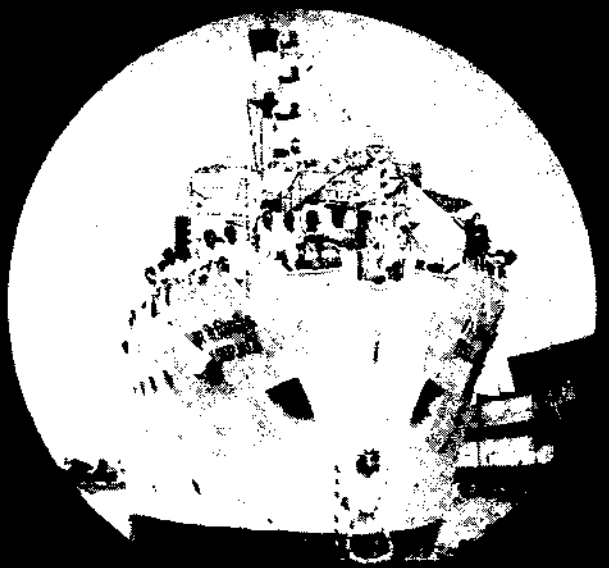

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Issued by:

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POST BAG 1912, COCHIN-682 018
INDIA

May, 1981

Cover photo: R. V. *SKIPJACK*
Institute's Research Vessel

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

COCHIN

Historical background

In the early forties especially during the 2nd World War and the post-war years, general food scarcity and the lack of adequate supplies of protein rich sea food prompted the Govt. of India to take a direct interest in the research, development and conservation of the fishery resources of the country. As a result of post-war reconstruction and development programmes taken up then, the Central Marine Fisheries Research Institute was started in 1947 with temporary Headquarters at Madras and in 1949 the Institute was shifted to its permanent H.Q at Mandapam Camp.

The Institute was directly under the control of the Ministry of Agriculture and Irrigation until October 1967 when the Indian Council of Agricultural Research took over the administrative control of the Institute. The H Q. of the Institute was transferred from Mandapam Camp to Cochin in 1970.

Establishments of the Institute

At present the Institute has a Regional Centre at Mandapam Camp: 11 Research Centres at Veraval, Bombay, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Madras, Kakinada, Waltair, and Minicoy. Smaller establishments known as Field Centres are located at 29 centres along the Coasts of India.

The Research Centres at Bombay, Madras and Waltair will soon be upgraded as Regional Centres.

The Institute has established field experimental laboratories at Narakkal (near Cochin), Kovalam (near Madras) and Veppalodai (near Tuticorin).

Objectives of the Institute

To conduct short-term and long-term multidisciplinary researches on the marine capture and culture fisheries of the country in order to provide RESEARCH support for the rational exploitation, conservation and management of the marine and brackishwater resources for stepping up production from the coastal water areas and the Exclusive Economic Zone, and DEVELOPMENT support for growth with stability of the industrial, artisanal and culture fisheries through transfer of technology, dissemination of information, EDUCATION TRAINING and EXTENSION.

These objectives are being achieved through the following functions:

- Estimation and monitoring of the exploited fishery resources;
- Assessment of untapped conventional and unconventional resources of the Exclusive Economic Zone by exploratory, acoustic and aerial surveys;
- Preparation of synoptic fishery maps;
- Studies on the population and biological characteristics of the commercial fishery resources;
- Monitoring of fishery environmental factors and developing a fishery environmental service;
- Marine pollution in relation to protection of living resources;
- Fisheries forecast;
- Survey of seed resources and location of suitable areas for coastal aquaculture;
- Development of low-cost technology for intensive culture of suitable organisms in different ecological systems;
- Crop-livestock-fish culture integration;
- Improvement of rural economy through blending of capture and culture fisheries;
- Studies on the economics of operation of the capture and culture fisheries;
- Strengthening of the Fishery Data Centre for collection and rapid dissemination of Integrated Fishery Data;
- Undertaking Operational Research Projects, pilot projects and National Demonstration Programmes for the propagation and establishment of mariculture enterprises;
- Transfer of technology through regular education and training programmes; and
- Fishery extension and consultancy service.

Organisational charts

Chart 1 (Centre spread page)

Depicts the organisation of the different wings of the Institute and their major functions

Chart 2

Sanctioned staff strength of the Institute including that of education, training and extension projects (as on 31-3-1981)

Director	—	1
Joint Directors	—	2
Scientific staff	—	190
Technical staff	—	259
Administrative staff	—	141
Floating staff	—	68
Motor driver, divers etc.	—	37
Miscellaneous supporting staff	—	262
Total		960

ACTIVITIES OF THE DIFFERENT DIVISIONS IN THE MAJOR AREAS OF RESEARCH

Fishery survey data being collected at the landing centre

Fishery Resources Assessment Division

The three major technical programmes of the division are Fishery Survey, Fishery Statistics and Fishery Data Centre. One of the early tasks of the institute was to estimate marine fish production in the country to form the base line for developing and planning of fisheries. Along the 6,100 Km stretch of coastline there are about 1,300 fish landing centres and various types of fishing crafts, both mechanised and non-mechanised and

different gears are employed for the fishing operations. To suit this diverse nature of the artisanal fishery, a sampling design which involves space time stratification was introduced in 1959 and it was extended to other coastal areas subsequently.

Over the years the Institute has developed capability for providing variety-wise estimates of marine fish production with seasonal and regional breakup along with the estimates of fishing effort expended to get the production.

Frame Surveys

The all india marine fish production crossed 1 million t. mark for the first time in 1970 and since then the production has stabilised around 1.4 million tonnes in recent years. The division conducts every 4-5 years National Frame Surveys of the fishermen population, fishing villages, fishing crafts, gears and other infrastructure facilities. This helps to understand the potentialities of the traditional small-scale fishery and changing pattern in the fishing industry. The data on such production means also helps in developing suitable Plan programmes.

Stock assessment

Since fishery resources are dynamic, renewable and ever changing, the stock assessment of various exploited resources are made by the division for proper fishery management.

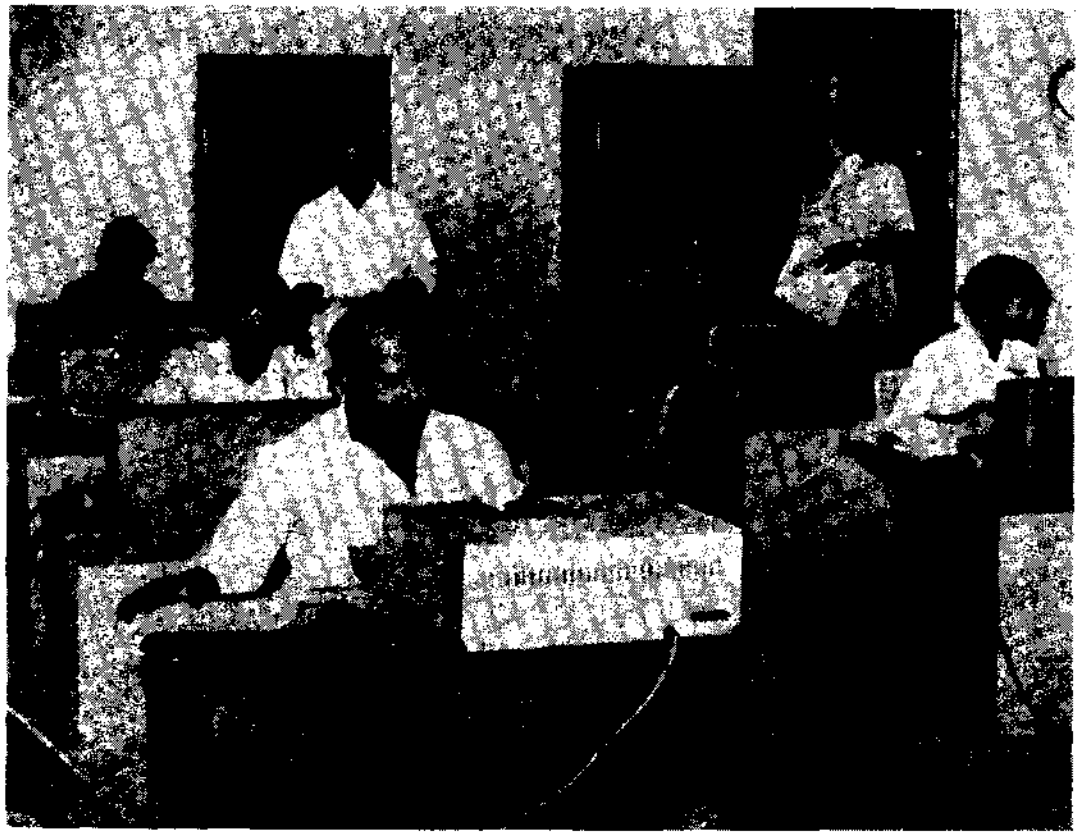
Fishery Data Centre

A wide range of statistical information is required to formulate a realistic plan

for the development of marine fisheries in India. The more accurate the basic statistical information are, the plans or programmes drawn up will be more realistic or correct. It is highly desirable that all types of fishery resources data are available at one central place. The Fishery Data Centre of the Institute is thus the store-house of all types of fishery data and is responsible for coordinating the work of several agencies collecting various types of data. The centre has laid down precise definition and methods for uniform collection of data and has devised standard proformae and circulated them to various agencies for collecting data. The centre is receiving all types of fishery resources data from the Exploratory Fishery Project, Integrated Fisheries Project and other private agencies. In addition to these data, the centre is also processing regular survey data collected from various fish landing centres along the coastline of India on the basis of sample survey programme of the Institute.

The main functions of the Fishery Data Centre are:-

1. Preparation and distribution of standard forms for collection of relevant data.
2. Codification and storage of the data.
3. Processing of data using the E. D. P. system.
4. Preparation of charts showing the abundance of various types of fisheries.



Computing Machines of the National Fishery Data Centre

(opp. page) Collection of Census data

5. Rapid dissemination of processed data to various national and international agencies and fishing industries.

Systematic collection of statistics on the synoptics and their analysis based on all commercial and exploratory operations will provide adequate information on the resources. These together with hydrological data will enable to draw up contour maps of various fisheries in relation to their abudance which will ultimately be of great help in the exploitation of untapped fishery resources

CAPTURE FISHERIES

Fin-fish resources constitute about 83% of the total marine fish production The main programmes of the Institute especially on capture fisheries are: monitoring the resource characteristics and biological studies on commercially important groups; based on recruitment studies, spawning behaviour and feeding habits to forecast the fisheries on a long term or short term basis; to conduct exploratory surveys for charting productive fishing grounds and new areas to be exploited and to suggest measures for proper management of our inshore and offshore resources.

The **Pelagic Fisheries Division** monitors the stocks and population characteristics of major resources as those of oil sardine, mackerel, Bombay duck and resources of lesser magnitude and which have higher unit value such as Pomfrets, carangids and seer fishes. With

Fish landings from mechanised vessels baing investigated

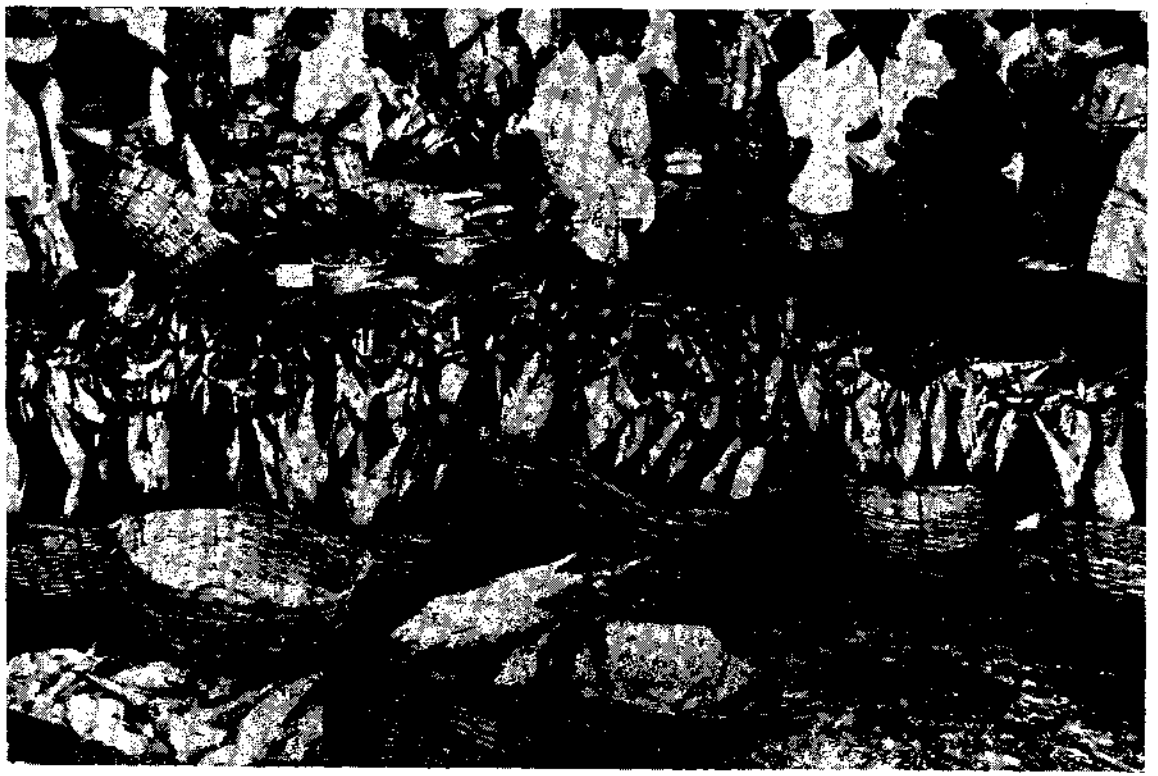
research vessel facilities the Division will undertake extensive surveys of the Exclusive Economic Zone to assess the potential of conventional resources such as tunas and related species and non conventional resources such as and gonostomatids. These surveys will help in the growths of an Oceanic fishery industry.

This Division conducts mark-recovery studies on pelagic fishes undertand their growth, migration and other aspects. Fishery forecasting and preparation of fishery atlases are also the important functions of this Division.

Demersal Fisheries Division

The research programmes of the Division in capture fisheries include evaluation of the biological and fishery characteristics of the ground fish resources such as silver bellies, thread, fin bream, Kalava, Ghol, Koth, Dara, Dhoma, Rawas, and Snappers from the presently exploited grounds. This involves close monitoring of the catches from mechanised fishing vessels, exploratory vessels, and participation in the fishing cruises.

In the coming years the evaluation of the demersal resources will be extended to non-traditional grounds and the Exclusive Economic Zone. The cat fish has been identified as one of the highly productive resource and special emphasis is given to their studies. Other demersal resources which are investigated include that of wam, lizard fishes, flat fishes, rays, skates etc.



Tuna landings at Sakthikulangara

Similarly the potential non-conventional resources such as that of *Priacanthus*, puffer fish, deepwater butterfish and *Chloropthalmus*, which are available in considerable quantities in the outer shelf will be evaluated.

Both these Division will prepare fishery maps on all major resources.

Crustacean Fisheries Division

The main thrust of research activities of this division in capture fisheries is on the monitoring projects for the assessment of resources. Prawns, lobsters and crabs constitute bulk of the exploited crustacean resources and they form the main stay of the marine products exported from India. The multispecies prawn fishery composed of two major groups namely penaeid and non-penaeid prawns is beset with many problems Increased fishing effort in certain regions of the coastline has created situations identical with over exploitation and in some other regions the rate of exploitation seems to have reach the optimum level. The major component of the fishery, the penaeid prawns occupy the marine and estuarine environment in their life history and in many parts of the country they are exploited from both these environments. The dynamics of the species between the environment and exploitation in such regions make the management of the resource very complex. The division carries out extensive studies on population characteristics and dynamics of the fishery in order to arrive at suitable management policies. The division also keeps track of the exploitation of the new found deep sea prawn, lobster and crab resources with a view to exercise control in their exploitation. This division is also responsible for fishery forcasts in prawn fishery of the coastal zones and exploratory surveys of the crustacean resources of theExclusive Economic Zone.

Molluscan Fisheries Division

The important research activities of this Division have been the monitoring of the molluscan resources of the country and to conduct resources survey on commercially important molluscs such as pearl oysters, chanks mussels, clams and cephalopods.

With an expertise developed for underwater diving with SCUBA team of scientists have already surveyed the extensive pearl and chank beds of the Gulf of Mannar and new batches of personnel are being trained in SCUBA Diving.

Future programmes of this Division will include resource surveys for the exploitation of Cephalopods in the Exclusive Economic Zone and adjacent waters, to meet increasing market demands

The forcasting of mollucan capture fisheries is also an important function of the Division

Fishery Environment Management Division

This Division is primarily responsible for investigations on fisheries Oceanography, primary and secondary production fish eggs and larvae, seaweeds, ecological energetics, mass culture of plankton organisms, marine pollution and ancillary marine resources.

The future programmes includes obtaining synoptic pictures of environmental parameters and preparation of fishery oceanographic atlases; intensification of the studies on marine pollution in relation to protection of living resources; assessing productivity of different ecosystems including mangroves for promoting mariculture, investigation on ancillary resources such as corals, sponges, gorgonids.

The Divison will collaborate with Indian Space Research Organisation; and National Remote Sensing Agency in the use of remote sensing techniques for resources and environmental studies.

The additional responsibilities of the Division include investigations on farm engineering and instrumentation and review of legal aspects pertaining to the conservation and management of marine resources in the context of the Law of the seas.

Physiology, nutrition and pathology Division

This new Division is intended to investigate various problems such as, neurosecretary, reproductive, respiratory and osmoregulatory physiology and environmental and biological stress. On the nutrition side studies will relate to

Oil Sardine

Bombay duck
being sundried

nutritional biology, preparation of artificial feeds, food conversion efficiencies large scale production of cheap and suitable feeds for culture organisms.

This Division will also take up research programmes on cataloguing ecto-and endo parasites of fin fishes and shell fishes, life history of parasites, host specificity, commensals, vectors, pathogenic bacteria, cancerous growth, histopathology, immunology etc. Diognostic and disease control measures will also be developed.

Extension and Fishery Economics Division

In capture fisheries, it must be ensured that both industrial fishery and small scale artisanal fishery have to be developed without detriment to each other. In view of the exploration and utilisation of exclus ve economic zone and integrated rural development through coastal aquaculture, a whole range of economics of fishery operations and socio-economic aspects have to be investiagated in detail to maximise production and improve the rural economy. Therefore, this new division will take up comprehensive investigations on the above aspects and provide reliable data on fishery economics for planning and implementation of development programme.

Extension: The Institute intends to have a massive transfer of technology to artisanal and farming communities by deploying sufficient man power to conduct field testing and adoption trials; to prepare and

distribute printed extension materials; to participate in Radio and Television programmes; to organise exhibitions, seminars, farmers day and Kisan Melas and to plan documentary films and news reel on relevant technology. The division will also provide efficient consultancy service and look after the maintenance of marine Museum and aquarium.

Library and Documentation Division

Fishery Science has shown a phenomenal growth in recent years and is expanding rapidly in every component disciplines with massive research efforts in the various laboratories the world over. Thousands of books, periodicals and other documents are published. The CMFRI has built up steadily one of the finest library facilities with a holding of 50,000 books and periodicals. In view of the expanding activities of the Institute and in order to keep abreast with the latest technologies developed in various fields the Division's main functions will be book Journal procurement, technical processing circulation, reference assistance to readers, documentation, reprography, printing and binding etc. Besides catering to the research needs of institute's own staff, the library services will be extended to other Institutes, universities and departments.

Inter Divisional Projects

Besides the independent programmes of the various divisions, the Institute also undertakes Inter-Divisional projects in multi—disciplinary fields, in order to maximise the use of expertise available in various divisions in common programmes. Some of the inter-divisional projects currently undertaken are Establishment of National Marine Parks, Sonar surveys of major pelagic fishery resources, stock assessment of commercially important fishes of the exploited zone, INational programme of tagging of commercially important fishes, and remote sensing and fisheries.

Resume of the Institute's contribution to marine capture fisheries

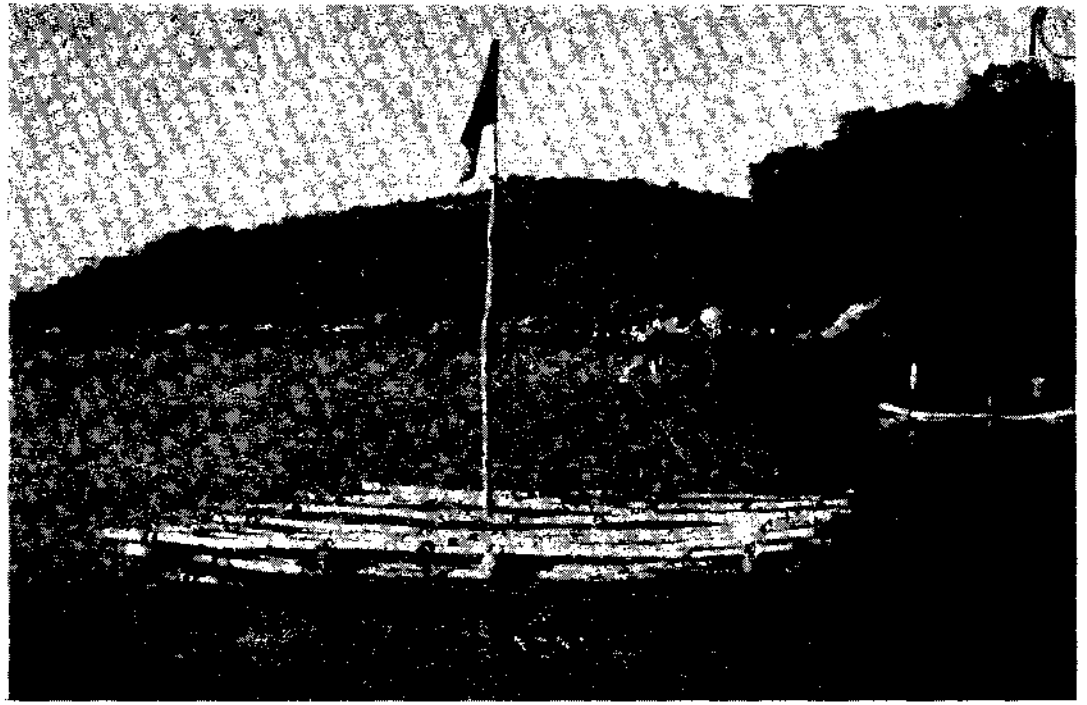
The Institute was started at a time when the country was facing acute shortage of proteinous food and a strong research base was very much wanting to lend adequate scientific support for various development plans to augment marine fish production. Over the past 33 years the Institute has steadily grown from strength to strength and it has now become a premier national organisation for marine fisheries research and development. The research programmes undertaken by the Institute are inter-disciplinary and are intended to provide technologies and data base to various departments/ organisations of the Centre, maritime States, the industry, Agricultural and other Universities and the individual fisherman and fish farmers for the ultimate objectives of fisheries development.

Notable impact on capture fisheries

As a result of the efforts of the Institute drawing attention to the extent of the exploited resources, new and additional untapped resources and the scope for increasing production by extending the area of fishing operations to non-traditional grounds, notable impact has been made on the overall development in capture fisheries in the recent years. The State Governments and the industry have progressively increased the mechanised fishing operations in Gujarath Maharashtra, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Orissa and Union Territories. Substantial increase in the catches of tunas, catfishes, perches, pomfrets and elasmobranchs has been witnessed after introduction of nylon gill net fishing for these species. Penaeid prawn catches in Kerala and non-penaeid prawns in Maharashtra have steadily increased during the 1970s and along the east coast both these groups have registered sharp increases in recent years. The recent introduction of purse-seines in Karnataka based on research information on Pelagic resources made available by the Institute enabled the State to double the catches of mackerel and oil sardine Purse seines are already in operation in Karnataka Kerala and Goa. Other maritime States are contemplating introduction of purse-seines for increasing the production from capture fisheries.

The Institute's estimate of potential resources in the seas around India and its findings on the pelagic. oceanic, deepwater and demersal resources (both conventional and non - conventional) assumes added significance in the context of exploration and utilization of the Exclusive Economic Zone.

CULTURE FISHERIES



Mussel Culture in Karwar Bay

Mariculture of fin fishes, shell fishes and other marine organisams has assumed great importance all over the world in recent years. In developing countries mariculture is particulary important in the context of urgent need for accelerating fish production to meet the ever increasing protein food requirement and in the context of dwindling catch returns from the marine capture fisheries.

Realising this, the CMFRI initiated a series of research projects on the culture of marine fin fishes, prawns, mussels, oyster, pearl oyster and seaweeds. Several important breakthroughs have been achieved by the Institute in pearl culture, prawn culture, mussel culture and eel culture. Mariculture work is distributed among the existing Divisions as follows;

Demersal Fisheries Division :

fin fish culture

Crustacean Fisheries Division

Prawn, lobster, crab culture and culture of live-food organisams compounding, artificial feed.

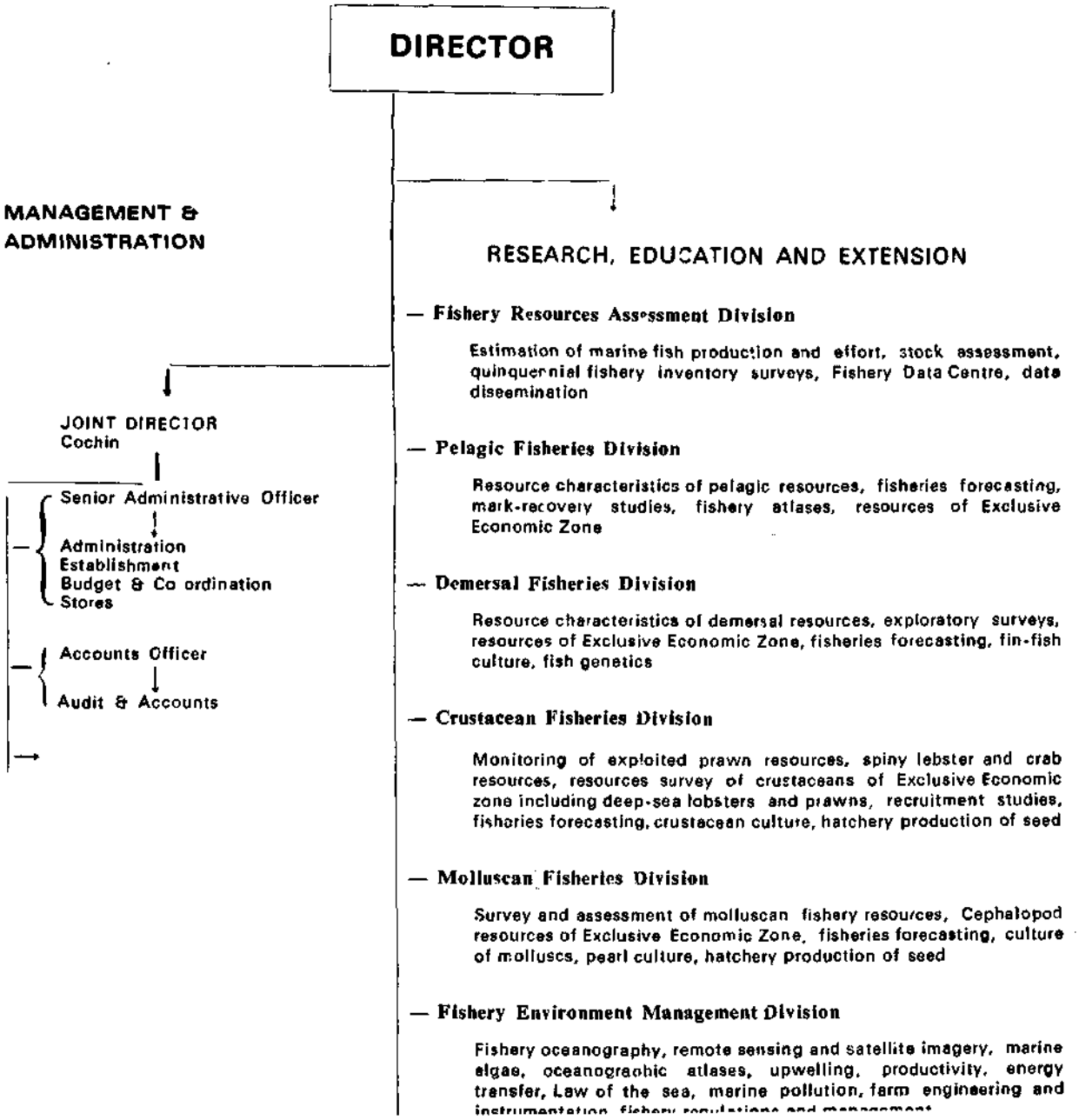
Molluscan Fisheries Division :

Pearl culture, edible oyster culture, mussel culture, clam and cockle culture.

Fishery Environment Division :

Seaweed culture, mass culture of plankters, productivity of culture ecosystems.

Chart 1. ORGANISATION AND MAJOR FUNCTIONS OF DIFFERENT WINGS OF C. M. F. R. I.



— Physiology, Nutrition and Pathology Division

Reproductive physiology, endocrinology, fish and shell fish nutrition, feed development, fish and shell fish diseases and control

— **Extension and Fishery Economics Division**

Extesnion programmes, economic studies on artisanal, industrial and culture fisheries, impact studies

— **Library and Docomentation Division**

Book-journal procurement, technical processing, circulation, reference assistance, documentation, reprography, printing, binding etc.

— **Inter-Divisional and Inter-Institutional projects**

Inter-Divisional projects in muti-disciplinary fields; Inter-Institutional projects involving collaboration and co-ordination with other Institutes

— **Sponsored Projects**

Projects funded by development agencies and implemented by CMFRI

— **UNDP/FAO Centre of Advanced Studies in Mariculture**

Post-graduate and Doctoral courses in coastal aquaculture

JOINT DIRECTORS (4)

Regional Centre, Mandapam Camp
Regional Centre, Bombay
Regional Centre, Madras
Regional Centre, Waltair

— **Trainers' Training Centre and Krishi Vigyan Kendra**

Transfer of Technology, training of technical personnel and fish farmers

— **Training Programmes**

Regular training programmes in various disciplines

— **Operational Research Project**

Rural fisheries development through integrated programmes, inputs

— **Lab-to Land Programmes**

Experimental transfer of appropriate technologies in coastal aquaculture

— **Research Vessels**

Cruise programming vessel maintenance, ship stores

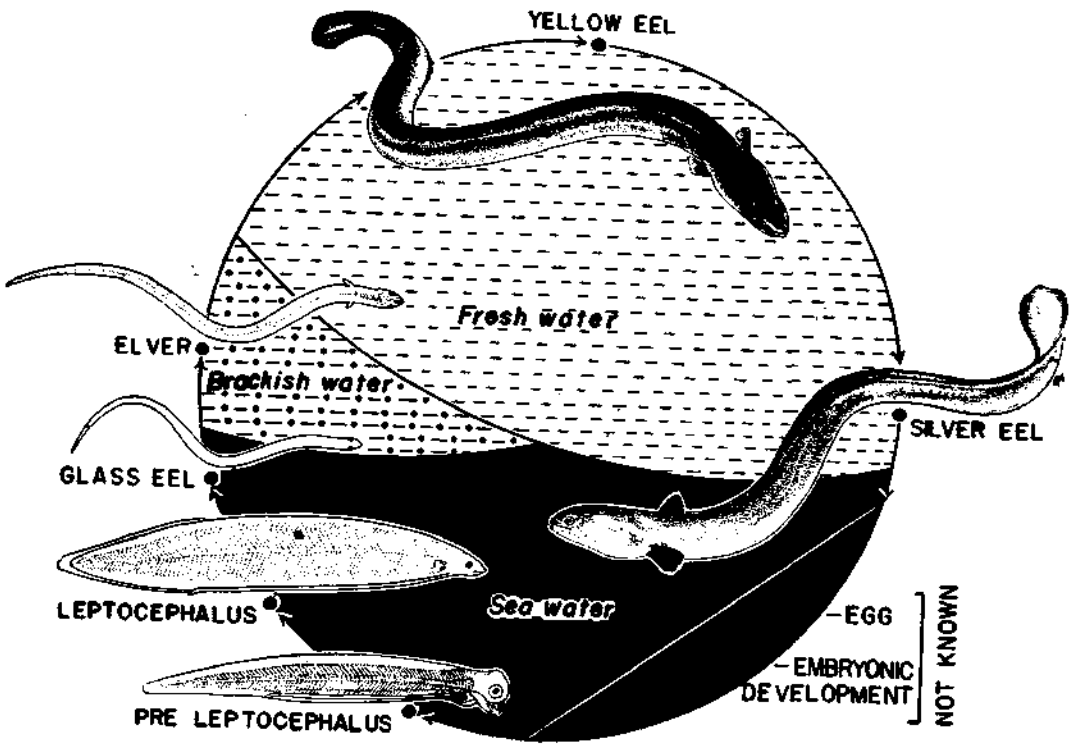
Fin fish culture

In our country many species of fishes such as milk fish, mullets and perches are suitable for culture in the low-lying areas and impounded brackish water.

By conducting well organised seed resources surveys the Institute has collected valuable data on the quantitative abundance of seed of cultivable species of fin fishes in different areas and different seasons along the east and south west coasts.

Experimental culture work has been conducted on the culture of milk fish in saline lagoons and ponds and on polyculture of mullets, pearl spot and prawns in brackishwater.

The Institute has developed proper techniques for the culture of the eel, *Anguilla bicolor bicolor* in running water as well as recycled running water. Seed resources of elvers and glass eels are abundant in the lower reaches of many rivers along the east coast. Seed elvers measure 55-100 mm in size and 0.16 to 2.0 g in wt. These are transported in suitable containers, conditioned and stocked in fibre glass tanks having running water facilities. The eels are fed with artificial feed at a daily ration of 5-10% of their body weight From an initial stocking weight of 7. 28 kg of elvers net increase of 14.94 kg and 27.3 kg was obtained at the end of first and second year respectively giving an average production rate of 2·2 and 4.1 kg/Sq.m. The production rates were much higher in



Life Cycle of Eel

Culture of Eels

outddor tanks using recycled running water giving net increase of 430%.

Experiments on induced breeding of eels and mullets have been undertaken using pituitary extracts and harmones such as gonodotrophin. There is a great potential for the induced breeding of sea breams, sea bass, polynemids and groupers.

Marine Prawn culture

The Institute has made rapid strides with in a short time in developing appropriate technologies in marine prawn culture as a result of intensive research work carried out in the Prawn Culture Laboratory at Narakal (PCL) and at the Field laboratories at Kovalam (Madras) and Tuticorin.

At Narakkal, breakthroughs were achieved in the spawning and rearing of larvae upto stocking size under controlled conditions of commercially important prawns such as *Penaeus indicus, P. monodon, Metapeaneus monoceros, M. dobsoni, M. affinis* and *Parapenaeopsis stylifera*. Some of these species have been successfully "domesticated". At Madras and Tuticorin breeding and rearding of *P. semisulcatus* has been achieved.

At Narakkal (PCL), adopting unilateral eyestalk ablation method and environmental manipulation prawns have been made to mature under controlled conditions in the laboratory. It has been possible to obtain repeated spawning from the same spawner within short intervals of 5-10 days.

1. CMFRI Prawn Culture Laboratory Narakkal
2. Rearing of prawn larvae
3. Prawn seed ready for shipment to distant places
4. Harvest of cultured prawns

1.

2.

3.

4.

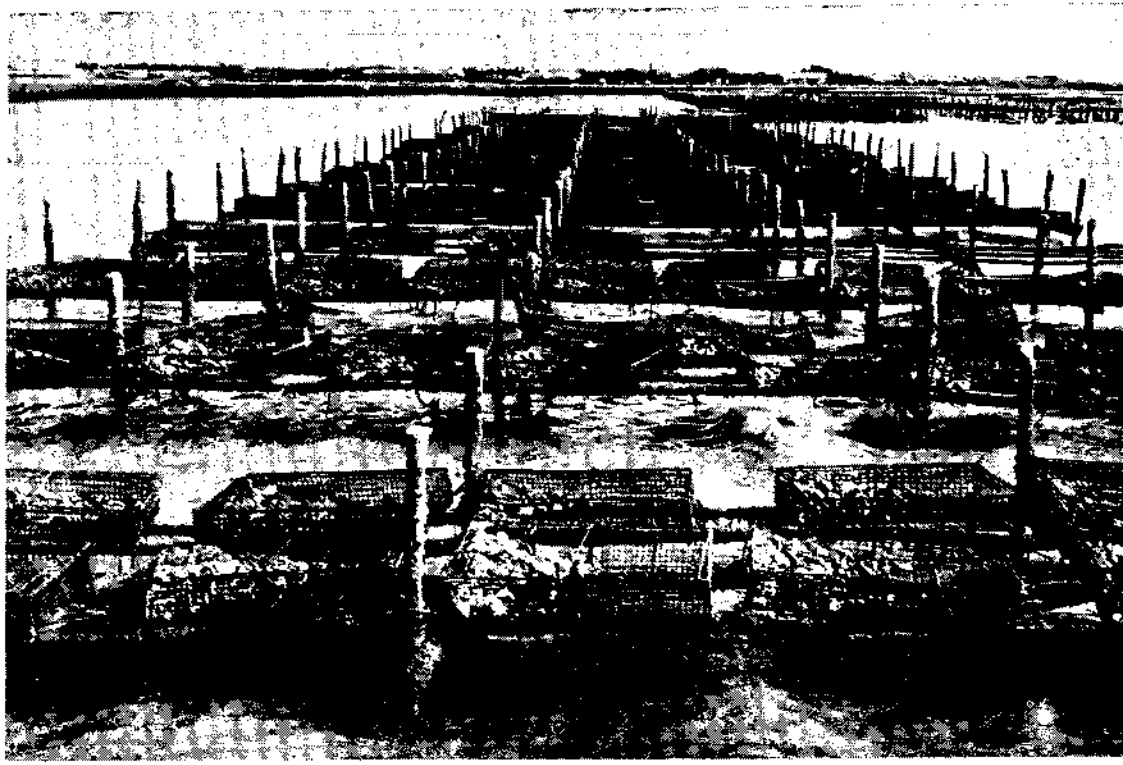
Mass culture of live-food organisms developed at the laboratory has enabled the successful rearing of prawn larvae to stockable size with high rate of survival. The *chaetoceros*/rotifer/Cladoceran feed cultures developed here has completely replaced the previous method of *Skeletonema*/*Artemia* type cultures, with great advantage.

The laboratory has evolved methods of transporting prawn larvae to distant places in polythene bags. As a result of these developments, over one million prawns seeds, chiefly that of *P. indicus* were made available by the PCL for intensive culture.

The Institute has evolved proper techniques for improvement in traditional prawn culture, selection of farm sites, construction of farms and scientific methods for prawn farming. The Institute has been able to demonstrate that with improved methods of culturing selected fast growing species with proper management, production rate of 1000-1500 kg/ha/annum could be achieved.

Pearl culture

The technology for production of cultured pearls and farming of pearl oysters were developed indigenously for the first time in India by CMFRI at Tuticorin in 1973. The raft culture method was introduced to rear pearl oyster. The important species cultured is *Pinctada fucata*. The surgery is performed in the shore laboratory and the operation consists of grafting a piece of mantle in



Rack culture of edible oyster at Tuticorin

the gonad or hepatopancreas region of the oyster, followed by the implantation of a spherical shell-bead mucleus.

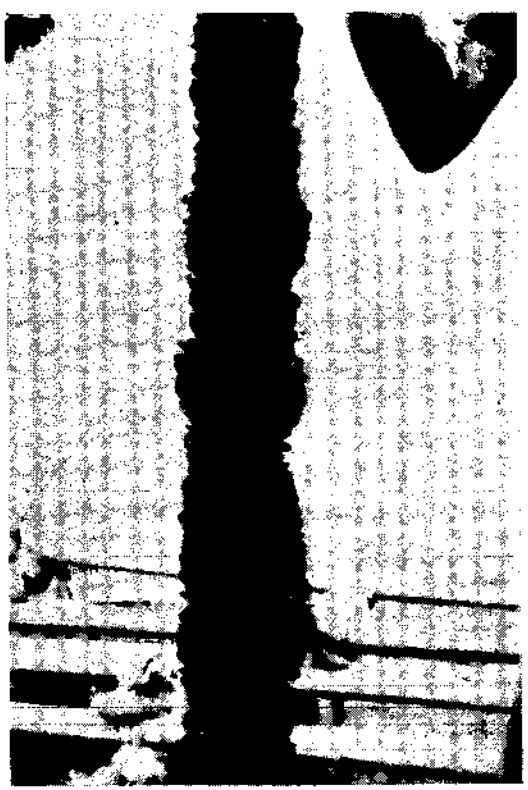
Although cent per cent success has been achieved in certain batches, the average production is about 60–70%. Multiple production of pearls in individual oysters has been achieved. The size of nucleus employed ranges from 2 mm to 7 mm diameter depending on the size of the oyster and the choice of single or multiple implantation. The rate of deposition of nacre is high and hence the duration of post-operative culture is considerably reduced, requiring only 3 months to 18 months for the range of 3 mm to 8 mm pearl for maturity. The shell beads required have been produced from the conch-shell wastes. The surgical tools have been fabricated indigenously.

Culture of edible oysters

Intensive work on the culture of the edible oyster, *Crassostrea madrassensis* is being carried out at the Tuticorin Research Centre. The techniques of oyster farming consists of collection of spats by using different spat collectors and growing them to marketable size by methods such as rack culture, long-line culture and tray culture. For collecting the spat, materials such as lime-coated tiles, oyster shells strung on galvanised, wire, empty coco-nut shells and rubberised coir mats are being tried. It has been shown that in rack culture, it is possible to put up at least 280 racks in one hectare and stock about one million oyster seeds which on

Brown mussel culrure, Vizhinjam

Green mussel cultured



intensive culture would yield about 135 t oysters (with shell) and a total meat yield of 13.5 t in a period of one year.

The farm grown oysters have been canned in different media and the product has received the attention of the industry for commercialisation.

Mussel culture

The techniques for mussel farming were developed at CMFRI Research Centres at Calicut, Vizhinjam and Madras. Mussel culture is also being taken up at Karwar. Two species viz, **Perna indica** (brown mussel) and **Perna viridis** (green mussel) occur in our country. The experiments conducted at Vizinjam on the culture of brown mussel followed the suspended raft culture method using ropes. The seeds of mussel are collected from the natural beds and transplanted to the ropes. After culturing the yield is estimated at 10-15 Kg/metre length of rope.

In the open sea raft culture of green mussel carried out at Calicut the average production per rope of 7 metres length is about 80kg of mussels in 5 months from an initial seeding of 3 kg of mussels. A system of mussel culture using submerged rafts suitable for rough sea conditions is under development at Madras Research Centre.

Culture of clams

At Kakinada Research Centre the culture of blood clam, *Anadara granosa*

has met with success. The clams were cultured in a farm enclosed with split bamboo screens interlaced with hemp twine. In an area of 625m² about 1 lakh clam seeds were stocked. and harvested after 5½ months the harvest was 2.6 tonnes. The ratio of flesh weight to total weight of clams was about 20%.

Seaweed culture

The culture experiments on seaweeds are carried out from the Regional Centre at Mandapam Camp. The cultivable seaweeds are agar–yielding plants like *Gracilaria* and *Gelidiella* species and algin yielding plants such as species of *Sargassum* and *Turbinaria*.

The method of cultivation of *Gracilaria edulis*, the fast growing species with minimum of seed material has been standardised. Culture experiments have been done by introducing fragments of seed material in the twists of coir ropes which are fabricated in the form of 5x2 metre size nets. These nets are then tied to wooden poles fixed in the coastal waters. The plants reach harvestable size after 60 days of growth.

Experiments have shown that other species of seaweeds such as *Sargassum* could also be cultured economically. There is increasing demand for seaweeds for the manufacture of agar-agar and algin which used to be imported previously.

Culture of other organisms

The Institute has also developed techniques for the culture of lobsters and

Blood clam

Surveying the sea bottom with SCUBA

Stages in the growth of cultured sea weed

crabs It has been observed that pueruli reared under controlled conditions grow to marketable size in a period of 18 months. In the culture of the green crab, *Scylla serrata* in metal framed cages seed crabs measuring 50-80 mm (across carapace) reach the marketable size of 145-160 mm in about 9-10 months.

A head-starting programmes for hatching and rearing marine turties, an endangered species is also underway.

Impact of these technologies for rural development

These recent technologies have had the desired impact on the maritime State Governments and coastal rural population. Pearl culture technology and seaweed culture are industry oriented. A pilot project on pearl culture has been started by the Kerala Government The prospects of developing cottage industries based on seaweed culture are bright

As a result of technologies developed In prawn culture there is an intense awareness among coastal rural population to take up scientific prawn farming. The coastal rural people are taking up mussel culture to increase their income and the industry is also evincing keen interest for processing mussel meat for export.

In general many of the maritime States are now coming forward to develop coastal aquaculture and intergrated farming for augmenting fish production in their States.

Major areas of thrust in mariculture research

Future programmes of the Institute in mariculture will have major thrust on the following aspects:

1. Efficient methods of seed collection, conditioning and transport to ensure supply of seed of desired species during different seasons.
2. Development of hatcheries for large scale production of seed of fishes, prawns, mussels, edible oyster pearl oyster and developing a low-cost technology for such hatchery production.
3. Standardisation of techniques for maturation and induced breeding for fin fish culture; immediate production oriented programmes in the culture of fin fish species for which induced breeding and larval rearing techniques are already available.
4. Development of designs for construction of farms and low-cost farm implements.
5. Genetic upgrading of cultivable organisms.
6. Monitoring pollution and physiological stress; pollution control in areas where culture operations are undertaken.
7. Technology for efficient methods of harvesting for quality control, product development and utilisation.

8. Developing integrated systems for crop-fish-livestock farming to ensure maximum possible utilisation of land and water areas during all seasons towards raising the living standards of coastal rural community.

TRANSFER OF TECHNOLOGY

In order to demonstrate the techno-economic feasibility of coastal aquaculture and development of small-scale capture fisheries the Institute has taken up a number of projects on technology transfer.

These programmes are benefiting maritime State governments, Universities, development agencies, the industry and individual fish farmers. These may be listed as follows:

Operational Research Project

The Operational Research Projecf on "Blending seafarming with traditional capture fisheries" is being implemented at Kovalam, a village near Madras. The village has 175 fishermen families and the fishermen are trained in pole culture of n ussels, prawn seed collection and prawn farming, popularising mussel meat for consumption and in nutrition gardening. The project aims at overall improvement of socio-ecomic condition of the fisherfolk. This integrated approach to blend culture fisheries with capture fisheries for rural development is a new concept in the marine fisheries sector of the country.

Sponsored Projects

CMFRI undertakes Sponsored projects funded by private and public sector agencies. A sponsored project on "Elver resources survey and eel culture" and another on "Assessment of fry resource of cultivable penaeid prawns at selected centres in Kerala and Karnataka" both financed by the Marine Products Export Development Authority have been implemented. During 1978-79 the Institute was participating in the Co-operative Intensive Prawn Farming project jointly undertaken by Kerala Government, MPEDA and CMFRI. This project was intended to demonstrate the economic viability of intensive prawn culture to the industry and fish farmers in the Ernakulam District.

Inter-Institutional Project

The Institute maintains close liaison, co-ordination and co-operation with other institutes in the ICAR, Govt. of India and other organisations in implementing its research programmes as well as extension programmes. The following are the Inter institutional projects undertaken.

1. Fish and prawn feed development for intensive culture. — This is being implemented at Cochin (with CIFT)

2. Product development and quality control of molluscan products at Cochin and other centres (With CIFT)

3. Operation of conventional and experimental Dol nets being implemented at Bombay and Veraval (With CIFT)

4. Improvements in gear and methods of lobster fishing being implemented at Cochin, Muttom and Tikoli (With CIFT)

5. Economics of marine fisheries in the Calicut area (With IASRI) has been undertaken. This project will suggest ways and means to improve the socio-economic condition of coastal fishermen and rural community and also study the impact of changing fishing pattern in the area.

6. Development of FRP/Synthetic floation units for open sea mariculture (With VSSC)

7. Impact of floods and flood control measures on estuarine and coastal fisheries. (With N. R S A & S A C)

Lab-to Land Programme

The Lab-to-Land programme organised by the ICAR during the Golden Jubilee Year was implemented at the Institute's level from the beginning of 1979. The appropriate technologies developed by the Institute on various aspects of coastal aquaculture were considered ideal for transfer to the fishermen and farmers in the coastal sector. During 1979, 302 families were involved under this programme as follows:

122 families of the Harijan Society at Valappu, Ernakulam District for intensive prawn culture.

15 families of marginal farmers in Quilon District for prawn and fish culture.

30 fishermen families selected at Elathur for mussel farming.

16 fishermen families for oysfer culture at Tutiċorin.

20 fishermen families at Mandapam for seaweed culture.

50 Harijan families at Muttukkad for prawn culture.

50 fishermen families for mussel culture at Karikkattukuppam.

10 fishermen families for mussel culture at Karwar.

All the farmers were trained in scientific farming methods and respective technologies in a phased manner. Critical inputs are provided by the ICAR and the scientists of the Institute are providing technical assistance.

Training programmes

One of the objectives of the Institute is to effect transfer of technology through various training programmes organised at different levels. Training is imparted in the undermentioned areas of specialisation to candidates sponsored by maritime State Fisheries departments. Agricultural Universities, developmental agencies such as the MPEDA and those from abroad sponsored through Govt. of India.

1. Training in marine prawn culture

This programme is usually conducted and Cochin and training is given on various aspects of prawn culture such as identification of larvae, post larvae and juvenilea of commercially important prawns, collection of spawners, breeding, rearing, stocking methods, scientific methods of prawn culture, etc. The courses includes group discussion, field and practical work besides lectures and demonstrations. Besides this, *ad hoc* training in prawn culture is given to students, in-service personnel and staff of other organisations who require such training. During 1978 and 1979 about 50 officers have been trained which included two from abroad.

2. Training in pearl culture

A long term trainer's training course of six months duration intended for officers from maritime State Fisheries Departments and a short-term course of 6 weeks duration in specific field of pearl culture intended for operative personnel are conducted at Tuticorin. About 10 candidates are trained in each batch. The Officers trained in these courses are now working in pearl culture projects in Kerala, Tamil Nadu and Gujarat.

3. Training in edible oyster culture

The main thrust of this training programmes is to transfer the technology of edible oyster culture to small scale ahd mariginal farmers so as to propagate this field among them. *Ad hoc* training course in edible cyster culture is also given to batches of students from Universities and Agricultural Universities.

4. Training in under- water diving by SCUBA

Under-water investigation through diving with SCUBA received considerable importance as a result of the pioneeriug work done by the scientists of CMFRI during the survey of pearl oyster and chank resources off Tuticorin. Under this training programme scientists are educated on the principles and methodology of SCUBA diving and on methods of underwater survey of resources. Practical training is given on swimming, snorkeling and use of self-contained under water breathing apparatus.

5. Training in fishery resource assessment and population dynamics

This is an important training programme in capture fisheries and the course of 6 weeks duration involves lectures and practical training on sampling techniques. statistical methods involved in processing and analysis of data and population dynamics for the assessment of fish stocks. The course is conducted at Cochin and usually about 12 candidates drawn from maritime States and Agricultural Universities are trained each year.

Krishi Vigyan Kendra

The Krishi Vigyan Kendra for mariculture was established in 1976 at Narakkal and it is designed and devoted to impart need-based an skill oriented vocational trainnig to fish farmers who intend to go for self employment. The KVK disseminates technical knowhow developed at the CMFRI on the culture of marine prawns, fishes and molluscs, ensuring a ready and regular flow of scientific and technical information from the labortary to farmers. The duration of training to each batch ranges from 5 days to one month. So far 928 persons have been trained, which include 262

farm women and 322 members belonging to Scheduled Caste. Some of the trainees have taken up prawn culture in their own fields or derelict waters. The farm women who have been trained are now engaged tn collecting prawn seed from the wild, thus utilising their spare time profitably. The KVK also organises mobile training programmes at other centres depending on the demands and needs of the fish farmers.

Education

Although the research programmes of the Institute are mostly of an applied nature basic research on complimentary aspects of capture and culture fisheries are also carried out mainly through research scholars and fellows who do post graduate work. The Institute has been recognised by many universities as a centre of post graduate research leading to M. Sc., and Ph. D degree. Many of the scientists hold Ph.D degree and have been recognised as guides or supervisors of students carrying out research for Ph.D degree. The scientists also serve as members of advisory committees, panels, Board of studies etc of many universities and also take classes for M. Sc. and Ph.D students in respective departments of Universiiies.

Centre of Advanced Studies in Mariculture

The Centre of Advanced Studies in Mariculture was instituted at the CMFRI, sponsored by ICAR / FAO / UNDP. The main objectives of the centre is to catalyse research and education in mariculture for augmenting the fish production of the country. The objective would be accomplished by providing adequate facilities to carry out research of excellence in mariculture, improving quality of postgraduate education, enhancing competence of professional staff, developing linkages and collaboration with other institutions in the country and organising seminars and workshops.

Training in under water diving

The first batch of 9 M. Sc students and 4 Ph. D scholars are attending the regular courses from the middle of 1980.

For this programme the ICAR contributes a sum of Rs. 18.25 lakhs for the duration of the scheme from 1979-80 to 1982-81. The expenditure on expert consultants from abroad, training of faculty members abroad and on importing equipments from abroad are met by the FAO/UNDP

Under the CAS, the programmes in mariculture will be intensified and made problem oriented as well as production-oriented and these will be technically assisted by expert consultancy of eminent foreign scientists in the respective fields.

Consultancy service

The Institute is regularly approached by small farmers, fish culturists, the industry, development agencies and government departments for consultancy on various aspects of capture fisheries, culture fisheries and environmental problems. In capture fisheries it is usually on matters relating to introduction of large mechanised vessels, location of fishing grounds, production and seasonal species composition, new resources that could be pofitably exploited, economics of fisheries operations etc. On culture fisheries, consultancy is rendered on suitablity of areas or selection of sites for farming, farm lay-out and construction, farming methods and the economic viability of culture operations. The industries which pose environmental problems consult the institute for pollution monitoring and pollution control measures.

The consultancy service rendered by the Institute at present is free of charge.

Facilities developed/being developed at the institute

The Institute has developed essential laboratory facilities at its headquarters in Cochin and in the Regional and Research Centres for various types of reseach activities. At the Fishery Data Centre, computer facility is being developed at Cochin for condification of all types of fisheries data and for its rapid dissemination to various agencies.

Field laboratories and farms have been established at Narakkal, Kovalam, Veppalodai and Mandapam and similar facilities are being extended to other centres as well to streamline the activities in research and technology transfer.

The research facilities include *R. V. SKIPJACK* a sophisticated 33.3 m research vessel and nine smaller vessels (13 m) of the CADALMIN series These are equipped to carry out all types of fisheries investigations in the seas around india including the Exclusive Economic Zone.

The Institute is developing wet laboratory facilities at major fishing harbours as in Cochin.

Other physical facilities include Mobile laboratory, vans, jeeps and fibre glass dinghies with out-board motors.

The Institute has an excellent library with a present holding of over 50,000 volumes and periodicals. Part of the main library is housed at Mandapam Camp where the main museum and marine aquarium are also located.

Publications of the Institute

The sutained research and research development activities of the Institute over the past three decades have resulted in building up a strong information base at the Institute through various publications of the Institute as detailed below:

1. Research information

Scientific and technical papers based on research work carried out the Institute are published in

(i) **Indian Journal of Fisheries**

Official journal of the Institute (now in its Vol. 24)

(ii) **CMFRI Bulletins**-on special scientific topics (29)

(iii) **CMFRI Special Publibations**-on selected topics of interest (6)

(iv) **Proceedings** of official **Symposia** and **Seminars** and in scientific Journals published in India and abroad

2. Information on consulty and Technology transfer

The Institute's serial entitled *Marine Fisheries Information Service* - Technical and Extension Series started in September 1978 envisages the rapid dissemination of information on marine and brackishwater fishery resources and allied data available with the Institute; of proven researches for transfer of technology to the fish farmers and the industry and of other relevant information needed for research and development efforts in the marine fisheries sector. Upto the end of 1980, 26 numbers of this series have been published.

The *CMFRI News Letter* brings out the important events that have taken place in the Institute in particular and the country as a whole in general in the marine fisheries sector

Extension pamphlets - The institute publishes a number of extension pamphlets on the various proven technologies developed at the institute and which are available for transfer or dissemination to prospective end users.

The *Proceedings* of Summer Institutes, Seminars and workshops organised in connection with technology transfer are also published. *Annual Reports* and *Project Reports* published by the Institute bring out the progress made in the research projects undertaken by the Institute.

The headquarters of the Marine Biological Association of India is also located at the Institute.

Publicity

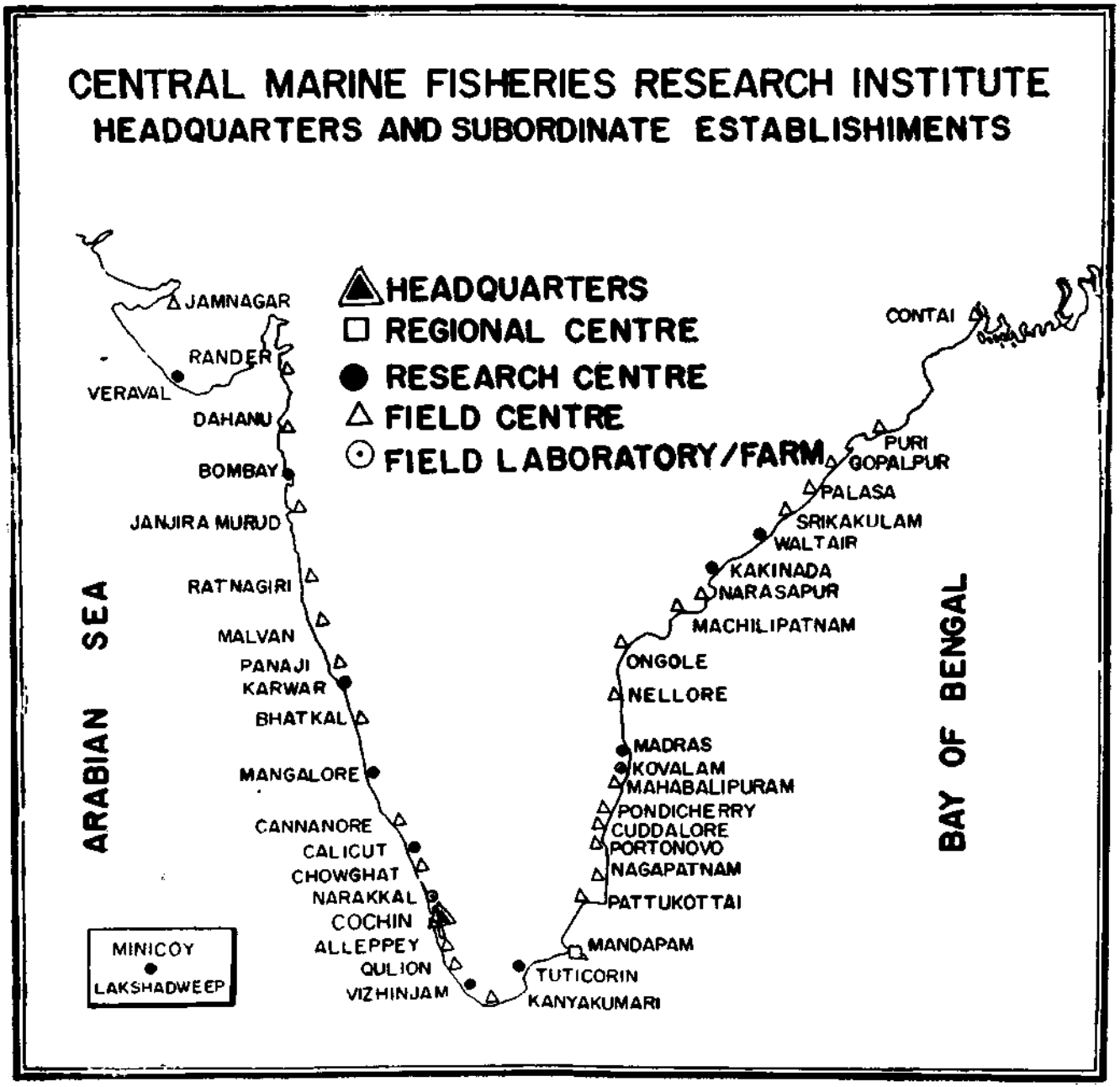
In order to publicise and project the activities of the institute, various publicity media are utilized. Popular articles on farm oriented research highlights are regularly written in different languages in leading news papers and magazines in the country. The scientists of the institute are invited by the different stations of the All India Radio to give talks on recent technologies developed by the Institute, which are of immediate benefit to the farmers or fishermen.

The scientists participate in programmes such as rural science gathering organised by the A. I R. The Institute's activities are also projected in the T. V. programmes.

The Films Division, Government of India has taken a number of documentary and feature films on the technologies developed by the Institute. These are being exhibited throughout the country. Recently the film entitled "Mariculture" won the President's Award for the best feature film.

The Institute regularly participates in Exhibitions, 'Open House' and Fairs organised at All-India, State and Municipal levels or by individual institutions. The Institute also organises Farmers' Day and Kisan Melas for the benefit of the farming community.

Dr. Ching-Ming-Kuo, expert consultant, CAS in Mariculture, explaining techniques of induced breeding of grey mullets



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