using mathematical method and was found to be 37 minutes. The above process time was optimum for getting a product with good sensory attributes and commercial sterility.

Storage studies of ready-to-serve rohu in curry in retortable pouches at room temperature were continued. Fresh rohu fillets were dipped in 10% brine and fried in vegetable oil. The fried samples were packed in pouches along with curry medium. The samples were then processed to F_0 value of 8.5 and stored at room temperature. The product had a shelf life of 18 months at room temperature. After a period of 21 months of storage, the product became soft and the pieces disintegrated.

Studies on suitability of indigenously available thermoformed containers for packing value added products were completed. The battered and breaded rohu fillets were packed in two indigenous thermoformed containers made of PVC and one imported container made of HDPE.

The samples were frozen and stored at –20°C and changes in various quality parameters during frozen storage were monitored. All the samples had a shelf life of 18 months. There was no significant difference among the three samples. The indigenous containers were as good as the imported HDPE conainers.

Studies were carried out on the effect of vacuum packing on the storage stability of dry shark. The dried shark was cut into small pieces and packed in pouches made of 12 μ polyester laminated with 300 gauge LDPE in air and under vacuum. The packed samples were stored at room temperature and changes in various quality parameters monitored at regular intervals. After 225 days of storage, it was observed that vacuum packed samples were slightly better in appearance than air packed samples. Air packed samples developed yellow colour. No significant difference was noticed among air packed and vacuum packed samples with regard to sensory and chemical parameters.

Green mussel (*Perna viridis*) collected from Calicut were depurated and the meat shucked. The meat was then fried in oil in an electric frier at 170-200°C, mixed with spices, chemical preservatives and packed in 12μ polyester laminated with 118 micron LD-HD co-extruded film under vacuum and in air. Sorption isotherm characteristics of the product indicate a sigmoid stage. The moisture content of the final product was 6%, water activity, 0.55 and the critical moisture content of the product, 25%. It was observed that vacuum packed samples were superior to air packed samples with regard to sensory parameters. The fried samples packed under vacuum had good acceptability up to ten months at room temperature, whereas, air packed samples developed slight rancidity and were acceptable only up to six months.

Studies on suitability of edible synthetic casings for packing fish sausages were undertaken. Collagen casings withstood processing at 121°C and the product showed good sensory characteristics. The sausages had good acceptability even after 5 months storage at room temperature.

Synthetic collagen based edible casings for fish sausage

BIOCHEMISTRY & NUTRITION DIVISION

Research Projects handled

1.	Title of Project	:	Biochemical, nutritional and functional properties of fish constituents
	Principal Investigator	:	Dr.P.G.Viswanathan Nair
	Location of project	:	Cochin and Visakhapatnam
	Co-investigators at Cochin	:	Dr.K.Devadasan, Smt.K.Ammu, Smt. Suseela Mathew, Shri.P.Madhavan, Shri. R.Anandan and Kum.K.K.Asha
2.	Title of Project	:	Nutrients, toxicants, pollutants and growth promoters in aquaculture system and processed marine products
	Principal Investigator	:	Shri A.G. Radhakrishnan
	Location of project	:	Cochin, Visakhapatnam and Veraval
	Co-investigators at Cochin	:	Smt.K.Ammu, Smt.Suseela Mathew and R. Anandan
3.	Title of Project	:	Pilot plant studies on absorbable surgical sutures from fish gut collagen
	Principal Investigator	:	Dr. M.K. Mukundan
	Location of project	:	Cochin
	Co-investigators	:	Dr. K. Devadasan and Kum. Seema M.K.*

** Senior Research Fellow, CIFT*

Chief findings

- A method was developed for improving the colour of PUFA concentrate.
- The method developed for production of PUFA concentrate was modified to reduce the consumption of water by about 15%.
- Increasing the level of PUFA in the diet of experimental animals (albino rats) from 1% to 2% did not have any added advantage in terms of reduced serum cholesterol or triglyceride levels.
- Metallothioneins (containing cadmium) were detected in the gall bladder of rohu.
- PUFA concentrate containing high concentration of peroxides was found to cause damage to the liver of experimental animals (albino rats).
- Free amino acid contents of different species of fish were found to vary considerably.
- Freshwater and brackishwater fish samples from Cochin were found to be free from organochlorine pesticides and polyaromatic hydrocarbons.

Improvements in the method of preparation of polyunsaturated fatty acids (PUFA)

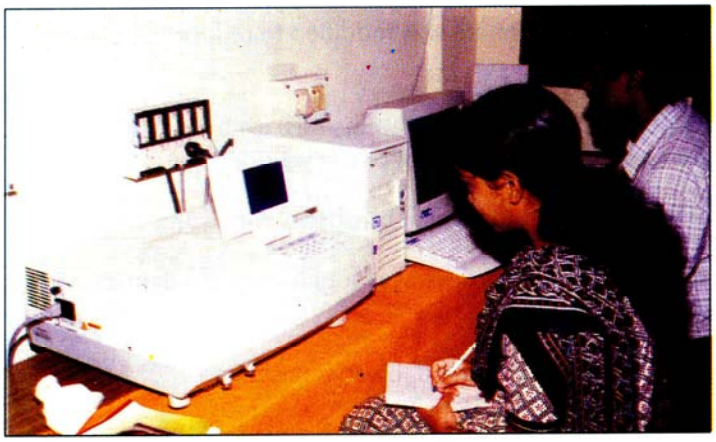
The PUFA concentrate prepared by the method standardised in this laboratory was dark red. As lighter colour would have better consumer appeal, a method for decolourisation of the product was standardised. The colour was improved significantly by the use of activated charcoal.

Experiments were continued by varying the proportion of water used in the process of preparation of PUFA concentrate. It was found that the quantity of water can be reduced by 15%, without affecting the quality or yield of the product.

Effect of PUFA concentrate on cholesterol metabolism

Studies were carried out to find out whether increasing the proportion of PUFA in the diet of albino rats from 1% to 2% had any effect on serum cholesterol levels or related aspects. The results indicated that this had no significant impact on the cholesterol or triglyceride levels in serum or on the ratio of HDL to LDL.

Albino rats were given PUFA supplemented diet for three months and then the same diet without PUFA was continued for 2 months to find out whether the effect of PUFA was retained even after discontinuing PUFA supplementation. It was observed that the cholesterol level did not increase up to two months on discontinuing PUFA.



Cholesterol estimation using UV - Visible Spectrophotometer

Effect of feeding peroxidised PUFA concentrate was studied in albino rats. A sample of oxidised PUFA (PV, 478 meq) was included in the diet of albino rats. After three months of feeding it was found that there was severe damage to the liver of the rats. This clearly indicated the toxic nature of oxidised PUFA. The changes in the level of reduced glutathione and activities of enzymes like lactate dehydrogenase, ATPase and catalase were similar to those caused by isoproterenol, a substance that can induce myocardial infarction.

Studies on metallothioneins in fish

Studies on metallothioneins in fish were continued. Metallothionein containing cadmium was detected in the gall bladder of the freshwater fish, rohu.

Studies on lipids

Samples of lipids extracted from the common species of fish available along the Visakhapatnam coast were analysed for fatty acid composition. Nothing unusual was observed in the fatty acid pattern of these lipids.

Pesticide residues, polyaromatic hydrocarbons, heavy metals and antibiotic residues in fish.

Freshwater fish from Muhamma in Alleppey District, Thiruvankulam in Ernakulam district and brackishwater fish from Narakkal were screened for 11 organochlorine pesticides, 16 polynuclear aromatic hydrocarbons and 7 antibiotic residues by GC and HPLC. None of these samples were found to contain any of these toxic substances and growth promoters. Water samples collected from these areas also showed the absence of organochlorine pesticides and polynuclear aromatic hydrocarbons.

In Visakhapatnam, cultured tiger prawn along with pond water and mud were tested for Hg and it was found that these samples were free of mercury. Fish and shellfish samples from Hirakud reservoir in Burla, Visakhapatnam fishing harbour and Godavari river near

Dowleswaram were also analysed for Hg and other toxic metals. Hg levels were more in muscle compared to organs like liver, gills and intestine.

Free amino acids in fish

Frozen storage studies on pearlspot and tilapia were carried out and changes in free amino acid pattern evaluated periodically. It was observed that the free amino acid content increased by 200% during a period of 6 months, indicating protein degradation. Concentration of taurine was found to decrease in pearlspot whereas in tilapia, a decrease in glycine concentration was observed.

Absorbable surgical sutures from fish gut

Ethylene oxide sterilizer was installed for the sterilization of absorbable surgical sutures from fish gut collagen. The samples sterilized in ETC sterilizer was found to give the desired sterility.

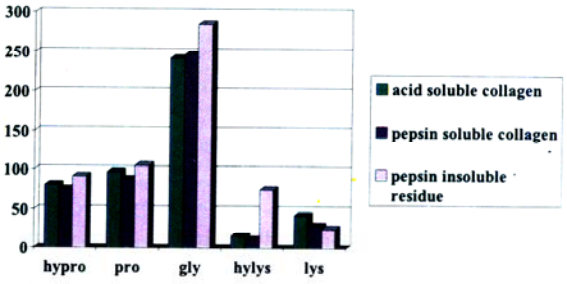
A solvent system consisting of dilute acetic acid and acetone was found effective for the reversible dissolution of collagen. A method to prepare reconstituted collagen from the skin of rohu is under standardization.

The precipitation of pepsin soluble collagen from skin of rohu in the form of fibres by extrusion was tried at M/s.Travancore Rayons Ltd. but was not found successful even though it could be precipitated reversibly. Thin transparent membranes however could be prepared easily from the pepsin soluble collagen.

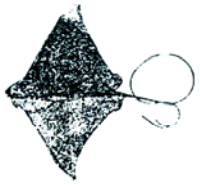
The yield of acid soluble collagen in gut of rohu was 1%, pepsin soluble collagen, 5% and pepsin insoluble residue, 12%. Electrophoresis of acid soluble collagen, pepsin soluble collagen and pepsin insoluble residue from the gut of rohu showed bands characteristic of x_1, x_2 and ß chains.

Amino acid composition of acid soluble collagen, pepsin soluble collagen and pepsin insoluble residue were characterized by high content of glycine, proline and hydroxy proline. Tryptophan, cysteine and cystine were absent in all these fractions.

Composition of Major Amino Acids in Various Collagen Fractions



The acid soluble collagen from the air bladder of rohu yielded only Type I collagen on fractionation, the yield being 4% of acid soluble collagen of the air bladder.



QUALITY ASSURANCE AND MANAGEMENT DIVISION

Research Projects handled

1.	Title of Project	:	Development of improved methods for quality and safety of fish and fishery products
	Principal Investigator	:	Dr.M.K.Mukundan
	Location of project	:	Cochin and Mumbai
	Co-investigators at Cochin	:	Shri. P.R.G.Verma, Dr. Francis Thomas, Shri. V. Muraleedharan, Dr.P.T.Lakshmanan, Dr.Sanjeev.S, Shri.K.P.Antony, Dr. Ashok Kumar, K. and Dr. D. Muthuchelvan
2.	Title of Project	:	Studies on incidence of toxic principles and parasites in seafoods
	Principal Investigator	:	Dr.M.K.Mukundan
	Location of project	:	Cochin
	Co-investigators	:	Dr. Ashok Kumar K., Dr.P.T.Lakshmanan, Dr. C.P.Gopinath* and Dr. V.Kripa*
3.	Title of Project	:	Occurrence, effect of processing and survival of halophilic pathogenic Vibrios in fishery products of the export trade
	Principal Investigator	:	Dr. T.S.G.Iyer
	Location of project	:	Cochin
	Co-investigators	:	Dr.Sanjeev.S, Shri. P.R.G.Varma, Smt.Leejee James** and Smt. Smitha, N.R.**
4.	Title of Project	:	Selective bio-accumulation of toxicants in cephalopods (viz. squid and cuttlefish) and changes in quality, its upgradation and safety of processed products
	Principal Investigator	:	Dr. P.T.Lakshmanan
	Location of project	:	Cochin
	Co-investigators	:	Kum. Prafulla,V.** and Kum. Liju Francis **

* *CMFRI, Cochin*

** *Senior Research Fellow, CIFT*

Chief findings

- A HACCP based package of practices was developed for the export of chilled fresh fish from India.
- Developed a software 'CIFT-Pinnacle HACCP & Record keeping' in association with M/s Pinnacle Innovative Technologies for implementation and management of HACCP in fish processing industries. This is a pioneering achievement in the field of fisheries.
- A test strip was developed for the rapid detection of sulphite above 1 ppm in prawns. Further evaluation is in progress
- Screened several samples of shellfish from Kerala coast for the presence of PSP / DSP. No PSP could be detected from any of the samples. However traces of DSP could be detected from many samples.

- Toxic metals, particularly cadmium, were higher in several samples of cuttle fish collected from Mumbai region than that observed in samples from Cochin, Mangalore and Kollam. The level of cadmium was greater than 10 ppm. However, on cleaning, the cadmium level was found to be below the permitted level.
- The haematological analysis of the blood of experimental albino rats fed with diets containing 40 ppm cadmium showed a lower haemoglobin content, packed cell volume, TC and platelet content, when compared to control animals, showing that organically bound cadmium and inorganic cadmium are equally toxic to albino rats.
- Most of the halophilic pathogenic *Vibrios* could not survive in chilled condition for two weeks.

Report of work done

Studies on Shigella and Vibrios

Survival of *Shigella dysenteriae* - an enteric pathogen (ATCC - 2335) in crab meat homogenate at -20°C and 7°C was studied. At -20°C the organism could survive up to 26 days and up to one month at 7°C . Survival of *V. flexneri* (ATCC - 12022), *S. sonnei* (ATCC - 11060) and *S. dysenteriae* (ATCC-2335) in prawn homogenate at -20° C and 7° C was also studied. At -20°C, *S. dysenteriae* could survive up to 35 days but the other two species could survive for more than 40 days.

Thirty three samples consisting of frozen fish and fishery products meant for export collected from five EU approved plants were examined for the incidence of pathogenic organisms. All the samples were found to be free from the enteric pathogen *Shigella*. Halophilic pathogenic *Vibrios* were isolated from seven samples.

Type cultures of pathogenic *Vibrios* viz. *Vibrio vulnificus, V. fluvialis, V.hollisae* and *V. mimicus* were obtained and their morphological, cultural and biochemical characteristics were studied in detail. Antibiotic sensitivity of *V. vulnificus* (18 strains) isolated from fish and fishery products was tested against 12 commonly used antibiotics by using disc diffusion method. All strains were found to be sensitive to chloramphenicol (100%), followed by nalidixic acid (94%), trimethoprim (89%), tetracycline (39%), ceftriaxone and neomycin (33%) and amikacin (17%). Least sensitivity was shown towards ampicillin and erythromycin (6%) followed by kanamycin and penicillin (11%).

Effect of chilling on pathogenic halophilic *Vibrios* were studied in cooked shrimps. Cooked shrimps inoculated with organisms were kept in chilled room in ice box with ice. *V.parahaemolyticus* showed the least survival, whereas *V. furnissi* and *V. fluvialis* were found to be viable even after two weeks. *V. cincinnatiensis, V. metschnikovii, V. mimicus* and *V. vulnificus* lost their viability in 10, 13, 5 and 11 days respectively.

Effect of salt curing and sun drying on halophilic pathogenic *Vibrios* were also studied. Dressed barracuda was dipped in cell suspension and mixed with salt in 1:4 ratio and kept for 24 hours. The bacterial load was analysed by MPN method. The samples were then drained and dried in sun for three consecutive days. *V.alginolyticus* and *V. cincinnatiensis* showed no reduction after salt curing. *V. parahaemolyticus and V. vulnificus* showed reduction in their number during curing. Almost all species were found to have lost their viability by three hours of sun drying, except *V. cincinnatiensis* which was found to have survived even after three hours of sun drying.

Bacterial quality of frozen seafoods

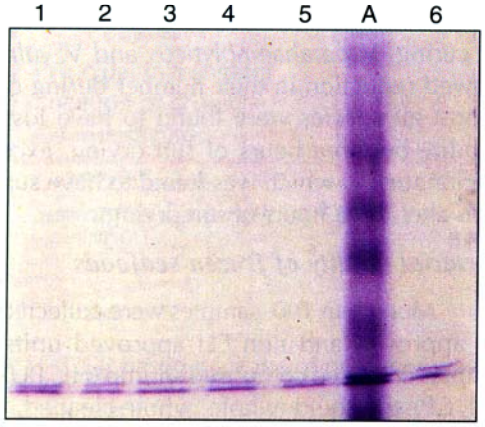
More than 100 samples were collected from EU approved and non EU approved units. The samples collected comprised shrimp (HL, PUD, PD and CP) and squid (whole, whole cleaned, tubes, tentacles and rings), cuttle fish (whole, whole cleaned and fillets) and cut crabs. The samples were analysed for indicator and pathogenic organisms. *E.coli* was present only in one sample of PUD shrimp. Coagulase positive *Staphylococci* was present in about 10% of the samples, mainly in squid, cuttle fish and cut crabs. *V. cholerae, Salmonella* and *L. monocytogenes* were totally absent.

Development of rapid method for the estimation of sulphite in prawns

Studies were initiated for the development of a spot test for the qualitative determination of metabisulphite and phosphate residues in prawns. The method developed for sulphite detection is quite simple and is being perfected for commercial use. The method consists of heating the minced prawn meat with dilute hydrochloric acid. The evolving sulphur dioxide is absorbed in a paper strip coated with soluble starch moistened with a few drops of iodine solution. If the sample contains sulphite, iodine will be decolorized. This method is superior to the malachite green test, which responds even to untreated samples.

Characterisation of metallothioneins by Poly Acrylamide Gel Electrophoresis (PAGE)

Metallothionein isolated from squid and cuttle fish liver by gel filtration technique using Sephadex G-75 and detected by UV detector was further purified by electrophoresis. Metallothionein 1 and low molecular weight bio-marker were used to characterise the protein. Bands were obtained corresponding to metallothionein standards.



PAGE pattern of matallothionein isolated from cuttle fish liver. 'A' represents the low molecular weight protein marker; other bands (1,2,3,4 etc.) represent metallothioneins

Monitoring of heavy metals in squid and cuttle fish from different geographical locations

Baseline data for important trace metals, viz. mercury, cadmium, lead, copper, zinc, chromium, cobalt, nickel, arsenic and selenium in the edible and non-edible components of squid and cuttle fish collected from Cochin, Kollam, Mangalore and Mumbai regions and also from FORV *Sagar Sampada* were generated.

Food fishes separated from the mantle cavity of squid and cuttle fish showed higher levels of cadmium and other metals, mostly in samples collected off west coast of Gujarat indicating probable source of toxic metals in cephalopods. Such fishes were identified, listed and metals determined. In whole fish, levels of cadmium and other metals were often above the limit.

Cochin region : Cadmium content of squid muscle ranged from 0.13-0.827 ppm; liver cadmium ranged from 10.01 - 81.79 ppm in squid and 16.02 - 113.9 ppm in cuttle fish.

Kollam region : Muscle cadmium content ranged from 0.23 - 1.008 ppm; cadmium levels of liver and ink ranged from 12.08 - 27.0 ppm.

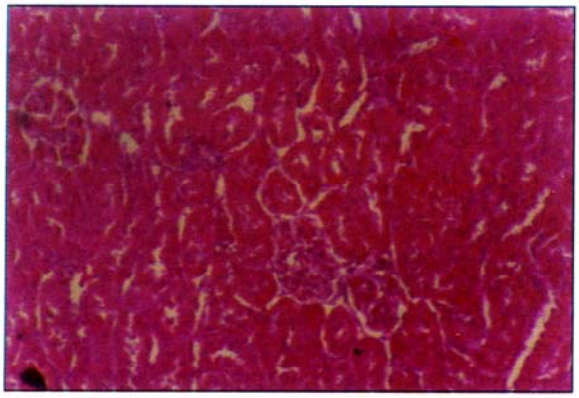
Mangalore region : Cadmium ranged between 0.02 to 0.91 ppm in edible muscle.

Mumbai region : The level of cadmium was above 1.0 ppm in the edible muscle of squid and cuttle fish. However, in the whole animal, cadmium level between 12 - 17.80 ppm was noticed . The levels of cadmium, copper and zinc in the body components like liver and gills were also high. However, the level of mercury was less than 0.1 ppm in these samples. Results indicate that cephalopods from Mumbai region have higher levels of toxic metals probably due to higher levels in the environment.

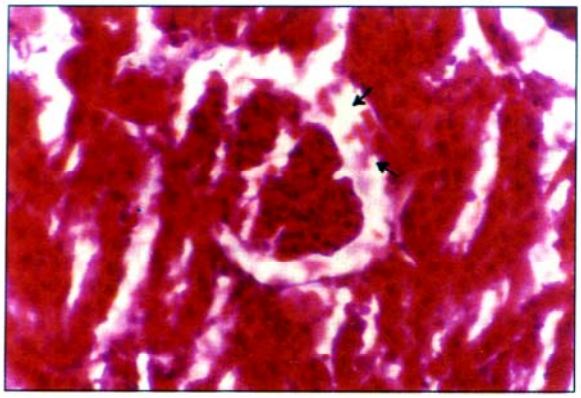
Evaluation of cephalopod liver bound cadmium toxicity in albino rats

Four weeks old albino rats were fed diet containing vacuum dried squid liver so as to provide 40 ppm cadmium in the feed. A control and another diet incorporated with cadmium chloride were also given. The body weight, urine and faecal matter etc were analysed for pH and metal levels. After the experiments, the animals were killed , the body components like liver, kidney and muscles were separated and metal levels analysed. These body components were subjected to histopathological studies. Degeneration and necrotic changes in liver and kidney tissues were observed, indicating the

deleterious effect of cadmium on the normal functioning of liver and kidney. Haematological analysis showed a lower haemoglobin content, packed cell volume, TC (white blood cells) and platelet content compared to the control animals showing that liver bound cadmium as well as inorganic cadmium were toxic to albino rats.



Kidney tissue of control albino rat showing normal architecture



Kidney tissue showing focal haemorrhage

Control of salting schedule of tuna in relation to brine concentration, resident time in brine etc for the preparation of masmin

Studies were carried out for the standardization of brining of dressed and scored tuna by using brine of varying concentration (5-10%). Duration of boiling time was also changed between 30 to 120 minutes depending on the brine strength. Brining concentration of 5% and boiling time of 60 min was found to be most suitable for the purpose.

Studies on quality upgradation for export of fresh fish

Studies were carried out on improvement in the quality of fish being exported. Live fish was placed directly in ice box containing ice-seawater slurry made by mixing flake ice and seawater in the ratio 3:1. In all the experiments, tuna (*Auxis thazard*) of size range 15-18 cm was used.The fish, deiced, gutted, gilled and cleaned was washed with chilled water chlorinated to the level of 5 ppm and chilled till the core attained 0 to 1^0 C, packed in polythene bags individually and placed in two types of insulated boxes, one in a PUF insulated plastic box and another in a thermocole box lined with polythene on the inner side. The temperature of fish was kept at 4^0 C or below throughout the experiment.

The ratio of fish: ice : dry ice used in the four experiments carried out were 1: 1: 0.5 ; 1 : 1 : 1 ; 1 :1.5 :1 and 1:1:2. In all the experiments, pathogens like *Salmonella* and *V.cholerae* were found to be absent. Coliforms including *E.coli* were also not detected. There was no change in the sensory qualities before packing or after storing for the periods mentioned in the experiments. All the above conditions excepting that of experiment number 1 can be commercially adopted for the export of chilled fish since the temperature of the fish was maintained below 4^0C throughout. The use of dry ice is advantageous in two ways - a) the quantity of fish exported in each pack can be increased, and b) the quality of the fish can be maintained in a better manner. Experiments are being continued with different combinations of ice, dry ice and fish.

Development of software for HACCP implementation

The Division in association with M/s Pinnacle Innovative Technologies developed a HACCP software named 'CIFT-Pinnacle HACCP & Record Keeping' for use in fish processing industries. This is a pioneering achievement in the field of fisheries.

The software is an interactive one which guides the user in a systematic manner to implement HACCP in seafood processing plants. The software has built-in libraries with ready-to-use HACCP plans for products such as shrimps (PUD, PD, HL etc), cephalopods (squid rings, tubes, cuttle fish whole cleaned and cuttle fish fillets), crabs, scombroid fishes, octopus etc. Besides, the software also has

the facility to develop HACCP plans for new food products. The software has well developed SSP and GMP procedures. Another key feature of the software is that it readily makes an HACCP manual for the plant. If properly administered, the software will be an effective and economic tool for food safety and quality assurance. This software can be further modified for use in any type of food processing activity.

Drying of prawns in controlled conditions for better colour attainment

Fresh tiny prawns (*M. dobsoni*) collected from the market were used for the studies. The prawns were divided into two portions and treated differently to get better colour. One part was blanched in 3% NaCl and dried in an electrical drier at 55°C and RH 60%. The second portion was dried as such at 75° C for the first 2 hours followed by drying further at 55° C and 60% RH to get a final moisture content of 12 %. The first process was found to give a better colour to the product.

Traditionally prepared dry prawns

Dry prawns with improved colour prepared as per CIFT technology

Studies on the changes in environmental aspects due to fish processing

To assess the impact of fish processing plant on the environment, evaluation of quality of process water and the effluent produced in selected fish processing units was initiated. It was observed that TSS ranged from 10-15 ppm, total organic carbon 1.2 – 2 ppm, nitrate 5-7ppm, surfactants 0.2 –1.2 ppm, BOD 1.5 –1.8 ppm , COD 4.2 – 5.8 ppm and residual chlorine 6 – 7.4 ppm in the treated water used for processing. There was no trace of oil or grease in the water. The effluent coming out of the processing hall, on the other hand, contained TSS 13-19 ppm, TOC 10-13.6 ppm, nitrate 9.1 – 10 ppm, surfactants 1.5 – 2.5 ppm, BOD 10-13.7 ppm, COD 39 – 42 ppm and available chlorine, 2 –3 ppm. The effluent also contained oil and grease in minute quantities (0.1 ppm). Studies are being continued to evaluate the changes in these parameters throughout the year and to suggest suitable remedial measures to control these factors.

Studies on the incidence of PSP and DSP in fish and shellfish

Based on the incidence of harmful algal blooms during 1998-2000 and the significance of the site in relation to farming, five locations were identified for routine sample collection. The stations identified are Vizhinjam, Neendakara / Thangassery , Dalavapuram, Fort Cochin and Calicut.

Green mussels (*Perna viridis*) and Donax were periodically collected from Calicut and Vizhinjam. Samples of oysters (*Crassostrea* sp) and clams (*Villorita* sp) were also regularly collected from these areas. The samples were collected in live condition. They were shucked to separate the meat and the hepatopancreas. They were analysed for Paralytic Shellfish Poison (PSP) and Diarrhetic Shellfish Poison (DSP) using standard mouse assay. PSP could not be detected from any of the samples, but DSP was detected in samples from Calicut and Fort Cochin. The samples are subjected to further analysis.

About 105 samples collected from various fish processing industries were analysed for PSP/ DSP. Samples included shimps, crabs, Baigai, mussels etc. PSP could not be detected from any of the samples. DSP was detected from 31% of crab samples collected from Chennai region.

MICROBIOLOGY, FERMENTATION AND BIOTECHNOLOGY DIVISION

Research Projects handled

1.	Title of Project	:	Investigations on prevalence of microbial hazards in fish and fishery environments and development of methods for their control
	Principal Investigator	:	Dr. P.K.Surendran
	Location of Project	:	Cochin
	Co-investigators	:	Dr. Nirmala Thampuran, Shri. V.Narayanan Nambiar, Dr. K.V.Lalitha, Dr. Toms C. Joseph, Dr. B. Madhusudana Rao and Shri. Rakesh Kumar

Chief findings

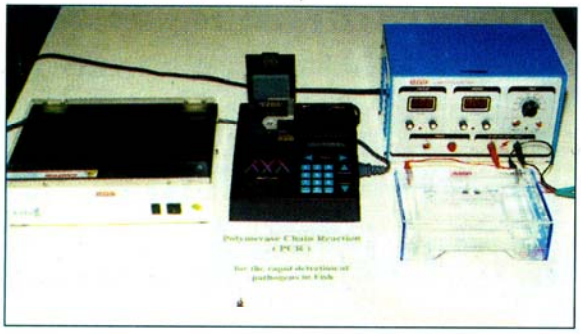
- An improved semi-nested PCR technique was developed and standardised for detection of White Spot Syndrome Virus (WSSV) , which caused the devastating white spot disease in farmed penaeid prawns.
- A coliphage test for rapid detection of faecal pollution of drinking water, water bodies and food articles including fish/ fishery products has been developed and successfully field tested.
- Farmed shrimps, fish and farm sediments from four southern states were screened for the presence of residues of eight different antibiotics in their tissues. Antibiotic residues were detected in three of the 240 samples examined; in two cases, trimethoprim and in one case, tetracycline were detected.
- Enteropathogenic *E. coli* O 157 : H 7 was found to be absent in brackishwater and clams collected from brackishwater farms. Water and mud samples collected from these farms did not show the presence of enteropathogenic *E. coli*.
- *Salmonella* serotypes were detected in 3% of the 110 frozen fish samples collected from the retail markets of Ernakulam District.
- Majority of the frozen fish samples (71%) collected from local markets were found to have total viable counts of more than 10^6 /g and *E. coli* counts of more than 100 /g (MPN) were observed in 69% of the frozen fish samples.
- *Shewanella putrefaciens*, *Aeromonas sobria* and *Aeromonas hydrophila* isolated from farmed *Macrobrachium rosenbergii* were found to be potential spoilers.
- *Clostridium botulinum* Type E was notably absent in farmed freshwater and brackishwater fish / shrimp and sediments.
- The microflora of clam meat (*Paphia malabarica*), used for feeding farmed freshwater shrimp , comprised mainly the family *Vibrionaceae* and was found to be a reservoir of coliforms including *E. coli*.
- Coliphages were found to tolerate up to 10 ppm chlorine and 20% sodium chloride. Significant correlation was observed between coliphages, *E. coli*, faecal coliforms and total coliforms. Coliphages were found to survive frozen storage at –20°C for more than 10 weeks whereas *E. coli* and faecal coliforms were completely destroyed within six weeks.

- Sixty percent of the 61 post larvae shrimp samples examined by PCR technique were found to be positive for the White Spot Syndrome Virus, (WSSV) indicating high prevalence of the virus in farmed shrimps larvae.
- Lactic acid bacteria isolated from intestines of healthy prawns were found to be inhibitory to *Vibrio harveyi*.
- *Pseudomonas fluorescens* producing fluorescein pigment were isolated from brackishwater.

Report of work done

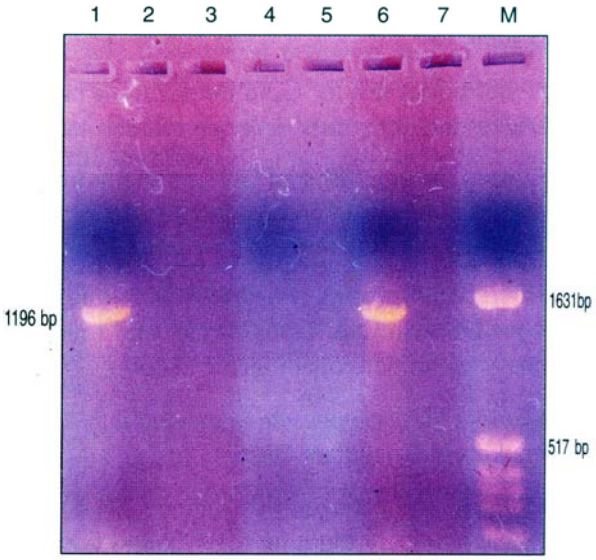
An improved semi-nested PCR technique for White Spot Syndrome Virus

An improved semi- nested Polymerase Chain Reaction (PCR) technique was perfected for the detection of White Spot Syndrome Virus (WSSV), using WSSV specific primers. WSSV virus affects penaeid shrimps, causing the devastating white spot disease. This disease first appeared in India in late 1995 in the tiger shrimp farms of Andhra Pradesh and subsequently spread to other states like Orissa, West Bengal, Tamil Nadu, Karnataka and Kerala.It reappeared in the Ernakulam and Kannur Districts of Kerala in 1999.



PCR set up for molecular level detection of viral diseases in shrimp

The improved semi-nested PCR method involved a two-step amplification process of a selected portion of the viral DNA by PCR. The first step gave an amplified DNA fragment of 1447 bp length, while the semi-nested step gave a 1196 bp length DNA fragment. The semi-nested PCR was found to be more sensitive than the single step PCR. Samples that were found to be negative for WSSV by the single step PCR were found to be positive by the two step semi-nested PCR. This PCR method was able to detect even latent stages of infection. The method was used to screen WSSV in post larvae, juveniles and adults of penaeid shrimps, *Penaeus monodon* and *P. indicus*. Out of the 61 post larvae samples examined, 60% were found to be positive for the White Spot Syndrome Virus, indicating high prevalence of the virus in farmed shrimp larvae.



Single step PCR for detection of WSBV DNA
Lanes 1 and 6 positive for WSB Virus. Shrimp samples from farms in Ernakulam District, where white spot disease appeared in 1999

Coliphages to detect faecal pollution of water and fish / fishery products

Detection of faecal pollution in water and food substances is important from the public health point of view because of the associated enteric infections. Epidemiological and microbiological findings have challenged the reliability of coliform bacteria as indicators of the enteric viral pathogen. A coliphage test to detect the presence of faecal pollution of drinking water, waterbodies and food

including fish and fishery products was developed, using coliphages, the phages which infect *Escherichia coli,* an indicator organism.

The newly developed coliphage test requires only six hours to detect the presence of faecal pollution of potable water, fishery products and environment, while the conventional test using coliforms as indicator takes 48 to 72 hours and is a very expensive culture medium. Conventional coliforms method may cost Rs. 100–150/- per sample. On the other hand, the coliphage based method requires very simple media costing Rs. 30-40/-. The only requirement is coliphage specific host bacterium and nutrient agar.

Significant correlation was observed between coliphages, *E. coli*, faecal coliforms and total coliforms. Coliphages were found to survive frozen storage at –20°C for more than 10 weeks whereas *E.coli* and faecal coliforms were completely destroyed within six weeks. Since coliphages were found to resist freezing (-20^0 C) for at least 12 weeks, tolerate high salt concentration (up to 20%) and high chlorine levels (up to 10 ppm), coliphage test is more effective and suitable to indicate faecal pollution of treated water and processed fishery products. This method was found to be suitable for hygiene and sanitational survey of drinking water, recreational waters, fishery products and fishery environments including aquaculture farms.

Antibiotic residues in farmed fish and prawn tissues and farm environments

Two hundred and forty samples of tiger prawn (*Penaeus monodon*), white prawn (*P. indicus*), fish and sediments from aquaculture farms in the four southern states of India were examined for the residues of the antibiotic *viz.* chloramphenicol, oxolinic acid, tetracycline, oxytetracycline, furazolidine, nalidixic acid, neomycin and trimethoprim. The antibiotic residues were not detected in 237 samples, while two prawn samples were positive for trimethoprim and one sediment sample was positive for tetracycline.

Enteropathogenic E. coli in fish

Samples of water and clams collected from brackishwaters in Kannamaly in Ernakulam District were tested for the presence of the enteropathogenic *E.coli* O157:H7. It was observed that addition of potassium tellurite to the isolation media (Sorbitol Agar) could help the isolation of the organism by suppressing the background flora. The addition of indigo carmine in the plating medium improved the discerning of colony characteristics facilitating easy identification. Twelve presumptive colonies isolated from the samples were tested with the latex-coated specific antibody and all the strains failed to give the desired agglutination, indicating the absence of the pathogen.

Plessiomonas shigelloides in fish

Samples of freshwater prawn *Macrobrachium rosenbergii* and water and mud samples collected from Vallakam near Vaikkom were analysed for the presence of *Plessiomonas shigelloides* using Ionositol Brilliant Green Bile Agar (IBB). The presumptive cultures isolated were subjected to various biochemical tests. All the cultures failed to give the characteristic reactions indicating the absence of the organism.

Production of antibacterial compounds by micro-organisms

The effect of low temperature on the recovery of *Streptomyces* species isolated from deep sea prawn *Heterocarpus woodmansonii* was studied by storing the sample at 4^{0}C for up to two weeks and plating on two types of actinomyces media followed by incubation at 5^{0}C and ambient temperature. Twelve *Streptomyces* cultures were isolated. Four of them showed mild antibacterial activity against gram positive bacteria.

Toxigenic Bacillus cereus in fish and fishery products

Frozen fish samples collected from local retail markets in Ernakulam District were examined for the presence of Enterotoxigenic *Bacillus cereus*. Altogether, 109 samples comprising 27 different fish species were analysed. *Bacillus cereus* was detected in 11 samples (10 %) which included *Etroplus suratensis, Acanthopagrus berda, Decapterus russelli, Scomberomorus commerson, Rastrelliger kanagurta, Sardinella longiceps, Lethrinus frenatus, Chirocentrus dorab* and *Pampus argenteus*. Out of the 11 cultures tested for the production of diarrhoeal enterotoxin by the Reversed Passive Latex Agglutination (RPLA) technique, 10 (90 %) were found to produce the diarrhoeal enterotoxin.

Salmonella serotypes in fish and fishery products and environments

Of the 109 frozen fish samples collected from local cold stores, *Salmonella* were detected in three

per cent of the samples. The positive samples included *Etroplus suratensis, Alepes djeddaba, Pampus argenteus* and *Lethrinus frenatus*. Frozen prawns and fish meant for export from the fish processing industry were also analysed for the presence of *Salmonella*. *Salmonella* was not detected in the 15 samples tested.

Microbial quality of fresh and frozen fish sold in retail markets

Samples of frozen fish collected from retail outlets in Ernakulam District were examined for their bacteriological quality. Out of the 109 samples of frozen fish analysed, 71% showed total plate counts above the acceptable limit of 10^6/g. *E. coli* counts (MPN) of more than 100/g were observed in 51% and only 39% showed *E. coli* counts of less than 20/g (MPN) which is the approved standard limit for human consumption. The overall microbial quality of the frozen fish samples was not very good even though *Salmonella* was detected only in 3% of the samples tested.

Yersinia enterocolitica in fish and fishery products/ fishery environments

Sixtysix samples of frozen fish comprising 21 species collected from local retail markets in Ernakulam District were examined for the incidence of *Yersinia enterocolitica,* which is a causative agent for diarrhoeal disease in man. The samples were analysed by directly plating on *Yersinia* Selective Agar and also by the enrichment technique using Phosphate-buffered saline. The enrichment broth was incubated at 4 °C for up to six weeks and periodically subcultured to detect the organism. One hundred and twenty suspected cultures isolated from the samples were subjected to detailed biochemical tests for the identification of *Yersinia enterocolitica*. Typical *Yersinia enterocolitica* strains could not be detected .

Toxigenic anaerobic bacteria, including Clostridium sp. in aquaculture systems

Samples of fish, prawn, mud and water collected from freshwater farm at Thiruvankulam and brackishwater farm at Puthuvypu and coastal aquaculture systems and open water farms in Ernakulam District were screened for the presence of psychrotrophic strains of *Clostridium botulinum*. Of the 14 samples of farmed shrimp and fish analysed, two were found to be positive for *C. botulinum*. Out of the 24 shrimp and fish samples from coastal aquaculture systems analysed, five were found to harbour *C. botulinum*. Toxin neutralization studies showed that *Clostridium botulinum* cultures isolated from farmed fish and environments belonged to Type C.

Microbiological changes during handling and chilled storage of farmed Macrobrachium rosenbergii

The effect of chilling in crushed ice on the microbial population of farmed freshwater prawn *Macrobrachium rosenbergii* was evaluated. The total psychrotrophic microbial population on the shell surface of *M. rosenbergii* was 1.0×10^3 cfu/g initially and flora was dominated by bacteria of the *Vibrionaceae* family. Gram positive bacteria belonging to *Streptococcus, Corynebacterium* and *Bacillus* predominated after five days of chilled storage. Again, after 12 days of continued storage, gram negative bacteria belonging to the family *Vibrionaceae* and genera *Pseudomonas, Shewanella* and *Moraxella* predominated. Bacteria belonging mainly to *Aeromonas hydrophila, A. sobria, Pseudomonas* and *Shewanella* spp. isolated from ice-stored *M. rosenbergii* showed potential spoilage activity. Clams (*Paphia malabaricus*) used as feed for freshwater shrimp *Macrobrachium rosenbergii* were found to harbour mainly *Shewanella, Pseudomonas, Cytophaga, Micrococcus, Bacillus, Corynebacterium* and *Arthrobacter. Further, Clostridium perfringens, Shewanella putrefaciens* and *Vibrio cholerae* non-O1 were also found to be present in the clam meat and such clam meat could be the source of these pathogenic and spoilage bacteria in freshwater prawn farms.

Shewanella putrefaciens - a potential protein spoiler of farmed shrimp

Probiotic bacteria such as Lactic Acid Bacteria and Bacillus in aquaculture feed and medicine

Lactic Acid Bacterial (LAB) cultures isolated from the intestine of farmed healthy prawns (*Penaeus monodon*) were screened for their antibacterial activity against *Vibrio harveyi*, which infects the post larvae of the prawns in hatcheries. Out of the 54 cultures of LAB tested, 10 strains were highly inhibitory to *V. harveyi* while 16 were found to exhibit moderate inhibitory activity. The highly inhibitory strains are being investigated as possible probiotics against *V. harveyi*.

Bacteriology of farmed freshwater fishes

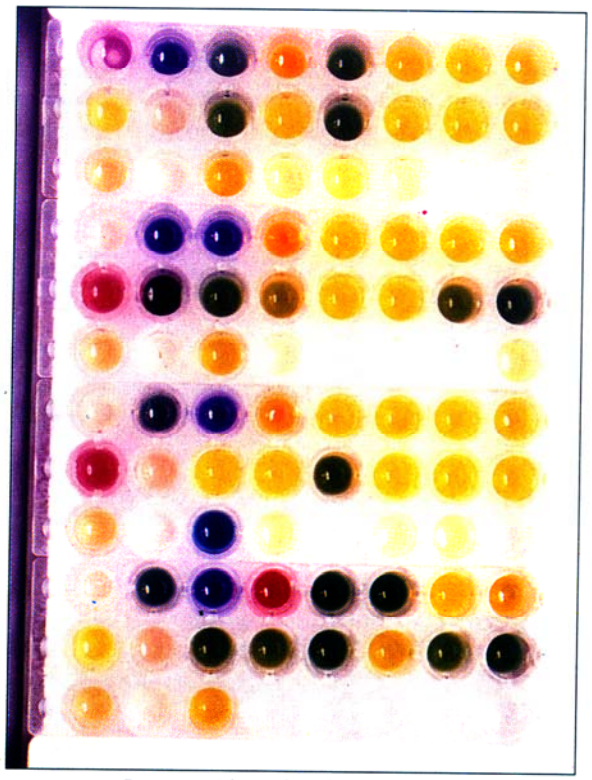
The physico-chemical parameters and the bacteriology of water and cultured rohu *(Labeo rohita)* collected from a freshwater farm at Thiruvankulam (Ernakulam District) were studied. *Aeromonas* and *Vibrios* were the major microflora on the skin surface of rohu. *Alcaligenes* and *Vibrios* were found in the intestines while *Pseudomonas* and *Aeromonas* predominated in the water samples. Bacteria belonging to *Enterobacteriaceae* were detected in quite large numbers in the farm water.

Microbiology of marine deep sea fish and shrimp

Pink sea prawn (*Heterocarpus woodmansonii*), Lobster (*Puerulus sewelli*) and Squid (*Loligo duvaucelli*) collected from landing centres in Cochin were studied for their bacteriological quality. The total plate count of the samples were $1.3x10^6$/g, $4.2x10^6$/g and $3.7 x10^4$/g, respectively. *E. coli*, sulphite reducing Clostridia and faecal Streptococci were also observed in all the samples. The levels of coliphages were 75pfu/g in the case of prawn, 240pfu/g in the case of lobster and 12pfu/g in the case of squid. The microflora of prawn was found to be predominated by gram positive bacteria like *Micrococcus*, *Bacillus*, *Staphylococcus* and *Arthrobacter*. In the case of lobster, *Vibrio*, *Pseudomonas*, *Enterobacteriaceae*, *Arthrobacter* and *Bacillus* constituted the flora.

Search for better bacterial indices for faecal pollution - Serratia and Proteus

Clams (*Meretrix meretrix*) and oyster (*Crassostrea madrasensis*) collected from landing centres were analysed for total *Enterobacteriaceae*. The counts were in the range of $5.3x10^6$/g in the case of clam and $2x10^5$/g in the case of oyster. The strains isolated were identified to the species level by a 12 test key developed and compared with Entero -Rapid 24 test marketed by La Chema, of Czech Republic. Of the eight cultures tested, seven gave very good to excellent identification. The scheme can be used for the identification of *Enterobacteriaceae*. Strains belonging to *Enterobacter*, *Citrobacter*, *Escherichia*, *Morganella* and *Serratia* were isolated from the samples.



Entero-rapid test for identification of enterobacteriaceae

Pseudomonas in fish and fishery environments

Samples of water, soil and fish collected from freshwater and brackishwater farms were tested for the presence of *Pseudomonas*, especially those producing fluorescein pigment. *Pseudomonas aeruginosa* and *P. fluorescens* were detected in brackishwater, and *P. putida* and *P. fluorescens* in freshwater farms. *P.putida*, P. *maltophillia*, *P. aeruginosa* and *P. cepacia* were isolated from mud samples collected from freshwater farms. *P. aeruginosa, P. fluorescens, P. putida and P. stutzeri* were isolated from samples of fish from the local markets. *P. fluorescens, P. aeruginosa* and *P. putida* produced fluorescein pigment.

Protein homology of aquatic Pseudomonas strains

Protein homology of the various strains of *Pseudomonas* was studied by SDS Poly-Acrylamide Gel Electrophoresis (PAGE). Medium size protein molecular weight marker was used to identify the bands and their molecular weights. 103 kilodalton (kda) and 20 kda proteins were specific for fluorescent *Pseudomonas* while 31 kda protein was specific for non-fluorescent *Pseudomonas*, 65kda, 41kda, 25kda, 17kda and 12 kda proteins specific to both fluorescent and non fluorescent *Pseudomonas* were separated as bands.

ENGINEERING DIVISION

Research Projects handled

1.	Title of Project	:	Development of fish processing equipment, deep sea fishing vessels and control and monitoring equipment for Indian fisheries
	Principal Investigator	:	Shri P.K. Chakraborthy and Shri P.N. Joshi
	Location of project	:	Cochin
	Co-investigators	:	Shri K. Ramakrishnan, Smt. K. Vijayabharathi and Shri M. Nasar
2.	Title of Project	:	Mechanisation and production of pearl nucleus
	Principal Investigator	:	Shri P.N. Joshi
	Location of project	:	Cochin
	Co-investigators	:	Shri Muhamed Ashraf
3.	Title of Project	:	Design, construction, performance monitoring and popularisation of new series of deep sea fishing vessels
	Principal Investigator	:	Shri M. Nasar
	Location of project	:	Cochin

Chief findings

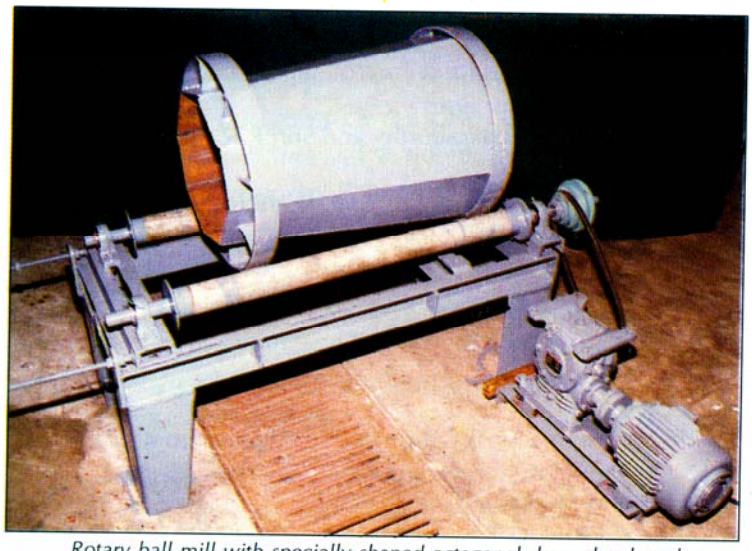
- Elephant draft power monitor was developed as part of the consultancy service taken up with College of Veterinary and Animal Sciences, Kerala Agricultural University, Mannuthy, for measuring the draft power up to 1000 kg developed by the elephant at the time of traction and carrying loads at different situations.
- Developed a rotary ball mill for shaping molluscan shell beads for production of pearl nucleii.
- Design packages were developed for 18m. deep sea steel trawler and 18m. deep sea gill-netter-cum-long liner.
- Performance monitoring was carried out of the newly developed 15.5m. fuel efficient steel fishing vessel, *SAGARKRIPA* under commercial conditions, and its fuel saving capability was found to be to the tune of 17% on an average compared to existing similar sized vessels demonstrated.

Report of work done

Technical data were collected to study various design parameters for the development of processing machines suitable for analogue fish products. The data collected were analysed and based on this technical data, a preliminary design of a suitable processing machine was developed for the production of analogue fish products from farmed freshwater fishes and low value marine fishes.

Designed, developed and fabricated a rotary ball mill. The design consisted of a specially shaped octagonal drum, which could be rotated at various speeds with the help of a driving mechanism. Suitable step pulleys with V belt were provided with a reduction gear drive system for the controlled operation of the machine. The equipment is fabricated with mild steel. Trials are being conducted to study its suitability for forming

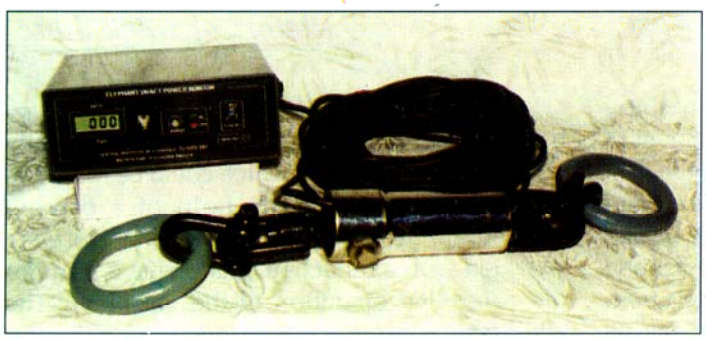
almost spherical molluscan shell pieces by varying the parameters such as load, speed, time, surface roughness, surface contour, etc.



Rotary ball mill with specially shaped octagonal drum developed by CIFT for shaping molluscan shell beads

Prepared the preliminary design of a shell cutting machine. Various cutting technologies such as hydraulic power hacksaw system, circular saw system, band saw system, chop saw system etc. suitable for cutting and slicing of molluscan shells available in irregular shapes were developed. Further work is in progress.

An elephant draft power monitor was developed as part of the consultancy services taken up with College of Veterinary and Animal Sciences, KAU, Mannuthy at a cost of Rs. 40,000/-. The instrument measures the draft power up to 1000kg developed by the elephant at the time of traction and carrying load at different situations. The instrument was handed over to KAU after initial trials.



Elephant draft power monitor

Design, fabrication and testing of a sensor using photosensitive device for measuring the attenuated light due to the presence of algae were completed for incorporating in the instrument Micro Algae Concentration Monitor.

Signal processing circuits were designed, fabricated and tested for incorporating in the tensile strength tester for surgical sutures. Design of the sensor has been completed and fabrication is in progress.

Development of software in machine language was completed for measurement and display of fuel consumption rate, inflow and return flow. Performance of the circuit and software were tested.

Design packages were developed for the construction of 18m. deep sea trawler and 18m. gill-netter-cum-long liner. The package includes production drawings and specification. The design package was prepared in such a way that the individual operators, according to operational convenience, could reorganise the deck arrangement.

The newly developed 15.5m. deep sea steel fishing vessel, *SAGARKRIPA* was operated under commercial conditions to monitor its performance, in collaboration with the Munambam Boat Owners' Co-operative Society Ltd., No.991. Performance studies have established that the vessel saved fuel by 17% on an average compared to similar -sized vessels operating under similar conditions in the same area. The motion characteristics and stability of the vessel were found to be superior to that of existing vessels. During the performance monitoring studies, the vessel netted 16% more catch compared to other vessels.

EXTENSION, INFORMATION AND STATISTICS DIVISION

Research Projects handled

1.	Title of Project	:	Studies on Human Resource Development and economic evaluation in fisheries.
	Principal Investigator	:	Dr. S. Balasubramaniam
	Location of project	:	Cochin, Veraval and Visakhapatnam
	Co-investigators	:	Dr. Krishna Srinath, Smt. Mary Thomas, Shri V. Annamalai, Dr. Nikita Gopal and Dr. Braj Mohan
2.	Title of Project	:	Development of Statistical models for evaluating the Economic viability of mechanised fishing trawlers
	Principal Investigator	:	Dr. G.R. Unnithan
	Location of project	:	Cochin
	Co-investigators	:	Dr. Nikita Gopal and Shri V. Radhakrishnan Nair

Chief findings

- A significant improvement was observed in the knowledge, attitude and skill levels of the trainees as a result of training imparted to them.
- Training need index scores were high (>80%) among the fisheries extension officials. Out of the 25 subject areas of fishery technology, the training need quotients were low (< 50%) only on eight subject areas.
- The average annual income of reservoir fishermen in Sanutikira fishing centre was significantly higher ($\bar{X}$:Rs.52,900) than the fishermen in Larbhanga centre ($\bar{X}$:Rs.34,500). The extent of adoption of technological practices in the two villages did not differ significantly and the variables such as the investment in fishing craft and fishing nets, number of family members, and risk preference were found to have positive and significant correlation with the extent of adoption of technological practices
- A study conducted among fishermen organisations in Ernakulam district of Kerala revealed that the services of these organisations had substantial influence on the development of small scale fisheries sector.The innovations in fishing propagated by them for adoption in the small scale mechanised sector included use of V-form otter boards for trawling, steel for boat construction, electronic equipment and information technology and methods of responsible fishing.
- The two critical factors affecting economic viability of fisheries were low income and the highly skewed distribution of this income.
- In terms of money spent on different food items, fish consumption ranked next to staple food, underlying the importance of fish in household food profile.
- In a six day fishing trip by larger trawlers, the revenue accrued ranged from Rs.45,000/- to Rs.1,33,000.
- The fuel consumption of larger trawlers was observed to be 1000 to 1300 litres, costing Rs.22,000/- on an average.
- The fuel cost alone was worked out at 43.5% of the average fishing cost of Rs.51,000/- per trip.
- Each fishing trip of trawlers was generally observed to be handled by six fishermen and the share of the crew was worked out as 35% of the amount equivalent to total revenue minus operational cost.
- The income to the primary producer working in larger trawlers was worked out at an average of Rs.1500/per trip.

Organisation of training programmes

During the period, 28 training courses were organised and 392 candidates were trained in the different fields of fishery technology. The major subject areas of training included fishing technology, fish processing and quality control, value added fish products, laboratory techniques for identification of bacteria in fish and fishery products, use of GPS, echosounders and radio telephones, HACCP concepts, quality control and bacteriology, seafood quality assurance, popularisation of square mesh cod end,fish processing techniques, in-plant quality control aspects of seafoods and their management, maintenance of OBM engines, and fishery technology and extension.

Effectiveness of training methods

Under the component 'Effectiveness of training methods among the target groups', structured questionnaires were developed for conducting pre-training and post-training evaluation. In a training programme on value added fish products, demonstrations and group discussions were conducted to train the participants. Data were collected from 32 respondents and tabulated. Before training, their knowledge, attitude and skill levels regarding the subjects of training were found as 20.78%, 58.80% and 23.82% respectively. After training , the respondents had significant improvements on their knowledge, attitude and skill variables.

Evaluation of training needs

In the study on Evaluation of training needs of fisheries extension personnel, structured questionnaires were developed to collect data on the selected socio-personal variables and training needs of fisheries officials. The initial analysis of collected data revealed that the training need index scores were high (> 80%) among the respondents. Out of the 25 subject areas of fishery technology, on eight subject areas viz., modern analytical techniques in biochemistry, biochemical technologies, nutrients and nutritional quality of fish, quality control in seafood processing, microbiology of fish spoilage, electronic instruments for fisheries research, etc, the training need quotients of fisheries officials were low (< 50 %). Further data collection is in progress.

Role of fishermen societies

Under the component 'Role of fishermen societies in the development of small scale fisheries', data were collected from six fishermen societies at Munambam, eight societies in Mumbai region, five societies in Burla region and one society in Malampuzha. Further data collection and tabulation are in progress.

Management of income fluctuations

In the study on Management of income fluctuations in artisanal fisheries, data on receipts, expenditure and savings were collected from 45 fishermen groups affiliated to two organisations in Kollam district, Kerala.

The two critical factors affecting economic viability of fisheries were (a) low income and (b) the highly skewed distribution of this income. About 70% of fisheries income was realised within the five-months period of May to September. Viability of fishing as well as the well-being of fishermen depended on the management of income generated during the short period so that its disposal could be extended to the lean period. A few NGOs were engaged in this operation absorbing funds during surplus and releasing it later based on needs. Data were collected in Kollam, Alappuzha and Cochin to compare the effectiveness of management of income fluctuations between fishermen covered by NGOs and fishermen who were on their own.

Consumption pattern of fish

Regarding the component on Consumption pattern of fish, initially this study was conducted in Ernakulam district to identify the factors that had affected the household fish consumption. In terms of money spent on different items, fish consumption ranked next to staple food, underlying the importance of fish in household food profile. This pattern holds true for both low income and high income groups. The study was extended to interior areas of the district. The data collected so far points to the confirmation of the earlier result. Data were collected from 80 households in Mulanthuruthi area in Ernakulam, Kerala. Data were also collected from 48 households in Sambalpur region and 63 households in Hirakud reservoir area. Tabulation and analysis of the data are in progress.

Economics of larger trawlers

The survey on the Economics of operation of larger trawlers (13.6-17.6 m) was initiated at two major mechanised fish-landing centres of Munambam and Cochin Fisheries Harbour. On the basis of the information collected, a suitable sampling plan was designed fixing the sample size as 5% of the annual fishing trips by trawlers. A detailed proforma was prepared for collection of data and pre-tested. Simultaneous collection of data from both the major landing centres is in progress.

Based on random sampling plan, trawlers were selected for the study on Consumption of fuel and operational costs of trawlers. Fuel consumption, expenditure on fuel per trip, crew bata, cost of ice, berthing and auctioning costs, crew share, cost of repair and maintenance, revenue realised etc. were collected from each trip selected.

It was observed that in the six day duration of fishing trips by larger trawlers, the revenue accrued ranged from Rs.45,000/- to Rs.1,33,000/-. The fuel consumption observed was 1000 to 1300 litres, costing Rs.22,000/- on an average. The fuel cost alone worked out at 43.5% of the average fishing cost of Rs.51,000/- per trip.

Development of statistical model

With a view to developing a statistical model, major factors contributing to the total operational cost and its inter-relations were probed. For this purpose, quantity and cost of fuel consumed, duration of fishing, distance from the shore, area of operation, depth of operation, speed of the boat etc. were taken into consideration for formulating a multiple regression model. More data are being collected for this study.

Returns to the primary producer

Under the study on Returns to the primary producer, it was observed that each fishing trip was generally handled by six fishermen and the share of the crew worked out as 35% of the amount equivalent to total revenue minus operational cost. The total revenue depended on catch composition as prawn and other quality fishes fetched lucrative auction prices. During the fishing season under report, red prawns located at 160m depth off Beypore in the north and at 200m depth off Kanyakumari in the South of Kerala brought good income to the fishermen, but only for a short period. The income to the primary producer working in larger trawlers was worked out at an average of Rs.1500 per trip.

Trawl ban studies

Trawl ban studies were continued during the period. Data were collected from traditional fishermen from fish landing centres all along the coast from Kasaragod to Kollam and a report was prepared.

Ring seines operated from traditional craft being loaded into trolleys after fishing during the trawl ban

Consultancy on evaluation of extension training programmes of MPEDA

A consultancy project offered by MPEDA on the evaluation of training programmes was completed during March - July, 2000 with a consultancy fee of Rs. 2.372 lakhs. After finalising the methodology, data were collected from the pre-processing personnel, fish processing personnel in the seafood processing factories and fishermen in Cochin- Alappuzha and Tuticorin-Kanyakumari regions by employing enumerators. Socio-economic profile, evaluation of training programmes, evaluation on the coverage and usefulness of subjects dealt in the training, effectiveness of training in terms of gain in knowledge, changes in attitude, adoption and impact perception, organisational arrangements, constraints and remedies were analysed. The final report with recommendations was submitted to MPEDA, Cochin.

VERAVAL RESEARCH CENTRE

Research Projects handled

1.	Title of Project	:	Development of eco-friendly trawls and resource specific trawls for demersal fishing
	Principal Investigator	:	Shri K.K. Kunjipalu
	Location of project	:	Cochin, Visakhapatnam and Veraval
	Co-investigators at Centre	:	Shri M.P.Remesan and Shri U. Sreedhar
2.	Title of Project	:	Human resource development programmes and economic evaluation in fisheries
	Principal Investigator	:	Dr. S. Balasubramaniam
	Location of project	:	Cochin, Veraval and Visakhapatnam
	Co-investigator at Centre	:	Shri M.P. Remesan
3.	Title of Project	:	Studies on materials protection and marine pollution
	Principal Investigator	:	Dr. Leela Edwin
	Location of project	:	Cochin and Veraval
	Co-investigator at Centre	:	Shri U. Sreedhar
4.	Title of Project	:	Evaluation of pre-processing hazards associated with fish landings at Veraval and studies on development and evaluation of value added products from low value fish landed in Gujarat.
	Principal Investigator	:	Shri K.K. Solanki
	Location of project	:	Veraval
	Co-investigators	:	Shri Zynudheen, A.A., Dr. Arnab Sen and Shri George Ninan
5.	Title of Project	:	Innovations in product development, preservation, process and quality control of traditional fishery products
	Principal Investigator	:	Shri K. George Joseph
	Location of project	:	Calicut and Veraval
	Co-investigator at Centre	:	Shri Zynudheen, A.A
6.	Title of Project	:	Nutrients, toxicants, pollutants and growth promoters in aquaculture systems and processed marine products
	Principal Investigator	:	Shri A. G. Radhakrishnan
	Location of project	:	Cochin, Veraval and Visakhapatnam
	Co-investigator at Centre	:	Shri Zynudheen, A.A.

Chief findings

- High opening trawl (HOT) of 34m attached with 30 mm square mesh has shown a good escapement CPUE of 22.08 kg /h as compared to the CPUE of 2.09 kg / h of diamond mesh of the same size.
- The escapement CPUE of 32 m large mesh demersal trawl fitted with 30 mm square mesh cod end was observed to be much better than when fitted with diamond mesh of the same size.
- The cadmium content in whole cuttle fish was found to be very high whereas in processed cuttle fish cadmium level was within the limit.
- Water quality analysis of effluents from various discharge points showed high level of COD and total dissolved solids.

Fishing gear

The 32 m shrimp trawl with 25 mm square mesh cod end was operated for 25.05 hours. The CPUE observed for this cod end was 56.13 kg/h mainly dominated by ribbon fish (31.8%) and sciaenids (36.8%) whereas an escapement CPUE of 40.26 kg/h dominated by *Acetes* (84.7%) was observed. Juveniles of commercial fishes were also seen to be present.

The 32 m large mesh fish trawl fitted with 30 mm diamond and square mesh cod end was operated for 17 hours. The cod end CPUE observed was 63.63 kg/h and 51.4 kg/h respectively in contrast to escapement CPUE which was as high as 92.92 kg/h and 62.0 kg/h respectively.

Square mesh cod end with 30 mm mesh size attached to a 34 m HOT had a retention CPUE of 14.74 kg/h which was less than the retention CPUE of diamond mesh (18.72 kg/h) of the same mesh size. The escapement CPUE in the case of square mesh cod end was 22.08 kg/h in comparison with diamond mesh which facilitate escapement of only 2.09 kg/h.

In case of 2 m LMDT the retention CPUE (21.44 kg/h) of 30 mm square mesh cod end was much better than the diamond mesh cod end (14.63 kg/h) of the same size. The escapement CPUE (15.8 kg/h) of square mesh cod end was higher than diamond mesh cod end (5.36 kg/h) at any time.

The locally used 30 m disco fish trawl fitted with 30 mm cod end showed a retention CPUE of 16.0 kg/h and escapement CPUE of 4 kg/h.

Length frequency studies were carried out on the following species retained both in the cod end as well as in the cod end cover - *(Otolithes cuvieri, Johnius glaucus, Trichiurus lepturus, Harpodon nehereus, Thryssa mystax, Pellona ditchella, Panulirus homarus, Acetes johnius, Coilia dussumieri* and *Caranx ignobilis)*. The length-weight studies and maturity studies of *Otolithes cuvieri* and *Johnius glaucus* were also carried out.

Samples of soft wood immersed in Veraval waters for collection of wood borers are being monitored. Panels of different wood species were also immersed to study the rate of wood boring and fouling.

Hydrological studies of Veraval sea waters were continued.

During the exclusive harvest technology cruise (cruise No. 184) of FORV *Sagar Sampada,* square mesh window studies using 40 mm, 50 mm and 80 mm mesh sizes were carried out. Morphometric measurements of all the species retained in and escaping from the cod end were taken. During the cruise, suber krub otter boards were used for operating the RMP 6 EL mega mesh midwater trawl. The net showed a vertical opening of 9.6 m and an average horizontal opening of 52.0 m.

An analysis of discards of the 184th cruise was undertaken. The percentage of discards and non-marketable fishes was as high as 77.77%. A total of 87 species were identified.

The sea truth data collected from Munambam fishing village, Kerala, was analysed with the OCM images generated by IRS P4 Space Application Centre, Ahmedabad. Observations and suggestions based on these studies were submitted to SAC . Validation programme of OCM data is in progress.

Fish processing

Regular analysis of water was carried out from specific discharge points and harbour mouth for physico-chemical and bacteriological parameters.

Whole cuttle fish samples analysed for the presence of heavy metals showed high levels of cadmium and lead. Study of cuttle fish for the accumulation of cadmium in different organs was also carried out.

Processed cephalopods were found to contain heavy metals within the tolerance level.

Effluent water samples from two chemical factories in the vicinity of Veraval were analysed for pollution parameters.

Non scombroid fish such as horse mackerel were found to contain histamine, with the levels increasing with storage.

Studies on leaching of heavy metals by bacteria are in progress.

Antibiogram pattern of heavy metal adapted strain of *Pseudomonas* revealed resistance to ampicillin, trimethoprin, cephatoxin and nalidixic acid. Sensitivity was highest to gentamicin and ciprofloxacin. A total of eight *Pseudomonas* isolates were tested.

Adaptation of 10 isolates of *Pseudomonas* to increasing concentrations of heavy metals viz. Pb, Cd and As was carried out. The adapted isolates showed good growth of heavy metals at concentrations of 800 ppm.

Fisheries extension and statistics

Data collection from 40 respondents on the component 'Productivity and associated factors among fishermen operating smaller craft' is being carried out every alternate month at Veraval and Chorwad.

Fabrication of 40 numbers of square mesh trawl cod ends with 35 mm mesh size was completed for distribution among fishermen of Saurashtra coast. The finance was provided by the State Government.

A study on the capacity utilisation of processing plants of Veraval is in progress. Details on the quantity of raw materials handled, finished products, number of labourers utilised, etc. are being collected from three fish processing plants regularly.

A survey was conducted on the local artisanal fishing gear used in Mongrol, Suthrapada and Jaleshwar.

VISAKHAPATNAM RESEARCH CENTRE

Research Projects handled

1.	Title of Project	:	Development of eco-friendly demersal trawls and resource specific trawls for demersal fishing.
	Principal Investigator	:	Shri K.K. Kunjipalu
	Location of project	:	Cochin, Visakhapatnam and Veraval
	Co-investigators at Centre	:	Shri S.V.S. Ramarao, Dr. G. Rajeswari and Dr. Raghu Prakash
2.	Title of Project	:	Studies on the effect of experimental installation of FADs for fishery resource enhancement in and around Visakhapatnam coast.
	Principal Investigator	:	Shri S.V.S. Ramarao
	Location of project	:	Visakhapatnam
	Co-investigators	:	Dr. G. Rajeswari and Dr. Raghu Prakash
3.	Title of Project	:	Performance evaluation of suitable selective devices for elimination of fish by-catch (BRD) and turtle (TED) in shrimp trawling.
	Principal Investigator	:	Shri Percy Dawson
	Location of project	:	Cochin and Visakhapatnam
	Co-investigators at Centre	:	Dr. G. Rajeswari
4.	Title of Project	:	Investigations on post harvest handling and processing of fish and shellfish of Andhra Pradesh.
	Principal Investigator	:	Shri Sib Sankar Gupta
	Location of project	:	Visakhapatnam
	Co-investigators	:	Dr. D.I. Khasim, Dr. R. Chakraborti, Dr. M.M. Prasad (transferred to Burla) and Shri A.K. Chattopadhyay
5.	Title of Project	:	Biochemical, nutritional and functional properties of fish constituents
	Principal Investigator	:	Dr. P.G. Viswanathan Nair
	Location of project	:	Cochin and Visakhapatnam
	Co-investigator at Centre	:	Dr. D.I. Khasim
6.	Title of Project	:	Nutrients, toxicants, pollutants and growth promoters in aquaculture systems and processed marine products.
	Principal Investigator	:	Shri A.G. Radhakrishnan
	Location of project	:	Cochin, Veraval and Visakhapatnam
	Co-investigator at Centre	:	Dr. D.I. Khasim
7.	Title of Project	:	Human resource development programmes and economic evaluation in fisheries.
	Principal Investigator	:	Dr. S. Balasubramaniam
	Location of project	:	Cochin and Visakhapatnam
	Co-investigator at Centre	:	Shri J. Charles Jeeva

Chief findings

- By-catch reduction devices (BRD) were designed and evaluated to test their efficiency in eliminating juveniles from shrimp trawl.
- A survey on by-catch composition in commercial trawl landings at Visakhapatnam harbour showed that more than fifty per cent of the trash fish landings was composed of juveniles of commercially important species.
- A simple needle assembly for removing the bones from the fish fillets of carps, an important freshwater fish, was developed thus enhancing value addition in processing and utilization of freshwater fish.
- Small varieties of bony fish, a rich source of Ca and P, were utilized for developing value-added products.
- The ink portion from cuttle fish contained good amounts of free amino acids, namely, alanine, taurine, aspartic acid, glutamic acid and leucine, besides high amounts of Cu.

Report of work done

Fishing gear

Trials were continued with the new designs of 30 m eco-friendly trawls at 20-30 m depth off Visakhapatnam. These trawls were efficient in catching offbottom fishes and were found to be ecofriendly as they could be operated without disturbing the bottom mud.

Three designs of by-catch reduction device and square mesh cod end were evaluated for elimination of by-catch from shrimp trawls. Square mesh window and circular grid were fitted in a shrimp trawl. The escaped fish was collected in the cover and the morphometric data analysed. About 60% of the escaped catch recorded were juveniles. Oval grid attached to square mesh cod end was fitted to the fish trawl. Small fish escaped through square meshes while bigger ones were retained in the cod end.

A benthic FAD constructed with scrap and other discarded materials was installed at 25 m depth off Visakhapatnam coast. Surveys were conducted to study the productivity and aggregation of fish around the FADs.

Fish processing

Common and rare species of fish including *Caranx ignibolis, Mugil lizaparsia, Carangidae, Scombroides, Cypsilures* sp. and *Scatophygus argus* were analysed for their proximate composition. The nutritional elements, amino acid and fatty acid composition as well as toxic heavy metals were analysed in the fish/shellfish samples collected from different centres along the east coast.

Monitoring studies

Heavy metal analysis: About 200 samples consisting of tissues of edible muscle, skin and liver of different varieties of fish/shellfish were digested for heavy metal analysis. The samples included marine fish from east coast, freshwater fish from Hirakud reservoir, Godavari river, Kolleru lake etc. As reported earlier, total mercury content was more in the freshwater spiny eel, *M. armatus* collected from the Godavari river near Kovvur. The river sediment sample at the site was also more. Total mercury in the meat of all the shrimp and fish being exported was very negligible and well below the tolerable limit. Other heavy metals such as Pb, Cd, Zn and Cu were within tolerable limits. Further monitoring is being continued.

Polycyclic Aromatic Hydrocarbon (PAH) compounds: The analysis of about 50 samples of fish tissues from the inshore waters of fishing harbour in Visakhapatnam where the water is exposed to oil pollution, showed the presence of naphthalene, acenaphthalene, phenanthrene and anthracene compounds.

Histamine: The histamine levels in the marine scombroids, mullets and carangids at the time of landing and after storage for 6-8 hours at ambient temperature were found to be below maximum admissible limit of 20 mg/100 gm muscle.

Fungi in dried fish: Two fungi - *Aspergillus flavus* and *Wallemia sebi* were isolated from the cured and dried fish samples from Visakhapatnam area. The water activity of the dried fish samples was in the range of 0.85 – 0.9. The studies on sensitivity of fungi to salt showed that *W. sebi* grew well in PDA (Potato Dextrose Agar) media containing 10% sodium chloride while delayed growth was noticed at 14% sodium chloride level.

Pathogens in fish and fish products: About 100 fresh and frozen fish/prawn and fish paste samples were screened for human pathogens and hygiene indicator bacteria. All the fish samples were +ve for faecal *Streptococci*, 25% for enteropathogenic *E. coli*, less than 15% for coagulase +ve *Staphylococci* and 18% for Non 01 *V. cholerae* respectively.

Studies on improving processing techniques

Improvement in total package of cured and dried fish: The STPP + sodium benzoate + citronella oil treated cured and sun dried mackerel packed in polythene bags were found to be in acceptable condition even after 12 months storage at room temperature. The control samples developed rancidity and insect infestation in the early stages of storage i.e. after two months. The peroxide value and TVN content were comparatively less in the treated samples. Overall quality of the treated samples was better than the control samples.

Salted and pressed fish: The deep sea fish, black ruf, collected from the FSI vessel was dressed, salted, pressed and packed in polythene bags. The samples treated with propionic acid at different concentrations (01. to 0.3%) were acceptable up to 90-105 days at ambient temperature whereas the untreated fish remained acceptable only up to 75 days.

Storage of live freshwater fish in cold hibernated conditions: *Clarias batrachus*, a fresh-water air breathing fish was hibernated between 12-13°C by gradual cooling with ice and water and constant aeration. The hibernated fish was stored in moist condition without water in a PUF insulated box under controlled temperature. The fish was found alive even after 30 hours of storage.

Processing of freshwater carp: To improve the value addition of fresh water carp by removing the fish bones in the fillets, one block of specific needles was fabricated for the purpose and the bones in the fillets removed manually using the needles, with little damage to the tissue of the fillet. An overall decrease of 10% was observed in the weight of the fillet when the bones were removed along with some loose meat. The loose meat may be reused again. Value-added battered and breaded products can be prepared using these boneless fillets.

Studies on product development

Value added products from small size fish by thermal processing: Small size fish of *Leiognathus* and *Sardinella* species, after dressing and beheading, were processed thermally in an autoclave for about 1 hour at 15 lb pressure to soften the bones completely. Ready-to-eat products with good oganoleptic score were prepared from this meat with softened bones. Attempts were also made to preserve the thermally processed fish meat as frozen blocks at -18°C. In the case of *Leiognathus* sp. 87.7% of total phosphorus and 68.5% of total calcium present in raw fish were retained in thermally processed meat. The total percentage of fat was found to be less in the thermally processed meat compared to raw fish.

Protein fraction from tuna liver: Attempt was made to separate protein fraction from tuna liver : Enzymatic soluble protein concentrate using papain was prepared.

Studies on medicinal substances from Sepia ink: Ink was collected from big size cuttle fish *Sepia pharaonis* and dried. Total amino acid composition of the dried ink showed high contents of aspartic acid and glutamic acid with some amount of alanine and leucine. Even the free amino acid analysis of a dried ink sample showed more contents of alanine, taurine, aspartic acid, glutamic acid and leucine. It also contained very high levels of Cu and Zn. Studies for other compounds are beig continued.

Human resource development:

Secondary data were collected from the office of the Commissioner of Fisheries (Andhra Pradesh), Hyderabad, under the component 'Evaluation of training needs of fisheries extension development personnel'. Preliminary field visits were made to the Primary Fishermen Co-operative Societies in the village viz. Jodugullapalem and Peda Jalaripeta in Visakhapatnam under the component, 'Role of co-operative societies in the development of small scale fisheries'.

BURLA RESEARCH CENTRE

Research Projects handled

1.	Title of Project	:	Improvements on the methods of processing fish in Orissa
	Principal Investigator	:	Shri J.K. Bandyopadhyay
	Location of project	:	Burla
	Co-investigator	:	Shri A.K.Chattopadhyay
2.	Title of Project	:	Development of value added products utilizing inland fishery resources
	Principal Investigator	:	Shri J.K. Bandyopadhyay
	Location of project	:	Burla
	Co-investigator	:	Shri A.K.Chattopadhyay
3.	Title of Project	:	Studies on pollution of fish and fish curing environments of Orissa
	Principal Investigator	:	Shri J.K. Bandyopadhyay
	Location of project	:	Burla
	Co-investigator	:	Dr. M.M. Prasad
4.	Title of Project	:	Development of fishing gear and techniques for harvesting reservoir fishery resources
	Principal Investigator	:	Shri A.A. Khan (upto June, 2000) Dr. B. Meenakumari (from July, 2000)
	Location of project	:	Burla
	Co-investigator	:	Shri Prem Kumar

Chief findings

- Wide variation is seen in the quality of commercial salt cured fish.
- Sudden mortality of *Gudusia chapra* was observed in the month of October 2000 in some areas.
- Potential fishing hamlets were identified for transfer of technology.
- As a part of 'Special component plan and women component plan under IX plan', SC and ST women groups who were actively engaged in post harvest fisheries were identified for imparting training on post harvest handling, pickling and smoking of fish.
- Studies on monoline operation in Hirakud reservoir were carried out with different size hooks. Results revealed that 17 and 18 number hooks were superior to other types. Catfish and freshwater prawns were dominant among the fish catches.
- Gill nets with high tenacity nylon monofilament and 30 mm bar mesh size landed better catches.

Report of work done

Fishing gear

Studies on monoline were carried out with different size hooks. Fresh fishes and small prawns were used as bait. A total of 52 observations were made and hooks number 17 and 18 were found to be superior to other types of hooks on the basis of catching efficiency. The catches comprised *Notopterus chitala, Mestacemblus armatus, Silonia silondia, Mystus seenghala* and *Macrobrachium malcomsoni.*

Gill nets of high tenacity nylon monofilament and 30 mm bar mesh size operated for 81 days

landed comparatively better catches. Catfish and carps dominated the catches. Designing of trammel nets was initiated.

Fish processing

Frozen storage studies were carried out on minced *Mystus aor* and *Silonia silondia* stored at -18°C, in polypropylene pouches. The quality of the fish was evaluated by physical, biochemical, bacteriological and organoleptic characteristics.

Salt cured fish samples were collected from different fish markets of Orissa and analysed for microbial, biochemical and organoleptic characteristics. The following trend was observed in the quality :

Moisture (%)	36.5 to 60.4
Fat (%)	0.9 to 12.1
Sodium chloride (%)	14.2 to 18.9
Peroxide value (m.e.q/kg. fish)	91.7 to 526.9
Total volatile nitrogen (mg%)	38.5 to 259.4
Alpha amino nitrogen (mg%)	57 to 629.3
Total bacterial count (Log CFU/g)	2 to 6
Total mould count (Log CFU/g)	1 to 4
Organoleptic scores	5 to 8 (on 10 point Hedonistic scale)

Frozen storage studies were carried out on minced *Mystus aor* and *Silonia silondia* stored at -18°C in polypropylene pouches. The quality of the fish was evaluated by physical, biochemical, bacteriological and organoleptic characteristics.

Data were collected on post harvest handling of fish, fish curing practices and socio-economic conditions of the fishermen community from 11 fishing villages of left and right dykes of Hirakud reservoir and three fishing hamlets around Burla. Cured fish samples were also collected for bacteriological, biochemical, physical, chemical and heavy metal analyses.

Spurt mortality of *Gudusia chapra* was observed in the month of October 2000 in some areas of Hirakud reservoir. Dead fish samples did not reveal any disease symptoms.

Fisheries extension

As a part of 'Special component plan and women component plan under IX plan', 15 fishing hamlets in and around Hirakud reservoir were surveyed . Among the middle reach fishing villages of Hirakud reservoir surveyed, Kurumkel was selected for transfer of technology, specially for drying and smoking of fish by scientific methods. In another middle reach village of the Hirakud reservoir, Mundomahal, the SC category women were identified as potential target group for transfer of technology. The primary fishermen Co-operative Societies around Hirakud reservoir were also surveyed.

Data were collected on fish consumption pattern in interior areas surrounding Hirakud Reservoir.

HOSHANGABAD RESEARCH CENTRE

Scientist associated : Shri George Ninan

Report of work done

Data from the survey conducted in the inland fishery sector of the State of Madhya Pradesh was analysed and a report on five reservoirs of Madhya Pradesh was prepared. The reservoirs of Tawa, Bargi, Gandhisagar, Barna and Halali covered under the benchmark survey were under the category of major reservoirs having a water spread area of above 5000 ha. Of the reservoirs surveyed, Gandhisagar, Bargi and Tawa were the biggest reservoirs in Madhya Pradesh, in that order.

Gandhisagar stands first, both in terms of production and yield. Major carps and local majors constituted about 90% of the total landings, ie. major share of the catch comprised quality fish which fetched good market price.

All the reservoirs fell well below the stocking target proposed by the State Fisheries Dept., mainly due to non-availability of sufficient quantity of good quality fish seed.

The main gear used was the simple gill net, commonly known as Rangoon net. Other gear used were the beach seine and long lines.

The landed fish for marketing remained exposed to the atmosphere for at least 24 hours before they are properly packed resulting in poor product. Quick means of transport and better methods of storage would go a long way in improving the quality of the catch.

About 75% of the total production from the reservoirs was marketed outside Madhya Pradesh. There is need to develop a strong chain of retail outlets for fish sale inside the State which will provide the population a cheap source of protein at affordable price after assessing consumer preference.

As regards the socio-economic conditions of the fishermen, it was seen that reservoir fishing was only a supplementary means of livelihood to the fishermen and the main occupations were agricultural labour and construction works during the closed seasons and during periods of low production.

CALICUT RESEARCH CENTRE

Research Projects handled

1.	Title of Project	:	Processing of marine and freshwater fishery resources into upgraded traditional products
	Principal Investigator	:	Shri K. George Joseph
	Location of project	:	Calicut
	Co-investigator	:	Kum. Bindu, J.
2.	Title of Project	:	Innovations in product development, preservation, processes and quality control of traditional fishery products
	Principal Investigator	:	Shri K. George Joseph
	Location of project	:	Calicut and Veraval
	Co-investigator at Centre	:	Kum. Bindu, J.
3.	Title of Project	:	Appropriate packaging for fish and fish products
	Principal Investigator	:	Dr. T.K. Srinivasa Gopal
	Location of project	:	Cochin and Calicut
	Co-investigator at Centre	:	Kum. Bindu, J.
4.	Title of Project	:	Development of suitable packaging materials for value added and ready-to-serve fish and fishery products
	Principal Investigator	:	Dr. T.K. Srinivasa Gopal
	Location of project	:	Cochin and Calicut
	Co-investigators at Centre	:	Shri K. George Joseph and Kum. Bindu, J.

Chief findings

- Very attractive and shelf-stable smoked and dried fillets were prepared from the freshwater fish, *Ophiocephalus striatus*, with shelf life of more than six months.
- As observed in the previous years, *Aspergillus glaucus* and *Rhizopus / Mucor* groups continued to lead the table of incidence of fungi in dried fish brought to Calicut Central Market from curing centres outside Kerala.
- Sampling during the year showed that the yield of mussel meat from shell-on mussels collected from harvesting grounds at Thikkodi and Pallikkandy (Calicut South Beach) was generally higher during September – November. The yield of raw meat in samples brought from Calicut during the same period was higher than the average while yield of cooked meat was less than the average. This property was found to be reversed in the case of samples from Thikkodi.

Report of work done

Storage studies on smoked and dried fillets from freshwater fishes

Trials on preparation of smoked and dried products from freshwater fish were continued using *Ophiocephalus striatus*. Skin-on and skinless fillets were prepared from freshly collected fish. The fillets from *Ophiocephalus* were cut into pieces and kept immersed in a bath containing 2% extract of turmeric in 10% brine for varying periods, drained, partially dried in the sun and then smoked using sawdust and coconut husk for two hours. The

smoked fillets were then dried in the sun for two days and packed in polythene bags for storage studies.

The storage studies have shown that fillets from *Ophiocephalus*, having been given 15 minutes' dip, retained the overall organoleptic characteristics for more than six months.

Studies on fungi in dry fish

Fortyfive samples of both dried as well as salted and dried fish of various species brought to Calicut Central Market from major curing centres outside Kerala State were analysed for their mycological quality and chemical characteristics.

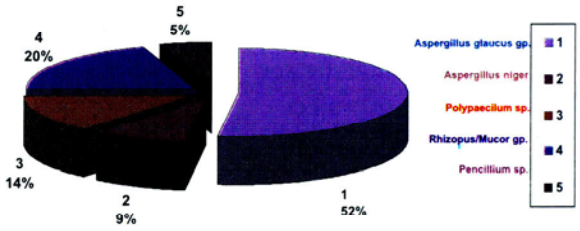
Chemical characteristics of the samples were as follows:

Characteristics	Average %	Range %
Moisture	37.81	14.23 – 52.00
Salt	19.70	5.00 – 27.49
Ash	22.54	13.00 – 35.28
Fat	10.28	0.12 – 25.00
Protein	33.52	21.00 – 55.20

Water activity (a_w) of the samples showed a range of 0.67 – 0.77. Two hundred and six fungal cultures were isolated from the samples, which were classified as follows:

Aspergillus spp.	-	51.46%
Aspergillus niger	-	09.22%
Polypaecilum sp.	-	13.59%
Rhizopus/Mucor group	-	20.39%
Penicillium spp.	-	05.34%

INCIDENCE OF FUNGI IN DRY FISH



Studies on seasonal variations in mussel meat

Studies on the effect of seasonal changes in quality and yield of mussel meat were initiated. Samples were collected on a fortnightly basis from Thikkodi and Pallikandy near Calicut and analysed for physical parameters like shell weight and raw meat weight. Proximate composition of the samples was also determined. The observations were as follows :

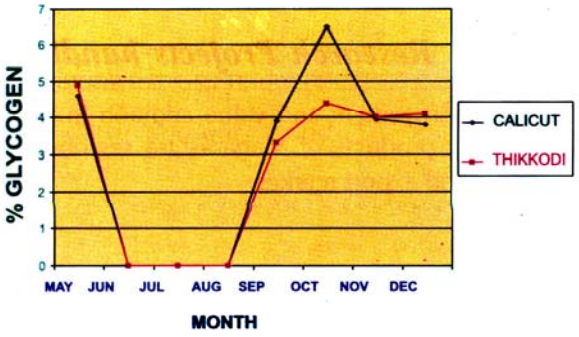
Thikkodi

Month	Moisture	Protein	Fat	Ash	Glycogen	Yield of meat%	
						Raw	Cooked
May	72.41	13.27	02.32	02.27	04.90	27	35
September	78.25	11.17	12.75	02.09	03.29	28	42
October	77.73	11.93	11.00	02.10	04.32	28	33
November	74.19	12.78	11.11	02.42	04.00	39	43
December	71.45	11.93	12.17	01.96	04.09	34	25

Pallikandy

Month	Moisture	Protein	Fat	Ash	Glycogen	Yield of meat%	
						Raw	Cooked
May	73.43	13.59	02.69	02.57	04.60	24	30
September	74.96	12.10	10.10	02.60	-	29	35
October	73.52	12.63	11.00	04.30	06.49	35	35
November	70.94	14.06	13.57	02.09	03.82	44	28
December	76.90	10.68	10.18	02.16	03.64	27	22

GLYCOGEN CONTENT IN MUSSEL MEAT - %



Sampling was not done during the months June – August due to nonavailability of mussels.

Studies on wet cured samples of local origin

Ten wet cured samples collected from the Central Fish Market were analysed for total bacterial count, halophilic bacteria and chemical parameters such as proximate composition, PV, TBN and FFA. The water activity of the samples was also determined.

The samples analysed were as follows:

Sole	-	1
Mackerel	-	2
Lactarius	-	*1*
Shark	-	2
Thrissocles	-	*1*
Silver belly	-	1
Sardine	-	1
Anchovies	-	1

The proximate composition was observed to be:

	Range %	Average %
Protein	25.00 – 37.00	30.70
Moisture	35.00 – 53.00	42.50
Fat	0.42 – 10.11	06.20
Ash	17.00 – 24.00	21.30

Water activity (a_w) of the samples ranged from 0.73 – 0.78.

Chemical parameters including total volatile nirogen, peroxide value and free fatty acid (as % of oleic acid) were also estimated.

Range

Total volatile nitrogen (mg%)	- 26 – 460
Peroxide value	- 62 – 270
Free fatty acid (% as oleic acid)	- 06 – 22

Microbiological analysis of the samples for the following factors was also done.

Total plate count	- 06.18×10^2 - 17.40×10^4
Total halophiles	- 27.05×10^2 - 32.43×10^4
Red halophiles	- 02.19×10^2 - 30.54×10^4

Studies on infestation of dried fishery products by mites

Stored samples of masmin, smoked freshwater fish, *Ophiocephalus striatus* and dried silver belly were analysed for the presence of mites. It was found that the commonly found fish mite, *Lardoglyphus konoi*, was present in the samples. Dry fish samples were also collected from fish curing sheds at Puthiyappa in Calicut.

MUMBAI RESEARCH CENTRE

Research Projects handled

1.	Title of project	:	Quality improvement and value addition in fish and fishery products of Maharashtra region for domestic and export market
	Principal Investigator	:	Shri D.K. Garg
	Location of project	:	Mumbai
	Co-investigator	:	Shri S.P. Damle
2.	Title of project	:	Development of improved methods for quality and safety of fish and fishery products
	Principal Investigator	:	Dr. M.K. Mukundan
	Location of project	:	Cochin and Mumbai
	Co-investigator at Centre	:	Shri D.K. Garg and Shri S.P. Damle
3.	Title of project	:	Development of value added, culinary, fortified and functional fish products, their processing and storage.
	Principal Investigator	:	Dr. Jose Joseph
	Location of project	:	Cochin and Mumbai
	Co-investigator at Centre	:	Shri D.K. Garg and Shri S.P. Damle

Chief finding

- External contamination, mainly of faecal origin, was found to be the main hazard associated with quality of fresh fish from landing centres.

Report of work done

Project on Quality improvement and value addition in fish and fishery products of Maharashtra region for domestic and export markets was completed and completion report submitted. The studies highlighted the urgent need for collection of detailed information on movement of marine and freshwater fish in domestic trade, quantity handled at different sources and availability of infrastructural facilities at different points.

Studies were carried out on the quality of fresh fish from landing centres. A total of 29 samples of fresh fish were collected from the landing centres. It was observed that external contamination, mainly of faecal origin, was the primary hazard associated with the quality. Poor and unhygienic handling on board the vessel as well as at the landing area was the main reason for contamination. In fresh fish samples, faecal *Streptococci* was observed in 25 samples and *E. coli* in seven numbers of samples. TVN value, an indicator of spoilage, was found to be high in two fresh fish samples. Nine samples of ice and eight samples of water were also collected from landing centres for analysis. Faecal *Streptococci* was found in five samples of water and seven samples of ice while *E. coli* was detected in two samples of water. Pathogens were absent in all the samples of fish, water and ice.

Studies on preparation of fermented products from 'Mandeli' (golden anchovy) were initiated and some of the low cost fish were screened for pickling and for preparing fermented products.

Fishing cruises

The following cruises were undertaken onboard the research vessel FORV *Sagar Sampada* during the year under report.

Cruise No. and period	***Participant(s)***	***Objective***
No.181 4-26 February 2000	Shri R.S. Manoharadoss Shri Prem Kumar Smt. Sally Simon Smt. Sherine Sonia Cubelio Smt. Latha Unnikrishnan Shri P.N. Sudhakaran	Harvest technology and catch composition of deep sea fishery resources in the Indian EEZ.
No.183 13 April – 1 May 2000	Dr. R. Raghu Prakash	Assessment of demersal resources of continental shelf region and study of DSL and toxic algal bloom
No.184	Shri U. Sreedhar Smt. Sally Simon Smt. Sherine Sonia Cubelio Smt. Latha Unnikrishnan Shri P.N. Sudhakaran	Square mesh panel studies and testing of RMP 6EL mega mesh midwater trawl developed at CIFT

Technologies assessed and transferred

- Designs of twelve different types of wooden fishing vessels in the size range of 7.6 m – 15.2 m
- Designs of steel fishing vessels of 15.5 m, 20 m and 24 m OAL
- Designs of aluminium craft for inshore waters and FRP pole and line fishing vessels for Lakshadweep
- Substitution of wooden boats by FRP canoes for use in backwaters and near-shore waters.
- Dual preservative treatment for low valued species of timbers for boat construction and formulation of indigenous preservatives for traditional fishing craft
- Painting schedules for aluminium magnesium alloy and FRP sheathing for underwater hulls of fishing vessels
- Development of toxic wood plastic composites (TWPC)
- Antifouling and anticorrosive paints for protection of fishing craft
- Mercury free anodes for cathodic protection of fishing craft
- Protective coating for cast iron propeller
- Specifications for different types of synthetic materials for fabrication of different types of fishing gear
- Designs of different types of fishing gear such as trawls for demersal, pelagic and semi-pelagic applications, gill nets, purse seines and traps for exploitation of the different fishery resources
- Otter boards of different sizes and designs to suit demersal trawl fishing operations and variable depth fishing
- V-form steel otter boards for demersal trawls
- Combination wire rope for deep sea fishing
- By-catch reduction devices 1) square mesh panel of 40, 50 and 60 mm mesh size and 2) fish eye for reduction of by-catch especially juveniles and young ones in shrimp trawls
- Turtle excluder device (TED) for conservation of marine turtles
- Designs of dryers such as tunnel dryer, rotary fish meal dryer and electrical fish dryer for cottage scale operation

- Designs of deep fat fryer, cutlet moulding machine, inboard/outboard drive, electro thermal smoke kiln, mechanised processing table and mechanical fish cleaner for spratts
- Fuel efficient propeller for fishing vessels
- Other fuel saving devices such as propeller nozzle
- Biogas plant from water hyacinth
- Fishing accessories including trawl winch, power-take-off clutch and gurdy
- Refrigerated sea water plant of 150 kg capacity
- Design of shark liver oil/fish oil plant to handle 1000 kg raw material per day
- Specific requirements in setting up fish processing plants
- Electronic instruments such as portable warp load meter for trawlers, ship installed warp load meter, electronic speed and distance log, trawl depth meter, fishing log, ocean current meter, salinity, temperature and depth meter, underwater lux meter, *in situ* turbidity meter, ship borne data acquisition system, freezer temperature meter, solar processing monitor, water current meter, soil thermometer, automatic sedimentation analyser, remote sediment monitor, aquaculture system monitor, solar radiation monitor and integrator, thermo hygrometer, animo meter with energy intergrator, environmental data acquisition system, hydrometeorological data acquisition system, wireless data telemetry system and net height meter
- Improved methods for freezing, freeze drying, canning, drying and curing different types of fish and shellfish
- Hygienic drying of anchoviella on raised platform
- Cleaning schedules for fish processing establishments and boat decks and preparation of deodorant and antiseptic ointment
- Method for economic utilization of low grade fish and conversion of fish wastes into useful by-products
- Methods for production of value added products such as wafers, pickles and soup powder from fish/shellfish
- Ready-to-use isinglass from fish maws
- Chlorine level indicator paper for instant reading of chlorine level in water used in fish processing plants
- Specifications for various types of seafood, process water and ice
- Procedure for implementation of HACCP
- Methods for extraction of chitin/chitosan from prawn shell waste and their application in textile and poultry industry and in the medical field
- Pilot plant for production of chitosan
- Method for extraction of shark fin rays and processing shark cartilage
- An 18 h depuration method to eradicate pathogenic bacteria and grit from bivalves, especially clams and mussles
- Collagen chitosan film from fish skin, bone and air bladder for treatment of burns and as a barrier material in guided tissue regeneration (GTR) in dentistry
- Fine grade absorbable surgical sutures from fish gut
- Bacteriological culture media for 1) direct detection and enumeration of the potent spoiler bacterium *Alteromonas putrefaciens* and 2) estimation of total plate count of cured/semi preserved/salted fishery products by preventing swarming of *Bacillus* sp.
- Method for isolation of squalene from shark liver oil for use in cosmetics
- Method for preparation of n-3 polyunsaturated fatty acid concentrates from fish oils
- High gel strength agar from sea weeds
- Device for drawing uniform samples from frozen fish blocks for microbiological evaluation
- Improved packaging materials for transportation and storage of fish

Training Programmes Conducted

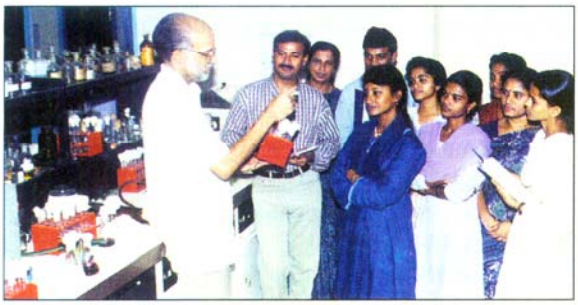
Subject	No. of participants	Venue and date
Laboratory techniques for identification of bacteria in fish and fishery products and methods for control of spoilage bacteria	1	Cochin 10 January – 5 February 2000
General bacteriology	7	Visakhapatnam 14-29 January 2000
Fishing technology	5	Cochin 17-29 January 2000
General bacteriology	2	Visakhapatnam 14 February – 14 April 2000
Fish processing and quality control	10 sponsored by South Indian Federation of Fishermen Societies (SIFFS), Thiruvananthapuram	Cochin 14-22 February 2000
General bacteriology	3	Visakhapatnam 28 February – 12 March 2000
Isolation and identification of bacterial pathogens in fish (*Salmonella, Vibrio, Aeromonas, Listeria* and *Clostridium*)	1	Cochin 29 February – 4 March 2000
Preparation of dried and speciality products from fish	1	Calicut 3-10 March 2000
Preparation of value added fish products	25 women trainees sponsored by Lakshadweep Social Welfare Board and Centre for Management Development, Thiruvananthapuram	Minicoy Island 3-11 March 2000
Laboratory techniques for identification of bacteria in fish and fishery products	9	Cochin 20 March – 1 April 2000
Preparation of pickle, ready-to-fry / cook convenient products and hygienic curing and drying of fish	30 fisherwomen	Visakhapatnam 28-31 March 2000
Analysis of chitin and chitosan	1	Cochin 3-7 April 2000

Improved methods of fish handling, curing and drying	36 fisherwomen sponsored by PREPARE, Srikakulam, A.P.	Srikakulam (A.P.) 17-18 April 2000
Preparation of ready-to-fry/cook convenient fish products	1	Visakhapatnam 4-22 May 2000
Quality control	1	Visakhapatnam 4-22 May 2000
Preparation of isinglass from fish maws	2	Cochin 8-10 May 2000
General bacteriology	4	Visakhapatnam 8-22 May 2000
Naval architecture	4	Cochin 8 May – 23 June 2000
Use of HPLC for amino acid analysis	2	Cochin 17-31 May 2000
Laboratory techniques for microbiological examination of seafoods	1	Cochin 22 May – 22 June 2000
Value added products from low cost fish	10 women sponsored by Matsyafed & Dept. of Fisheries, Kerala	Cochin 29 May – 3 June 2000
HACCP concepts	17	Cochin 19 – 24 June 2000
Fish processing and preparation of fishery products	30 women candidates sponsored by Fisheries College, Panangad	Cochin 20 June, 2000
Creation of awareness in fish finding and navigational equipment	40 boat operators/owners – under auspices of Trawl Net Boat Owners' Organisation	Munambam 26 June 2000
Preparation of dried and speciality products from fish	2	Calicut 26 – 30 June 2000
Fish processing technology	3	Anakapalli (A.P.) 4-6 July 2000
Fish drying	2	Visakhapatnam 11-14 July 2000
General bacteriology	4	Visakhapatnam 24 July – 6 August 2000
Quality control and bacteriology	1	Cochin 27 July – 9 August 2000

Laboratory techniques for identification of bacteria in fish and fishery products	9	Cochin 31 July – 11 August 2000
Hygienic drying and preparation of ready-to-use fish products, fish/prawn pickle	30 fisherwomen	Nizampatnam 2 – 6 August 2000
Preparation of dried and speciality products from fish	3	Calicut 7-11 August 2000
Water analysis	1	Cochin 7-19 August 2000
Fish processing	100 women sponsored by Kollam Social Service Society – in five batches	Kollam 16-28 August 2000
Testing procedure	1	Visakhapatnam 17-21 August 2000
Preparation of diverse products from fish and shellfish	3	Calicut August 2000
HACCP concepts	5	Cochin 23-29 August 2000
Modern techniques in microbial analysis	5	Cochin 30 August – 2 September 2000
Fabrication of square mesh trawl cod ends	25 fishermen, boat owners and net makers	Veraval 29 September 2000
HACCP concepts	2	Cochin 14-19 September 2000
Seafood quality assurance	13	Cochin 18-30 September 2000
Preparation of dried and speciality products from fish	1	Calicut 20-22 September 2000
Harvest and post-harvest technologies developed at CIFT (demonstration)	25 including conveners of self-help groups and entrepreneurs – candidates sponsored by DRDA, Kanyakumari	Kanyakumari 12 October 2000
Bacteriological assessment of quality and fishery products, ice, water, salt etc.	2	Veraval 2000
General microbiology	12	Visakhapatnam 6-20 November 2000

Scientific methods of salting, drying, reprocessing of commercial dry fish and packaging of dried fish	34 women sponsored by Dy.Director of Fisheries, Malappuram	Ponnani 4 – 15 November 2000
Fish processing technology	3	Cochin 13-25 November 2000
Analysis of water	1	Cochin 15 November – 1 December 2000
Preparation of mussel pickle and pre-processing of commercial dry fish	15 women from self-help groups at Chombala, Vatakara	Calicut 18 November 2000
Fish processing	25 women sponsored by SHGS of Chellanam and Dept. of Fisheries, Ernakulam	Chellanam 27-29 November 2000
Seafood quality assurance	21 MFSc students of Barkatullah University, Bhopal	Cochin 27 November – 12 December 2000
Maintenance and repair of outboard motors	16 fishermen candidates sponsored by Petroleum Conservation Research Association, Cochin	Cochin 28-30 November 2000
Scientific methods of salting, drying, re-processing of commercial dry fish and packaging of dried fish	32 women sponsored by Dy. Director of Fisheries, Kasaragod	Kasaragod 4-6 December 2000
Laboratory techniques for identification of bacteria in fish and fishery products	1	Cochin 7-21 December 2000
Fishery technology and extension	18	Cochin 11-15 December 2000
Seafood quality assurance	1	Cochin 16-22 December 2000
Scientific methods of salting, drying and re-processing of commercial dry fish and packaging of dried fish	37 women sponsored by Dy. Director of Fisheries,Kannur	Kannur 21-23 December 2000
Scientific methods of salting and drying of fish	1	Calicut 28-30 December 2000

Training programmes conducted by CIFT



Laboratory techniques for identification of bacteria in fish and fishery products

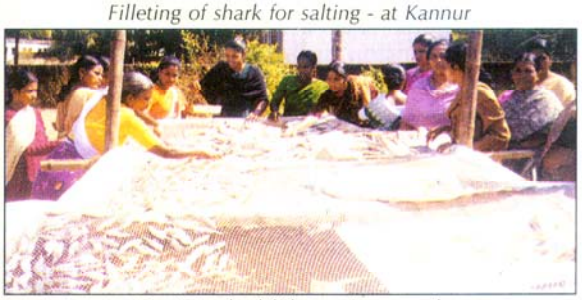
Pesticide residue analysis

Seafood quality assurance

Fishing technology

Value added products from low cost fish

Filleting of shark for salting - at Kannur



Drying salted fish - at Kasaragod

Repair and maintenance of out board motor

Inauguration of training on square mesh cod end fabrication - at Veraval

Analysis of products / materials

Testing of samples of products and raw materials were continued at the Institute, both at its Headquarters and Research Centres. A total of 2390 such products were tested druing the year as shown below:

Headquarters

Nature of sample / particulars of analysis	No. tested
Water and ice	1329
Fish products	816
Packaging materials	103
Calibration of thermometers	71
Miscellaneous	71

The Research Centres also analysed a number of products.

Reply to queries

Technical queries on fishing, fish processing, fisheries extension and related aspects received from various parts of the country were replied during the period. About 386 such queries were replied during the year. The topics covered were process details for production of value added fish products, trainings to be conducted, adhoc training proposals, HACCP, Seafood quality assurance etc.

Supply of designs and publications

One hundred and twenty eight copies of designs of dryers and traps, and various publications brought out by the Institute were supplied to different individuals and agencies.

Exhibitions

The Institute participated in the following exhibitions during the year under report.

- Millennium Expo – National Exhibition organised by St. Thomas College, Palai as part of Golden Jubilee celebrations of the College, 1 – 10 January, 2000
- Exhibition in connection with 5th Annual Indian Fisheries Forum at Central Institute of Freshwater Aquaculture, Bhubaneswar, 17-20 January 2000
- Krishi Expo 2000 at Pragati Maidan, New Delhi, 25 January – 4 February 2000
- Exhibition at MES Central School, Thazhepalam, Tirur, Malappuram Dist., 27-29 January 2000
- MATSYA 2000 organized by MES Ponnani College, 18-22 February 2000
- India International Trade Fair (IITF) 2000 at Pragati Maidan, New Delhi, 14-27 November, 2000
- Exhibition in connection with National Seminar on Sustainable fisheries for nutritional security sponsored by National Academy of Agricultural Sciences and M.K. University at Chennai, 29 November – 2 December, 2000
- Jathara Crafts Mela organized by State Govt. of Andhra Pradesh at Madhurawada Village as part of New Millennium Visakha Utsava 2000, 24-27 December 2000

Exhibits were also sent to ICAR for display at Food and Agriculture Expo at Budapest, Hungary in August 2000

Dr. R. S. Paroda, Director General, ICAR in the CIFT stall at Krishi Expo 2000 at Pragati Maidan, New Delhi

Radio talks / T.V. broadcasts

The following radio talks / T.V. broadcasts were organised during the year :

- Preparation of pickles from prawn / fish meat (in telugu) - Dr. Khasim Saheb
- Conservation measures in fish harvest (in telugu) - Dr. G. Rajeswari
- Interview with Dr. K. Devadasan, Director, CIFT (over Asianet)

National Award

- Dr. Krishna Srinath, Head, Extension, Information and Statistics Division received the National Award for Women's development through application of science and technology for the year 2000. The award instituted by the Science and Society Division, Dept. of Science and Technology, Govt. of India was presented by Dr. Murli Manohar Joshi, Union Minister of Science and Technology, Human Resource Development and Ocean Development.

- Dr. Leela Edwin Scientist (Sr. scale) was awarded the Jawaharlal Nehru Award for Post Graduate Agricultural Research - 2000 instituted by ICAR. Her thesis was titled 'Studies on the Ring Seine fishery of South Kerala coast'. She carried out her work under the guidance of Dr. C. Hridayanathan, Director, School of Industrial Fisheries, Cochin University of Science & Technology.

- Shri G.R. Unnithan, Sr. Scientist was awarded Ph.D. by the University of Calicut under the Faculty of Science (Statistics) for his thesis titled 'Stochastic models in fishery economics with special reference to Kerala'. He carried out his studies under the guidance of Prof. K. Kumaran Kutty, Prof. of Statistics (Retd.), University of Calicut.

- Shri Braj Mohan, Scientist (Sr. Scale) was awarded Ph.D. by Dr. Bhimrao Ambedkar University, Agra for his thesis titled 'Study of extent of adoption of post harvest technology in fisheries in Kerala State'. He carried out his work under Dr. D.P. Singh, Head, Department of Agricultural Extension, R.B.S. College, Bichpuri, Agra.

- Shri M.V. Baiju, Naval Architect, obtained M.Tech. degree in Computer aided structural analysis and design from the Dept. of Ship Technology, Cochin University of Science and Technology.

M.F.Sc. programme on post harvest technology

Officer-in-charge, PGP : Dr. Jose Joseph
Scientist associated : Shri T.V. Sankar
Administrative staff associated : Shri R.D. Goswami

The first batch of M.F.Sc. completed the course on 31 August 2000. A farewell meeting was organised in this connection at the Institute on 2 September 2000 at which Dr. S. Ayyappan, Director, CIFE, Mumbai highlighted the importance of specialized courses for the development of the fisheries industry. The meeting was presided over by Dr. T.S.G. Iyer, Jt. Director of the Institute. Others who spoke on the occasion were Shri V. Venkatesan, Director, MPEDA, Dr. C. Hridayanathan, Director, School of Industrial Fisheries, CUSAT, Dr. D.M. Thampi, Dean, Fisheries College, Panangad and Dr. Jose Joseph, Officer-in-charge, Post Graduate Programme, CIFT.

Shri B.K. Joseph, a M.F.Sc. student of 1998-2000 batch was adjudged as best student of the period and was awarded a gold meal and citation. He was also the recipient of the gold medal for securing the highest OGPA in M.F.Sc.

The five 1999-2001 batch students took up their disseration work under the various divisions of the Institute. The topics included :

- Lipase activity in different tissues of lean and fatty fishes
- Studies on the effect of various disinfectants on the bacteria associated with fish and fish products

The first batch of M.F.Sc. students with Dr. S. Ayyappan, Director, CIFE, Mumbai, CIFT staff and other officials.

- Studies on the effect of vacuum packaging on the shelf life of chilled fish
- Application of chitosan as an additive in glaze in the frozen storage of fish
- Incidence of indicator and pathogenic organisms in seafoods for export and sources of contamination
- Correlation between volatile bases and indole during storage

Ad-hoc/sponsored/collaborative programmes

The following are the Ad-hoc/Sponsored/Collaborative projects/programmes undertaken at the Institute during the year :

- Design, construction, performance monitoring and popularisation of a new series of deep sea fishing vessels – *ICAR ad-hoc project*
- Harvest technologies – Assessment of marine living resources research on board FORV *Sagar Sampada* – *DOD sponsored project*
- Processing and test marketing of fish curry in retortable pouches – *MPEDA sponsored project*
- Value added marine products – *MPEDA sponsored programme*
- Value added products from low cost fish and their quality improvement – *Ministry of Food Processing Industries sponsored project*
- Selectivity of trawl nets with respect to commercially important species of fin fish and shell fish caught off Cochin, South west coast of India – *ICAR ad-hoc project*
- Occurrence of *Vibrio vulnificus* in tropical marine fish and development of methods for their eradication – *ICAR ad-hoc project*
- Occurrence, effect of processing and survival of halophilic pathogenic vibrios in fishery products of the export trade – *ICAR ad-hoc project*
- Selective bio-accumulation of toxicants in cephaopods (viz. squid and cuttle fish) and changes in quality, its upgradation and safety of processed products – *ICAR ad-hoc project*
- Development of technology for processing fish and fish products in aluminium cans and flexible pouches – ICAR ad-hoc project
- Pilot plant studies on absorbable surgical sutures from fish gut collagens – ICAR ad-hoc project
- Studies on incidence of toxic principles and parasites in seafoods – ICAR ad-hoc project

(Details of these projects are given in the reports of the respective Divisions)

Technical guidance / consultancy

The Institute offered technical guidance and consultancy to entrepreneurs on various topics related to harvest and post harvest technology of fish and associated aspects.

Consultancies and guidance were offered on :-

Software for seafood HACCP

Production of chitin/ chitosan

Production of isinglass from fish maws

Improved design of 15.5 m fuel efficient steel fishing vessel Sagarkripa

Production and distribution of processed fish and fish products

MPEDA consultancy - data being collected from landing centre, Therespuram, Tuticorin

Consultancies / guidance offered	Beneficiary
Fabrication and supply of elephant draft power monitor	College of Veterinary and Animal Sciences, Kerala Agrl. University, Mannuthy, Thrissur
Evaluation of extension training programmes	Marine Products Export Development Authority, Cochin
Improved design of 15.5 m OAL fuel efficient fishing vessel *'Sagarkripa'*	Munambam Fishing Boat Operators Co-operative Society Ltd., Munambam
Software for seafood HACCP	Pinnacle Innovative Technologies P. Ltd., Cochin
Production of polyunsaturatd fatty acid (PUFA) from fish oil – effective in preventing heart disease	Strides Arcolab, Mangalore
Preparation of isinglass from fish maws	Brewers Nest, Chennai
Production of chitin / chitosan from prawn shell waste	Gadre Marine Exports, Mirkawada, Ratnagiri, Maharashtra
Production and distribution of processed fish and fish products	Jnanodayam Sabha, Edacochin Cochin
Standardisation of retort pouch package for crab soup and whelk meat using indigenous retortable pouches	Harbour Fresh Foods (P) Ltd., Ezhupunna, Alleppey
Establishment of a unit for manufacture of consumer packs of dried fish under the brand name 'C-Boat'	'Seamum Fisheries' Puthiyappa
Standardisation of heat penetration parameters for raw shrimp	Abad Exim (P) Ltd., Kakkanad
Standardisation of heat parameters for four grades of blanched shrimp meant for export	Integrated Rubian Exports Ltd., Cochin, and Baraka Seafoods, Cochin
Processing tuna in oil in retortable pouches and casings for tuna sausage	Lakshadweep Devt. Corpn. Ltd.,
Processing mushroom in brine and curry medium	National Research Centre for Mushroom, Solan
Production of coconut milk, coconut curry masala, pinacolada in retortable pouches	FRESHCO Industries, Irinjalakuda
Measurement of water level and water current and estimation of total annual discharge of water at proposed water sources, Kanakkankadavu, Purapallikavu, Pathalam and Manjummal	GCDA, Cochin
Testing and performance evaluation of Integrated Fish Finder and Navigational Guidance System developed by BEL, Bangalore	Bharat Electronics Ltd., Bangalore.

The Scientists and technical officers of the Institute were also called upon on several occasions to deliver guest lectures at Universities, educational institutions and training institutes.

MANAGEMENT COMMITTEE

Chairman

Director, CIFT, Cochin

Members

1. Director of Fisheries,
   Govt.of Kerala,
   Vikas Bhavan, IV th Floor,
   Thiruvananthapuram-695 003.

2. Director Fisheries,
   Govt. of Karnataka,
   Mahaveer Complex, K.G. Road,
   Bangalore-9, Karnataka

3. The Dean,
   Faculty of Fisheries,
   Kerala Agricultural University,
   College of Fisheries, Panangad P.O.,
   Cochin-682506.

4. Dr. A.D. Diwan,
   Asst. Director General (MFy), ICAR,
   Krishi Bhavan, New Delhi.

5. Shri Ran Vijay Bahadur Singh,
   Advocate, Civil Court,
   Distt. Remur,
   Bhabhua, Bihar.

6. Shri Sunil Kumar Choudhry,
   Narayani Bhavan,
   Anugrah Narayan Road,
   Murarpur, (Gaya), Pin-893 001.

7. Sr. Finance and Accounts Officer,
   Central Marine Fisheries Research Institute,
   Cochin-682 014.

8. Dr. P.K. Surendran,
   Head, Division of Microbiology,
   Fermentation and Biotechnology,
   CIFT, Cochin.

9. Dr. Imam Khasim Saheb,
   Sr. Scientist, Visakhapatnam Research
   Centre of CIFT,
   Visakhapatnam-530 003, Andhra Pradesh.

10. Shri M. Nasar,
    Sr. Scientist, CIFT, Cochin.

Member Secretary

Sr. Administrative Officer,
CIFT, Cochin.

The Management Committee met on 17-3-2000 and 8-12-2000.

Management committee meeting in progress

INSTITUTE JOINT STAFF COUNCIL

Chairman

Dr. K. Devadasan, Director, CIFT, Cochin

Members (Official side)

1. Dr. M.K. Mukundan,
   Head, Division of Quality
   Assurance and Management

2. Dr. B. Meenakumari,
   Head, Division of Fishing Technology

3. Shri A.G. Radhakrishnan,
   Sr. Scientist

4. Sr. Administrative officer

5. Shri P.A. Uthup,
   Asst. Finance & Accounts Officer

Secretary (Official side)

Shri T.S. Unnikrishnan Nair,
Principal Scientist

Members (Staff side)

1. Shri V.V. Ramakrishna,
   Technical Officer (T-5)
2. Shri T. Gopalakrishnan, T-II-3
3. Shri T.M. Ramaraj, Assistant
4. Shri V.S. Ambasuthan, Sr. Clerk
5. Shri P.A. Thomas, SSG IV
6. Smt. C.G. Radhamoney, SSG II

Secretary (Staff side)

Shri M.K. Kuttikrishnan Nair,
Technical Officer (T-5)
The IJSC met on the following days.

43rd meeting on 4-5-2000
44th meeting on 28-8-2000
45th meeting on 14-2-2001

44th IJSC at Mumbai

GRIEVANCE CELL

The Grievance Cell, re-constituted in March 1998, continued to function with the following members during the year under report.

Chairman

Director, CIFT

Members

1. Dr. P.K. Surendran, Head, Division of Microbiology, Fermentation and Biotechnology
2. Sr. Administrative Officer
3. Asst. Finance & Accounts Officer
4. Shri G. Ratnakaran Nair, T-4 (Technical)
5. Shri C. Ravindran Nair, Assistant (Administrative)
6. Shri T.A. Gopalakrishnan, Bearer (Auxiliary)
7. Shri P.A. Thomas, SSG IV (Supporting)

Nominated Member Secretary

Shri R.S. Shanmughan, Asst. Admn. Officer

PROJECT ADVISORY COMMITTEE

The Project Advisory Committee with the following as members met four times during the period and reviewed the progress of the work under the various research projects.

Chairman

Dr. T.S.G. Iyer,
Head, Division of Fish Processing

Members

1. Dr. P.G. Viswanathan Nair,
   Head-in-Charge, Division of Biochemistry & Nutrition
2. Dr. P.K. Surendran,
   Head, Division of Microbiology, Fermentation & Biotechnology
3. Shri P.K. Chakraborthy,
   Scientist-in-Charge, Division of Engineering
4. Dr. B. Meenakumari,
   Head, Division of Fishing Technology

5. Dr. M.K. Mukundan,
Head, Division of Quality Assurance and Management

Member Secretary

Dr. Krishna Srinath,
Head, Division of Extension, Information & Statistics

RESEARCH ADVISORY COMMITTEE

The Research Advisory Committee of CIFT, constituted in May 1998 for a period of three years, functioned with the following as members.

Dr. (Mrs.) Rugmini Sankaran,
89-B, Gokulam, 2nd Stage,
Near J.K. Nursing Home,
12th Cross, V.N. Mohulla,
Mysore-570 002.

Members

1. Dr. N.C. Ganguli,
Secretary,
National Academy of Agricultural Sciences,
New Delhi
2. Dr. K.R. Prasad,
President,
Confederation of Indian Aquaculture Industry Welfare Organisation,
Visakhapatnam.
3. Prof. P.S. Rao,
7 Steps, Block No.279, J.P.N. Nagar,
Miyapur,
Hyderabad-500 050.
4. Shri M. Swaminathan,
20/583, Varshi, Dilkush Lane,
Thrissur-680 004.
5. Shri K.M. Iyer,
Retd. Principal Scientist, CIFT
Sreekrishna, 13th Cross Road, Girinagar,
Cochin-20.
6. Dr. R.A. Selvakumar,
Asst. Director General (M.Fy),
ICAR Representative
7. Dr. K. Ravindran, then Director, CIFT

Member Secretary

Dr. K. Devadasan, then Head,
Division of Biochemistry and Nutrition, CIFT

Dr. P.K. Surendran,
Head, Division of Microbiology,
Fermentation and Biotechnology
was nominated as Member Secretary, RAC from 19 December 2000.

All heads of scientific Divisions were also invited to attend the meeting.

The committee met once on 18 March 2000

The Research Advisory Committee in session

Fifth Quinquennial Review Team

The fifth QRT comprising of the following members visited the headquarters and research centres of CIFT.

Chairman

Dr. P.V. Dehadrai
Ex-DDG (Fy.)
ICAR HQ, New Delhi
D-III/3403, Vasanth Kunj
NEW DELHI-110 070

Members

1. Prof. Y. Sreekrishna
(Ex. Acting Director,
CIFE) (Fishing Technology)
Sri Laxmi Nilayam, D.No.16/225-7-3,
Gudivida-521 301
Krishna Dist., Andhra Pradesh

2. Dr. P.U. Varghese
Ex- Director, MPEDA
37/1306 Pullkotil House,
Kumaranasan Road
Kochi-682 020

3. Dr. Rugmini Sankaran
Ex- Director, DFRL,
89-B, Gukulam 2nd Stage,
Near J.K. Nursing Home
12th Cross, V.V. Mohalla,
Mysore-570 002

4. Dr. S.L. Shanbhogue
Director of Instruction,
College of Fisheries
Mangalore (Karnataka)

Member Secretary

Dr. G.R. Unnithan
Sr. Scientist
CIFT

at CIFT Cochin

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The QRT

↓

at Visakhapatnam Centre

The fifth Quinquennial Review Team visited the CIFT headquarters and research centres and critically evaluated the achievements for the period 1993-1999. The QRT had its first sitting at CIFT headquarters on 19 & 20 July, 2000. The activities of various Divisions were presented by the respective Head of Divisions and Scientists. After detailed discussions, the team visited the various laboratories to have a first hand information about the modern facilities provided at the laboratories. The QRT visited the Calicut Research Centre on 21 July, Mumbai and Veraval Centres on 24 - 25 August and Visakhapatnam Centre on 31 October and 1 November, 2000 to evaluate the activities of the centres.

The Women's Cell was reconstituted with the following members.

1. Smt. R. Thankamma, Scientist (S.G.), Liaison Officer
2. Smt. T.T. Annamma, T-6(T.O.), Member
3. Smt. K.R. Gita Rani, Assistant, Member
4. Smt. C.G. Radhamony, SSG II, Member

During the reported period, the Committee organised the following programmes under the auspices of the Women's Cell.

1. A meeting of all the women employees of the institute on 19-10-2000 to discuss issues related to them.
2. Talks by eminent personalities :
   - Prof.K.N.Chandrasekhara Pillai, School of Legal Studies, Cochin University of Science and Technology, on 'Human rights – New dimensions' on 25-11-2000.
   - Smt. Leela Menon, renowned journalist, on 'Issues pertaining to women' on 15-12-2000.

Smt Leela Menon emphasises a point

Representation in Committees

The following officials represented the Institute in various committees, board panels etc. in various capacities.

Dr. K.Devadasan, Director (from 29/5/2000)

As Chairman

- Organising Committee, National Seminar on Riverine and Reservoir Fisheries – Challenges and Startegies, jointly organised by SOFT(I) and CIFT

As Expert Member

- ASRB Boards

As Member

- Academic Council of CIFE, Mumbai (from 29/5/2000)
- Senate of Cochin University of Science and Technology (from 29/5/2000)

Dr. K. Ravindran, Director (upto 28.5.2000)

As Chairman

- Task Force on Fisheries and Aquaculture, constituted by the State Planning Board, Govt. of Kerala to study and suggest legislative measures for introduction of aquarian reforms.

As Member

- Academic Council of CIFE, Mumbai (upto 28/5/2000)
- Board of Management,CIFE, Mumbai
- State Committee on Science and Technology
- Board of Studies in marine biology
- Senate of Cochin University of Science and Technology(upto 28/5/2000)

Dr. T.S.G. Iyer, Head, Fish Processing Division

(upto 30/11/2000)

As Principal Member

- Supervisory Audit Team for monitoring performance of Inter Departmental Panel and approval of fish processing establishments for export to European Union

As Member

- Core committee for value added products - constituted by MPEDA
- Subsidy committee for captive peeling sheds (MPEDA)
- Interest subsidy committee (MPEDA)
- FAD 12 - Standards committee for fish and fishery products of Bureau of Indian Standards
- FAD 45 - Standards committee on food hygiene of Bureau of Indian Standards
- State Committee for Institute Village Linkage Programme (IVLP) under NATP
- Subject matter committee - PG curricula, CIFE, Mumbai

Dr. M.K.Mukundan, Head, Quality Assurance and Management Division

As Principal Member

- Supervisory Audit Team constituted by Govt. of India for monitoring performance of Inter Departmental Panel and approval of fish processing establishments for export to European Union.
- BIS sectional committee on quality criteria for seafoods

As Member

- Subsidy committee of MPEDA

Dr. P.K.Surendran, Head, Microbiology, Fermentation and Biotechnology Division

As Member

- Supervisory Audit Team constituted by Govt. of India for monitoring performance of Inter Departmental Panel and approval of fish processing establishments for export to European Union.

Dr. Krishna Srinath, Head, Extension, Information and Statistics Division

As Member

- High level committee on extension and training constituted by MPEDA

- Core group on value added marine products - committee constituted by MPEDA

Shri. P.K. Chakraborty, Principal Scientist, Engineering Division (upto 30/9/2000)

As Member

- Subsidy committee of MPEDA, Cochin on flake ice plant

Shri. K.K. Solanki, Scientist-in-charge, Veraval Research Centre

As Chairman

- Nagar Rajya Bhasha Karyavayan Samithi, Veraval
- Hindi teaching scheme at Veraval

As Member

- DPC, NRCG, Junagadh
- Management committee, NRCG, Junagadh
- Inter Departmental Panel of experts for approval of seafood processing factories/fishing boats/landing centres for European Union.
- Faculty of fisheries, GAU, Gujarat

Shri. P.R.G. Varma,Senior Scientist,QAM Division

As Member

- Inter Departmental Panel for assessment of seafood plants for EU approval for Kerala, Tamil Nadu and Karnataka regions

As Alternate Member

- Committee constituted by MPEDA for scrutinising applications for releasing subsidy to pre-processing plants
- BIS Sectional Committee on quality criteria for seafoods

Dr. P.T.Lakshmanan, Senior Scientist, QAM Division

As Member

- Inter Departmental Panel for assessment of seafood plants for EU approval for Kerala, Tamil Nadu and Karnataka regions
- Committee for aquaculture inputs, MPEDA

As Subject Expert

- Assessment board for approval of technologists at Export Inspection Agency, Cochin

Dr.T.K.Srinivasa Gopal, Senior Scientist,FP Division

As Member

- Committee constituted by CIFT and MPEDA to identify value added fish products for export, select companies for production, transfer of technology, training of personnel etc.
- Collaborative project of MPEDA, CIFT and IFP on upgradation of seafood packaging

Dr. Imam Khasim Saheb,Senior Scientist, Visakhapatnam Research Centre

As Alternate Member

- Inter Departmental Panel for approval of fish processing plants and factory vessels for export to European Union

Shri Sibsankar Gupta, Scientist-in-charge, Visakhapatnam Research Centre

As Member

- Inter Departmental Panel for approval of fish processing plants and factory vessels for export to European Union

Shri P.N. Joshi, Senior Scientist, Engineering Division

As Technical Expert Member

- Subsidy committee constituted by MPEDA for technical scrutiny of grant-in-aid applications for (1) machinery and equipment for production of value added marine products, (2) chilled fish storage in fish processing plants, (3) upgradation of cold storages, (4) chilled fish storage at international airports, (5) effluent treatment plant and (6) water purification system

Shri V. Narayanan Nambiar, Senior Scientist, MFB Division

As Member

- Inter Departmental Panel of the Export Inspection Council of India for assessing fish

processing establishments for approval for export of fishery products to European Union

Dr. Sanjeev S., Senior Scientist, QAM Division

As Member

- Inter Departmental Panel for assessment of seafood processing plants for EU approval for Kerala, Tamil Nadu and Karnataka regions

Shri R.S. Manoharadoss, Senior Scientist, FT Division

As Member

- Expert committee and team for operation of TED in the Orissa coast

Dr. S. Balasubramaniam, Senior Scientist, EIS Division

As Member

- High level committee on extension and training constituted by MPEDA

Shri S.P. Damle, Senior Scientist, Mumbai Research Centre

As Member

- Inter Departmental Panel for assessing fish processing establishments for export of fishery products to European Union

Shri A.C. Joseph, Senior Scientist, FP Division

As Member

- Core group on value added marine products - committee constituted by MPEDA

As Alternate Member

- FAD 45 - Food hygiene sectional committee - Bureau of Indian Standards
- FAD 58 - Food analysis and nutrition sectional committee- Bureau of Indian Standards

Shri D.K. Garg, Scientist-in-charge, Mumbai Research Centre

As Member

- Consultative committee for Mumbai base of Offshore Fishery Survey of India

Dr. C.N. Ravishankar, Scientist, FP Division

As Alternate Member

- Inter Departmental Panel of the Export Inspection Council of India for approval of fish processing establishments for export to European Union

As Member

- Collaborative project of MPEDA, CIFT and IFP on upgradation of seafood packaging

Shri V. Vijayan, Senior Scientist, FT Division

As Member

- Procurement Committee for purchase of Fishery and Oceanographic research vessel for ICAR marine fishery research Institutes, CIFT, CMFRI and CIFE
- Aquarian refroms committtee, Govt. of Kerala

As Director's representative

- Expert group entrusted with task of formulation of national marine fisheries policy

Shri M. Nasar, Senior Scientist

As Member

- Committee constituted by ICAR to promote cage culture of fishes in the country
- Expert Committee to draw up a Fisheries Master Plan for Kerala

Shri M.R. Boopendranath, Senior Scientist

As Member

- Committee of experts under the MPEDA scheme for extending financial assistance for installation of fish finder, GPS, radio telephone and fish hold

Participation in Symposia / Seminars / Workshops / Conferences

Participant(s)	Name of Seminar / Symposia / Workshop etc. and organiser	Venue and date
Within the country		
Dr. Krishna Srinath (as moderator)	Inter – University Women's Seminar (Sacred Hearts' College, Thevara)	Cochin 4 January 2000
Dr. P.T. Mathew	Workshop on Recent trend in aquaculture, harvest and post harvest technology and eco-system management (NSS College, Changanacherry)	Changanacherry 6 & 7 January 2000
Shri M.V. Baiju	SIFFS (South Indian Federation of Fishermen Societies) R&D Round Table 2000	Thiruvananthapuram 8 February 2000
Dr. A.R.S. Menon	Science Writers Workshop (Swadeshi Science Movement)	Thiruvananthapuram 10-13 February 2000
Shri P.N. Joshi	18th International Cryogenic Conference (Indian Institute of Technology)	Mumbai 21-25 February 2000
Dr. G.R. Unnithan Shri V. Radhakrishnan Nair	National Seminar on Probability models and applied statistics' Dept. of Statistics, Calicut University)	Calicut 24 & 25 February 2000
Shri M.V. Baiju Shri Moka Swamy Kumar	Seminar on Biodiversity and conservation of aquatic resources with reference to the threatened fish, mahseer. (Madhya Pradesh Council of Science and Technology and Central Institute of Aquacultural Engineering)	Bhopal 26 & 27 February 2000
Shri S.V.S. Ramarao Dr. G. Rajeswari	Seminar on Coastal Zone 2000 (SPICAM)	Hyderabad 26-28 February 2000
Dr. Leela Edwin	Seminar on Recent trends in small scale fisheries (South Indian Fedn. of Fishermen Societies)	Thiruvananthapuram 29 February & 1 March 2000
Dr. Krishna Srinath Shri P.K. Vijayan Dr. Imam Khasim Saheb	Workshop on Monsoon post harvest losses – Phase III. (jointly by NRI, U.K. and College of Fisheries, Mangalore)	Chennai 10 & 11 April 2000
Dr. A.G.G.K. Pillai Dr. B. Meenakumari Dr. Krishna Srinath	Workshop on Integrated management of coastal zones (Cochin University of Science and Technology (CUSAT), Technical University, Delft, Netherlands and Wageningen Agricultural University, Netherlands)	Cochin 29 February-3 March 2000

Dr.R.Chakrabarti	Seminar on Marine based industries with special reference to hygienic production of dry fish (Orissa Assembly of Small and Medium Enterprises	Orissa 16 April 2000
Smt. K. Vijayabharathi *Shri C.R. Gokulan*	Seminar on Surface mount technology and PCB rework systems (Institution of Electronics and Telecommunication Engineers (IETE), Cochin Centre and MEL systems & Services Ltd., Chennai)	Ahmedabad 13 June 2000
Dr. B. Meenakumari	2nd Workshop on Integrated approach for fishery forecasts using ocean colour. (Space Application Centre, Ahmedabad	Ahmedabad 13 June 2000
Dr. Krishna Srinath *Shri R.S. Manoharadoss* *Dr. Leela Edwin* *Dr. M.D. Varghese* *Shri V. Vijayan* *Shri Percy Dawson* *Shri M.R. Boopendranath*	National workshop on Impact of trawling on sea bottom ecology and effectiveness of monsoon trawl ban on rejuvenation of fish wealth. (School of Industrial Fisheries)	Cochin 7 August 2000
Shri Rakesh Kumar	Summer School on Recent advances in marine biotechnology (Central Institute of Fisheries Education)	Mumbai 7-27 August 2000
Dr. Jessy Joseph *Shri P. Shankar*	National Seminar in Official Language (Coconut Devt. Board)	Cochin 14 August 2000
Kum. Bindu J.	Servo – Matsyafed OBM 2T Oil lubrication Seminar (Indian Oil Corporation and Matsyafed)	Kasargod 23 August 2000
Dr. B. Meenakumari	Workshop on EU-INCODEV Cell (Nansen Environmental Research Centre, India)	Cochin 24 & 25 August 2000
Dr. B. Meenakumari	Seminar on GIS for Kerala (Dept. of Information Technology)	Thiruvananthapuram 28 August 2000
Shri V. Vijayan *Dr. M.D. Varghese*	First Indian Science Congress (Fisheries Professionals of Mumbai and Punjab University)	Chandigarh 21-23 September 2000
Shri J. Charles Jeeva	Regional Workshop on Planning and management of agricultural extension training (Southern Zone) (Directorate of Extension, Ministry of Agriculture)	Hyderabad 12 & 13 October 2000

Dr. K. Devadasan	ICAR Directors' Conference	New Delhi 12-14 October 2000
Dr. Krishna Srinath	ATIC's launching workshop (Central Res. Institute for Dryland Agriculture (CRIDA))	Hyderabad 18 & 19 October 2000
Dr. K. Devadasan *Shri K.K. Balachandran* *Shri T.S. Unnikrishnan Nair* *Dr. M.K. Mukundan* *Shri A.G. Radhakrishnan* *Shri K.P. Antony* *Shri V. Muraleedharan* *Shri K.K. Kunjipalu* *Dr. C.N. Ravi Shankar*	National Seminar on Scombroids (Central Marine Fisheries Research Institute)	Cochin 19 & 20 October 2000
Dr. K. Devadasan	Brainstorming session on Manpower requirements and HRD in fisheries sector (Central Institute of Fisheries Education)	Mumbai 20 & 21 October 2000
Dr. S. Balasubramaniam	Annual Review Workshop of ICAR Transfer of Technology (ToT) projects of Kerala and Lakshadweep (Central Plantation Crops Research Institute (CPCRI))	Kasargod 23 & 24 October 2000
Dr. K. Devadasan	Inauguration of Website on ornamental fishes (School of Industrial Fisheries)	Cochin 27 October 2000
Dr. B. Madhusudana Rao	(UNESCO / FAO Sponsored) International Workshop on Biotechnological tools in pathogen detection and fish / shrimp health management	Mangalore 30 October – 4 November 2000
Dr. K. Devadasan	State Level Workshop on Professional education in Kerala (Centre for Socio-Economic and Environmental Studies)	Cochin 5 November 2000
Dr.K. Devadasan *Shri V. Vijayan* *Dr. K.V. Lalitha* *Shri P. George Mathai* *Shri M.P. Remesan* *Shri A.A. Zynudheen* *Shri George Ninan*	10th Swadeshi Science Congress (Swadeshi Science Movement)	Cochin 7-9 November 2000
Shri Moka Swamy Kumar	Krishak Sangosti (CIFE, Powerkheda, Hoshangabad Dist)	Hoshangabad 8 November 2000
Dr. Ravi Shankar	Indian Convention of Food Scientists and Technologists (ICFOST – 2000) (AFST (I))	Mysore 22-24 November 2000

Shri K.K. Balachandran *Dr. S. Balasubramaniam*	Seminar on Sustainable fisheries and aquaculture for nutritional security (M.K. University and Aquaculture Foundation of India)	Chennai 29 November – 2 December 2000
Dr. K. Devadasan	National symposium on Medicinal plants and industrial biotechnology (Cochin University of Science and Technology)	Cochin 1 December 2000
Dr. A.R.S. Menon	Seminar on History and philosophy of science (Cochin University of Science and Technology)	Cochin 1 & 2 December 2000
Dr. B. Meenakumari *Dr. U. Sreedhar*	5th Pacific Ocean Remote Sensing Conference (PORSEC 2000)	Goa 5-8 December 2000
Dr.P.K. Surendran	South Asian Conference on Food Safety (International Life Sciences Institute)	N.Delhi 11-13 December 2000
Shri M. Nasar	International Conference on Ship and Marine Technology –2000	Cochin 19-20 December 2000
Abroad		
Dr. Krishna Srinath	Final Workshop on Women in Aquaculture in India	Bangkok, Thailand 1-3 May 2000
Dr. K. Devadasan	Workshop on Utilizing different aquatic environments for small scale aquaculture (International Institute of Rural Reconstruction, Cavite)	Philippines 18-28 September 2000

Dr. Krishna Srinath, Head, EIS Division with other participants of Final Workshop on Women in Aquaculture in India held at Bangkok, Thailand

Participation in training programmes

Participant (s)	Training attended	Venue and date
Smt. P.K. Shyma	Sensors and transducers	1-15 January, 2000
Dr.K. Ashok Kumar	Liquid chromatography (M/s. Waters (India) P.Ltd.)	Bangalore 8-11 February 2000
Dr. P.T. Mathew Shri P.K. Vijayan	Value added fish products (Lakshadweep Social Welfare Board and Centre for Management Development Thiruvananthapuram)	Minicoy 3-11 March 2000
Shri Rakesh Kumar	69th Foundation Course for Agricultural Research Service (FOCARS), (National Academy of Agricultural Research Management)	Hyderabad 6 January – 4 May 2000
Shri P. Muhamed Ashraf	Managing digital libraries (Kerala Agricultural University)	Thrissur 1-10 April 2000
Kum. K.K. Asha Dr. D. Muthuchelvan Shri V. Radhakrishnan Nair	70th Foundation Course for Agricultural Research Service (FOCARS) (National Academy of Agricultural Research Management)	Hyderabad 2 June - 29 September 2000
Dr. Krishna Srinath (as resource person)	Refresher training programme for state level extension officers (Extension Training Centre)	Mannuthy 13 June 2000
Dr. Raghu Prakash	Prediction of potential fishing zones (Space Application Centre)	Ahmedabad July 2000
Dr. U. Sreedhar	Generation of chlorophyl images from raw satellite data (Space Application Centre)	Ahmedabad 17-27 July 2000
Dr.K.V. Lalitha	Senior Level Programme on Agricultural Scientists' development for personal and organisational effectiveness (National Academy of Agricultural Research Management)	Hyderabad 17-28 July 2000
Shri P.T. Sebastian	Maintenance and upkeep of electrical equipments and machines (Kerala State Productivity Council)	Kalamassery 20-21 July 2000

Shri Prem Kumar	Geo informatics for coastal management (Indian Institute for Remote Sensing)	Dehradun 7 August – 31 December 2000
Dr. B. Madhusudana Rao	M S Office Training (NIIT)	Cochin 6-10 October 2000
Shri Zynudheen, A.A.	Isolation and identification of fungus in dried fish samples (Central Institute of Fisheries Technology)	Cochin October-November 2000
Dr. Raghu Prakash	GIS Application in aquaculture (National Academy of Agricultural Research Management)	Hyderabad 6-11 November 2000
Dr. Krishna Srinath (as speaker)	Inaugural session of short term training course (Fisheries Staff Training Centre - Kerala State Fisheries Dept.)	Cochin 14 December 2000
Dr. D. Muthuchelvan	Quality management in export of seafood products (Central Institute of Fisheries Education)	Mumbai 19 December 2000 - 8 January 2001

Study visits / tour

- Kum. J.Bindu , Scientist, Smt. M.K. Sreelekha, T-II-3 and Shri T. Gangadharan, T-I-3, conducted a field study of Kasaba village in Kasaragod District from 12-14 September 2000, as a preliminary step in adopting the fishing village for transfer of proven technologies to the women of the village. The details of the study have been compiled under the title 'Kasaba Village, Kasaragod – A report on the possibilities and probabilities of adoption for technology transfer'.

- A survey on the technological needs of fisheries development in Arunachal Pradesh, Meghalaya and Assam was undertaken by Shri Prem Kumar, Scientist and Dr.M.M. Prasad, Scientist (Sr. Scale) and reports on the same brought out. The reports covered information collected on 1)Survey of technological needs in the NEH region in the fisheries sector, 2) Development of techniques for processing of freshwater fishes, 3) Suitable fishing techniques for fish harvest from Brahmaputra and its tributaries, and 4) Training needs in relevant aspects of fisheries technology for the NEH region.

- Dr. B. Meenakumari, Head, Fishing Technology Division, Shri R.S. Manoharadoss, Shri Percy Dawson, Senior Scientists, Shri C.R. Gokulan, Technical Officer and Shri P.S. Nobi, T-1-3, undertook an in-depth survey of the Aliar and Amaravathi reservoirs near Pollachi during 18-21 October 2000. The survey was undertaken at the request of the Tamil Nadu Fisheries Development Corporation Ltd., for effecting improvement in the major carp resources of the reservoirs.

The Administration Division deals with recruitment, service and policy matters, discipline, staff welfare, land & buildings, procurement of stores, budget expenditure, settlement of claims etc.

The Research Centres at Burla, Hoshangabad and Calicut continued to function in rented buildings. Research Centres Mumbai, Veraval and Visakhapatnam functioned in their own buildings.

During the period under report the following committees met as shown below:

1. Departmental Promotion Committee : 5 times (details given below)
2. Departmental Screening Committee : 2 times
3. Assessment Committee : 6 times
4. Placement Committee : 2 times
5. Compassionate Appointment Committee : Once

In addition to these, 2 scientisists joined the Institute on the basis of results of ARS examination held by ICAR.

Action for assessment of Technical Personnel for the period ending December, 2000 has also been intimated.

Posts filled on direct recruitment, test etc. during 1.1.2000 to 21.12.2000

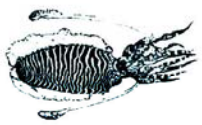
Scientific	-	4 Nos.
Technical	-	-
Administrative	-	-
Supporting	-	2

Staff position as on 31.12.2000

Category	Sanctioned	Filled
Scientific	101	82
Technical	175	152
Administrative	100	96
Supporting	138	95
Auxiliary	7	6
	521	**431**

Cases considered by the Departmental Promotion Committee

Category	Promotion	Declaration of probation	Confirmation	Assured Career Progression (ACP) Scheme
Scientific	-	-	-	-
Technical	53	1	1	-
Administrative	-	-	-	7
Auxiliary	-	-	-	6
Supporting	-	5	5	7



The Technical Section monitors various technical matters pertaining to compilation of research project programmes of the Institute, preparation and submission of RPF Database, technical reports, agenda notes for ICAR Directors' Conference and Regional Committee Meetings, updating of project files etc, besides attending to work relating to collaborative/ad-hoc projects, Staff Research Council meetings, participation of Scientists in Seminars/Symposia/Workshops/Short term training courses etc. The Section also attends to matters relating to Awards, Fellowships, publication of research papers, Personnel Directory etc.

Compilation of research project programmes document

The Research Project Programmes of the Institute for the year 2000-2001 were compiled taking into consideration the recommendations of the Project Advisory Committee and Research Advisory Committee. The document contains details of 14 ongoing projects, eight new projects, five ICAR ad-hoc projects and summary of 10 projects completed during 1999-2000. This comprehensive document forms the base material for reference of all the research activities being undertaken at the Institute Headquarters and Research Centres.

Computerization of research projects (RPFs)

As per directives from the Agricultural Research Information Centre of ICAR, a summary of each ongoing research project of the Institute in the prescribed computerized format has to be sent to the ARIC at regular intervals to maintain uniformity in computerization of RPFs. Accordingly, the relevant information such as project title, objectives, technical programmes, project abstract, major achievements etc. pertaining to all the Institute projects for the year 2000-2001 and to those projects completed during 1999-2000 were compiled and sent to the ARIC. This database would be connected to ICAR website for providing online information on the ICAR research projects. Prompt submission of the relevant information from this Institute has been highly appreciated by the ARIC of ICAR.

Compilation of technical reports

Monthly Report to ICAR :

The monthly feedback to Council on the important activities of the Institute, significant research findings, training programmes, seminars, symposia, workshops etc. conducted and participated by the staff, important policy decisions taken, information on new projects / programmes initiated, visit of officers abroad and visit of foreign delegates to the Institute, details of extension activities etc. were compiled and sent to ICAR regularly for inclusion in the ICAR monthly reports to the Cabinet Secretariat.

Report for the ICAR Regional Committee Meetings/ Directors' Conference :

Detailed report on the research and extension activities carried out at the Research Centres for the last two years were compiled and sent to ICAR for presentation in the respective Regional Committee Meetings of Region No. V (Burla and Visakhapatnam), No. VI (Veraval) and No. VII (Mumbai and Hoshangabad). The action taken report on the recommendations of the previous meetings of the Regional Committees was also furnished to the Member Secretary of the concerned Regional Committee.

Similarly, materials for the agenda notes of ICAR Directors' Conference and action taken report on the recommendations made in the previous meeting were furnished as and when required.

Ad-hoc/collaborative projects

Various ad-hoc/collaborative projects including National Agricultural Technology Projects being undertaken at the Institute, are monitored in the Technical Section. For proper implementation of the programmes, the half yearly/annual reports were collected from the Principal Investigators and sent to Council at the appropriate time.

Publication of scientific papers

Scientific papers, research notes, popular articles etc. received from scientists, for publication/ presentation were presented before a Scrutiny Committee for assessing their suitability or otherwise for publication. During the reported period, 45 such papers were processed and Director's approval for publication/presentation of 40 papers communicated to the concerned authors.

Participation of scientists in seminars/ symposia/workshops/short term training courses

Requests for participation of scientists in various seminars/symposia/workshops and short term training courses were processed.

Updating of project files

The project files of all the ongoing Institute projects were maintained up-to-date by collecting the consolidated quarterly/half yearly/annual progress reports from the Principal Investigators and co-investigators for the relevant periods. The summary of ten projects completed during the year 1999-2000 was forwarded to the Agricultural Research Information Centre, ICAR to append the RPF Database maintained at the ARIC.

Personnel directory

A Personnel Directory containing the residential address and telephone numbers of all staff at Headquarters was compiled. The Directory also contains a brief account of the Institute as well as contact details of other Fisheries Research Institutes and personnel.

Other technical matters

The Technical Section answers queries on various technical matters received from other organizations, for and on behalf of Director. Besides, matters relating to awards/fellowships/tour reports of scientists etc. are also being attended to.

Official language implementation

During the period under report the Institute carried out various activities as per the programme issued by Department of Official Language, Ministry of Home Affairs, Govt. of India for the year 2000-2001 for implementation of the Official Language Policy.

Official Language Implementation Committee meetings

The quarterly OLIC meetings of the Institute reviewed the official language implementation activities of CIFT. The committee consisted of the following members:

Chairman

Dr. K. Devadasan, Director

Members

Dr. M.K. Mukundan, Head, Division of Quality Assurance and Management

Dr. Krishna Srinath, Head, Division of Extension, Information and Statistics

Dr. P.K. Surendran, Head, Division of Microbiology, Fermentation and Biotechnology

Dr.B. Meenakumari, Head, Division of Fishing Technology

Dr. P.G. Viswanathan Nair, Head-in-charge, Division of Biochemistry and Nutrition

Shri P. Madhavan, Head-in-charge, Division of Fish Processing

Shri P.A. Uthup, Asst. Fin. & Accounts Officer

Shri R. Anil Kumar, Sr. Admn. Officer-in-charge

Member Secretary

Dr. C. Jessy Joseph, C., Asst. Director (OL)

Four quarterly meetings were conducted on 4.3.2000, 8.5.2000, 23.6.2000 and 6.11.2000.

Technical reports

Three quarterly reports and one annual report pertaining to the activities of Official Language at the Headquarters and Research Centres were forwarded to the Council.

Reports were also sent to Cochin TOLIC regarding the implementation of Official Language in the Institute.

Hindi Chethana Maas

The Institute celebrated Hindi Chethana Maas during September 14 to October 13. Competitions were held in letter writing, terminology, translation, precis writing, best scientific article and Hindi quiz. Official Language Commemoration day and Hindi Chethana Maas concluding day were conducted on 14.9.2000 and 13.10.2000 respectively.

Workshops organised

During the period under report six official language workshops were conducted as given below.

Category	*No. of participants & date*
Junior Technical Staff	40 (7.11.2000)
Junior Administrative Staff	15 (8.11.2000 & 10.11.2000)
Senior Technical Officers	15 (9.11.2000)
Senior Admn. Officers & Staff	15 (9.11.2000 & 10.11.2000)
Senior Scientists	20 (13.11.2000)
Scientists	10 (14.11.2000)

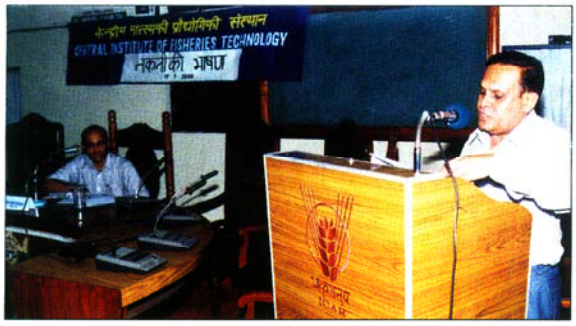
An official language workshop in progress

Joint Hindi Week Celebration – 2000

The staff members of the Institute participated in different competitions conducted by the Cochin Town Official Language Implementation Committee during the Joint Hindi Week.

Technical lectures delivered in Hindi by eminent personalities

Subject & date	*Speaker*
Fisheries sector and IDBI (17 July, 2000)	Shri Prafulla Ojha, General Manager, IDBI
Application of polymer (29 November 2000)	Dr. Sunil Narayanan Kutty, Senior Lecturer, Dept. of Polymer Science, CUSAT, Cochin



Shri. Prafulla Ojha, General Manager, IDBI delivering a talk on Fisheries sector and IDBI

Publications in Hindi/Bilingual

The following Hindi/bilingual publications were brought out during the period:

1. House Journal 'Jaladhi'
2. Annual Report
3. Fish Technology Newsletter
4. Research Highlights
5. Pollution of aquatic environment and impact on fishery resources
6. Gill nets
7. Fish curry in retortable pouch
8. CIFT training courses
9. Quality Assurance & Management
10. Microbiology, Fermentation & Biotechnology
11. Fuel efficient fishing vessel developed by CIFT
12. Collagen-chitosan membrane from fish
13. Marine electronic instruments developed at CIFT
14. Post graduate course in Post Harvest Technology of Fish.
15. Folder on CIFT

Rajbhasha Rolling Trophy

The Institute won the Rajbhasha rolling trophy for securing the first position for best performance in Official Language implementation among the autonomous organisations.

Dr. K. Devadasan, Director receiving the rolling trophy

National Seminar in Official Language on Pollution of Aquatic Environment and its Impact on Fishery Resources

A National Seminar in Official Language on ' Pollution of Aquatic Environment and its Impact on Fishery Resources' was held on 6 & 7 September, 2000. Shri V.N. Rai, Chairman & Managing Director, FACT, Cochin inaugurated the Seminar. Felicitations were offered by Shri Anil Kumar Dubey, Director (Hindi), ICAR, New Delhi, Smt. Jayashree Shanbagh, Station Director, All India Radio, Cochin and Dr. Chandrasekhara Pillai, Professor, Law Dept., CUSAT, Cochin. A total of 16 papers were presented in three technical sessions. Dr. Jacob Thomas, IAS, Chairman, Port Trust, Cochin was the Chief Guest at the valedictory function.

Shri. V.N.Rai, Chairman and Mg. Director, FACT inaugurating the seminar in official language on Pollution of aquatic environment and its impact on fishery resources

Acquisition

A total of 184 books were purchased for the library during the year. Subscriptions were made to 48 foreign and 32 Indian scientific periodicals. International Databases like ASFA, FSTA and AGRIS on CD-ROM have also been acquired. At present, the library holds 8769 books, 5324 bound volumes of journals and 71 CD-ROMs.

Automation

A Library automation software SLIM + + was installed in the library during the period. The software is in 4 modules which includes acquisition, cataloguing, circulation and serial control. Development of necessary database for the same is in progress. Barcoding of library books is also in progress. Barcoded 4000 books available in the library during the period.

Services

During the year 4280 bonafide readers visited the library and 2286 books were issued and retrieved. Reprographic unit of the library supplied copies of 55000 pages of documents on requisition. Issues of current contents were brought out fortnightly. Lists of monthly additions of books were circulated among various divisions and research centres of the Institute. The library in association with NIO, Goa continued to act as a national input centre of ASFA database.

National Science Day

The Institute celebrated National Science Day on 28 February 2000. Post graduate students and staff of the Dept. of Chemistry of two local colleges were given exposure to the working of some of the important analytical equipments at the Institute. A booklet entitled 'Modern equipments for chemical analysis at CIFT' was brought out on the occasion and distributed to the students.

Students being briefed on the working of some of the analytical equipment on National Science Day

GIS facility inaugurated

Facility for getting fishery resource information on potential fishing zones directly from Space Application Centre (SAC), Ahmedabad, based on data generated by the country's first remote sensing satellite was inaugurated at Munambam on 30 March 2000 by Dr. K. Ravindran, the then Director of CIFT. Shri E. Ravikumar, President, State Mechanised Boat Owners' Association presided over the function. Dr. B. Meenakumari, Head, Fishing Technology Division, CIFT, introduced the facility to the users. This facility was provided to the fisherfolk at Munambam under the collaborative project of the Institute and SAC in order to monitor the predicted potential fishing zones as Munambam is the most progressive area in Cochin where almost all boats are equipped with GPS and echo sounders, making geo- referenced fishing possible.

Application of remote sensing in fisheries - Dr. K. Ravindran, former Director, CIFT, hands over the FAX machine to a representative of the Mechanised Boat Owners Association under a participatory study of CIFT, SAC and the fishermen

Inauguration of fabrication of FRP canoes

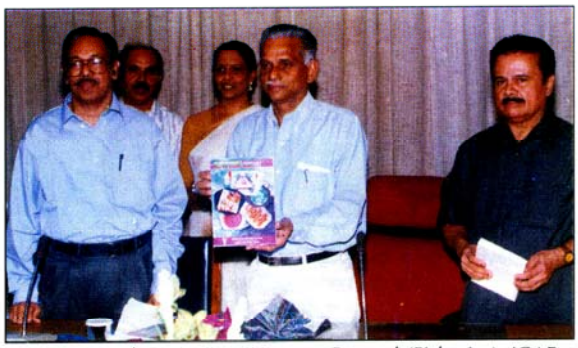
Fabrication of Fibreglass Reinforced Plastic (FRP) canoes designed by the Institute was inaugurated by Prof. K.V. Devraj, former Vice Chancellor, UAS, Bangalore and Chairman, ICAR High Power Committee at the boatyard of M/s. Samudra Engineering Co., Aroor on 15 March, 2000. The boat, 5.78 m in length, made entirely of FRP, is meant mainly for fishing in the backwaters, but can be used for coastal fishing too at times.

Inauguration of FRP fishing canoe production

FRP canoe

Publications / technologies released

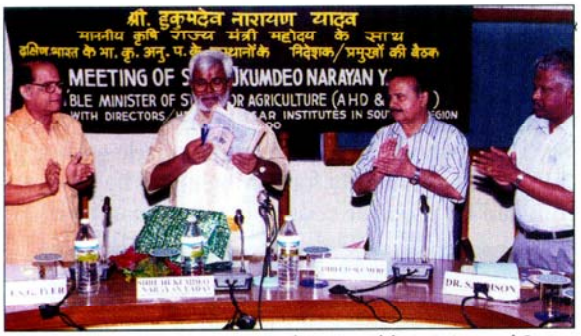
A training manual 'Seafood quality assurance' brought out by the Institute was released by Dr. K. Gopakumar, DDG (Fy.), ICAR at a function held at CMFRI on 4 January 2000. Another book



Dr. K. Gopakumar, Dy. Director General (Fisheries), ICAR, releases the training manual 'Seafood Quality Assurance'

entitled 'Quality assurance in seafood processing' brought out by the Society of Fisheries Technologists (India) and CIFT was also released by the DDG on the occasion.

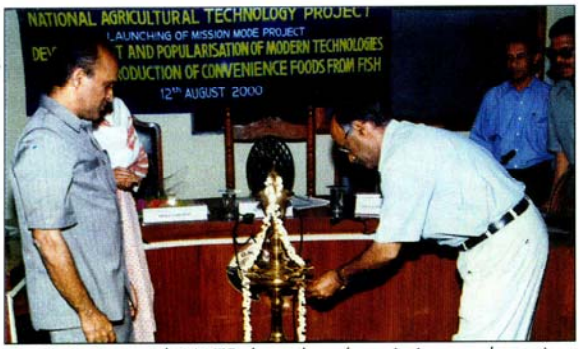
Two technologies – one on Poly Unsaturated Fatty Acid (PUFA) from fish oils for preventing heart disease and another on package of practices for chilled fish for export – were released by Hon'ble Union Minister of State for Agriculture (AHD & DARE), Shri Hukumdeo Narayan Yadav at a programme organised at the Institute in honour of the visit of the Minister on 13 May 2000.



Shri. Hukumdeo Narayan Yadav, Hon'ble Minister of State for Agriculture (AHD & DARE) releases techologies on PUFA and Package of Practices for chilled fish for export

Project launched

The Mission Mode National Agricultural Project 'Development and popularisation of modern technologies for the production of convenience foods from fish' was formally launched on 12 August 2000 by Dr.K.P. Agrawal, National Co-ordinator (Mission Mode), NATP, at a simple function held at the Institute.



Dr. K. P. Agrawal, NATP, launches the mission mode project on Development and popularisation of modern technologies for convenience foods from fish

World Environment Day

The Institute observed World Environment Day on 14 June 2000 at the Peeling Shed Owners' Association Hall, Eramalloor. Special talks on 'Sanitation and hygiene in seafood processing plants', 'Environmental pollutants from the seafood industry', 'We and our ecology', 'Fish processing' and 'Exploitation and conservation of fisheries resources' were delivered. The programme was presided over by Shri M.K. Abdul Gafoor Haji, President, All Kerala Peeling Shed Owners' Association. Peeling shed owners, processing workers, fish farmers and fishermen participated.

Dr. T. S. G. Iyer, Joint Director, addresses the participants on World Environment Day

Seminar on shrimp diseases

A seminar on shrimp diseases was organised at Chellanam on 16 August 2000 in association with Chellanam Village Small Scale Shrimp Farmers' Society. About 150 fish farmers participated in the programme. Shri V.B. Raghu, President, Chellanam Panchayat presided. Talks were delivered on shrimp disease, shrimp feed and shrimp in nutrition.

Dr. P.K. Surendran, Head, Microbiology, Fermentation and Biotechnology stresses a point at the seminar on Shrimp Diseases

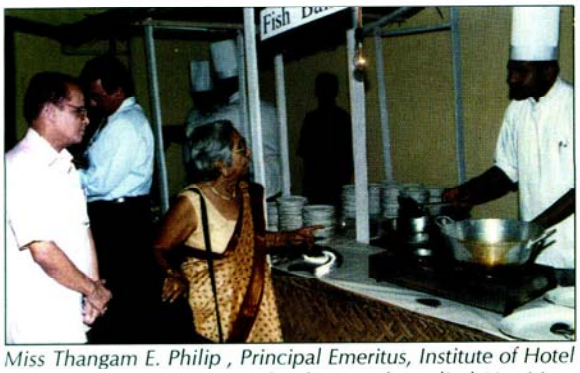
National Technology Day

The Institute celebrated National Technology Day on 29 May 2000. The theme for the day was Employment generation through advancement of technology. Members of Nehru Yuva Kendras and

Anganwadis in Cochin, numbering about thirty participated in the programme. Special talks on value added fish products, bacteria in daily life, products of medicinal application from fish, environmental pollution, fish waste utilization and employment generation through fisheries technology were delivered by the scientists of the Institute. The programme also included an exhibition, a quiz and a video show.

World Food Day

The Institute celebrated World Food Day on 16 October 2000. The programmes included an Open House on Value added fish products in which products developed at the Institute were introduced to the seafood and the hotel industry in and around Cochin. Students of a local college gave a demonstration of the preparation of a few products. The World Food Day celebrations and Open House was inaugurated by Mrs. Thangam E. Philip, Principal Emeritus, Institute of Hotel Management, Catering Technology and Applied Nutrition, Mumbai.



Miss Thangam E. Philip , Principal Emeritus, Institute of Hotel Management, Catering Technology and Applied Nutrition, Mumbai, at one of the fish stalls set up on World Food Day

Awareness programmes

An awareness programme on modern electronic instructments in fishing industry (fish finders, global positioning system and radio telephone) was organised at Munambam Mechanised Fishing Boat Owners' Association hall on 20 June 2000. Nearly 50 boat operators and owners belonging to different associations participated in the programme.

An awareness programme on fabrication of square mesh trawl cod ends was organised at Veraval on 29 September 2000 for the benefit of fishermen, boat owners and net makers.

An extension programme was organised at Kanyakumari Dist. in association with the District Rural Development Agency, Kanyakumari on 12 October 2000 in which the various technologies developed by the Institute were explained/ demonstrated. About 25 participants, including conveners of Self-Help groups, attended the programme.

Fishermen being explained the operational aspects of GPS used in fishing vessels

Women in Agriculture Day

The Women in Agriculture Day was observed by the Institute's Headquarters at Chellanam on 4 December 2000 in association with Petroleum Conservation Research Association and Matsya Mahila Vedi. A seminar on 'Reduction in fuel expenses for rural households' was organised in this connection in which nearly 200 women participated.

At Visakhapatnam Research Centre, the Day was observed at Lawson's Bay fishing village where fisherwomen were exposed to improvements in fish harvesting techniques as well as various quality control measures in order to get good returns from their catch. The topics covered included (1) hygienic handling of fish, (2) role of bacteria in prevention of spoilage of fish , (3) use of ice in insulated boxes to increase the shelf life of fish, (4) gear fabrication, and (5) methods of preparation of fish products and by-products from seafoods. An exhibition was also set up for their benefit.

Agricultural Technology Information Centre (ATIC)

The Agricultural Technology Information Centre (ATIC) under the National Agricultural Technology Project (NATP) was allotted to the Institute during the year. The Centre provides on-the-spot display of the latest available technology for all groups of people including traditional users and those in search of new technologies for new ventures. It covers all technologies related to harvest and post harvest technology of fish and connected aspects.

Scientific talks

The following scientific talks were arranged during the year:

Topic	Speaker and date
Geographic Information System	Dr.T.S. Jith, Director, Cavalcade Softwares, Cochin (11 August 2000)
A software on HACCP	M/s. Pinnacle Innovative Technologies, Cochin (19 August 2000)
Fish collagen – structure, types and application	Smt. Suseela Mathew, Scientist, CIFT, Cochin (3 October 2000)
Rubber wood – preservation and utilisation for marine application	Dr. Leela Edwin, Scientist (Sr. Scale) CIFT, Cochin (4 November 2000
Polymerase chain reaction – strategy and uses	Dr. Toms C. Joseph, Scientist, CIFT, Cochin (12 December 2000)
Intellectual property rights	Dr. K.N. Gopalarishna Pillai, Professor, School of Legal Studies, CUSAT, Cochin (18 December 2000)
DNA Finger printing	Dr. Lalji Singh Director Centre for Cellular and Molecular Biology, Hyderabad (2 December 2000)

The Institute participated in the ICAR Zone III Inter-Institutional sports meet held at Sugarcane Breeding Institute, Coimbatore from 11 to 16 December 2000. The following were declared winners in various events.

Women

Javelin	Smt. V. P. Vijayakumari	- I
Carroms (single)	Smt. V. P. Vijayakumari	- II
100 m. sprint	Smt. M. V. Valsala	- I
200 m. sprint	Smt. M. V. Valsala	- I
Long jump	Smt. M. V. Valsala	- I

Men

Shuttle badminton	Shri Jose Kalathil
	Shri Santhosh Alex
	Shri Pravin Puthra
	Shri N. Sunil
	Shri K. D. Santhosh

Smt. M. V. Valsala was declared ICAR Zone III Champion (Womens)

Participants of the ICAR Zone III inter- institutional sports meet with Dr. K. Devadasan, Director

The following are some of the dignitaries who visited the Institute during the year:

- ICAR High Power Committee
- Sri Lankan delegation comprising
  1) Mr. A.M. Jayasekara, Director General, National Aquaculture Devt. Authority, Sri Lanka
  2) Mr. S. Amarasekara, Secretary, Ministry of Fisheries and Aquatic Resources Devt., Colombo, Sri Lanka
- Mr. Hukumdeo Narayanan Yadav, Union Minister of State for Agriculture (AHD & DARE), Govt. of India
- Mr. M.P. Singh Kohli, Head, Dept. of Aquaculture, CIFE, Mumbai
- Mr. Bhaskar Khulbe,Director, DOPLT, Govt. of India & Advisor (AIP), EOI Brussels (Designate)
- Three member delegation from National Institute of Agricultural Research (INRA), Morocco
  1) Dr. Abdorrahomane L. Yamani, Head of Research Programme on Autumn Cereals
  2) Dr. Boucheib Boulanouar, Head of Research Programme on Red Meat
  3) Dr. Ousama El Gharass, Researcher
- Mr. M.K. Mandal, AMA to Govt. of India
- Dr. Debendra Pradhan, Hon'ble Union Minister of State for Agriculture, Animal Husbandry and Dairying & DARE (Burla and Veraval)
- Dr. S.P.S. Ahlawat, Director, Central Agricultural Research Institute, Port Blair, A&N Islands
- Mr. Babubai Bokharia, Minister of State for Fisheries, Govt. of Gujarat, accompanied by Mr. N.A. Vohra, IAS, Commissioner of Fisheries, Govt. of Gujarat
- Dr. B.N.Singh, ADG (Inland Fisheries) ICAR, New Delhi (Veraval)
- Ms. Shashi Sareen, Director (I&Q.C), EIC, New Delhi
- Mr. Suresh Pujari, Member, ICAR Governing Body (Veraval)
- Mr. N.A. Vohra, IAS, Commissioner of Fisheries, Gujarat (Veraval)
- Dr. Lalji Singh, Director, Centre for Cellular and Molecular Biology, Hyderabad

Srilankan visitors

Shri. Hukumdeo Narayan Yadav, Hon'ble Minister of State for Agriculture (AHD & DARE)

ICAR High Power Committee

Dr. Lalji Singh, Director, Centre for Cellular and Molecular Biology, Hyderabad

Shri Babubhai Bokharia, Minister of State for Fisheries, Govt. of Gujarat

Moroccan team

Shri Debendra Pradhan, Hon'ble Union Minister of State for Agriculture, Animal Husbandry and Dairying & DARE at Burla Research Centre

MANAGERIAL PERSONNEL

DIRECTOR			**Dr. K. Ravindran** (up to 31-3-2000) **Dr. T.S.G. Iyer** (in-charge up to 28-5-2000) **Dr. K. Devadasan** (from 29-5-2000)
Heads of Divisions			
1.	Fishing Technology Division	:	Dr. (Mrs) B. Meenakumari
2.	Fish Processing Division	:	Dr. T. S. G. Iyer (up to 30-11-2000) Shri P. Madhavan Principal Scientist (from 1-12-2000)
3	Quality Assurance & Management Division	:	Dr. M. K. Mukundan
4.	Biochemistry & Nutrition Division	:	Dr. K. Devadasan (up to 28-5-2000) Dr. P.G. Viswanathan Nair Principal Scientist (from 29-5-2000)
5.	Extension, Information & Statistics Division	:	Dr.(Mrs) Krishna Srinath
6.	Microbiology, Fermentation & Biotechnology Division	:	Dr. P.K. Surendran
7.	Engineering Division	:	Shri. P. K. Chakraborty (up to 30-9-2000) Dr. M.K. Mukundan (In-Charge from 1-10-2000)
Scientist -in-Charge of Research Centres			
	Veraval Research Centre		Shri K.K.Solanki
	Visakhapatnam Research Centre		Shri Sib Sankar Gupta
	Burla Research Centre		Shri J.K.Bandyopadhyay
	Hoshangabad Research Centre		Shri George Ninan (up to 21-6-2000) Shri. Prem Kumar (up to 19-7-2000) Shri Moka Swamy Kumar (Officer-in-Charge from 20-7-2000)
	Calicut Research Centre		Shri K. George Joseph
	Mumbai Research Centre		Shri Dinesh Kumar Garg
Head of Office and Senior Administrative Officer			Shri Sandeep Chatterjee (upto 19.08.2000) Shri M. George Joseph, Sr.Admn. Officer I/c (from 20.08.2000 to 28.02.2001)
Assistant Finance and Accounts Officers			Shri P.A.Uthup Shri H Ganesha

OTHER PERSONNEL

HEADQUARTERS - COCHIN

SCIENTIFIC PERSONNEL

Principal Scientist

1. Shri K. K. Balachandran
2. Dr. P.G.Viswanathan Nair
3. Shri T.S. Unnikrishnan Nair
4. Dr. K.G.Ramachandran Nair

Senior Scientist

1. Dr. P.T.Mathew
2. Dr. T.K.Srinivasa Gopal
3. Shri K.K.Kunjippalu
4. Dr.A.G.Gopalakrishna Pillai
5. Shri A.C.Joseph
6. Dr. Jose Joseph
7. Shri A.G. Radhakrishnan
8. Shri P.R.Girija Varma
9. Shri A. Vasanth Shenoy
10. Shri P. N. Joshi
11. Shri V. Muraleedharan
12. Shri P.K. Vijayan
13. Dr. T.K. Thankappan
14. Dr. Nirmala Thampuran
15. Shri P. George Mathai
16. Dr. Francis Thomas
17. Shri V. Narayanan Nambiar
18. Smt. Mary Thomas
19. Dr. M. R. Boopendranath
20. Dr. S. Sanjeev
21. Dr. P.T.Lakshmanan
22. Shri P. Ravindranathan Nair
23. Shri V. Vijayan
24. Shri K. Ramakrishnan
25. Smt. K. Vijayabharathy
26. Dr. G. R. Unnithan
27. Shri Percy Dawson
28. Dr. K. V. Lalitha
29. Dr. S. Balasubramaniam
30. Shri K. P. Antony
31. Shri V. Annamalai
32. Smt. K. Ammu
33. Shri M. Nasar

Scientist (Selection Grade)

Smt. R. Thankamma

Scientist (Senior Scale)

1. Shri T. V. Shankar
2. Smt. Saly N. Thomas
3. Shri Pravin Puthra
4. Dr. Braj Mohan
5. Dr. Leela Edwin
6. Dr. C.N. Ravi Shankar
7. Dr. K. Ashok Kumar

Scientist

1. Smt. Suseela Mathew
2. Dr. Toms C. Joseph
3. Shri Muhamed Ashraf
4. Dr. B. Madhusudana Rao
5. Dr. Nikita Gopal
6. Shri Rangaswamy Anandan
7. Shri Rakesh Kumar
8. Shri Radhakrishnan Nair
9. Dr. D. Muthuchelvan
10. Smt K.K. Asha

TECHNICAL PERSONNEL

T-9 (Technical Officer)

Shri K.J.Francis Xavier

T-8 (Technical Officer)

Shri K.S. Ganesan

T-7 (Technical Officer)

1. Shri D. C. Besra
2. Dr. A.R.Sasindranatha Menon
3. Shri M.S. Rajan

T-6 (Technical Officer)

1. Shri N. Sriharshan
2. Smt. T.T. Annamma
3. Shri C. Chandrasekharan
4. Shri P. Ravindranathan

T-5 (Technical Officer)

1. Shri T. K. David
2. Shri C.R.Gokulan
3. Shri M.V. Baiju
4. Shri M.M. Devassia
5. Shri P.S. Alias
6. Shri V. Gopalakrishna Pillai
7. Shri G. Ramadas Kurup
8. Shri Thomas J. Mammoottil
9. Shri P.T Sebastian
10. Shri N. M. Vasu
11. Shri M. K. Sasidharan
12. Shri M. K. Kuttikrishnan Nair
13. Shri G. Ratnakaran Nair
14. Shri V.V. Johny

T-4

1.	Smt. K. Sobha	:	Senior Hindi Translator
2.	Smt. K. B. Beena	:	Technical Assistant
3.	Shri E.K. Balakrishnan	:	Senior Draughtsman
4.	Shri K.V. Baladasan	:	Technical Assistant
5.	Smt K. Sarasamma	:	Senior Draughtsman
6.	Shri T. Gopalakrishnan	:	Metal Maker
7.	Shri P.A. Josi Augustine	:	Refrigeration Mechanic
8.	Smt P.K. Shyma	:	Wireless Operator
9.	Smt. Sumathy K.K.	:	Junior Laboratory Assistant
10.	Shri A.B. Varghese	:	Bosun
11.	Shri P.A. John	:	Cockswain
12.	Shri K.B. Thampi Pillai	:	Draughtsman
13.	Smt. Mary V.C.	:	Junior Laboratory Assistant
14.	Shri K.B. Thilakan	:	Junior Laboratory Assistant
15.	Shri T. K. Bhaskaran	:	Junior Laboratory Assistant
16.	Smt. G. Usha Rani	:	Junior Laboratory Assistant
17.	Smt. T. Silaja	:	Junior Library Assistant
18.	Shri K.N. Rajagopalan	:	Refrigeration Mechanic
19.	Shri Jose Kalathil	:	Refrigeration Mechanic
20.	Shri M. Baiju	:	Technical Assistant
21.	Shri P. Bahuleyan	:	Telephone Operator
22.	Shri T. N. Manibhadran	:	Tindal
23.	Shri Joseph P.M.	:	Machinist

T-3

1.	Smt. K.K.Kala	:	Technical Assistant
2.	Smt. Ancy Sebastian	:	Technical Assistant
3.	Smt. A. Indira Devi	:	Technical Assistant
4.	Shri Sibasis Guha	:	Photographer-cum-Artist
5.	Shri P.K. Pushpangadan	:	Deckhand
6.	Smt. K.G. Sasikala	:	Junior Laboratory Assistant
7.	Shri P. Sankar	:	Hindi Translator

8.	Shri G. Omanakuttan Nair	:	Junior Laboratory Assistant
9.	Smt G. Remani	:	Junior Laboratory Assistant
10.	Shri P.N. Sudhakaran	:	Net Making Supervisor
11.	Shri Aravind S. Kalangutkar	:	Senior Field Assistant
12.	Shri T. Balan	:	Deckhand
13.	Shri E.K. Chinnappan	:	Deckhand
14.	Shri K. D. Jos	:	Field Assistant
15.	Shri A.A. Kunjappan	:	Field Assistant
16.	Smt. K.P. Leelamma	:	Junior Laboratory Assistant
17.	Shri P.S.Raman Namboodiri	:	Junior Laboratory Assistant
18.	Shri Philip Durom	:	Senior Carpenter
19.	Shri P.S. Babu	:	Senior Field Assistant
20.	Shri V.V. John	:	Junior Laboratory Assistant

T-II-3

1.	Shri B. Ganesan	:	Animal House Keeper
2.	Shri K.K.Narayanan	:	Boilerman
3.	Shri M.K.Asokan	:	Deckhand
4.	Shri P.T. Viswambharan	:	Electrician
5.	Shri K.A.Gopinath	:	Engine Driver
6.	Shri C. Rajendran	:	Refrigeration Mechanic
7.	Shri K.E. Mani	:	Senior Mechanic
8.	Shri C.C. Sivan	:	Welder-cum-Blacksmith
9.	Shri V.N. Dileep Kumar	:	Engine Driver
10.	Shri J. Samarajan	:	Field Assistant

T-I-3

1.	Shri Tomy Rebello	:	Boilerman
2.	Shri P.S. Nobi	:	Net Making Supervisor
3.	Smt K.S. Mythri	:	Junior Laboratory Assistant
4.	Shri Subhash Chandran Nair C	:	Projector Operator

T-2

1.	Shri M. Sankara Panicker	:	Senior Carpenter
2.	Smt. N. Lekha	:	Junior Laboratory Assistant
3.	Shri T. Mathai	:	Junior Laboratory Assistant
4.	Shri P.D. Padmaraj	:	Junior Laboratory Assistant
5.	Smt P.K. Geetha	:	Junior Laboratory Assistant
6.	Shri P.N. Sukumaran Nair	:	Field Assistant
7.	Shri N. Sunil	:	Plant Attendant

T-1

1.	Shri G. Gopakumar	:	Carpenter
2.	Shri P.V. Sajeevan	:	Draughtsman
3.	Shri Sajith K. Jose	:	Draughtsman
4.	Shri G. Jyothikumar	:	Driver
5.	Shri K. Nakulan	:	Driver
6.	Shri K.V. Mohanan	:	Driver
7.	Shri R. Rangaswamy	:	Driver
8.	Shri T. B. Assise Francis	:	Driver
9.	Shri Umesh D. Aroskar	:	Driver

10.	Smt. N.C. Shyla	:	Field Assistant
11.	Smt. Tessy Rony	:	Field Assistant
12.	Shri K.D. Santhosh	:	Junior Laboratory Assistant
13.	Smt. P.A. Jaya	:	Junior Laboratory Assistant
14.	Shri N. Krishnan	:	Junior Laboratory Assistant
15.	Shri V.T. Sadanandan	:	Junior Laboratory Assistant
16.	Shri C.K. Suresh	:	Machine Operator
17.	Smt. Bindu Joseph	:	Media Assistant
18.	Shri Gokul Chandra Meher	:	Oil man
19.	Shri K. Dinesh Prabhu	:	Plant Attendant
20.	Shri V. A. Sudhakaran	:	Plumber
21.	Shri V.K.Siddique	:	Refrigeration Mechanic
22.	Shri P.D. George	:	Tindal
23.	Shri P.A. Shanmughan	:	Tindal
24.	Shri Babu K.S.	:	Turner

ADMINISTRATIVE PERSONNEL

1.	Shri M. George Joseph	:	Asst. Administrative Officer
2.	Shri S. Naveenchandra Prabhu	:	Asst. Administrative Officer
3.	Shri R. Anilkumar	:	Asst. Administrative Officer
4.	Smt T.K. Sarala	:	Asst. Administrative Officer
5.	Shri R. S. Shanmughan	:	Asst. Administrative Officer
6.	Shri P.A. Uthup	:	Asst. Fin. & Accts. Officer
7.	Shri H. Ganesha	:	Asst. Fin. & Accts. Officer
8.	Dr.(Mrs) C. Jessy Joseph	:	Asst. Director (Official Language)
9.	Shri K. Ravindran	:	Private Secretary

Assistant

1. Shri A. George Joseph
2. Shri M. Gopalakrishnan
3. Shri V. N. Rajasekharan Nair
4. Shri M. T. Joseph
5. Shri A.K. Venugopalan
6. Shri P.K. Sreedharan
7. Smt. C. G. Marykutty
8. Shri V. R. Kesavan
9. Smt. M. A. Prasanna
10. Smt. K. R. Gita Rani
11. Smt. N. Prabhavathy Amma
12. Shri C. Ravindran Nair
13. Smt. Pushpalatha Viswambharan
14. Shri T. M. Ramaraj
15. Shri G. Somappan
16. Smt. M. Jully
17. Shri Y. Philipose
18. Shri R. Viswanathan
19. Smt. K.A. Nazeem
20. Smt. T. K. Susannamma
21. Smt. K. Gracy

Stenographer

1. Smt. N.K. Saraswathy
2. Smt. R. Vasantha
3. Smt. V.P. Vijayakumari
4. Shri P.K. Raghu
5. Smt. N. Leena
6. Smt. S. Kamalamma
7. Shri K. V. Mathai
8. Shri R. D Goswamy

Junior Stenographer

1. Smt. Anitha K. John
2. Shri T. Viswanathan

Senior Clerk

1. Shri P. Krishna Kumar
2. Smt. P.C. Kamalakshy
3. Shri P.V. Venugopalan
4. Smt. N.I. Mary
5. Shri P. P. Varghese
6. Smt. M. S. Susanna
7. Shri P.K. Thomas
8. Smt. P.K. Thankamma
9. Smt. A. A. Cousallia
10. Shri K. K. Sasi
11. Shri P. Padmanabhan
12. Smt. A.R. Kamalam
13. Smt. T.K.Shyma
14. Shri V.S. Ambasudhan
15. Shri A.P. Gopalan
16. Smt. T. D. Usheem
17. Smt. V. S. Aleyamma
18. Smt. G. N. Sarada
19. Shri K.B. Sabukuttan
20. Smt. P.A. Sathy
21. Shri K.C. Baby
22. Shri C.K. Sukumaran

Lower Division Clerk

1. Smt. Lillykutty George
2. Shri P.K. Somasekharan Nair
3. Shri P. Mani
4. Smt. Jaya Das
5. Shri P. Bhaskaran
6. Shri M.N. Vinodhkumar
7. Smt. P.R. Mini
8. Smt. V.K. Raji
9. Smt. K. Renuka
10. Shri K. Das
11. Shri T. N. Shaji
12. Smt. A.R. Raji
13. Smt E. Jyothilekshmy

Cook

Shri V. Ramachandran

SUPPORTING PERSONNEL

Supporting Staff Grade IV

1. Shri O.A. Krishnan
2. Shri P.A. Thomas
3. Shri K. Balakrishna Pillai
4. Shri P.J. George
5. Shri A.G. Vasu

Supporting Staff Grade III

1. Shri T. V. Manoharan
2. Shri C. A. Krishnan
3. Shri K.K. Karthikeyan
4. Shri K.N. Mukundan
5. Shri P. Gopalakrishnan
6. Shri K.B. Bhaskaran
7. Shri K.A. Kunjan
8. Shri T.T. Thankappan
9. Shri P.R. Unnikrishna Panicker
10. Shri R. Chellappan
11. Shri A.R. John

Supporting Staff Grade II

1. Shri K.N.Velayudhankutty
2. Shri T.G. John
3. Shri P.A. Sivan
4. Smt. C.G. Radhamoney
5. Shri C.D. Parameswaran
6. Shri P.P.George
7. Shir A.V.Chandrasekharan
8. Shri P.V. Raju
9. Shri E. Damodaran
10. Shri M.M. Radhakrishnan
11. Shri K.K.Karthikeyan
12. Smt. C. Ammini
13. Smt. P. Ammalu
14. Shri M.N. Sreedharan
15. Smt. U.K. Bhanumathy
16. Shri T.K. Rajappan
17. Shri M.T. Udayakumar

Supporting Staff Grade I

1. Smt. Mary Vinitha P.T.
2. Shri O.P. Radhakrishnan
3. Shri P. Raghavan
4. Shri T.M. Balan
5. Shri Deepak Vin V.
6. Shri T.D. Bijoy

Auxiliary

1. Shri K.C. Mohanan : Tea Maker
2. Shri T. A. Gopalakrishnan : Bearer
3. Shri C.N. Chandrankutty : Bearer
4. Shri M. V. Rajan : Bearer

VERAVAL RESEARCH CENTRE

SCIENTIFIC PERSONNEL

1. Shri Rajendra Badonia : Senior Scientist
2. Shri M.P.Ramesan : Scientist
3. Dr. Arnab Sen : Scientist
4. Shri A.A. Zynudheen : Scientist
5. Shri Sreedhar Uttravalli : Scientist

TECHNICAL PERSONNEL

1. Shri J.B. Paradwa : T-5 (Technical Officer)
2. Shri K.U. Dholia : T-5 (Technical Officer)
3. Shri G. P. Vaghela : T-5 (Technical Officer)
4. Shri K.U. Sheikh : T-4 (Jr. Lab. Assistant)
5. Shri D.R. Aparnathi : T-3 (Jr. Lab. Assistant)
6. Shri G.B. Tandel : T-3 (Deckhand)
7. Shri G.R.Bhogte : T-3 (Deckhand)
8. Shri G.M. Vaghela : T-I-3 (Jr. Lab. Assistant)
9. Shri H.V. Pungera : T-2 (Jr. Lab. Assistant)
10. Shri Sida Hanif Ummer Bhai : T-1 (Driver)

ADMINISTRATIVE PERSONNEL

1. Shri P. Vasudevan : Asst. Administrative Officer
2. Shri Veersingh : Assistant
3. Shri S.B. Purohit : Senior Clerk
4. Shri M.M. Damodara : Senior Clerk
5. Shri D.P. Parmer : Lower Division Clerk

SUPPORTING PERSONNEL

1. Shri P.A. Abdul Rehman : Supporting Staff Grade IV
2. Shri Harbajan : Supporting Staff Grade III
3. Shri B.M.A. Khoker : Supporting Staff Grade II
4. Shri Dhana Bhima Chudasama : Supporting Staff Grade II
5. Shri Kantilal Jivabhai Damor : Supporting Staff Grade II
6. Smt. Chandrika C. Tank : Supporting Staff Grade II
7. Smt. Gangaben Naren Chorwadi : Supporting Staff Grade II
8. Shri Dhodiya Khoda Viram : Supporting Staff Grade II
9. Shri Jitendra Bachubhai Malamdi : Supporting Staff Grade II

10.	Shri Ramjilal Nathalal Gosai	:	Supporting Staff Grade II
11.	Shri Aswinkumar Mohanlal Vala	:	Supporting Staff Grade I
12.	Shri Makvana Karsan Kana	:	Supporting Staff Grade I
13.	Smt. Harshaban A. Joshi	:	Supporting Staff Grade I
14.	Shri Narasinh K. Masani	:	Supporting Staff Grade I
15.	Smt. Motiben K. Fofandi	:	Supporting Staff Grade I
16.	Smt. Pushpaben P. Chudasama	:	Supporting Staff Grade I

AUXILIARY

1.	Shri Jethwa Kishan Khodidas	:	Wash Boy
2.	Smt. Veena Sreedhar Narkar	:	Coffee/Tea Maker

VISAKHAPATNAM RESEARCH CENTRE

SCIENTIFIC PERSONNEL

1	Dr. Imam Khasim Saheb	:	Senior Scientist
2	Shri A.K. Chattopadhyay	:	Senior Scientist
3	Dr. Rupshankar Chakraborthy	:	Senior Scientist
4	Dr. G. Rajeswari	:	Scientist
5	Dr. R.Raghu Prakash	:	Scientist
6	Shri J. Charles Jeeva	:	Scientist

TECHNICAL PERSONNEL

1.	Shri A. Veeranjaneyulu	:	T-5 (Technical Officer)
2.	Shri V.V. Ramakrishna	:	T-5(Technical Officer)
3.	Shri. Srihari Babu	:	T-5(Technical Officer)
4.	Shri KVSSS Kusuma Harnath	:	T-5(Technical Officer)
5.	Shri B. Ramaiah	:	T-4(Jr. Laboratory Assistant)
6.	Shri Santhosh Alex	:	T-3(Jr. Hindi Translator)
7.	Shri K. Prakasa Rao	:	T-3(Engine Driver)
8.	Shri N. Ventaka Rao	:	T-3(Field Assistant)
9.	Shri M. Venkateswara Rao	:	T-3(Driver)
10.	Shri P. Radhakrishna	:	T-2(Junior Laboratory Assistant)

ADMINISTRATIVE PERSONNEL

1.	Shri G.C. Adhikari	:	Assistant
2.	Smt. D.A.L. Satyanarayanamma	:	Stenographer
3.	Smt. B. Hemalatha	:	Senior Clerk
4.	Shri Y. Kanakaraju	:	Senior Clerk
5.	Shri G. Chinna Rao	:	Senior Clerk

SUPPORTING PERSONNEL

1.	Shri N. Gnanaranjana Rao	:	Supporting Staff Grade – IV
2.	Shri Orilika Heman	:	Supporting Staff Grade – IV
3.	Shri C. Kamaraju	:	Supporting Staff Grade – III
4.	Shri K. Kameswara Rao	:	Supporting Staff Grade – III
5.	Shri V. Kamaraju	:	Supporting Staff Grade – III
6.	Shri B. Sivanadam	:	Supporting Staff Grade – III
7.	Shri K. Appa Rao	:	Supporting Staff Grade – III
8.	Shri S. Appa Rao	:	Supporting Staff Grade – III
9.	Shri Vasippilli Yelliah	:	Supporting Staff Grade – III

10.	Shri Dibyalochan Pattanaik	:	Supporting Staff Grade – II
11.	Shri S. Chakram	:	Supporting Staff Grade – II
12.	Shri V. Venkata Ramana	:	Supporting Staff Grade – II
13.	Shri G. Bhushanam	:	Supporting Staff Grade – II
14.	Shri M. Sreevishnu Prabhakara Rao	:	Supporting Staff Grade - I

BURLA RESEARCH CENTRE

SCIENTIFIC PERSONNEL

	Dr. M.M. Prasad	:	Scientist(Senior Scale)

TECHNICAL PERSONNEL

1.	Shri Baikunta Pradhan	:	T-5(Technical Officer)
2.	Shri Binod Kumar Pande	:	T-5 (Technical Officer)
3.	Shri Asok Kumar Panigrahi	:	T-4 (Technical Asst.)
4.	Shri P.M. Pattanayak	:	T-4 (Senior Lab. Asst.)
5.	Shri Sathrughan Kumara	:	T-3 (Tindal)
6.	Shri Damodar Rout	:	T-3 (Jr. Lab. Asst.)
7.	Shri Radhu Pandey	:	T-3 (Driver Launch)
8.	Shri Kirtan Kisan	:	T-II-3 (Electrician)
9.	Shri A.K. Naik	:	T-I-3 (Mechanic)
10.	Shri Rabinarayan Sahoo	:	T-2 (Driver Launch)
11.	Shri Himansu Sekhar Bag	:	T-1 (Driver)

ADMINISTRATIVE PERSONNEL

1.	Shri Jatindra Kumar Mishra	:	Assistant
2.	Shri Laxminarayan Badi	:	Senior Clerk
3.	Shri Premlal Panda	:	Lower Division Clerk

SUPPORTING PERSONNEL

1.	Shri Gajendra Karali	:	Supporting Staff Grade – IV
2.	Shri K.C. Mehar	:	Supporting Staff Grade – IV
3.	Shri Santhosh Banchor	:	Supporting Staff Grade – IV
4.	Shri Satrughan Seth	:	Supporting Staff Grade – III
5.	Shri Krishna Chandra Nayak	:	Supporting Staff Grade – III
6.	Shri Sadhu Charan Mehar	:	Supporting Staff Grade – III
7.	Shri Badri Narain Guru	:	Supporting Staff Grade – II
8.	Shri Satyanarayan Mirdha	:	Supporting Staff Grade – II
9.	Shri Jaisingh Oram	:	Supporting Staff Grade – II
10.	Shri P.K. Bhangaraj	:	Supporting Staff Grade – II
11.	Shri Godabari Mahanandia	:	Supporting Staff Grade – II
12.	Shri Surjananda Dishri	:	Supporting Staff Grade – II
13.	Shri Sanyasi Ganik	:	Supporting Staff Grade – I
14.	Shri Triloknath Banchor	:	Supporting Staff Grade – I
15.	Shri Sachida Nanda Dash	:	Supporting Staff Grade – I
16.	Shri Basant Kumar Deo	:	Supporting Staff Grade – I
17.	Shri Nande Oram	:	Supporting Staff Grade – I
18.	Smt Gyananetri Nag	:	Supporting Staff Grade I

HOSHANGABAD RESEARCH CENTRE

SCIENTIFIC PERSONNEL

Nil

ADMINISTRATIVE PERSONNEL

	Shri Udekar Pande	:	Senior Clerk

SUPPORTING PERSONNEL

	Shri Rattan Chand	:	Supporting Staff Grade IV

MUMBAI RESEARCH CENTRE

SCIENTIFIC PERSONNEL

	Shri S.P. Damle	:	Senior Scientist

TECHNICAL PERSONNEL

1.	Smt. Sangeetha D. Gaikwad	:	T-5 (Technical Officer.)
2.	Smt. Triveni Gopal Adiga	:	T-5 (Technical Officer)
3.	Shri B. B.. Pinjari	:	T-1 (Driver)
4.	Shri Prakash B. Bait	:	T-1 (Plant Attendant)

ADMINISTRATIVE PERSONNEL

1.	Shri Milind S. Bhatkar	:	Assistant
2.	Smt. Smitha K. Shirishkar	:	Assistant
3.	Shri Avinash N. Agawane	:	Lower Division Clerk

SUPPORTING PERSONNEL

1.	Shri B.S. Tambe	:	Supporting Staff Grade – III
2.	Shri Bandhu M. Ghare	:	Supporting Staff Grade – III
3.	Shri Chandrakant B. Kolvalkar	:	Supporting Staff Grade – II
4.	Shri Vinod S. Salvi	:	Supporting Staff Grade – II
5.	Shri Tulsiram A. Waghmare	:	Supporting Staff Grade – I

CALICUT RESEARCH CENTRE

SCIENTIFIC PERSONNEL

	Smt. Bindu J.	:	Scientist

TECHNICAL PERSONNEL

1.	Shri K. Vasudevan Nair,	:	T-7(Technical Officer)
2.	Smt. M. K. Sreelekha	:	T-4 (Jr. Lab. Asst.)
3.	Smt. Tara Karupalli	:	T-4 (Jr. Lab. Asst.)
4.	Shri T. Gangadharan	:	T-3 (Sr. Lab. Asst.)
5.	Smt.M.V. Valsala	:	T-1 (Field Assistant)
6.	*Shri T.P. Balakrishnan*	:	*T-1 (Driver)*

ADMINISTRATIVE PERSONNEL

1.	Shri M. Ravindran	:	Assistant
2.	Shri K.P. Velayudhan	:	Senior Clerk

SUPPORTING PERSONNEL

1.	Shri P. Rajeev	:	Supporting Staff Grade – II
2.	Smt. Shiji John	:	Supporting Staff Grade – I

1. Ammu, K., Raghunath, M.R., Sankar, T.V., Lalitha K.V. & Devadasan, K. (2000) – Repeated use of oil for frying fish: Effect of feeding the fried fish to rats – *Nahrung, 44 : 368*
2. Antony, K.P., Muraleedharan L. & Mukundan, M.K.(2000) – Convenience products from quality upgraded masmin – Paper presented at National Workshop on Scombroids; organized by CMFRI, Cochin, 19-20 September
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4. Ashok Kumar, K., Ravishankar, C.N., Badonia, R. & Solanki, K.K.(2000) – Quality changes in whale shark (*Rhiniodon typus* Smith) meat during storage in ice – *Fish. Technol.* 37(1) : 15
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- Research Highlights 1999-2000
- Fish Technology Newsletter
  Vol. X. Nos. 2, 3, 4
  Vol. XI Nos.1 & 2
- Booklet on Training Courses of CIFT - 2000

Books

- Post harvest technology of fish and fishery products – by Shri K.K. Balachandran
- Quality assurance in seafood processing {in association with Society of Fisheries Technologists (India)}

CIFT Technology Advisory Series

- Technology of coated fish products
- Frozen squid and cuttle fish
- Biochemical composition of fish
- Gill nets

Information folders on:

- Fish soup powder
- Fish fingers
- Fish cutlets
- Fish balls
- Fish wafers
- Fish pickle
- Agricultural Technology Information Centre (ATIC)

Training manual

- Seafood quality assurance

Booklet

- 'Sagarkripa' – the 15.5m fuel efficient steel fishing vessel developed at CIFT
- Value added fish products from low value fish (in Malayalam)

Others

- First issue of ATIC Newsletter
- Leaflet on FRP canoes designed and developed at the Institute
- Folder on activities of Visakhapatnam Research Centre (in Telugu)