

ANNUAL REPORT 1983-'84

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY
COCHIN

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY
(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)
COCHIN-682 029, INDIA



ANNUAL REPORT

1983-'84

Central Institute of Fisheries Technology

(Indian Council of Agricultural Research)

Matsyapuri P. O., Cochin-682029

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**COVER & PHOTOGRAPHY
K. BHASKARAN**

CONTENTS

	Page
1 INTRODUCTION	1
Organisational Set-up	3
2 PROGRESS OF RESEARCH	19
Headquarters: Cochin	19
Craft Materials	19
Gear	21
Freezing	23
Canning	24
IDRC Project - 'Fish Processing-India'	27
Proteins, Enzymes & Lipids	29
Fish Microbiology	31
Quality Control of Fish & Fish Products	32
Packaging of Fish & Fishery Products	34
Diversified Products from Fish & Fish Wastes	36
Processing & Marine Engineering	39
Electronics & Instrumentation	41
3 VERAVAL RESEARCH CENTRE	42
4 KAKINADA RESEARCH CENTRE	44
5 BURLA RESEARCH CENTRE	46
6 CALICUT RESEARCH CENTRE	48
7 BOMBAY RESEARCH CENTRE	50
8 GOA RESEARCH CENTRE	52
9 EXTENSION ACTIVITIES	52
10 STATISTICS	59
11 PUBLICATIONS	61
12 APPENDICES	69

1. INTRODUCTION

Ever since the Institute was established in the year 1957, it has been catering to the needs of the fishery industry, undertaking research investigations in all aspects relating to fishing and fish processing. During the year, it joined the country in observing the Qaumi Ekta Week and conducted programmes during the National Agricultural Input Fortnight for the main benefit of the fishermen.

A galvanic anode free from mercury was developed for the first time in India for use in cathodic protection of fishing boats and metallic marine structures. A high build oil bound wood preservative was developed for use on indigenous crafts.

High density polyethylene yarn was found suitable for fabrication of small meshed gill nets as an alternative to nylon multifilament twines. Comparative studies with trawls with straight and tapering jibs have shown the efficiency of the latter over the former.

The CIFT standardised lobster traps continued to maintain their popularity along the Kanyakumari coast of Tamil Nadu and Vizhinjom coast of Kerala .

An Environmental Data Acquisition System was developed for automatic acquisition of marine environmental data.

A HM-HDPE film of 100 gauge thickness was found superior to many other packaging materials tried for packing frozen fishery products.

A recipe was worked out for processing canned prawn curry.

Starvation in water from natural habitat was rated as the best method for depuration of live clams.

Direct smoking yielded a better product than addition of smoke liquor while processing smoked canned froglegs and smoked mussel.

Chitin when added in limited quantities to feed formulations showed appreciable growth promoting property in albino rats.

Short term training programmes and demonstrations in the various technologies developed were organised both at the Headquarters and Research Centres in which a number of personnel sponsored from industry and trade participated and derived benefits.

M. R. NAIR,
DIRECTOR

1.1 ORGANISATIONAL SET-UP

The Institute is headed by the Director with whom all administrative and financial powers regarding research and management of the Institute are vested. He is assisted by a Sr. Administrative Officer, Administrative Officer and Assistant Administrative Officer for dealing with matters relating to general administration, an Accounts Officer and Asst. Accounts Officer for looking after the financial and accounting aspects as also internal audit of the Institute. One Technical Officer (T-7) attends to the technical matters including those connected with research projects handled by the Institute at its Headquarters at Cochin and Research Centres at Veralal (Gujarat), Kakinada (Andhra Pradesh), Burla (Orissa), Calicut (Kerala), Bombay (Maharashtra) and Panaji (Goa).

The Research work is carried out by the following Research Divisions:

1. Biochemistry and Nutrition
2. Microbiology
3. Processing and Packaging
4. Craft
5. Gear
6. Engineering
7. Electronics and Instrumentation
8. Extension, Information and Statistics

1.2 MANAGEMENT COMMITTEE

The Management Committee of the Institute continued to function with the following members.

- | | | |
|--|----|-----------------|
| 1. Director, CIFT | .. | <i>Chairman</i> |
| 2. Director of Fisheries,
Govt. of Kerala, Trivandrum | .. | <i>Member</i> |
| 3. Director of Fisheries,
Govt. of Tamil Nadu | .. | —do— |
| 4. Director of Research,
Kerala Agricultural University,
Mannuthy, Trichur | .. | —do— |

5. President,
All India Fishermen's Federation Limited,
Bombay .. —do—
6. Shri N. H. Shetty,
Chairman & Managing Director,
Ganesh Flour Mills, Delhi .. —do—
7. Dr. P. N. Kaul,
Scientist S-3, CIFT .. —do—
8. Shri P. Vasudeva Prabhu,
Scientist S-3, CIFT .. —do—
9. Dr. K. Devadasan,
Scientist S-3, CIFT .. —do—
10. Shri P. D. Antony,
Scientist S-2, CIFT .. —do—
11. Assistant Director General (F),
ICAR, New Delhi .. —do—
12. The Accounts Officer
CMFRI, Cochin .. —do—
13. The Administrative Officer,
CIFT .. —do—

Four meetings were held during the year 1983 and one in 1984 and some important recommendations made.

1. 3 STAFF JOINT COUNCIL

On the expiry of the term of the Joint Council on 3-10-1984, elections were held on 20-2-1984 to reconstitute the Council.

1. 4 MONITORING CELL

The Monitoring Cell of the Institute met twice during 1983 and once in 1984 to consider the progress made in plan expenditure, procurement of stores, vacancy position, filling up of posts and construction work.

1. 5 GRIEVANCE CELL

The Cell continued to function with the following members.

- | | | |
|--|----|--|
| 1. Dr. C. C. Panduranga Rao,
Director | .. | <i>Chairman</i> |
| 2. Dr. K. Gopakumar,
Scientist S-3 | } | <i>Members nominated by
Management Committee</i> |
| 3. Shri T. K. Sivadas,
Scientist S-3 | | |
| 4. Dr. Jose Stephen,
Scientist S-2 | } | <i>Elected representatives
of S-1 and S-2 Scientists</i> |
| 5. Shri V. Vijayan,
Scientist S-2 | | |
| 6. Sr. Administrative Officer | .. | <i>Member Secretary</i> |

1.6 ADMINISTRATION

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

The Research Centres continued to function in rented buildings. Addresses of the Research Centres are given as Appendix I. List of staff under Scientific, Technical, Administrative, Auxiliary and Supporting categories as on 31-3-1984 is given as Appendix II.

Details of budget provision and actual expenditure are furnished as Appendix III.

1.7. TECHNICAL SECTION

- 1.7.1. The Technical Section collected important research materials from the different divisions of headquarters and Research Centres for preparation of technical notes and reports. Correspondences and follow-up actions on all technical matters were attended to promptly. Project proposals/schemes/enquiries/etc. received from the other Institutes and Research Organisations like College of Fisheries, Mangalore, Jadavpur University, Calcutta, Government of India, Ministry of Energy, New Delhi etc. were deftly dealt with and reports communicated to the concerned. Correspondences and follow-up actions relating to problems of exploitation of the resources of the reservoirs of other States like Gujarat, Maharashtra, Madras, Himachal Pradesh etc. were attended to. Correspondences on procurement and utilisation of bigger vessels, pooling of larger vessels of CIFT, CIFE and CMFRI, craft designs, follow-up actions on the recommendations made at the conference of project co-ordinators/Directors of ICAR, short term training of scientists, ad-hoc project on the development of diversified fishery pro-

ducts were promptly executed. Enquiries received from National Institute of Oceanography, CMFRI, CIFE, MPEDA, State Departments and similar organisations and ICAR on technical matters were also attended to.

1. 7. 2. Institute's Research Projects

The research project programmes of the Institute for the year 1983-'84 were compiled as per directions offered by the Project Advisory Committee, Staff Research Council and Director. There were a total of 37 projects during the year under report out of which 30 were on-going projects and 7 were new projects. Four projects have been completed during the year 1982-'83. Follow-up of the various technical programmes envisaged and the work done by each scientist were gone through and achievements in research work carried out in different disciplines communicated to Director General, ICAR. The project leaders' files consisting of reports of project leader and each of the associates were maintained in proper order.

1. 7. 3. Staff Research Council

The Staff Research Council met once during the period. The Assistant Director General (Fisheries) ICAR, all the Scientists at Headquarters and many Scientists from Research Centres attended the meeting. Projects were reviewed taking into consideration the recommendations of the ADG and DDG (ICAR) and the deliberations at the previous meeting.

1. 7. 4. Publication of Technical Papers

Twenty nine technical papers prepared by the Scientists were processed for approval for publication in different journals.

1. 7. 5. Fortnightly, monthly and quarterly reports to Council

Materials pertaining to important significant events were sent to Council at the appropriate time as required by them.

1. 7. 6. Mid-term Appraisal of 6th Plan

A report of mid-term appraisal of the 6th plan projects was prepared incorporating informations such as title of project, date of start, objectives, scientists involved, progress of work and constraints causing non-completion of technical programme for both plan and non-plan projects and submitted to Director for onward transmission to Council..

1. 7. 7. Seventh Plan Proposal

As desired by DDG (AS) a critical review was made of the on-going research projects taking into consideration the mid-term appraisal reports, quinquennial review team's report (1970-1980) and their major recommendations. In the light of suggestions offered by DDG (AS) and ADG (F), ICAR, an outline of research strategies for the 7th plan proposals was prepared and submitted to Director. The proposals received from Scientists in charge of Research Centres and headquarters are being processed for preparing detailed report of the 7th plan of the Institute.

1. 7. 8. Five Yearly Assessment of Scientists

Five yearly assessments of 59 ARS Scientists belonging to the grade S-3 (2 Nos), S-2 (18 Nos) and S-1 (39 Nos) were taken up during the year under report for the periods ending December 1980, 81 and 82 along with supplementary informations in the case of those eligible for the respective qualifying years. Their assessment and career information proforma were scrutinised and sent for remarks of reviewer and Director. The connected documents were forwarded to Council within the prescribed time limit.

The results of assessment of scientists for the period ending 1979 were communicated by Council. Out of nine S-1 scientists, five got promoted to S-2 and out of three S scientists, two got promoted to S-1. The supplementary informations of 5 scientists who did not get promotion to the next higher grade for the period ending 1980, 81 and 82 were submitted to ASRB along with other documents. The individual project files along with publications of the respective scientists were presented before the assessment committee at New Delhi.

1. 7. 9. Project Advisory Committee

The Committee met frequently and reviewed the progress of the various projects. It also suggested measures to overcome the difficulties faced in the implementation of projects and allocated priorities among the research problems at different Research Centres. A special meeting of the Committee was held to evaluate the progress made in the 6th plan, and to locate new areas of work in the fishing and fish processing sectors which could be proposed under the 7th plan programmes of the Institute.

1. 7. 10. Quinquennial Review Team

The quinquennial review team (earlier termed 'Achievement Audit Committee') was re-constituted in 1982 with the following as members.

1. Shri S. N. Rao,
Director, MPEDA, Cochin .. *Chairman*
2. Dr. D. P. Sen,
(Retd. Scientist from CFTRI, Mysore)
Salt Lake City,
Calcutta-64 .. *Member*
3. Dr. S. Paramanandam
Director General,
Naval Design, Naval Hqrs.,
N. Delhi .. —do—
4. Dr. D. V. Regi,
Prof., Food Technology,
Department of Chemical Technology,
University of Bombay,
Bombay ... —do—
5. Shri M. Jayaraj,
Director of Fisheries,
Government of Karnataka,
Bangalore-560001 .. —do—
6. Dr. C.C. Panduranga Rao,
Offtg. Director, CIFT,
Cochin-682029 ... *Convener*

The Committee met three times during the year 1983 to review the working and progress of the Institute for the ten year period 1970-'80. It also held discussions on the programmes of the Institute for the next 5 years. A report was submitted to the Council incorporating recommendations for building up better infrastructural facilities, successful implementation of the future programmes, etc.

1.8 LIBRARY

During the year, 458 books and 78 bound volumes of journals were added to the collection of the Institute's library, bringing the total to 5422 books and 2353 bound volumes of journals.

One hundred and seventy five Indian and foreign journals together were subscribed during the period and 50 others received on gratis/exchange basis.

Indexing of current literature, compilation of bibliography of Fishery Technology, photocopying service, ready reference service etc. were continued. Inter-library loan facilities were maintained in collaboration with other libraries.

In addition to the scientists and staff of the Institute, visitors including students, teachers and research scholars from Universities, educational and research institutions and technical persons from the fishing and fish processing industries made use of the library facilities.

1.9 COMMITTEES REPRESENTED BY THE INSTITUTE

Director served on the following scientific and allied bodies.

1. *Chairman* .. Committee on Aquaculture Engineering Research and Training
2. *Chairman* .. ISI Sectional Meeting of AFDC: 27
3. *Member* .. Scientific Panel for Fisheries Research, ICAR
4. *Member* .. Board of Studies, Kerala Agricultural University
5. *Member* .. Board of Directors, Kerala Fisheries Corporation
6. *Member* .. Committee on Mechanisation of Boats in the Country
7. *Member* .. CIFNET Consultation Committee
8. *Member* .. CIFNET Upgradation Committee
9. *Member* .. Integrated Fisheries Project, Consultative Committee
10. *Member* .. Central Board of Fisheries
11. *Member* .. Committee on Utilisation of Trash Fish in Andhra Pradesh constituted by Department of Agriculture, Government of India
12. *Member* .. Task Force of the State Department of Science and Technology of Kerala State
13. *Member* .. Committee on Marine-Based Industries Constituted by Government of Kerala
14. *Member* .. Working Group for VII Plan Proposals of Department of Agriculture (Fisheries)

The following are the other Committees in which the Institute was represented.

1. *Shri M. R. Nair*, Scientist S-3:
 - a) Alternate Member: ISI, AFDC: 27, Fish and Fishery Products Sub-Committee
 - b) Principal Member: ISI, AFDC: 27 : 2, Frozen Fish Products Sectional Committee
 - c) Member: ISI, AFDC: 36:9, Metallic Contaminants Sub-Committee
 - d) Member: Panel of Experts for hearing appeals against rejection of canned prawns (Export-Inspection Agency, Cochin)
 - e) Member: Board of Studies in Mariculture (University of Cochin)
 - f) Member: Board of Examination, University of Agriculture, Bangalore.

2. *Shri R. Balasubramanyan*, Scientist S-3:
 - a) Alternate Member: ISI, MCPD-2, Indian Harbour Craft and Fishing Vessels Sectional Committee
 - b) Member: Marine Corrosion Sub-Committee of the CSIR
 - c) Member: Consultative Committee for FRP Technology of the National Council of Science and Technology
 - d) Member: Co-ordinating Committee of MPEDA, Cochin, to Promote Shark Fishing
 - c) Member: Co-ordinating Committee of MPEDA, Cochin, to Promote Lobster Fishing
 - f) Member: Expert Committee for the Acquisition of Trawlers for the Tamil Nadu Fisheries Development Corporation Ltd., Madras

3. *Dr. K. Ravindran*, Scientist S-3:
 - a) Subject Expert: Faculty of Marine Sciences, University of Cochin

- b) Member: Marine Cargo Movement and Packaging Division Council (MCPDC of ISI)
- c) Member: Standing Working Committee on Marine Cargo Movement and Packaging (SWCMC of ISI)
- 4. *Shri P. Appukutta Panicker*, Scientist S-3:
 - a) Member: Consultative Committee for Tuticorin, Vizhinjom and Cochin Base of Fishery Survey of India
- 5. *Shri V. C. George*, Scientist S-3:
 - a) CIFT Nominee: Co-ordination Committee of MPEDA on the Survey of Stake Nets in Kerala
 - b) CIFT Nominee: Inter-Institutional Infra-structural Facilities Evaluation Committee of ICAR Fisheries Institutes
 - c) CIFT Nominee: Advisory Committee for Tuna Long Line of MPEDA
- 6. *Shri T. S. Gopalakrishna Iyer*, Scientist S-3:
 - a) Member: Panel of Experts under IPQC|MIPQC Scheme—Cochin, Quilon, Alleppey, Trivandrum
- 7. *Dr. K. Gopakumar*, Scientist S-3:
 - a) Alternate Member: ISI, AFDC-27:5, Fish Meal Sub-Committee
 - b) Member: ISI Sub-Committee CDC 56:4 on Common Salt and Marine Chemicals
- 8. *Dr. T. K. Govindan*, Scientist S-3:
 - a) Member: Sub-Committee to Examine Amendments and Instructions for Fish and Fishery Products, Export Inspection Agency, Cochin
- 9. *Shri P. V. Prabhu*, Scientist S-3:
 - a) Principal Member: ISI, AFDC-27:5, Fish Meal Sub-Committee
- 10. *Shri S. Ayyappan Pillai*, Scientist S-2:
 - a) Member: ISI, MCPD-3:7, Sub-Committee on Machinery for Dredgers, Tugs, Hoppers, Barges and Mechanised Fishing Boats

- b) Member: National Committee of the International Institute of Refrigeration
 - c) Member: Executive Committee: Indian Cryogenic Council, South Zone
11. *Shri K. K. Balachandran, Scientist S-2:*
- a) Member: ISI, AFDC-27 : 1, Canned Fish Products Sub-Committee
12. *Shri K. Sreedharan Namhoodiri, Scientist S-2:*
- a) Member: ISI, MCPD - 21:2, Sub-Committee on Mechanised Fishing Boats
13. *Shri H. Krishna Iyer, Scientist S-2:*
- a) Member: Committee for Setting up a Computer at MPEDA
14. *Shri Cyriac Mathen, Scientist S-2:*
- a) Member: Panel of Experts under IPQC/MIPQC Scheme-Madras Region
15. *Shri T. K. Sivadas, Scientist S-2:*
- a) CIFT Nominee: Organising Committee, Second Indian Conference in Ocean Engineering, CWPRS, Pune
 - b) Member: Paper Selection Committee on Instrumentation for Ocean Projects
16. *Shri K. K. Solanki, Scientist S-2:*
- a) Member: ISI, AFDC-27, Fish and Fishery Products' Sub-Committee
 - b) Member: Panel of Experts under IPQC/MIPQC Scheme of Export Inspection Agency
17. *Shri H. N. Mhalathkar, Scientist S-2:*
- a) Member: Fourth Consultative Group Meeting of Mangalore Base of Exploratory Fisheries Project
18. *Shri K. A. Sadanandan, Scientist S-2:*
- a) Member: Co-ordination Committee Federation. Fisheries Co-operative Society, Hirakud Reservoir, Sambalpur

19. *Shri T. S. Unnikrishnan Nair*, Scientist S-2:
 - a) Alternate Member: ISI, AFDC-27:3, Dried Fish Products Sub-Committee
 - b) Member: Panel of Experts for Visiting the Fish Processing Plants under the IPQC Scheme
20. *Shri S. Gopalan Nayar*, Technical Officer, T-7:
 - a) Principal Member: ISI, TDC-42. Textile Materials for Fishing Net Purposes, Sectional Committee
21. *Shri A. P. Valsan*, Technical Officer, T-7:
 - a) Principal Member and Convener: ISI, AFDC-27:3., Dried Fish Products Sub-Committee
22. *Smt. K. Radhalakshmy*, Asst. Technical Officer, T-5:
 - a) Alternate Member: ISI, TDC-42, Textile Materials for Fishing Net Purposes, Sectional Committee
23. *Shri K. K. Kunjipalu*, Scientist S-1:
 - a) Member: Consultative Group for Exploratory Fisheries Project (Fishery Survey of India), Bombay and Probander Bases
24. *Shri V. Narayanan Nambiar*, Scientist S-1:
 - a) Member: State Level Committee for the Co-ordination of Work on Marine Fisheries, Maharashtra
 - b) Member: Panel of Experts for IPQC|MIPQC Scheme for Fish and Fishery Products and IPQC Scheme for Frozen Frog Legs for Bombay Region
25. *Shri K. N. Kartha*, Scientist S-1:
 - a) Member: Technical Committee on Improvement of Dry Fish Production Base in India, constituted by MPEDA, Cochin
26. *Dr. M. D. Varghese*, Scientist S-1:
 - a) Subject Expert: Doctoral Committee, University of Cochin
 - b) Supervising Guide: Ph.D. Degree (Faculty of Marine Sciences), University of Cochin

**1.10. SYMPOSIA/SEMINARS/MEETINGS/CONFERENCES/
WORKSHOPS/ETC. ATTENDED**

Shri M. R. Nair, Scientist S-2, attended Meeting convened by Honourable Minister of Community Development & Fisheries, Govt. of Kerala, to discuss the problems of pollution due to factory effluents, at Trivandrum, February 22, 1983.

Shri M. R. Nair & Dr. K. Ravindran, Scientists S-3, attended Meeting of ICAR Regional Committee No. 8, at Cochin, Sept 12 & 13, 1983. Shri. M. R. Nair also attended the meeting of the Sectional Committee of ISI, AFDC : 27 in joint session with its Sub-Committees. AFDC : 27:1 27:2 and 27:3 at Cochin, Sept. 20, 1983.

Shri K. Krishna Rao, Scientist S-2, attended the 7th Conference of Agricultural Research Statisticians of ICAR Institutes at Bangalore, July 28-30, 1983. One paper was presented at the Conference.

S|Shri V. C. George, P. Appukutta Panicker, Scientists S-3 and K. Sreedharan Namboodiri, Scientist S-2, attended Seminar on Artisanal Fishing Technology, organised by Centre for Appropriate Technology, at Quilon, March 18-20, 1983.

Dr. P. G. Viswanahtan Nair, Scientist S-2, attended All India Seminar on Trends in Instrumental Analysis jointly organised by Hinditron Services P. Ltd., Bombay, in collaboration with M|s Varian, Switzerland and Indian Chemical Society, Bombay Branch at Bombay, April 11-13, 1983.

S|Shri K. G. Ramachandran Nair, Scientist S-2 and M. R. Raghunath, Scientist S-1, attended 3rd Indian Convention of Food Scientists and Technologists, organised by Assn. of Food Scientists and Technologists (India), at Mysore, June 2-4, 1983. Two papers were presented at the Convention.

Shri A. P. Valsan, Technical Officer, attended All India Conference on Pre-shipment Inspection, jointly organised by Indian Institute of Foreign Trade and Export Inspection Agency, at Bombay, July 15 & 16, 1983.

Shri V. C. George Scientist S-3, attended Workshop on Supporting Technologies Appropriate for Rural Development with Particular Reference to Kerala, at Vellanad, October 2, 1983. A paper was presented at the Workshop.

Dr. P. K. Surendran, Scientist S-2, attended 53rd Session of the National Academy of Sciences, India, at Goa, October, 27-29, 1983. A paper was also presented at the Meeting.

Shri T. K. Sivadas, Scientist S-2 attended Seminar on Underwater Transducers, organised by National Physical and Oceanographic Laboratory, at Cochin, November 8-10, 1983.

Shri K. Sreedharan Namboodiri, Scientist S-2, attended Seminar on Fuel Economy in Deep Sea Fishing organised by Assn. of Indian Fishery Industries, Visakhapatnam, November 11 & 12, 1983.

Shri V. C. George, Scientist S-3, attended Orientation Training Course on Fisheries Extension organised by Directorate of Fisheries, Trivandrum, at Cochin, December 21 & 22, 1983.

Dr. C. C. Panduranga Rao, Offtg. Director, Dr. K. Ravindran, Scientist S-3 and S|Shri T. K. Sivadas, Scientist S-2 and P. N. Joshi, Scientist S-1, attended 2nd Indian Conference in Ocean Engineering (INCOE-'83), at CWPRS, Pune, December 14-16, 1983. Five papers were presented at the Conference.

Shri S. M. S. Abuthahir Ali, Scientist S-12, attended Conference on Environmental Management in the Chemical Industry, organised by Indian Institute of Chemical Engineers, at Pune, January 4-7, 1984. A paper was presented at the Conference.

Shri T. K. Sivadas, Scientist S-2 attended Third World Instrumentation Symposium (India-'84), at New Delhi, January 11-14, 1984. A paper was also presented at the Symposium.

Shri S. Sanjeev, Scientist S-1, attended 29th Annual Conference of Indian Public Health Association at IVRI, Izatnagar, February 10-12, 1984. A paper was presented at the Conference.

S|Shri A. P. Valsan, Technical Officer and V. Narayanan Nambiar, Scientist S-1 attended Workshop on the Identification of Minimum Vocational Competencies in Fisheries, jointly organised by National Council of Educational Research and Training and Central Institute of Fisheries Education, at Bombay, March 19-24, 1984.

Shri P. V. Prabhu, Scientist S-3, participated in the National Symposium on the Oceans: Realities and Prospects, organised by the Dept. of Ocean Development, Dept. of Fisheries, Ministry of Agriculture and Jawaharlal Nehru University, New Delhi, March 26-28, 1984. A paper was presented at the Symposium.

1.11. FELLOWSHIP/TRAINING/DEPUTATION

Shri T. K. Srinivasa Gopal, Scientist S-2, was awarded a Fellowship by the Norwegian Agency for International Development (NORAD)

for undergoing a diploma course in fishing and fish technology at the University of Trondheim, for a period of 10 months from 23 August 1983.

Twelve S-1 Scientists attended the different Orientation Courses in Agricultural Research Management at the National Academy of Agricultural Research Management (NAARM), Hyderabad during the year under report. They are S|Shri T. Joseph Mathai, V. Muraleedharan, P. George Mathai, T. P. George, K. George Joseph, K. Ramakrishnan, N. Unnikrishnan Nair, P. Srinivasa Rao, G. Rajagopalan Unnithan, V. Vijayan, J. Sitharama Rao and Francis Thomas.

Dr. K. Devadasan, Scientist S-3 and Shri Cyriac Mathen, Scientist S-2 also attended the Course on Agricultural Research Project Management at NAARM.

1.12. AWARD/DEGREE

The University of Cochin awarded Ph.D. degree to the following Scientists during the year.

Shri M. K. Mukundan, Scientist S-2, for his thesis "Studies on Fish Lipases". He conducted his studies under the supervision of Dr. K. Gopakumar, Scientist S-3, CIFT.

Shri T. K. Govindan, Scientist S-3 for his thesis "Studies on the freezing technology of commercially important species of prawns".

Shri K. Devadasan, Scientist S-3, for his thesis "A comparative study of the muscle proteins of fishes and shell fishes of tropical waters". He conducted his studies under the guidance of Dr. K. Gopakumar.

Shri M. Arul James, Scientist S-2, for his thesis "Studies on microbial pathogens, *Salmonella* and *Vibrio parahaemolyticus* in selected marine products". Shri James conducted his studies under Prof. (Dr.) C. T. Samuel, Dean, Faculty of Marine Sciences and Head of Department of Industrial Fisheries, University of Cochin.

1.13. VISITORS

The visitors to the Institute during the period include:

1. Expert team from NORDCO Ltd., Newfoundland, Canada.
2. Four Chief Fisheries Officers from Nigeria, Mr. Alhaji D. D. Apanpa, Mr. Tola Ojo, Mrs. E. Opulah and Mrs. Agbalajobi, sponsored under Artisanal and Inshore Fisheries Devt. Project, Lagos under the FAO.



H. E. Mr. Abdul Gayoom, President of Maldives in the gear laboratory



In the craft laboratory



*Dr. E. M. Thain, Director, Tropical Development and Research
Institute, London, in the processing laboratory*

3. Dr. Farouq Noorudin Qasim, Director of Institute of Fish Wealth, Aden.
4. Mr. S. Bama, Director of Fisheries, West Bengal.
5. Dr. K. Sivasubramanian, Sr. Fishery Biologist, Marine Fishery Resources Management in the Bay of Bengal, Colombo.
6. French team of Engineers from French National School for Rural Development of Water and Forests, Paris.
7. His Excellency, Maumoon Abdul Gayoom, the President of Republic of Maldives accompanied by his wife and Foreign Minister.
8. A Fish Quality Control Study Team of 3 Maldivian officials.
9. Mr. Khin Maung Aye, Mr. Hla Tun Kyaw and Mr. Zeya, FAO Fellows from Burma.
10. French team of Experts from CNEXO, France-Mr. Aubert, CNEXO Head of Promotion Exportation Office and Mr. Michel, Head of Aquaculture Programs Office of CNEXO, France accompanied by Mr. P. K. Jethi, Industrial & Engineering Projects P. Ltd., Bombay.
11. Dr. E. M. Thain, Director, Tropical Devt. and Research Institute, London.

Dr. C. D. Wood, Scientist (Fishery Technologist) of Tropical Development and Research Institute London visited C.I.F.T., Cochin, during October and November 1983 as a part of the collaborative Research Project between CIFT and TDRI, London. During this visit, Dr. Wood worked in the laboratory of the Processing and Packaging Division of CIFT and studied the different aspects of production of fish minces from shrimp by-catch and other low cost fish.

1.14. NATIONAL AGRICULTURAL INPUT FORTNIGHT

As a part of the programmes held in connection with the National Agricultural Input Fortnight, the Institute conducted group discussion with fishermen of Saudi, a fishing village near Cochin, and demonstrated the application of an improved wood preservative for use on the traditionally used country crafts. About 75 fishermen and women participated in these discussions.

The objective of this programme was to make the fishermen aware of the new technologies developed at the Institute for maintenance of their

fishing craft and to help them enhance their fish landings by operation of improved designs of fishing gear.

A question-answer session was part of the discussions in which doubts were cleared and means of solving various technical problems pointed out. The fishermen were appraised of the possibilities of self employment by undertaking fabrication of trawl nets based on the Institute's know-how which would be imparted through training and demonstration as also by utilising less economic fish for production of diversified products.

The preservative, CREOSCOR- a CIFT formulation- was applied on a 15.25 m plank built canoc.

Samples of the wood preservative, fishing gear materials and some of the processed fish products were also displayed for the benefit of the participants.

At Calicut, a demonstration-cum-training programme was held on improved methods of salt curing and smoking of fish and minced meat.

1.15. QAUMI EKTA WEEK

The Institute also joined the nation in observing the Qaumi Ekta or National Integration week during 19-25 November 1983. Exhibitions were organised in schools and other places in and around Cochin and opportunities given to students of local colleges to acquaint themselves with the various activities of the Institute.

1.16. LAB-TO-LAND PROGRAMMES

During the year under report, bench mark surveys were conducted of 35 families at Puthiyappa (Calicut District) and 25 families at Puthivaippu (a fishing village in Ernakulam) for transfer of technologies on fabrication of high opening trawl and improved preservative for traditional crafts.

At Vaikom (Kottayam Dt.) a preliminary survey was conducted on the catch, handling, preservation and marketing of the clam meat with a view to selecting 15 families under this programme.

1.17. SCIENTIFIC TALKS

The Scientific talks continued as one of the regular activities of the Institute in which the Scientists evinced keen interest. Dr. K. Ravindran, Scientist S-3 (Convener) formulated the programmes for the Scientific



Application of the improved chemical preservative on a traditional craft in progress

talks which were presided over by Dr. C. C. Panduranga Rao, Offg. Director. A list of talks held during the year is given below:

<i>Date</i>	<i>Name of Speaker</i>	<i>Topic</i>
26-4-83	Dr. H. R. S. Sastri	Antartica Expedition
20-7-83	Shri P. K. Chakraborty Scientist S-2 (Chemical Engineering)	Artificial dehydration in fish processing industry.
9-11-83	Shri T. S. G. Iyer, Scientist S-3 (Fish Processing Technology)	<i>Salmonella</i> Serotypes in fishery products.
16-3-84	Dr. E. M. Thain, Director, Tropical Development and Research Institute London.	Activities of the TDRI, London.

2. PROGRESS OF RESEARCH

HEADQUARTERS: COCHIN

2.1. CRAFT MATERIALS:

(R. Balasubramanyan, Dr. K. Ravindran, N. Unnikrishnan Nair,
A. G. Gopalakrishna Pillai).

2.1.1. CHIEF FINDINGS

A galvanic anode free from mercury for use in cathodic protection of fishing boats and metallic marine structures has been developed for the first time in India. Extensive field trials carried out with copper creosote on indigenous crafts at Chellanam, Saudi and Puthuvypeen fishing villages in Kerala have shown that copper creosote is more efficient in preventing biodeterioration and is also more economical compared to the traditional preservatives normally used by the fishermen.

A high build oil bound wood preservative incorporating resin and copper compounds in creosote for use on indigenous fishing crafts was also developed. Apart from its prophylactic properties against fungi, the preparation, termed CREOSCOR, imparts a smooth surface finish to the craft enabling its smooth sailing in water. Copper creosote and CREOSCOR are both novel preservatives and adoption of these marks a breakthrough in the preservation of indigenous crafts.

2.1.2. RESEARCH IN HAND

Boat Building Materials

Fibreglass reinforced plastic

The performance of a FRP light fishing craft constructed by a private boat yard based on the technology developed at CIFT is being monitored and studied.

Ferrocement

Studies were conducted on the stress-strain behaviour of polymer incorporated ferrocement in tension. Among other aspects, the study has thrown light on inter-facial binding and puncture strengths of polymer impregnated ferrocement (PIFC) which are parameters of major importance in the designing of fishing craft and other structures.

Marine plywood

The effect of toxic wood preservatives developed by the Institute on preventing rotting of marine plywood is being assessed.

Marine corrosion

Service trials are in progress of the mercury free ternary aluminium anodes to evaluate their field performance. Development of such mercury free galvanic anodes is a significant contribution in the wake of the proposed legislation barring use of mercury containing anodes in marine environment owing to possibility of mercury contamination of the environment.

Toxic wood plastic composites

The rate of absorption of sea water and distilled water on samples of toxic wood plastic composite and ordinary wood plastic composite (without toxin) incorporated Balsa, Aini, Mango wood and Haldu at different intervals was studied. The irradiated panels showed reduced absorption values compared to the untreated parent timber samples. Among the treated timbers, Mango wood had the maximum absorption value. The reduced water absorption characteristic of polymer impregnated wood is advantageous, especially for fishing crafts, as greater absorption of water by normal timber results in considerable increase in weight of such structures.

2.1.3. RESEARCH CONTEMPLATED

1. Design, development and standardisation of fishing craft above 16 m. OAL, including combination vessels

2. Design, development and construction of smaller crafts out of aluminium, ferrocement, vulcanized reinforced rubber and fibreglass
3. Further studies on wood plastic composites, toxin incorporated wood plastic composites, polymer impregnated ferrocement, marine aluminium alloys and cupronickels, vulcanized rubber
4. Studies on chemical wood preservation by the establishment of noble wood preservation plants at selected locations
5. Further studies on marine coatings, anodes and other corrosion and fouling control measures

2.2. GEAR

(V. C. George, P. Appukutta Panicker, Dr. K. Ravindran, S. Gopalan Nayar, Dr. M. D. Varghese, K. N. Kartha, T. M. Sivan, N. A. George, T. P. George, P. George Mathai, K. Radhalakshmy, K. V. Mohan Rajan, A. C. Kuttappan, B. Meenakumari)

2.2.1. CHIEF FINDINGS

Comparative trials carried out with 32 m. large mesh demersal trawl is 50% more than that of the four panel trawl.

Survey of the trawl gear operated by large vessels show that changes have been effected in the initial Mexican designs to suit the local fishing conditions.

Field trials carried out with HDPE yarn (0.25 mm-dia) gill nets in comparison with nets made of nylon multifilament 210/1/2 twines have shown that the former can serve as an alternative material for the latter in fabrication of small meshed gill nets.

2.2.2. RESEARCH IN HAND

Design details were worked out for three types of rectangular cambered otter boards.

Comparative fishing operations were carried out with 32 mm BOBP and long wing trawls. The catch/hr. of fish of the former was better than that of the latter. Prawn catch was reported nil.

Two vertical curved otter boards of size 2240 mm x 1120 mm (each of 200 Kg. weight) were fabricated and tested under actual fishing conditions in combination with 24 m. equal panel midwater trawl. Studies are being continued.

On the basis of information gathered from the fishing cruise conducted on board *MFV 'Saraswathy'* of the Central Institute of Fisheries Education, Bombay, designs were developed for three types of mid-water trawls for operation from such class of vessels.

A survey was conducted of the fishing gear operated from 22 and 23 m. Mexican trawlers belonging to about twenty organisations based at Visakhapatnam. Most of the vessels are rigged with two, four seam shrimp trawls of H. R. length 24-26 m. and provided with long wings and overhang. Jibs were of single straight or slanting types or of the double slanting pattern. Throughout the body of the net, a uniform mesh size (50-55 mm) has been adopted. At the cod end, the mesh size ranged from 35-40 mm. The body of the net is fabricated out of 2 mm dia HDPE twines and the cod end, of 2.5 mm dia twine. The design aspects reveal that considerable changes have been brought about in the original design to suit the local fishing conditions.

Based on preliminary observations made on board *R. V. Skipjack* of CMFRI, design details of 40 m. triple bridle four seam trawl and 40 m. two seam trawl were finalised as also that of a 2200 x 1100 mm. otter-board of 390-425 Kg.wt

A mini purse seine, designed, developed and operated from the local traditional crafts with cost benefit aspects in now ready for large scale adoption in the small scale fishing sector.

The existing 'thanguvala' (one boat seine) and its operations have become more productive consequent on motorization of the crafts and intensified fishing operations off Cochin.

Metal lobster traps standardised by CIFT continued to maintain their popularity along the Kanyakumari coast of Tamil Nadu and Vizhinjam coast of Kerala. The trends in the seasonal landings at all centres were closely watched and the morphometric data of the commercial landings collected to study the size groups, weight and sex so as to recommend suitable conservative measures. The existing escapement gaps provided in the traps are also being closely watched for the effective, automatic release of under-sized juveniles.

Comprehensive bait studies were also made using diesel soaked brick, diesel soaked cotton waste, crushed sea-urchin, cattle hooves and the conventional live mussels and the comparative efficiency of each bait system studied.

Design details have also been finalised of an outdoor aquarium for fish behaviour studies.

A cast net was fabricated with polypropylene twine of specification 190/1/2 and field trials initiated. Studies are being continued.

Polypropylene twines of different diameters were subjected to ultraviolet radiation and the co-efficient of deterioration 'k' determined based on the breaking strength of the twine before and after exposure to the UV radiation for varying lengths of time. Studies are continued.

2.2.3. RESEARCH CONTEMPLATED

1. Model testing of midwater trawl designs for operation from large vessels
2. Fabrication and operation of demersal trawls
3. Behaviour studies of fish in the vicinity of the net both under controlled conditions and on board the vessel
4. Improved methods of crab fishing for enhancing present commercial production

2.3. FREEZING

(Dr. K. Gopakumar, P. A. Perigreen, Chinnamma George, Jose Joseph, P. R. Nair, Nirmala Thampuran).

2.3.1. CHIEF FINDINGS

Fresh squid iced on board and frozen as mantles, remained in acceptable condition even after 13 months storage.

Studies on the individually quick frozen (IQF) and block frozen mackerel were completed. The block frozen glazed samples have better shelf life compared to the IQF samples.

Absolutely fresh oil sardine (fat content 29.77% on DWB) frozen as glazed blocks remained in edible condition for 9 months at -23°C.

2.3.2. RESEARCH IN HAND

The frozen storage characteristics of squids with different initial qualities were studied at -23°C. Fresh squid iced immediately after catch for four hours and frozen as mantles were acceptable at the end of 13 months' storage while mantles, frozen after storage in ice for 24 hours became unacceptable. The mantles lost their characteristic flavour, texture became fibrous and colour turned poor. In all the samples, protein solubility remained higher than 60% upto 6 months' storage, after which it

decreased. The α amino N content was more in the fresh frozen samples compared to the others.

Studies were completed on the freezing and storage characteristics of mackerel at -23°C . IQF mackerel (fat content 10% on wet weight basis) had a shelf life of only 20 weeks at -23°C and on storage for 24 weeks, showed rancidity and textural changes. The block frozen glazed samples had better shelf life and were just acceptable after 36 weeks of frozen storage. The quality of the meat with respect to texture and taste had however, deteriorated to some extent. It was also observed that mackerel with low lipid content produced less trimethyl amine, had higher peroxide but low TBA values, with greater release of free fatty acids. Shelf life was also longer compared to mackerel with high fat content.

Comparative studies were carried out on the quality of cutlets prepared using minces from lizard fish, threadfin bream and miscellaneous fishes (comprising soles, jew fish etc.) Cutlets prepared from lizard fish and thread fin bream were of good organoleptic quality; but those prepared from miscellaneous fishes were of slightly inferior quality. Tapioca was successfully used in preparation of the cutlets in place of potato.

The storage characteristics of cutlets (both raw and fried) prepared from lizard fish meat were also studied at 2 to 4°C , -8° to -10°C and -20°C to -23°C for changes in chemical, bacteriological and organoleptic characteristics. The product stored at 2 to 4°C remained in good condition for 5 to 7 days and those stored at -8 to -10°C for 3 months. Cutlets stored at -20 to -23°C were acceptable even after 5 months' storage.

2.3.3. RESEARCH CONTEMPLATED

1. Further studies on freezing cuttle fish
2. Studies on freezing and storage of fatty fishes

Investigations on effect of spices on the quality of frozen minced fish and development of products from minced fish

2.4. CANNING

(K. K. Balachandran, P. V. Prabhu, P. K. Vijayan, Dr. P. K. Surendran).

2.4.1. CHIEF FINDINGS

Storage life of fish canned in curry, either incorporating red chilly or pepper powder, was assessed to be a maximum of 18 months, based on organoleptic qualities.

A recipe was worked out for processing canned prawn curry. In processing light smoked canned frog legs and smoked mussel direct smoking was found to yield a better product than addition of smoke liquor.

Preliminary studies carried out on canning fresh water fishes, rohu and mrigal, have shown that under identical conditions of processing, mrigal exhibits better texture compared to rohu.

Considering the extent of depuration, mortality and bacterial quality, starvation in water from the natural habitat was rated the best method for depuration of live clams.

2.4.2. RESEARCH IN HAND

Storage studies were undertaken for a period of 20 months on fish canned in two curry formulation, one incorporating red chilly and the other, pepper powder. In the case of the former, at the end of 18 months, the can lacquer, particularly at the ends, was seen affected. Corrosion had taken place in areas subjected to mechanical strains, like can ends and the areas adjoining the seams. The curry also developed a slight bitter taste, contributed perhaps by the dissolved lacquer. At the end of 20 months, the bitter taste intensified, the internal corrosion became more prominent and the curry acquired a definite lacquer taste. In the case of the latter sample, both can and contents remained intact upto 16 months. By the end of the 20th month, the curry started developing a bitter taste. Corrosion of the can interior was however absent.

After experimenting with several recipes, an acceptable one was worked out for canning prawn in curry, taking into consideration the extent of retention of original characteristics like taste, flavour, consistency etc., after heat processing. The product obtained according to this formula stored well for a period of nine months, without either the organoleptic qualities of the product or the can interior being affected.

Studies were undertaken on canning light smoked frog-legs and smoked mussel meat. In order to have better control over the smoke flavour imparted to the product in the case of light smoked froglegs, addition of liquid smoke to the product was tried. Smoke generated by burning coconut husk or saw dust was passed through water. This after filtration was diluted to yield an acceptable smoke flavour and then added to the frog-legs in cans and processed. But an acceptable flavour in the product could not be got. Direct smoking was therefore tried. By smoking froglegs directly for 30 minutes and then canning, an acceptable light smoked product could be obtained.

In the case of processing smoked mussel meat also, the same was the case. Attempts made using smoke liquid did not yield any satisfactory result. Direct smoking of steamed and shucked mussel meat for two hours at 60°C followed by canning yielded a good, acceptable product.

To work out the processing requirements of canning freshwater fish, studies were carried out using mrigal and rohu collected from a fish farm. Skinless, boneless fillets were processed in different ways, like 'salmon style' as well as after various pre-treatments, in unlacquered quarter dingley cans. From initial observations made, it is seen that of the different products, those canned in tomato sauce were most acceptable, both in case of mrigal and rohu. Inter-species difference in quality, particularly with regard to texture was also noticed. Mrigal yielded a product better in texture. On storage, the can lids were found slightly corroded in all cases where rohu was concerned and those canned in 'Salmon style' in the case of mrigal. In cases where both the fishes were canned in tomato sauce, corrosion was observed throughout the cans.

Studies were undertaken to evolve a standard, suitable method for depuration of live clams for utilising the meat for further processing. Different methods were tried and their relative efficiencies compared taking into consideration the extent of depuration achieved, mortality as also the bacterial property of the resultant meat. Water collected from their natural habitat, potable water and dilute salt solution (the concentration of which was made upto that of natural water), all chlorinated to 5 ppm level, were separately used for depuration. It was observed that depuration in water from the natural environment gave the best results under laboratory conditions.

Studies were also initiated to determine the optimum tin coating required for cans. Cans with two different levels of internal coatings of tin further lacquered with S-R lacquer manufactured by M/s Poysa Industrial Co. were used in the studies. Prawns were packed in these cans under the standard conditions and stored at two different temperatures viz. room temperature and 37°C. At the end of one month's storage, no discernible difference was observed in the samples kept at either of the temperatures. Further studies are in progress.

2.4.3. RESEARCH CONTEMPLATED

1. Further studies on storage of canned fish|prawn curry
2. Further studies on smoked fish|shell fish and canning fresh water fish
3. Solid loss during different stages of canning and its prevention

4. Heat penetration in canned fish and shell fish
5. Evaluation of bacterial safety in canned fish

2.5 IDRC PROJECT: FISH PROCESSING - INDIA

(Dr. C. C. Panduranga Rao, P. V. Prabhu, K. K. Balachandran, S. Ayyappan Pillai, G. R. Unnithan, Francis Thomas).

i) *Installation and operation of one-tonne tunnel dryer*

Installation of the tunnel dryer was completed during this period. Trial runs carried out on drying of fish indicate the need for certain modifications to be implemented for the satisfactory performance of the dryer. The air distribution system required modification for obtaining uniform air velocity at different levels of the drying tunnel, which was achieved by providing required type of baffle plates. The air velocity was found inadequate in the initial trials, which was rectified by suitably increasing the RPM of the blower. The air recirculation duct was insulated to reduce the noise.

Drying trials were carried out using *Anchoviella*, *Nemipterus* sp and *Johnius* sp. The resultant products were good in all characteristics and could be readily sold fetching higher rates than those prevailing in the market. Further data on temperature and energy requirements, labour, drying time etc for assessing the cost of production will be carried out in the ensuing year.

ii) *Studies on smoking of fish*

Studies were undertaken in the laboratory for arriving at the optimum smoking conditions required to yield a palatable smoked fish product. Pre-treatment conditions like extent of salting, extent of initial drying to facilitate proper absorption of smoke on surface, temperature of smoking, source of smoke etc. and their effect on the quality of the product and its safe storage after processing are being subjected to detailed study. From the initial studies conducted using jew fish and lactarius, it was found that immersing split open fish for 10 minutes in saturated brine followed by drying under sun for two hours and then smoking for 2-3 hours at a temperature around 50°C yielded a good product. The smoked fish was further dried under sun for 2-4 hours to bring down the moisture to a satisfactory level for safe storage. Saw dust from five different species of wood were used as source of smoke. From initial experiments it was observed that the colour of the smoked product was excellent with jack wood saw dust and the taste with 'anjili' wood dust.

iii) *Installation of smoker/dryer at KFC*

The smoker/dryer was installed at Kerala Fisheries Corporation. The chamber was modified by providing an inner aluminium lining and trial runs carried out using jew fish. Some problems like non-uniform distribution of smoke were encountered during the trials. Hence, modifications are being worked out to overcome these and the smoker is expected to be ready for operation in the coming year.

iv) *Marinated mussel meat*

Studies were continued on the amenability of mussel meat for marinating as a short term preservation method. Whole mussels were steamed, the meat shucked out, washed well in clean water and kept immersed in 4% acetic acid overnight. The meat was drained and packed in 4% acetic acid containing (1) 1% salt, (2) 2% salt, (3) 3% salt, (4) 4% salt and in 2% acetic acid containing (1) 2% salt, and (2) 4% salt. in glass bottles and stoppered well. A few samples were kept exposed to light and others in the dark. The former developed brownish colour at the top in two weeks' time, compared to one month in the latter. All the samples had high acid taste. The samples packed in 2% acetic acid containing 4% salt were better in taste and could be used for further preparations.

v) *Marinated sardines*

Dressed sardines were kept in 4% acetic acid solution containing different proportions of salt. All the samples became very soft in a week's time and further storage rendered them unsatisfactory. The sardines were therefore partially fried and marinated. Although this procedure retained the texture of the fish better, the process was not found very satisfactory.

vi) *Canning of sardine-natural pack*

Cans required for experimental production and test marketing of sardine in natural pack were procured and some sample cans were prepared and handed over to Kerala Fisheries Corporation.

The high cost of sardines resulting from the poor landings in Cochin and other adjoining areas stood in the way of large scale canning of sardine being taken up.

Survey of dry fish markets

The survey of dry fish/salt cured fish production and marketing centres in Kerala was continued. Comprehensive data have been collected on different aspects connected with the trade.

Regular surveys were undertaken on the quality of dry fish available in a major market with a view to collecting information on the quality of fish sold from time to time and comparing with the quality of fish produced by the improved method.

2.6 PROTEINS. ENZYMES & LIPIDS

(M. R. Nair, Dr. K. Devadasan, P. D. Antony, A. G. Radhakrishnan, Dr. P. G. Viswanathan Nair, Dr. Jose Stephen, Dr. M. K. Mukundan, K. Ammu).

2.6.1. CHIEF FINDINGS

Heat treatment of fish muscle in an aqueous medium enhanced the rate of subsequent hydrolysis of muscle proteins by trypsin. Sardine lipase was found to be specific for the α -ester bond in triglycerides. In all fishes studied, hepatopancreas recorded the highest lipase activity. Six marine bacterial strains, showing lipase elaboration above 7 units/ml of culture filtrates, were isolated. Unsaturated fatty acids were found to be more powerful protein denaturants compared to saturated acids of the same chain lengths. Sardines were richer in dicarbonyls, acetaldehyde, 2-hexanone etc. whereas formaldehyde, propionaldehyde, acetaldehyde, acetone etc., were more in mackerels. Fresh water fishes in general showed low autolytic protein degradation.

Oxidized fish oil, when incorporated in feeds, adversely affected feed intake, and protein digestibility and consequently the growth rate. The effect was more or less proportional to the extent of fat oxidation. The level of toxic amine produced from amino acids by endogenous amino acid decarboxylases was very low. Red meat of fishes was found to be nutritionally superior to white meat as indicated by feeding trials using albino rats. The lipase and protease activities in serum and liver of the animals fed on red meat were higher than of those fed on white meat.

2.6.2. RESEARCH IN HAND

Coagulation of fish sarcoplasmic proteins in solution was studied using 11 different fish species. It was pronounced above 55°C. Non-protein nitrogen showed irregular variations, whereas -SH content generally showed an initial rise followed by decrease. Changes in the electrophoretic

patterns were also studied as a function of heating temperature, keeping the time, pH of the extract etc. constant.

Rate of tryptic hydrolysis of fish muscle protein increased after a preliminary heat treatment of the muscle in aqueous medium. Sardine lipase was found to be specific for the α -ester bond in triglycerides. Several species of fresh water fishes were screened for the lipase activities in their muscle and hepatopancreas. Rohu alone showed high levels of lipase activity. Hepatopancreas was generally the richest part in lipase activity followed by red meat and then white meat.

A number of strains of marine bacteria were screened for lipase activity and 6 of them showed lipase elaboration above 7 units/ml of the culture filtrate.

Fatty acid induced protein insolubilization in fish muscle was studied using different fish species, fatty acids etc. at different pH levels. Unsaturated fatty acids insolubilized proteins to a greater extent, compared to saturated fatty acids of the same chain length.

Carbonyls from sardine and mackerel muscle were isolated and identified. Saturated aldehydes and methyl ketones were present in both. Sardine muscle had a higher carbonyl content than mackerel. Sardines were richer in dicarbonyls, acetaldehyde, 2-hexanone etc, whereas mackerel muscle had higher amounts of formaldehyde. Propionaldehyde, acetaldehyde, acetone etc. were also detected in both cases. Autolytic protein degradation was very feeble in pearl spot upto 4 hours. Freezing and thawing of muscle, incorporation of activators like cysteine etc. did not increase autolysis significantly. This low level of autolysis appears to be a characteristic feature of fresh water fishes.

The content of endogenous amino acid decarboxylases is not significant in causing histamine toxicity in oil sardine and mackerel. The levels of toxic amines cause concern only in highly advanced state of spoilage.

Oxidized fish oil incorporated feed preparations adversely affected the feed intake, protein digestibility and consequently growth rate, the effect being more or less proportional to the extent of fat oxidation.

Red meat from fish samples was nutritionally superior to white meat. It increased the metabolic activity of the fed animals as far as protease and lipase activities were concerned.

The biochemical and nutritional evaluation of fish solubles from different fish species are under way. Investigations are also being carried out to assess the costly/quality fishes in relation to their nutritional status among other food fishes.

2.6.3. RESEARCH CONTEMPLATED

1. Effect of heating fish muscle in an aqueous medium on coagulation of proteins, rate of protein hydrolysis by proteolytic enzymes etc
2. Isolation and characterization of lipase from fishes and bacterial sources
3. Lipid induced protein denaturation in fish muscle, using invitro model systems
4. Isolation and identification of carbonyls from fish muscle
5. Autolysis in marine fishes, shell fishes and fresh water fishes-a comparative study
6. Toxic amines in food fishes
7. Nutritional evaluation of fish solubles
8. Effect of red and white meat of fish on the enzyme systems in albino rat
9. Mechanism of hypocholesterolemic effect of fish lipids and proteins

2.7. FISH MICROBIOLOGY

(K. Mahadeva Iyer, M. Arul James, Dr. P. K. Surendran, Nirmala Thampuran, S. Sanjeev, K. V. Lalitha)

2.7.1. CHIEF FINDINGS

Studies on the nature of bacterial flora associated with brackish water fishes viz. 'Attuwala' (Wallago attu) and Mullet (Mugil cephalus) and fresh water fish Ophio cephalus have shown that the total plate counts (TPC) of these at 37°C were significantly higher than those at room temperature, indicating the prevalence of higher number of mesophiles in these fishes compared to the marine fishes, where the counts at room temperature were always higher than those at 37°C. Coliforms including E. coli, Streptococci and Staphylococci were also seen associated more with the brackish water fishes.

2.7.2. RESEARCH IN HAND

Studies were initiated on the stress or injury caused to *E. coli* cells as a result of freezing and storage and also to find out the effect of medium on the recovery of freeze-stressed *E. coli*. The percentages of unharmed,

dead or injured cells of *E.coli* on account of freezing and storage at low temperature were determined. An agar medium was also standardised for use in the droplet technique for enumeration of bacteria in fishery products.

The relative distributions of facultative anaerobic and obligate anaerobic bacteria on fresh sardines just landed and specimens obtained from the fish markets were studied. Clostridial count was almost nil on the skin of fishes collected from the market. However, levels of $1.07 \times 10^3/g$. to $9.3 \times 10^2/g$ of the organisms were observed in the gut contents of the fish. Studies were also made on the biochemical characteristics of the strains isolated.

2.7.3. RESEARCH CONTEMPLATED

1. Further studies on the nature of the microflora on brackish water fishes and their taxonomy including their principal physiological and biochemical functions
2. Regeneration of stressed cells
3. Distribution and nature of pathogenic bacteria in fish.

2.8. QUALITY CONTROL OF FISH AND FISH PRODUCTS

(T. S. Gopalakrishna Iyer, Cyriac Mathen, P. R. G. Varma, Dr. P. T. Lakshmanan, Francis Thomas)

2.8.1. CHIEF FINDINGS

Studies carried out on the effect of delayed icing on the quality and shelf life of cat fish, prawn and rohu indicated that delay in icing seriously affected the shelf-life of the fish.

Incidence of Salmonella in frozen seafoods collected from Cochin was found to be below 2%. Vibrio cholerae was absent in all the samples tested.

2.8.2. RESEARCH IN HAND

A detailed study was undertaken on the quality of ready-to-eat fish items served to the public through hotels and restaurants in Cochin City. A total of 101 samples comprising fish fry (48), fish curry (43) and fish/prawn pickle (10) were drawn from 34 different hotels and analysed for various quality parameters. Important observations made were:-

- i) All the samples were free from *Salmonella* and *V. cholerae*.
- ii) Coagulase positive *Staphylococci* were present in 6% and 2.5% of the fried and curry samples respectively.

- iii) The curry samples were better than fried samples in all aspects (except for the presence of *E. coli*).
- iv) Five percent of the curry samples had *E. coli*.
- v) About 70% of the prawn|fish pickles tested were below average in taste. The major defect detected in the prawn pickle was the crumbling nature of the prawn. In the case of fish pickles, the solid pieces of fish were rather hard to chew.
- vi) There was not much change in the samples of fish fry when kept overnight at refrigerated temperatures. But in the case of samples of fish curry, there was considerable change in quality, the bacterial load increasing 10 times, although the change in the taste of the product was only slight.
- vii) Fried fish samples stored at room temperature had acceptable taste upto 9-12 hours, whereas the curry samples remained in good condition upto 6-9 hours only.

The dry matter contents of about 210 samples of commercially frozen and thawed shrimp meat were found to average 14.3% compared to 13.6% in commercially available raw shrimp meat, 24.5% in meat from freshly caught prawns and 20.4% in fresh shrimp meat after freezing and thawing.

'Thelly' prawn meat was subjected to treatment with a solution of sodium tri-polyphosphate, potassium hydrogen phosphate, sodium hydrogen phosphate and sodium chloride, frozen as blocks of 2.37 kg. each and stored in frozen storage. Drained weight was retained upto one month, after which there was appreciable fall.

Studies were continued on the effect of delayed icing on the quality and shelf life of fish. It was observed that the shelf life of fish was seriously affected by delay in icing. For eg. rohu, iced immediately after catch, was acceptable upto 20 days of storage in ice. But, if icing was done nine hours after catch, the shelf life was reduced to six days..

About 146 samples of canned fishery products consisting of tuna, mackerel, sardine, marlin, perch, prawns, crab, mussel and oyster were tested for the presence of heavy metals like Hg., Cu, Zn, Fe, Cd, Pb, Sn and Mn. Results indicate that the contents, of heavy metals were not at levels to cause any serious public health problem. However, as observed earlier in studies made at Kakinada, the contents of Cu and Zn were above the permitted level in oysters and some of the crab meat samples.

2.8.3. RESEARCH CONTEMPLATED

1. Biochemical quality of commercially frozen shrimp
2. Quality control in frozen clam meat production
3. Quality control in frozen lobsters
4. Study of bacterial inter-competition between *E. coli* and *Salmonella*
5. Survey on the incidence of *Shigella* in fishery products.
6. Comparison of the existing method for enumeration of *E. coli* with the MPN technique
7. Studies on enteropathogenic *E. coli* in fish

2.9. PACKAGING OF FISH AND FISHERY PRODUCTS

(T. K. Govindan, P. A. Perigreen, C. V. N. Rao, T. K. Srinivasa Gopal, K. P. Antony.)

2.9.1. CHIEF FINDINGS

Of the different synthetic films of varying gauges tried in packing frozen fishery products, like LDPE, HDPE, HM-HDPE, cellophane/polythene and MXXT cellophane coated with PVC, HM-HDPE film of 100 gauge thickness was found superior to the others.

2.9.2. RESEARCH IN HAND

A good number of the corrugated fibre board master cartons employed by the industry fall short of the ISI specifications. With a view to elucidating the reasons for this, several samples of the raw material used in manufacture of the cartons, viz. kraft paper, both virgin and recycled stuff, employed by the carton manufacturers were collected and their physical properties during storage at low temperatures analysed. Samples of kraft paper from five different manufacturers were used for the study. Even though variations in their substance per unit area were not significant (ranging from 118 to 153 gsm), the important physical properties that contribute to the quality of the finished cartons varied widely. Burst factor varied from 16 to 33, tear factor from 56 to 124 in machine direction and 75.8 to 154 in cross direction, breaking length from 2464 to 4880 m. in machine direction and 1800 to 3220 m. in cross direction and ring stiffness from 0.47 to 0.75 kgf.

Virgin and recycled kraft paper held at -23°C for 3 months resulted in loss of bursting strength by 43% and 90%, ring crush strength by 30% and 44% and tensile strength by 22% and 30% respectively.

Different types of corrugated fibre board master cartons were fabricated for evaluation of their functional properties.

In order to standardise the unit duplex board cartons used in the frozen fish industry, physical parameters of the paper board samples varying from 250 to 350 gsm. were studied. The boards were also coated with different percentage of wax to study its water proofing effect on the boards.

Salt cured and dried shark samples with high moisture level were dusted with sodium benzoate and calcium propionate at 1% level, sealed in 200 gauge LDPE bags along with untreated controls and stored at ambient temperature. The control samples became infested with fungus within 17 days while the treated samples remained unaffected even after one month storage.

A design was developed of semi-bulk packages for dried fish in gunny fabric with 300 gauge LDPE film lining inside and arrangements made for their fabrication.

Blanched prawns, packed with brine in 250 gauge polypropylene film followed by sealing in 12 micron metallised polyester pouches, got bleached in the course of a couple of months. With a view to exclude the influence of oxygen in this phenomenon, the outer pouches were flushed with carbon dioxide before sealing. Prolonged storage studies of the product at ambient conditions showed that the sterility was retained even after 10 months, though there was a marked deterioration in the organoleptic properties.

Studies were initiated on the transportation of live clams. Live clams were packed in three different forms: (1) as such in plastic buckets and covered with lid, (2) sealed in 2 kg lots in polythene bags with oxygen and water collected from their own habitat and then packed in plywood boxes with expanded polystyrene insulation, and (3) bulk sealed (10 kg. lots) in 700 gauge polythene bag with water and oxygen, further packed in expanded polystyrene insulated plywood boxes and maintained at 18°C . Minimum rate of mortality was observed in the first case, viz. nil in the first 24 hours, 25% after the second 24 hours and 64% after the third 24 hours.

Oil sardines (fat content 11.7%), frozen and sealed in different synthetic films and stored at -18°C exhibited better organoleptic properties than the control samples after 3 months of storage.

2.9.3. RESEARCH CONTEMPLATED

1. Improvements in functional properties of corrugated fibre board boxes and duplex board cartons
2. Standardisation of waxed unit cartons of duplex board for frozen shrimp
3. Studies on effect of packaging materials and vacuum sealing on the shelf life and quality of frozen fishery products
4. Development of sea worthy packages for dried fishery products
5. Development of retort pouches from indigenous packaging laminates to replace the conventional cans
6. Further studies on transportation of live clams

2.10. DIVERSIFIED PRODUCTS FROM FISH AND FISH WASTES

(Dr. K. Gopakumar, K. M. Iyer, P. V. Prabhu, P. Madhavan, K. G. Ramachandran Nair, A. Lekshmy Nair, A. V. Shenoy, P. T. Mathew, R. Thankamma, T. K. Thankappan, P. Ravindranathan Nair)

2.10.1. CHIEF FINDINGS

Chitin, when added in limited quantities to feed formulations showed appreciable growth promoting property in albino rats. Attempts were made at drying jelly fish and a product comparable to that available in international markets could be obtained.

Cooking the pressed cake at 100°C resulted in substantial improvement in the quality of dried fish mince.

2.10.2. RESEARCH IN HAND

Investigations were undertaken on collection and dehydration of fish galls, both of fresh water and marine origin. It was shown that gall bladders could be separated from the liver and viscera only if the fish was in a very fresh condition, as the gall tended to get damaged as soon as spoilage of the fish set in. While collecting the galls, extreme care was necessary to avoid breaking and loss of bile and contamination with blood and other impurities.

The yield of dry gall extract from catla, mrigal and rohu worked out to 0.04%, 0.05% and 0.06% respectively of the body weight. Different modes of drying galls were adopted, viz. sun drying, vacuum drying and

freeze drying. Sun drying was found comparable to the other methods tried though it gave a product with slightly deeper colour. Similar studies on galls collected from marine fishes were made. From the data so far collected on the galls taken from fresh water and marine fishes, it was seen that the contents of gall present in marine fishes were very low compared to those from fresh water fishes.

Animal feeding experiments using mechanically separated and dried self juice of whole prawn shell showed that the food intake and growth rate were better compared to protein extract prepared by alkali digestion and drying.

Adoption of chitin in the feed formulation of test animals, viz. albino rats, showed considerable improvement in the growth rate of the animals. Similarly, prawn shell when incorporated into fish showed enhanced growth rates in the case of common carps. These results indicated the growth promoting property of chitin when added to feed formulations in limited quantities.

A method was tentatively worked out for drying jelly fish to produce a product comparable to that available in the international market. The method followed consisted of repeated treatment of the jelly fish with common salt and alum containing a little bleaching powder. It was then kept at 4°C, when the product got hard, losing moisture and got bleached. Subsequently it was dipped again in concentrated salt solution and drained. Circular, flat jelly fish umbrellas could then be obtained. The work is to be continued.

The effects of particle size and initial concentration of metal ions in solution, time of treatment and mode of treatment on the adsorption property of chitosan for metal ions were studied. It was observed that under specified conditions, chitosan could remove mercury from its solution to a level non-detectable by a mercury analyser.

Experiments conducted on the special applications of chitosan in chromatography, fruit preservation and as binding agent gave encouraging results. A coating of chitosan in acetic acid given to mangos by a dip treatment showed significant delay in ripening of the fruit, thereby prolonging its shelf life at ambient temperature. A solution of chitosan in formic acid when mixed with fine carbon and the resultant slurry applied on a smooth surface, gave a glossy black coating. On drying, the gloss was lost, but left good adhesion. The possibility of making use of this property to utilise chitosan in preparation of cosmetics is being explored.

Feeding experiments on albino rats with mechanically separated and spray dried squilla protein showed no untoward symptoms on the

animals and the food intake, growth rate and PER values were comparable to those fed on casein.

Samples of dehydrated salt mince prepared from threadfin bream when stored at room temperature were found to have a storage life of 36 weeks. The effect of chilling the mince overnight under ice and salt was evaluated to find out whether the method could be adopted on board. Studies were also continued on the effect of addition of an antioxidant and synergist on the prevention of rancidity. Comparative studies were also undertaken to determine the improvement in quality, if any, of the dried mince by cooking the pressed cakes at 100°C. Cooking brought about marked improvement in the quality of the product.

Studies were continued on the utilization of red meat of tuna. About 25% red meat was mixed with cat fish meat and utilized for preparation of fish soup powder and fish wafers. Consumer acceptability of the product has been rather good.

Red tuna meat was also smoked for four hours using coconut husk as the source of smoke and the PER of the smoked tuna meat determined.

Two species of unutilized fish, *Trypane vagina* (Day) and *Goboides rubicundus* (Day) were studied for their suitability for human consumption.

Studies were also initiated on the preparation of fish protein concentrate from low priced fish with improved textural properties. The product is being tried as a substitute for meat in various preparations.

2.10.3. RESEARCH CONTEMPLATED

1. Identification of chemical constituents of fish galls and study of the differences in galls of marine and fresh water fish
2. Nutritional studies on prawn shell waste
3. Effect of carotenoid pigments in formulated feed
4. Application of chitosan in food processing industry, chromatography and in processing other special products
5. Further studies on development of products using squilla protein
6. Standardisation of process variables of squid drying and shelf life studies
7. Preparation of fermented products

8. Further studies on salt mince and improvement of quality of tuna red meat
9. Conversion of low cost unused fish as protein replacers in animal feeds

2.11. PROCESSING AND MARINE ENGINEERING

(S. Ayyappan Pillai, K. Sreedharan Namboodiri, P. K. Chakraborty, P. N. Joshi, K. N. Kartha, T. M. Sivan, S. M. S. Abuthahir Ali).

2.11.1. CHIEF FINDINGS

The electro-thermal method of generation of smoke without use of direct fire worked quite satisfactorily. Smoke generation and distribution inside the chamber was uniform and the generation could be controlled by regulating the voltage supplied to the system. Rise in temperature during smoking was very marginal (5°C more than room temperature) and the temperature was maintained at the desired level by use of an additional heater. The smoked product developed the characteristic smoked colour and flavour and was accepted as a quality product, far superior to the conventionally available products.

Preliminary design of an experimental digester to handle water hyacinth as feed stock was completed. Designing of a commercial model of the mechanical device for cooking prawns is in progress.

Fabrication of the prawn washing machine to remove filth, sand and other extraneous matter has been taken up.

Design was developed of a pilot plant to produce 10 Kg/litre of glucosamine hydrochloride.

The optimum process parameters for treating industrial effluents with chitosan to remove mercury from them have been worked out.

A cylindrical cover fitted to the existing propeller of a 9.76 m. (32 ft.) fishing vessel gave an increase in bollard pull by 11.7%, while with a tapering cover, the increase was only 3.6%.

Trial operations were carried out successfully with the electronic torque measuring instrument designed and developed

to measure the torque of the propellers of fishing vessels. The response of the instrument has been found to be quite rapid and linear.

Cost benefit comparisons made between the imported out-board motor and the indigenously developed diesel drive units for mechanisation of country crafts showed the diesel units to be greatly economical.

2.11.2. RESEARCH IN HAND

As a first step in the development of solar ice box for storage and transportation of fresh fish, designing of a solar absorption refrigeration system was undertaken.

Designing was also undertaken of a 25 kg./batch (input) rotary dryer for drying chitosan flakes, based on the principle of indirect contact drying.

Trial runs were carried out with the deep freezer (-30°C) which has been assembled and erected. Based on these trials, possibilities of maintaining a still lower temperature of -40°C are being studied.

A new fish pump with a larger diameter pipe to increase the pumping capacity was fabricated and successful trials carried out in the laboratory. Field trials will be taken up soon after procuring a portable diesel air compressor unit.

Design was developed of a propeller nozzle as another means of reducing cost of operation of mechanised fishing vessels. A Kaplan propeller has also been fabricated.

2.11.3. RESEARCH CONTEMPLATED

1. Fabrication of experimental digester and trials on production of biogas
2. Process development for production of quality smoked products using electro-thermal smoke kiln
3. Studies on the possibility of electric propulsion system for mechanised boats
4. Development and modification of deck machinery on board fishing vessels

2.12. ELECTRONICS AND INSTRUMENTATION

(T. K. Sivadas, K. Ramakrishnan, K. Vijayabharathi)

2.12. CHIEF FINDINGS

An Environmental Data Acquisition System (EDAS) was developed as part of the programme for development of buoy telemetering system for automatic acquisition of marine environmental data. The EDAS can scan and display/print/record, 16 environmental parameters within a radius of 1 km. from a site at desired pre-set intervals. The system can be operated from a 12 v. chargeable battery or accumulator in order to avoid the inconvenience that can be caused due to power supply failure when operated from AC mains. Details of the data obtained are given below:

<i>Water salinity</i>	: 0 to 500 \pm 5 ppm for inshore waters 0 to 38 \pm 0.1 ppt for coastal waters 33 to 38 \pm 0.05 ppt for offshore waters.
<i>Water temperature</i>	: 0 to 50 \pm 0.1°C
<i>Water turbidity</i>	: Equivalent to water transparency of 100% to 0% \pm 2%
<i>Water level</i>	: Different ranges available. 2 M, 5 M, 10 M, 20 M \pm 0.5%
<i>Water current</i>	: 0 to 360, \pm 2 cms./sec.
<i>Current direction</i>	: 0 to 360°, \pm 5°
<i>Water density</i>	: 1 to 1.2, \pm 0.002 gm/cm ³
<i>Air temperature</i>	: 0 to 50, \pm 0.1°C
<i>Soil temperature</i>	: 0 to 50, \pm 0.1°C
<i>Wind velocity</i>	: 0 to 200, \pm 2 Km./hr.
<i>Wind direction</i>	: 0 to 360°, \pm 5°
<i>Humidity (RH)</i>	: 0 to 100% \pm 2%
<i>Barometric pressure</i>	: 950 to 1050 \pm 1 m. Bar
<i>Sunshine</i>	: 0 to 200, \pm 2 Lux x 1000
<i>Soil moisture</i>	: 0 to 100, \pm 3%
<i>Rain</i>	: 200 mm. diameter Jar with 500 mm. height

Another instrument developed was the crane load monitor and alarm for the safe operation of cranes in Port and Harbour applications. In this, the load handled was indicated, giving a warning signal when the load exceeded the limit. The main features of the instrument are:

<i>Capacity</i>	: 0 to 20 tonnes
<i>Accuracy</i>	: @ 0.1% of the range
<i>Power consumption</i>	: 50 m A at 9 V supply (without outdoor digital LED display)

Yet another instrument developed was the remote operated water density meter for measuring the density of water for fishery hydrographic and oceanographic studies. A portable unit for field investigations is under preparation.

2.12.2. RESEARCH IN HAND

Buoy telemetry system

Various sensors developed for the system are being subjected to environmental field tests in order to estimate and evaluate the accuracy, resolution and other limitations.

Low cost fish finder

A transmitter circuit of frequency 200 KHz with 60 V peak to peak output voltage has been developed. The receiver circuit is being prepared with finer tuning arrangements.

2.12.3. RESEARCH CONTEMPLATED

1. Development of an S.O.S. transmitter for safety of fishermen operating country crafts as well as mechanised boats
2. Field evaluation studies of the various instruments developed and their parallel application in other fields

3.0. VERAVAL RESEARCH CENTRE

(K. K. Kunjipalu, K. K. Solanki, N. Subramonia Pillai, M. R. Boopendranath, A. C. Joseph, Anil Agarwal, M. R. Raghunath)

3.1. CHIEF FINDINGS

Attachment of sail kite to the head rope of a 25 m. high opening trawl has shown increase in total catch, especially Ribbon fish.

Frozen minced meat showed lower organoleptic scores compared to individual mince after 10 months storage.

The desired red colour of whole cooked lobsters could be achieved by bringing down the pH of blanching brine to acidic range using acetic acid or vinegar.

Development of light green discolouration in the belly portion of frozen ghol fillets could be prevented by prompt evisceration and icing.

A method was standardised for preparation of fish 'pakoda'.

Hilsa roes canned in tomato juice and squid mantles canned in their own recovered blanching brine remained in good condition even after 18 months of storage at room temperature.

3.2. RESEARCH IN HAND

Experiments carried out to study the effect of current and its direction on the catch of gill nets yielded better catches of pomfret, sharks and other fishes when the nets were set across the current. Field operations were carried out with a newly designed nylon gill net of 22 units. Fishes like Hilsa, pomfret, shark and other miscellaneous fish were landed.

Studies on the quality of individual minces from lactarius and dhoma and their mixed minces (in the ratio 60:40) kept in frozen storage for 44 weeks showed that during storage, the salt soluble nitrogen (SSN) fraction decreased significantly in the case of mixed mince compared to the individual minces. Based on sensory evaluation, however, lactarius mince was significantly superior to dhoma as well as mixed minces.

Treatment of shark meat with 25% salt solution and 0.5% jack bean meal solution prior to freezing was very effective in reducing the urea content.

A method was developed for preparation of fish 'pakoda' incorporating as much as 30% edible fish powder in the basic mix. The product showed good storage life with a protein content of 7% in the final stage. Further studies are in progress.

As part of the studies on the incidence and isolation of pathogenic organisms in fresh and processed fish and fishery products, 67 samples of different species of fish, processed fishery products and swab samples were tested for the presence of *Salmonella*, *Vibrio parahaemolyticus* and *V. cholerae*. None of the samples showed the presence of these organisms. One hundred samples of fish meal tested were also free from *Salmonella*.

3.3. RESEARCH CONTEMPLATED

1. Studies on mid-water trawls
2. Fabrication and operation of three new designs of trawls, viz. 25 m. new high opening trawl, 25 m. large mesh trawl and 25.60 m. Pajot's BOBP high opening trawl
3. Trial operations with 21 m. multipanel high opening trawl
4. Studies on new gill net materials and effect of different types of mounting in gill nets
5. Studies on freezing and storage characteristics of Elasmobranchs
6. Canning fish and shell fish with vegetables
7. Techno-economic aspects of commercial freezing of ghol fillets and lobsters
8. Preparation of products incorporating fish powder

4.0. KAKINADA RESEARCH CENTRE

(G. Narayanappa, D. Imam Khasim, R. Mangayya Naidu, A. V. V.

Satyanarayana, S. V. S. Rama Rao, J. Sitarama Rao, R. Chakraborty, Sibsankar Gupta, Subrata Basu).

4.1. CHIEF FINDINGS

Comparative studies on the effect of different mesh sizes on catch showed that nets with small mesh size were least effective with more consumption of fuel per hour.

Bag net, designed by the Institute, yielded better catch, both quantitatively and qualitatively, than the local gear.

Smoked prawns stored at room temperature remained acceptable upto eight months. On further storage, the prawns turned powdery.

*Refrigerator storage studies (at -10°C) of dressed pieces of *C. mrigala* and *C. catla* showed that the storage life of the dressed pieces obtained from fresh fish was 33 days in the case of the former and 35 days in the latter.*

Of the different methods tried for freezing clams, frozen whole boiled meat stored at -18°C remained in good condition even after one year.

4.2. RESEARCH IN HAND

Studies were initiated during the year on currents and their effect on trawling gear and catch. The gear employed was a 20 m. bulged belly net in combination with 1.39 x 0.63 m. otter boards. Hauls were taken against, along and across the current direction. The catch rate of the hauls taken along the different directions worked out to 45.02, 44.4 and 42.9 kg. respectively, indicating the slightly better yield when towing against the current.

A 27 m. high opening trawl and a BOBP design high opening trawl were designed/fabricated and trial operations carried out.

Studies were continued with multi-meshed gill nets of 30, 40 and 55 mm. mesh size operated from 'Nava'—a local traditional craft—along with single mesh units. The nets with 30 mm mesh size were found to be the most effective for exploitation of the resources which comprised mostly *Pellona* sp. and *Engraulis* sp. Studies are in progress.

About 150 samples of tissues of different varieties of fish and shell fish from different areas in Andhra Pradesh were collected and analysed for presence of heavy metals and mercury. The sources of this contamination were also investigated. Very high levels of total mercury were observed in the bottom soil from the Godavari river near Rajahmundry (Kovvur). As in the previous year, cadmium accumulation was seen more in the gills and copper in the viscera contents of blood clam. Zinc content was more in shell fishes than in the other fishes.

Preliminary studies carried out to identify the halophilic bacteria in the brine used for fish curing revealed the presence of mostly gram positive micrococci. Studies are to be continued.

Ice storage studies on *Psenus* sp. showed that the fish could be stored in ice (at 0°C) in acceptable condition upto 9 days in direct contact and upto 14 days when packed in polythene bags and then kept in ice.

Attempts were made to utilise other low cost fishes like *Decapterus*, silver bellies etc. for conversion into value-added products. Silver bellies, cured (with salt in different ratios) and sun-dried gave a very good product when fried in oil.

Fish powder was prepared from dressed silver bellies at 10% level along with bones and used for preparing wafers incorporating rice powder and sago and sun-drying. The product packed in polythene bags remained in good condition even after four months.

Ice storage studies on steamed and raw clam meat indicated that the former remained in acceptable condition upto 8 days and the latter upto 5 days when held in direct contact with ice.

A few fish feed samples received from some local parties were analysed and test report furnished.

4.3. RESEARCH CONTEMPLATED

1. Improvements in trawl gear design with a view to effecting reduction in fuel consumption
2. Comparative field trials with the improved high opening trawl and BOBP high opening trawl
3. Further studies on current direction and its effect on trawling operations
4. Development of suitable gear for exploitation of crab resources of Kakinada Bay
5. Processing of fatty fishes like *Decapterus* sp. into smoked products
6. Study on presence of carcinogenic materials in smoked prawns
7. Quality evaluation of commercially cured and dried fishes at wholesale and retail markets
8. Studies on transportation of live fish and shell fish
9. Preservation of commercially important fishes by modified atmospheric storage techniques and by cryogenic freezing

5.0. BURLA RESEARCH CENTRE

(K. A. Sadanandan, A. A. Khan, T. Joseph Mathai, S. K. Bhattacharyya, J. K. Bandyopadhyay, A. K. Chattopadhyay, Percy Dawson, J. Sita Rama Rao, M. Mukundan and R. Chakraborti)

5.1. CHIEF FINDINGS

Frame nets with 60 mm. mesh bar, 50 m. length and 3 m. hung depth were recommended for rational exploitation of pre-dominant size group of fishes of Pitamahal reservoir.

For capture of predatory fishes of the reservoir, simple gill nets of 35 to 45 mm bar and hooks of size no. 17-20 were found more suitable.

Pickled products from Gudusia chapra and roes of Labeo rohita prepared using acetic acid showed shelf lives of 6 and 6½ months respectively when stored at room temperature.

Citrus reticulata, a cheap and abundantly available local variety of lime was found quite suitable for incorporation in fish pickle. Ice storage studies on Catla catla, Mystus seenghala and Eutropiichthys vacha showed that C. catla of 500 gm. average weight could be stored in ice upto 18 days, M. seenghala of 800 gm. average weight upto 14 days and E. vacha of 300 gm. average weight also upto 14 days. Smaller sized E. vacha of 150 gm. average weight could be stored in ice only upto 9 days.

5.2. RESEARCH IN HAND

Studies of the fishing problems of Hadgarh, Mandira and Darjong reservoirs in Orissa, Krishnagiri, Chinnar and Thirumurthi reservoirs in Tamil Nadu and Jayakwadi and Koyna reservoirs in Maharashtra were initiated. Based on information gathered during the survey conducted of the reservoirs at Tamil Nadu and Maharashtra, a detailed report, incorporating, particulars of the existing fishing gear, improvements to be effected in the gear and fishing methods etc. was prepared and submitted.

Studies were continued on developing better dried products from *Gudusia chapra* after blanching in different concentrations of brine containing 1% acetic acid. No appreciable improvement in quality or storage life of the products was observed when blanching was done in brine containing 1% acetic acid compared to those blanched in brine alone, except for a slight improvement in the texture of the fish muscle.

A survey was conducted of the traditional smoking practices prevalent in and around Sambalpur. The three practices now followed are (1) smoking and drying of the fish in perforated mud pots kept over open fire—locally termed 'Handi shukha' (2) smoke drying fish in bamboo or iron sieves kept over open fire—termed 'Chali shukha' and (3) burning fish using rice husk or paddy straw termed 'Pooal dhora'.

Studies on the presence of pathogenic bacteria in smoke dried market samples of fresh water fish revealed absence of *Salmonella*, *Staphylococci* and coagulase positive organisms in all the five samples tested. *Streptococcus faecalis* were however present in the order of $4.62 \times 10^2/g$ to $1.48 \times 10^3/g$.

The juice of *Citrus reticulata*, a cheap, locally available lime could effectively replace acetic acid to some extent in preparation of fish pickles.

This is especially beneficial for those who do not like the taste of vinegar. Storage studies of fish pickle from *Rita chrysea* incorporating juice of the *C. reticulata* are in progress.

Studies have been initiated on the effect of black pepper and sodium benzoate (used separately) on the keeping qualities of fish pickles prepared from *G. chapra* containing the juice extracted from the lime *C. reticulata*.

5.3. RESEARCH CONTEMPLATED

1. Scope of mid water trawling in Hirakud reservoir
2. Effect of light and bait on fishing
3. Studies on storage lives of different types of traditionally smoked and sun dried fish at different atmospheric conditions
4. Development of better smoked products from fish and pickled products from fresh water molluscs and crustaceans
5. Studies on the effects of different spices and preservatives on the keeping quality of fish pickles
6. Studies on effect of delayed icing on spoilage characteristics of fresh water fish stored in ice

6.0. CALICUT RESEARCH CENTRE

(T. S. Unnikrishnan Nair, V. Muraleedharan, K. George Joseph, N. Kalaimani)

6.1. CHIEF FINDINGS

Good quality marinated mussel meat with enhanced storage life could be prepared by boiling the meat shucked in live condition, in 3% brine for 5 minutes and processing the blanched meat in a mixture of 3% brine and 2% acetic acid (weak vinegar). The product remained in good condition and was organoleptically acceptable for more than three months.

6.2. RESEARCH IN HAND

Further investigations were carried out on pickle curing of sardines. Fresh sardines were eviscerated, washed well and pickle cured in large cement tanks using ordinary salt. Another batch was also salted in a plastic container using refined salt and their qualities compared after storage. It was observed that the pickled sardines in both the cement tank and plastic container remained in good condition even after six months of

storage. In the commercial practice now followed, pickling (using ordinary salt) is done in large cement tanks capable of accommodating tonnes of fish and the product remains as such until it is marketed.

Studies were continued on the effectiveness of calcium propionate as a suitable preservative for cured fish products. Samples of dried products from shark, sole, jew fish, silver belly and anchoviella, collected from the Central Fish Market, Calicut were treated with the chemical and kept for observation. The treated samples remained in good condition even after four months storage, whereas the control samples got spoiled soon.

Experiments were initiated to study the extent of insect infestation in dried mussel meat and its prevention. Mussel meat dried to a moisture level of about 1% were stored in glass bottles in two different ways. In one case, the lid of the bottle was sealed airtight with paraffin wax immediately after packing. In the other, the lid was secured simply, without airtight wax sealing. After a storage period of one month, it was seen that the product in the unsealed bottle was not only infested with fungus but had also turned dark brown in colour, while that in the sealed bottle was superior in all respects. No insect infestation was however noticed in both the samples.

The method of estimation of uric acid, an index of the degree of infestation in dry fish products, has been standardised.

Dried samples of mussel meat prepared in the laboratory were stored in polythene bags of different gauges, viz. 100, 200, 300 and 400. The samples were seen to be free of insects, even after 60 days of storage.

Samples of dried anchoviella purchased from the market were further dried to 9.3% and 20.5% moisture levels and packed in 200 and 300 gauge polythene bags. These samples were also free from insect attack after two months of storage. Further studies on all these aspects are in progress.

Studies were continued on the preservative effect of certain medicinal plants in cured fish. The plants taken for study were *Asparagus racemosus* (aqueous extract of roots), *Withania somnifera* (dried powder of roots mixed with refined salt for sprinkling as well as aqueous extract of roots), *Phyllanthus niruri* (aqueous extract of plant as a whole) and *Ocimum sanctum* (extract of the leaves). Aqueous extracts of different concentrations are being tried for dip treatment before salting.

Samples of fish curry and fish fry from various hotels in the city were drawn and subjected to detailed bacteriological analysis with special emphasis on pathological organisms.

Twelve samples of water, six of ice, four of fishmeal, two of dry prawn, one sample of fish manure and twelve samples of soil (used in culture ponds) were analysed and test reports furnished.

6.3. RESEARCH CONTEMPLATED

1. Further studies on insect infestation and preservative effects of certain medicinal plants in cured fishery products

7.0. BOMBAY RESEARCH CENTRE

(A. P. Valsan, V. Narayanan Nambiar, S. P. Damle, D. K. Garg).

7.1. CHIEF FINDINGS

Studies on the quality of ready-to-eat fish preparations from different grades of hotels and restaurants in the city were completed. It was observed that 50% of the samples were of fairly good quality, 30% of average quality and about 20% of poor quality. About 2% of the products were contaminated with extraneous material like hair and house fly. A negligible number were contaminated with E. coli and coagulase positive Staphylococci spp. Pathogens like Salmonella, Clostridium and Vibrio parahaemolyticus were however absent in all the samples. These studies showed that majority of the samples did not pose any potential health hazard to the consumer and very little difference was noticed in the quality of the samples collected from the different grades of establishments.

A cheap and effective method was developed for producing good quality, dried, non-penaeid prawn using black low density polythene sheets. Methods were also developed for preparation of good quality soup powder and a tasty product similar to "Kropak udhang" - popular in South East Asian countries - from non-penaeid prawns.

Studies on the frozen storage characteristic of non-penaeid prawns showed that the frozen blocks could keep in good condition upto four months.

7.2. RESEARCH IN HAND

Though sun drying is the cheapest form of utilization of non-penaeid prawns, the present day methods are far from satisfactory since

they yield very low quality end products containing substantial quantities of sand and other extraneous matter. With a view to improving the quality of the product, comparative studies were made with cemented area, white low density polythene (LDPE) sheets and black low density polythene sheets as drying surfaces. It was observed that the surface temperature in black low density polythene sheet was much higher compared to the cemented area or the white LDPE sheet, enhancing the drying rate. The black LDPE sheet, which is reasonably cheap and available in desired dimensions was spread on any clear and levelled area and the prawns spread on it at the rate of 1 kg/m² under direct sun. The yield and quality of the end product were greatly improved since breakages were considerably reduced and the product was free of sand and dirt. The LDPE sheathing is re-usable, adding to the economy of the technique. This method is expected to have high commercial potential in view of its many advantages.

Studies were also carried out to produce more sophisticated consumer products from these tiny crustaceans. Various formulae were tried incorporating ingredients like egg, tapioca powder, spices and the prawn paste. One of the formulae tried gave a very good product, similar to 'kropuk udhang' a very tasty, popular product of S. E. Asian countries. The product, with good swelling property when fried in oil, also had good shelf-life and could be stored for a long time. One difficulty experienced was in cutting the gelatinised dough into thin slices for drying. Studies are in progress to solve this problem.

Another product attempted was soup powder using the whole non-penaetid prawns, avoiding the cumbersome procedure of extracting the meat. The proximate analysis of the soup powder, yield and cost of production were worked out.

The nature of microflora on some of the commercially important fishes of Bombay coast viz. Rawas (*Eleutheronema tetradactylum*), Red snapper (*Lutjanus argentimaculata*) and Sole (*Cynoglossus* sp.) was examined. About 50% of the flora was constituted by the gram negatives and another 50% by the gram positives. The gram negative flora was constituted by various proportions of *Pseudomonas* - *Achromobacter* group (50-60%), *Vibrio* (30%) and *Flavobacteria-Cytophaga* (10%). Majority of the *Pseudomonas* were found capable of causing spoilage in fish muscle.

7.3. RESEARCH CONTEMPLATED

1. Studies on the sources of contamination of fresh fish and processed fishery products

8.0. GOA RESEARCH CENTRE

(H. N. Mhalathkar, V. Vijayan, M. Syed Abbas, R. S. Manoharadoss)

8.1. CHIEF FINDINGS

Comparative fishing trials with 15 m. bulged belly trawls with straight and tapering jibs in combination with 120 x 60 cm. flat boards indicated the better efficiency of the net with tapering jib.

The 15 m. bulged belly trawl fitted with 6.0 cm. mesh separator panel was more effective than the net with 5.0 cm. mesh separator panel in separating fish from prawn.

8.2. RESEARCH IN HAND

Out of the different speeds of 1100, 1200 and 1300 rpm. tried with a 10.3 m. large mesh unequal panel mid water trawl in combination with a 120 x 60 cm. vertically curved otter board with 50 m. bridles, the catch rate per hour was more at 1200 rpm.

A survey was conducted of the existing gill net designs in different villages in Gao. The mesh size ranged from 4 to 20 cm. and the fishes normally caught were shoaling fishes like sardine, mackerel, pomfret and seer. Based on the data collected, design of a multi-purpose gill net is being developed.

Another survey was conducted in the villages Chapora, Sialim, Morjim and Chopdomfor selecting a suitable site for carrying out investigations on operation of the chinese dip net.

8.3. RESEARCH CONTEMPLATED

1. Intensive field trials with the 10.3 m. unequal panel mid water trawl with varied rigging to study its efficiency in aimed fishing

9.0. EXTENSION ACTIVITIES

(M. R. Nair, Dr. P. N. Kaul, M. K. Kandoran, P. N. R. Kaimal, S. Balasubramaniam, K. C. Purushothaman, Mary Thomas).

9.1. Replies to technical queries

As during earlier years, queries continued to be received from private entrepreneurs, State and Central departments and others on various

aspects relating to fishing/fish processing. About 425 such queries were received during the year.

Comments were offered on the availability and use of jelly fish, on the reason for changes in quality after encapsulation of cod liver oil, shelf life of different forms of frozen shrimp and other shell fishes and froglegs, frozen storage life of some marine products at -18°C to -23°C and handling and transport fresh fish in India.

Comments were also offered on use of potassium di-hydrogen phosphate in treating frozen prawns and effectiveness or otherwise of hydrogen peroxide in fish preservation. Information was furnished on wastages during processing of frogs for preparation of frozen froglegs, on methods of cutting the froglegs for freezing and products that can be manufactured on small scale industry basis.

Information was also furnished on preparation of printing ink from sardine oil, production of chitosan from prawn waste and preparation of project report, composition of fish feed and formula for a balanced poultry feed.

Details were provided on methods of canning fish and shell fish, production of dehydrated fish, bacteriological peptone from trash fish, speciality and by-products from fish and on the application of calcium propionate in preservation of cured fish.

On the craft and gear side, comments were offered on use of copper creosote as a wood preservative, fibreglass as a material for construction of fishing boats, suitability of engines of different H.P. for different sizes of vessels. information provided on machinery required for fish net manufacture, design details of propeller nozzle for trawlers and on the aquatic weed harvester. A survey report of a coastal fishing village of Kerala was also given to a party on request.

9.2. *Testing of materials and products*

Analysis reports of 2013 products and materials as detailed below were furnished during the period.

<i>Products/materials</i>	<i>No. of samples</i>
Canned fish and shell fish products	41
Frozen fish and shell fish products	1793
Freeze dried prawns	5
Speciality products	6
By-products	19

Fresh fish samples	1
Packaging material	4
Water	76
Ice	47
Fishing gear materials	14
Fishing craft materials	7

9.3. Publications

Five issues of the publication Fish Technology Newsletter,, viz- Vol. III Nos. 6 to 10, were brought out during the period as also a technical pamphlet in malayalam on 'Development of Fishing Gear'.

9.4. Supply of designs and publications

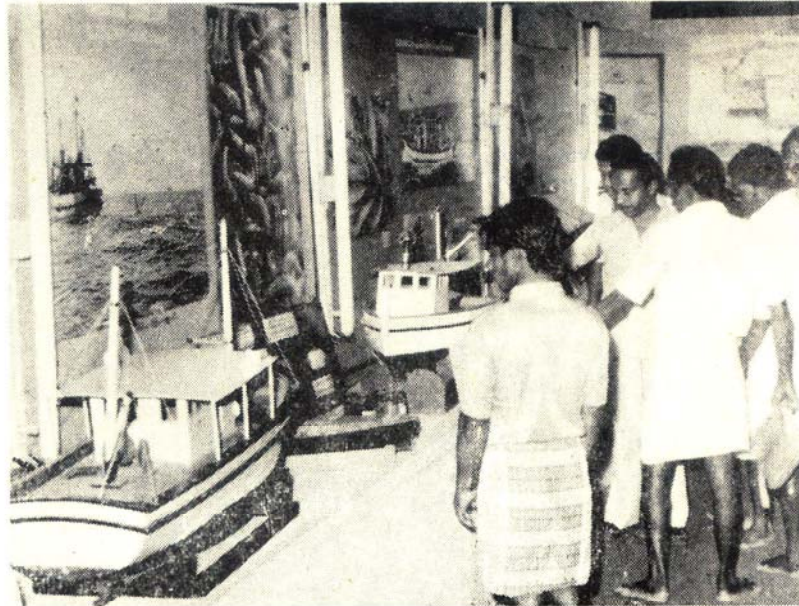
In all, 63 designs of gear, craft, dryers etc. were issued as detailed below.

<i>Design</i>	<i>No. supplied</i>
Trawl nets	13
Otter board	3
Mechanised fishing craft	31
Indigenous craft	1
Fish dryers	12
Layout for boat building yard	1
Layout for repairing yard	1
Stockless anchor	1

Eighty seven copies of the publication "Quality Control in Fish Processing", fifteen of the Special Bulletin 9 - "Indigenous Marine Fishing Gear and Methods of India - I-Karnataka State", eleven copies of the Special Bulletin 8 - "Abstracts of CIFT Publications - 1957 to '80" and three copies of the Special Bulletin -I- "An Account of the Inland Fishing Gear and Methods of India" were supplied to interested parties on request.

9.5. Exhibitions and film shows

The Institute participated in three major exhibitions during the year. These included 1) The Exhibition at Valapad from 25th Nov. to 5th Dec. 1983 held in connection with the Sree Rama Polytechnic Silver Jubilee Celebrations 2) The All India Industrial, Cultural, Educational,



Visitors clarify certain points regarding CIFT designed fishing vessels

AT THE VARKALA EXHIBITION



Another view of the stall

Agricultural Science and Technology Exhibition at Varkala from 1st Dec. '83 to 4th Jan. '84. and 3) the Science Fair at the local Central School during Nov. 1983.

Film shows were also held at a few places in and around Cochin and in the Institute for the benefit of the visitors to the Institute, students and those connected with the fishery industry.

9.6 INFORMATION — SEEKING BEHAVIOUR IN FISHERIES TECHNOLOGY

(Dr. P. N. Kaul, Mary Thomas)

RESEARCH IN HAND

During the period Jan. 1982 to Dec. 1982, 457 technical queries were received. The largest number (38.07%) were received during Jan.-March 1982. The number of queries received declined from 15.54% in January to 0.44% in December. The largest number of queries were received in January 1982 (15.54%), the second largest in March 1982 (15.10%). The number of queries declined gradually thereafter from 11.16% in June through 7% in August, and 0.44% in December. Subject-matter-wise distribution of some of the queries is as under: Extension publications (22.77%), extension training (10.64%), analysis of fishery products including packaging materials (9.36%), fishery by-products (8.09%), audio-visual aids (6.38%), fish drying, curing and smoking (5.74%), engineering and engine testing (5.32%), fishing craft (4.68%); (for this analysis, N = 470, as some parties asked for information under more than one subject).

The queries from foreign countries were 3.9%. Among the Indian States, some of the top ones are Kerala (29.44%), Delhi (15.15%), Maharashtra (11.47%), Tamil Nadu (11.04%) and Gujarat (5.84%). Complete replies were sent for 91.31%, partial replies for 7.39% and there was no satisfactory reply for 1.3% of the queries. The average number of days taken in replying was 30.73 with S.D. of 23.53.

9.7. ADOPTION OF INNOVATIONS DEVELOPED AT CIFT

(Dr. P. N. Kaul, M. K. Kandoran, H. Krishna Iyer, A. K. Kesavan Nair, S. Balasubramaniam, Mary Thomas).

RESEARCH IN HAND

Data pertaining to the technological gap between the traditional and mechanised fishing in the States of Kerala and Karnataka were col-

lected and those pertaining to the traditional fishermen of Kerala analysed. Five improved practices were taken into consideration. It was found that all the fishermen were aware of some of the practices like use of cheaper materials for construction of wooden fishing boats, use of ice on board the vessel and use of synthetic netting and some, of the use of engines for craft propulsion. But none was aware of the use of the chemical preservatives. The reasons for non-adoption of the technologies and problems involved therein were recorded.

As regards adoption of craft designs, data collected from the coast of Kerala are in the process of analysis. Finalisation of questionnaire is in progress with regard to quality control of frozen prawns and trainings held at the Institute. Data collection is also in progress with respect to lobster traps and trainings conducted on quality control of seafoods.

RESEARCH CONTEMPLATED

Work will be continued on the different aspects

9.8. DEMONSTRATION AND TRAINING PROGRAMME

A number of short term training programmes were held during the year, in association with State Departments of Fisheries and other organisations. Details of programmes conducted are given below.

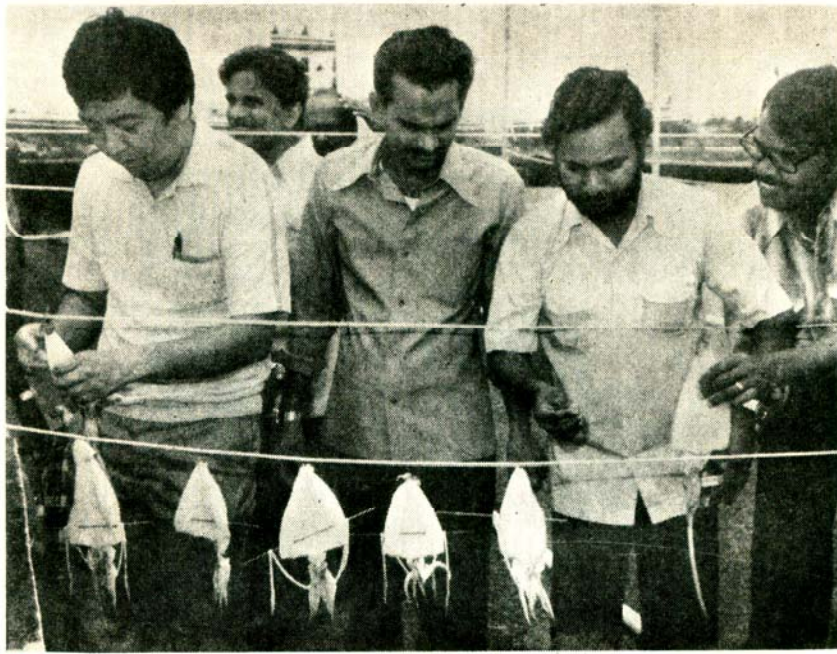
- (i) A three day demonstration -cum-training programme on the techniques of fish pickling and improved methods of sun-drying, ending 21 April 83 at Thebra village in Sambalpur District, Orissa: Organised by Burla Research Centre in collaboration with Orissa State Fisheries Department and Thebra Primary Fishermen Co-op. Society: Participation - 39 personnel including State Fisheries Department staff. Scientists associated S/Shri S. K. Bhattacharyya, J. K. Bandyopadhyay, A. K. Chattopadhyay.
- (ii) Demonstration on method of preparation of fish wafers and fish pickle on 27 April '83 at Kadungalloor Village, Alwaye, at the request of the President, Kadungalloor Panchayat. Scientists associated -S/Shri M. K. Kandoran, K. K. Balachandran, Smt. R. Thankamma, Smt. Mary Thomas.
- (iii) Demonstration on processing dried squid, 2-5 Sept. '83, by Mr. Junichi Takahashi, Japanese Fish Processing expert: Organised by MPEDA under ITC/SIDA Programme of Technical Co-operation in Export Promotion with Government of India, in collaboration with CIFT. Scientists associated -S/Shri P. V. Prabhu, Jose Joseph, P. K. Vijayan.



Training on processing lobster tails



Preparation of fish wafers - at Kadungallur



Training on processing dried squids - the squid being hung on hooks



Training on lobster trap fishing - the participants being briefed on the operation of the gear



Extraction of sardine oil - at Malpe



Demonstration on fish handling and preservation by ice on board fishing vessels at Veraval - sorting the catch on board a vessel

- (iv) Demonstration on application of calcium propionate in preservation of cured fish products at Mankavu, Beypore, Malpe, Mangalore, Calicut Fish Market, Quilandy, Parappangadi, Aug.-Oct. '83. Scientists associated - S|Shri P. V. Prabhu, M. K. Kandoran, T. S. Unnikrishnan Nair, N. Kalaimani, V. Muraleedharan.
- (v) Training course in quality control of frozen lobster tails, 3-21 Oct. 1983: Jointly organised by MPEDA and CIFT: Participation—30 technologists representing fish processing establishments in and around Cochin. Scientists associated—Dr. K. Gopakumar, S|Shri T. S. Gopalakrishna Iyer, Cyriac Mathen, P. A. Perigreen, K. K. Balachandran, M. K. Kandoran, P. R. G. Varma, Dr. P. T. Lakshmanan, S|Shri Francis Thomas, Jose Joseph, Smt. Mary Thomas.
- (vi) Training in designing, fabrication, maintenance and operation of improved gear for a group of Adivasis and tribals in and around Pitmahal reservoir: Organised by Burla Research Centre. Scientists associated—S|Shri T. Joseph Mathai, M. Mukundan, J. Sita Rama Rao.
- (vii) Demonstration-cum-training in preparation of fish pickles and fish wafers at S. Parur, Kerala State, at the request of Sisters of Adoration Convent, 22 Oct. 1983: Participation—About 100 women, including fisherwomen. Scientists associated—S|Shri M. K. Kandoran, K. K. Balachandran, P. K. Vijayan, Smt. R. Thankamma, Smt. Mary Thomas.
- (viii) Training course on improved methods of lobster trap fishing, 24 Oct.-3 Nov. 1983: Organised in collaboration with MPEDA: Participation—6 fisheries officials of different maritime states. Scientists associated—S|Shri M. K. Kandoran, K. V. Mohan Rajan, Kum. B. Meenakumari, Smt. Mary Thomas.
- (ix) Demonstration in fish pickling and sun drying at Tamdei, Sambalpur Dt., Orissa, 19-20 Nov. 1983: Organised by Burla Research Centre at the request of Dy. Director of Fisheries (North Zone), Orissa: Participation—39 fishermen from four fishing villages. Scientists associated—S|Shri S. K. Bhattacharyya, J. K. Bandyopadhyay, A. K. Chattopadhyay.
- (x) Training-cum-demonstration on processing fish oils, at Malpe, 7-9 Jan. 1984: Organised in collaboration with Dept. of Fisheries, Karnataka: Participation—20 candidates representing the industry including women. Scientists associated—S|Shri P. V. Prabhu, P. Madhavan, M. K. Kandoran.

- (xi) Demonstration on fish handling and preservation by ice on board fishing vessels at Veraval, 16-22 Jan. 1984: Organised by MPEDA and CIFT in association with Fisheries Training Institute (Govt. of Gujarat) and Shree Kharva Samyuktha Machimar Boat Assn. Veraval: Participation—230 fishermen. Scientists associated—S|Shri K. K. Solanki, Anil Agarwal.
- (xii) Demonstration on drying frog galls and freezing clams at Calcutta and Bhubaneswar, 23-27 Jan. 1984: Organised by MPEDA in collaboration with CIFT: Participation—About 35. Scientists associated—S|Shri K. G. Ramachandran Nair, Jose Joseph.
- (xiii) Training-cum-demonstration in preparation of fish pickles and wafers at Pattambi, 23-24 Jan., 1984: Organised by Krishi Vigyan Kendra of Regional Agricultural Research Station, Pattambi: Participation—About 26 at Pulasseri Mahilasamajam and 21 at Thiruvegappura Mahilasamajam, Pattambi. Scientists associated—Shri P. K. Vijayan, Smt. R. Thankamma.
- (xiv) Training course on handling practices of shrimps and fishes at pre-processing and processing plants, 21 Feb.-16 March, 1984: Organised jointly by MPEDA and CIFT. Participation—44 candidates. Scientists associated—Dr. K. Gopakumar, S|Shri P. V. Prabhu, K. K. Balachandran, Dr. K. Devadasan, S|Shri H. Krishna Iyer, P. A. Perigreen, P. R. G. Varma, Francis Thomas.

Ad-hoc training was also imparted on the following aspects.

<i>Subject area</i>	<i>Place</i>	<i>Duration</i>	<i>No. of trainees</i>
Quality control of seafoods	Cochin	1 month	1
—do—	"	3 weeks	2
Speciality products from fish shellfish	"	2 days	6
—do—	"	1 week	6
Microbiology of seafoods	"	3 weeks	1
Sampling and analysis of frozen seafoods for bacteriological characteristics	"	3 weeks	1
In all disciplines of fishing and fish processing	"	3 weeks	1

9.9. RADIO TALK

A radio feature was broadcast on the Badagara Taluk Matsya Pravarthaka Mahila Sangham, on the self-employment programme undertaken by the fisherwomen of Kooriyadi Beach at Badagara. (Calicut Dt.) in fabrication of trawl nets, as a result of the training imparted under the Lab-to-Land Programme of the Institute.

10.0. STATISTICS

(A. K. Kesavan Nair, H. Krishna Iyer, K. Krishna Rao, G. R. Unnithan, P. Srinivasa Rao, P. T. Lakshmanan, R. G. Nair, R. Chakraborty, Anil Agarwal.

10.1. CHIEF FINDINGS

For comparing the efficiency of trawl nets, a procedure to remove the non-additivity of the data has been developed which renders the application of Analysis of Variance technique to the data more purposeful. The cost benefit analysis of 9.82 m. and 11 m fishing trawlers showed that the number of fishing trips undertaken by the trawler is the most dominating factor for determining the profit or loss of the trawler. A survey undertaken to study the nature of involvement of workers at the pre-freezing stage of the fish processing industry, revealed that 93% of the workers were women, with majority of them in the middle age group and that 90% of them were literate. The analysis of the data on the project 'Survey on the utilisation of fish in India' showed that in the year 1982, shrimp processing plants at Cochin received 48% of the total quantity of raw material from Centres near about Cochin. Also the PD and PUD material accounted for 87% of the total supplies.

10.2. RESEARCH IN HAND

Tukey's test was applied to five sets of data on gear efficiency studies and in all the sets, the test revealed the presence of highly significant non additivity. The analysis further showed the presence of outliers and also the need for a suitable transformation of the data. When the outliers were removed and the power transformations were made, the data were found to be additive. This procedure was applied for the experimental data on bulged belly and high opening trawls for silver bellies and was

found to be successful in establishing the superiority of the latter over the former.

The effect of increasing the number of fishing trips on the economic efficiency of 9.82 m and 11 m. fishing trawlers along Kerala Coast was studied with the help of a mathematical model. Cost benefit analysis of the said sizes of trawlers indicated that with increase in the fishing trips, the profit has also increased. Using the mathematical model, the minimum quantities of prawn and fish to be landed for 0.20% profit for varying number of fishing trips were worked out. The breakover points for 9.82 m. and 11 m. trawlers were observed to be 185 and 210 fishing trips respectively.

A survey was undertaken in the fishing villages near Cochin on the nature of involvement of workers at the peeling and sorting stages of fish processing industry. It was found that at the pre-freezing stages of processing, 93% of the workers were women. The age group of women workers ranged between 10 and 53 years with majority of them in the middle age group. Nineteen per cent of the women workers were under 15 years and 5% above 50 years. More than 90% of the women workers were literate. Among the literate, 15% studied upto High School. Not even 5% of the workers have received training in quality control method.

Under the Project 'Survey on utilisation of fish in India', the data on the quantity of raw material received by shrimp processing plants at Cochin, Veraval and Kakinada were collected and analysed. The processing plants at Cochin received a total quantity of 18,354 tonnes of raw materials during the year 1982. Out of this, 8737 tonnes of material (about 48%) were received from Centres located near about Cochin. Of the remaining, 7778 tonnes (42%) were received from Centres south of Cochin, 1743 tonnes (9%) from north and 96 tonnes (0.5%) from Tamilnadu and other States. PD and PUD types of material accounted for 11,361 tonnes and 4474 tonnes respectively, both together accounting for 87% of the material, the rest being made up of froglegs, headless shell-on shrimp, cuttle fish etc. Similar estimates for processing plants at Veraval and Kakinada are under preparation.

10.3. RESEARCH CONTEMPLATED

1. Development of statistical test procedures for comparing the efficiency of fishing gears
2. Optimum number of fishing boats for a viable fishing base|harbour
3. Economic aspect of boat|net combination in fishing

11. PUBLICATIONS

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4. *Balachandran, K. K. & Surendran, P. K.* - Studies on depuration of live clams (*Vilorita* sp.) - *Fish. Technol.*, 21(1): 1984.
5. *Balachandran, K. K. & Surendran, P. K.* - Purification of live clams for processing - *Fish Technol. Newsletter*, III (11): 14, 1984.
6. *Balachandran, K. K., Vijayan, P. K. & Prabhu, P. V.* - Canning of edible oyster meat - *Fish. Technol.* 21(1): 1984.
7. *Balasubramanyan, R.* - Fishing boat maintenance: Some basic guide-lines - Paper presented at Orientation Training Course in Fisheries Extension organised by Dept. of Fisheries, Kerala, Cochin, Dec. 21-23, 1983.
8. *Balasubramanyan, R.* - Cheaper wooden fishing boats - Paper presented at Orientation Training Course in Fisheries Extension organised by Dept. of Fisheries, Kerala, Cochin, Dec. 21-23, 1983.
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10. *Balasubramaniam, S. & Kaul, P. N.* - Discriminant analysis of selected variables in the adoption of fish curing (*Fish. Technol.* 21(1): 1984.
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15. *Devadasan, K.* - Freshness and factors affecting freshness of fish and fishery products - Course Note on Training Course on Handling Practices of Shrimps and Fishes at Pre-Processing and Processing Plants, Cochin, 21 Feb.-16 March, 1984.
16. *George, V. C.* - Fishing technology for the fishermen - Paper presented at the Workshop on Supporting Technologies Appropriate for Rural Development with Particular Reference to Kerala, Vellanad, Oct. 2, 1983.
17. *George, V. C.* - Transferable fishing gear technology - Paper presented at Orientation Training Course in Fisheries Extension conducted by Department of Fisheries, Kerala, Cochin, Dec. 21-22, 1983.
18. *Gopakumar, K.* - Lipid oxidation and its effect on fish quality - *Industrial Fisheries Assn. Annual* 1983 (issued in 1984): 53.
19. *Gopakumar, K.* - Dry fish production - improved methods - Paper presented at Orientation Training Course in Fisheries Extension organised by Dept. of Fisheries, Kerala, Cochin, Dec. 21-23, 1983.
20. *Gopakumar, K.* - Methods of handling and preservation of fish on board fishing vessels - Course Note on Training Course on Handling Practices of Shrimps and Fishes at Pre-Processing and Processing Plants, Cochin, 21 Feb.-16 March, 1984.
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85. Sivadas, T. K., Ramakrishnan, K. & Vijayabharathi, K. - An electronic speed and distance log - Paper presented at 2nd Indian Conference in Ocean Engineering, Pune, Dec. 14-16, 1983.
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91. *Varma, P. R. G.* - Filth: its significance and testing in fishery products - Course Note on Quality Control Training Course on Frozen Lobster Tails, Cochin, 3-21 Oct. 1983.
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12. APPENDICES

APPENDIX - I

HEADQUARTERS: CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY,
Willingdon Island, Matsyapuri P.O.
COCHIN-682029, KERALA

TLX No. 0085-440

Telephone No. 6845 (10 lines)

Telegram: MATSYAODYOGIKI or
FISHTECH, COCHIN

Director's Telephone: Per: 6880

DIRECTOR .. Dr. C. C. Panduranga Rao

Scientist-in-charge

Biochemistry & Nutrition Division	.. Shri M. Rajendranathan Nair
Processing & Packaging Division	.. Dr. K. Gopakumar
Microbiology Division	.. Shri K. Mahadeva Iyer
Craft Division	.. Shri R. Balasubramanyan
Gear Division	.. Shri V. C. George
Engineering Division	.. Shri S. Ayyappan Pillai
Electronics & Instrumentation Division	.. Shri T. K. Sivadas
Extension, Information & Statistics Division	.. Shri M. Rajendranathan Nair

RESEARCH CENTRES

Sl. No.	Place	Address	Telephone No.	Telegram	Scientist-in-charge
1	2	3	4	5	6
1.	VERAVVAL	Research Centre of CIFT Bunder Road, Veraval-362265, Gujarat	297	MATSYAOUUDYOGIKI	Shri K. K. Solanki
2.	KAKINADA	Research Centre of CIFT D. No. 54-2-9, Yesuvari St., Jagannaickpur, Kakinada-533002, Andhra Pradesh	4436	MATSYAOUUDYOGIKI	Shri G. Narayanappa
3.	BURLA	Research Centre of CIFT Burla-768017 Sambalpur Dist., Orissa	19	MATSYAOUUDYOGIKI	Shri K. A. Sadanandan
4.	BOMBAY	Research Centre of CIFT 162, Sassoon Dock, Colaba, Bombay-400005, Maharashtra	213892	FISHPROCESS (FT)	Dr. M. Arul James
5.	CALICUT	Research Centre of CIFT Beach Road, West Hill, Calicut-673005, Kerala	76607	CARE 'KADALMIN'	Shri T. S. Unnikrishnan Nair
6.	GOA	Research Centre of CIFT 2nd Floor, 'Shanta' 18th June Road, St. Inez, Panaji-403001, Goa	5905	MATSYAOUUDYOGIKI	Shri H. N. Mhalathkar

APPENDIX - II

List of Personnel in C.I.F.T. as on 31-3-1984

HEADQUARTERS-COCHIN

SCIENTIFIC PERSONNEL

DIRECTOR

Dr. C. C. Panduranga Rao
(Officiating)

Scientist S-3

- | | |
|--|-----------------------------------|
| 1. Shri M. Rajendranathan Nair
(Joint Director) | 7. Shri K. Mahadeva Iyer |
| 2. Dr. K. Gopakumar | 8. Dr. K. Ravindran |
| 3. Shri R. Balasubramanyan | 9. Shri V. C. George |
| 4. Dr. P. N. Kaul | 10. Shri T. S. Gopalakrishna Iyer |
| 5. Dr. T. K. Govindan | 11. Dr. K. Devadasan |
| 6. Shri P. V. Prabhu | 12. Shri P. Madhavan |
| | 13. Shri P. Appukutta Panicker |

Scientist S-2

- | | |
|----------------------------------|-------------------------------------|
| 1. Shri S. Ayyappan Pillai | 14. Dr. P. K. Surendran |
| 2. Shri C. V. Narasimha Rao | 15. Shri K. G. Ramachandran Nair |
| 3. Shri K. K. Balachandran | 16. Shri P. T. Mathew |
| 4. Shri K. Sreedharan Namboodiri | 17. Dr. Jose Stephen |
| 5. Shri T. K. Sivadas | 18. Dr. P. G. Viswanathan Nair |
| 6. Shri P. D. Antony | 19. Shri N. Unnikrishnan Nair |
| 7. Shri P. K. Chakraborty | 20. Shri A. G. Gopalakrishna Pillai |
| 8. Shri M. K. Kandoran | 21. Smt. A. Lakshmy Nair |
| 9. Shri H. Krishna Iyer | 22. Shri T. K. Sreenivasa Gopal |
| 10. Shri K. Krishna Rao | 23. Dr. M. K. Mukundan |
| 11. Shri P. A. Perigreen | 24. Shri K. V. Mohan Rajan |
| 12. Shri A. K. Kesavan Nair | 25. Shri Cyriac Mathen |
| 13. Smt. Chinnamma George | |

Scientist S-1

- | | |
|----------------------------|----------------------------------|
| 1. Shri P. N. R. Kaimal | 15. Kum. B. Meenakumari |
| 2. Shri P. R. Girija Varma | 16. Shri Francis Thomas |
| 3. Smt. Mary Thomas | 17. Shri P. Srinivasa Rao |
| 4. Shri A. Vasanth Shenoy | 18. Shri G. Rajagopalan Unnithan |
| 5. Shri P. N. Joshi | 19. Smt. K. Ammu |
| 6. Shri K. N. Kartha | 20. Shri S. Sanjeev |
| 7. Shri P. George Mathai | 21. Dr. P. T. Lakshmanan |
| 8. Shri T. P. George | 22. Smt. K. V. Lalitha |
| 9. Shri P. K. Vijayan | 23. Shri P. Ravindranathan Nair |
| 10. Shri K. Ramakrishnan | 24. Shri S. Balasubramaniam |
| 11. Smt. K. Vijayabharathy | 25. Shri K. P. Antony |
| 12. Shri Jose Joseph | 26. Dr. M. D. Varghese |
| 13. Shri T. K. Thankappan | 27. Smt. R. Thankamma |
| 14. Smt. Nirmala Thampuran | 28. Shri A. G. Radhakrishnan |

Scientist 'S'

1. Shri A. C. Kuttappan

TECHNICAL PERSONNEL

Technician T-7

- | | |
|------------------------------|-----------------------------|
| 1. Shri K. S. Ganesan | .. Workshop Engineer |
| 2. Shri M. S. Fernando | .. Skipper |
| 3. Shri K. J. Francis Xavier | .. Skipper |
| 4. Shri S. Gopalan Nair | .. Technical Officer (Fish) |
| 5. Smt. P. J. Cecily | .. Jr. Technical Officer |

Technician T-6

- | | |
|-----------------------------|-----------------------------------|
| 1. Shri K. C. Purushothaman | .. Editor-cum-Information Officer |
|-----------------------------|-----------------------------------|

Technician T-5

- | | |
|---------------------------|-----------------------------------|
| 1. Shri T. M. Sivan | .. Asst. Technical Officer (Fish) |
| 2. Smt. K. Radhalekshmy | .. Asst. Technical Officer (Fish) |
| 3. Shri N. A. George | .. Asst. Technical Officer (Fish) |
| 4. Shri M. S. Rajan | .. Fishing Mate |
| 5. Shri N. Sriharshan | .. Engineer |
| 6. Shri V. K. Ibrahim | .. Head Draughtsman |
| 7. Smt. T. T. Annamma | .. Sr. Technical Assistant |
| 8. Shri K. Vasudevan Nair | .. Sr. Technical Assistant |
| 9. Smt. Annamma Mathew | .. Sr. Technical Assistant |
| 10. Shri K. Bhaskaran | .. Photographer-cum-Artist |

Technician T-4

1. Shri Varghese Paul	..	Technical Assistant
2. Shri A. Kassim Kunju	..	Technical Assistant
3. Shri C. Chandrasekharan	..	Superintendent (E&M)
4. Shri N. Vareethiah	..	Glass Blower
5. Shri G. Mohanan	..	Artist
6. Shri P. Ravindranathan	..	Librarian
7. Shri O. Subramanian	..	Sr. Welder
8. Shri K. K. Poullose	..	Instrument Technician
9. Shri T. K. Sayed Ali	..	Technical Assistant

Technician T-II-3

1. Shri P. Sadanandan	..	Technical Assistant
2. Shri Thomas J. Mammoottil	..	Technical Assistant
3. Shri M. K. Sasidharan	..	Technical Assistant
4. Shri P. T. Sebastian	..	Technical Assistant
5. Shri V. Gaspar	..	Technical Assistant
6. Shri P. S. Alias	..	Superintendent (Instrumentation)
7. Shri M. L. Anslem	..	Sr. Draughtsman
8. Shri M. Abdul Sathar	..	Media Supervisor
9. Shri B. Anandan	..	Foundry Assistant
10. Shri R. Gopalakrishnan Nair	..	Computer
11. Shri M. U. Vijayan	..	Sr. Mechanic
12. Shri T. K. David	..	Fitter

Technician T-I-3

1. Shri K. J. Augustine	..	Sr. Turner
2. Shri A. K. Jaisingh	..	Bosun
3. Shri T. S. Bhaskara Menon	..	Sr. Mechanic
4. Shri K. E. Mani	..	Sr. Mechanic
5. Shri P. M. Joseph	..	Mechinist
6. Shri A. K. Dharaneedharan	..	Media Assistant
7. Shri K. K. Subramanian	..	Engine Driver
8. Shri V. V. Johni	..	Sr. Field Assistant
9. Shri V. K. Ramachandran	..	Sr. Lab. Assistant
10. Shri E. K. Balakrishnan	..	Draughtsman
11. Smt. K. Sarasamma	..	Draughtsman
12. Shri G. Ratnakaran Nair	..	Refrigeration Mechanic
13. Shri M. M. Devassya	..	Jr. Library Assistant

Technician T-2

1. Shri P. K. Damodaran	.. Sr. Lab. Assistant
2. Shri Shaju A. Averah	.. Draughtsman
3. Shri Shanmugavel	.. Refrigeration Mechanic
4. Shri C. Rajendran	.. Refrigeration Mechanic
5. Shri Jose Kalathil	.. Refrigeration Mechanic
6. Shri N. R. Gopan Nair	.. Refrigeration Mechanic
7. Shri P. A. Josi Augustine	.. Refrigeration Mechanic
8. Shri K. V. Madhavan	.. Electrician
9. Shri C. C. Sivan	.. Welder-cum-Blacksmith
10. Shri K. V. Rajan	.. Jr. Lab. Assistant
11. Shri K. B. Thilakan	.. Jr. Lab. Assistant
12. Shri K. K. Pappukutty	.. Driver (Launch)
13. Shri T. Gopalakrishnan	.. Metal Worker
14. Shri P. A. John	.. Cockswain
15. Shri T. N. Manibhadran	.. Tindal
16. Shri T. K. Vasudevan	.. Jr. Lab. Assistant
17. Shri T. K. Aravindakshan	.. Jr. Lab. Assistant
18. Smt. K. K. Sumathy	.. Jr. Lab. Assistant
19. Shri T. K. Bhaskaran	.. Jr. Lab. Assistant

Technician T-1

1. Shri O. M. Samuel	.. Jr. Lab. Assistant
2. Shri V. V. John	.. Jr. Lab. Assistant
3. Shri A. A. Kunjappan	.. Field Assistant
4. Shri K. K. Narayanan	.. Boilerman
5. Kum. Usha Rani	.. Jr. Lab. Assistant
6. Kum. K. G. Sasikala	.. Jr. Lab. Assistant
7. Kum. V. C. Mary	.. Jr. Lab. Assistant
8. Kum. K. P. Leelamma	.. Jr. Lab. Assistant
9. Shri C. R. Gokulan	.. Jr. Lab. Assistant
10. Shri P. S. Raman Nampoothiri	.. Jr. Lab. Assistant

ADMINISTRATIVE PERSONNEL

Sr. Administrative Officer	.. Vacant
Administrative Officer	.. Shri P. James Abraham
Asst. Administrative Officer	.. Shri Varghese Paul
Accounts Officer	.. Shri K. T. Abubacker
Asst. Accounts Officer	.. Shri S. P. Nair

Superintendent

1. Shri P. J. Joseph
2. Smt. T. N. Ambujakshy Amma
3. Shri P. A. Uthup
4. Shri M. George Joseph
5. Shri S. Naveenchadra Prabhu
6. Smt. K. A. Devaky

Senior Stenographer

Shri K. J. Thomas

Assistant

1. Smt. Alice M. Joseph
2. Smt. Nafeesa Ali
3. Shri A. George Joseph
4. Shri T. M. Padmanabhan
5. Smt. N. K. Sulochana
6. Shri R. Anil Kumar
7. Smt. T. K. Sarala
8. Shri R. S. Shanmughan
9. Shri A. L. John
10. Shri T. Gurumoorthy

Stenographer

1. Smt. Mariamma Sadanandan
2. Shri K. Ravindran
3. Smt. N. K. Saraswathy

Senior Clerk

1. Shri M. Gopalakrishnan
2. Shri M. T. Joseph
3. Shri V. N. Rajasekharan Nair
4. Shri P. Vijayan
5. Shri A. K. Venugopal
6. Shri M. J. Sebastian
7. Shri M. Ravindran
8. Smt. Annamma Varghese
9. Smt. C. G. Marykutty
10. Smt. M. S. Susanna
11. Smt. N. Prabhavathy Amma
12. Shri C. Ravindran Nair
13. Smt. K. R. Gita Rani
14. Shri T. M. Ramraj
15. Shri G. Somappan
16. Shri K. Bhaskaran
17. Smt. M. Jully
18. Shri Y. Philipose
19. Smt. M. A. Prasanna
20. Shri R. Viswanathan

Junior Stenographer

1. Smt. R. Vasantha
2. Shri P. K. Raghu
3. Kum. S. Kamalamma
4. Kum. V. P. Vijayakumari

Junior Clerk

- | | |
|----------------------------|---------------------------|
| 1. Shri V. R. Kesavan | 12. Kum. P. K. Thankamma |
| 2. Smt. K. A. Nazeem | 13. Smt. A. A. Causallia |
| 3. Shri P. K. Sreedharan | 14. Shri K. K. Sasi |
| 4. Smt. K. Gracy | 15. Shri P. Padmanabhan |
| 5. Shri P. V. Venugopalan | 16. Smt. A. R. Kamalam |
| 6. Shri K. P. Velayudhan | 17. Shri K. V. Mathai |
| 7. Smt. T. K. Susannamma | 18. Kum. T. K. Shyma |
| 8. Smt. P. C. Kamalakshy | 19. Kum. T. D. Usheem |
| 9. Shri K. Rajappan Pillai | 20. Shri V. S. Ambasuthan |
| 10. Smt. N. I. Mary | 21. Shri A. P. Gopalan |
| 11. Shri P. K. Thomas | |

Telephone Operator-cum-Receptionist

Shri P. Bahuleyan

Caretaker

Shri A. Chakrapani

AUXILIARY PERSONNEL

- | | |
|--------------------------------|-----------------------|
| 1. Smt. T. L. Hemalatha | .. Hindi Translator |
| 2. Shri V. S. Augustine | .. Sr. Carpenter |
| 3. Shri Philip Durom | .. Sr. Carpenter |
| 4. Shri Joseph Paul | .. Carpenter |
| 5. Shri A. Gopalakrishnan Nair | .. Staff Car Driver |
| 6. Shri P. P. Poullose | .. Staff Car Driver |
| 7. Shri M. G. Narayanan Nair | .. Driver |
| 8. Shri V. P. Raphel | .. Driver |
| 9. Shri T. Neelakandan | .. Projector Operator |
| 10. Shri C. C. Gandhi | .. Plant Attendant |
| 11. Shri N. C. Bhaskaran | .. Plant Attendant |
| 12. Shri K. R. Kesavan | .. Plant Attendant |
| 13. Shri K. K. Lakshmanan | .. Deck hand |
| 14. Shri T. Balan | .. Deck hand |
| 15. Shri P. K. Pushpangadan | .. Deck hand |
| 16. Shri T. K. Dasan | .. Deck hand |
| 17. Shri T. K. Bava | .. Deck hand |
| 18. Shri E. K. Chinnappan | .. Deck hand |
| 19. Shri M. K. Asokan | .. Deck hand |
| 20. Shri D. G. Rao | .. Deck hand |
| 21. Shri E. R. Krishnan | .. Cook |
| 22. Shri A. P. Zachariah | .. Photo Assistant |

SUPPORTING STAFF

Supporting Staff Grade IV

1. Shri M. K. Prabhakaran
2. Shri K. K. Radhakrishnan
3. Shri O. C. Lonan

Supporting Staff Grade III

- | | |
|-------------------------------|--------------------------------|
| 1. Shri E. S. Balachandra Pai | 9. Shri K. K. Appachan |
| 2. Shri E. S. Sreedharan | 10. Shri K. X. Joseph |
| 3. Shri P. A. Thomas | 11. Shri T. T. Das |
| 4. Shri K. Balakrishna Pillai | 12. Shri O. M. Thankappan |
| 5. Shri P. J. George | 13. Shri O. A. Krishnan |
| 6. Shri P. C. Sukumaran | 14. Shri M. K. Thevan |
| 7. Shri A. G. Vasu | 15. Shri P. M. Pakeer Mohammed |
| 8. Shri C. A. Subran | |

Supporting Staff Grade II

- | | |
|--------------------------|----------------------------|
| 1. Shri K. Raghavan | 8. Shri K. N. Mukundan |
| 2. Shri K. K. Madhavan | 9. Shri P. Gopalakrishnan |
| 3. Shri S. Rajan | 10. Shri K. A. Gopinath |
| 4. Shri T. V. Manoharan | 11. Shri P. D. George |
| 5. Shri T. T. Velayudhan | 12. Shri K. B. Bhaskaran |
| 6. Shri C. A. Krishnan | 13. Shri K. K. Karthikeyan |
| 7. Shri P. A. Shanmughan | 14. Shri K. A. Kunjan |

Supporting Staff Grade I

- | | |
|------------------------------------|----------------------------------|
| 1. Shri T. T. Thankappan | 15. Shri T. Mathai |
| 2. Shri P. K. Unnikrishna Panicker | 16. Shri P. T. Anthappan |
| 3. Shri R. Chellappan | 17. Shri T. K. Viiswanathan |
| 4. Shri T. Kochukuttan Nair | 18. Shri P. A. Sivan |
| 5. Shri A. R. John | 19. Kum. C. G. Radhamony |
| 6. Shri C. N. Raghavan | 20. Shri P. K. Somasekharan Nair |
| 7. Shri A. Ravindran Nair | 21. Shri N. Krishnan |
| 8. Shri P. N. Sukumaran Nair | 22. Shri C. D. Parameswaran |
| 9. Smt. P. L. Rosely | 23. Shri V. T. Sadanandan |
| 10. Shri T. K. Rajappan | 24. Shri A. Thomas Baby |
| 11. Shri K. N. Velayudhan Kutty | 25. Shri P. V. Narayanan |
| 12. Shri K. K. Lakshmanan | 26. Shri T. S. Lawrence |
| 13. Shri T. G. John | 27. Shri P. C. Chacko |
| 14. Shri O. K. Xavier | |

VERAVAL RESEARCH CENTRE

SCIENTIFIC PERSONNEL

Scientist S-2

Shri K. K. Solanki
Shri A. C. Joseph
Shri K. K. Kunjipalu

Scientist S-1

- | | |
|------------------------------|-------------------------|
| 1. Shri N. Subramania Pillai | 4. Shri M. R. Raghunath |
| 2. Shri H. K. Beri | 5. Shri Anil Agarwal |
| 3. Shri M. R. Boopendranath | |

TECHNICAL STAFF

- | | |
|----------------------------------|---------------------------------|
| 1. Shri G. P. Vaghela | .. T-II-3 (Technical Assistant) |
| 2. Shri J. B. Paradwa | .. T-II-3 (Technical Assistant) |
| 3. Shri D. K. Ukhabhai | .. T-II-3 (Technical Assistant) |
| 4. Shri M. Ravindran Nair | .. T-I-3 (Bosun) |
| 5. Shri S. R. Jethwa | .. T-I-3 (Senior Mech.) |
| 6. Shri Mohammed Jaffer | .. T-I-3 (Engine Driver) |
| 7. Shri N. J. Tandal | .. T2 (Driver- Launch) |
| 8. Shri M. M. Vara | .. T2 (Field Assistant) |
| 9. Shri M. K. Kuttikrishnan Nair | .. T2 (Sr. Field Assistant) |
| 10. Shri K. U. Sheikh | .. T1 (Jr. Lab. Asst.) |
| 11. Shri D. R. Aparnathi | .. T1 (Jr. Lab. Asst.) |
| 12. Shri A. P. Joshi | .. T1 (Tindal) |
| 13. Shri T. Gangadharan | .. T2 (Sr. Lab. Asst.) |

ADMINISTRATIVE STAFF

- | | |
|------------------------|--------------|
| 1. Shri P. Vasudevan | .. Assistant |
| 2. Shri Veer Singh | .. Jr. Clerk |
| 3. Shri S. B. Purohit | .. Jr. Clerk |
| 4. Shri M. M. Damodara | .. Jr. Clerk |

AUXILIARY STAFF

1. Shri G. B. Tandel .. Deck hand
2. Shri H. M. Kotiya .. Deck hand
3. Shri G. R. Bhogte .. Deck hand
4. Shri Malam Bachu Sidi .. Deck hand
5. Shri G. L. Tandel .. Cook

SUPPORTING STAFF

1. Shri S. M. S. Yadav .. SS. Gr. III
2. Shri P. A. Abdul Rahman .. SS. Gr. III
3. Shri K. C. Fofandi .. SS. Gr. II
4. Shri G. M. Vaghele .. SS. Gr. II
5. Shri K. A. Masani .. SS. Gr. II
6. Shri N. N. Goswami .. SS. Gr. II
7. Shri Harbhajan .. SS. Gr. I
8. Shri B. M. A. Khoker .. SS. Gr. I
9. Shri D. P. Parmar .. SS. Gr. I
10. Shri D. B. Chudasama .. SS. Gr. I
11. Shri K. J. Damer .. SS. Gr. I
12. Smt. Chandrika C. Tank .. SS. Gr. I
13. Shri P. N. Chudasama .. SS. Gr. I
14. Shri H. V. Punjera .. SS. Gr. I

KAKINADA RESEARCH CENTRE

SCIENTIFIC PERSONNEL

Scientist S-2

1. Shri G. Narayanappa
2. Shri Sibsankar Gupta
3. Shri S. V. S. Rama Rao

Scientist S-1

1. Shri J. Sita Rama Rao
2. Shri Subrata Basu
3. Shri D. Immam Khasim Sahib
4. Shri R. Mangayya Naidu
5. Shri Rupshankar Chakraborty

TECHNICAL STAFF

1. Shri A. V. V. Satyanarayana .. T-7 (Technical Officer-Fish)
2. Shri A. Veeranjeyulu .. T-II-3 (Technical Asst.)
3. Shri Srihari Babu .. T-II-3 (Technical Asst.)
4. Shri V. V. Ramakrishna .. T-II-3 (Technical Asst.)
5. Shri K. V. Baladasan .. T-I-3 (Engine Driver)
6. Shri Laxmanadu .. T-I-3 (Bosun)
7. Shri Veera Raju .. T-I-3 (Tindal)
8. Shri N. Babu Rao .. T-2 (Sr. Field Assistant)
9. Shri B. Ramaiah .. T-2 (Jr. Lab. Assistant)
10. Shri Prakash Rao .. T-1 (Driver - Launch)
11. Shri N. Venkata Rao .. T-1 (Field Assistant)
12. Shri K. V. S. S. Kusuma Harnath .. T-1 (Jr. Lab. Assistant)

ADMINISTRATIVE STAFF

1. Shri N. Venugopal .. Senior Clerk
2. Smt. Satyanarayanamma .. Jr. Stenographer
3. Shri Ch: Satyanarayana .. Jr. Clerk
4. Kum. B. Hemalatha .. Jr. Clerk

AUXILIARY STAFF

1. Shri K. Sarangadharadu .. Deck hand
2. Shri Karri Gangaraju .. Deck hand
3. Shri G. Subba Rao .. Cook

SUPPORTING STAFF

1. Shri B. Suryaprakash Rao .. SS. Gr. IV
2. Shri Koppada Gandhi .. SS. Gr. IV
3. Shri Thirupathi Rao .. SS. Gr. III
4. Shri N. Gnanaranjana Rao .. SS. Gr. III
5. Shri C. Kamaraju .. SS. Gr. II
6. Shri V. Kamaraju .. SS. Gr. II
7. Shri S. C. Meher .. SS. Gr. II
8. Shri K. Kameswara Rao .. SS. Gr. II

9. Shri Melladi Perraju	..	SS. Gr. II
10. Shri G. Chinna Rao	..	SS. Gr. II
11. Shri O. Heman	..	SS. Gr. II
12. Shri Vasippilli Yelliah	..	SS. Gr. I
13. Shri K. Appa Rao	..	SS. Gr. I
14. Shri B. Sivanadham	..	SS. Gr. I
15. Shri S. Chakram	..	SS. Gr. I
16. Shri S. Appa Rao	..	SS. Gr. I
17. Shri R. Ranga Swamy	..	SS. Gr. I

BURLA RESEARCH CENTRE

SCIENTIFIC PERSONNEL

Scientist S-2

1. Shri K. A. Sadanandan
2. Shri T. Joseph Mathai
3. Shri Anwar Ahmed Khan

Scientist S-1

- | | |
|-------------------------|------------------------------|
| 1. Shri M. Mukundan | 4. Shri J. K. Bandhyopadhyay |
| 2. Shri J. Sitarama Rao | 5. Shri S. K. Bhattacharya |
| 3. Shri Percy Dawson | 6. Shri A. K. Chatopadhyay |

TECHNICAL STAFF

- | | | |
|---------------------------|----|--------------------------|
| 1. Shri Baikunta Pradhan | .. | T-II-3 (Technical Asst.) |
| 2. Shri Gurudas Ram | .. | T-I-3 (Tindal) |
| 3. Shri P. M. Pathanayak | .. | T-I-3 (Sr. Lab. Asst.) |
| 4. Shri Radhu Pandey | .. | T-1 (Driver - Launch) |
| 5. Shri Sathrugan Kumara | .. | T-1 (Tindal) |
| 6. Shri Damodar Rout | .. | T-1 (Jr. Lab. Asst.) |
| 7. Shri Ashok Kumar Naik | .. | T-1 (Mechanic) |
| 8. Shri Rabinarayan Sahoo | .. | T-1 (Driver - Launch) |

ADMINISTRATIVE STAFF

- | | | |
|-------------------------------|----|--------------|
| 1. Shri Jatindra Kumar Mishra | .. | Assistant |
| 2. Shri G. C. Adhikari | .. | Junior Clerk |
| 3. Shri Udekar Pande | .. | Junior Clerk |

AUXILIARY STAFF

1. Shri Narasingh Panda .. Driver

SUPPORTING STAFF

1. Shri Gajendra Karali .. SS. Gr. IV
2. Shri K. C. Meher .. SS. Gr. III
3. Shri Laba Nag .. SS. Gr. III
4. Shri G. C. Meher .. SS. Gr. II
5. Shri Rathan Chand .. SS. Gr. II
6. Shri Sathrugan Seth .. SS. Gr. II
7. Shri K. C. Nayak .. SS. Gr. II
8. Shri Kirtan Kisan .. SS. Gr. II
9. Shri Thomas Topno .. SS. Gr. I
10. Shri Badrinarain Guru .. SS. Gr. I
11. Shri Jaisingh Oram .. SS. Gr. I
12. Shri P. K. Bhangaraj .. SS. Gr. I
13. Shri Satyanarayan Mirdha .. SS. Gr. I
14. Shri Premlal Panda .. SS. Gr. I
15. Shri Dibyalochan Pattanayak .. SS. Gr. I
16. Shri Godabari Mahanandia .. SS. Gr. I
17. Shri Surajananda Dishri .. SS. Gr. I

BOMBAY RESEARCH CENTRE

SCIENTIFIC PERSONNEL

Scientist S-2

1. Dr. M. Arul James

Scientist S-1

1. Shri V. Narayanan Nambiar
2. Shri S. P. Damle
3. Shri Dinesh Kumar Garg

TECHNICAL STAFF

1. Shri A. P. Valsan .. T-7 (Technical Officer (Fish.))
2. Shri N. M. Vasu .. T-II-3 (Technical Asst.)

ADMINISTRATIVE STAFF

1. Shri Y. N. Mhadgut .. Senior Clerk
2. Smt. Smita K. Shirishkar .. Junior Clerk

AUXILIARY STAFF

1. Shri B. B. Pinjari .. Driver

SUPPORTING STAFF

1. Shri S. S. Salvi .. SS. Gr. IV
2. Shri A. T. Waghmare .. SS. Gr. III
3. Shri B. S. Tambe .. SS. Gr. II
4. Shri B. M. Ghare .. SS. Gr. I
5. Shri Vinod S. Salvi .. SS. Gr. I

CALICUT RESEARCH CENTRE

SCIENTIFIC PERSONNEL

Scientist S-2

1. Shri T. S. Unnikrishnan Nair

Scientist S-1

1. Shri V. Muraleedharan
2. Shri N. Kalaimani
3. Shri K. George Joseph

TECHNICAL STAFF

1. Shri T. John .. T-II-3 (Technical Asst.)
2. Shri P. Gopalakarishna Pillai .. T-II-3 (Technical Asst.)
3. Smt. M. K. Sreelekha .. T-1 (Jr. Lab. Assistant)
4. Smt. Tara Karupalli .. T-1 (Jr. Lab. Assistant)

ADMINISTRATIVE STAFF

1. Shri M. Balan Nambiar .. Senior Clerk
2. Kum. V. S. Aleyamma .. Jr. Clerk

SUPPORTING STAFF

1. Shri E. Gangadharan Nair .. SS. Gr. III
2. Shri C. M. Gopalan .. SS. Gr. III
3. Shri K. K. Lakshmanan .. SS. Gr. I

GOA RESEARCH CENTRE

SCIENTIFIC PERSONNEL

Scientist S-2

Shri H. N. Mhalathkar

Scientist S-1

1. Shri R. S. Manoharadoss
2. Shri V. Vijayan
3. Shri M. Sayed Abbas

TECHNICAL STAFF

1. Shri A. B. Varghese .. T-I-3 (Bosun)
2. Shri Koruthu George .. T-2 (Engine Driver)

ADMINISTRATIVE STAFF

1. Shri A. B. Rodrigues .. Senior Clerk

AUXILIARY STAFF

1. Shri M. Venkateswara Rao .. Driver

SUPPORTING STAFF

1. Shri D. D. Naik .. SS. Gr. III
2. Shri R. D. Padnekar .. SS. Gr. II
3. Shri Vasudeva G. Kubal .. SS. Gr. II
4. Shri Menino Souza .. SS. Gr. II
5. Shri P. S. Morajkar .. SS. Gr. II
6. Shri C. B. Shirodhkar .. SS. Gr. II
7. Shri V. P. Halnekar .. SS. Gr. I
8. Shri Gopixenkar Chodankar .. SS. Gr. I
9. Shri Chandrakanth Kolvalkar .. SS. Gr. I

ON DEPUTATION

<i>Sl. No.</i>	<i>Name</i>	<i>Deputation with</i>	<i>Designation</i>
1.	Shri P. Sulochanan Scientist S-2	Fisheries Survey of India Bombay	Joint Director
2.	Shri Y. Sreekrishna Scientist S-2	Central Institute of Fisheries Education, Bombay-61.	Professor (Fisheries Technology)
3.	Shri R. Rajendran Scientist S-1	CIFNET, Cochin-16.	Instructor (Craft & Gear)
4.	Dr. M. Shahul Hameed Scientist S-1	University of Cochin	Reader
5.	Shri C. Hridayanathan Scientist S	University of Cochin	Lecturer
6.	Dr. G. Jagatheesan	Tamil Nadu Agricultural University, Coimbatore	Associate Professor (Fish Technology)
7.	Shri K. Gopalakrishnan Scientist S-1	Fisheries Survey of India Bombay	Deputy Director
8.	Shri S. Sadanandan Superintendent	ICAR Research Complex for NEHR, Shillong	Asst. Admn. Officer
9.	Shri C. K. Muraleedharan Junior Clerk	ICAR Research Complex for NEHR, Shillong	Senior Clerk
10.	Shri S. M. S. Abuthahir Ali, Scientist S-1	Dept. of Environment, New Delhi	Environmental Officer

APPENDIX-III

FINANCE

Details of budget provision and actual expenditure during the year 1983-84

PLAN

	<i>Budget Provision Rs.</i>	<i>Actual Expenditure Rs.</i>
Salary of Officers	—	—
Salary of Establishment	77,300	77,278.90
Dearness Allowance	97,700	97,644.60
Interim Relief	7,700	7,733.55
Bonus	3,600	3,629.00
Overtime Allowance	—	—
House Rent Allowance	15,800	15,782.25
City Compensatory Allowance	2,000	2,016.00
Other Allowances & Honoraria	1,000	1,021.15
Travelling Expenses	2,50,000	2,49,803.42
Other Charges	74,41,100	74,41,355.04
Total	78,96,200	78,96,263.91

NON-PLAN

Salary of Officers	16,97,600	16,97,569.66
Salary of Establishment	13,03,100	13,03,107.17
Dearness Allowance	31,67,400	31,67,441.25
Interim Relief	2,31,200	2,31,184.75
Bonus	93,000	92,966.70
Overtime Allowance	31,200	31,238.75
House Rent Allowance	3,42,800	3,42,784.55
City Compensatory Allowance	29,800	29,799.50
Other Allowances & Honoraria	1,48,400	1,48,383.48
Travelling Expenses	70,000	69,384.01
Leave Salary Contribution,		
Pension & P. F. Contribution	400	360.00
Other Charges	15,57,600	12,82,677.60
Grant-in-aid, Contributions etc.	21,500	21,480.42
Total	86,94,000	84,18,377.84