

RESEARCH HIGHLIGHTS

1987 - 1997



केन्द्रीय खारापानी जलजन्तु पालन संस्थान
(भारतीय कृषि अनुसंधान परिषद)
नं.१४१, मार्शल्स रोड, एगमोर, चेन्नै - ६०० ००८.

CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE
(Indian Council of Agricultural Research)
141, Marshalls Raod, Egmore, Chennai - 600 008.

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July 1997

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Cover Photos

Top Left : *Laboratory building at Muttukadu Experimental Station*
Top Right : *Shrimp Hatchery Facility at Muttukadu Exp. Stn.*
Bottom Left : *Fish broodstock holding facility at Muttukadu Exp. Stn.*
Bottom Right : *Tide - Fed ponds at Narakkal Research Centre.*

PREFACE

Brackishwater Aquaculture of fish and shellfish has been recognised as one of the high potential areas for increasing production which can contribute to our food security and to our exports for earning foreign exchange. Marginally productive or unproductive lands can be better utilised for production of fish and shrimp which leads to employment generation and establishment of ancillary industry. It helps in economic and social development of coastal populations in the country. The Central Institute of Brackishwater Aquaculture (CIBA) has been established during the seventh five year plan by the Indian Council of Agricultural Research (ICAR) for the sustainable development of this sector through Research and Development support.

As a nodal Institute at the national level, CIBA has achieved commendable progress in brackishwater aquaculture research during the last decade (1987-1997). The Institute has taken up programmes in priority areas such as hatchery production of penaeid shrimp (*Penaeus monodon*; *P. indicus*) seed, captive broodstock development, breeding and seed production of finfish (*Lates calcarifer*; *Mugil cephalus*), nutrition and feed technology, disease diagnosis and control and environmental management. The R&D efforts of this Institute catalysed rapid growth of brackishwater aquaculture in general and shrimp culture in particular. The area under shrimp farming expanded to 100,000 ha and the annual shrimp production reached 80,000 tonnes in the last ten years.

During the decade the Institute received national and international recognition. In addition to its own research programmes, the Institute received sponsored projects from the Department of Biotechnology, Govt. of India and the World Bank (NARP-Phase-II). CIBA has established good linkages not only with national organisations but also with several international organisations namely FAO, Rome, NACA, Thailand, INRA France, SEAFDEC, Philippines and Institute of Aquaculture, Stirling, U.K.

The Research Highlights of CIBA are brought out on the occasion of the completion of 50 years of India's Independence. As the nation celebrates Golden Jubilee year of Indian independence, CIBA forges ahead with new strength in the service of the nation. CIBA salutes ICAR and expresses gratitude to Dr. R.S. Paroda, Director General, ICAR & Secretary, Dept. of Agricultural Research and Education, Dr. P.V. Dehadrai, Deputy Director General (Fy.), Dr. K. Radhakrishna, former Assistant Director General (M.Fy), Dr. A. Selvakumar, Assistant Director General (M.Fy), ICAR and Dr. K. Alagarswami, Former Director, CIBA, for their contributions and guidance to its growth and development. The services rendered by all the staff members of this Institute are gratefully acknowledged.

I wish to record my deep appreciation to Dr. S. Ahamad Ali, Dr(Mrs) Munawar Sultana, Dr.K. Gopinathan and Shri M. Kathirvel, Senior Scientists, for preparing and bringing out this publication.

G.R.M. Rao
Director

Chennai
9th July 1997

BRACKISHWATER AQUACULTURE SECTOR - A PROFILE

Brackishwater aquaculture has been identified as one of the high potential areas under inland aquaculture for increasing fish and shellfish production and for deriving maximum economic and social benefits through better utilisation of unproductive or marginally productive coastal lands, swamps and brackishwater bodies of our country. With a long coastline of 8,129 km, the country has vast brackishwater resources viz., the brackishwater lakes most important of which are the Chilka and Pulicat Lakes and Vembanad backwaters, estuarine systems formed by the major rivers confluencing with the sea and an estimated potential area of 1.19 million ha available for brackishwater aquaculture. The coastal area of the country has 2.54 million ha of salt affected soils which are unfit or only marginally fit for agriculture, excluding 0.57 million ha under mangroves. The country is also rich in diverse species of fishes, crustaceans, molluscs and aquatic plants distributed in different agro-ecological regions.

Brackishwater aquaculture of fish and shrimp has been in vogue for over a hundred years in India as a traditional farming system and is practised in the States of West Bengal, Kerala, Karnataka and Goa. During recent times it has evolved into different farming systems and gained much importance in view of the significant progress made in production of shrimp for export. The total area under shrimp farming has increased from 60,235 ha in 1989-1990 to 100,700 ha in 1995-96 and the production of shrimp reached 83,000 tonnes in 1994-95.

Area developed under brackishwater aquaculture and production of shrimp

Year	Area developed under brackishwater aquaculture (ha)	Production of shrimp (tonnes)
1989-90	60,235	29,985
1990-91	65,100	35,500
1991-92	68,227	40,000
1992-93	70,700	47,000
1993-94	82,540	62,000
1994-95	100,700	83,000
1995-96	100,700	70,000

The entire development has been in the private sector (90% of the area in the small-scale sector with holdings less than 2 ha area each) and spread out in all the maritime states viz., Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Pondicherry (U.T), Andhra Pradesh, Orissa and West Bengal. As a result, the economy of the coastal region has been boosted. There has been a considerable increase in the quantity and value of shrimp exports and about 40% of the total foreign exchange earned by export of shrimp is from the aquaculture sector.

Export of Shrimp

Year	Type	Quantity in tonnes (Capture & culture)	Value in Rs (Crores)
1989	Frozen shrimp	56,413	451.3
1990	-do-	61,896	606.0
1991	-do-	75,217	955.0
1992	-do-	65,440	973.3
1993	-do-	72,816	1341.0
1994	-do-	105,358	2551.3

Shrimp Farming

Brackishwater shrimp farming is comprised of (i) traditional farming with production levels around 350-500 kg/ha/year (ii) extensive farming at 750-1500 kg/ha/year (iii) semi-intensive farming at 2.5-5 tonnes/ha/year (2 crops) and intensive farming with production levels of 5-10 tonnes /ha/year (2 crops).

Out of 100,700 ha under shrimp farming, a larger area (50,000 ha) is under traditional system of farming and the remaining under extensive, modified extensive and semi - intensive / intensive systems. The rapid expansion of farming activities have turned aquaculture into an industry and concomitant with its expansion, other ancillary industries associated with it viz., shrimp seed production, shrimp feed manufacture and feed import, shrimp processing, export and marketing etc. also developed.

The growth and expansion in brackishwater aquaculture, shrimp farming in particular has largely been due to research and development efforts of the Fisheries Research Institutes of the Indian Council of Agricultural Research and the Fisheries Division of the Department of Agriculture and Cooperation of the Union Ministry of Agriculture. At the small-scale level shrimp farming is primarily intended to provide a source of income to the farmers while at the corporate level, the efforts are mainly aimed at intensifying production for direct export.

ESTABLISHMENT AND GROWTH OF CIBA

The Central Institute of Brackishwater Aquaculture (CIBA) was established during VII Plan by transferring the Madras Research Centre, Kakdwip Research Centre and Puri Research Centre of the erstwhile Central Inland Fisheries Research Institute and the Narakkal Research Centre of the Central Marine Fisheries Research Institute. This was done under a re-organisation plan of Fisheries Institutes under ICAR for carrying out accentuated research and providing development support to a fast growing and expanding fisheries sector with diversification. CIBA started functioning with its own budget from April 1987.

The Institute has been built up from a modest base of manpower and infrastructure to meet the challenges of a fast growing brackishwater aquaculture sector which has been rapidly gaining economic significance due to its export potential. It has made strident progress in every sphere of activity, despite several constraints and has emerged as a pioneer research organisation on brackishwater aquaculture looked towards by the farmers, line departments of States, planners and policy makers for developmental, strategic and management support.

Infrastructure

Laboratories

Pending construction of permanent laboratory-cum- administrative building at Chennai, laboratories have been established in hired building. Nutrition and Feed Laboratory has been fully equipped with sophisticated analytical and feed production equipments. A Central Instrumentation Laboratory has been created for research on biochemistry, biotechnology and genetics. The Pathology and Microbiology Laboratory is equipped for all types of bacteriological, mycological, histopathological and a good part of virological research. A general Chemistry Laboratory is provided for routine chemical analytical work required for different disciplines. A Computer Laboratory has been established for database work, routine scientific data analysis and rapid communication. Some amount of upgradation of Soil and Water Chemistry Laboratory has been carried out at Kakdwip Research Centre. Investment made on major laboratory equipments is of the order of Rs 1.75 crores which has been possible with the budget allocation of ICAR to the Institute and support received under externally funded schemes.

Library

As a new Institute, the library has been built up from an initial holding of 5 journals and 52 reference books. The library now has 940 reference books and subscribes for 33 international and 33 Indian journals. It has exchange programmes with national and foreign institutions and several publications are added gratis.

Field Facilities

Another most significant area of growth has been the creation of working field facilities at Muttukadu, about 35 km from Madras where the Institute has a total area of 49.10 ha with a seafront which forms the ground for all its present technology development programmes. A part of the lagoon area is utilised for pen and cage culture and for captive shrimp and fish broodstock development. The Institute has also planned to develop a 35 ha experimental farm complex at Polekurru, Andhra Pradesh.

Buildings

Since the formation of CIBA, the following buildings were developed :

- (a) Headquarters : (i) Farm-cum-laboratory building which houses Soil and Water Chemistry (Muttukadu) Laboratory, Nutrition and Biochemistry Laboratory and Biology Laboratory, (ii) Shrimp Hatchery, Nursery and Effluent treatment facility (iii) Wet laboratories for experimentation in Nutrition, Genetics and Disease Diagnostics (iv) Essential Staff Quarters and (v) Fish Broodstock Holding Tanks and Fish Hatchery.
- (b) Kakdwip : Residential Quarters Type IV under construction.

MANDATE

The Institute has the following mandate:

- to conduct research leading to development of techno-economically viable and sustainable culture systems for finfish and shellfish in brackishwater.
- to act as a repository of information on brackishwater fishery resources with a systematic data-base.
- to undertake transfer of technology through training, education and extension education programmes.
- to provide consultancy service

RESEARCH PROGRAMMES

The research programmes of the Institute were carried out under five divisions viz., Crustacean Culture Division, Fish Culture Division, Technology Improvement Division, Aquaculture Engineering and Environment Division and Extension, Economics and Information Division. About 15 major research programmes have been implemented under the Institute's budget. The major thrust areas of research during 1987-96 were as follows:

Production Technology: Shrimps, fishes, crabs, live food organisms; seed production; crop production; broodstock development and induced maturation.

Nutrition and Feed Development: Feed formulation based on raw material evaluation; feed production and testing; larval and grow out feeds; basic research on nutritional requirements and digestive physiology; improvement of feed quality through biotechnological approach.

Diseases and Health Management: Database on diseases and their etiology; conventional and rapid diagnostic techniques, DNA probes; immunostimulants; prevention and control of diseases.

Physiology and Genetics: Basic research on eco-physiology, physiology and digestion, excretion, reproduction and selective breeding. Aquaculture stock improvement through genetic engineering, ploidy manipulation and selective breeding.

Shrimp farm environmental survey and impact assessment: Environmental survey of shrimp farms; database on soil and water quality; productivity management; assessment of environmental impact of brackishwater aquaculture and database on environmental management.

Economics and Extension: Database on brackishwater aquaculture; socio-economic analysis; training; extension literature.

Concurrently, the Institute has been able to propose and get a number of externally sponsored and funded research schemes falling within the purview of its mandate. These are:

- * **FAO/Bay of Bengal Programme:** Development of water-stable shrimp feed for artisanal sector (1989-90).
- * **FAO/Bay of Bengal Programme:** Study of shrimp fry by-catch in West Bengal (1990-91).
- * **Department of Biotechnology, Govt. of India:** Quantitative requirements of amino acids and fatty acids for the prawn *Penaeus monodon* and use of additives in grow out feeds for improving feed efficiency and growth promotion (1991-94).
- * **Department of Biotechnology, Govt. of India:** Development of feed technology for semi-intensive and intensive shrimp farming (1992-96).
- * **ICAR Cess Fund Scheme:** Impact of brackishwater aquaculture on environment (1992-95).
- * **ICAR/IBRD/NARP:** Basic Research Sub-project on Aquaculture - Identification and characterisation of digestive and gut microbial enzymes in brackishwater fish and prawn and enzyme-mediated bioconversion of feed ingredients (1992-96).

ACHIEVEMENTS

Shrimp Culture

Significant contributions have made in increasing production / productivity levels in the traditional, extensive and semi-intensive sectors of shrimp farming through the following programmes:

- In the traditional sector, a study of shrimp farming in West Bengal and Kerala was taken up. Monitoring of farms was carried out and technical assistance was rendered to small farmers for improving production levels.
- In the extensive sector, production levels of 1194 kg/ha/crop have been achieved with tiger shrimp *Penaeus monodon* at Kakdwip (West Bengal) with Institute formulated feeds. As compared to traditional levels (300-500 kg/ha/year), the above productivity level is high.
- In the first-ever demonstration of semi-intensive/intensive shrimp farming at Nellore (Andhra Pradesh) under the Dept. of Bio-technology project, implemented by MPEDA in scientific association with CIBA, production of 5 tonnes / ha / crop was achieved.

Shrimp Seed Production

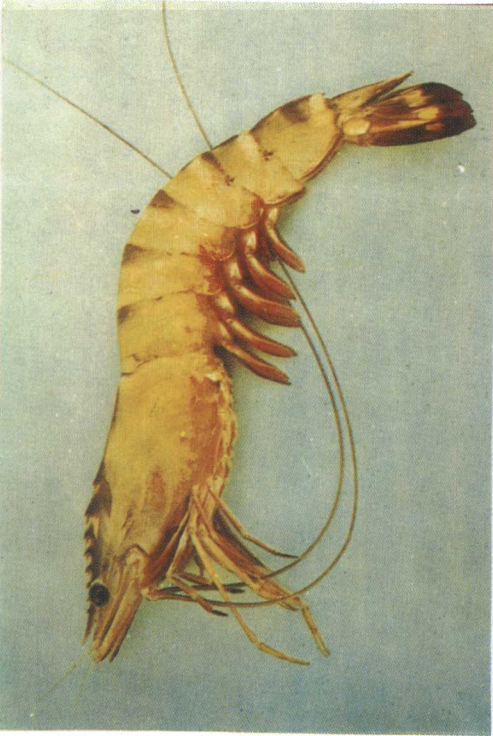
The Institute has developed shrimp hatchery technology :

- A simplified cost-effective backyard hatchery **technology package** was developed by the Institute for the seed production of white shrimp *Penaeus indicus* for small and medium farmers.
- A **technology package** was developed for captive broodstock maturation of tiger shrimp *P. monodon*. This can solve the problem of lack of sufficient broodstock for hatchery production of seed.
- A **technology package** for the culture and cyst production of the brine shrimp *Artemia*, an important live food item for shrimp in hatcheries, developed by the Institute, can meet the requirements of live food.
- The Institute has developed shrimp hatchery lay-out and designs for small-scale (2, 5 and 10 million capacity) and backyard shrimp hatchery.

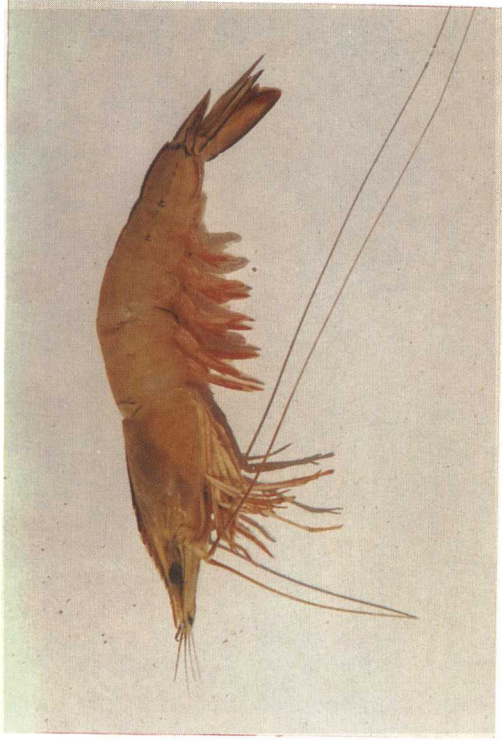
Shrimp Feed Development

The Institute has carried out extensive work in shrimp feed formulation and feed processing and production technology :

- The Institute has generated good database on the nutritional requirements of candidate species of shrimp *P. monodon* and *P. indicus* which has been widely utilised for formulating feeds by the shrimp feed industry. More than 30 feed mills were established in the States of Andhra Pradesh, Karnataka, Tamil Nadu and Kerala with indigenous shrimp feed technology information provided by the Institute. For improving farm made feeds, a farmers contact programme was conducted in the districts of Godavari, Krishna, Prakasam and Nellore in Andhra Pradesh. Several farmers and small-scale shrimp feed mills were benefitted through improvement of the feed formulations and water stability of farm-made feeds produced by them.
- Shrimp feeds developed in the Institute for *P. indicus* and *P. monodon* using indigeneous feed ingredients were field-tested in farmers ponds and obtained a feed conversion ratio obtained (FCR) of 1.76:1 which was comparable to that of imported brands of shrimp feed (FCR 1.64:1). Investigations on incorporating plant sources such as soyflour and *Spirulina* as substitute for fish meal which is scarce animal protein have been taken up.
- A small-scale shrimp feed processing and production **technology package** was developed by the Institute which is being adopted by small farmers.
- A **technology package** has been developed for micro- particulate feed production, using indigenous ingredients for rearing post-larvae of *P. indicus* upto PL20 and beyond and primarily intended for medium-scale hatchery operations. Micro-particulate diets using indigenous ingredients are also being developed for tiger shrimp *P. monodon*.
- The availability of marine protein resources in different maritime states for aquaculture feeds has been assessed and a comprehensive report was brought out on the marine protein resource availability in India as raw materials for shrimp feeds for the benefit of shrimp feed industry.



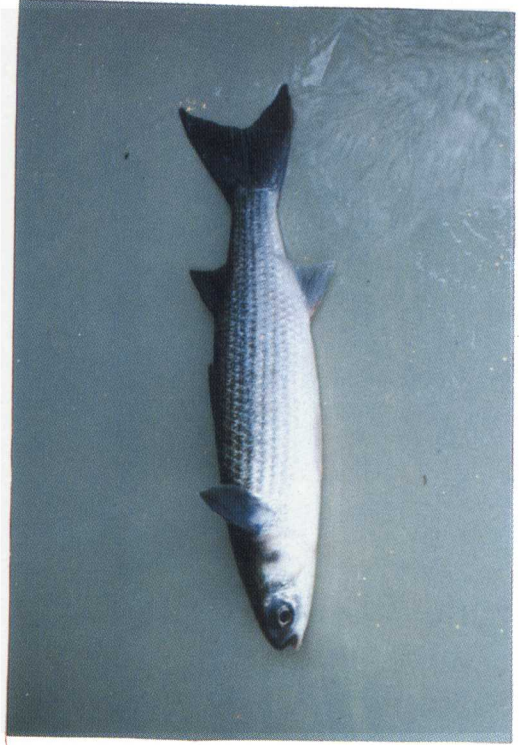
Tiger Shrimp (*Penaeus monodon*)



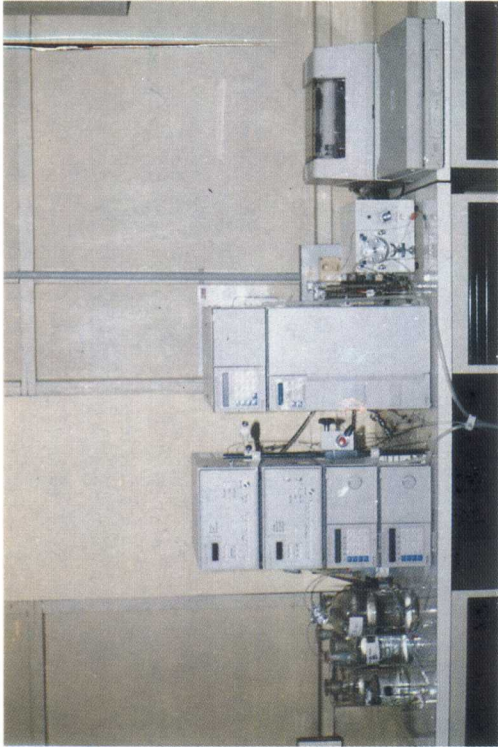
White Shrimp (*Penaeus indicus*)



Seabass (*Lates calcarifer*)



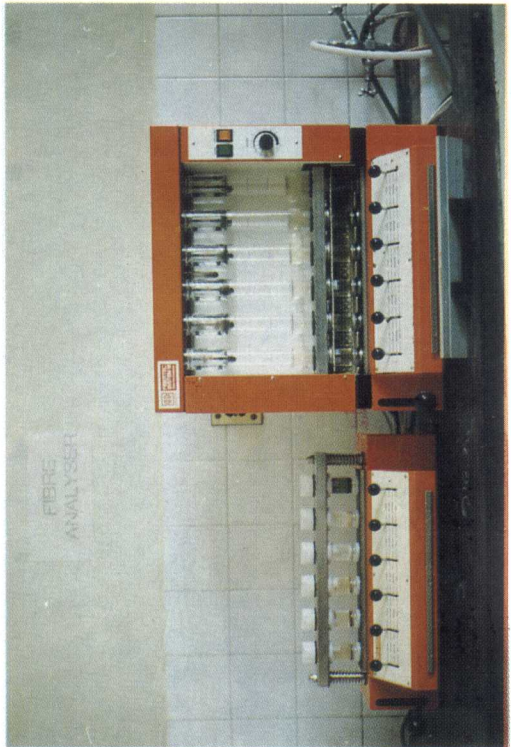
Grey mullet (*Mugil cephalus*)



High Performance Liquid Chromatograph



Laser Densitometer



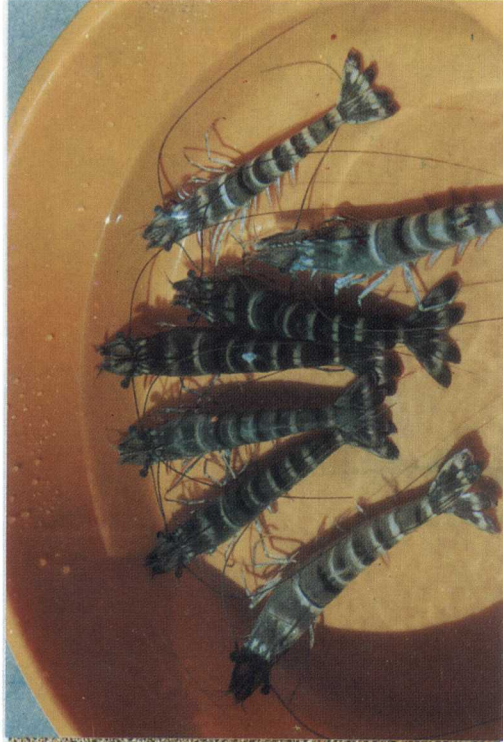
Tecator Fibretech System



Computer with E-mail



Artemia biomass (left), Cysts (right)



Broodstock of tiger shrimp



Diseased tiger shrimp with swollen carapace (vibriosis)



White spot disease in tiger shrimp



Diseased shrimp infected with *Zootamnium* sp.



Mud crab (*Scylla tranquebarica*)



Training Programme - farmers



Training Programme - students

Shrimp Disease Investigations

The Institute has conducted extensive investigations on the bacterial and viral diseases affecting shrimp in farms and hatcheries in various maritime states of Tamil Nadu, Andhra Pradesh, Orissa, Kerala and West Bengal :

- The major disease which struck shrimp farms has been diagnosed as the white spot disease and the causative agent was identified to be a virus (the Systemic Ectodermal and Mesodermal Baculovirus or SEMBV). Other important diseases investigated were Monodon Baculovirus (MBV), Infectious Hepatopancreatic and Lymphoid Organ Necrosis, Vibriosis, luminescent bacterial disease, larval mycosis, mixed bacterial infection, black gill disease, bacterial septicemia and soft shell disease. Parasitic infestations and Epizootic Ulcerative Syndrome affecting finfishes were also investigated. Advisory services have been rendered to farmers in shrimp health management and disease prevention while on field investigation.
- The Institute has brought out information (**technology package**) on shrimp diseases and shrimp health management in the form of extension pamphlet/bulletin for the use of farmers and hatchery operators.
- Diagnostic tests viz., Dot Immunoassay and ELISA (Enzyme-linked Immunosorbent Assay) have been standardised for the diagnosis of shrimp bacterial diseases caused by *Vibrio parahaemolyticus*, *Pseudomonas* sp. and *Aeromonas* sp. Advanced techniques of immunodiagnosics and gene probes are being developed for rapid diagnosis of shrimp diseases.

Environmental Impact Assessment

The Institute has conducted extensive investigations on the impact of shrimp farming on the environment :

- Several extensive, semi-intensive and intensive shrimp farms in Tamil Nadu (Tuticorin) and Andhra Pradesh (Nellore district) were surveyed. A number of physical, chemical and biological parameters of the culture systems have been investigated. The investigations on farm environment over a period of time have shown that severe deterioration of soil and water quality in the ponds have been primarily responsible for the disease outbreaks during 1994-96.
- Standards were developed for the discharge of effluents from shrimp culture ponds suitable for Indian conditions.
- Salinisation of coastal soils adjacent to shrimp culture farms in Nellore District was studied.
- The "permissible safe levels" of heavy metals and pesticides in brackishwater medium for tiger shrimp *P. monodon* was estimated.
- Effective and economical dose of lime materials required for treatment of acidic farm effluents was evaluated.

- With the help of the extensive database generated on impact assessment, the Institute has assisted the Union Ministry of Agriculture and the Govts. of Andhra Pradesh and Tamil Nadu in formulating guidelines for brackishwater aquaculture and standards for discharge of farm effluents from shrimp culture ponds.
- Recently the Institute launched a comprehensive survey of impact assessment due to shrimp farming. The first phase of the study carried out on seawater-based farms in the Nellore district of Andhra Pradesh indicated that the major negative impacts were higher levels of chloride values of drinking water from borewells in adjoining villages, salt intrusion into lands adjoining the farms and access problem. The positive socio- economic impacts due to aquaculture are higher levels of employment generation to the village people (2-15% increase) 6-22% increase in income and 3-20% increase in consumption pattern index and improvement in infrastructure facilities in these distant villages.
- Monitoring / advisory services on soil/water quality and maintenance of hygienic pond environment of farmers ponds has also been rendered by the Institute which has contributed to prevention of diseases and raising productivity levels.

Fish Broodstock Development, Breeding and Seed Production

To overcome dependence on commercial catches for breeders and to ensure production of quality fish seed for culture purpose, the Institute has undertaken the broodstock development and fish breeding programme of commercially important brackishwater finfishes such as seabass *Lates calcarifer*, grey mullet *Mugil cephalus* and pearlspot *Etroplus suratensis* :

- A technology package has been evolved for the pond breeding of the pearlspot *E. suratensis* which can be easily followed by the fish farmers particularly of the Kerala region where this fish has a good market demand.
- The broodstock of seabass and grey mullet have been successfully maintained under pond conditions with formulated feeds / live trash fishes.
- Induced maturation of captive fishes has been attempted through hormone implantation. The females of seabass were observed to attain IV stage of maturity (ova diameter 0.4 mm to 0.54 mm). This is the first time the species has reached the stage of maturity in captivity in India.
- Induced breeding of grey mullets *Liza macrolepis* and *Mugil cephalus* has also been conducted. Hatchlings of *L. macrolepis* were reared successfully to fry / fingerling stage.
- A captive broodstock of grey mullet *Mugil cephalus* and seabass *Lates calcarifer* are presently being held in cement concrete tanks with a total storage capacity of 500 t at Muttukadu and the technology for broodstock development is being perfected for adoption.

Fish Culture

- The Institute has achieved success in cage/pen culture of milkfish *Chanos chanos* at Muttukadu.

At a stocking density of 7500 no./ha with supplementary feeds, a production rate of 980 kg/ha/317 days was obtained with average size at harvest being 302 mm/182 g.

- Polyculture of *Chanos* in ponds with shrimp *Penaeus indicus* has also given encouraging results. At a stocking density of 2000 no./ha, with supplementary feeds, the average growth of fish recorded in 6 months was 340 g with a total production of 821 kg/ha/6 months.
- Culture of seabass in tide-fed ponds at Kakdwip has shown that the fish attained 0.8 to 1.0 kg size in 10-12 months culture period.
- Low-input integrated fish/shrimp cum poultry farming has given encouraging results.

TRANSFER OF TECHNOLOGY PROGRAMMES AND BENEFITS

The benefits of research conducted by CIBA in different areas of shrimp/fish aquaculture have percolated to the farmers and industry by means of publication of bulletins and extension literature (disseminated through State Fisheries Depts. / BFDA's), training to farmers, officials of State Departments / BFDAs, interaction with farmers through farmers meet / exhibitions and lab-to-land type programmes.

Bulletins

- a) An overview of brackishwater shrimp and finfish culture research in India in 1980's.
- b) Prawn farming - candidate species.
- c) Shrimp diseases, their prevention and control.
- d) Technology for *Artemia* cyst and biomass production.
- e) Microparticulate feed for postlarvae of shrimp *Penaeus indicus*
- f) Development of broodstock and maturation of tiger prawn *P. monodon* in captivity
- g) Backyard hatchery technology for *P. indicus*
- h) Seed production of pearlspot *Etroplus suratensis*
- i) Marine protein resource availability in India as raw materials for prawn feed

Extension pamphlets / Brochures

- 1) Shrimp culture : Pond preparation
- 2) Shrimp culture : Water quality management
- 3) Shrimp culture : Feeds and feed management
- 4) Shrimp culture : Diseases and health management
- 5) Chlorination in brackishwater aquaculture
- 6) Lime and its application in brackishwater aquaculture
- 7) Training programmes in CIBA
- 8) Site selection and farm design
- 9) Finfish farming
- 10) Small scale shrimp hatchery technology

- 11) Disease diagnosis and health management in shrimp farms
- 12) Shrimp nutrition and feed technology
- 13) The Brine shrimp *Artemia* : Biomass and cyst production

Training programmes

A number of training programmes were conducted by the Institute, the details of which are listed below:

Training programmes conducted by CIBA from 1987 - 1995

Year	Course Topics	Target Group	No. of Trainees	Centre of Training	Period
1987	Brackishwater farming	Fisher Youth from Gujarat	14	KRC	28.2.1987 to 20.3.1987
1988	Shrimp Hatchery Technology	Vietnamese officials	3	MS,NRC, PRC	18.2.1988 to 11.4.1988
1988	Shrimp Culture Technology	- do -	3	MS, NRC, KRC	15.2.1988 to 12.4.1988
1988-89	Shrimp Hatchery and Culture Technology	- do -	1	MS, NRC, PRC, KRC	19.1.1988 to 12.1.1989
1988-89	Brackishwater Farming	Fisher Youth from Gujarat	14	KRC	26.12.1988 to 8.2.1989
1989	Prawn Hatchery Technology	Fisheries officials from Karnataka	1	MS	21.8.1989 to 2.9.1989
1990	Prawn Hatchery	Fisheries Officials from Gujarat, Karnataka, Kerala, Pondichery, Orissa & West Bengal	10	NRC	22.1.1990 to 17.2.1990
1990	Brackishwater Aquaculture	Fisher Youth from Gujarat	14	KRC	1.2.1990 to 17.3.1990
1991	Culture of <i>P. monodon</i>	Fisher Youth Gujarat BFDA	15	KRC	1 month Feb 1991
1991	Brackishwater Aquaculture	-do-	15	KRC	1 month Mar 1991

contd.....

Training Programmes (contd.)

Year	Course Topics	Target Group	No. of Trainees	Centre of Training	Period
1992	Backyard Hatchery Technology	Officials of Fisheries Dept & SAUs	14	NRC	3.2.1992 to 8.2.1992 17.2.1992 to 22.2.1992
1993	Brackishwater Aquaculture	Superintendent of Fisheries, Govt. of Goa	1	MS	15.4.93 to 17.4.93
1993	Brackishwater Aquaculture	Officers from Department of Fisheries, Govt of Rajasthan	5	MS	19.4.93 to 28.4.93
1995	<i>Artemia</i> cyst production	-do-	2	MS	12.7.93 to 18.7.93
1993-94	'Semi-intensive Shrimp farming Technology' (World Bank Project)	Extension Officers of BFDA's from W.B. & Orissa	20	MS	15.12.93 to 15.1.94 (WB-10) 27.12.93 to 24.1.94 (ORISSA-10)
1994	"	Extension Officers of BFDA from Orissa & A.P.	20	MS	5.7.94 to 3.8.94 (ORISSA-7 & A.P-13)
1995	"	Extension Officers of BFDA from A.P.	7		17.5.95 to 15.6.95
"	"	Extension Officers of BFDA from W.B. & A.P	27		21.8.95 to 19.9.95 (A.P-9) 28.8.95 to 25.9.95(W.B-18)
1995	Biotechnological approaches in Fish/Shrimp nutrition (under DBT sponsored project)	Officials from SAU's and R & D	16	MS	15.2.95 to 7.3.95
1995	Shrimp disease monitoring	Research Assistants from Dept. of Fisheries, Tamil Nadu	3	MS	26.6.95 to 1.7.95

contd.....

Training Programmes (contd.)

Year	Course Topics	Target Group	No. of Trainees	Centre of Training	Period
1995	Backyard hatchery technology	Sub-Inspectors of Dept. of Fisheries Government of Pondicherry	2	MS	21.8.95 to 3.12.95
1995	Water quality management	Small farmers from Nellore (A.P)	20	MS	18.10.95 to 19.10.95

MS - Chennai Headquarters of CIBA, KRC - Kakdwip Research Centre, PRC - Puri Research Centre, NRC - Narakkal Research Centre.

Farmers Day/Meet

- Farmer's Day was organised at the headquarters of the Institute at Chennai on 25th February 1988.
- Farmers meet was organised at headquarters, Chennai on 14-15 March 1988.
- National Science Day was celebrated at the Ennore Field Centre of the Institute on 28 February 1988.
- National Science Day celebrated at Headquarters, Chennai and research centres on 28th February 1989, 5th March 1989 and 7th March 1990.
- Coastal Aquaculture Awareness Programme for fishermen & small farmers was conducted at Muttukadu, Chennai on 6th October 1990.
- A Farmers Day celebration was conducted at Muttukadu on 16.10.96.

Participation in Exhibitions

The Institute participated in the following exhibitions to bring in awareness of brackishwater aquaculture among people:

- INDAQUA aquaculture show organised by the MPEDA at Madras during 19-23 March 1993.
- INDAQUA aquaculture show organised by the MPEDA at Madras during 27-30 January 1995.
- "Food Security Expo' 96" organised by the Rotary Club of Madras East and supported by TNCC Charitable Trust and M.S.Swaminathan Research Foundation at Chennai during 9-14th November 1996.
- "Aqua Fair" - organised by Inland Fishing Society of India, Barrackpore (W.B.) during 16-17 March, 1997.

Workshops / Seminars

- Seminar on "Status and prospects of Brackishwater Aquaculture in Orissa, organised at Puri on 14th October 1988.
- Workshop on Brackishwater Finfish Breeding & Seed Production was held at Chennai on 6th and 7th December 1989.
- National Workshop on Transfer of Technology for Sustainable Shrimp Farming was held at Chennai on 9-10 January 1995.

Lab to land - type activities

The research results achieved by the Institute have also been passed on for the benefit of the farmer through lab to land type activities *viz.*

- a) Monitoring of farmers ponds mainly with regard to water and soil quality and shrimp health monitoring was carried out in the states of Andhra Pradesh and Tamil Nadu. The shrimp farmers have gained much information from this type of service provided by the Institute.
- b) Field testing of feeds developed by the Institute was carried out in selected farmers ponds (small/medium farmers) and in farms belonging to corporate sector in Andhra Pradesh. Several farmers have benefitted from these trials.
- c) Improvement in the nutritional quality of farm made shrimp feeds through farmers contact programme was carried in the Godavari, Krishna, Prakasam and Ongole districts of Andhra Pradesh.
- d) Technology for backyard shrimp hatchery technology for white shrimp *P. indicus* was extended to farmers in Kerala and Karnataka.
- e) Prawn culture in tide-fed pond extended to farmers in Kakdwip (West Bengal).
- f) Based on a study conducted by the Institute on the confined prawn farming system in the Chilka Lake area under ERRP/ADAP and BFDA scheme, suggestions were given to the farmers for the improvement of productivity and production of the rain-fed pond system in the Chilka Lake area.
- g) Microbial disease investigations in prawn hatchery - extended to hatchery operators in Tamil Nadu and Andhra Pradesh.
- h) The feasibility of developing the waste lands of Bhal area of Gujarat and the inland surface areas of Rajasthan for aquaculture activities was brought out by the Institute based on survey of the areas and suggestions were given to the concerned State Depts. for carrying out aquaculture (shrimp farming) in those areas.

In addition, the Institute has also provided consultancy to various private agencies on survey and site selection, farm design, shrimp hatchery, shrimp farming, shrimp feed formulation and production, water and soil quality management and shrimp disease diagnostics and health management.

LINKAGES AND CO-ORDINATION

The Institute has established linkages with Central Ministries / Depts, State Depts, State Agricultural Universities / Traditional Universities and other non- governmental organisation as given below:

Dept. of Agriculture and Cooperation (DAC), Ministry of Agriculture, Govt. of India

The Institute has well developed linkages with the Dept. of Agriculture and Cooperation, Ministry of Agriculture and is continuously interacting with them in important areas of research and development. Environmental issues related to shrimp culture and shrimp/fish health monitoring and management are two such important areas.

Marine Products Export Development Authority (MPEDA), Ministry of Commerce, Govt. of India

The Institute has collaborated with the Marine Products Export Development Authority (Ministry of Commerce) and Dept. of Biotechnology, New Delhi, in demonstration of semi- intensive culture technology at MPEDA farm in Nellore, Andhra Pradesh.

- Another demonstration on performance of shrimp feeds developed by the Institute is being undertaken at a farm in the Andaman & Nicobar Islands under the Andaman & Nicobar Shrimp Farming Development and Research Agency (AN-SFDA) programme implemented jointly by MPEDA and DOD (Dept. of Ocean Development).

Dept. of Biotechnology, Govt. of India

The Institute has close linkages with the Dept. of Biotechnology, New Delhi, in development of feed technology for semi-intensive and intensive shrimp farming.

DBT has funded two projects, the first project viz., "Studies on quantitative requirements of essential amino acids and fatty acids for the prawn, *Penaeus monodon* and use of additives in grow-out feed for improving feed efficiency and growth promotion (Budget 12.5 lakhs), was undertaken from 1991-94 at CIBA and CIFT; the second project on development of feed technology for semi-intensive and intensive prawn farming is under implementation at CIBA (1992-96) (Total budget 19.0 lakhs).

The DBT also sponsored a short-term training course on Biotechnological Approaches in Fish/ Prawn Nutrition and Feed Technology conducted at CIBA from 15 February to 7 March 1995.

Linkages with State Depts. / BFDAs

The linkages established with State Depts. / BFDAs are mainly with regard to transfer of technology as shown below:

Linkages with State Departments / BFDAs

	Area	First line demonstration / TOT	State Depts.
1.	Shrimp hatchery technology	Technical advice from planning to execution and demonstration of shrimp seed production	a) Dept. of Fisheries, Govt. of Karnataka b) Dept. of Fisheries, Govt. of Pondicherry
2.	Brackishwater aquaculture potential in Inland states	Survey of potential areas with ground salt water potential and reporting of	Dept. of Fisheries, Govt. of Rajasthan
3.	<i>Artemia</i> cyst production	Training in <i>Artemia</i> biomass and cyst production technology	Dept. of Fisheries Govt. of Rajasthan
4.	Master plan for shrimp farming	Survey, training in shrimp farm environmental impacts in Nellore district, Andhra Pradesh and guidelines	Dept. of Fisheries Govt. of Andhra Pradesh
5.	Evaluation of aquaculture system	Evaluating of FFDA's and demonstration shrimp farm (Killai) report thereof	Govt. of Tamil Nadu
6.	Evaluation of confined pond shrimp culture in Chilka area	Survey of confined pond (rain fed) shrimp culture system around Chilka Lake under ERRP/BFDA Schemes for environmental and productivity management	Dept. of Fisheries Govt. of Orissa
7.	Social, economic, environmental issue of shrimp culture in Tamil Nadu	Guidelines on sustainable coastal aquaculture, legislating Tamil Nadu Aquaculture Regulation Act, 1995	Govt. of Tamil Nadu
8.	Human Resource Development	Training in aspects of semi-intensive shrimp culture technology, hatchery technology etc.	State Project Units (SPU) of World Bank Project in West Bengal, Orissa and Andhra Pradesh Dept. of Fisheries, States (several)

Linkages with NGOs

Institute's linkages with NGO's are given below:

Area	Actual Project	Name of the NGOs
Aquaculture	Site selection and planning shrimp culture farm and hatchery for demonstration and training at Karaikal (under DBT-scheme)	Dr.M.S.Swaminathan Research Foundation Chennai

Linkages with ICAR Institutes

Linkages with ICAR institutes are shown below :

Major area / programme	Project Investigation	Co-operating ICAR Institute
Nutritional requirements of shrimp (DBT sponsored)	Qualitative requirements of Essential Amino Acids for shrimp <i>Penaeus monodon</i>	CIFT, Cochin
Basic research Sub-project on Aquaculture (NARP-II)	Pond bio-energetics, digestive enzymes and microflora in fish and prawn under aquaculture	CIFA, Bhubaneshwar

