1983
ANNUAL REPORT

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE

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1983

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
(Indian Council of Agricultural Research)
BARRACKPORE-743 101 .WEST BENGAL
INDIA

Credits

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Cover: A VIEW OF CIFRI'S PENCULTURE INSTALLATIONS IN AN OX-BOW LAKE AT MAZAFFARPUR, BIHAR.

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BARRACKPORE

1. DIRECTOR'S INTRODUCTION

HISTORY

The Central Inland Fisheries Research Station was formally established in March, 1947 in Calcutta under the Ministry of Food and Agriculture, Government of India. From the modest beginning as an interim scheme, the organisation has since grown to the status of premier research institution in the field of inland fisheries in the country. By the year 1959, the Station acquired its status as Central Inland Fisheries Research Institute (CIFRI) and moved to its own buildings at Barrackpore, West Bengal. Since 1967, the Institute is under the administrative fold of Indian Council of Agricultural Research (ICAR). At present, CIFRI is one of the biggest research institutes under ICAR with 250 scientific and technical personnel working under 36 centres spread across the country.

MANDATE AND OBJECTIVES

The Institute was set up with a mandate to take up studies on ecology and management of natural fisheries in rivers, lakes, reservoirs, estuaries and lagoons and to take up studies on basic and applied research on freshwater and brackishwater aquaculture to achieve high production rate per unit area from those systems.

ORGANISATION :

To meet the above objectives, the Institute's organisational set up was accordingly structured. It has 3 Divisions, namely Riverine & Lacustrine Division, Estuarine Fisheries and Brackishwater Aquaculture Division and Freshwater Aquaculture Division. The Riverine and Lacustrine Fisheries Division works on capture fisheries relating to rivers, lakes, reservoirs, beels etc. This Division also gives emphasis on ecology of these water bodies and studies relating to water pollution and aquatic productivity. The Estuarine Fisheries and Brackishwater Aquaculture Division with its present headquarters at Barrackpore studies all aspects relating to ecology and management of fisheries of estuaries and lagoons. This Division also works on brackishwater aquaculture for which necessary infrastructure facilities have been developed at Kakdwip. The Freshwater Aquaculture Division located now at Dhauli works on all aspects of pond culture. In addition, the Institute has 4 All India Coordinated Research Projects, viz., Composite Fish Culture and Fish Seed Production, Air-breathing Fish Culture in Swamps, Reservoir Fisheries, and Brackishwater Fish Farming. These Coordinated Research Projects are basically meant for testing various technologies developed by the Institute in diverse eco-climatic conditions.

The Institute has 18 outstation centres and survey centres under 3 Divisions and 11 Institute-based centres under the 4 All India Coordinated Research Projects spread all over the country. In addition, Institute has Extension Section at Barrackpore, KVK on Brackishwater Fish Farming at Kakdwip and KVK/TTC on freshwater aquaculture at Dhauli, Kausalyagang, and one Operational Research Project at Krishnagar. Library and Documentation Section, Administrative, Accounts, Audit, Stores and other sections also function at Headquarters.

IMPORTANT ACHIEVEMENTS IN 1983

Pen culture of carps in oxbow lakes :

The Institute has developed a pen culture technology suitable for adoption in oxbow lakes and other riverine wetlands in the form of **mans, beels**, etc. Indian major carps catla, rohu and mrigal were cultured in a 0.1 ha pen erected in Gandak basin, Muzaffarpur, Bihar and a production rate of 4t/ha was achieved in six months. Pen culture in oxbow lakes ensures a 76.2% return on investment. Pen culture technology developed by CIFRI has become very popular in the region and the nationalised banks have started financing pen culture ventures by progressive fish farmers and fisheries cooperatives.

Paddy-cum-freshwater prawn culture using treated sewage effluents :

The giant freshwater prawn *Macrobrachium rosenbergii*, when reared in specially designed paddy fields receiving treated sewage effluents yielded highly encouraging production rates. After 12 months of rearing, 264 kg/ha of prawns was harvested. Paddy planted along the periphery of the plot yielded 1,700 kg/ha. Silver carp stocked for controlling the algal bloom gave a production of 163 kg/ha. The new combination was tried in a 0.4 ha plot at the farm of the Rahara Research centre of CIFRI.

Indian major carps breed at high altitude :

CIFRI has succeeded in breeding the Indian major carps, rohu and mrigal at Sattal Lake, at an altitude of 4000 ft above MSL. These fishes normally breed at much lower altitudes and this breakthrough goes a long way in ensuring the availability of major carp seed at high altitude stations.

A new therapy for fish bacterial disease :

An uncommon bacterial disease that infected *Clarias batrachus* in a private farmer's pond at Port Canning was successfully treated with sulphadiazine. Symptoms of the disease included loss of barbels or swelling at the root of barbel, reddish mouth, fin rot and dermal ulcers. Later, sulphadiazine was effectively used to control dermal ulcers caused by a strain of *Pseudomonas* in the same fish. The drug was adminis-

tered @ 100 mg/kg of feed for seven days and after treatment an almost total recovery was achieved.

Culture of common carp in Kashmir rural ponds :

Common carp was cultured in village ponds in Kashmir adopting low inputs and a production @ 3,000 kg/ha/7 months was achieved. Pond fertilisation was done by diverting the domestic and cattle wastes of the village into the pond. Fingerlings were stocked at the rate of 7000/ha and the fish grew from 40 g to 500 g in just 7 months rearing period.

Low input carp culture technology :

A low cost composite fish culture technology without resorting to any artificial feed has been successfully demonstrated at the Jaunpur Research Centre (U. P.). Management measures included intensive fertilisation with nitrogenous or phosphatic fertilisers. A six species combination yielded 3,333 to 3,985 kg/ha in 9 months. From a 0.1 ha pond fish worth Rs. 3,576 to Rs. 4,241 were raised against an input level Rs. 376 to Rs. 479 only.

Record fish production in semi-arid zone at Karnal (Haryana) :

Fish production to the tune of 8,208 kg/ha/8 months was obtained at Karnal Centre of CIFRI. This is the highest production from the region so far in experimental trials on composite fish culture in Haryana. A six species combination of catla, rohu, mrigal, silver carp, grass carp and common carp at a stocking density of 4,000 fingerlings under scientific management resulted in this record production.

IMPORTANT EVENTS

Workshops on Brackishwater Aquaculture and Reservoir Fisheries

The fifth workshop on Brackishwater Fish Farming and the seventh workshop on Reservoir Fisheries were jointly held at Barrackpore from 8 to 10 March, 1983. Inaugurating the joint session, Shri B. S. Sharma, Secretary of Fisheries, Govt. of West Bengal pointed out the vast resources in reservoir and brackishwater sectors and emphasised the need for their optimum utilization.

The Fifth Workshop on Brackishwater Fisheries critically reviewed the work done under the All India Coordinated Project on Brackishwater Fish Farming from October, 1981 to December, 1982. Dr. A. V. Natarajan, Director, CIFRI, while welcoming the delegates highlighted the major achievements of the project. He also pointed out certain constraints in prawn culture and other problems of operational nature. The workshop discussed the issues pertaining to selection of farm site, hatchery management, seed resources, ecological studies nutritional requirements of brackishwater species, etc. The workshop was attended by eminent personalities like Dr. L. N. Mondal, Vice Chancellor, Bidhan Chandra Krishi Viswa Vidyalaya, Shri G. N. Mitra, Dr. P. S. B. R. James, Prof. S. K. Moitra, Prof. N. C. Dutta and Dr. V. D. Singh, apart from the scientists of CIFRI. The workshop also finalised the programme for 1984.

The workshop on Reservoir Fisheries spanned into four technical sessions wherein the progress of work in three centres of the project was reviewed. The workshop also discussed the final reports of Nagarjunasagar, Bhavanisagar, Rihand and Getalsud reservoirs. The question of introducing silver carp in Indian reservoirs was a subject of animated discussion. The other areas discussed were the evolution of gear, spawn collection, stocking and management measures to be taken in resrvoirs. The distinguished gathering included Shri G. N. Mitra, Dr. Y. R. Tripathi, Dr. V. D. Singh, Dr. G. P. Dubey, Dr. S. K. Moitra, Dr. P. S. B. R. James, Prof. N. C. Dutta, Shri Narayan Prasad, Shri S. N. Dwivedi and Dr. L. N. Mondal.

Hon'ble Minister Shri Rao Birendra Singh visits CIFRI

Shri Rao Birendra Singh, Hon'ble Minister for Agriculture and President, Indian Council of Agricultural Research visited CIFRI on 28th December, 1983. The

Minister was given a rousing welcome by scientists and staff of the Institute. In his address to the scientists and staff of the Institute, the Hon'ble Minister described CIFRI an'Institute of high national imprtance' entrusted with research towards development of inland fisheries sector and thereby providing high quality protein to the people. He impressed upon the staff that by pursuing the development of inland fisheries, they are serving a noble cause of feeding the millions. He exhorted the members of CIFRI staff to fulfil their duties to the society with dedication.

CIFRI'S participation in All India Exhibition

CIFRI has participated in the All India Exhibition held at Calcutta Maidan from 27-December, 1983 to 11.1.1984. CIFRI's achievements and research activities were highlighted in the exhibition through modern audio-visual aids, apart from models, charts, blow-up photographs etc. The distinguished visitors included Hon'ble Minister Shri Rao Birendra Singh and several other Union Ministers and distinguished personalities.

MPs Visit CIFRI

Four members of Parliament paid a visit to CIFRI on 29th December, 1983. The team was led by Shri Ram Vir Singh, Member of Lok Sabha. The MPs evinced keen interest in the activities of the Institute. Dr. A. V. Natarajan, Director CIFRI briefed them on the work of the Institute and the achievements made in the areas like freshwater fish culture, brackishwater fish culture and capture fisheries.

World Environment Day

The Institute observed the world Environment Day by resolving to serve the cause of a healthy environment. The highlight of the day was a thought-provoking talk by Dr. B. I. Sunderaraj who cautioned against any apathy towards environment, as the survival of life on this planet depended on a balanced environment. Dr. A. V. Natarajan also spoke on the occasion and he stressed the need for an environmental conscience of a higher order. Both Dr. Sunderaraj and Dr. Natarajan urged the members of CIFRI family to cultivate a high sense of awareness about environment and to make positive contribution to its improvment.

COLLABORATION

International level :

Dr. Janos Olah, FAO, consultant on fish pond microbiology at FARTC, Dhauli trained CIFRI scientists on microbial analysis of water and sediment samples and study of docomposition rates.

Nine scientists of the Institute were trained abroad under FAO/UNDP fellowship programme on various subjects like catfish culture, prawn hatchery, frog hybridization and genetics, fish genetics, nutrition, etc.

A nine days training programme was arranged for two fisheries officers from Nigeria who were at CIFRI under FAO study tour programme.

Freshwater Aquaculture Research and Training Centre of CIFRI at Dhauli continued its activities as a joint venture by ICAR and FAO/UNDP.

National level :

The Institute worked in collaboration with Genetics Research Unit of the Zoology Department, University of Calcutta in selective breeding and hybridization of commercially important frog species.

Paddy cum fish culture experiments were conducted in collaboration with Rice Research Institute at Chinsura (West Bengal). Three paddy plots of 0.01 ha belonging to the Institute were kept at the disposal of CIFRI for conducting experiments.

Similar cooperation was extended to CIFRI by the Central Soil Salinity Research Institute at Canning where the CIFRI has conducted successful paddy cum fish culture experiments.

The four All India Coordinated Projects based at the Institute continued to work in close liaison with 15 States/Agricultural Universities.

MANPOWER DEVELOPMENT

S/shri R. K. Das, C. S. Puruthothaman and S. Ayyappan received training in pond microbiology from Janos Olah, FAO consultant. S/Shri D. K. Chatterjee, C. R. Das, S. R. Ghosh, Radheshyam and D. P. Chakraborti were also benefitted by the training.

FAO/UNDP Fellowships

Dr. N. K. Thakur, visited Thailand from 19-5-83 to 20-6-83 to acquaint hemself with the latest techniques of culture and propogation of *Pangasius sufchi* at the Thai Department of Fisheries.

Dr. A. K. Mondal, Scientist has been to the Rice University Houston, Texas where he worked on various aspects of frog embryology and genetics.

Shri A. V. P. Rao, Scientist at Madras has undergone a 5 months training course in prawn hatchery management in Malaysia, Indonesia and Thailand. Shri Rao visited Port Dickson, Gingor, Malacca, Puchong, Jakarta, Jepara, Prigi and Bangkok and studied hatchery design, feeding, parasite control, etc.

Shri H. A. Khan Scientist has undergone a training in fish genetics at Gosniorkh, Leningrad (USSR) for three months.

Shri G. V. Kowtal, Scientist has undergone training in fish culture genetical engineering in USA.

S/Shri M. A. Khan, S. N. Mehrotra, R. K. Banerjee, M. Kaliyamurti, D. P. Chakraborti S Radhakrishnan and K. Gopinathan have undergone the reorientation couse in National Academy of Agricultural Research Management (NAARM) at Hyderabad.

Dr. H. C. Joshi attended the school of Toxicology of Pesticides from 17-19 November 1983 at Regional Research Laboratory, Hyderabad. The school comprised lectures and workshop on biological and toxicological evaluation, structure activity relationship, target enzyme interaction, selectivity, neurotoxicity and delayed neurotoxicity *in vitro* and *in vivo* metabolism, persistance, and decomposition residue analysis and computer aided statistics.

Shri A. K. Chattopadhyay at KVK, Kakdwip underwent a two weeks training in dryland agriculture at All India Coordinated Research Project on Dryland Agriculture, Hyderabad, The training lasted from 3 January to 14 January, 1984.

HONOURS, AWARDS, ETC.

The following scientists of CIFRI were awarded the degree of Doctor of Philosophy during 1983.

	Name	University	Topic of Research
1.	M. Kaliyamurti	Magadh University	Studies on the percoid fishes of Pulicat Lake, south east coast of India.
2.	R. K. Banerjee	Patna University	Ecological studies of effluents from certain industrial and municipal sources and of agricultural waste materials.
3.	M. J. Bhagat	Ranchi University	Fishery and biological aspects of two commercially important fishes *Schizothoraichthys esocinus* and *S. niger* collected from Dal Lake.
4.	H. P. Singh	Banarus Hindu University	Control of aquatic weeds.
5.	Smt. Usha Moza	University of Kashmir	Studies on the neurosecretary organs of fishes of Kashmir.
6.	S. Radhakrishnan	Magadh University	Studies on the macrophytic flora in Lake Pulicat with special reference to their utilization as organic manure and artificial feed for fish.
7.	Sree Prakash	Banarus Hindu University	Fishery and biology of North Indian freshwater prawn *Macrobrachium birmanicum choprai.*
8.	K. J. Rao	Andhra University, Waltair	Studies on the fishery and biology of important prawns of Lake Kolleru in Andhra Pradesh with an account of *Macrobrachium rosenbergii* culture in pond ecosystem.
9.	K. V. Ramakrishna	Andhra University, Waltair	Studies on the ecology, biology and culture of edible oyster *Crassostrea madrasensis* of Pulicat, India.
10.	M. A. Khan	Agra University	On some aspects of biology of *Notopterus notopterus* of Tilaiya Reservoir, Bihar.
11.	M. Sinha	University of Calcutta	Biology and Fishery of the canine catfish eel—*Plotossus canius.*

EXTENSION AND NATION BUILDING ACTIVITIES

Extension lectures, Fish Farmers Days, training programmes and participation in exhibitions were the highlights of CIFRI's extension work during the year 1983. A large number of private fish farmers, entrepreneurs students and government functionaries were benefitted by the extension activities of the Institute.

Extension lectures :

Twenty-eight extension lectures were delivered by the extension personnel on varying subjects ranging from Induced breeding, Nursery pond management, Modern aquaculture practices, Fish diseases and their control, Air breathing fish culture, Reservoir and beel fisheries and Fish seed transport.

Training :

A nine days training was arranged for Mr. N. E. Nirole and Mr. V. H. Amire, Nigerian Fishery Officers from 1-9 January, 1983.

—A 5 days training programme was arranged for Dr. O. H. Ayinla, from Nigeria under a FAO sponsored study programme.

—One day training was organised for 5 fisheries extension officers of FFDA, U. P. on different aspects of inland aquaculture on 25.6.1983.

—A 10-days training programme including field visits was arranged for three French scientists from 7th July, 1983.

Four fish farmers of Arunachal Pradesh were trained in various aspect of aquaculture from 19th July, 1983.

Fish Farmers' Days :

A Fish Farmers' Day was organised at Aniya, Chanditala Block on 29.1.1983 in which 250 fish farmers took active participation. They have exchanged views with the extension personnel of CIFRI ragarding the problems faced by them.

Exhibitions :

CIFRI participated in 8 exhibitions conducted in different parts of West Bengal to propagate the modern concepts of aquaculture and innovated technologies of CIFRI. Apart from audiovisual aids, live specimens and models were the added attractions in CIFRI pavilions.

—CIFRI's stall at the 'Bharat Mela' exhibition at Calcutta Maidan attracted 50,000 visitors including distinguished personalities like Union Ministers, MPs etc.

—Participated in the Annual Fair of Vivekananda Institutes for Community Service (VICS) at Mandya, Hooghly from 25-27-March, 1983. About 10,000 farmers visited the pavilion.

—Participated in the Exhibition at Bally Dewangung (Dighra) Hooghly District from 15th February. The exhibition was organised by Palli mangal, Ramkrishna Mission, Belur and more than 5,500 people turned up to see the CIFRI stall.

—Participated in the exhibition at Dewanpara Krira-O-Sankriti Sangha, Belgharia from 17-20 February, 1983. About 75,000 people comprising enterpreneure, fish farmers and students visited the exhibition.

- Participated in Grameen Mela at Seakhala at Hooghly from 26-29 Jan, 1983 where more than 10,000 persons visited the pavilion.

—Participated in the Grameen Mela at Serampore, Hooghly from 10-24 March, 1983. 2,000 villagers visited the CIFRI pavilion.

Visitors briefed :

There was a steady inflow of visitors from various walks of life like farmers, trainees, officials, academicians etc. who were briefed on the latest technologies developed by the institute and the research work in progress through charts, photographs, film shows and other audiovisual aids.

During the year, 445 students from different educational Institutions like College of Fisheries Mangalore ; Bethune College, Calcutta ; Madurai Agricultural College ; Subhashini Balika Shikshalaya, Harinavi, West Bengal ; Tamil Nadu Agricultural University ; Meerut University ; Nowgang Fisheries Training Centre, M. P. ; Barrackpore Govt. High School ; Bihar Veterinary College, Patna ; Gyan Bharati Vidyapith, Calcutta ; Central Institute of Fisheries Education, Bombay ; Cantonment Hindi Vidyalaya, Barrackpore ; Pragyothish College, Gauhati and St. Antony's College, Shillong visited the Institute. Besides, trainees from Cooperative College, FFDAs, IITs and different state departments were briefed about the activities of the Institute.

A batch of 21 trainees from Network of Aquaculture Centres in Asia (NACA) visited the Institute accompanied by Dr. Chua.

Advisory services provided :

Necessary advices/suggestions on various aspects of inland aquaculture were rendered to 103 fish farmers for their 202 ponds and 14 bheries. Similar services were extended to private companies, Cooperative Societies and some voluntary organisations.

Information on various aspects of aquaculture were provided through letters to 89 fish farmers, entrepreneurs and other agencies. Relevant literature was also sent to them on request.

Gland collection and supply of fish seed :

A total of 1,500 fish pituitary glands were collected from Calcutta fish markets and supplied to 4 different centres of the Institute. More than 25,000 magur fishlets were supplied to the Department of fisheries, Karnataka on request. About 500 common carp fry were supplied to the Air Force Welfare Society, Jaffarpur.

Radio/TV Programme :

Calcutta Doordarshan Kendra telecast a programme **'Mach Chaser Prasar** on 2. 3. 1983. The programme presented under the popular **Pallikatha** services included a film on 'Composite Fish Culture'. The film was followed by an interview on extention problems on fish culture with S/Shri P. Das and U. Bhowmick, Scientists and Suphal Pakira,A Lab to Land Farmer of Chanditala. Shri P. Chatterjee, Programme Officer, LLP conducted the interview.

Calcutta Doordarshan also telecast a programme on the activities of KVK, Kakdwip in their Pallikatha Programme on 1. 6. 1983 based on the material supplied by CIFRI.

Dr. T. Rajyalakshmi, Scientist participated in a dialogue on "Culture of tiger prawn—best methods" broadcast from AIR Vishakhapatnam. □

LAB TO LAND PROGRAMME :

The transfer of technology under the second phase of Institute's Lab to Land Programme was continued in the States of Orissa and West Bengal. Three hundred families benefitted by the programme included 101 scheduled cast, 2 ST and 197 other category farmers.

The highlights of Lab to Land Programme during 1983 were : –

– A demonstration on composite fish culture at Kalyanbati.

– A group discussion on induced breeding and nursery pond management at Alipore village where 27 fish farmers where benefitted.

– Production of 7 lakhs spawn of Indian major carps and 4 lakh spawn of Chinese carps.

– Monoculture of **P. monodon** demonstrated to 10 brackishwater fish farmers of Ganeshnagar, Namkhana, 24-Parganas.

– Under freshwater paddy-cum-fish culture in farmers' ponds, production to the tune of 4,548 kg of paddy, 6,267 kg of hay 782 kg of fish/prawn and horticultural products worth Rs. 1,575·00 were obtained per hectare.

– Under brackishwater paddy-cum-fish culture, production rates upto 2113·5 kg/paddy, 2816 kg hay and 689 kg of fish/prawn were obtained from the plots adopted under Lab to Land Programme. □

□

KRISHI VIGYAN KENDRA AND TRAINERS' TRAINING CENTRE

KVK, Kakdwip :

Krishi Vigyan Kendra, Kakdwip conducted 50 offcampus and 27 on-campus training programmes covering crop production, horticulture, aquaculture and home science. A total of 871 persons were benefitted by the programmes. The highlight of this year's programme was mixed cropping of paddy and fish to get maxium additional returns. During the course of different training programmes, 380 farm families spread in 12 villages were benefitted.

Training courses organised by Krishi Vigyan Kendra (C. I. F. R . I.), Kakdwip.

Duration	Type	Crop production		Horticulture		Fisheries		Home science		Total	
		(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
1-day	On-campus	—	—	—	—	—	—	—	–	—	—
	Off-campus	8	148	9	70	5	76	10	80	32	374
2-5 days	On-campus	1	10	5	59	7	73	5	44	18	186
	Off-campus	3	46	—	—	10	161	5	25	18	232
7-15 days	On-campus	3	30	—	—	3	25	3	24	9	79
	Off-campus	—	—	—	--	—	—	—	—	—	—

(a) Number of courses conducted. (b) Total number of trainees participated.

KVK, Kausalyagang :

Krishi Vigyan Kendra, Kausalyagang conducted 17 on-campus and 7 off-campus training courses on various aspects of fish culture and home science. A total of 382 persons were benefitted by the courses.

Training courses organised during 1983-84 at KVK, Kausalyagang.

Programme	Fish culture		Home Science	
	No. of courses organised	No. of farmers trained	No. of courses organised	No. of farm women trained
On-campus	13	165	4	60
Off-campus	4	119	3	38

TTC, Kausalyagang :

Forty four inservice personnel sponsored by the Orissa State Fisheries Department, 2 Officers from Land Development Bank, Orissa and 7 Extension personnel sponsored by the Bihar State Fish Seed Corporation, Patna were trained in different aspects of fish culture fish seed production and integrated fish farming. In 5 different courses on composits fish culture, fish seed production and integrated farming with 1 to 6 months duration, a total of 82 trainees were trained.

Family and pond survey work was undertaken during the period under report with the help of the TTC staff in 8 villages to acquaint the trainees with the farmers and to train the participants on methodology of survey work for extension in pisciculture at block level. Fifty nine farm families were covered under the programme.

The farmers of Gobardhanpur village were trained in brood fiish maintenance, selection of breeders and induced breeding. During August, 1983, 4·8 lakh spawn of mrigal was produced in this village through simplified induced fish breeding techniques. □

LIBRARY AND DOCUMENTATION

Library

The total holdings of CIFRI Library stood at 5,378 books, 5,917 reprints, 2,236 miscellaneous publications and a stockpile of bound journals, pamphlets, maps, reports etc. During 1983, 213 books, 34 reprints and miscellaneous publications were added to the library. The Institute continued to subscribe 51 foreign and 59 Indian journals. Another 250 titles were received either as gratis or in exchange. Besides maintaining old exchange relationships, 19 new exchange relationships were established during the year. The Institute continued to supply publications to INSDOC, New Delhi and its centres all over the country.

Arrangements for exchange of publications were made with Nagarjuna University ; Fisheries and Crocodile Project, DVC, Hazaribagh, NABARD, etc. for inter library loan of publications.

About 120 technical queries from India and abroad were attended to by the personnel of Documentation Section. In many cases reprints, departmental publications and xerox copies were supplied.

During the year 38 reports on the progress of research were compiled and sent to ICAR. Forty nine scientific papers on different aspects of inland fisheries emanating out of the research conduted in the Institute were sent for publication. Twenty eight scientific papers have been presented by the scientists of the Institute at different symposis/seminars/conferences, etc.

Information :

The Institute has made arrangements for quick dissemination of information to the Scientists by employing modern methods. Selective Dissemination of information, abstracting service, current contents list and information (search) file are the highlights of information activities.

Selective Dissemination of Information (SDI)

The SDI service of the Institute, concerved in the year 1982 has became operational during the year under report. Interest profiles pertaining to the 200 scientific personnel of the Institute are prepared along with subject-wise index. During the year, all the incoming documents were scanned and the prospective users work notified in the prescribed proforma. The feedback data collected are being processed. SDI service ensures that all CIFRI scientists are kept notified about the nascent literature in their fields of specialisation.

Indian Fisheries Abstracts :

Publication of quarterly Indian Fisheries Abstracts was continued. Informative abstracts of all papers covering the entire gamut of fisheries in Indian have been prepared with proper indexing. This publication forms a valuable guide to the scientific community in general and CIFRI scientists in particular.

The Institute also published the **Library accession list** and **current contents list**

The following departmental publications were brought out by CIFRI during the year ;—

1) Annual Report, 1982

2) Indian Fisheries Abstracts 18(1-4), 1979.

3) CIFRI Newsletter 5(3-6) May-December, 1982 and 6(1-2) January-April, 1983.

4) Contents List Nos. 1-12 Jan-Dec., 1981.

5) Bulletin No. 36 'Pattern of energy flow in freshwater tropical and subtropical impoundments' by A. V. Natarajan & V. Pathak.

6) Report on 5th Workshop, All India Coordinated Research Project on Brackishwater Fish Farming, March 8 & 9, 1983 **(Mimeo).**

7) Report on 7th Workshop, All India Coordinated Research Project, Ecology and Fisheries of Freshwater Reservoirs March 9-10, 1983 **(Mimeo).**

8) Final Report 1971-81, All India Coordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs, Rihand Centre. (Inland Fisheries Research Information Series 2, May, 1981).

9) Final Report, 1971-81, All India Coordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs, Nagarjunasagar Centre. (Inland Fisheries Research Information Series 3, March, 1983).

10) Lecture note on composite fish culture and its extension in India for Senior Aquaculturists from Asia and the Pacific Region (Session 1983-84). (Regional Lead Centre of ICAR, UNDP/FAO Project, FARTC, Dhauli, Kausalyagang, Orissa).

11) Rural prosperity through rural aquaculture—A profile of CIFRI's pioneering role in the development of production technologies in aquaculture **(Mimeo).**

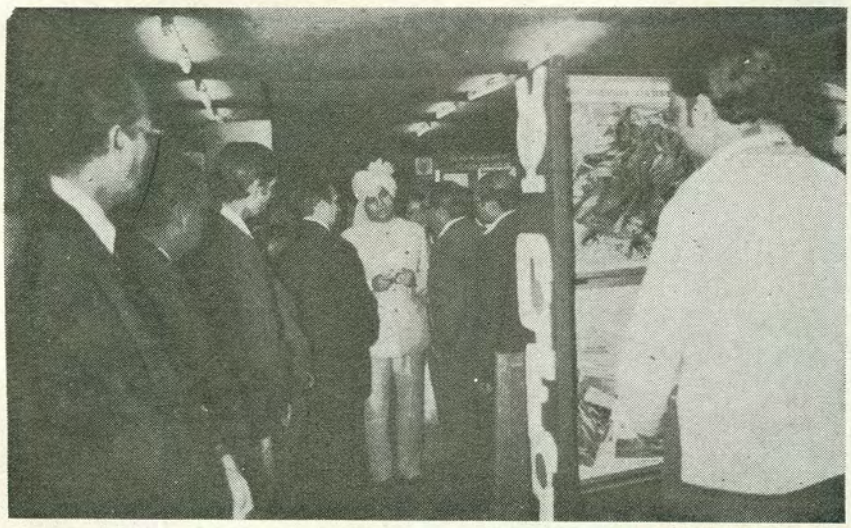
□

Honourable Minister Rao Birendra Singh Visits CIFRI

Shri Rao Birendra Singh, Hon'ble Minister for Agriculture and Rural Development, Government of India and the President ICAR visited CIFRI on 28th December, 1983. On his arrival, the Minister was given a rousing welcome at the Institute.

Above : Soon after his arrival Shri Rao Birendra Singh had a discussion with Dr. A. V. Natarajan, Director, CIFRI and his senior colleagues.

Middle : Later, while addressing the members of CIFRI family, the Minister described CIFRI as an Institute of high national importance.



Below : The Minister also had a visit to the CIFRI exhibition pavilion at Calcutta maidan.

Workshop on Brackishwater Fish Farming and Reservoir Fisheries

The Fifth Workshop on All India Co-ordinated Research Project on Brackishwater Fish Farming and the Seventh Workshop on Reservoir Fisheries were held at Barrackpore during 8-10 March 1983.

Top : Dr. A. V. Natarajan, Director, CIFRI, wel-coming the scientists and guests to the workshops at the inaugural session.

Middle : Shri B. C. Sharma, Secretary to the Dept. of Fisheries, Govt. of West Bengal inaugurated the joint session. Progress of work at various centres was discussed in various technical sessions and the work programme for each centre was finalised.

Below : Presentation of technical report of Bhavanisagar Centre (Reservoir Fisheries) in one of the sessions.

Sewage-fed plots gave a yield of 294 kg/ha of the freshwater prawn and 163 kg/ha of silver carp when reared alongwith paddy planted along the periphery of the plot. The yield of paddy was 1,700 kg/ha. Institute's sewage-fed paddy-cum-fish culture plots at Rahara Centre is shown in the picture.

Paddy-cum-fish culture adds a new dimension to the utilization of low lying saline tracts in lower Sunderbans. From KVK (Kakdwip) adopted Lab to Land plots 2,500 kg of paddy and 2,250 kg of fish under freshwater phase and 1,800 kg of paddy and 80 kg of tiger prawn under brackishwater phase was obtained from one hectare area. In the picture, a harvest is under progress in one of the plots.

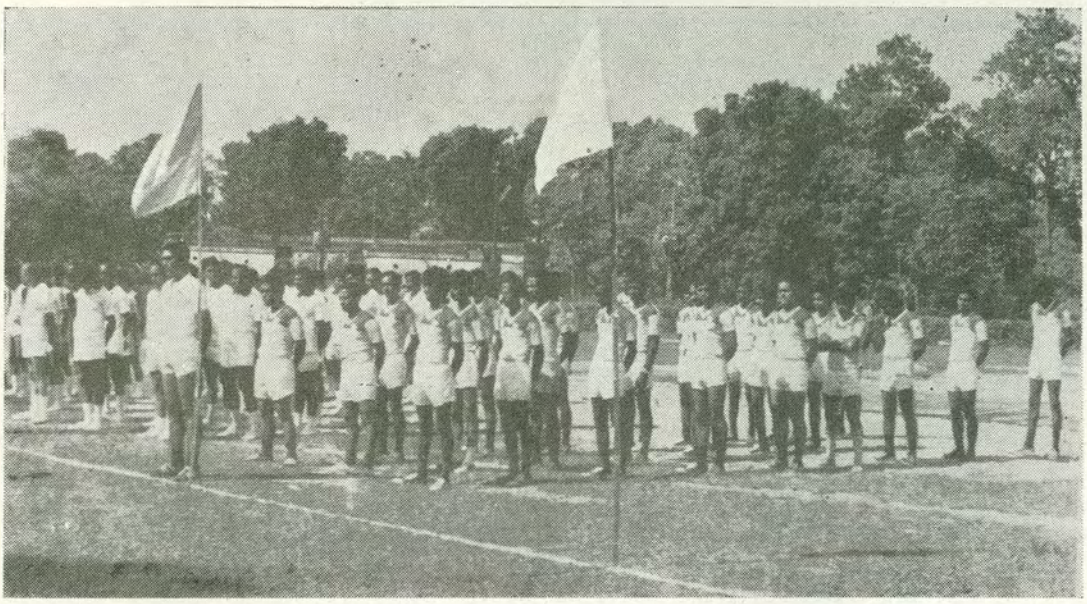
CIFRI's pen culture experiments at Manika man (ox-bow lake), Muzaffarpur recorded a production of 400 kg carps from a 0.1 ha pen in six months. The technology holds immense promise for additional sources of fish production from ox-bow lakes and wetlands. The picture shows a harvest from one of the pens.

Rearing of the brine shrimp, *Artemia* and mass production of its cysts was achieved from the salterns at Digha, West Bengal (picture). Vast stretches of salterns are available at both the coasts of the country. The rearing technique if adopted widely can thus dispense with the importof the highly sought after *Artemia* cysts for the rearing of prawn larvae.

Extension

One hundred families have been adopted by the Extension Section under the Lab to Land Programme in fish clture. Growth of fish in one of the adopted pond is studied by the Extension scientists. Dr. D. J. Roy, Zonal Co-ordinator, Lab to Land Programme is also seen in the picture.

Sports



A 53 member CIFRI contingent took active part in the 3rd ICAR East Zone sports meet held at ILRI, Ranchi. The team secured 3rd position among the Institutes participated in the meet.

The technology of composite fish culture was demonstrated in a pond at Raj Bhavan Campus, Patna. The production obtained was 5292 kg/ha in eleven months. The picture shows the stocking of the pond with fish seed.

The KVK (CIFRI) Kakdwip imparts knowledge in agriculture, family welfare, etc. In the picture, a demonstration on applied nutrition programme to the women of the families adopted by the KVK is in progress.

VISITORS

The following is a list of other distinguished personalities and scientists from different parts of the country and abroad who visited the Institute and its regional centres. They were taken round the research laboratories, experimental and demonstration centres to apprise them of the achievements of the Institute.

Acharya, R. M. (Dr.)	Dy. Director General (Animal Sciences), ICAR, New Delhi.
Agbalatobe, T. I.	Ministry of Agric. & Coop., Lagos, Nigeria.
Agbigay, Celestina N. (Mrs.)	Biological Experimental Station, Pili, Philippines.
Ayinla, O. H.	Institute of Oceanography & Marine Research, Lagos, Nigeria.
Ahmed, M.	Director of Fisheries, Department of Fisheries, Govt. of Assam, Gauhati.
Alam, A. (Dr.)	Assistant Director-General (Agric. Engg.) ICAR, New Delhi.
Apanpa, A. D. D.	Department of Fisheries, Lagos, Nigeria.
Bandopadhyay, A. K. (Dr.)	Central Soil Salanity Research Institute, Canning.
Bapat, S. V. (Dr.)	Joint Director, Central Marine Fisheries Research Institute, Cochin.
Bhuiya, N. I. (Dr.)	Acting Head of Soil Chemistry Division, Bangladesh Rice Research Institute, Jaydevpur, Dacca.
Bora, L. C. (Dr.)	Associate Director of Extension Education, Assam Agricultural University, Jorhat.
Borthakur, D. N. (Dr.)	Director, ICAR Research Complex for N. E. H. Region, Shillong.

Bose, T. K. (Dr.)	Prof. & Dean of Hort., Bidhan Chandra Krishi Viswavidyalaya, Mohonpur, Kalyani.
Bounmy, (Mr.)	Laon, Vientine.
Chakraborty, A. C. (Dr.)	Director, Jute Technological Research Laboratory Tollyganj, Calcutta.
Chakraborty, A. C. (Dr.)	Dy. Secretary (Fisheries) to the Govt. of W. B., Calcutta.
Chakraborty, P. C.	Jt. Director of Fisheries, Govt. of West Bengal, Calcutta.
Chatterjee, S. N.	Jt. Director of Fisheries, M.P.
Chaudhury, T. M. (Dr.)	Dy. Director (Vet.) Govt. of West Bengal, Calcutta.
Dasgupta, S. K.	Dy. Director of Fisheries, Govt. of Assam, Gauhati.
Das, Upendra Chandra	Hon'ble Minister for Fisheries, Panchayat & Community Development, Govt. of Assam, Gauhati.
Dinneweth, Christian	Agricultural Engineer, State University of Ghent, Belgium.
Dubey, G. P. (Dr.)	Ex-Director of Fisheries, Bhopal, M. P.
Janos Olah (Dr.)	FAO Consultant to India, Fisheries Researeh Institute, Searvas, Hungary.
Fernando, S.	Director of Fisheries, Dept. of Fisheries, Sri Lanka.
Field, Irene M. (Dr.)	Sr. Fellowship Officer, FAO, Rome.
Garrity, D. P. (Dr.)	International Riee Research Institute, Manila, Philippines.
Gautam, O. P. (Dr.)	Director General, ICAR, New Delhi.
Guha, H. (Dr.)	Director of Animal Husbandry, Govt. of West Bengal, Calcutta.

Guha, Kamal	Hon'ble Minister for Agriculture, Govt. of West Bengal, Calcutta.
Guignard, Francois (Miss)	National Institute of Rural Engineering and Water & Forestry, Paris, France.
Gupta, S. (Dr.)	Additional Director of Animal Husbandry, Govt. of West Bengal, Calcutta.
Gopalakrishnan, V. (Dr.)	Chief Technical Advisor, FAO/UNDP, Chilanga, Zambia.
Hazarika, L. P.	Deputy Minister of Fisheries, Govt. of Assam, Gauhati.
Hup, Lim Koon	Mardu Kubang Karanzi, West Malasia.
Ingle, G. S. (Dr.)	Professor, Dept. of Agricultural Engineering, Indian Institute of Technology, Kharagpur.
Ismunadji, M. (Dr.)	Bogor Research Institute for Food Crops, Bogor, Indonesia.
Jeswani, L. M. (Dr.)	Assistant Director-General (FC), ICAR, New Delhi.
Juurikkala, Jyri	Helsinki University, Helsinki, Finland.
Kaviraj, Anilava (Dr.)	Department of Zoology, Kalyani University, Kalyani.
Khomtong, Nipansri (Mrs.)	Rangist Rice Research Centre, Pathuthan, Thailand.
Kibria, Golam	Sr. Scientific Officer, Dept. of Fisheries, Bangladesh.
Kuila, R. K. (Dr.)	Dean, Veterinary Science, Bidhan Chandra Krishi Viswa Vidyalaya, Mohanpur, Kalyani.
Kundu, P. V. (Dr.)	Director of Veterinary Service, Govt. of West Bengal, Calcutta.
Lavarde, Patric	National Institute of Rural Engineering and Water & Forestry of Paris, France.

Malakar, Bina Rani	Fisheries Development Authority, Kusla Lumpur.
Malhotra, M. R.	Sr. Programme Officer, FAO/UNDP, New Delhi.
Mallik, S. K.	District Fisheries Development Officer, Govt. of Assam, Gauhati.
Mamaril, C. P. (Dr.)	International Rice Research Institute, Manila, Philippines.
Mandal, L. N. (Dr.)	Vice-Chancellor, BCKVV, Mohanpur, Kalyani.
Mitra, G. N.	Fishery Consultant, Cuttack.
Moitra, D. N. (Dr.)	Reader, Faculty of Vety. & Animal Science, BCKVV, Mohanpur, Kalyani.
Mondal, A. K. (Dr.)	Director, Jute Agricultural Research Institute, Nilgunj, Barrackpore.
Mondal, B. (Dr.)	Director of Agriculture, Govt. of west Bengal, Calcutta.
Motiramani, D. P. (Dr.)	Vice-Chancellor, AAU, Jorhat.
Mukherjee, D. (Dr.)	Add. Director (Agricultural Research) Govt. of West Bengal, Calcutta.
Nair, J. S.	Asstt. Fishery Officer, Arunachal Pradesh.
Nelle, H. U. (Dr.)	International Rice Research Institute, Manila, Philippines.
Neuvoneu, Jorma.	Helsinki University, Helsinki, Finland.
Opulah, E. O.	Ministry of Natural Resources, Port Harcourt, Nigeria.
Oto, Tola	Ministry of Natural Resources, Alkura, Nigeria.
Panda, P. B. (Dr.)	Dy. Director (A. H.), Govt. of West Bengal, Calcutta.
Pande, H. K. (Dr.)	Director, CRRI, Cuttack.

Piloquet, Jean-Mare	National Institute of Rural Engineering and Water & Forestry, Paris, France.
Prasad, C. (Dr.)	Assistant Director General (CDN), ICAR, New Delhi.
Prasad, Raghu (Dr.)	Emeritus Scientist, Central Marine Fisheries Research Institute, Madras.
Price, C. R. (Dr.)	Technical Cooperation, Box 6079, Dhaka, Bangladesh.
Randhawa, N. S. (Dr.)	Deputy Director-General (S), ICAR, New Delhi.
Roychoudhury, Subhas	Agricultural Reporter, Jugantar, Calcutta.
Roy, D. J. (Dr.)	Zonal Coordinator, (Lab to Land Programme) BCKVV, Mohanpur, Kalyani.
Roy, G. L. (Dr.)	Project Director, Bidhan Chandra Krishi Viswa Vidyalaya, Mohanpur, Nadia, West Bengal.
Rumeau, J. G. (Dr.)	FAO Representative in India, New Delhi.
Samaddar, C. R.	Secretary to the Govt. of Assam, Dept. of Fisheries, Labour & Veterinary, Gauhati.
Santiago, Alfredo C. (Jr.)	SEAFDEC Aquaculture Dept., Tigbauan, Iloilo, Philippines.
Sen, A. (Dr.)	Toklai Experimental Station, Jorhat.
Sen, S. (Dr.)	Prof. of Genetics & Plant Breeding & Dean, BCKVV, Mohanpur, Kalyani.
Shamshuddin, M. (Dr.)	Prof. of Biology, Dept. of Veverinary Science, Birsa Agticultural University, Ranchi.
Sharma, P. K. (Dr.)	Director of Post Graduate Studies, AAU, Jorhat.
Shenoy, P. V.	Secretary (Agriculture) Govt. of West Bengal, Calcutta.

Shetty, H. P. C (Prof.)	Director of Instruction, University of Agricultural Sciences, College of Fisheries, Mangalore.
Singh, G. B. (Dr.)	Assistant Director-General (Agro), ICAR, New Delhi.
Singh, Panjab (Dr.)	Assistant Director-General (IDA), ICAR, New Delhi.
Singh, Ranavir	M. P. (Lok Sabha), New Delhi.
Singh, Rao Birendra	Hon'ble Union Minister for Agriculture & President, ICAR, New Delhi.
Somsak,	Laos, Vientine,
Sopha,	Laos, Vientine,
Sriharan, T. P. (Dr.)	Assistant Director-General (PP) ICAR, New Delhi.
Srivastava, D. S.	Officer-in-Charge, CPRI Regional Station, Patna.
Srubanti	Laos, Vientine.
Sundararaj, B. I. (Dr.)	Professor of Zoology, Delhi University, Delhi.
Welreratne, Anura	Secretary, Ministry of Fisheries, Govt. of Sri Lanka, Sri Lanka.

CONFERENCES AND SYMPOSIA

The following are the important meetings organised/hosted by the Institute during 1983.

Vth Meeting of ICAR Regional Committee No. II—held during 4 & 5th February, 1983.	Hosted by Central Inland Fisheries Research Institute, Barrackpore.
Sixth Workshop on All India Coordinated Research Project on Composite Fish Culture and Fish Seed Production—held during July 1 & 2, 1983.	Organised by Freshwater Aquaculture Research & Training Centre, Dhauli,
7th Workshop on All India Coordinated Research Project on Ecology & Fisheries of Freshwater Reservoirs-held during 9 & 10 March, 1983.	Central Inland Fisherihs Research Institute, Barrackpore, „
5th Workshop All India Coordinated Research Project on Brackishwater Fish Farming—held during 8 & 9 March, 1983.	-do- „

The scientists of the Institute participated in various conferences/symposia/seminars and meetings during 1983 wherein they presented their research findings and exchanged views with the delegates. List of scientists who participated and presented papers in such gatherings is furnished below. :—

Conferences/Symposia	Place	Title of the paper presented	Authors
"National Seminar on Environment" held during 20 to 23 January, 1983.	Environmental Planning & Coordinated Organisation, Bhopal.	Patterns of energy utilization and productivity in beel ecosystem.	V. Pathak, S. B. Saha & M. J. Bhagat.
"International Conference on Water Hyacinth" held during February 7-11, 1983.	Regional Research Laboratory, Hyderabad.	Observations on chemical control of water hyacinth (*Eichhornia crassipes*) for better prospects of fish culture.	T. Ramaprabhu *et al.*
		Chemical control of water hyacinth—Its economic significance and fertilizer value in fish culture.	S. Patnaik & K. M. Das.

National Seminar on "Cage and Pen Farming" held during 30 & 31 March, 1983.	Tamil Nadu Agricultural University, Fisheries College, Tuticorin.	Observations on cage culture of *Heteropneustes fossilis* in nylon cages at Ulubari fish farm, Gauhati (Assam).	M. P. S. Kohli & S. C. Pathak.
		Pen farming—Utilizing marginal areas of beels in Assam for carp culture.	Y. S. Yadava *et al.*
		Culture of air breathing fishes in cages and pens.	V. K. Murugesan & S. Parameswaran.
"International Conference on Development and Management of Tropical Living Aquatic Resources" held during 2-5 August, 1983.	University of Agriculture, Malayasia.	Cage culture of common carp and silver carp in Sankey tank, Bangalore (Karnataka) India.	B. V. Govind *et al.*
		Solar energy transfer efficiency of a natural waste stabilization pond at primary producer level in River Ganga stretch at Bhagalpur.	A. K. Laal, S. K. Sarkar & A. Sarkar.
		Role of algae in manipulating pH, carbonate, bicarbonate and free CO_2 during their photosynthetic activity in an ox-bow lake of River Ganga system at Bhagalpur.	A. K. Laal, A. Sarkar & S. K. Sarkar.
"Management of coastal saline soils of Orissa & West Bengal" held during 7-8 April, 1983.	Orissa State Co-op. Marketing Federation Ltd., Bhubaneswar.	A pilot study on Paddy-cum-brackish-water aquaculture in coastal saline soils.	G. N. Chattopadhyay.
National Seminar on "Management of Natural and Built Environment" held during 18-19th April, 1983.	School of Planning and Architecture, New Delhi.	Environmental pollution and its abatement and control to protect inland fishery resources of the Country.	A. V. Natarajan & B. B. Ghosh.
Seminar on "Production Programmes on Inland Fisheries in Karnataka" held in May, 1983.	Veterinary College, Hebbal, Bangalore.	The status of composite fish culture in Karnataka.	B. V. Govind.
All India Seminar on "Effects of Pesticides on Aquatic Fauna" held during 21 to 25 June, 1983.	Govt. Postgradute College, Mhow, M. P.	Dynamics and impact of pesitcides in aquatic environments.	A. V. Natarajan & H. C. Joshi.

		Size related toxicity of carbaryl and its metabolitc, I-Naphthal to the fish *C. carpio* Communis Linn.	R. S. Panwar *et al.*
Centenary Seminar on "Conservation in Developing Countries—Problems and Prospects" held during 6-10 December, 1983.	Bombay Natural History Society, Bombay.	Culture of air-breathing fishes using organic waste as feed.	D. Kumar, B. Venkatesh & P. V. Dehadrai.
National Workshop on KVK held during 29 to 31 October, 1983.	Ramakrishna Mission Ashram, Nimpith.	Position paper on KVK, Kakdwip ; Position paper on KVK, Kausalya-gang & Position paper on TTC in freshwater fish culture at Kausalya-gang.	Participants A. V. Natarajan V.R.P. Sinha & N. C. Basu.
"Fourth All India Seminar on Ichthyology" held during 29th October to 2nd November, 1983.	D. A. V. College, Dehradun.	On the retardation of growth of abnormal fry, fingerlings and table size specimens of *Labeo rohita* (Ham.) in village ponds.	B. N. Singh *et al.*
		Fishery potential of high mountain lakes of Kashmir Himalayas.	K. K. Vass & H. S. Raina.
		Sudden fish kill associated with bacterial bloom in an undrainable rural fish pond.	Radheyshayam *et al.*
"National Workshop on Development of Inland Fishery Resources" held during 1-3 November, 1983.	Indian Institute of Management, Ahmedabad.	Review of database for planning and control.	K. K. Ghosh.
"International Conference on Biometeorology" held during 26-30 December, 1983.	New Delhi.	Role of inorganic phosphate in the life cycle of phytoplankton in beel ecosystem.	V. Kolekar *et al.*
International Congress of Genetics held during 12-21 December, 1983.	New Delhi.	——	Participated by George John.
Seminar or "Production Programme on Inland Fisheries in Karnataka" held in November/December, 1983.	University of Agricultural Sciences, Bangalore.	Air breathing fish culture in Karnataka—An overview.	S. Parameswaran.
International Symosium on Recent Advances in Life Sciences held during 29 to 31 December, 1983.	Magadh University Bodhgaya.	Toxicity of 2-methoxy ethyl mercuric chloride, copper sulphate and mercuric chloride to freshwater snail *Viviparus Bengalensis* (Swainson).	R. N. Seth *et at.*

National Workshop on Inland Fishery Resources, 1-3 November, 1983.	11M, Ahmedabad.	—	Participated by A. V. Natarajan and S. Paul.
"7th Conference of Agricultural Research Statisticians of ICAR Institutes, Agricultural Universities and other Central & State Depts." held during 28 to 30 July, 1983.	University of Agricultural Sciences, Hebbal, Bangalore.	—	Participated by K. K. Ghosh.
"53rd Annual Session of the National Academy of Sciences" held during 27-29 October, 1983.	National Institute of Oceanography, Panaji, Goa.	Some ecological considerations of the Rihand Reservoir polluted by industrial wastes of Kanoria Chemicals, Renukoot (U. P.), India.	K. Chandra *et al.*
7th Workshop All India Coordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs—held during 9 & 10 March, 1983.	Central Inland Fisheries Research Institute, Barrackpore	Thermal and chemical effluent pollution in Rihand reservoir, District—Mirzapore, Uttar Pradesh.	K. Chandra *et al.*
		Productivity of reservoirs as a function of hydrological and ecoenergetic parameters.	V. Pathak.
		Fishing in reservoir—Certain economic considerations.	S. Paul and V. V. Sugunan.

The Director and other experts in various disciplines have delivered lectures at IIT Kharagpur and College of Agricultural Banking, Reserve Bank of India, Pune. The details are given below :—

Name of the course	Place	Topic of lecture	Scientist
Short term course on "Agricultural Engineering (Fish Farm Construction)" held on 3rd January, 1983.	Indian Institute of Technology, Kharagpur.	On some engineering aspects of design and construction of fish pond (Lecture script).	A. V. Natarajan.
"Fourth Programme on Financing Fishery" held during May 30 to 4 June, 1983.	College of Agric. Banking, Reserve Bank of India, Pune.	Techno-economic apsraisal of coastal aquaculture.	Apurba Ghosh.
		Techno-economic appraisal of paddy cum-fish culture.	Apurba Ghosh.

		Techno-economic appraisal of culture fishery-carps, cat fish and murrels.	S. Paul.
		Inland fishery resourees—culture and capture fishery-water resources and their distribution—requirements of fish seed.	B. N. Saigal.
"Fifth Programme on Financing of Fishery" hed during 12 to 24 September, 1983.	College of Agricultural Banking, Reserve Bank of India, Pune.	Inland fishery resources-culture and capture fisheries—water resources and their distribution-requirements of fish seed.	B. N. Saigal.
-do-	-do-	Marketting/storage and processing aspects of inland fishery projocts.	B. N. Saigal.
-do-	-do-	Techno-economic appraisal of paddy-cum-fish culture/coastal aquaeulture.	Apurba Ghosh.
-do-	-do-	Economics of induced breeding-economics of financing a hatchery unit.	Apurba Ghosh.

FINANCE

The provision of funds for the financial year April 1983 to March 1984 was as under.

Non Plan—	1,68,45,000
Plan—	28,20,000
Total—	1,96,65,000

Against the above provision, the expenditure from 1-4-83 to 31.12-1983 was as follows :—

Non-Plan—	1,24,75,787.04
Plan—	9,71,531.44
Total—	1,34,47,318.48

2. PROGRESS OF RESEARCH

RESEARCH IN HAND

Project No. FA/B/1 : Ecology and productivity of fish culture ponds.

Personnel : V. R. P. Sinha, D. K. Chatterjee, C. S. Purushothaman and Radheshyam.

Duration : 1983-1988

Location : Dhauli

A survey of 32 rural undrainable fish ponds in the districts of Puri and Cuttack was carried out to form base for future work under the project.

The age of the ponds ranged from 1 to 15 years and the area of water surface from 0.02 to 2.13 ha. Water depth varied from 14 to 144 cm. Macrophytes dominated in many of the ponds, appearing commonly in shallow nursery ponds. *Eichhornia crassipes* and *Pistia stratiotes* were the common species of floating vegetation. Water colour was greyish-brown in most of the ponds indicating low phytoplankton density. Planktonic detritus varied between 1900 and 19,300 μ/ml, bacterioplankton between 0.2 and 12.9 million/ml and seston from nil to 347 μ/1. Sediment organic carbon varied between 3.2 and 47.7 mg/g. Sediment detritus between 40 and 1400g/m^2 , benthic animals upto 2660μ/m^2 and zoobiotecton upto 2838μ/m^2 . Species of *Microcystis*, *Oscillatoria* and *Euglena* were found to be the common phytoplankton, whereas, *Ceriodaphina*, *Keratella*, *Diaptomus*, *Cyclops*, *Brachionus* and *Bosmina* were common among zooplankton. Chironomids, oligochaetes and gastropods formed the zoobenthos, and ostracods, coelenterates, gastropods, shrimps and insects constitu ted the zoobiotecton.

The ponds surveyed, showed pH ranging from 7.0 to 8.8 and alkalinity from 52 to 244 mg/1. NH_4-N concentration was generally below 20 μg/1 and that of NO_3-N below 5 μg/1, indicating that nitrogen is a limiting factor. PO_4-P was present upto 52 μg/1. The sediment was found to be rich in nutrients in sharp contrast to the water column.

One of the above ponds was studied in more details to enumerate the major groups of bacteria taking part in the nutrient cycles in water and the sediment. The studies indicated high nutrient concentration in sediment and a low oxygen level. The diurnal variations in the nutrient cycles, nutrient uptake and oxygen level were also studied. An experiment to study the decomposition process in the water column and sediment layer indicated that the sediment-water interface was the most active zone.

Presently two undrainable ponds are being studied in detail. Water qualities of these ponds indicated that pH remained alkaline (7.6-8.2), total alkalinity ranged from 100-112 ppm, dissolved inorganic nitrogen from 0.02-0.05 ppm and dissolved phosphate from 0.02-0.04 ppm.

pH, available N, P_2O_5 and organic carbon content of the bottom sediment of these ponds were 6.9-7.0, 72.1-77.9 mg/100g, 0.8-1.6 mg/100g and 1.38-1.44%, respectively.

Oligocarbophilic bacteria in water and sediment were from 1320 to 1730 μcm^{-3} and from 2,30,000 to 3,90,000 $gm.^{-1}$ on wet weight basis respectively.

Project No. FA/B/2 : Ecology of sewage-fed fish ponds.

Personnel : G. N. Chattopadhyay, A. C. Nandy, N. M. Chakraborty, P. K. Saha & B. Ghosh.

Duration : 1983-1986.

Location : Rahara (West Bengal).

Ecological studies on sewage-fed ponds were initiated in June 1983. The study intends to correlate the important physico-chemical parameters with biological productivity before and after the intake of sewage effluents into the ponds. The inorganic nitrogen and phosphorus values increased to 4.7 and 0.9 ppm after the application of sewage effluent (BOD_5 550 ppm) from the initial values of 0.2 and 0.04 ppm and then decreased gradually to 0.04 and 0.08 ppm respectively. The BOD values decreased from 25.0 to 5.0 ppm. The total alkalinity ranged between 280 and 190 ppm while pH values remained throughout the period within 7.6 to 7.8. Despite the use of primary sewage, D. O. level remained favourable between 3.0 and 8.4 ppm. The net primary production increased to 1162.5 $mgC/m^3/h$ after one week of application of sewage against initial value of 187.5 $mgC/m^3/h$ and decreased to the initial level after 4 months of sewage application.

The monthly average plankton population ranged from 550 to 5,19,262 u/l with the minimum and maximum in November and July-August respectively. Phytoplankton dominated throughout the period except in November when the zooplankton occured in large numbers. The phytoplankters belonged to three major classes. Cyanophyceae the most important group was represented mainly by species of *Lyngbya* (80864 u/l), *Anacystis* (184832 u/l) and *Oscillatoria* (34656 u/l) closely followed by Chlorophyceae (188390 u/l) and Euglenophyceae (2310 u/l) respectively. The phytoplankters recorded in the order of abundance were *Anacystis* sp, *Lyngbya* sp, *Merismopedia* sp (Cyanophyceae) ; *Scenedesmus*, *Closterium* and *Crucigenia* sp (Chlorophyceae) ; and *Euglena* sp and *Phacus* sp (Englenoideae).

The zooplankters belonged to three groups of which Rotifera was the most abundant having maximum representation in terms of species. This was followed by Copepoda and Cladocera. The dominant species recorded in their order to abundance were *Brachionus*, *Keratella*, *Filinia*, *Cyclops*, *Diaptomus*, *Moina*, *Daphnia* and *Ceriodaphnia*.

The qualitative estimation of periphyton community was initiated in September 1983. In terms of habit the following chief categories could be distinguished.

Prostrate of heterotrichous green algae (e.g. *Stigeoclonium* sp), unicellular algae, mostly diatoms attached by general mucilage (e.g. *Rhopalodia* sp., *Selenastrum* sp., *Scenedesmus* sp.) ; colonial with individuals at the end of branched stalks (e.g. *Epistylis* sp & *Vorticella* sp); and ciliates by mucilageneous (e.g. *Lacrymana* and *Bursaria* spp).

The most dominant species recorded were *Epistylis*, *Vorticella* and *Stigeoclonium* throughout the period of study.

The abundance of bottom macrofauna (up to a depth of 5 cm) varied from 48/m² (November) to 2507/m² (July-August). The peak of bottom biota (July-August) coincided with the induction of sewage into the pond. Chironomid larvae alone dominated the bottom fauna followed by oligocheate worms and molluscs.

Project No. FA/B/3 : Studies on digestive physiology of carps.

Personnel : D. N. Swamy, K. Kumar and S. N. Mohanty.

Duration : 1981-85.

Location : Dhauli.

Under this project three types of sinking dry pellet feed were prepared using laboratory model (CPM, USA) pellet mill.

i) Chicken feed containing 19.32% protein and 4.5% fat,

ii) Groundnut oil cake+rice brean+vitamins+minerals+trace elements containing 23.54% protein and 4.5% fat and

iii) Groundnut oil cake+rice bran containing 22.8% protein and 4.3% fat.

These pelleted feeds were tested on rohu fingerlings to find out the stability, acceptability, growth and total digestibility. The maximum growth level was recorded with groundnut oil cake+rice bran+vitamins+minerals+trace elements from 15.3g to 45.6g (10 nos.) followed by GOC+RB from 15.4g to 38.6g and chicken feed from 14.3g to 35.2g. While further work is needed to know the total digestibility, test diets prepared with aquatic weed protein and rice bran, oil cake, vitamins and minerals will be evaluated in terms of their water stability, acceptability, on the effect of fish growth and their digestibility.

Project No. FA/B/4 : Endocrinological studies of Asiatic carps, inhabiting running and confined waters.

Personnel : H. A. Khan, V. R. P. Sinha, R. C. Das, A. K. Sahu, S. K. Sarkar and G. C. Sahoo.

Duration : 1983-1988.

Location : Dhauli.

Histological studies of internal tissue of *Labeo rohita*, collected from ponds, revealed correlative cyclic changes in gonads and interrenals. The activities of interrenal cells increased with the progress of the process of gonadal maturation and decreased considerably during regression and resting phase. The mean nuclear diameter of the interrenal cells was highest (19.2) in July, the peak breeding month and lowest (12.8) in December.

Gonads of silver carp were studied round the year. Histological preprations revealed that ova were in the 1st and 2nd stages of maturity during the period from January to March and measured 50-175 μm. From May onwards, ova showed a many fold increase in the diameter (75-950 μm) and were in the 3rd and 4th stages of maturity. During June-September the highest diameter of ova egg was found to be 1000 μm, (IV-VI

stages of maturity) During October mostly ova were in the reabsorbing stage. This process continued upto December.

Experiments on gonadal hydration were conducted in *Labeo rohita* comprising of four males and 4 females in the water medium consisting of 50% tapwater+50% deionised water in the first set and 100% deionised water in the second set. The fishes died in one experiment. However, the fishes in the second experiment showed considerable gain in weight and the males put in 100% deionised water showed heavily oozing of milt.

With a view to produce common crap as donor fish for standardising the dosage of pituitary on the basis of quantitative content of gonadotropins, 5 nursery ponds (each 0.02 ha) were prepared. One with organic fertiliser, one with inorganic fertiliser and two with combination of both fertilisers on equivalent nitrogen basis i.e. 120 kg N/ha/year. In addition, supplementary feed of rice bran and groundnut oil cake in equal proportion was provided @ 6% of the body weight of stocked fish in two ponds where both organic and inorganic fertilisers were given. One pond was kept as control, in which no feed or fertiliser was given. All 5 ponds were stocked with common carp fingerlings (av. 60g) @ 5000/ha in January 1983. In ponds where both fertilisers and feeds were given, common carp recorded on an average weight of 138 and 233g respectively, followed by 125g in pond with organic fertiliser alone and 110g with inorganic fertiliser alone. In control ponds the fish showed the poorest growth i. e. 85g only.

The total fish production and survival rate in respective ponds were 414 kg—6% ; 700 kg—60% ; 270 kg—26% and 385 kg—70%. The culture period was 7 months. The control pond gave 170 kg with 40% survival.

Project No. FA/B/5 : Cytological, morphological and biological investigations of carp hybrids.

Personnel : R. K. Jana and P. V. G. K. Reddy.

Duration : 1983-1986.

Location : Dhauli.

A total 4,000 fry of rohu-catla hybrid were raised from a batch of 0.3 lakh of hybrid spawn.

Rohu-catla hybrid with an average length and weight of 13.6 mm/32.8 mg were reared in four 0.02 ha nurseries for 3 months at a stocking density of 50,000/ha. Supplementary feeding with GOC+RB in the ratio of 1 : 1 and fertilisation with nitrogenous fertiliser only were resorted in two ponds for each set keeping the amount of nitrogen added either as feed or fertiliser constant.

The average length and weight of fingerlings with fertiliser and supplementary feed, varied from 74.8-77.0 mm and 4.1-4.8g with a survival of 48.2-50% and 84.0-124.0 mm and 6.5-23.2g with a survival of 18.2-52.9% respectively.

Problem No. FA/B/6 : Studies on the digestive enzymes of Rana hexadactyla from Bengal.

Personnel : A. K. Mondal and J. J. Ghosh.

Duration : 1980-1984.

Location : Kalyani.

Work programme was not carried out during the year.

Project No. FA/B/7 : Genetical characteristics of carp hybrids.

Personnel : S. K. Mukhopadhyay, S. K. Saha.

Duration : 1983-85.

Location : Rahara.

Rohu male X mrigal female and their reciprocal cross hybrids were procured and are being reared. Muscle protein was extracted at different pH and serum was also collected from the fingerlings of mrigal male X rohu female hybrid. These are preserved for polyacrylamide gel electrophoresis.

Project No. FA/A/1 : Breeding of culturable freshwater fishes.

Personnel : K. K. Sukumaran, P. V. G. K. Reddy, S. D. Gupta, D. N. Swamy, R. C. Das, R. K. Jana, A. K. Sahu, C. D. Sahoo, K. C. Pani & H. K. Muduli.

Duration : 1981-1984.

Location : Dhauli.

Rearing of brood fishes :

Rohu was stocked @ 1000 kg/ha in two ponds of 0.1 ha each in mid-March, 1983 and were fed @ 3% body weight with a mixture of groundnut oil cake and rice bran (1 : 1) till the end of May. Subsequently from June, in one pond, formulated feed comprising of GOC, RB, calcium diphosphate, multivitamins, trace elements and vitamin E & C were provided while in the other pond the conventional feed (GOC and RB) was continued.

In another two ponds (III & IV) of the same size catla was stocked @ 400 kg/ha and supplementary feed was provided as in the case of rohu. In the 5th pond silver carp was stocked @ 750 kg/ha and was fed with formulated feed as mentioned above. In the formulated feed the protein level was kept at 30%, carbohydrate 35% and fat 11%.

Induced breeding of rohu did not reveal any difference in fish, fed with formulated and conventional feed, the response being about 40%.

In case of catla slightly higher response was observed in fish fed with formulated feed. However, the number of sets tried was too few to draw any conclusion and percentage of fertilisation and consequently recovery of spawn was low.

In the case of silver carp 90% success was obtained in fish fed with formulated feed as against 80% in fish obtained from reservoir.

In rohu, HCG with pituitary gland, and HCG+ LHRH did not show any positive response.

In silver carp two sets with HCG alone and one set with HCG+pituitary gland responded successfully.

Incidental to the above experiments 8.85 lakhs of silver carp and 0.13 lakhs of grass carp and 0.3 lakhs of rohu, catla hybrid were produced.

Fry and fingerling rearings :

Studies initiated in 1982 and ended in 1983, on the effect of aeration on the growth and survival of silver carp fry (47 mm/0.95g) stocked @ 0.2 million/ha in 0.2 ha size nurseries with three different treatments *viz.*, with feed alone, organic fertilisers alone and inorganic fertilisers alone against control recorded growth of 141 mm/20.1g ; 138 mm/18.1g and 9.0 mm/-6.5g with aeration against 86 mm/5.8g, 78 mm/6g and 71 mm/5.1g in control with similar treatments respectively.

Rohu spawn stocked @ 4 m/ha recorded a survival of 16-61.7% while silver carp stocked @ 1.15, 2.1 and 3.0 m/ha recorded 26-30% survival.

Rearing of the fingerlings of rohu and silver carp alone and rohu with silver carp in the ratio of 1 : 1 at a stocking density of 0.1 m/ha is in progress.

Project No. FA/A/2 : Breeding and culture of Mystus Spp.

Personnel : S. P. Singh, R. N. Seth, N. K. Srivastav.

Duration : 1982-83.

Location : Allahabad.

Culture of *Mystus seenghala* in pond :—

The culture of *M. seenghala* in the 0.05 ha pond at Yusufpur near Allahabad was continued during 1983. *M. seenghala* stocked at an average length of 70 mm in the pond in July, 1980, attained 625 mm in av. size (595-760 mm) in May 1983 in a rearing period of 34 months. The maximum weight attained was 2.100 kg (length : 760 mm).

The live food for the growing seenghala in the pond comprised forage fishes introduced in the pond prior to initial stocking of seenghala in 1980. The forage fishes present in the pond were *Amblypharyngodon mola*, *Puntius ticto*, *P. sophore*, *Oxygaster bacaila*, *Ambassis ranga* and shrimps. These continued to breed prolifically in the pond and formed a sizeable stock to serve as food for the different sizes of growing seenghala. Manuring the pond with raw cowdung 50 kg/month, enhanced production of food for the fry of forage fish.

Breeding of *Mystus Seenghala* in pond :—

The successful breeding of *M. seenghala* was achieved during March 1983 about one month earlier, compared to first breeding in April, 1982. The formation of breeding pits commenced in the last week of February, '83. Eggs were first encountered in one of the pits on 10. 3. 1983 and the hatchlings of *M. seenghala* (size range : 6-10 mm) on 15. 3. 1983. The pits were formed first in the shallow area of the pond and later in the deeper parts. The depth range (0.90-1.15m) in the pond at the commencement of pit formation in February, '83 was generally maintained throughout the breeding period till end of June, '83, by adding freshwater from a tubewell. A total of 41 live breeding pits, harbouring eggs/hatchlings of seenghala were observed during the period March to June, '83. The number and size range of hatchlings of *M. seenghala* per live pit were estimated to range between 300-1000 nos. and 6-65 mm respectively. In a live pit, hatchlings of two distinct size groups were noticed which possibly indicated use of the same pit twice for breeding.

Experiments were conducted to study whether artificially prepared breeding pits, resembling the natural ones, in plastic containers embedded at the pond bottom could be used by the brooders. No breeding in such containers was observed. However, pits were formed close to the containers were breeding was observed.

Breeding of seenghala in the pond was hampered after a sudden unusual heavy shower in the morning of 10. 5. '83, resulting in the onrush of water from the vicinity into the pond. The fishes were observed to be in distress during night and afterwards mortality of hatchlings and brooders was noticed. Immediate control measures were adopted and after the addition of freshwater from tubewell continuously for 10 hours, splashing the pond water and treatment by $KMnO_4$, the D. O. of pond water could be raised and distress in the fishes removed. Thus, further mortality of fishes could be checked. Breeding in the pond was again observed which continued till the onset of monsoon in June, 1983.

Culture of *Mystus aor* in Pond :

To initiate pond culture of *M. aor*, attempts were made to procure its seed from rivers for stocking. During the survey of a 5 km stretch of river Rapti near Bansi in June, '83, two breeding pits in 2-3m deep water, harbouring *M. aor* in the size range of 70-86 mm were encountered indicating the breeding ground for collection of seed from the pits. In case of seenghala, the

pits were generally encountered at depth ranging between 0.30 and 1.0m.

The fry/fingerlings (size range 48-195 mm) of *M. aor* were encountered in the cast net (1/2" mesh), drag and spawn net (1/2" mesh) operations in rivers Yamuna and Ganga during the period August to October, '83. The fingerlings collected were conditioned in hapa/cage in pond before stocking in a suitable pond selected for the culture experiment in village Khaninar.

The pond was earlier stocked with forage fishes mainly comprising *Amblypharyngodon mola*, *Puntius ticto* and *P. sophore* to serve as feed. The fishes are thriving well and the culture is in progress.

Project No. FA/A/3 : Breeding and culture of mahseer (Tor putitora) at Behimtal (U.P.)

Personnel : C. B. Joshi.

Duration : 1983-84.

Location : Bhimtal (U.P.)

The work on the breeding and culture of mahseer (*Tor putitora*) was continued during July-September 1983 at Bhimtal in Uttar Pradesh. Out of 1.003 lakh eggs stripped from 33 fishes weighing 24.5 kg, 0.339 lakhs fry were produced with the survival rate ranging from nil—63.6%. The survival rate for the eggs & hatchlings recorded during the season ranged from nil—70.2% and nil— 97.0% respectively, as against the rate of fertilization ranging 60.0—100%. The total time taken from the stripping to the complete absorption of yolk-sac in the fry ranged between 10 and 13 days at the water temperature range of 19.0-23.2°C.

The experiments on the rearing of the early fry of mahseer in plastic pools, nylon cages and nursery tanks were also continued at Bhimtal. The survival rate of fry ranged from 60.4-84.0 in plastic pools and 90.0-100.0% in the nylon cages in the lake during 15 to 30 days of rearing.

The trials on the artificial feed formulated at Central Inland Fisheries Camp, Bhimtal (U.P.) are also in progress.

Project No FA/A/4 : Experimental feeding of schiozothoracid fishes with artificial feed in laboratory conditions.

Personnel : K. K. Vass, H. B. Singh and Usha Moza.

Duration : 1983-84.

Location : Srinagar.

Under laboratory conditions the feeding experiments were conducted on the fry of *Schizothoriachthys esocinus*, measuring 15-25 mm/0.500-0.600g. The experimental feeds consisted of dried algal powder, maize powder, soyabean meal, maida and pinch of salt, in various percentage composition. The chemical composition of different feeds was estimated to be—crude protein 10-17%, fat 2-3%, carbohydrate 45-50% and ash 18-20%. Regular feeding was done with each feed for a fixed duration at 8-10% of body weight of fish. No feeding was done during night. The experimental results revealed that *Schizothorax* fry feeds in the column, does not come to surface for feeding and takes longer time to take to artificial diet. Different experiments showed the feed acceptability to range from 68-78%. The gut analysis further revealed that fry in the size range of 15-18 mm had a low feeding intensity, but the fry of 20-25 mm size had plenty of food in their mid and hind gut. The laboratory experiments indicate that feeds with a little more plant matter may be suitable for schizothoracids. Further experimentation is required to arrive at a positive conclusion.

Project No. FA/A/5 : Breeding, nursing and intensive culture of carps and air-breathing fishes in recirculatory filtering system (RFS) of ponds.

Personnel : K. L. Sehgal, Kuldip Kumar, R. K. Das and N. C. Basu.

Duration : 1983—84.

Location : Barrackpore.

For the first time rearing of young ones of freshwater prawn, *Macrobrachium rosenbergii* have been taken up. In 85 days of rearing in 150 m^2 RFS pond the prawn attained an average weight of 20g from initial weight of 1.5g at 1.5 lakhs/ha stocking density with 60% survival. The prawn on formulated diet at 5% body weight has shown feed coefficient of 1 : 1.8 with feed efficiency 57.0%. The pond has been thinned by 50% to avoid overcrowding. Polyculture of Indian and exotic carps to raise table size fish has been initiated in a pond having area of 370 m^2. The pond was stocked with yearlings of silver carp 15% ; rohu 40%, mrigal 15% and common carp 30% at the rate of 6,000/ha. In 92 days rearing silver carp attained an average weight of 400g from initial weight of 185g ; rohu 250g from initial weight of 123g ; mrigal 210g from initial weight of 102g ; and common carp 200g from initial weight of 102g. The fish fed on formulated agglomerates twice a day at 4.0% body weight has given feed coefficient of 1 : 2.1 and feed efficiency 54.0%. The rearing is continued.

Breeding of *Clarias batrachus* :

24 specimens of *Clarias batrachus* (13 ♂ and 11 ♀) were put to trial for induced breeding in a specially designed breeding pit of 6" diameter earthen pond filled with *Hydrilla verticillata* having water depth ranging between 25-30 cm. The fish was injected with ampoules of carp pituitary extract @3 mg/100g followed by final dose of 5 mg/100g. The water in the pond was recirculated after passing through bio-filter for about 4 hours after the final dose of pituitary injection. They did not respond to breeding.

Breeding ot *L. rohita* :

Due to non-availability of silver carp brooders, breeding of *Labeo rohita* was undertaken in RFS pond during September 1983. The brooders ranging from 340-400g in weight were given homoplastic pituitary extract and released in cloth hapas installed near the vicinity of waterfall. Sixty percent of the brooders bred with fertilisation rate ranging from 70-90%.

The fertilised eggs were incubated in double walled cloth hapas. The hatching percentage was 70% and a total of 16,413 hatchlings were obtained. These were later transferred into nursery ponds and reared alongwith *M. rosenbergii*.

Under the biotic study of the RFS ponds, monthly analysis of the plankton of the nursery as well as rearing ponds was undertaken.

Planktonic organisms of the rearing ponds mainly belonged to Chlorophyceae, rotifers and crustaceans. The total plankton fluctuation during October to December ranged from 11,700-85,176 u/litre. The maximum concentration of the plankton was in rearing pond No. 2 during all the studied months. The cycle of standing crop of plankton as reflected in total volume and dry weight indicated December and October as the peak and trough months in all the three ponds. Increased values during December were due to bloom of Chlorococcales and copepods pulse. Maximum volume and dry weight recorded were 86.0 cc/m^3 and 9.8g/m^3 respectively. The dominant forms recorded were *Coelastrum microporum*, *C. proboscideum*, *Pediastrum simplex*, *P. duplex*, *P. reticulatum*, *Ankistrodesmus sigmoids*, *Trochiscion*, spp., *Oocystis* spp., *Chlorella vulgaris* and *Chlorococcum* spp. among Chlorophyceae ; *Brachionus* spp., *Lacane* spp., and *Keratella* among Rotifera ; *Ceriodaphnia* and *Macrothrix* among Cladocera.

In the nursery ponds the plankton ranged 3,042-1,13,600u/litre. The maximum concentration was observed during summer months (July-August) due to bloom

of *Microcystis* and *Spirulina*. The most dominant group among phytoplankton was Chlorophyceae superseded at times by Myxophyceae. Among the zooplankton, Copepoda was the dominant group followed by Cladocera. Maximum volume and dry weight recorded were 80.0 cc/m^3 and 5.0 g/m^3 in nursery pond 2 during the month of August. The common forms encountered were *Microcystis*, *Coccochloris*, *Gomphosphaeria*, *Spirulina*, *Oscillatoria* among Myxophyceae ; *Pediastrum* spp., *Scenedesmus*, *Ulothrix*, *Cladophora*, *Rhizoclonium* and *Hormidium* among Chlorophyceae ; *Cocconeis*, *Nitzchia* and *Fragilaria* among Bacillariophyceae, *Brachionus* and *Lecane* among rotifers ; *Eucyclops* spp., naupli and copepodid stages of *Diaptomus* among copepods.

Project No. FA/A/6 : Breeding of major carps through canal breeding technique.

Personnel : G. N. Mukherjee, Ravish Chandra, G. N. Srivastava, K. Chandra and R. K. Dwivedi.

Duration : 1977-86.

Location : Allahabad.

Canal breeding experiments were repeated in the monsoon season of 1983 in the existing breeding chamber at Beniganj in Madhya Pradesh. The breeding experiments were conducted with 53 brooders (*L. rohita* : 39 and *C. mrigala* 14) on 17th July, 1983 and 22nd July, 1983 when the weather conditions improved after a spell of hot days. Since the brooders did not respond favourably, sympathetic breeding was also attempted through pituitary hormone injections using 2 sets of mrigals on 28th July, 1983 and 1 set of rohu on 29th July, 1983 but no tangible results were obtained. During the course of investigations, 13 mrigals died in the 'Breeding Chamber' presumably due to continued high temperature ranging between 30 to 47°C. The failure of the canal breeding experiments this year was attributed to scanty rains and continued high temperature throughout the period of the investigations.

Physico-chemical observations during the breeding experiments revealed that pH ranged between 7.40 and 8.0, DO between 6.60 and 8.0 mg/1, chloride between 14 and 22 mg/1, hardness between 21 and 36 mg/1, alkalinity between 100 and 122 mg/1, specific conductance between 75 and 120 micromhos/cm, and transparency between 10.6 and 40.0 cm.

Project No. FA/A/7 : Qualitative segregation and rearing of spawn from river Yamuna.

Personnel : G. N. Mukherjee, K. P. Srivastava, R. K. Dwivedi, R. K. Saxena, S. N. Mehrotra and N. K. Srivastava.

Duration : 1983-86.

Location : Allahabad.

Experiments for segregation of quality fish seed from the wild riverine spawn were repeated this year too with the help of multi-meshed concentric sieves. In two sets of experiments the spawn was released in the inner most sieve (Mesh 1/20") and after one hour hatchlings retained in different chambers were counted and analysed. The average percentages of desirable spawn retained in different chambers were counted and analysed. The average percentages of desirable spawn retained in 1/20", 1/24", 1/28", 1/30" and 1/36" meshed sieves were 86.0%, 49.0%, 17.0%, 5.0% and 0.0% respectively. The escaped hatchlings from 1/36" meshed sieve were entirely minor carps.

Segregation of spawn in the tail pieces, while the shooting nets were in operation, was attempted this year with tail pieces of different mesh sizes. After

analysing the spawn samples in different tail pieces, it was observed that the percentage of desirable spawn varied. The hatchlings retained in 1/18", 1/20", 1/24", 1/28" and 1/32" meshed cloth were estimated at 84.0%, 78.0%, 40.0%, 6.0% and 4.0% respectively. It is interesting to note that these figures are, to a great extent, in conformity with the experiments conducted by concentric sieves.

About 200 ml (*c* 1.0 lakh hatchlings) of spawn, collected from river Yamuna, was released in re-circulatory filtering system pond. The stock was fed with twice the weight of the hatchlings till 10th day and thrice the weight for subsequent three months.

The feed comprised rice bran and groundnut oil cake in the ratio of 1 : 1. The raised fingerlings will be stocked in Bachchara reservoir.

During the course of 43 days of investigations from 1st August to 12th September, 1983 a total of 3170 ml of spawn (*c* 15.85 lakh hatchlings) was collected in three major spurts, using five numbers of standard shooting nets. In addition to this 122 ml of spawn was also collected in two rising phases of the river, thus taking the season's total yield to 3292 ml (*c* 18.75 lakh hatchlings) during the year 1983. The first, second and third spurts, occuring during the receding phases of I, II and III floods, contributing 1585 ml (48.2%), 1275 ml (38.7%) and 310 ml (9.4%) in the seasons total yield. The rising phase's contribution was only 122 ml (3.7%).

Microscopic analysis of spawn samples revealed the average percentages of major carps, minor carps and others at 37.8, 58.5 and 3.7 respectively as against 37.9 37.0 and 25.1 in the year 1982. The percentages of desirable spawn in first, second and third spurts were estimated at 25.9%, 47.6% and 40.0% respectively. Seasonal indices of quantity and quality in the year 1983 were 648 ml and 71.8% respectively as against the values of 790 ml and 48.2% in the year 1982. Nursery and plastic pool rearings showed the average percentage of major carps as 71.8% as against 48.2% of 1982. *C. mrigala*, *C. catla*, *L. rohita* and *L. calbasu* contributed 35.2, 12.3, 22.6 and 1.7% respectively, while the minor carp share was 28.2%.

Although the current velocity ranged between 0.5 to 1.8 km/hr in the season, during the availability period the values ranged between 0.58 to 1.5 km/hr. Turbidity fluctuated between 240 to 1200 ppm but in the availability period it varied from 330 to 550 ppm only. Other factors did not appear to have any effect on the availability and abundance of spawn in the stretch.

About 2000 ml of spawn (*c.* 10 lakh hatchlings) was released in the Jail Nursery, Naini, for raising to fingerlings size to stock Bachchara reservoir. About 5000 fingerlings were stocked. The size range of *C. catla*, *C. mrigala* and *L. rohita* varied from 130 to 180 mm, 100 to 140 mm and 85 to 198 mm respectively.

A number of experiments for testing the suitability of different types of feed on the riverine hatchlings/fry/fingerlings were conducted in the laboratory. The hatchlings were kept in glass jars and effect of different combinations of food on the survival and growth was recorded. The results indicated that the feed, comprising soyabean, rice polish, linseed oil cake and dried plankton in the ratio of 0.5 : 1 : 1 : 0.5 was the most suitable for growth and survival of the fish seed.

Project No. FA/A/8 : Increasing fish production in drainable and non-drainable ponds.

Personnel : V. R. P. Sinha, C. R. Das, N. K. Thakur, D. K. Chatterjee, B. R. Dutta, C. S. Purushothaman and H. K. Muduli.

Duration : 1983-88.

Location : Dhauli.

Ten non-drainable ponds of 0.1 ha each were used to assess the growth performance of various fish species

in non-drainable ponds under different packages of management practices. Five packages of management practices, were followed, *viz.*, (i) with feed, fertiliser and aeration; (ii) with only feed and fertiliser; (iii) with organic and inorganic fertilisers ; (iv) with organic manure alone ; and (v) with only manual inputs, involving no cash cost.

All the ponds were uniformly stocked @ 3000 fingerlings/ha in December 1982, the species ratio being ; catla 0.5 ; rohu 3.5 ; mrigala 1.5 ; silver carp 3.0 ; grass carp 0.5 ; common carp 1.0. Five H. P. electric aerators were used in early morning hours at 2 hrs/day. The programme of aeration, however, could not be strictly followed because of frequent power cuts. Feeding and fertilisation was done as per standard practices. All these ponds were totally submerged during 1982 floods causing heavy deposition of silt and organic detritus at the bottom. Most of the ponds thus had heavy infestation of submerged macrophytes and algal blooms. During the peak summer month (May, 1983), the ponds had to be filled up to the desired level taking water from the adjoining irrigation canal.

Final harvesting of the ponds was done after 10 months. Total fish stock, however could not be totally harvested because ponds were choked with submerged vegetation. Only the pattern of comparative growth rate could be worked out (Table-I).

Table—Average weight attained by various fish species in 10 months under different packages of management practices.

Management practices	Weight attained by various fish species (g)					
	Catla	Rohu	Mrigal	Silver carp	Grass carp	Common carp
With feed, fertiliser and aeration	1445	0950	0355	0352	3466	0925
With only feed and fertiliser	2365	1394	NR	1975	1300	NR
With inorganic and organic fertilisers	1220	0417	0463	0882	0640	0950
With only organic fertiliser	1410	0315	0329	0533	0714	1400
With only manual input	NR	0125	NR	0525	NR	NR

NR=not represented.

As can be seen from Table, the performance of various fish species was relatively better in ponds where feed and fertilisers were applied. The aeration effect could not be assessed, primarily because it could not be operated regularly owing to power cuts.

Project No. FA/A/9 : Monoculture of common carp in temperate climate.

Personnel : K. K. Vass, H. B. Singh and R. K. Langer.

Duration : 1982-84.

Location : Srinagar.

The work could not be taken up in 1983.

Project No. FA/A/10 : Culture of fishes in sewage-fed ponds.

Personnel : Apurba Ghosh, S. K. Mukhopadhyay, K. K. Bhanot (Smt.) A. K. Dutta, P. K. Chakraborty, A. K. Roy, N. M. Chakraborty, P. K. Saha, B. K. Saha, G. P. Bhattacharya, B. Ghosh.

Duration : 1983-88.

Location : Rahara, Chinsurah and Canning (W. Bengal).

Culture of carps with sewage waters :

With a view to examining the efficacy of sewage effluents in carp culture, trials with different treatments against suitable control were taken up in 12 ponds at Patulia Farm for 3 replicates in each case. The details of treatments and the method followed in control sets during the first phase of trials are given below :

		Size of ponds (ha)
TRETMENT I		
(Sewage-fed)	: Initial and periodical use of sewage effluents	0.31, 0.21 0.10
TREATMENT II		
(Partly sewage-fed & partly composite culture)	: Besides conventional supplementary feeding	0.30
	initial fertilisation with sewage effluents	0.30 0.07
TREATMENT III		
(Composite culture)	: Use of fertilisers and supplementary feed as required	0.33, 0.21 0.11
CONTROL SET		
(Farmer's method)	: Traditional farmers' method was followed with application of little feed & fertiliser.	0.17, 0.06 0.11

Pre-stocking operations in these ponds included the measurement of the effective water area, dewatering, manuring, liming, etc. The ponds under treatments I & II were initially manured with sewage effluents in the ratio of 1 : 1 (sewage effluents : freshwater).

In order to maintain the nutrient status of the ponds under the treatment I, the ponds were further manured with sewage effluents periodically @ 20,446 litre/ha. In case of treatment II the ponds were not treated further with sewage effluents after the initial intake of the sewage. The ponds under composite culture (treatment III) were manured with cow dung @ 2,000 kg/ha/-month, lime @ 200-300 kg/ha initially, single superphosphate @ 250 kg/ha/annum and urea @ 200 kg/ha/annum. Liming was also necessary at the same rate as in treatment III for the stabilisation of the ponds under treatment I & II.

Major post-stocking activities included raking, netting, sampling of fishes, etc., and periodic intake of sewage effluents for the appropriate set (treatment I).

Feeding with rice bran and mustard oil cake (1 : 1) @ 2-3% of the body weight of the cultivated fishes were followed in case of treatments I & III only and occasional feeding in case of control set.

Stocking started in the month of August and continued up to October 1982. All the ponds were stocked at a density of 8,000/ha with carp fingerlings in the ratio of catla 2 : rohu 2.5 : mrigal 2 : silver carp 2 : grass carp 0.5 : common carp 1. The respective average sizes of the fingerlings at stocking were 143.3/32.4, 124.9/16.9, 128.1/21.6, 109.7/15, 94/10 and 57 mm/3.5g.

Harvesting began from the month of May 1983. The average yield rates were 4,861.9 kg/ha/yr in treatment I, 4,185.8 kg/ha/yr in treatment II and 3,602.1 kg/ha/yr in treatment III against 1,031.4 kg/ha/yr in the control set. The survival rates varied from 85.1 to 89.1% in the ponds under treatment when control ponds recorded 73.77% (average) retrieval.

Average growth attained by the fishes at the time of harvest was as follows :

Species	Treatment I	Treatment II	Treatment III	Control Set
C. catla	319.9mm/356.3g	268.9mm/270.2g	264.2mm/220g	210.1mm/93.2g
L. rohita	362.2mm/346.7g	289.9mm/298.3g	272.7mm/275g	201.7mm/88.2g
C. mrigala	329.8mm/322.7g	315.2mm/325.2g	318.9mm/325g	330.5mm/220.6g
H. molitrix	443.9mm/942.2g	400.5mm/660.7g	364.7mm/465g	265.6mm/174.8g
C. idella	392.1mm/690.3g	399.6mm/795.1g	354.2mm/460g	220.9mm/131.7g
C. carpio	272.0mm/357.9g	253.1mm/250.3g	251.3mm/495g	168.1mm/93.3g

The second phase of carp culture experiment in sewage water was initiated in the month of June, 1983. With a view to standardising the stocking density of carp fingerlings keeping the parameters constant like sewage effluent and freshwater ratio (3 : 2), species composition and ratio (catla 1.5, rohu 2.5, mrigal 1.5, silver carp 2.5, grass carp 0.5 and common carp 1.5).

Three sets of experiments, first set comprising 5,000 carp singerlings/ha, second set 7,000 carp fingerlings/ha, and third set 10,000 carp fingerlings/ha are being conducted in triplicate using a total water area 1.95 ha. In addition to carp, giant freshwater prawn *Macrobrachium rosenbergii* juveniles were stocked @ 1500/ha in each case to evaluate their survival and growth possibilities in mixed culture system under sewage environment. To maintain the nutrient status and carrying capacity of the pond the experimental ponds are being fed weekly with sewage effluent @ 18,174 litres/ha.

Observations in the ectoparasites were continued. During December 1983 catla from two ponds with 5,000 and 7,000/ha stocking densities were found to be infected with protozoan parasite *Henneguya* sp. The rate of infestation was 15.6 and 4.2% in the ponds respectively. The affected specimens were given a dip treatment in 3% potassium permanganate solution (aqueous) and the cysts were removed gently by the blunt end of a scalpel.

The average Hb value for the dropsy infected specimens were recorded as 3.3% ranging from 2.6 to 4.4g% while the RBC count (cu/mm) ranged from 3.4 to 6.5 lakh averaging 4.8 lakh. Further work on this aspect is in progress.

Details regarding stocking and growth attained within December 1983 by the fishes were as follows :

Species	Stocking period	Initial size (mm/gm)	Size attained (mm/gm)	Culture period (days)	Growth increment/day (gm)
Set I (5,000/ha)					
C	August to September. 1983	222.1/95.3	314.3/481.8	155	2.49
R		133.1/26.6	281.0/260.7	114	2.05
M		144.9/31.5	272.1/220.7	99	1.91
Sc		117.5/18.3	323.9/381.7	104	3.49
Gc		115.2/41.0	278.6/425.0	101	3.80
Cc		107.7/23.0	277.3/202.5	104	1.73
Pr		78.4/4.2	128.4/16.7	97	0.13

Set II (7,500/ha)

C		218.9/127.2	266.4/249.7	138	0.89
R		199.3/116.3	284.9/265.8	137	1.09
M	July to	288.9/154.0	298.5/275.3	136	0.89
Sc	September	249.7/190.6	323.4/430.3	123	1.95
Gc	1983	251.2/182.1	361.6/513.2	137	2.42
Cc		103.1/18.0	187.8/70.0	105	0.50
Pr		78.4/4.2	109.1/20.0	95	0.17

Set III (10,000/ha)

C	185.8/95.6	236.0/207.4	113	0.99
R	120.0/12.9	254.3/200.0	120	1.56
M	127.5/29.6	237.8/148.2	86	1.38
Sc	12.5/22.4	270.5/223.5	100	2.01
Gc	85.6/5.5	155.4/61.5	93	0.60
Cc	96.7/15.0	171.3/74.3	101	0.59
Pr	78.4/4.2	128.2/21.9	94	0.19

Studies on the quality of sewage effluent, used for culture, indicated a value ranged from 260-550 ppm for BOD_5 : 45-80 ppm for free CO_2 ; total alkalinity 375-400 ppm ; chloride 95-100 ppm ; pH 7.4-7.6 ; inorganic nitrogen 60-80 ppm ; and phosphorus 2.9-3.4 ppm.

Nursery management with sewage effluents.

In the year 1983, a total of 3.395 lakh carp spawn could be obtained. Among the spawn produced through hypophysation *Puntius javanicus* was 1.69 lakh, *Cirrhinus mrigala* 0.09 lakh, *Labeo rohita* 0.735, *Labeo bata* 0.035 lakh and *Catla catla* 0.035 lakh. These seeds were produced successfully from 6 sets of *P. javanicus* (av. 400g), 3 sets of mrigal (each female 400g), 3 sets of rohu (each female 700g) and 1 set of catla (female 1 kg).

Three sets of silver carp were tried for induced breeding through hypophysation and five sets by the injection of HCG. In case of HCG, females were injected @ 6 or 8 mg/kg body weight as the first dose and @ 10 or 12 mg/kg body weight as the final dose while males were injected @ 2 or 4 mg/kg body weight in a single dose along with the final dose of females. Females oosed freely at a slight pressure when injected with pituitary extract but did not respond with HCG at all even when stripped with high pressure.

With a view to observe the nurturing possibilities of spawn in sewage-fed ponds without providing any supplementary feed, all the nurseries were manured with sewage effluents in the proportion of 3 : 1 (freshwater : sewage effluent) excepting one of javapunti where the ratio was 1 : 1 (freshwater : sewage effluent). These nurseries were also treated with lime @ 200 kg/ha and soap oil emulsion prior to stocking.

Mrigal spawn was reared in a 0.04 ha nursery pond at a stocking density of 3 million/ha while the spawn of catla, rohu, and bata were nurtured together in another 0.04 ha nursery pond at a stocking density of 2.7 million/ha same was maintained in a third nursery pond of 0.025 ha. After 15 days rearing, only mrigal fry were harvested while the rearing period for other species was extended up to 3 months for the production of

fingerlings as no separate rearing pond was available for this purpose. A total of 47,500 mrigal fry with 52.3% survival was obtained while the respective numbers of catla, rohu and bata fingerlings were 602, 433 and 18 with 17.2, 0.59 and 0.51% survivals on completion of rearing. The number of javapunti fingerlings produced was 8,300 ; recording only 4.9% retrieval. Complete harvest for javapunti was not possible as total dewatering could not be done owing to seepage. The growth attained by catla, rohu, bata and javapunti after 3 months' rearing was 156.7/51.3, 100.1/12, 149.8/33.3 and 66.5 mm/2.6g reepectively.

Monoculture of tilapia with sewage effluents :

A 0.17 ha pond near Titagarh Municipal Sewage Treatment Plant was stocked with fingerling of *Saratherodon mossambica* @ 20,000/ha during August 1983. The sex ratio for the species was 10 : 11.3 (male : female). During October 1983 fingerlings of *Lates calcarifer* were also released into the pond at a stocking density of 400/ha for controlling excessive growth of tilapia population and for studying adaptibility of bhetki in such a new environment like the sewage-fed pond. By the end of December 1983, the male tilapia grew from 96.5 mm/18.6g to 228.5 mm/202g, the female tilapia from 78.64 mm/12.04g to 172 mm/86g and *L. calcarifer* from 119.8 mm/17.5g to 161.48 mm/61.06g.

One month prior to stocking, the pond was treated with sewage effluents in the ratio of 1 : 1 (sewage effluent : freshwater). Liming was also done for the stabilisation of the ecosystem. To maintain nutrient status of the pond more or less steady and favourable, periodic intake of sewage effluents was practiced.

Studies on biotic and abiotic environment of the pond was continued. The pH, D. O. and alkalinity of the pond water varied from 7.6 to 8.4, 3.4 to 6.8 ppm and 210 to 366 ppm respectively during the period of culture under report.

Culture of tilapia in floating cages : Fingerlings of *Saratherodon mossambica* (av. 85.6 mm/10.5g) were stocked @ 50 nos./sq m in a split bamboo cage of 2.37 × 0.9 × 0.75m to prevent random breeding. The cage was allowed to float freely in a sewage-fed pond partially immersed upto a depth of 60 cm. Culture was continued for 7 months without supplementary feeding and the production was 2.693 kg/sq.m (i.e. 26.93 tonnes/ha) with 70% survival. The sex ratio for stocking was 3 : 1 (male : female). At harvest, the male fishes grew to 197.2 mm/99.7g and the female fishes to 124.7 mm/38g.

Production of fishes in sewage-fed ponds by multiple stocking and harvesting :

Fish culture using sewage effluents and supplementary feed :—After successful completion of the first trial in 1981-82, the second trial on mixed culture of carps on the principle of multiple stocking and repeated harvesting using sewage effluent was initiated in a 0.17 ha pond of Titagarh Municipality in the last week of April 1982. After treatment and preparation of pond with water : sewage (1 : 1), the pond was stocked at a stocking density of 18,000 fingerlings/ha and at a stocking ratio of *H. molitrix* 1 : *C. catla* 2 : *L. rohita* 3 : *C. mrigala* 2.5 : *C. carpio*, 1.5. The stocking sizes for *H. molitrix*, *C. catla*, *L. rohita*, *C. mrigala* and *C. carpio* were 336.76/373, 221.87/136.83 ; 225.7/117, 228.34/97 and 225.65 mm/198g respectively. The pond was fortnightly treated with sewage effluent and the fishes were periodically fed with mustard oil cake @ 0.5% body weight of biomass. Partial harvesting started from the month of August 1982. General harvesting size was around one kg for *H. molitrix* and 400g and above for other carps. Altogether harvesting was done on eight occasions whereas replenishment of stock was done only 3 times. As per the programme, complete replenishment of stock could not be done after November 1982 because of draught condition prevailed in the area resulting in low water column in the pond (50-75 cm). Complete harvesting was done in the month of April 1983. Total yield of 1465.195 kg of carps was obtained from the experimental pond. The retrieval rate and

percentage to the total production for *H. molitrix*, *C. catla*, *L. rohita*, *C. mrigala* and *C.* carpio were 76.37 21.59, 74.84/11.30, 94.63/30.67, 85.32/27.47 and 18.95/8.97% respectively.

Plankton population ranged from 131-2050 units per litre. The dominant phytoplankton species were *Euglena*, *Closterium*, *Scenedesmus*, *Coelastrum*, *Merismopedia*, *Pediastrum* and *Microcystis* ; and among zooplankters, rotifers comprising mainly *Brachionus*, *Keratella*, and *Filinia* which dominated over copepods like *Cyclops* and *Diaptomus*.

The probability of capture per haul for *H. molitrix*, *C. catla*, *L. rohita*, *C. mrigala* and *C. carpio* was 0.33, 0.5, 0.077, 0.076 and 0.07 respectively, while the same for all the species combined together was 0.075.

Length-weight relationship and condition factor of all the cultured species of 0.17 ha pond of Titagarh Municipality have been calculated for all the months during the experimental period of April 1982 to March 1983 (Table).

Table : The ranges of regression coefficient (b), intercept (log a) and coefficient of condition (k) values are furnished below for each species indicating months of of occurrences in the bracket :

Species	b	log a	k
H. molitrix	1.29 (June) to 3.97 (Sept)	—5.94 (Dec) to 1.72 (July)	0.96 (Jan) to 1.18 (Oct)
C. catla	1.57 (Apr) to 3.17 (Sept)	—5.31 (Feb) to 1.55 (Apr)	1.25 (Apr) to 1.6 (Sept)
L. rohita	2.72 (Oct) to 3.41 (July)	—5.95 (July) to 4.24 (Oct)	1.08 (Feb) to 1.58 (Mar)
C. mrigala	2.14 (Aug) to 3.56 (Oct)	—6.42 (Oct) to 2.86 (Jan)	0.81 (Apr) to 1.51 (Jan)
C. carpio	2.01 (Apr) to 2.95 (Dec)	—4.63 (Dec) to 2.47 (Apr)	1.57 (Sept) to 1.92 (Nov)

Project FA/A/11 : Ecology and fish culture in jute retted waters.

Personnel : B. N. Saigal, Amitabha Ghosh, G. K. Vinci, M. J. Bhagat, A. R. Chaudhury, G. N. Chattopadhyay.

Duration : 1974-85.

Location : Barrackpore.

A pond of 0.07 ha was stocked with Indian major carps and exotic carps in the ratio of C10 : R7 : M5 : Sc 2 ; Gc 2.5 @ 9500/ha. After 45 days of rearing Catla grew to 173 mm/55g while rohu and mrigal grew to 133 mm/36.7g and 130 mm/35.0g respectively. Plankton density ranged from 0.6 to 1.9 ml/40.1. Zooplankton was principally represented by *Diaptomus* while phytoplankton *Coelastrum* and *Synedra*. *Viviparus*, *Pila* and Lamellidens were the principal forms of molluscs encountered.

The chemical parameters of jute-retted waters during the late retting period were : DO 2.4 ppm ; pH 7.0 ; phosphates 0.79 ppm ; ammonical nitrogen 0.09 ppm and total alkalinity 104 ppm while during post-retting period, the above parameters were : 8.4 ppm; 8.2 ; 0.9 ppm ; 2.1 ppm and 240 ppm respectively thereby showing enhanced fertility of the pond waters.

Project No. FA/A/12 : Paddy-cum-fish culture.

Personnel : Apurba Ghosh, S. K. Mukhopadhyay, K. K. Bhanot (Smt.) G. N. Chattopadhyay, P. K. Chakraborty, K. R. Naskar, R. N. Dey, G. P. Bhattacharya, B. K. Saha, A. K. Datta, (All CIFRI) B. Banerjee (Rice Research Station), A. K. Bandopadhyay, C. R. Biswas and S. C. Mondal (All CSSRI, Canning).

Duration : 1982-85.

Location : Rahara, Chinsurah and Canning (W. Bengal).

Freshwater paddy-cum-fish culture :

Experiments were conducted in five 0.01 ha ponds at the Rice Research Institute, Chinsurah. Line sowing of Patnai variety of paddy was done in the last week of June, 1983. Plots were provided with 45 cm wide and 30 cm deep channels across the field for young fishes to take refuge when water receded. The depth of water during fingerlings rearing varied between 10 and 40 cm.

Fry of catla, rohu and mrigal were introduced into the field in the last week of September, 1983. Number of fishes stocked varied from 164 to 204 in different ponds. The species ratio was C9 : R9 : M2. Supplementary feeding was done with mustard oil cake and rice bran (1 : 1) @ 1% of body weight. After 2 months of rearing the following growth was obtained.

Species	*Initial*		*Harvested*	
	Size (mm)	wt. (g)	Size (mm)	wt. (g)
Catla	61.4	3.8	117	21.6
rohu	67.95	3.9	92	9
mrigal	29.6	1.5	90	7.8

The overall survival was very poor (9%). Further trials are required to improve the growth and survival.

Sewage water paddy-cum-fish culture : The juveniles of *M. rosenbergii* (70.9 mm/2.6g) were stocked in a saucer-shaped sewage-fed pond (0.4 ha) at a low density of 10,000/ha only during the end of August and beginning of September 1982. Subsequently *H. molitrix* fingerlings were introduced @ 150/ha into the system to control excessive bloom of algae while deep water paddy (Jaladhi—2) was planted at the margins (0.02 ha) to provide shelter for the prawns and substrate for the growth of periphyton. Nutrient status of the pond was enriched with periodical inflow of the sewage effluents in the ratio of sewage : water 1 : 3. In the initial phase, supplementary feeding was done daily @ 2% of the body weight with molluscan meat/tilapia meat and rice bran for the first two months and then fortnightly. Paddy was harvested in December 1982 and the prawns and fishes by the beginning of May 1983. The yield rates were 1700 kg/ha for deep water paddy (Jaladhi—2), 499.8 kg/ha/8 months for the prawn and 162.6 kg/ha/8 months for the fish. The retrieval rates for *M. rosenbergii* and *H. molitrix* being 72.18 and 86.7% respectively. The male prawns grew to 125g and the females to 59g. *Lyngbya*, *Anabaena*, *Cladophora*, *Cymatopleura*, *Pinnularia*, *Synedra*, *Chlorella*, *Closterium* and *Merismopedia* were the phytoplankters encountered in the environment. Crustacean eggs, nauplii, *Cyclops*, *Brachionus*, *Keratella* and dipteran larvae were the zooplankters. The predominant forms in the bottom biota were *Amphora*, *Gyrosigma*, *Navicula*, *Pinnularia*, *Synedra*, *Lyngbya*, *Anabaena*, *Cladophora*, *Spirogyra*, *Chlorella*, *Closterium*, algal spore, *Vivipara*, *Planorbis*, crustacean eggs and dipteran larvae.

Gut analysis of the prawn revealed that among natural food 45% were green and blue green algae, 33% diatoms, 12% crustaceans and 10% plant tissues and other debris.

Carp culture with paddy was taken up in a 0.38 ha plot having two ponds (0.07 ha each) on either sides. The central portion (0.24 ha) of this rectangular plot is being used for paddy cultivation. After holding freshwater in the entire stretch of the plot fingerlings of *Catla catla* (60g), *Labeo rohita* (20g), *Cirrhinus mrigala* (45g), and *Cyprinus carpio* (3.5g) were cultured by stocking them @ 5,000/ha and in the ratio of 1 : 3 : 3 : 3. Subsequently fingerlings of *P. javanicus* (9.0g) were also introduced @ 225/ha to control excessive algal bloom. The fish yield after 9 1/2 months by June 1983 was 956.96 kg/ha for the total pond area. Ratna plus deep water paddy Jaladhi—2 were cultivated without sewage effluents during 1982 winter and Ratna plus Jaya with sewage effluents during 1983 summer. The paddy crops were harvested during November-December 1982 and

May-June 1983 while the yield rates were 425 and 6389 kg/ha for the paddy grown area of the plot.

After the harvest, the water sheet of the plot was treated with sewage effluent in the ratio of 1 : 3 (sewage : water) and the experiment was reset. Deep water paddy (Jaladhi—2) was transplanted by 31 July 1983 and the plot was stocked with fingerlings of *L.* rohita (78.9 mm/4.5g), *P. javanicus* (87.35mm/8.75g), *L. bata* (107.55mm/10.25g), and *L. calbasu* (54.25 mm/2.5g) @ 4,000/ha and in the ratio of 2.5 : 3.7 : 1.5 : 2.3 during 19. 9. 83 to 4. 10. 83 besides stocking juveniles of *M. rosenbergii* (78.35 mm/-4.19g) @ 2,000/ha. *L. tade* fingerlings (58.3 mm/3.0g) were further stocked @ 134/ha on 29. 11. 83. *M. rosenbergii*, *P. javanicus*, *L. bata L. rohita* grew to 133.33 mm/20g, 101.8 mm/10g, 150.1 mm/28g and 114.8 mm/16g in 60, 50, 60 and 40 days' culture respectively. Biotic and abiotic environment of the plot is being also studied. The yield of deep water paddy (Jaladhi—2) was 1150 kg/ha for the paddy growing area during the Kharif crop.

One hundred banana plants (Kabuli variety) were planted on the plot dyke and a production of 3000 banana were obtained during August-December, 1983.

Brackishwater paddy-cum-fish culture :With a view to assess the possibilities of integrating brackishwater aquaculture with paddy cultivation in monocropped low lying coastal regions, the project was initiated in 1982 in two paddy plots (0.015 ha each) at CSSRI Farm, Canning and a normal yield of paddy (3062 kg/ha) in addition to an average yield (1165 kg/ha/169 days) of prawns and fishes were obtained. About 1/3 of the aquacultural produce was prawn.

During April-July 1983 sequential brackishwater aquaculture with *P. monodon* postlarvae (av. 1.3 mm) and *L. parsia* fry (av. 66 mm/3.2g) at a total stocking density of 42,500 nos/ha in the species ratio of 1 : 1 was conducted in two plots of 0.015 ha each using saline tidal water from the adjacent Matlah River. Specific conductivity of water varied from 9.1 to 32.0 mmhos/cm during the period of brackishwater acquaculture. This resulted in salinisation of the soil up to a value of 22.6 mmhos/cm. The gross production of prawn and fish in 90 days' culture was 407.133 kg/ha when they attained 142 mm/20.8g and 103 mm/11.0g respectively. Their respective survival rates were 48.7 and 70.7% and the contribution of prawn to the total yield was 56%.

During post-harvest period after utilisation of the paddy plots for brackishwater farming during summer fallow months, the soil salinity was lowered down to only 1.6 nmhos/cm through frequent run off and leaching of rain water. On restoration of the congenial ecosystem, one month-old seedlings of three paddy varieties, *viz.*, CSR-1, SR-26B and Assam-S were transplanted by mid-August 1983. These plots were further utilised for synchronous culture of freshwater prawn and fish along with paddy. Juveniles of *M. rosenbergii* (78.35mm/4.19g) and fry of *P. javanicus* (63.9 mm/3.0g) were stocked @ 15,000 and 10,000 nos./ha respectively in both the plots during September.

Harvesting of paddy was completed by the first week of December 1983 and the average yields was 2814 kg/ha for CSR-1, 3280 kg/ha for SR-26B, and 3375 kg/ha for Assam-S which were at par with the yield rate from a good cropping of the area. The prawn and the fish were harvested after 72 and 87 days' culture respectively with an average production of 487.867 kg/ha where the contribution by the prawn was 44.82%. The prawn attained 113 mm/10.07g and the fish 164.5 mm/49.24g when harvested. The survival rates were 95.43% for the prawn and 43.14% for the fish. Thus, besides usual paddy cropping an additional average production of 895 kg/ha of prawns and fishes in only 177 days was obtained through judicious integration technique.

Dominant plankters were *Gyrosigma*, *Cladophora* and *Brachionus* during sequential culture and *Amphora*, *Lyngbya*, *Cladophora*, algal spore and nauplii during synchronous culture. Similarly, predominant benthos

were *Nitzschia*, *Amphora*, *Gyrosigma*, *Lyngbya*, *Cladophora*, *Closterium* and eggs of crustaceans and rotifers during brackishwater farming and *Pinnularia*, *Amphora*, *Gyrosigma*, *Nitzschia*, *Lyngbya*, *Cladophora*, *Spirogyra*, *Closterium*, *Monostyla*, *Brachionus*, crustacean eggs and nauplii during freshwater aquaculture.

The ranges of some physico-chemical properties of water of the plots during the period of study were :

E. C. (mmhos/cm)	2.8—32.0
pH	7.4— 7.6
Alkalinity (ppm)	120—364
N (ppm)	0.5—1.01
P (ppm)	trace— 0.2

Before sequential brackishwater farming the plots were treated with rice bran @ 1,000 kg/ha for the growth of lab-lab and urea @ 60 kg/ha for cultivation of paddy.

Insecticide, i.e. 0.1% aqueous solution of Dimecron @ 667 l/ha, was applied to the paddy thrice during growing stages and once during flowering stage on 29. 8. 83, 9. 9. 83, 13. 9. 83 and 1. 10. 83 without any mortality of prawn or fish during synchronous culture.

Project No. FA/A/13 : Cage culture of carps in tanks.

Personnel : B. V. Govind (upto April, 83) S. Sivakami (Smt.), S. Ayyappan, S. L. Raghavan and M. F. Rahman.

Duration : Three years (1983-85).

Location : Sankey tank, Bangalore.

Cage Culture experiments : Cage culture of silver carp and catla were carried out. Water quality and plankton were also studied. Water was alkaline (pH 8.2-8.7) with carbonate and bicarbonate alkalinity values in the ranges of 10-16 ppm and 72-94 ppm respectively. The dissolved oxygen content was around 6 ppm. The specific conductivity values ranged from 134.20-190.32 mmhos/cm, and the nutrients were in low concentrations. The parameters of plankton analysed by settling volume were (5-15 ml/m^3), wet weight (0.125-1.70 g/m^3), dry weight (0.03-0.45 g/m^3) and total counts (580000-2414000/m^3). While species *Microcystis* and *Melosira* were abundant among phytoplankters, rotifers and copepods formed the bulk of zooplankton.

Cage culture of silver carp :

The experiment on the cage culture of silver carp was initiated with a stocking density of 11.84 lakhs/ha (1250 nos. in the cage of 10.56 sq.m. area), with one cage as control on 28. 7. 1982. The artificial feed given comprised rice bran and groundnut oil cake in equal proportions, at 10% of the body weight. The fry grew from an initial average length/weight of 60.3 mm/2.30g to 162.13 mm/12.6g in the test and 151.25 mm/10.45g in the control cages, in a period of four months. They were restocked with a density of 10.7 lakhs/ha (1131 nos. in the experimental cage) and reared for about 8 months (247 days). The final average length/weight of fish in the test cages was 171.76 mm/57.56g and that in the control was 168.53 mm/56.17g. The experiment was concluded on 5. 8. 1983 and the survival rates were 54.11% (test) and 45.40% (control). It was observed that the acceptance of the artificial feed was poor, resulting in comparatively similar growth rates of fishes in the experiment and control cages.

Rearing of catla fry :

Catla fry with an initial average length/weight of 27.25 mm/0.204g stocked in the cages at a density of 14.1 lakhs/ha in September, 1982, grew to an average length/weight of 37.17 mm/5.33g in test and 35.25 mm/4.80g in the control cages in about two months (1. 12. 1982). They were restocked at a density of 4.1 lakhs/ha (430 nos. in the cage) and reared till 18. 3. 1983, when they had reached 141.54 mm/50.16g (test) and 104.15 mm/19.06g (control). The survival rates were 8.93% and 4.48% in the cages.

Rearing of catla fingerlings :

The next phase of culturing fingerlings to table-size was carried out for a period of 185 days, till 19. 9. 1983. The stocking density was 1.26 lakhs/ha (133 nos. in the experimental cage). The artificial feed comprising rice bran and groundnut oil cake in equal proportions, having a crude protein content of around 23% was provided, daily, at about 5-10% of the total body weight. The final average length/weight of fish were 360.16 mm/772.20g in the test and 264.75 mm/299.64g in the control cages ; the increments being 219.16 mm/-722.20g and 160.60 mm/280.58g in the two cages. The survival rates were 87% (experimental) and 47% (control). The weight of fish in the experimental cage was 89.575 kg and that in the control was 8.39 kg. The gross fish production worked out to 8.48 kg/sq.m. or 5.65 kg/cu.m. or 84.8 tonnes/ha in six months and the net production was 7.85 kg/sq.m. or 5.24 kg/cu.m. or 78.5 tonnes/ha in six months.

Another experiment on **rearing of catla fry** to fingerling stage and further, was initiated on 11. 10. 1983, with stocking of 1900 fry (stocking density 17.99 lakhs/ha), with a average length/weight of 46.92 mm/1.0g. Artificial feed of rice bran and groundnut oil cake (1 : 1) was given daily observing the consumption. A control cage was also maintained, without feeding. The sampling carried out on 9. 12. 1983 recorded an average length/weight of 79.30 mm/5.45g in the test and 59.36 mm/3.76g in the control cages. The survival rates were 71.4% and 27.42% in the test and control cages respectively. The experiment was reset on 9. 12. 1983 by stocking of 700 fry each in the test and control cages (density 6.628 lakhs/ha), with the specimen measuring 79.30 mm/5.45g in the experimental cage.

It is proposed to culture common carp fingerlings to table-size at a higher density (10 lakhs/ha) in replicates, and also to take up cage culture of grass carp.

Biochemical studies on carps cultured in cages : This project envisages investigations on the impact on nutrient quality of different feeds on the histomorphological structure of alimentary canal and the chemical composition of the fish cultured in cages.

The experiment under this project was started on 12. 3. 1982, with advanced fry of silver carp stocked at a density of 2.8 lakhs/ha. The fish in the experimental cage were fed on artificial feed of wheat bran (40%), maida (40%), groundnut oil cake (10%) and soya bean powder (10%). The Fish with an average initial length/weight of 66.48 mm/3.43g showed an increase to 259.60 mm/132.17g in a culture period of 9 months in the experimental cages. In the control cage the growth was to 152.94 mm/32.14g. The fish was harvested in December 1983 and it amounted to 17.565 kg/6.25 sqm area.

Biochemical analyses of the fish cultured were made from the preserved samples. Moisture content in the test fish was 82.36% in the first month of the experiment i.e. March and increased to 89.85% in April and thereafter it decreased to 73.69% in December, with a corresponding increase in other constitutents. Protein contents was 12.3% in March which gradually increased to 21.77% in November. Glycogen was 0.08% in March which increased to 0.15% in November. Fat 2.12% in March and 3.88% in November.

In the control fish, while moisture content did not exhibit any remarkable fluctuation, protein and fat contents were showing slightly increasing tendency. Glycogen was found to be generally low during the course of the experiment.

The experiment will be repeated with same species of fish, which will be fed upon 2 other feeds.

During the period under report, cage culture of common carp to study the proximate composition in relation to different stages of maturity was attempted. A cage with an area of 6.25 sqm was stocked with advanced fingerlings of common carp (stocking density 1.3 lakhs/ha) during January 1983. They had an initial average length/weight of 165.70 mm/56.40g. They were

fed on artificial feed comprising of silkworm pupae (50%), rice bran (30%) and groundnut oil cake (20%) at the rate of 20% of the body weight daily. Periodical sampling was done and fish (both sexes) were grouped in 5 stages of maturity. Biochemical composition (moisture, protein+glycogen) of flesh, liver and gonad in stage I (immature) stage II (maturing) and stage III (mature) was studied during the report period. The fish grew to an average length/weight of 272.62 mm/346.29g in 6 months.

In females, moisture content in the muscle and liver was found increasing from 79.72% to 81.52% and from 72.68% to 78.62% respectively from stage I to stage III, whereas, in the ovary it was decreasing from stage II to stage III. Protein content in the muscle and liver was decreasing with maturity while in the ovary though it decreased from 23.60% in stage I to 7.73% in stage II, it was again increasing thereafter along with maturity. Glycogen content was showing a building up tendency towards maturity in all the 3 tissues in general.

In males, moisture content in muscle and liver was found to increase from stage I to stage II and thereafter decreased in the stage III. In testes, the moisture con. tent was 80.02% in stage I and was around 78% in the next two stages. Protein was more in stage I in muscle and liver. In testes, it was found increasing from 10.3% to 12.96% along with maturity. Glycogen content in the muscle was increasing from 0.21% in stage I to 1.46% in stage III, whereas, in the liver and testes, it was decreasing from 3.69% to 2.06% and from 0.74% to 0.30% respectively (The values are given on the wet weight basis). Further studies are in progress.

Project No. FA/A/14 : Culture of commercially important fishes and freshwater prawns in cage and pen in Kolleru Lake in Andhra Pradesh.

Personnel : K. V. Rao, K. J. Rao, T. S. R. Raju and K. S. Rao.

Duration : Five years (1982-86).

Location : Kolleru Lake (A.P.).

A pen enclosure of 0.01 ha area made of bamboo split matting was installed in Kolleru lake at Kalakurru, 12 km from Eluru. It was stocked with Rohu and grass carp and *P. pangasius* at the stocking rate of 10,000 ha during the first week of January '83. The stocking details are given below :

Rohu	50 nos.	130.5 mm/18.5g.
Grass carp	50 nos.	110.5 mm/ 9.5g.
Pangasius	20 nos.	155.1 mm/30.0g.

Only the grass carp was fed on *Hydrilla*, abundantly available in the pen enclosure.

The bamboo matting of pen enclosure was damaged due to strong gales during first fortnight of June, 1983 resulting in considerable escapement. The remaining stock of fish was harvested on 18. 6. 1983, after five months culture period. The particulars of fish are given below :

Species	Average wt. at stocking (g)	Avetage wt. at harvesting (g)	Percentage of survival	Production (t./ha)
Rohu	18.5	455.3	68.0	
Grass carp	9.5	767.4	46.0	3.439 t.
Pangasius	30.0	180.0	35.0	

A production of 34.390 kg was obtained from 100 sqm pen area within 5 months of culture (3,439 t./ha/5 months).

Project No. FA/A/15 : Fish feed formulation and nutritional bioenergetics of Asiatic carps.

Personnel : S. D. Tripathi, D. V. Pahwa, B. N. Singh, D. N. Swamy, S. N. Mohanty, Kuldeep Kumar and N. K. Tripathy.

Duration : 1983-87.

Location : Dhauli.

With a view to formulating artificial fish diets the proximate composition of four samples of groundnut oil cake and five samples of rice bran were analysed.

Optimum protein requirement of *C. mrigala* was found to be 45% at 29°C based on tests with complete synthetic diets of casein. The carbohydrate content of the diet giving optimum growth rate was 28%. A high rate of survival (96%) was obtained when the spawn of rohu, mrigal and catla was fed with conventional diet fortified with 'nuvimin', a poultry vitamin given in trace mineral supplements. However, the gain in weight with fortified feed was lower and the appetite of the fry was reduced in field experiments. Skeletal deformities were also observed.

Micro-encapsulated whole egg diet ;

A freeze-dried preparation of the micro-encapsulated whole egg diet fortified with minerals and vitamins was made for the first time and tested in relation to traditional feeds (cake-bran mixture) and plankton on the spawn of Asiatic common carp, grass carp and silver carp.

	Moisture	*Protein*	*Fat*	*Ash*	*Fibre*	*NFE*
Groundnut oil cake	6.5—8.9	29.0—40.0	9.2—12.0	6.8—7.8	8.6—12.3	22.4—33.2
Rice bran	6.5—9.2	3.6—10.9	6.5—8.0	18.6—21.0	28.2—32.1	26.2—34.0

In addition, protein and fat contents of the feed stuffs being utilised at the Centres of the All India Co-ordinated Research Project on Composite Fish Culture and Fish Seed Production were also analysed.

Proximate analysis of alimentary canal and associated glands in 36 specimens of *Labeo rohita* (150-350 mm/ 50-500 g), collected from Reservoir I of the Centre, indicated 24-34% protein and 21-60% fat. The fish were occasionally fed with conventional supplementary diets.

Three experiments with common carp, grass carp and silver carp were conducted in the laboratory in 8 l glass jars at 28-30° with 3 replicates for each of the four feeds. The feeds *viz.*, the micro-encapsulated diet, traditional feed mixture (groundnut oil cake and rice bran in the proportion of 1 : 1), plankton and plankton+traditional feed were provided *ad libitum*. The protein content of the micro-encapsulated diet and the traditional feed was 46.8 and 23.4% respectively. The average growth of fish attained in 15 days with different feeds is given below :—

Species	Initial average		Final average wt (g)			
	Length (mm)	Weight (g)	ED	TF	P	P+TF
Common Carp	7.35	.001876	.00696	·00615	·05179	·07503
Grass Carp	6.50	·0018	·00592	·00606	.03861	·09627
Silver Carp	8.18	.0030	.01171	.00025	.11036	—

ED=Encapsulated diet TF=Traditional feed P=Plankton P+TF=Plankton and traditional feed.

The results indicate that plankton with traditional feed gives the best results in all cases followed by plankton alone. However, between the traditional feed and encapsulated diet, grass carp followed by common carp appears to make the best use of encapsulated diet while silver carp, the traditional mixture. The results are being further analysed to determine the reasons of differential growth pattern.

Fasting catabolism :

Studies on fasting catabolism were undertaken with a view to collecting data for bio-economic modeling. A 30-days experiment was set up in plastic pools at two temperatures (18° and 30°C) with silver carp (1.2 to 45.8 g) stocked individually or in batches of 5 and 10/pool. Five of the 10 pools maintained at 30°C were aerated round-the-clock. A high rate of mortality was recorded in the aerated pools over unaerated, as well as the ones kept at 18°C. Mortality rate was higher in fry than in fingerlings stage.

The weight loss was much more at 30°C than at 18°C. While 21.4-31.7% was lost in 20 days at 30°C, the same loss was registered in 30days at 18°C. A far greater weight loss (25-33%) was recorded in fry (1.2-3.0g) in just 10 days indicating a faster rate of metabolism than in fingerlings.

In another experiment on fasting catabolism with rohu, weight losses ranging from 1.63-6.77%, 3.11-9.16%, 8.96-13.04% and 10.83-17.39% during the first, second, third and fourth weeks respectively were noted in fish maintained in plastic pools at ambient temperatures of 23.2-27.0°C during November-December, 1983. The fish used for the experiment ranged from 30-1066g with 4, 2, 8, 10, 8 and 2 animals in the weight groups of upto 50g, 51-100g, 101-250g, 251-500g, 500-1000g and above 1000g.

Project No. FA/A/16 : Genetic improvement of stock through selection of shoot carp.

Personnel : H. A. Khan, P. V. G. K. Reddy and S. D. Gupta.

Duration : 1983-88.

Location : Dhauli.

Work on chemical marking of common carp has been initiated. Common carp measuring 90-255 mm were marked subcutaneously by blue dye (Blue R S containing dichloratriasine). The injected fishes have been observed to have retained marks more than one month. Further work is in progress.

Project No. FA/A/17 : Production of gynogenetic, androgenetic and polyploid populations of Indian and exotic carp.

Personnel : George John, P. V. G. K. Reddy and R. K. Jana.

Duration : 1983-85.

Location : Dhauli.

a) *Gynogenesis :* Three experiments were conducted, on artificial gynogenesis in rohu. Partial success was recorded in one experiment. About 20 gynogenetic rohu were produced by fertilizing rohu eggs and with irradiated common carp milt followed by temperature shock (12°C ; 15 minutes).

From the gynogenetic catla fry produced in 1982, one catla attained 950 grams after 10 months of pond rearing, while four others showed a weight of 300 grams after 5 months of pond rearing.

b) *Polyploidy-induction :* One experiment on polyploidy induction in rohu gave about 4,000 hatchlings, from rohu eggs fertilized with rohu milt and

subjected to cold shock 12±10°C for 10 minutes. The survival rate was poor and only five reached the size of 5 cm. In the remaining two experiments, 24 suspected polyploids were produced and are being reared for cytological studies.

Polyploidy induction was attempted by treating fertilized eggs (rohu×rohu) with colchicine (0.01%). The experimentation did not yield viable offsprings as they all died during different stages of development.

Project No. FA/A/18 : Fish diseases and their control.

Personnel : Dilip Kumar, B. K. Mishra and R. K. Dey.

Duration : 1983-88.

Location : Dhauli.

It is a common observation that common carp gives relatively poor survival in larval nursing inspite of best nursery management practice. Effect of treating nursery ponds with soft organophosphorus insecticide—Malathion—and of prophylactic measures in larval nursing have been tested in sixteen 0.01 ha nursery ponds. Use of Malathion @ 0.25 ppm, five days prior to stocking for eradicating larger copepods followed by prophylactic treatment of the larvae with antibiotic and $KMn0_4$ solution, has given better survival rate compared to the control groups.

Group	*Treatment*	*Survival %*
A	Malathion	45.5
B	Malathion+medication	54.5
C	Medication	26.75
D	Control	16.25

Fifteen strains of bacteria isolated from diseased fish were investigated and typed. Out of fifteen, seven gram-negative rods ; among them, six were *Aeromonas hydrophila*, one was *Enterobacteria*. Other eight were gram-positive isolates including five *Bacillus*, two *Arthrobacter* and one *Clostridium* strain.

A communicable disease was encountered in silver carp which resulted in emaciation, haemorrhage on body sides and accumulation of ascitic fluid in the coelomic cavity. Bacterial isolates from kidney, liver, heart and coelomic fluid await confirmative identification. Heavy deposition of haemosiderin pigments have also been found in the liver sections of the fish.

Histopathological observations were made in the kidney of diseased specimens of major carps suffering from myoxosporidiasis and microsporidiasis. Degeneration and necrosis of renal tubules along with formation of cysts and spores of parasites were observed in both the cases.

Use of drugs to reduce post-handling mortalities of fish was studied. Preliminary trials with ascorbic acid/or/and antibiotic, 2-3 days prior to handling were tested in field experiments. Observations, made so far, indicated a positive trend towards the use of ascorbic acid and antibiotic combination.

Project No. FA/A/19 : Culture of algae and duckweeds using sewage.

Personnel : A. C. Nandy, A. C. Banerjee, K. R. Naskar & B. Ghosh.

Duration : 1982-85.

Location : Rahara (West Bengal).

Laboratory and yard experiments for mass culture of *Spirulina* spp were carried out using different fertilizers and nutrient media such as CFTRI mix, Zarouk's medium, Scenedin mix, and NPK fertilisers. The strain was obtained from Central Food Technological Research Institute, Mysore. The propagation and growth of *Spirulina platensis* was remarkably higher with NPK fertiliser at 515 ppm compared to the other

0.8-1.0 at 560 nm from initial optical density of 0.1 at media tried. The culture reached an optical density of 560 nm within 12 days corresponding to about 1.5 g/l dry algal biomass. The initial pH of the medium was 8.5 and it reached 10.5 in seven days after inoculation. Harvesting was done by pouring the algal slurry over cotton cloth filters when the culture optical density reached 0.8-1.0 at 560 nm. The algae floated as mats in the early hours facilitating easy harvest by simply scooping the algal mats with cotton filters.

Recycling of domestic waste water through production of duckweeds : In circular cement cisterns (0.018 ha each) at Patulia Farm large-scale culture of *Wolffia arrhiza* has been done using sewage effluents mixed with fresh-water in 1 : 0, 2 : 1 and 1 : 1 ratios with one replicate each having one metre water depth throughout the experimental period. The initial inoculum of the weeds per cistern was 2 kg. An average production of 752 kg (41,332 kg/ha), 520 kg (28,325 kg/ha) and 367 kg (20,183 kg/ha) of *Wolffia* per cistern was obtained from 1st, 2nd and 3rd treatment respectively during 150 days' culture period.

The planktonic algae in the experimental cisterns consisted of *Anacystis* sp, *Anabaena* sp, *Scenedesmus* sp, *Pediastrum* sp, and *Chlorella* sp. pH and total alkalinity values of cistern water ranged between 6.8 and 6.6 ; and 288 and 178 ppm respectively. DO level ranged from 3.5 to 10.6 ppm.

The total produced *Wolffia* was utilised as fish feed. One cement cistern was stocked with exotic carps *C. idella* (85 mm/5.5g), *H. molitrix* (110 mm/15.5g), *C. carpio* (96 mm/15g) and *P. javanicus* (95 mm/9.5g) in the ratio of 3 : 3 : 3 : 1 and with a stocking density of 8,800/ha and the fishes were fed with *Wolffia* at the rate of 10% (on the basis of dry weight, 1 kg of fresh *Wolffia*=100 gm of dry *Wolffia*) of body weight. *H. molitrix*, *C. idella* and *C. carpio* attained 248 mm/143g/143 days, 272 mm/266g/82 days and 190 mm/110 g/105 days respectively.

Project No. FA/A/20 : Studies on aquatic weed control.

Personnel : S. Patnaik, T. Ramabrabhu, S. R. Ghosh and K. M. Das.

Duration : 1983—1986

Location : Dhauli.

With a view to study the percentage of bulk increase and weed succession in two ponds (0.01 ha) water hyacinth was introduced and its rate of growth recorded periodically.

Observations from weed infested ponds (completely covered with *Salvinia cuccullata*) showed that the dissolved oxygen increased by about 19% from morning to mid-day as compared to open water without any weeds in which the increase was 24% during the same period. In the case of *Hydrilla verticillata* infestation the increase was 206% for the same period. However, the D. O. levels decreased by 3 to 6% in both weed infestations and without weeds, from mid-day to evening.

In a pond of 0.4 ha in Killa, treated with 2, 4 D for clearance of lotus, normal growth of plankton and fish were recorded. Similar observations were also made in a pond of 0.05 ha treated with paraqueat for control of *Salvinia*.

Observations in two small ponds at Killa fish farm where infestation of *Hydrilla* and *Nechamandra* have been treated with 1 ppm of dimethyl urea indicated no regeneration of weeds for a period of 6 months after treatment.

Project No. FA/A/21 : Use of ammonia in fishery management.

Personnel : T. Ramaprabhu, S. D. Tripathi, S. Jana, S. R. Ghosh and K. M. Das.

Duration : 1982-85.

Location : Dhauli.

Preliminary results obtained in two 0.1 ha rearing ponds treated with ammonia to standardize the doses of ammonia for use as fish toxicant in relation to the size, depth and condition of the pond showed that 200 to 250 kg of anhydrous ammonia/ha-m costing about Rs. 2000/- will be required in ponds of 1.5-2.0m depth and above, at the prevailing pH (7.1-8.0) and temperature (29.0-31.8°C) conditions.

Project No. FA/A/22 : Seed production of the giant freshwater prawn *Macrobrachium rosenbergii*.

Personnel : M. Subrahmanyam.

Duration : 1979-84.

Location : Kakinada.

Experiments on rearing of the seed of *M. rosenbergii* were continued in 4 plastic ponds and 8' F. R. P. tank with reduced power and reduced labour/hr. Based on operating costs, the production cost of 1,000 seed averaged Rs. 47.00 and 21.00 respectively in the two experiments.

Seeds were stocked in a private farmer's pond and in a 24' plastic portable tank in the laboratory to raise brood stock. Stocking and culture techniques were demonstrated in a private farmer's pond. Rupees two hundred was realised through sale of seed to private farmers.

Project No. FA/A/23 : Seed production of freshwater prawn *macrobrachium malcolmsonii* **; Nursery rearing of prawn post larvae to stockable juveniles.**

Personnel : K. Janaki Ram, D. R. Rao, and P. S. C. Bose.

Duration : 1982-85.

Location : Kakinada.

Seed production : Berried females of *M. malcolmsonii* were collected from nature and maintained in the laboratory. The zoeae were reared in clean filtered brackishwater in F. R. P. tank/plastic portable tanks having 300-500 litre capacity. *Artemia* nauplii, tubificid worms, *Acetes* sp. or locally available cheap feeds were utilized as feed for the growing larvae. The larvae were reared till they metamorphosed into postlarval stages.

Nursery rearing : Postlarvae of *M. rosenbergii* were reared in cement tanks (10 X2 X0.5m) or plastic pools (5t) at stocking densities varying from 1,000-5,000/m². Shades and shelters were provided. Feeds indentified included blood clam flesh+rice bran ; *Acetes*+rice bran or other locally available feeds depending on their consumption. The growth rates were recorded at fortnightly intervals till they attain 5-6 cm length.

Project No. FA/A/24 : Development of artificial feeds for rearing the larvae of commercially important palaemonid prawns.

Personnel : L. H. Rao, D. R. Rao, P. S. C. Bose.

Duration : 1979-84.

Location : Kakinada.

Clear seawater was procured from the Bay in the month of February and again during the last week of May and first week of June for experimental work.

The brood prawns (*Macrobrachium rosenbergii*) were procured from the nature and maintained in the laboratory till hatching.

During the first half of the year 3 sets of prawn larvel rearing experiments were carried.

In the first set (small-scale indoor experimentation—February and March) few larvae of *M. rosenbergii* were

reared till metamoryhosis on a diet of *Acetes indicus* tissue suspension in newly mixed saline medium (15± 2 ppt.) (settling period 10 days).

In the second set of outdoor trials (March & April) about 10,000 to 15,000 Nos. of prawn larvae reached Vth to VIth zoeal stage in a plastic pool (500 l.) in green medium (salinity 15±2‰). The larvae when transferred to a larger pool (2.5 t.) having similar medium survived upto VIIth to VIIIth zoeal stage (7 to 8 days).

The third set of outdoor trials (April to June) were carried in 6 plastic pools (500 l.) in green saline medium (15±2‰) on mixed diets (mainly *Acetes* tissue suspension supplemented by other observed useful feeds) with a control. Due to rise in the ambient temperature (above 32°C.) the outdoor experimentation was stopped and the prawn larvae (IVth & Vth zoeal stages) were transferred to 4 indoor pools (500 l.) after counting. The indoor trials were continued with same diets and a control. All the rearing pool's bottom was cleaned, about 30% of the medium replaced and the number of dead larvae were counted daily. The results indicating the number of larvae stocked ; no. of larvae died in molting ; no. of postlarvae obtained ; no. of larvae (advanced) missing and no. of leftover advanced larvae after closure of the indoor experiments were.... (I) Experiment : 18,000 ; 10,512 ; 34 ; 7,375 & 79— (II) Experiment : 25,000 ; 15,854 ; 6 ; 8,685 & 455— (III) Experiment : 1,100 ; 467 ; 7 ; 576 & 50— (IV) Experiment : 9,500 ; 556 ; 2 ; 8,619 & 323 respectively. From the left over advanced prawn larvae, an additional 44 postlarvae were obtained, thus the total of postlarvae produced being 93.

Though, the reason for large number of missing advanced larvae (25,255 Nos.) could not be accounted, the experiments indicate the possibility of rearing the larvae in good numbers to advanced stage on mixed diets without employing nauplii of *Artemia*.

During the second half (August to December) of the year, most of the prawn larval rearing experiments were vitiated due to unprecedented monsoon rains and cyclonic storms. However, in one experiment conducted in indoor conditions utilising the available undiluted limited volume of the medium (15±2‰ salinity) so far 105 post larvae were obtained employing *Acetes indicus* tissue suspension mainly on larval food.

Projecj No. FA/A/25 : **Seed prospecting and culture of *Macrobrachium malcolmsonii* near Kolleru lake and its connected waters.**

Personnel : K. V. Rao, K. J. Rao, T. S. R. Raju, K. S. Rao.

Duration : 1974-85.

Location : Kolleru lake area.

Work under this project was not done in 83 due to the repair work undertaken in the farm.

Project No. FA/A/26 : **(a) Breeding and rearing of *Macrobrachium birmanicum choprai* under laboratory conditions.**

(b) Survey of seed resources of *Macrobrachium ceoprai* in river Ganga and to study the growth pattern in ponds and plastic tanks.

Personnel : Shree Prakash, D. R. Kanaujia and S. N. Mehrotra.

Duration : 1983-87.

Location : Buxar.

Breeding : Adult males and females of *choprai* collected from Ganga river, were reared in plastic tank (3'×6') and glass aquaria for breeding. Berried females (eggs bearing female) released larvae after 10-12 days. Newly hatched zoea larvae were reared in glass aquaria, glass

jars (10 lit.) and plastic tanks (3'×3', 3'×2' and 3'×6') filled with tap water. Aeration was done depending upon the power supply. Tubificid worms, bone marrow of goat, goat liver, crust dried prawn powder, egg custard, Osapan tablet, yeast tablet, groundnut powder and zooplankton were tried as food for larvae. The zoea larvae survived for 10-20 days but died after attaining 3rd stage of larval development.

100 l of sea water was transported from Digha to Buxar for larval rearing. The experiments to rear the larvae in freshwater mixed with 10-20% sea water gave encouraging results.

The experiments were done in a dark room with temperature variations only 1-3°C. The water was aerated with air pump. Waste food materials were removed through shiphoning. In those trials, the zoea larvae attained 2nd stage in 10-15 days and survived for 28-32 days. Their growth was very poor. The above mentioned feed items were used as food for larvae also. But the larvae did not accept the food.

It is remarkable to note that the reported *choprai* juveniles (45 mm) hatched larvae in freshwater. These larvae attained 2nd stage on 4th day and 3rd stage on 6-7 day but died within 10 days. There sizes were bigger than *choprai* larvae. It indicated that these juveniles cannot be *choprai* juveniles but adult *M. lamarei lamarei.*

Problem No. FA/A/27 : Breeding, hatchery and nursery management and culture of commercially important frog species of India.

Personnel : A: K. Mondal and S. C. Mondal.

Duration : 1983-85.

Location : Kalyani.

A production of 1.2 million pre-hatching stages and hatchlings of the Indian bullfrog and *Rana crassa* was achieved. Out of this, about 1.12 million hatchlings were released in the nature as a part of the re-stocking programme and the rest were utilized to conduct various experiments.

8 sets of *Rana pipiens* and 1 set of laboratory reared North-American bullfrog were successfully bred with iso-pituitary extracts in the former and with a combination of pituitary extract and LH and LH-releasing factors in the latter species. The staging of embryos and the normal developmental pattern in *R. pipiens* under 15°, 18° and 23°C were studied in detail.

In a yard experiment of 3-week duration conducted in five plastic pools, 4-day-old tadpoles of *R. tigrina* stocked at 2.0 million/ha and regularly fed with silkworm pupae powder, in addition to their natural food, gave an average survival to 86.7% early frogs. The same experiment taken up in a pond could not be completed since the water level quickly receded due to the drought situation. However, the tadpoles showed excellent growth and precocious metamorphosis and the early frogs raised were bigger in size than the normal ones, due to feeding with silkworm pupae powder.

Breeding of the house fly and one locally available species of cyclorrhaphan fly and healthy growth of their maggots were obtained in a medium containing raw cow dung, bone meal and mustard oil cake. The maggots became healthy when little urea and dried silkworm pupae were added to the above medium. This confirmed the previous findings. Based on the observations made so far, a cage is being designed for field application of this technology for large-scale feeding and rearing of frogs under culture.

In three experiments on microbiologicol studies on septicemic bullfrog (*Rana catesbeiana*), the various disease producing bacteria from intestines and whole tadpole homogenates were successfully isolated by growing them on BHI and Rimler-shotts media and their pure cultures were raised. The mass culture of

Aeromonas hydrophila (strain 22) in 5 litres of synthetic MMA medium was done and the toxins produced by the bacterium were isoloted and concentrated with the help of millipore machine. An experiment to study the role of various amino acids on the growth of and toxin production by this bacterium in the presence of minerals like Fe and Zn was carried out, which revealed their excellent growth and increased protease activity in glutamic acid, followed in order of sequence by glycine, leucine, alanine, histidine and proline, in presence of zinc. Inactivation of protease activity in toxins was also done.

Induced hybridization between *Rana trigina*, *R. crassa* and *R. limnocharis* was successfully done, and the cleavage pattern of eggs was studied in the parents and the hybrids. While no irregularity was observed in crosses between *R. tigrina* and *R. crassa*, the hybrid embryos produced from those between *R. limnocharis* × *R. tigrina* and *R. limnocharis* × *R. crassa* showed abnormal cleavage and gastrulation resulting in many deaths at the embryonic stages and deformity in hatchlings.

The production of androgenetic haploids in *Rana pipiens* was successfully achieved by enucleation technique, which involved removal of the egg nucleus prior to the second polar body formation from the fertilized eggs. The identification of the characteristics of haploid embryos and confirmation of haploids and diploids on the basis of epidermal cell-size was successfully done in three experiments. Production of gynogenetic haploids by inactivation of spermnucleus was also successfully achieved in this species. Production of gynogenetic diploids and also polyploids was also achieved in *R. pipiens* by applicaton of pressure technique.

Transplantation of blastula nucleus into activated enucleated eggs of *R. pipiens* was successfully done by nuclear transplantation method, and the development studied in detail.

In a series of studies carried out on the migration of primordial germ cells in the embryonic developmental stages of *R. pipiens* under various temperature gradients (15°, 18° and 23°C) and photoperiods revealed their origin from the ventral endodermal cells and that the dorsal mesentery also played certain positive role in their migration. Similar studies have been taken for the parents and the hybrids amongst the Indian species for selection of improved and superior strains hybids.

Project No. FA/A/28 : Economic investigations on carp culture and air-breathing fish culture in India.

Personnel : M. Ranadhir, M. Rout, N. K. Tripathy and C. D. Sahoo.

Duration : 1980-86.

Location : Dhauli.

For Badampudi Centre of the AICRP on Composite Fish Culture, fish production from composite fish culture can be estimated by the following equation :

$$Y=275.96862+0.01459\ X_1+0.09789\ X_2+2.17595\ X_3+0.37000\ X_4-0.50150\ X_5-451.87048\ X_6-1.29662X_7+0.01068X_8.$$

Where Y = Fish production in kg.
X_1 = Mahua oil cake in kg.
X_2 = Organic manure in kg.
X_3 = Chemical fertilizer in kg.
X_4 = Feed in kg.
X_5 = Stocking number.
X_6 = Size of pond in ha.
X_7 = Lime in kg.
X_8 = Weeds in kg.

A windmill has been installed at Dhauli. The average discharge of water through windmill during October-December, 1983 was observed as 0.5 litres/second. On the economics of filling undrainable ponds through different sources of water supply, it was shown

that the cost was minimum when the water was drawn from the wind mill (Rs. 1,000/ha-m) followed by irrigation canal (Rs. 1,080/ha-m) and diesel (Rs. 1,800/ha-m). The maximum expenditure was incurred on the supply through dug wells (Rs. 2,250/ha-m). The rates of diesel and electricity in the present analysis were Rs. 1.31/L and Rs. 0.16/KW/hr (1979-80 level).

Project No. FA/A/29 : Adaptive research in freshwater aquaculture.

Personnel : N. K. Thakur, B. N. Singh, S. L. Kar, C. S. Purushothaman, S. K. Sarkar, B. B. Satpathy, J. P. Verma, B. R. Datta, Radheshyam and N. Sarangi.

Duration : 1983-87.

Location : KVT/TTC, Kausalyagang, Orissa.

Village survey : The data pertaining to the survey of 336 farm families of 83 villages conducted during the period 1977 to 1979 in the Pipili Block of district Puri were analysed and a report was prepared incorporating information on the socio-economic status of the farm families surveyed, the available resource potential in the villages for aquacultural development, fish culture practices that are followed in the villages and constraints thereof. Taking into consideration the potentials of aquaculture resources in the villages covered under the survey programme the training needs of the farmers in the field of freshwrter aquaculture were identified.

A fresh programme survey work has been initiated in villages falling under the jurisdictions of Balianta and Balipatna Blocks of district Puri. Block-level details of 18 villages in Balipatna Block and 31 under Balianta Block have been obtained. The survey work is in progress.

Low input fish culture : A pond of 0.75 ha has been stocked with 2,000 fry of rohu and common carp each on 8. 11. 83. About 360 silver carp and 100 grass carp will be stocked during December '83, as per the availability of the seed. No fertilisation is being done since the pond has some algal bloom. The water analysis data for the month of November '83 were as follows : D. O. 5.2 ppm ; pH 7.2 ; T. A. 124 ppm ; P_2O_5 0.16 ppm ; NH_3+NO_2—N 0.005 ppm. The volume of plankton was 0.5 ml/50 l. The culture is in progress.

Project No. FC/B/1 : Ecology of mountain lakes.

Personnel : K. K. Vass, H. B. Singh, Usha moza and R. K. Langer.

Duration : 1983-85.

Location : Srinagar.

I ECOLOGY OF SAR

a) *Biological studies*

Zooplankton estimates column-wise from different stations revealed that Protozoa, Rotifera, Cladocera and Copepoda were the main groups. At pelagic site the total density (units/l) ranged between 270-480 at surface, (with rotifers contributing 70-90%) ; 195-315 at 1m (with rotifers contributing 60-95%). 315-705 at 2m (rotifers forming 2-70%) ; 360-510 at 3m (with rotifers 22-86%) and 330-775 at 4m (with 35-60% rotifers). At the two littoral stations the density ranged between 210-600 units/l with rotifers as dominant group.

Phytoplankton were recorded in substantial quantity. The range of total density at 0m, 1m, 2m, 3m and 4m depth zones was 0.8-2.5, 0.9-1.8, 1.4-1.84, 1.94-2.83 and 1.46-2.83 (units 1×10^5). The forms recorded were mostly members of Myxophyceae and Bacillariophyceae.

The benthic fauna recorded from different stations was mostly composed of molluscs (60-70%), oligocheates (4-6%) and dipterans (15-20%). The population density of total benthos ranged from 500-13,000 individuals/m^2.

The dominant submerged macrophytes were *Myriophyllum spicatum* and *Ceratophyllum demersum*. At littoral site mainly *Potamogeton* and *Nymphoides* were recorded. The average biomass production during the period varied between 4.8-12.6 g/m^2/day.

b) *Fishery*

The Sar abounds mainly in *Cyprinus carpio* and *Schizothorax* sp. Due to heavy weed infestation fishing is rather difficult. The estimated catch per man hour was between 350-750g with *Cyprinus carpio* comprising about 70-90% of total cateh. The fishes caught were usually in the range of 50-450g in weight and 110-350mm in length. The fish production estimated was at 40 kg/ha/yr.

c) *Primary production*

Phytoplankton photosynthesis estimated profile-wise was integrated to get the picture on area basis. During the period photosynthesis ranged between 150 mg C/m²/d recoded in December/January and 651 mgC/m²/d recorded in May. The photosynthetic efficiency ranged between 0.01%—0.28%. The macrophytes fixed as high as 5.6g C/m²/d during the period with an estimated efficiency of 2.5%.

d) *Physical-chemicol features*

Perameters	*Pelagic site (Depthwise)*	*Littoral site*	
		Site-I	*Site-II*
Transparency (m)	4.5-5.8	2.0-3.25	1.5-2.5
Water Temp. (°C)	6.5-21 (Om)		
	6.5-20 (1m)		
	6.5-20 (2m)		
	6.5-18 (3m)		
	6.5-17.5 (4m)		
	6.5-17 (5m)		
DO (ppm)	8-12 (0.2m)	7-13	5.7-12
	5.6-12 (3m)		
	3.3-12 (4m)		
	5.7-12 (5m)		
	above 7.8	above 7.8	above 7.8
pH	100-122 (surface)	100-174	150-180
Total alkalinity	108-170 (middle zone)		
(ppm)	128-176 (bottom)		

Parameters	*Pelagic stte (Depthwise)*	*Littoral site*	
		Site-I	*Site-II*
Sp.conductivity (μs/25°C)	310-420 (surface) 320-400 (middle zone) 340-420 (bottom)	315-390	320-400
Dissoved organic matter (ppm)	42-60	48-62	50-80
Chloride (ppm)	4-8	5.4-7.8	
Calcium (ppm)	42-64	40-58	
Magnesium (ppm)	1.2-2.4	1.2-2.4	
Orthophosphate (ppm)	Tr.—0.015	Tr.—0.050	

During winter months, the sar is isothermal while with the onset of spring/summer, a stratification of 3-4°C was recorded. As summer advanced, the bottom zone showed an oxygen depletion.

(e) *Energy flow*

In the Sar most of the energy fixed by macrophytes remains unutilized as no vegetation feeder fish is present in the system. The conversion efficiency between primary producers and zooplankton is 0.055% and between former and fish it is 0.002%. The fish production is estimated at 4,800 calories/m²/yr. From energy transfer, the Sar ecosystem is not efficient, as about 80% of energy is fixed by macrophytes alone at primary level which is returned to the system.

FISHERY OF WULAR LAKE

a) *Fishery aspects*

(i) At Nasa landing site of lake, the average catch was estimated at 1.2 kg/man/hr., in which exotic carp formed 70% and schizothoracids, only 30%. Among exotic carps the two varities encountered were scale carp having a weight range of 100-550 g and mirror carp in the range of 150-320 g. Schizothoracid was represented in catches by *Schizothorax curvifrons* with length/weight range of 100-200 mm/50-60 g. At Kanibathi landing site the average estimated catch was 1.8 kg/man/hr, in which exotic carp

(*Cyprinus carpio*) was 66% by weight and shizothoracid 33% only. Among carp catches the composition was 48% scale carp and 18% mirror carp. Their length/weight ranged between 220-325 mm and 150-550 g. Among schizothoracid the species composition in catches was *Schizothoriachthys esocinus* (22%) having length/weight range of 200-375 mm and 100-370 g; *Schizothorax curvifrons* (8%) having length/weight range of 210-260 and 100-220 g. The remaining (3%) was contributed by *Schizothorax niger*.

(ii) The experimental fishing at Baniyar station of lake revealed in catches about 90% by weight of exotic carp and only 10% of schizothoracid. In experimental catches, among exotic carp, the mirror carp formed 31% of fish-biomass and scale carp 57%. Schizothoracid was mainly represented by *Schizothorax niger* 180-300 mm and 240-275 g. The length/weight ranges of experimental catches were 280-300 mm and 240-275 g in case of exotic carp and 245 mm/275 g in case of Schizothorax *niger*. The estimated catch was 900-1,000 g/man/hr.

Spawning grounds of Schizothorax.

Upper strech of Madhumati (one of the main feeding streams of lake) was surveyed for local endemic fish seed. The size of mixed spawn ranged from 16 to 40 mm, The main species encountered in the zone were *Schizothoriachthys esocinus*, *Schizothorax plagiostomus*. *S. curvifrons* and *S. niger*. The density of mixed spawn in the time and space ranged between 2-240 fry/m^2. The percentage composition of *Schizothorax* spawn *vis-a-vis* other fishes was 69% *Schizothorax*, 29% *Nemacheilus* and 2% *Gambusia* at station-A of upper stretch. At station-B, the composition was *Schozothorax* nil, *Nemacheilus* 95% and *Gambista* 5%; while at lower stretch *Schizothorax* was nil, *Nemacheilus* nil and *Gambusia* 100% Approximately 800-1000 fry could be collected in one hour by two persons. A field seggregation attempt on this mixed spawn in the size group of 25-35 mm was also made taking into account the shape and length of head, shape, suckers nature and size of dorsal fin, etc.

(d) *Physico-chemical aspects*

The lake water is highly turbid, with Secchi depth recording 20-25 cm. At all stations, lake water was isothermal with a temperature range of 17-23°C throughout water column. Surface heating to the extent of 1-2°C was usually recorded in summer. However no thermal stratification was recorded. The pH of water (7.3-7.8) did not differ in surface and bottom waters. The dissolved oxygen concentration in the column was to the level of 4.5-6.2 ppm with no bottom depletion recroded at any station. The other parameters ware; Specific conductivity, 140-200 μs/25°C ; Chloride 4-6 ppm ; Calcium, 34-38 ppm ; Magnesium, 1-2-2.2 ppm and dissolved organic matter 14-60 ppm. No marked stratification for these chemicai parameters was noted in surface and bottom waters in any month.

(c) *Biological limnology*

(i) A marked variation in total phytoplankton density was recorded at different stations. At Baniyar station maximum densityw as 85,000 units/1 recorded in summer with a decline to 10,500 units/1 in autumn. At Laharwalpora station, the density range was 30,600-45,000 units/1 during the period. At Kanibathi station the density was low i.e. 2,200-7,040 units/1. The percentage composition was 33-100% Bacillariophyceae ; 6-50% Chlorophyceae and 11-50% Myxophyceae. The species diversity within the group was rather low.

(ii) Zooplankton population in the lake is usually low. At Baniyar station maximum density of 184 units/1 was recorded in surface water during summer, and minimum of 124 units/1 in autumn. The bottom zone usually recorded less number of zooplankton. Among different groups mainly rotifers (24-64%) and protozoa (9-52%) dominanted. At Laharwalpora the density range was 140-152 units/1 throughout the column with maximum (53%) density recorded by Protozoa and (32%) by Rotifera. The Kanibathi station also recorded almost uniform distribution (180-192 units/1). Among total zooplankton, rotifers formed 25-40% of population, cladocerns 20-25% and protozoans 8-15%.

(iii) The benthic macrofauna from different stations revealed three main groups—Oligocheata (72-93%); Diptera (7-15%) and Mollusca (2-7%). The population density was estimated to be 488-1955 individuals/m^2 at Baniyar and 445-798 individuals/m^2 at Laharwalpora. The fresh weight biomass was 97-313 g/m^2 and 3-155 g/m^2 at Baniyar and Laharwalpora, respectively. The biomass was mainly dominated by oligocheates. At Kanibathi station the density ranged from 45 to 88 individuals/m^2 with a biomass range of 0.5-1.4 g/m^2. The main forms recorded during the period were *Chaetogaster*, *Aelosoma* and *Nais* among oligocheates, *Tendipex*, *Culieoides* and *Pentaneura* among Diptera; and gastropods and bivalves among molluscs.

(iv) The gross phytoplankton productivity estimated from differents stations recorded variations from surface and bottom samples. At Baniyar station the mean production was 30 mgC/m^3/h ar surface and 15 mg C/m^2/h at bottom. At Laharwalpora the surface mean production was 37 mgC/m^2/h while it was 22 mgC/m^3/h at bottom. Kanibathi station frecorded a production range of 40-85 mgC/m^3/h at surface and bottom.

Project No.FC/B/2 **Comparative study of fisheries and ecology of River Ganga and 'Kol' at Bhagalpur**

Personnel A. K. Laal, S. K. Sarkar and A. Sarkar.

Duration 1983-85

Location Bhagalpur

Physico-chemical and hydrobiological studies were carried out at Hanumanaghat in River Ganga and at Adampurghat in river Ganga at Adampurghat in 'Kol'. In addition to these sites, two more sites, i. e. Manik sarkarghat confluence zone and main sewage which emerge in 'Kol' were also covered for studying the impact of community sewage waste in 'Kol'. Physico-chemical parameter, primary productivity value and plankton desnity were higher at confluence zone in the 'Kol' than at Adampurghat in 'Kol' and at Hanumanghat in main River Ganga.

In River Ganga, gross and net primary productivity were in the ranges 28.42 (Oct.) to 175.00 (Jan.) and 24.32 (Oct.) to 131.25 (Apr.)mg C/m^3 /hr respectively. Community respiration was in the range 18.75 (April, May & Aug.) to 27.0 (Jan.) mgC/m^3/hr, whereas, at Maniksarkarghat confluence gross and net primary production were in the ranges 25.94 (Jan.) to 718.75 (May) and 187.50 (June) to 468.75 mg C/m^3/hr (May) respectively. Community respiration varied in the range of 12.00 (Jan. & Feb.) to 487.5 mg C/m/hr (April). In river Ganga, Phytoplankton popularion ranged from 32 u/l (Aug.) to 3312 u/l (March). Phytoplankton population during August, September & October were minimum due to heavy flood which ultimately incresed the turbidity. Maximum phytoplankton during March was due to in increase in transparency and nutrient load. *Gonatogygon* sp. was ubiquitous. Zooplankton comprised of rotifers, cladoceran and copepode ranging from 2 u/l (Aug.) to 340 u/l (May). *Difflugia* sp. amongst the Protozoa was found in zooplankton sample during monsoon which is not the endemic zooplankton member of the Ganga River System rather appeared in the river eco-system due to flood flushing.

In 'Kol' the phytoplankton succession showed an interesting rapidly changing pattern, both at Adampurghat and Maniksarkarghat confluences. At Maniksarkarghat confluence, *Closterium* sp. was dominating in January. *Euglena viridis*, *Euglena acus* and *Phacus* sp. amongst eugleneids were in peak in April though they were quite in good number also in February and March. In April, *Scendesmus quadricauda*, *S acuminatus*, *S opoliensis* were also in higher density (15000 u/l). *Microcystis aeruginosa*, *Oscillatoria* sp., *Spirulina*, sp. *Anabaena* sp. and *Mesotaneium* sp. amongst Myxophyceae were present in heavy density during summer (May & June).

At Maniksarkarghat conflucnce zooplankton sample, was comprised of members of Protozoa, Rotifera,

Cladocera, Copepoda and Ostracoda while benthos comprised of Oligochaeta, *Chironomous* and Nematoda. In February and March, *Moina* sp. was found in swarm in form of redish floral shape in littoral zone during morning in calm shinning weather and like thick redish border on either side of this zone in afternoon when wind velocity increased. In April, *Moina* sp. was restricted to small grooves in the littoral region whereas *Brachionus rubens* were dominant in littoral region. Appearance of such swarm of *Moina* sp. and *Brachionus rubens* to the extent of 25 ml. per one litre water reflect the hyper-eutrophic condition of this zone probably due to its function as natural sewage oxidation pond.

Project No FC/B/3 Impact of Farrakka barrage on the riverine ecosystem and breeding of fishes with particular reference to *Hilsa ilisha*.

Personnel Ravish Chandra, R. K. Saxena, K. P. Srivastava, B. D. Saroj and Ramji Tiwari.

Duration 1982-1984

Location Allahabad

Observations on the spawning of hilsa were initiated from October and continued till December. Fortnightly collections were made at Madauka, Sirsa and Manda near Allahabad. Observations were also made at Buxar and Bhagalpur in Bihar.

While no hilsa spawn was encountered in the river Yamuna, centres at Ganga *viz.*, Sirsa, Manda, Buxar and Bhagalpur showed the presence of hilsa hatchlings. The details are as under.

Table showing fortnightly occurrence of hilsa larvae (nos)

	Centre	Oct.		Nov.		De
		I	II	I	II	I
R. Yamuna	Madauka	—	—	—	—	—
R. Ganga	Sirsa	12	—	—	—	—
	Manda	—	1	—	—	—
	Buxar	—	10	131	3+8 juveniles	5 juveniles

The size of the hatchlings ranged between 6-16 mm. It is evident that the fish bred during October and early November. The breeding activities seemed to be stopped by November end.

Landing of hilsa at Allahabad and Buxar were very poor, while at Bhagalpur it was better. The detailed landings were as under.

Centres	Landings
Allahabad	0.35 t
Buxar	0.18 t
Bhagalpur	2.89 t

Project No. FC/B/4 : Riverine fish catch statistics of the middle and lower stretches of the Ganga River System.

Personnel : R. A. Gupta, N. Sharma, S. K. Wishard, Balbir Singh, R.K. Tyagi, N.K. Srivastava, D.N. Srivastava, B.D. Saroj, J.P. Mishra, Bhai Lal, D. R. Kanaujia, Ramji Tiwari, A. K. Laal, R. C. Singh, A. Sarkar, B. L. Pandey, R. K. Chakraborty.

Duration : 1968-Continue

Locations : Allahabad.

Fish landing from different centres in the middle and lower stretches of River Ganga(Table) during this year showed a marginal decline by 4.5% at Sadiapur and 2.69% at Bhagalpur whereas, Daraganj and Lalgola landings increased by 15.4% and 18.2%. The catches at Sadiapur were dominated by major carps over catfishes and the average major carp/catfish ratio was estimated at 1.93 over the last three years with minor fluctuations. The catches at Daraganj were dominated by catfishes and the above ratio at this centre was 0.43. This clearly indicates that the stock abundance in R. Ganga is dominated by catfishes whereas, in R. Yamuna, it is the major carps.

Fish landings at Buxar were dominated by miscellaneous fishes (55.31%) followed by *M. seenghala* (9.09%) and *M. aor* (8.58%). Among major carps, *L. calbasu* was the dominant species contributing 8.34% in the total catch. Hoewever, the landings of hilsa were very poor (177 kg only) at this centre.

The fish landing recorded at Hanuman Phatak Buxar retail fish market under the period ending December 1983 was as follows:

Species	Total catch in kg.
c. mrigala	648
C. catla	597
L. rohita	715
L. calbasu	1430
Major carps.	3390
M.aor	1470
M. seenghala	1558
W. attu	1065
Selected catfishes	4093
H. ilisha	177
Miscellaneous	9479
Total	17139

At Bhagalpur miscellaneous varieties contributed the maximum (47.59%) to the total catch. Among other species of major carps and catfishes, *W. attu* was the dominant species (14.03%) followed by *M. aor* (6.78%), *M. seenghala* (4.53%), *N. chitala* (4.04%), small prawn (3.42%), *C.garua* (3.13%), *H. ilisha* (2.98%), *C. catla* (2.93%), *C. mrigala* (1.29%), *L. rohita* (1.21%) and *L. calbasu* (0.35%).

The landings at Lalgola were dominated by *Hilsa ilisha* which contributed 37.15% to the total catch followed by miscellaneous fishes (21.34%), prawn (7.63%), major carps (2.88%) and *N. chitala* (0.24%). The annual average length of *Hilsa ilisha* in the catch at the above centre was estimated at 310 mm (125-550 mm) and the av. weight at 358g (25-1800 g) with the predominant size group ranging from 225-375 mm (80.47%). The average length of other species erew: *W. attu* 754 mm, *M. seenghala*, 655 mm; *L. rohita*, 725 mm; *L. calbasu*, 480 mm; *C. catla* 630 mm and *C mrigala*, 729 mm.

Project: FC/B/5 **Fisheries of Kolleru Lake and its connected waters.**

Personnel: K. J. Rao, K. V. Rao, T.S.R. Raju and K. S. Rao.

Duration: 1982-1986

Location Tadepalligudem

The annual fish yield (January '83 to December '83) from Kolleru Lake was estimated to be 2561.990 t, and it accounts to 102.48 kg/ha/year. Akividu centre contributed about 47.16 followed by Eluru centre with 3.67t and Bhimavaram 17.17t of the total yield of 2561.990 t.

The fish yield from the lake during different months revealed higher landings in June (361.199 t) and lowest in February (73.634 t). At Akividu centre peak landings were recorded in the month of June and low catches during March. The monthly maximum and minimum landings at Eluru were observed in the month of May and February respectively. In case of Bhimavaram the peak landings were recorded in the month of August and least during May.

An examination of the catches from the lake revealed that the catfishes, perches and prawns formed the major constituent in the fishery contributing 29.33%, 28.33% and 20.53% respectively of the total annual yield of the lake followed by murrels 11.25% carps 7.51% and mullets 1.32%. The annual landings of the important species from different groups of fish with percentage in total fish yield of the lake are given below:

1. *Anabas testudineus* 677.161 t.—26.43%
2. *Hetropneustes fossilis* 588.037 t.—22.95%

3.	*Metapenaeus monoceros*	459.643 t.—17.94%
4.	*Channa striata*	262.119 t.—10.23%
5.	*Catla catla*	72.653 t.— 2.83%
6.	*Clarias batrachus*	61.183 t.— 2.39%
7.	*Labeo rohita*	59.068 t.— 2.30%
8.	*Wallago attu*	52.144 t.— 2.03%

Among prawns, *M. monoceros* (459.643 t.—17.94%) was landed followed by *M. malcolmsonii* (24.118 t.—0.94%), *M. rosenbergii* (15.926 t—0.62%) and *P. monodon* (13.748 t.—0.53%).

Catla catla (72.653 t.—2.83%), *L. rohita* (59.068 t.—2.30%), *C. mrigala* (29.133 t.—1.14%) and *P. sarana* (20.922t.—0.82%) were the main species among carps in the lake.

Among catfishes, *H. fossilis* (588.037 t.—22.95%) formed dominant fishery followed by *C. batrachus* (61.183 t.—2.39%), *W. attu* (52.144 t.—2.03%) and *M. gulio* (44.632 t.—1.74%).

C. striata (262.119 t.—10.23%) was the most dominant species among murrels.

This lake system is very much polluted by the release of industrial effluents-Sugar factory effluents from Messers K.C.P. Limited, Vuyyuru, during dry season, February to May through Venkaiah Kalva to the *Western sector* of the lake. The paper and pulp industrial effluents are being released frequently into the lower reaches of the estuarine zone of the lake, Upputeru through Yenamadurru drain causing considerable damage to the fisheries of the lake.

Project No. FC/B/6 : Impact of the water pollution on freshwater environment and physiology of fishes.

Personnel : R. S. Panwar, M. Peer Mohamed M. A. Khan, S. N. Mehrotra, Balbir Singh, P. K. Mukhophadhyaya, G. N. Srivastava, R. N. Seth, R. K. Tyagi, K. Chandra, B. D. Saroj, J. P. Mishra and Ramji Tiwari

Duration: : 1983-87

Location : Allahabad

Impact of chemical wastes on the biota of Rihand reservoir

Chemical: Investigations revealed that the wastes released into the Rihand reservoir by Kanoria Chemical Ltd., manufacturing caustic soda, bleaching powder and gammexane, were acidic to alkaline (pH 6.2 to 9.3) and transparency values ranged from 6.5 to 15.5 cm, pH at the outfall showed alkaline range (8.4 to 8.5) during post monsoon and acidic range (6.2 to 6.3) during pre-monsoon period. This zone was characterised by low alkalinity (30 mg/1) and low oxygen level (3.2 mg/1) accompanied with high concentration of free chlorine (194.8 mg/l), chloride (850 mg/l) alongwith high ionisation capacity of water (3250 micro-mhos/cm), while the samples from other stations (20 m and 50 m from the outfall) registered increase in pH (7.6 to 7.8), alkalinity (40 to 42 mg/l) and dissolved oxygen (4.8 to 5.2 mg/l) and declining trend in the values of free chlorine (53.2 to 21.2 mg/l), chlorides (432 to 301 mg/l) and conductance (1904 to 272 mocro -mhos/cm). Mercury content at the outfall was found to be 0.01 mg/l.

Plankton: Plankton population was nil upto station No. 3 (50 m) during pre-monsoon period whereas, at station 1 (outfall) and station 2(20)m nil values for plankton were observed during monsoon and post-monsoon seasons respectively. Qualitatively post-monsoon period was rich (2162 u/1) in plankton compared to pre-monsoon (624 u/l) and monson period (1,240 u/l) at all the stations. Bottom fauna (damsel nymphs and fly and chironomids) were found beyond station 3. Qualitative estimation of phytoplankton revealed numerical dominance of *Microcystis* over other phytoplanktonic forms such as *Anabaena, Navicula* and *Pediastrum*. Among zooplankton, rotifers (*Keratella, Lecane* and *Brachionus*) dominated over microcrustaceans (*Cyclops, Moina* and nauplii). Chlorophyll content of phytoplankton of polluted and unpolluted zones were 1.18 μg/ml and 4.86 μg/ml respectively. Mortality of fishes like *C. mrigala,*

L. calbasu and *M. seenghala* was observed throughout the study periods in the effected zone.

Laboratory experiment : Laboratory experiments conducted with 0.18% combined effluent showed 100% mortality of *T. mossambica* in 24 hrs exposure time.

Soil: The soil samples collected at the outfall indicated neutral to alkaline range (7.0 to 8.0) with a chlorides content ranging between 55 to 72 mg/100 g soil. The carbon content ranged between 0.08 and 0.094%. Estimation of mercury in the soil samples of the reservoir is being done.

Impact of thermal wastes on the biota of Rihand reservoir.

The wastes of Renu Sagar Power Co., and National Thermal Power Corporation, producing electricity @210 MW electricity/day, showed temperature between 42 and 47°C and 36 and 38°C respectively. The waste mainly comprised of ash mixed with water. The physico-chemical characteristics of water of Renu Sagar Power Co. at the outfall point indicate neutral to alkaline (pH 7.8 to 8.2) with high values of alkalinity (190 mg/l), chlorides (32 mg/l) and conductivity (480 mocrombos/cm) whereas, dissolved oxygen (4.5 mg/l) and transparency (7cm) were low. At 50 m and 100 m away from outfall point, the water temperature ranged between 30 and 32°C ; pH 8.0 and 8.3 ; dissolved oxygen 5.2 and 5.6 mg/l ; alkalinity 130 and 140 mg/l; chlorides 12 and 61 mg/l; and conductivity 330 to 362 micromhos/cm. Maganese content was found to be less than 0.1 mg/l in water samples whereas, it was estimated to be 0.15 ppm in soil samples at the outfall. No appreciable difference in physico-chemical proporties of water of NTPC at the outfall and below the outfall point were recorded.

Plankton: Studies at the Renusagar revealed the plankton population of 286 u/l, 342 u/l and 174 u/l at the outfall during pre-monsoon and post-monsoon periods respectively and almost the same population was recorded at 1000 m away from the outfall which does not indicate any adverse impact of thermal wastes on the biota at both study sites. At NTPC centre, plankton population of 112 u/l, 148 u/l and 132 u/l were encountered during pre-monsoon, monsoon and post-monsoon seasons respectively.

Benthic population was recorded nil throughout the study. No fish mortality was recorded at both the centres throughout the study period. At Renusagar, rotifers amongst zooplankton and algae amongst phytoplankton dominated the planktonic population, whereas at NTPC centre, microcrustaceans amongst zooplankton and diatoms amongst phytoplankton were the pre-dominant groups.

Impact of IFFCO wastes on river Ganga, Allahabad

Investigations revealed that the wastes, released @5000 cubic metres/day into river Ganga at Dumduma near Allahabad by IFFCO complex manufacturing mainly Urea @1550 tons/day, were characterised by high value of pH (8.4 to 8.6), free ammonia (8.0to 23.5 mg/l), alkalinity (140 to 460 mg/l), hardness (100 to 124 mg/l), chlorides (10.8 to 36.5 mg/l), specific conductance (1475 to 1530 micromhos/cm) and oil in traces. Heavy metals namely arsenic and chromium estimated by Atomic absorption Spectrophotometer inidcated presence of Arsenic (0.02 mg/l) and chromium (0.5 mg/l) in the effluent. The water of the river Ganga indicated normal conditions as revealed by water quality and planktonic organisms. Presence of ammonia upto 3.6 mg/l in 1 M depth samples was recorded during post-monsoon (November) and same was recorded in traces during monsoon. The water quality of river Ganga was characterised by pH (7.8 to 8.0), alkalinity (210 to 290 mg/l), chlorides (10.40 to 12.80 mg/l), dissloved oxygen (6.8 to 7.6 mg/l), free ammonia (nil) and specific conductance (68.12 to 71.56 micromhos/cm).

Soil: The soil samples indicated presence of heavy metals *viz.*, arsenic and chromium at a very high concentration. The soil samples of IFFCO nallah showed presence of very high arsenic content (31.0 ppm) and chromium (7.5 ppm). Arsenic was also present in the soil samples of Bairagiya nallah (3.6 ppm) and chromium content was not present in measureable quantities.

Plankton : The average plankton population ranged between 684/u l to 1312 u/l. The phytoplankton dominted over zooplankton at outfall and 300 m away from the outfall region. At the outfall region, phyto and zooplankton were 86.4% and 13.6% respectively. While 300 m away from the outfall, the phyto and zooplankton were 70% and 30% respectively.

At the outfall, phytoplankton was dominated by Myxophyceae (50.4%.), followed by Chlorophyceae (20.6%) and Bacillariophyceae (16.0%). Zooplankton was dominated by rotifers (6.0%) followed by copepods (5.2%) and cladocerans (2.4%).

300 m away from the outfall the phytoplankton was dominated by Chlorophyceae (40%), followed by Bacillariophyceae (18.0%) and Myxophyceae (12.0%). Zooplankton was dominated by rotifers (12.8%) followed by copepods (12.20%) and cladocerans (7.0%).

Amongst phytoplankton, Myxophyceae was represented by *Nostoc* and *Microcystis*, Chlorophyceae by *Ulothrix*, *Scenedesmus*, *Spirogyra*, *Crucigenia*, *Ankistrodesmus*, *Pediastrum*, *Zygnema*, and *Tetraspora* and Bacillariophyceae by *Navicula*, *Gyrosigma*, *Pinnnularia*, *Synedra* and *Asterionella*.

Amongst zooplankton, rotifers were represented by *Brachionus*, *Filinia* and *Polyarthra;* copepods by *Cyclops* and nauplii and cladocerans by *Bosmina*, *Diaphanosoma*, and *Daphnia*. *V. bengalensis* ($33/m^2$), *Carbicula* sp. ($19/m^2$) and chironomid larvae ($19/m^2$) constituted macrobenthic fauna.

Physiological experiments : Experiments were performed to study the effects of sublethal metal and pesticides on fishes. In *Cyprinus carpio* (Av. wt. 1.0 g) the metabolic rate of control fish (63/mg/kg/hr) increased to 91 and 127 mg/kg/hr during 24 hr and 96 hr exposure to 0.02 ppm mercury at 30°C. The random activity was also increased from 19 to 31 and 40 counts/hr during 24 hour and 96 hr respectively.

In *Tilapia mossambica* (Av. Wt. 5.1 g), the control metabolic rate increased from 73 to 83 mg/kg/hr at 30°C during 48 hr exposure to 0.01 ppm mercury. But the random activity was reduced from 11 to 4 counts/hr.

The standard metabolic ranges were found to be 75.3, 101.7, 113.7 and 140.2 mg/kg/hr in 0.01 ppm aldrin, and 9.31, 107.9, 127.7 and 145.0 mg/kg/hr in 0.02 ppm aldrin during 24, 48, 72 and 96 hr exposure respectively. During 96 hr exposure the negative trend in the rate of oxygen consumption in relation to activity at 0.02 ppm suggests that lower random activity is associated with higher metabolic rate.

The routine metabolic rate (mg/kg/hr) and random activity (counts/hr) were 147.8 and 110.0, 165.3 and 5.8, 119.5 and 3.3 and 95.8 and 2.0 for 0.01 ppm aldrin; 166.0 and 17.8 for 0.02 ppm aldrin during 5,10,15 and 20 days exposure respectively. From the results, it is clear that both metabolic rate and swimming activity are affected by sublethal aldrin.

Laboratory experiments on fish food organisms : Chemical toxicants *viz.*, $HgCl_2$, $CuSO_4$ and MEMC were screened for their toxicity. Lc 50 values of these toxicants with *V. bengalensis* as test animal for 24, 48,72 and 96 hours at $30 \pm 2°C$ were estimated at 0.555 mg/l, 0.5 mg/l, 0.45 mg/l and 0.356 mg/l respectively for $HgCl_2$, 3.4 mg/l, 3.25 mg/l, 2.8 mg/l and 2.4 mg/l respectively for $CuSO_4$ and 2.4 mg/l, 2.16 mg/l, 2.06 mg/l, 1.48 mg/l respectively for MEMC. In another set of experiments, Lc50 values of $HgCl_2$ at water temperature $20 \pm 1°C$ were estimated at 0.566 mg/l for 24 hrs and 0.365 mg/l for 96 hrs exposures period. Long term and short term experiments were conducted to determine the efiect of $CuSO_4$. Aldrin and $HgCl_2$ on survival and reproduction of *Ceriodaphnia cornuta*. Lc 50 values for 6 hrs were computed for $CuSO_4$ and $HgCl_2$ as 1mg/l and 0.07 mg/l respectively and for Aldrin 2.2 mg/l for 12 hrs. The water temperatures were in 33°C, 20°C and 20°C for $CuSO_4$, $HgCl_2$ and Aldrin respectively.

Long-term experiments : (i) *$CuSO_4$* : Experiments were conducted for 10 days at two temperatures *viz.*,

20°C and using 0.01, 0.05 and 0.1 mg/l of $CuSO_4$. It was observed that reduction in daphnid population, as compared with control, was 25%, 16% and 80% in 0.01,0.05 and 0.1 mg/l of the toxicant.

(ii) *Aldrin* : Experiments were made for 3 weeks at water temperature 20±1°C using 0.001, 0.003 and 0.004 mg/l of toxicant, respectively.

(iii) $HgCl_2$ Experiments were conducted for a weeks at a water temperature 32±1°C using 0.001 and 0.003 mg/l of $HgCl_2$. A reduction of 25% and 10% in population of *C. cornuta* was observed in former and latter respectively when compared with control.

Fish : Lc50 values of Aldrin (30% EC), $CuSO_4$, and $HgCl_2$ with respect of *Cyprinus carpio* (TL 4.5-5.6 cm) ranged from 0.0019 mg/l (96 hr) to 0.0021 mg/l (24 hr), 0.195 mg/l (96 hr) to 0.255 mg/l (24 hr) and 0.10 mg/l (96 hr) to 0.135 mg/l (24 hr) respectively.

Effects of pesticides on fish blood (RBC) and haemoglobin (Hb): *C. mrigala* (Av TL: 105 mm) and *L. rohita* (Av TL: 80 mm) were treated with 0.05 ppm of BHC whereas, *C. catla* (Av. TL: 152 mm) was given a treatment of 0.02 ppm of DDT. In case of *C. mrigala* and *L. rohita*, the blood samples after 30 days of exposure showed a decline in Hb and RBC when compared with. control. The mean values of blood samples for *C. mrigala* and *L. rohita* were found to be: Hb 3.89 %, RBC 1.95×10^6/mm³/100 ml of blood respectively. *C. catla* was observed in distress after 2 hrs of exposure. Blood samples were collected after 2,4,8 and 12 hrs. A reduction in RBC content and an increase in Hb were observed. After 8 hrs. of exposure, the mean values for Hb and RBC were found to be 8.3 g% and 0.72×10^6 mm³/100 ml of blood.

The findings indicate that the *C. catla* is more susceptable to pesticide hazards than the other major carps on account of lesser numbers of RBC in its blood. This also provides a plausible explanation for early surfacing of this fish in oxygen deficient waters when compared to other carps.

Project No FC/A/1 : Ecology and fishery management of peninsular tanks

Personnel : B.V. Govind (upto April, 83), S. Sivakami (Smt), S. Ayyappan, P K. Sukumaran and S. L. Raghavan

Duration : 4 years (1983-86).

Location : Bangalore

TURUNGANUR TANK

Ecological studies : Monthly observations on the hydrobiological parameters of Turuganur tank (21ha) near Mandya were made.

The atmospheric temperature ranged between 21.5 and 35.0°C. The water temperature varied from 24.5°C in January to 34.0°C in June. The ranges of other parameters are as follows:-

Dissolved oxygen (ppm)	4.20—12.40
pH	7.0—9.2
Free carbon dioxide (ppm)	0—14.4
Carbonate alkalinity (ppm)	0.0—30.0
Bicarbonate alkalinity (ppm)	36.96—224.0
Sp. conductivity (μmhos/cm)	86.96—153.72
Nitrate nitrogen (ppm)	Tr —0.557
Phosphate phosphorus (ppm)	Tr —0.0075
Silicate (ppm)	Tr —0.052
Iron (ppm)	0.02—0.05

Primary Production: The gross primary production in the water ranged from 29.04 to 448.47 mg C/m³/h, the highest recorded in October. Net primary production values varied from 11.25 to 256.27 mg C/m³/h (October) while respiration was high during September (209.25 mg C/m³/h).

Plankton: Plankton collections were made from surface water at four stations. The settling volume varied between 1 and 14 ml/m³. The other parameters analysed were wet weight (0.05—1.0 g/m³), dryweight

(0.01—0.04g/m³) and total counts (92,000 to 21,08,000/m³). Zooplankton was higher in quantum than phytoplankton. The latter was mainly comprised of *Microcystis*, *Ulothrix*, *Pediastrum* and *Pinnularia*. Rotifers (*Brachionus*, *Keratella*, *Filinia*), cladocerans (*Bosmina*, *Daphnia*, *Moina*) and copepods formed the bulk of zooplankton. The aquatic vegetation comprised of *Hydrilla*, *Ceratophyllum*, *Potamogeton*, *Nelumbo* and *Vallisnaria*.

Littoral fauna: The density of littoral fauna ranged from 1-90 u/m² by number and 0.002-1.775 g/m² by weight. The organisms recorded were—insects (*Ranatra*, mayfly and damselfly nymphs, dragon fly nymphs,) molluscs (*Bythinia*, *Gyraulus*), fish fry and prawns (*Macrobrachium*).

Sediment: The sediment samples were silty in texture with the pH in the range of 6.5 to 8.0. The specific conductivity values were in the range of 29.28-510.00/μ mhos/cm. The other parameters analysed were available nitrogen (7.03-37.24 mg/100 g), available phosphorous (0.00-7.19 mg P 05/100g), free calcium carbonate (1.0-6.0%) and organic carbon (0.38-2.75%).

Fishing: Gill netting operation in the tank during March, 1983 yielded a total catch of 626.25 kg of fish comprising of *Labeo rohita*, *Cirrhinussp*, *Cyprinus carpio* var. *communis*, *L. calbasu*, *Puntius sarana*, *C. reba*, *Mystus cavasius*, *Mastacembelus armatus*, *Channa striatus*, *Clarias batrachus* and *Notopterus notopterus*.

Two more perennial tanks around Bangalore, *viz*, Yalahanka and Bandemata tanks have been selected for ecological investigations under the project. The studies have been initiated in November, 1983.

SANKEY TANK

Microbiological studies : Monthly hydrobiological collections along with microbial analyses of water (surface and bottom) and sediment samples of Sankey tank, Bangalore, were carried out. Studies on the decomposition rates of organic substrates were started in April, 1983. Quarterly diurnal studies of the water quality and plankton were initiated during May, 1983.

Physico-chemical conditions : The atmospheric temperature ranged from 20.0 to 25.0°C. The average depth at the first station was 4.5 m and at the second 2.5 m. The variations in the water temperatures were 21.0°C-27.0°C (surface) and 20.5°C-26.5°C (bottom). With the turbidity values below 100 ppm, Secchi disc transparency was around 50 cm. Ranges of other paramerers were as follows:-

Parameters	*Surface*	*Bottom*
Dissolved oxygen (ppm)	3.2—8.43	2.94—6.14
pH	8.0—8.8	8.0—8.7
Free carbon dioxide (ppm)	0—8.0	0—8.0
Carbonate alkalinity (ppm)	0—32.0	0—20.0
Bicarbonate alkalinity (ppm)	72.0—176.0	76.0—188.0
Hardness (ppm)	40.0—96.0	40.0—96.0
Nitrate nitrogen (ppm)	Tr —0.10	Tr —0.10
Phosphate phosphorus (ppm)	Tr —0.0163	Tr —0.0195
Silicate (ppm)	Tr —0.15	Tr —0.25
Iron (ppm)	0.01—0.51	0.01—0.525
Dissolved organic (ppm)	0—11.8	0—13.0
Sp. conductivity (μmhos/cm)	129.32—268.40	129.32—270.80

The ranges of parameters in the diurnal studies on water quality during the months of May, August and November were as follows:

Months	*May*	*August*	*November*
Atmospheric temperature (°C)	22 0—32.52	1.5—28.0	20.0—25.0
Water temperature (°C)	26.0—31.0	24.5—26.5	21 5—25.0
Dissolved oxygen (ppm)	1 82—9.58	1.6—6.4	3.2—5.2
pH	8.3—9.1	8.0—8.5	7.0—8.5
Free carbon-dioxide (ppm)	0—8	0—8	2.0—5.6

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Months	*May*	*August*	*November*
Carbonate alkalinity (ppm)	0—20	0—20	—
Bicarbonate alkalinity (ppm)	88—130	106—136	116—128
Specific conductivity μmhos/cm)	205—273	141—205	158—268

Primary production: The primary production values were higher in the surface waters. The ranges of values in the two levels were as follows:

Parameters	*Surface*	*Bottom*
Gross production (mg C/m³/h)	83.1—554.8	142.7
Net production („)	upto 474.9	27.1
Respiration („)	40.0—438.4	133.3

The diurnal variations were as follows:

Gross production values (mg C/m³/h)	*May*	*August*	*November*
Day	upto 324.7	upto 14.2	15.6 —109.4
Night	14.4—99.7	„ 50.0	upto 15.6

Plankton: The settling volume of plankton ranged from 1 to 14 ml/m³, in the month of June and August values were higher. The wet weight varied between 0.9 & 2.8 g/m³ and the dry weights were in the ranges of 0.17 to 0.6 g/m³. The total counts varied from 109000 in October to 2464000/m³ in June. The phytoplankton in the net plankton was meagre. Rotifers (*Brachionus* spp), cladocerans (*Bosmina*, *Moina*, *Daphnia* and *Disphanosoma*) and copepods (Diaptomus and larval forms) were the main constitutents.

The diurnal variations were as follows:

Parameters	*May*	*August*
Settling volume (ml/m³)	3-26	3-30
Wet weight (g/m³)	0.20—2.15	0.7—4.40
Dry weight (g/m³)	0.03—0.60	0.22—1.35
Total count (No/m³)	324000—218600	1400000—3432000

Benthic and littoral fauna: The bottom fauna of the tank ranged from 44 to 244u/m² and 0.08 to 6.68 g/m² by weight. *Chaoborus* and chironomid larvae were the forms encountered. The littoral fauna varied from 7 to 201/m² in number and 0.09 to 5.94 g/m² by weight. Mayfly and damsel fly nymphs, insects (*Belostoma*, *Ranatra*, *Gerris*), molluscs (*Lymnaea*, *Gyralus*, *Goniobasis*, *Bythinia*, *Melania*), fish fry (*Aplocheilus*, *Tilapia*, *Glossogobius*) and minor prawns (*Macrobrachium* and *Caridina*) formed the bulk of littroal fauna.

Sediment: The sediment depth in the tank varied from 0.5 m to 2.25 m. The clayey sediment remained slightly alkaline, with pH ranging between 7.05 and 8.0. The parameters analysed and their ranges were : specific conductivity (275.72—634.40 μmhos/cm), available nitrogen (19.85-85.50 mg/100 g), available phosphorus (1.87—17.44 mg P$_2$O$_5$/100 g); free calcium carbonate (1.86—5.04%) and organic carbon (2.50—6.00%).

Decomposition studies: The vertical variations in the rates of microbial decomposition of organic substrates were measured by providing leaves of *Eichnornia*, filter paper (cellulose) and silk (protein) on bamboo poles, for a usual period of fifteen days. The decomposition loss in case of leaves varied from 13 to 95% during the different months, with high values in column water. June recorded higher loss rates. The loss of filter paper was upto 55% in April, towards the sediment-water interphase. Decomposition of the silk base was low (upto 33%), with higher values in bottom waters.

Microbial analyses : Surface and bottom water and sediment samples (two stations put together) were analysedfor some of the bacterial groups involved in nutrient cycles from April, 1983 onwards. The groups and ranges were as follows:

Group	Surface Water (No/ml)	Bottom Water (No/ml)	Sediment (No/g)
On sodium caseinate agar	148—1775	165—1230	17750—172500
Ammonifiers	320—1320	100—1400	7600—50000
Nitrifiers—I (mpn)	10—134	10—67	333—1334
Nitrifiers-II (mpn)	33—667	33—333	67—1334
Aerobic nitrogen fixers (PC)	5—80	8—63	24—600
Anaerobic nitrogen fixers(mpn)	3—67	3—100	33—1000
Urea decomposers (PC)	8—211	8—250	100—7500
Inorganic phosphorus solubilisers (PC)	10—170	12—120	283—1600
Anylolytic bacteria (*PC*)	18—102	20—186	625—3040
Aerobic cellulose decomposers (mpn)	1—67	1—33	10—667
Anaerobic cellulose decomposers (mpn)	33—67	33—67	333—1000
Methane producers (mpn)	1—67	1—67	10—667
Protein decomposers (producing sulphide (mpn)	10—169	10—195	100—3667
Iron bacteria (mpn)	33—67	33—100	333—667

PC=Standard dilution Plate Count Technique using agar medium

mpn=most probable number method using liquid medium

It is proposed to take up studies on bacterioplankton, nutrient exchange, vertical distribution of nutrients in sediment and diel nutrient variations, diurnal oxygen changes and sediment respiration, gas production at the bottom, additional microbial analyses and experiments on nutrient enrichment and specific bacteria cultures.

Project No. FC/A/2 : Ecology and fishery management in small reservoirs/lakes in alluvial ecosystem.

Personnel : Ravish Chandra, S. N. Mehrotra D. N. Singh, K. P. Srivastava, R. K. Dwivedi, M. A. Khan, R. K. Saxena, R. A. Gupta and Neelima Sharma.

Duration : 1983-87

Location : Allahabad

BACHCHARA RESERVOIR

Hydrological Studies: Hydrological studies were continued. The nutrient studies of the reservoir was found to be of moderate order. The values of individual parameters were as under:

Item	Range	Minimum	Maximum
1. Water temp.	17—33°C	January	July
2. Transparency	28—120 cm	April	January
3. pH	7.6—8.3	July & Sept.	June
4. Free CO_2	2.6—4.0	Sept. Zone I	Sept. Zone II & III
5. Alkalinity	120-162 ppm	Feb. & August	July
6. Hardness	34.45 ppm	Feb.	July
7. Calcium	19.0—24.00 ppm	Sept.	May, June & July
8. Nitrate	0.11—0.16 ppm	April	July and August
9. Phosphate	0.08—0.15 ppm	Feb. & April	July

Item	Range	Minimum	Maximum
10. Silicate	7.8—12.2 ppm	Feb.	August
11. D.O.	5.6—7.8 ppm	June	January
12. Specific conductivity μmhos/cm.	248-376	January	June
13. Primary organic production.			
(a) Net	375—100 mgC m^3/hr	August	May
(b) Gross	50—112.5 mgC m^3/h	Aug & Sept.	May
(c) Respiration	12.5—25 mgCm^3/hr	Jan., Feb., & April.	June

The soil of the reservoir was found to have near neutral pH, whereas, organic carbon varied between 0.84 and 0.9% $CaCO_3$ showed narrow fluctuation (2.0—2.4%). Available nitrogen and available phosphorus were found to be 25.4 mg/100 g and 2.4—2.6 mg/100 g respectively.

Plankton: Average plankton population was estimated to be 346 u/l, with a peak during March and trough during September. Phytoplankters, forming 62.8% of the total plankton population were dominated by Chlorophyceae (32.6%), followed by Bacillariophyceae (18.4%) and Myxophyceae (11.8%). *Oedogonium, Spirogyra, Pediastrum, Scenedesmus, Microcystis, Anabaena, Oscillatoria* amongst algae; *Navicula, Synedra, Surirella, Gomphonema* amongst diatoms dominated over other forms. *Cyclops, Microcyclops, Bosmina, Ceriodaphnia* and their nauplii dominated amongst microcrustaceans. The main forms of rotifers were *Brachionus, Keratella, Polyarthra, Lecane* etc.

Macrobenthos : macrobenthic fauna of the Bachchara reservoir ranged between 342 and 950 u/m^2, maximum in June and minimum in August. They were dominated by insect larvae (59.9%) annelids (33.1%) and molluscans (7.0%). The insect larvae were represented by species of *Chironomus, Chaoborus, Phylopotamus* and Coleoptera ; annelids by *Aulodrilus, Pluriseta* and *Branchiura sowerby* ; and molluscans by *Pisidium, Parreysia, Indonaia,* Lamellidens (Bivalves), *Melanoides, Viviparus Gyraulus, Lymnea* and *Indoplanorbis.* No significant variation between the zones was observed.

Periphyton : Only two observations, during August and October were made. The important genera encountered were *Phormedium, Aphanocapsa, Protodirune, Stigeogonium* (Myxophyceae) *Oedogonium and Navicula.*

Experimental fishing:

Experimental fishing using 12 pieces of multimeshed gill nets (40-119 mm mesh bar) were conducted from February onwards. A total of 82.34 kg of fish comprising 74.63 kg of major carps, 0.95 kg of catfishes, 3.79 kg of minor carps and 2.97 kg of featherback were harvested. Major carps were dominated by *C. mrigala* (29.62 kg ; 17specimens)followed by *L. rohita* (12.3 kg; 17specimens). Only 4 specimen of *C. catla* weighing 3.25, 3.00, 0.250 & 0.24 kg were caught. Catfishes did not appear to be much as evidenced by the fact that only 2 specimen of *S. silondia.* weighing 0.95 kg were caught. Minor carps were dominated by *P. sarana* forming 2.97 kg (9 specimen). Featherback group was represented by *N. notopterus* (2.97 kg, 14 specimen)

Pre-and post-recruitment studies

(a) Pre-recruitment studies: Observations on the fish spawning were made for about 40 days in the upper reaches of the reservoir. No evidence of any spawning was observed as reflected by non-availability of either spawn or hatchlings.

(b) Post-recruitment and escapement studies :-

Samples within the reservoir and in the escapement channel were taken by operating cast nets. The samples revealed only the presence of wild fishes *viz., A. nama, O. cotio, P. stigma, P. sophore* and other miscellaneous fishes *Viz, M, cavasius, O. pabda, G. mullaya* etc. No major carp fingerling was encountered.

Induced breeding : No experiment could be done due to non-availability of breeders.

Rearing of major carps in pens:

Two pens of 1/40″ and 1/60″ mesh size of nylon material were installed in the reservoir but due to heavy draw down of water through irrigation channel the pens could not be inundated till September. However, during October two pens were inundated and were stocked with 900 major carp fingerlings. Heavy mortality occurred due to sudden decrease in the water level. The remaining stock had to be released in the reservoir.

Stocking and tagging:

About 5000 fingerlings and yearlings reared in the Jail Nursery from the riverine spawn and seeds received from Calcutta were stocked and 600 specimen (12%) were tagged using anchor tags.

Fish biology : Observations on the feeding habit of *L. calbasu*, *C. mrigala* and *L. rohita* are being made.

Mc PHERSON LAKE

Hydrology:

Four hourly observations of water with respect to water temperature, pH, dissolved oxygen, free carbon-dioxide, carbonate and bicarbonate showed that water temperature and pH was highest generally between 14 and 18 hrs. Dissolved oxygen study showed maximum variation in the month of March and minimum during winter months. Free CO_2, carbonates and bicarbonates also showed maximum variations during summer months and minimum during winter.

Monthly observations indicated that the hardness ranged between 92 to 126 ppm and specific conductance between 271 to 582 μ mhos/cm. Nutrient content of the lake was also high.

Soil analysis:

Soil analysis showed pH from 5.8 to 6.0, organic carbon from 2.5 to 3.8%, available nitrogen from 45.5 to 50.5 mg/100 g soil and available phosphorus from 11.8 to 13.1 mg/100 g soil.

Plankton:

Zooplankton population dominated (59.78%) over phytoplankton (40.22%). Macrocrustaceans were the dominant forms among zooplankton. Population of rotifers was also rich compared to other forms of zooplankton. Chlorophyceae was the dominant group among phytoplankton both quantitatively and qualitatively followed by Myxophyceae and Bacillariophyceae. Diurnal plankton study did not show much fluctuation in most of the forms, However, nauplii, *Keratella* spp. and *Brachionus* sp showed clear diurnal fluctuations. Their population was rich at the surface during morning hours (7 to 8 hrs) and again in the evening (6 to 8 hr) It was observed that phytoplankton population did not show much movement despite higher temperatures of the surface because of choking by aquatic weeds as they got shelter underneath.

Dry wt of phytoplankton could not be done due to the presence of lot of colloidal particles and detritus throughout the water column of the lake. Productivity was measured by dark and light bottle technique.

Macrobenthos: Benthic population in the lake was negligible. However, the macro-invertebrate fauna associated with macrophytes was quite rich. Molluscs (1004 nos/sq m/year) and insects with their larvae (1279 nos./sq m/year) dominated the collections. Annelids (523 nos/sq m/year) were also recorded in appreciable quantity. Population of ostracods (138 nos/sq m/year) was the lowest observed. With this study it appears that the bottom fauna, due to obnoxious gases like CO_2 and H_2S at the bottom layer of soil, have moved up to get shelter and food amongst the aquatic weeds.

Periphyton: Periphyton population was recorded between 14 to 22.5 mg/m²/day, diatoms dominated in terms of species.

Macrophytes: Lake was observed to be chocked by aquatic weeds like *Hydrilla*, *Potamogeton*, *Azolla*, *Vallisneria* etc. Yearly average standing crop was recorded to be 907.08 g. dry wt/m². Minimum dry wt biomass was observed in the month of August (235 g/m²) and maximum during April (1777 g/m²).

Energy utilisation: Detritus biomass was higher during summer months (42.5 g/sq m dry wt in May) as well as the dry biomass of aquatic weeds (1777 g/m² in April). This shows the maximum energy utilisation in the lake water was during this period as reflected by higher diurnal variation of oxygen. It was observed that the production and consumption was almost balanced in this ecosystem during most of the months of the year.

Project No. FC/A/3 : Ecology and fishery of Dhir beel in Assam

Personnel : Y. S. Yadava, M. Choudhury and V. Kolekar (Till 31.8.83)

Duration : 1981-83

Location : Gauhati

Catch statistics: During the period under report a total of 79.8 m. tons of fishes were estimated to have been caught from Dhir beel as compared to 110.6 m. tons during the corresponding period of the previous year, thereby showing decline in the catch by 27.83%. Details of groupwise and specieswise landings are presented in table.

Table : Groupwise landings at Dhir beel (Dec. '82 to Nov. '83)

Group	Total (kg)	%
Major carps	13,963	17.49
Minor carps	1,051	1.32
Cat fishes	10,358	12.97
Featherbacks	3,296	4.13
H. ilisha	10	0.01
G. chapra	22,404	28.06
Miscellaneous	18,760	23.50
Live fishes	9997	1.52
Total	79,839	

The usual methods of fishing were adopted during the year under report, the only exception being the use of 'ghurni berr' instead of 'Ghayel'. The former was preferred due to the excessive sub-merged vegetation in the beel specially during the post-monsoon months.

Production in the beel ranged from 5 kg/ha/month (June 1983) to 67 kg/ha/month (December 1982). The average monthly production was 31 kg/ha whereas, the annual production worked out to be 372 kg/ha/yr. Winter months yielded maximum fish while in monsoon the catch was minimum.

Plankton analysis : The overall monthly plankton during the period was 1,27,599 u/l which consisted 67,641 u/l of phytoplankters and the rest of zooplankters at surface, while at bottom, it was 14,61,302 u/l which consisted of 12,53,836 u/l of phytoplankters and the rest zooplankters.

In the surface samples Myxophyceae (31,993 u/l) dominated over Chlorophyceae (22,833 u/l), Bacillariophyceae (8,480 u/l) and Desmidiaceae (4,335 u/l) among the phytoplankters. Among the zooplankters, protozoans (23,975 u/l) dominated over copepods (18,098 u/l), rotifers (12,910 u/l) and cladocerans (4975 u/l).

In the bottom samples Bacillariophyceae (5,18,147 u/l) dominated over Chlorophyceae (3,85,366 u/l), Myxophyceae (2,41,667 u/l) and Desmidiaceae (45,333 u/l), among the phytoplankters. Among the zooplankters copepods (76,200 u/l) dominated over rotifers (65,600 u/l), protozoans (49,000 u/l) and cladocerans (16,666 u/l).

Fortnightly water samples were collected from the surface and bottom levels of the three sectors of the beel and analysed for pH, dissolved oxygen, CO_2, total alkalinity, hardness, Iron, Calcium, Magnesium, Ammonical nitrogen, Nitrate nitrogen, Silicate, Phosphate, dissolved organic matter and electrical conductivity. Air and water temperature during the period ranged from 18.7°C to 31.0°C and 18.8°C to 32.2°C in the surface and bottom levels respectively. Transparency varied from 71.0 cm to 131.2 cm and depth from 99.8 cm to 413.2 cm.

Primary production : Gross and net primary production in surface and bottom waters ranged from

nil to 562.5 mgC/m³/hr and nil to 156.25 mgC/m³/hr respectively. Respiration ranged from nil to 750.0 mgC/m³/hr.

Soil was analysed for texture, pH, organic carbon, phosphorus and potash. In sector II and III it ranged from 4.67 to 6.31 and 4.65 to 6.90 respectively. Phosphate registered high values during March, April and May in all the three sectors.

Macrobenthos : The average occurrence of macrobenthos was 3,394 Nos/m². It comprised mainly of gastropods (2,382 Nos/m²), pelecypods (654/m²), oligochaetes (160/m²), Diptera larvae (125/m²), Coleoptera and Odonata (17/m²), *Hirudinea* (11/m²), etc. Gastropoda dominated throughout the year.

Macrovegetation : The macrovegetation density in the three sectors of the beel ranged from 0.723 to 0.959 kg/m² (wet weight) and 0.067 to 0.0763 kg/m² (dry weight). The vegetation consisted of rooted and submerged types and infestation was more severe during winter months.

Project No. FC/A/4 : Ecology and fisheries management in beels of West Bengal.

Personnel : S. B. Saha, V. Pathak and M. J. Bhagat.

Duration : 1980-1985

Location : Barrackpore

Due to unprecedented drought condition, the Kulia beel, Kalyani, under study, got completely dried up this year (1983). Last year's total rainfall was also much below normal.

This years rainfall was also scanty, catchment drainage filled only part of the beel. Average depth was 0.5 m and in the deeper parts 1 m. Therefore the work only was started is the 2nd half of 1983.

Occurrence of zooplankton (200-296n/l) was more compared to phytoplankton (116n/l) in initial stage but gradually phytoplankton increased (phyto 186n/l Zoo 70n/l). No regular stocking could be done. Only partial stocking and harvesting was made. Fish production was comparatively negligible. No pen culture experiment could be undertaken.

From Dec. '83 one new perennial beel (Media) at Gobardanga in 24, paraganas Dt. was selected for further study with pen culture facility. This is an open beel (baor) with water area of approximately 100 ha and managed by fishermen's co-operative society. This is a semicircular beel separated into 2parts by one pukka road with big culverts. Regular hydrobiological samplings and other related experiments are being conducted in this beel.

In Kalyani beel—soil and water quality indicated productive nature of the ecosystem. Basin soil was slightly acidic and the major nutrients viz. nitrates, phosphorus and organic carbon were quite high. The primary productivity studies indicated that gross and net primary productivity were of the order 634 and 412 mg C/m³/day respectively.

Plankton fluctuation during the year was 5,10,000 to 3,712,000 u/m³. The cycle of standing crops of total plankton indicated June and December as peak and trough periods respectively.

Project No. FC/A/6 : Economics of fishing in reservoirs—A case study of selected reservoirs

Personnel : S. Paul, V. V. Sugunan and H. K. Sen

Duration : 1983-85

Location : Barrackpore

The work was initiated by sending questionnaires to the concerned respondents in respect of seven states. Necessary data have been received from the states of Gujarat and Tamil Nadu and these are being processed

and tabulated. Besides this, available secondary data are also being examined.

Project BF/B/1 : **Ecology and productvity management of brackishwater ponds.**

Personnel : R. K. Chakraborty, D. D. Halder, M. L. Bhowmik, S. K. Mandal and D. Sanfui.

Duration : 1983-1986.

Location : Kakdwip.

Rangafala fish farm with a big shallow area and good natural food concentration and organic carbon content proved to be conducive for growth and production of brackishwater fishes and prawns. But due to inadvertent entry of *Lates calcarifer*, survival was vary poor for *P. monodon* in both the ponds. An average growth of 40 mm/month during the first 3 months and 10-15 mm/ in next 2 months was observed.

Project BF/B/2 : **Ecology and management of bheries.**

Personnel : G. N. Saha, S. C. Thakurta, G. C. Laha, H. C. Karmakar, P. B. Das and N. M. Majumder.

Duration : 1982-1986.

Location : 24 Paraganas, West Bengal.

Ecological and inventory studies were conducted in selected bheries located in different saline zones at Sunderbans, West Bengal. These ranged from high saline zone at Golabari through medium saline zone at Haroa (sewage-fed Kulti estuary region) to low saline area at Kharibari. Maximum salinity recorded was 37.8% at Golabari in June and the minimum was 0.54-0.64% in low and medium saline zones during October. At the latter two areas, the maximum salinity recorded was 8.6 and 15.8 ppt respectivety, during April-May. The electrical conductivity values also ranged accordingly. The analysis of water and soil samples during the year gave the following average values.

Place	*Kharibari*	*Haroa*	*Kulti* (*Sewage-fed*)	*Golabari*
Zone	I	II		III
Water phase				
pH	7.8	7.9	7.9	8.0
E. C. (micro mhos/cm)	6215	8883	10218	23039
Salinity (ppt)	4.12	5.4	5.7	20.8
Total alkalinity (ppm)	155.0	148.0	146	107.0
P_2O_5 (mg/100 g)	0.06	0.07	1.30	0.31
NO_3-N	0.05	0.06	0.93	0.04
Soil phase				
pH	7.6	7.6	7.7	7.6
E. C. (micromhos/cm)	3849	4448	4381	15441
P_2O_5 (mg/100g)	8.5	10.0	26.0	10.7
Org. carbon (%)	1.28	1.04	1.34	1.00
Primary Productivity (mg cm^3/h)	196.3	162.5	105.0	263.0

The pH of soil and water did not vary much at different Zones. P_2O_5 and NO_3-N recorded highest in sewage-fed bheri at Kulti. Higher values were also observed at high saline bheri at Golabari. Primary productivity was highest at this zone.

Inventory survey : The survey was designed to cover an area coming under the jurisdiction of 13 police stations. Part of the areas, coming under eight police stations, viz. Gosaba, Parthapratim, Rajgarh, Baduria, Swasupnagar, Gaighata, Hingalgunga and Bhangar (total 15,179.4 ha) was covered during the year. The 414 bheris were recorded from this area ranging from 0.25 ha to 715 ha. Low saline bheris were generally seasonal. Medium and high saline bheris were either seasonal or perennial.

Paddy-cum-fish culture was more practical in medium and low saline areas. On the basis of the survey, it was estimated that the annual production per hactare of fish and prawn ranged from 281 to 3817 kg, 1192 to 2376 kg and 277 to 3440 kg in low medium and high saline zones respectively. The contribution by *P. monodon* to total production was 8.39 % in low saline zone, 17-33% in medium saline zone and 7-14% in high saline zone. M. *rosenbergii* cultured in low saline zone formed 2.6% of total catch and 12% in freshwater sewage fed bheri. Indian major carps were cultured in all areas except high saline zones. Mullets were there in all the zones. Labourers employed in bheri fishery form two categories : (i) Casual workers on daily wage basis at the rate of Rs. 8.10/day and regular workers on whole time basis with a monthly salary of Rs. 200-300/month with food and lodging.

Project BF/B/3 : **Ecology and Fisheries of Hooghly-Matlah estuarine system.**

Personnel : K. K. Ghosh, P. M. Mitra, H. C. Karmakar, M. M. Bagchi, D. K. De, S. B. Saha, V. V. Sugunan, V. K. Unithan, G. K. Vinci (Mrs.) A. R. Chowdhury, R. N. De, S. N. Sar, H. S. Majumdar, A. K. Roy, N. D. Sarkar, N. C. Mondal and A. R. Paul.

Location : River Ganga down stream of Farrakka Barrage.

Hilsa Catch Structure : During the 12 months period Nov. 82-Oct. 83 an estimated total of 1295.8 tonnes of hilsa comprising 22.6% of the total fish landings (5734.9) was landed from the Hooghly estuary as against 31% in the corresponding period of the last year. Barring the two bumper catch, 71-72 and 81-82, the catch of hilsa during the aforesaid period was only 13% less than the average catch (1500t) in the earlier years. The low catch of hilsa compared to 81-82 was mainly due to very poor winter catch particularly at Digha. The early monsoon catch of hilsa this year was also very poor. This is probably due to poor rainfall in early monsoon. The landing of hilsa in late monsoon period of this year was, however, good. About 643.2 tonnes comprising about 50% of total hilsa landings during the period under review was landed in the month of August and September 1983. During the 4 months period July-Oct., which is usually the period of monsoon run of hilsa, an estimated total of 871t, comprising 67% of total hilsa landings, was landed from the estuary as against the range of 211.9 t to 793.3 t landed in the corresponding period in the six year period 72-78 and 743.2 t and 1184.0 t in 81 and 82 respectively.

Effort and CPUE pattern of different hilsa gears : The effort and CPUE for different hilsa gears in mid-estuary in the monsoon of 1983 was much lower (30-50%) compared to 1981 and 82 but more or less of the same order compared to 1973-76. The effort in Rupnarayan was about 24% lesser compared to 1982 but 15-37% higher compared to 1981 and 73-76 and CPUE was 100% lesser than in 1982 but more or less of the same order as in 1981 and 73-76. In the upper stretch the effort by two hilsa gears, namely purse net and set-gill were almost of the same order as in 1981 and 82, but the effort by drift gills were 50% higher compared to 81 and 82, while CPUE was about 36% and 26% lesser for purse net compared to 82 and 81 respectively, 100% and 30% lesser for drift gills compared to 82 and 81 respectively and for set-gill it was more or less of the same order as in 82 and 81. Compared to 1973-76, the effort by different hilsa gears in the freshwater zone were much higher in 83 but the CPUE was more or less of the same order. The zonewise total hilsa catch, effort, CPUE by different hilsa gears in 1982-83 and 81-82 are shown in the table.

Other species : The other species which dominated the catch during this period were prawns (554.1 t, 9.7% of the total catch), *H. nehereus* (281.9 t, 4.9% of the total catch), *S. cinereus* (247.9 t, 4.3% of the total catch), *S. phasa* (245.2 t, 4.3% of the total catch), *P. pama* (221.5t, 3.9% of the total catch).

Inventory of gears : The census of active of fishermen engaged in the fishing in Zone I, II and IV of the Hooghly system and their holdings in terms of boats, gears and fishing (implements) was completed. This inventory survey was executed alongside normal catch survey. This inventory was being taken afresh since the last inventory pertains to 1956-58. In Zone I (Nabadwip to Baranagar near Calcutta) for which inventory was completed this year, the structural change in gear inventory was very significant. Preliminary analysis showed that like in Zone II and IV (salient results of these two zones were reported last year) a marked decline in seines, purse (or clap) lift nets, longlines was observed in Zone-I. Trawl and trapnet, which did not operate in Zones II and IV, also showed a marked decline in Zone-I. Like Zones II and IV, the most marked increase has been in hilsa gill nets. Drift gills, a gear mainly used for catching hilsa, at an average growth rate of 2% per year increased from 49435 in 56-58 to 67966 in Zone-I, the percentage increase being 37. Set-barrier nets, like in other two zones, also showed marked increase in Zone-I. But unlike in Zone-II and IV bagnets decreased from the 1956-58 level of inventory in Zone-I. The decline in purse nets, seines, lift nets and such low catch per unit effort (CPUE) gears in faovur of high CPUE gears in reflective of economic factor of income from fishing. Salient results of inventory in Zone I are tabulated below :

TABLE : No of pieces of net held in Zone-1

	Trawl	Small Seine	Large Seine	Purse	Drift	Lift	Cast	Bag	Set gill	Set barrier	Traps	Hooks & Lines
1956-58	1067	9204	9375	12329	49435	3648	4635	887	680	1311	6386	186
1982-83	439	6595	1413	4330	67975	1483	2434	582	1176	2132	4490	136

Catch of hilsa at Farakka was 236.1 t during 12 months period from Nov. 1982 - Oct. 1983 as against 142.2 t in the corresponding period last year.

TABLE : Zone-wise total hilsa catch, effort and CPUE by different hilsa gears in 81-82 and 82-83.

Zone	*Gear*	*Catch (kg)*		*Effort (net-tides)*		*CPUE (kg)*	
		81-82 (Nov.-Oct.)	82-83 (Nov.-Oct.)	81-82 (Nov.-Oct.)	82-83 (Nov.-Oct.)	81-82 (Nov.-Oct.)	82-83 (Nov.-Oct.)
I	Purse	88574	75771	232095	258815	0.38	0.29
	Drift	235169	274045	383050	583740	0.61	0.47
	Set-gill	93860	159002	35190	34483	2.67	4.61
	Bag	974	12446	—	—	—	—
II	Drift	356791	59831	99386	58847	3.59	1.02
	Bag	—	2255	—	—	—	—
III	Drift	5779752	586331	—	—	—	—
IV	Drift	330115	120048	134854	89567	2.45	1.34
	Bag	—	6093	—	—	—	—
Total		6885235	1295822				

Ecological studies : The ecological study reveals that the freshwater zone of the estuary extended upto the confluence of *R. Rupnarayan* with Hooghly (salinity range of confluence ; Nurpur : 21-596 ppm) and gradient salinities were observed at Kakdwip (7.5-18.1 ppt). Highest salinity values were recorded at Digha (11.2-31.0 ppt) and Canning (6.3-33.0 ppt). Specific conductivity, hardness and other chemical parameters showed similar trends. The pH ranged from 7.9-8.5 and DO from 5.2-8.8 ppm in the entire stretch under study.

The primary productivity was found to be higher (maximum GPP 78.12-16.328 mg C/m/hr., maximum NPP 62.50-109.3 mg C/m /hr.) in the upper stretch from Medgachi to Farakka, in comparison to that at Nawabgunj (maximum GPP 25.0 mg C/m /hr., maximum HPP 46.87 mg C/m /hr.) lying in the industrial belt. Highest values were recorded in the marine zone at Digha (maximum GPP 187.5 mg C/m /hr. and maximum HPP 203.1 mg C/m /hr.) and at Port Canning on the estuary of Matlah (maximum GPP 163.3 mg C/m /hr. and maximum NPP 149.2 mg C/m /hr).

The soil analysis results indicate that the soil pH ranges from 6.9-7.2 in the entire stretch and the C/N ratio ranges from 4.0-15.1 in the Hooghly-Matlah-Rupnarayan ecosystems, whereas it is much less at Digha (1.6-5.1), where the soil is sandy in texture and deficient in organic carbon.

Plankton studies : Plankton samples were collected from different centres along the river Hooghly from Farakka downwards to Kakdwip, Canning, and Digha to study the seasonal distribution and fluctuation pattern of plankton population in this ecosystem especially in relation to Farakka discharge.

In the upper zone viz. Farakka, Jangipore, Nabadwip, Medgachi, etc. plankton population was poor both in number and variety as reported earlier in 1982. It appears that the production of plankton has not yet stabilized in this zone. Production in the middle zone was also comparatively poorer in this year. Fresh water organisms dominated in this zone (max. no. phyto-195/1 and zoo-71/1 in winter months).

In the lower zones, viz. Digha and Canning, plankton production showed appreciable increase both in number and variety. Mainly brackishwater and marine forms predominated in this zone. Average production all the year round was highest in this zone compared to the upper and middle zones (max. phyto no. 9663/1 and 200-242/1 also in the winter).

The normal summer minor peak and the major winter peak in plankton production were observed in almost all the collection centres along the Hooghly estuary.

Biology and growth studies : Growth studies on young hilsa showed that the growth increment in the first month after spawning is 33 mm and in the subsequent months between 10 mm to 20 mm. Average monthly growth rate in the end of 2nd, 3rd, 4th and 5th month age groups recorded to be 23.7 mm, 20.3 mm, 18.8 mm and 17.1 mm respectively.

The food and feeding habits of fry, juveniles and adults of hilsa were studied.

The length frequency data showed that June to October had more larger size groups (341-481 mm) than other months. From January to May small size groups (201-361 mm) were observed.

Project No. BF/B/4 : **Seed abundance and recruitment of brackishwater fishes and prawns in Hooghly-Matlah Estuarine System**

Personnel : K. K. Bhanot, R. N. De and H. S. Mazumder.

Duration : 1968-1984

Location : Kakdwip

Brackishwater fish and prawn seed were collected from Nurpur and Barrackpore along with Hooghly

estuary during the highest high tide period corresponding with the new and full moon each fortnight. The gears used were the standard Midnapur type of spawn collection net and dry collection net.

Shooting net : Quantitative and qualitative assessment of the seed potential was made. The observations revealed a distinct seasonal abundance of the commercially important fish and prawn during the peak period, the availability of *Penaeus monodon*, *Metapenaeus monoceros*, *M. brevicornis*, *Macrobrachium mirabilis*, *M. rude*, *Palaemon stylifera*, *P. fluminicola*, *Liza parsia* and *Eleutheronema tetradactylum* were recorded per net per hour as 41 (15-53 mm in February) 510 (15-55 October), 241 (17-64 November), 387 (15-84, March), 72 (20-36 February), 335 (15-70, November), 273 (25-52, June), 28 (20-36, February) and 27 (14-54, March) respectively.

Distribution of the different species of fish and prawn seed are as follows : (Data was not collected during April, May and Decemer).

		Jan.	*Feb.*	*Mar.*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*
P.	*monodon*	—	65	56	—	—	—	—	—	—
M.	*monoceros*	—	194	167	449	387	773	996	146	—
M.	*brevicornis*	137	177	53	302	193	321	357	595	198
M.	*mirabilis*	—	76	775	—	—	258	370	556	527
M.	*rude*	—	—	—	106	34	—	—	—	—
P.	*stylifera*	135	135	602	121	296	—	—	307	622
P.	*fluminicola*	201	—	96	497	—	—	—	—	216
L.	*parsia*	35	95	43	—	—	—	—	—	—
E.	*tetradactylum*	—	—	38	—	21	—	—	—	—

Fry collection net : Fry collection net made of mosquite netting and nylon material of 80 ft. x 15 ft. dimension was used at Barrackpore for the collection of the seed. The net was towed against the current and the contents were removed every 15-20 mts. Fry of *L. parsia* and *Rhinomugil corsula* were obtained, with peak periods during March/April and September/October respectively. The size of the seed ranged from 3-5 cm. Live seed of these species could be collected at the rate of 80 and 140 per hour respectively. Prawns mostly *P. fluminicola* and *Macrobrachium rude* were obtained in abundance. *M. rude* in mature stages (8-10 cms) was obtained during December-January. The food analysis of the fry stages of *L. parsia*, *R. corsula* and *Polynemus paradiseus* revealed that parsia and corsula feed on algal matter, copepods and detritus and *Polynemus paradiseus* on fish larvae, prawns and other crustaceans.

Project BF/B/5 : **Digestive physiology of brackish-water fishes.**

Personnel : K. M. Das and Amitabha Ghosh

Duration : 1983

Location : Barrackpore.

Studies on the morpho-histology and physiology of the alimentary canal of *Mugil parsia* was initiated. The alimentary canal of *M. parsia* consists of a narrow oesophagus, a highly muscularised thick walled gizzard like stomach ; a long and looped intestine and five intestinal caeca at the junction of gizzard like stomach and intestine. The RLG was found to range between 2.07 and 2.60 which is indicative of herbivorous nature of the fish.

Histological studies of the alimentary canal revealed the presence of glandular structures in the anterior part of the gizzard like stomach. Such structures are absent in the posterior part. The wall of the posterior part of the gizzard like stomach was found to be highly muscular

consisting mostly of ciruclar muscles. Histological investigations of the intestinal caeca showed the presence of AB (2.5) positive cells in the mucosa.

Physiological investigations revealed that there was no acid digestion and pH of the different parts of the alimentary canal varied from 7.0 to 8.0. Studies on the digestive enzyme activities indicated that carbohydrate splitting enzyme was present throughout the length of the alimentary canal. However, liver demonstrated maximum amylase activity (1162 C/mg protein/hr.). The chief sites of protease activity were liver and anterior intestine (482 and 477 u/mg protein/hr. respectively). Presence of lipase, maltase and invertase were also detected in the intestine of the fish.

Project BF/B/6 : **Studies on the effect of industrial (metal-borne) agricultural (pesticide) and metropolitan (Calcutta) wastes on the estuarine environment and adjoining impoundments in West Bengal.**

Personnel : B. B. Ghosh, M. M. Bagchi, M. K. Mukhopadhyaya, H. C. Joshi, P. K. Mukhopadhyaya, R. K. Banerjee, A. C. Nandy, R. N. Pal, B. B. Das and, S. K. Chatterjee.

Duration : 1983-1986

Location : Barrackpore.

(i) Two pesticide manufacturing plants-ACCI, Rishra producing BHC, Ziran and Thiram and Shaw Wallace, Haldia producing Dimethoat and Ethion are located near the Hooghly estuary. ACCI is discharging its wastes into the estuary through Bazar Khal receiving municipal and domestic wastes. The Shaw Wallace Factory discharges its wastes into an open surface drain which also carries the wastes of Hindusthan Liver and ultimately joins the Hooghly estuary.

(ii) 96-hour, LC 50 of DDT was estimated as 0.52 mg/l for *Tilapia mossambica* at 28-29°C, 4.4-6.0 mg/l DO, 8.0-8.2 pH, 240-248 mg/l hardness, under static condition.

96 hour acute toxicity tests conducted with metals (Cu and Zn) indicated more Cu-toxicity to biotic organisms (LC 50 for *Approcryptes* sp.-0.940 ppm, *L. parsia*-7.240 ppm and Chironomid larvae-336.50 ppm) compared to Zn-toxicity (LC50 for *Appocryptes* sp.-245.47 ppm, *L. parsia*-81.14 ppm and Chironomid larvae-668 ppm). While Zn-toxicity for *T. jarbua*, daphnia and molluscs were 266.07, 0.540 and 227.76 ppm respectively, Cr-toxicity for *T. mossambica* in freshwater condition was 69.05 ppm. Saline condition is found to reduce the toxicity of Cu and Zn to a greater extent. Amongst the biotic organisms, bottom dwellers were most resistant and zooplankters the least to Zn and Cu-toxicity. At acute concentrations of metals the respiratory rate, Hb and RBC count were reduced.

(iii) Pesticide residue monitoring, once in spring season (Feb-March) and once in monsoon (July-Sept.), have been conducted in the Hooghly river in its 350 km stretch between Farakka in the north and Haldia in the south. A total number of 435 samples, comprising of estuarine sediments, water, fish, plankton, molluscs and suspended particulate matter were collected from 14 different locations. Thin layer chromatography (TLC) detection and identification revealed incidence of DDT residues in 32%, BHC in 9.2% and Dimethoate in 3.0% of the samples. Gas liquid chromatography (GLC) examination showed presence of DDT in fish, mollusc and plankton upto the level of 0.46, 0.963 and 0.13 ppm, respectively. Incidence of pesticide residues was maximum in molluscan samples (57%) followed by suspended particulate matters (50%), sediment (41%), fish (39%), plankton (28%) and water (3%). Pesticidal contamination of the estuarine sediments is

mainly confined to the industrial-urban zone between Kuntighat and Garden Reach and Haldia. There is also, perceptible increase in the incidence of pesticide residue in the monsoon season unlike the previous year.

Out of 75 sediment samples collected from 25 freshwater and brackishwater fish ponds, 46 samples showed presence of pesticide residues. Incidence of BHC residues was maximum (22) followed by DDT (12), phosphamidon (8), endosulfan (5), methyl parathion (2), dimethoate (2), dieldrin (2) and malathion (1)

Under estuarine condition of the fish *Rita rita* showed higher Hb content (8.45 g/100 ml) and RBC count ($1.83x10^6/mm^3$) in non industrial stretch at Nabadwip compared to the same fish collected from industrial stretch at Hazinagar (8.00 g/100 ml) and $1.79x10^3/mm^3$). Adverse haematological condition (Hb, RBC) were observed in summer compared to monsoon.

(iv) In long term exposure with 0.75 ppm Zn as $ZnSO_4$, 7 H_2O, *Tilapia mossambica* under freshwater and saline condition showed decline in gastrosomatic indices, fecundity and finally recruitment in the population. Although there was a decline in the condition factor of the test fishes under freshwater condition, it was found to be unaffected in saline condition. Damage in germinal epithelium of ovary and abnormality in the testis were recorded. Decline in Hb content and RBC count were observed. Mollusc (*Lymnaea lentcola*) exposed under 0.75 ppm Zn as $ZnSO_4$ for a period of 90 days indicated 27% mortality and adverse effect on the breeding potential as evident from higher recruitment (163%) in the control.

(v) Samples of bottom organisms and plankton collected from the Hooghly estuary have been processed for bioaccumulation study of heavy metals by AAS.

GLC examination of some biotic samples has shown 0.963 ppm of DDT in molluscs and 0.13 ppm of DDT in plankton. Experiments conducted for 7 days on gastropod (*Lymnaea lentcola*) indicated inhibition of growth and thinning of cells at 0.1, 0.5 and 1.0 ppb of DDT. Biomagnification of DDT in gastropod was estimated as 3310, 1670 and 1200 respectively at the above concentrations.

(vi) The plankton population, as in the previous year, showed lower intensity in the industrial belt between Kuntighat and Garden Reach (23-95 no./l) in comparison to the non-industrial belt in the lower stretch adjoining Kakdwip (33-374 no./l), while the plankton population fluctuated between 17 and 92 no./1 in the upper non-industrial belt adjoining Nabadwip.

(vii) The enzyme Na , K , Mg --ATPase was assayed in the gills of *T. mossambica* expossed to Zn (2 ppm as ZnSO4) under different salinity levels (2.0, 4.0 and 7.0 ppt). The enzyme activity was enhanced in the fish with the rise of salinity upto 4 ppt, while a sudden decreasing trend was noted at 7 ppt salinity. The increase in the enzyme activity upto a level of 4 ppt salinity may suggest that this enzyme plays an important role in the active transport processes in the tissue.

(viii) District I of Calcutta covering the area in between circular canal at the north and east, the river Hooghly in the west, and Keshab Sen Street in the south has been surveyed. The total drains and sewers in the area is 201.57 km and discharge about 24 mgd effluent. There are about 375 small industries in the area of which about 100 concerns are injecting their wastes containing toxic materials into the sewarage system as evidenced from the survey. The wastewater gets Hg from 31 mirror silvering industries, hydrocarbons from 5 paints and 1 insecticide manufacturers, and metals like Zn, Cu, Pb, etc. from 18 wet-battery manufacturers

and 22 electroplating industries. In addition, the effluent receives huge settleable solids from many stone and glass grinding concerns.

Seasonal analyses of the effluents from different manholes in the said district have been done and the overall character was as follows : pH 7.2-7.8 ; settleable solids 2.2-3.4 mg/l ; total solids 512-1574 mg/l ; suspended solids 210-415 mg/l ; sulphate (SO_4) 1-14 mg/l ; phosphate as PO_4 10.8-21.3 mg/l ; BOD 55-158[4] mg/l ; COD 150-417 mg/l ; total nitrogen 13.0-19.0 mg/l ; Cu 0.06-1.9 mg/l and Zn 1.3-4.7 mg/l.

(ix) Pathological studies of water, soil, fish and prawns conducted in the impoundments adjoining Bidyadhari, Matlah and Deyganga canal (river) revealed that the TPC, coliform and *Staph-sureus* load in water and soil of the impoundments are less compared to the rivers.

No bacterium was encountered from the circularoty system of healthy prawns though *Pseudomonas* was encountered from 3 dead prawns. TPC load and the total count of *Pseudomonas* bacteria from 1 gm of flesh of these dead *P. monodon* varied between 1-3.5x10[2] and 1-2.2x10[4] respectively

(x) Samples of water were collected from 10 different centres of the Hooghly estuary (Nabadwip-Kakdwip) covering the industrial and non-industrial belt for studying the water quality. The water quality variations were 21-32.5°C temperature, 3.5-8.5 pH, 3.0-8.4 mg/l DO, 11-22562 mg/l salinity, 12-3260 mg/l total hardness as $CaCO^3$, nil-596 mg/l total alkalinity as CaCO3 and 194-46430 micromhos/cm specific conductivity. The lower value of pH (3.5), low DO (3.0 mg/l) and absence of total alkalinity (nil) were found near the outfall of Kesoram Rayon Industries at Kuntighat and high values of water temperature (32.5°C) and total alkalinity (596 mg/l) was found near the outfall of sewage at Kuntighat about 1 km south of the Kesoram Rayon outfall.

Project No. BF/A/1 : Breeding and culture of brackish-water fin fishes in ponds and bheries

Personnel : D. D. Halder, N. K. Das, R. K. Chakraborty, P. K. Ghosh, S. K. Mondal, J. G. Chatterjee, H. Singh, S. R. Das and D. Sanfui

Duration : 1983-1988

Location : Kakdwip

(a) *Mullets* :

Studies were made in respect of breeding behaviour of mullets which required further investigation for making a key note. In respect of growth of mullets it has been seen that mullets attained bigger size in bigger ponds. However, it has not been possible to find out the definite role of any environmental factors on growth and production of mullets.

In nursery rearing of *L. parsia* with a stocking density of 1 lakh/ha only 51.9% survival was observed on an average in about 2 months without supplementary feeding.

In nursery rearing of *L. tade* with a stocking density of 50,000 nos./ha heavy mortality occurred.

In polyculture of mullets and penaeid prawns with a combined stocking density of 30,000 nos./ha, heavy mortality was observed in the middle of the year and only 14.5 kg of *L. tade*, 5.0 kg of *P. monodon* and 4.5 kg of miscellaneous fish and prawns were harvested.

Fresh polyculture experiments were again initiated with a combined stocking density of 73,330 nos./ha and a gross production of 1015 . 0 kg/ha was achieved from one pond and 62.0 kg/ha from another pond.

In November, 1983, monoculture experiments of *L. tade* were initiated with stocking density of 8,750 nos/ha and fish atttained an average size of 64.57 mm/2.43 g after one month.

Attempts were made to breed 2 sets of *L. tade* injected with carp pituitary during this year. But no spawning was observed. In the first quarter of the year carp pituitary was injected to 3 sets of *L. parsia*. Though free spawning was observed, no sign of fertilization was observed. In the last quarter, attempts were again made with 4 sets of *L. parsia* without success.

Specimens of *L. parsia* and *L. tade* were collected from farm ponds and reared with proper feed mixture for gonadal development.

Mature specimens of *L. tade* (female) were collected and maintained in an earthen-race-way erected in a bheri at Sandeshkhali for breeding but due to non-availability of oozing males breeding trials could not be undertaken.

Estimation of population number of catch statistics was done and it was found suitable for *L. tade* only. The escapement of *L. parsia* from drag net was more than that of *L. tade* violating the assumption of equal probability of catch.

Effect of salinity of *L. parsia* fry was studied. *L. parsia* fry was acclimatized in farm water of salinity 12.5 ppt. The fry was then released in water of higher salinity and the following mortality was observed at different salinity.

Salinity	12.5	18.5	24.0	29.5	34.5
Mortality (%)	3.3	3.3	33.3	56.7	100

It was seen that the fry could tolerate a rise of salinity by 5 ppt. It started dying when salinity was raised by 10 ppt. The size of fish varied from 14 mm-18 mm.

L. parsia fry was also released in water of lower salinity after acclimatizaing them in water of salinity 24 ppt and the following mortality was observed upto 72 hrs.

Salinity (ppt)	24.0	19.0	14.0	9.0	4.0	0
Mortality (%)	0	0	0	10	0	100

It was noticed that *L. parsia* fry could withstand a lowering of salinity even by 20 ppt.

The experiments will be repeated in the next season.

(b) *Etroplus suratensis* :

A consignment of *E. suratensis* seed was received from Keshpur Farm, Ganjam, Orissa for initiation of the culture operation. While transporting the seed (50.3 m/3.1 g) 93.0% of survival was recorded in oxygen packing. Two 0.02 ha ponds were prepared and stocked with the seed at 15,000 nos./ha during November, 1983. After a rearing period of 60 days the fishes attained 56.0 mm/5.0 g and 61.5 mm/7.0 g respectively without any supplementary feeding. Other management measures were followed as per technical programme. The work is in progress.

(c) *Hilsa ilisha* :

Our all out efforts to collect seed locally and transport from other localities failed and as such the experiment could not be initiated.

(d) *Lates calcarifer* :

Two tier culture management were followed to initiate the project i. e. collection of seed from canals and rear them in nursery @ 10,000/ha to obtain uniform stockable materials and to start culture experiment with the aim to obtain table size bhetki.

In nursery (0.02 h) 92.2 mm/7.2 g fingerlings ragistered a growth of 126.7 mm/33.3 g in 120 days rearing.

In culture pond *Lates* registered growth from 278.81 mm/263.78 g to 399.7 mm/680 g and 126.7 mm/33.3 g to 177.2 mm/73.7 g in 6 months culture stocked at the rate of 1,600 fingerlings/ha. It is expected that a production of 500 kg/ha/yr. may be obtained. *Lates* were fed with fishes and prawn which entered with tidal ingress of water at every fortnight.

Laboratory trials :

(i) A series of experiments were conducted to see the food preference of *Lates* fry. It has been observed

that *Lates* fry or fingerlings feed on *P. monodon* (Bagda) followed by other prawns and fishes. They also accepted fish meal but not the dead fishes or prawns.

(ii) A set of experiments on the rate of oxygen consumption by bhetki fry and fingerlings were carried out. It has been revealed that a bhetki fingerling of 10 g body weight consumes 3.568 mg O_2 per hour. It appears that 100 nos. of bhetki fry of 1 g body weight each may safely be transported for 12 hours supplying 658.8 mg of oxygen.

Project BF/A/2 : **Seed abundance and recruitment of brackishwater fishes and prawns in Hooghly-Matlah estuarine system.**

Personnel : P. R. Sen, K. K. Bhanot, D. K. De D. Nath and A. Hajra.

Duration : 1981-1985

Location : Barrackpore

(a) **Artificial fecundation** of hilsa (*Hilsa ilisha*) was successfully done in Dhaulian, Nimtila stretch of the Ganga during the month of October, 1983. Male and female hilsa in running condition were collected from the river and wet stripping was done. Out of six sets of females successful fertilization took place in two sets only. On an average the percentage of fertilization was about 50. The developing eggs were kept in three different systems (i) hatchery with the provision of running water, (ii) in hapas fixed in the river and (iii) in the earthen vats without provision of running water. Maximum number of hatchlings were obtained from the hapas fixed in the river followed by hatchery. Earthen vats used for hatching did not prove useful. Temperature in the hatchery and in the river was in the ranges of 26°C and 28°C, whereas, the ambient temperature in the earthen vats was about 23°C. The hatching time varied between 16 to 19 hrs depending upon the water temperature and other physicochemical factors. About 0.12 million hatchlings were produced from the experiments.

(b) The experiments were conducted on the **transport of hilsa fry** in both open as well as closed containers. Better results were obtained in open containers without any artificial aeration and oxygenation. In this system, fry of hilsa were transported at density of 125-200 nos in 100 litres of water for a period of 5 hrs 30 min. with 40-60% survival. While transporting the hilsa fry in open containers, water temperature was between 23°C and 25°C. In this system the containers were filled with only river water or 50% river water and 50% tube well water and the results were compared. Better survival of fry was obtained in those experiments were only river water was used.

In closed system high rate of mortality of hilsa fry was observed during transport. In the close system the fry were transported in plastic bags in oxygen packing and pith and without the use of anaesthetics at densities 5 to 10 per litre of water. The survival was very poor ranging between 0 and 10%.

(c) **Culture prospect** of hilsa, *Hilsa ilisha* (Hamilton) in freshwater was studied in a pond (0.1 ha) stocked with fry of hilsa (15-60 mm). The hilsa were reared for 2 years 8 months without the provision of supplementary feed. The stock attained an average growth of 180 mm/125 g and 310 mg/300 g respectively at the end of 1st and 2nd year of rearing. The average length/weight attained by the fishes at the conclusion of the experiment was 350 mm/425 g. In few instances the maximum weight attained by fish was 600 g.

Physico-chemical parameters of the pond were also studied. Oxygen content of the pond was kept between 4-6 ppm in the morning hours by circulating air with the help of electrical aerator. For the production of plankton, Cowdung was applied at the rate of 200 kg/ha/month.

After 2 years 8 months of rearing retarded growth and mortality of hilsa was noticed due to accidental entry of tilapia. In order to remove tilapia, the pond was treated with mahua oil cake @ 250 ppm and after 15 days lime was also applied of 200 kg/ha. In order to start a new experiment the pond was restocked with 300 fry (20-60 mm) of hilsa during December, 1983. The pond was fertilized with raw cowdung @ of 250 kg/ha/ month.

(d) **Non-conventional feed** items like Karamja oil cake, deoiled neem oil cake, brewery waste powder, til oil cake and rice polish were provided to the mrigal fry. The experiment was conducted in 10 l glass jars and single individual feed item was provided to the fish at a time. It was observed that the acceptability of non-conventional feed items were found to be poor and the fishes did not grow well.

The second **laboratory experiment** was conducted with mrigal fry and the fishes were provided with compounded feed mixture made of the same non-conventional feed ingredients. The first compounded feed was prepared out of karamja oil cake 25% plus til oil cake 25% plus rice polish 50%. The second feed was prepared with neem oil cake 25% plus til oil cake 25% plus rice polish 50% and the thrid one was prepared with brewery waste 25% plus til oil cake 25% plus rice polish 50%.

The growth performance of mrigal with those feeds were compared against the fourth feed prepared out of groundnut oil cake plus rice polish mixed at the ratio of 1 : 1 by wieght. Average growth of fishes after 22 days trial was 0.081 g with feed no 1 ; 0.045 g with feed no. 2 ; 0.057 g with feed no. 3 and 0.1000 g with conventional feed no. 4. The results with these unconventional feed items were not found satisfactory.

The third experiment was conducted in yard on mrigal fry with the same compounded feed items and fifth feed item was compounded with till oil cake 50% plus rice polish 50%. In this experiment while preparing the feeds Karamja oil cake and neem oil cake were roasted at 60 deg. C before compounding the feeds.

The average growth of fishes in 24 days trial was 0.395 g with feed no. 1, 0.425 g with feed no. 2, 0.230 g with feed no. 3, 0.325 g with feed no. 4, and 0.310 g with feed no. 5. The average survival of fishes in all the treatments were highly satisfactory which ranges between 76 % and 100%.

Project No. BF/A/3 : Breeding and nursery management of brackishwater fishes.

Personnel : T. Rajyalakshmi (from 22-4-83) S. M. Pillai, P. Ravichandran, N. A. Reddy (upto 24-12-83) A. N. Mohanty (from 8-8-83)

Duration : 1980-1984

Location : Puri

Survey for collection of breeders of *Lates calcarifer* was under taken at Dhamra and Mahanadi estuarine beaches, Puri coast and Chilka Lake. A few mature males in the size of 880 to 930 mm/8-9 kg were found in trawler catches at Talchua during May, 1983.

Induced breeding experiments of *Mugil cephalus* were carried out on 19 sets at Chilka Lake-mouth. Female fishes were injected with varying doses of mullet pituitary extract. Out of the 19 sets, successful ovulation and fertilization was observed in 8 sets. Due to fall in temperature, development of eggs was arrested in most of the cases. Natural spawning was observed in one fish, but there was no synchronisation of milt release. However, a few eggs were obtained by stripping the spent fish. The hatchlings survived upto 8 days only.

Liza macrolepis was successfully bred both by hypohysation and stripping. In all the 10 sets, female fishes (600-1000 g) attained mature condition when injected. Low temperature experienced at night interferred with development and only in one set, 4 lakhs hatchlings were obtained. The larvae showed characteristic mig-

gration pattern. The larvae were fed with *Chlorella* at the rate of 103 cells/ml. The larvae survived upto 14 days.

Breeding experiment of sea bream, *Sparus datnio* was tried. Of the 5 sets tried, successful ovulation was observed in two sets only and hatchlings obtained in one case. Since the fishes were in early stages of maturity and were injured, the response for pituitary injection was very slow.

Hatchery Land : About 6 acres of land for construction of hatchery is under process of transfer from Govt. of Orissa to CIFRI, Puri. A tentative design for hatchery has been completed.

Project BF/A/4 : **Breeding and seed production of brackishwater finfishes.**

Personnel : K. V. Ramakrishna, K. N. Krishnamurthy, G. R. M. Rao, M. A V. Lakshmanan, R. D. Prasadam, S. Krishnan, S. Radhakrishnan, S. Srinivasagam and K. O. Jeshep.

Duration : Five years (1979-1984)

Location : Pulicat and Ennore, Madras

Breeding : Twenty four female breeders and sixty six male breeders of *L. macrolepis* were collected from commercial catches of Pulicat Lake. The females ranged from 185 to 295 mm in length and 80 to 250 g in weight. Males ranged from 145 to 235 mm in length and 20 to 100 g in weight. These were given the injections of mullet and carp pituitary extracts and also HCG singly and in combination. These breeders died without spawning at different intervals. On one occasion, one female released the eggs after administering HCG witnout resorting to stripping and another female was stripped. In both the instances the fertilized eggs died after reaching 4-celled stage.

At Ennore, 19 females of *L. macrolepis* (148 mm/100 g to 290 mm/250 g) and 47 males ranging from (145 mm/30 g to 212 mm/90 g were used for conducting induced breeding experiments. Carp glands, mullet glands and HCG were administered singly and in combination trying different doses. Embroyonic development did not progress beyond cell division.

Records on hydrological conditions were maintained.

Fish food culture : Extracts of poultry droppings+diammonium phosphate+urea gave higher yield of *Chlorella* sp. (404 to 5.37 lakhs/ml) than diammonium phosphate+urea+glycine (0.96 to 1.2 lakhs/ml). The seawater treated with Miqual solution gave a maximum diatom density of 38,800 u/ml.

Attempts were made to isolate different species of diatoms to grow them in various culture media. Unialgal cultures of *Amphora* sp. and *Nitzschia* spp were made in the laboratory using enriched agar-agar medium. *Amphora* sp. showed a maximum cell density of 1,48,000/ml.

Seawater (40 1 each) when treated with urea+diammonium phosphate+ammonium sulphate+ferric chloride gave higher diatom density in 7 days (91,200 u/ml) than with urea+diammonium phosphate +groundnut cake (48,900 u/ml in 10 days). Fish feed organisms (*Navicula* sp. *Diploneis* sp., *Nitzschia* spp. *Amphora sp.*, *Lyngbya* sp. etc.) were mass cultured in fibreglass tank using lake water (1 tonne) treated with urea+DAP+ammonium sulphate+ferric chloride+EDTA. A maximum cell concentration of 1,48,000 u/ml was obtained in 10 days. High density *Chlorella* (11.2 to 12.8 lakhs/ml) was maintained in polythene tubs (40 1) by repeated fertilization of water with groundnut cake, DAP and urea. In an outdoor cutlure of marine diatoms, plastic pools containing 100 l each of seawater when treated with modified Miquel solution yielded a diatom (*Skeletonema* sp., *Coscinodiscus* sp., *Thalassiothrix* sp., *Nitzschia* spp etc. concentration of 33,700 to 51,600 u/ml. About two litres of cultured diatom was harvested and stored in the deep freezer for feeding fish and prawn larvae.

Brachionus sp. and *Oithona* sp. were successfully cultured under yard conditions. Both *Brachionus* and *Oithona* were introduced at the rate of 1 individual/ml in the plastic pools containing 100 l each of diluted seawater and were fed daily with yeast at the rate of 1.0 mg/l and *Chlorella* at the rate of 10 ml/l (Average cell concentration-10 lakhs/ml). The population of *Brachionus* showed a remarkable increase of 10 to 17.6 individuals/ml within 7-10 days. In the case of *Oithona* the maximum concentration obtained was 7 individuals/ml in 10 days.

100 l of freshwater enriched with G. O. C., ammonium sulphate and diammonium phosphate yielded 2,25,000 u/ml of pure *Chlorella* sp. against 1,95,00 u/ml in 40 l at Pulicat.

In an experiment with 10 l of salt water (12.5 ppt) inoculated with *Brachionus* sp. at the rate of 1/ml, on an average, a concentration of 14/ml was obtained within a week when fed with *Chlorella* sp. and baker's yeast against 11/ml in control where only *Chlorella* sp. was given as feed.

Three plastic pools with 100 l each of salt water (15.5-16.0 ppt) showed an average concentration of 13/ml of rotifers when fed with bakers yeast and *Chlorella* sp.

Artemia salina were successfully cultured in plastic pools and viable cysts produced in the laboratory were collected and preserved.

Toxicity Studies : Fish from Ennor estuary showed a concentration of Hg (0.550 u/gm) compared to nondetectable background level Hg in the fish from Pulicat lake.

Project No. BF/A/5 : Breeding and culture of penaeid prawns in ponds and bheries.

Personnel : D. D. Halder, S. R. Das, H. Singh, P. K. Ghosh, R. K. Chakraborti, S. K. Mondal and D Sanfui.

Duration : 1983-1988

Location : Kakdwip

A 0.06 ha pond was stocked with juveniles of 20.0 to 46.7 mm at the rate of 20,000/ha during May, 1983. The prawns attained an average size of 123.5 mm in 73 days. But during the first week of August mass mortality occurred due to heavy rains.

Further stocking will be done after collecting seed from nature during February, 1984.

Gonadal maturation of *P. monodon* reached upto III stage within 20 days of ablation. Work in this regard is continued.

Effect of salinity of *P. monodon* postlarvae was studied. The postlarvae were acclimatized in water of salinity 24 ppt. The salinity was lowered by adding freshwater. The mortality at different salinity was as given below :

Salinity (ppt)	24.0	19.0	14.0	9.0	4.0	0
Mortality (%)	5.0	15.0	15.0	5.0	20.0	100.0

The lowering of salinity had little effect on *P. monodon* postlarvae. Mortality was not significant even when the salinity was lowered by 20 ppt.

Estimation of population number was done by marking method. It was found that estimation by marking was feasible upto one month only.

Breeding of *P. monodon* in cages/tanks/cement cisterns.

The experiment could not be initiated due to non-availability of adult (brood) tiger prawn, *P. monodon* locally.

Breeding of *P. monodon* in bheries.

Gonadal maturation reached upto III stage in case of bilaterally ablated females within 10-12 days of ablation. No females survived after reaching III stage. Efforts were made to find out the reason of their mortality. In this regard pollution of the Kulti estuary by the discharge of Calcutta sewage could not be ruled out. As

such, it has been decided to shift the centre to further lower stretches of Sunderbans. After surveying some places, Jharbhali/Deulbari has been found to be suitable for the purpose.

Project No. BF/A/6 : **Breeding and hatchery development of Penaeus monodon and other shrimps.**

Personnel : T. Rajyalakshmi (from 22-4-83) P. Ravichandran, S. M. Pillai, N. A. Reddy (upto 24-12-83) G. V. Kowtal and A. N. Mohanty (from 8-8-83).

Duration : 1982-1987

Location : Puri

Intensive survey for availability of brood prawns was carried out at Astharang, and Paradip, trawler bases, Baliapanda and Pentakatta landing centres at Puri and other landing centres of Chilka Lake. Only few prawns could be collected from Paradip due to frequent cyclones in the area during 1983. The prawn catch was poor in Chilka Lake and a few prawns above 100 g could be collected and transported to the hatchery.

Survey was also made to study the maturity stages of penaeid prawns at Pentakatta and Baliapanda landing centres.

Induced maturation experiments were carried out with *P. monodon*, *P. merguensis* and *M. affinis*. The prawns attained advanced II stage of maturity but failed to develop further. Black spot bacterial disease was noticed in most of the ablated prawns.

Culture of diatoms, algae, *Artemia* and *Tubifix* are in progress.

Project No. BF/A/7 : **Breeding and seed production of brackishwater crustaceans (*P. indicus* and others).**

Personnel : K. Raman, K. V. Ramakrishna, K.N. Krishnamurthy, A.V.P. Rao, G. R. M. Rao, S. Radhakrishnan, S. Srinivasagam, M. Sultana (Smt.), M. A. V. Lakshmanan, K. O. Joseph, P. M. A. Kadir and S. Krishan.

Duration : 4 years (1982-1985)

Location : Pulicat Lake, Madras

Breeding of Penaeus : Of the many attempts made, only on 4 occassions, i. e. thrice at Pulicat once at Madras, *P. indicus* collected off Pulicat, could be made to breed. The specimens ranged from 135 to 160 mm in length and 20 to 125 g in weight. About 100 nos. of nauplii, reared in 10 l. glass jars containing filtered sea water, fed with a mixed diet of bakery yeast, diatoms and squash of *Hypnea* + *Squilla*, attained postlarval stage within 12 days. Of these, 23 nos. could be reared to juveniles within 30 days.

At Madras *P. indicus* collected off Royapuram released eggs on two occassions which developed upto zoea I stage. After that they died due to fungal infection which could not be controlled by treatment with Chloroamphenecol @ 1 ppm.

In general, heavy mortality was noticed during the transitional stages between naupliar, zoeal and postlarval stages.

During November when the mature specimens of *Penaeus monodon* started appearing in the trawler catches, three breeding attempts were made. On one occasion unfertilized eggs were shed by the female, and on the

other two occasions though the eggs were fertilized, all the resultant nauplii perished during first nauplius stage. These eggs were smaller (0.204 to 0.221 mm in diameter) than those reported in successful experiments from elsewhere (0.25 to 0.27 mm in diameter). The size of females ranged from 170 to 193 mm and 50 to 60 g. Larger females were not available in the catches.

During August to December samples were regularly examined to study the reproductive biology of the penaeid prawns.

Rearing of prawn : *P.indicus* reared in a pond (0.05 ha) at Pulicat showed an increment of 33.9 mm/3.11 g in 50 days. They were provided with a feed mixture of fish meal, G. O. C. and rice bran (1 : 1 : 1). Heavy mortality was encountered during the last fortnight of rearing,

Two nylong hapas (7.5 m^2 each) were stocked with *P. indicus* and fed with a mixture of fish meal+G. O. C. +rice bran (1 : 1 : 1) in one hapa and raw fish in the other hapa. At the end of 58 days the growth was 29.9 mm/3.34 g and 34.9 mm/3.69 g respectively. The percentages of survival were 80 and 15 respectively.

In another experiment conducted on the same lines as above, for a period of 5½ months the growth was 123.8 mm/16.67 g and 123.0 mm/15.56 g amounting to a production of 1000 kg/ha and 933.6 kg/ha in two hapas respectively. The survival was 60% in both the hapas.

P. monodon at a stocking density of 1 lakh/ha was reared in 4 nylon hapas of 2.0 m^2 each. The feeds tried in the first three hapas were G. O. C. + rice bran (1 : 1), raw fish, G. O. C. + rice bran + raw fish (1 : 1 : 1). The 4th hapa was kept as control without any feed. At the end of 4 months the growth increments were 53.6 mm/12.62 g, 76.3 mm/25.73 g, 67.3 mm/21. 33 g and 30.5mm 6.56 g respectively. The percentages of survival were 100, 90, 85 and 45 and the production/ha/4 months worked out to be 1550, 2575, 2100 and 425 kg.

Two experiments were conducted in glass jars on the growth of *P. indicus* trying different artificial feeds. In In the first experiment a mixture of squilla powder wheat flour (3 : 2) gave better growth and in the second, a mixture of prawn head powder, G.O.C. and rice bran (3 : 4 : 4) and green water showed better growth when compared to the other feeds.

Breeding of Crabs : Eggs of *Portunus pelagicus* which hatched out into prezoeal stage could be reared upto second zoeal stage using yeast, green water and prawn suspension. Eye stalk ablated *Scylla serrata* reared in a tide flushed pond at Pulicat became berried and the eggs hatched out into pre-and first zoeal stages in plastic pools.

Rearing : The eye stalk ablated females of *S. serrata* (85 to 125 mm ; av. 99 mm/176 g) recorded an average monthly growth of 8 mm/63 g against 6.1 mm/48 g in unablated ones (90 to 116 mm ; av. 99 mm/161 gm). The ablated females of *P. pelagicus* (86 to 110 mm; av. 97 mm/58 g) registered an average monthly growth of 9 mm/18.25 g against 6 mm/11.2 g in unablated ones (80 to 110 mm ; av. 91 mm/51 g).

Ablated females, unablated females and males of *P. pelagicus* were reared together in a nylong hapa fixed in Pulicat lake. The ablated females did not show any sign of maturity. They have recorded a growth of 4 mm/6 g and for the unablated ones it was 2 mm/4 g. Males showed an average growth of 4 mm/7 g in a month.

The berried specimens of *P. pelagicus* and *P. sanguinolentus* brought from Ennore estuary hatched out larvae which could be reared for a week upto zoeal stages in glass troughs and plastic pool using *Chlorella*, *Skeletonema*, *Brachinous* and a mixture of *Sepia*, *Squilla Hypnea* suspension.

Rearing of crab : Out of the 4 experiments conducted on the feeding of crabs, the feed mixtures fish head powder and wheat flour (2.5 : 1) gave better growth in case

of *P. pelagicus* (8.5 mm/5.0 g/month) and *S. Serrata* (2.0 mm/1.6 g). The percentage survival in both the cases was 37.5

Toxicity studies : The concentrations of Hg and Cd in the *P. indicus* collected from Ennore were 0.45 and 0.229 g/g respectively compared to non-detectable background levels of these metals in prawns from Pulicat lake.

The 48 hour LC 50 Buckingham canal water to *P. indicus* was found to be 7.6% at a temp. of 28.1∓1°C.

Static bio-assay tests for acute toxicity of Cr (VI) to juveniles of *P. indicus* were conducted in the laboratory. Both the exploratory and final tests were done in 10 l. glass jars. The LC 50 (48 hours) value of Cr (VI) to *Penaeus indicus* at salinity value of 25.0 ppt and at a temp. of 28.4°C±2°C was calculated as 12.55 μg/ml.

Project BF/A/8 : **Oyster cum fish Culture**

Personnel : K. V. Ramakrishna, R. D. Prasadam and Munawar Sultana.

Duration : Five years (1979-1983)

Location : Pulicat Lake.

A total of 665 oysters were arranged in wooden trays at the rate of 30 per tray and were kept on rafts in an open enclosure (10 x 5 m). The oysters were in the height range of 40-85 mm with an average of 60.3 mm and the length range was from 35 to 75 mm with an average of 50.0 mm. At the end of 4 months, they were having height ranging from 35 to 120 mm (Av. 70.0 mm) and length from 25 to 85 mm (Av. 50.2 mm). The percentage survival was 69.1. The lower minimum size was due to the addition of freshly fallen spat. The spat fallen were 318 in numbers. Mortality of spat was noticed subsequently resulting in only 42.1% survival. *Siganus* sp. (Av. length 39.0 mm) and *Etroplus* sp. (Av. length 38.0 mm) were stocked along with oysters. After 4 months, they registered a total weight of 430g along with *L. calcarifer* and *P. indicus* which entered the enclosure. Due to heavy rains during November/December the enclosure was submerged and all the fishes and prawns escaped vitiating the experiment.

Project BF/A/9 : **Pen and cage culture of fishes and prawns in lagoon eocsystem.**

Personnel : R. D. Prasadam, G. R. M. Rao, K. V. Ramakrishna, K. Raman, K. N. Krishnamurthy, M. A. V. Lakshmanan, P. M. A. Kadir and S. Krishnan.

Duration : Six years (1980-85 ; extended by three years).

Location Pulicat lake / Ennore / Muthupet

100 chanos (Av. 114 mm/10 g) were stocked in a 50 m^2 cage and reared for 4 months with artificial feed G. O. C. + R. B. (1 : 1) given at the rate of 10% body weight. An increment of 49.1 mm/20.0 g during the rearing period was observed.

Another experiment with 200 chanos (Av. l/w ; 36 mm/0.4g) stocked in the same sized cage and feed is in progress.

A pen of 0.06 ha area was stocked with *Etroplus suratensis* (Av. wt. 80.9 mm/17.8 g) at the rate of 20,000/ha. The fish are being reared on natural food alone. Sampling could not be made due to high water level in the lake. The experiment is in progress.

Three cages (5 mx2 m) have been stocked with the same species (72.3 mm/11.9 g ; 61.3 mm/7.3 g ; 79.6 mm/18.3 g) at the rate of 20,000/ha in each. The fish are being reared on natural food alone. They have grown to an average length/weight of 91.2 mm/26.7 g ; 82.7 mm/17.6 g and 94.4 mm/25.2 g at the end of 3 months showing

an increment of 18.9 mm/14.8 g ; 22.4 mm/10.3 g and 14.8 mm/6.9 g respectively. The experiment is in progress.

Initial experiment on the cage culture of *Siganus* sp. gave encouraging results. Based on these results, cage culture of this species is proposed to be taken up on a larger scale.

During August, the pen made of velon screen (30 × 10 m) fixed in the lake Pulicat was stocked with milk fish, mullets and prawns in the ratio of 1 : 3 : 6 at a rate of 3.3 numbers per m^2. At the end of two months *Chanos* measured 190 mm and 58 g on an average. Mullets and prawns could not be sampled. The experiment was vitiated due to heavy rains during November-December.

Lates calcarifer (av. 142 mm/38 g) were stocked in two cages of 70 m^2 and 50 m^2@ 5000 ha in Pulicat lake. Initially they were reared on natural food comprised of small prawns, mysids, *Acetes*, caridians and small fishes that entered the cages. Subsequently, trash fish was given as additional feed. A growth increment of 39 mm/49.5 g in cage I and 34.7 mm/81 g in cage II was observed during the period of 3 months. The experiment is under progress.

Project BF/A/10 : **Fish disease in brackishwater and sewage ecosystems.**

Personnel : R. N. Pal, P. B. Das and S. P. Ghosh

Duration : 1980-1985

Location : Barrackpore

During the period under report, an uncommon disease of *Clarias batrachus* could be controlled by using Sulphadiazene, a bactericidal drug. Symptoms of the disease were loss of barbels, reddish swelling at the root of the barbels, reddish mouth and dermal ulcers. High stocking density of the fish (3,00,000/ha) and blue-green algal bloom were the predisposing factors for the manifestation of the disease. Week long treatment of the fish with Sulphadiazene could control the spread of the disease. The dose prescribed was 100 mg/kg of feed (comprising carbohydrate and protein in the ratio of 3 : 2, added with minerals and vitamins).

Twenty percent fry of Indian major carps, when stocked @0.2 million/ha in a 2ha pond at Barasat developed symptoms of tail rot and dropsy within a culture period of 3 months when the stock was not supplied with any supplementary diet. Thinning out the population and provision made for daily feeding the stock with a mixture of rice bran and ground-nut oil cake to the tune of 3% of the total weight of fish stocked could control the spread of the disease. The water body was also treated with lime @ 200 kg/ha towards its sanitation.

Water samples collected from 9 ponds of Khardah farm were examined monthly to see the bacterial load therein. TPC ranged between 1×10^3 to 5×10^2 after 48 hours incubation at 20°C. Morphologically the bacterial flora exhibited varied forms viz., Gr+Cocci, gr-short rods and actinomycetes. Of the gr-short rods, *Pseudomonas* and citrobacters were predominant. Actinomycetes were encountered from such ponds where the fish stocks were supplied with supplementary diet.

Environmental stress often causes a disease of *Penaeus monodon*. The disease, named by local fishermen as PD, is recognised by the symptoms of pulpiness and nonformation of exoskeleton of the host. Sudden fluctuation of temperature and salinity are supposed to be stress factors. However, the study is under progress.

Pseudomonas sp., presumptively identified as the causative organism for the ulcer disease of *Clarias batrachus*, needs confirmatory tests. Whether the strain is host-specific, is also being studied using *Heteropneustes fossilis* as the test animal.

Project BF/A/11 : **Brackishwater aquaculture : problems of financial viability.**

Personnel : S. Paul and H. K. Sen

Duration : Three years (1982-85)

Location : Barrackpore

The collection of economic data is likely to take considerable time in view of the inadequacies of data base. However, attempts are being made in collaboration with Project Coordinator, All India Coordinated Project on Brackishwater Fish Farming to obtain the data pertaining to various centres.

Project BF/A/12 : **Adaptive research in fish culture in high saline brackishwater paddy plots.**

Personnel : J. G. Chatterjee, A. K. Chattopadhyay and S. Saha.

Duration : 1983-86.

Location : Kakdwip

Two experiments were conducted in farmer's plots growing rice varieties like SR-26B, Talmukur and Tangra. Pesticide application was made 10 days before stocking prawn fry at the rate of Dimceron (100%) 1/2 ml/l, BHC dust (10%) @ 11.25 kg/ha, BHC 50 wp @ 5g/l Himosan 1 ml/l and streptocyclene 75 g/ha.

Project AN/B/1 : **Studies on different aqatic ecosystems.**

Personnel : V. Pathak

Duration : 1980-86

Location : West Bengal (Kalyani) and Assam (Gauhati)

Energy transformation through primary production : Studies were made in three beels chocked with aquatic macrophytes. The rate of energy input through autotrophic primary production was 61,160 to 80,000 cal/m²/day (3.1 to 4.1 % of available visible light), the contribution of phytoplankton being only 5,605 to 18,500 cal/m²/day (0.3 to 0.94% of light). The energy input through primary production by macrophyte was 2.66 to 3.56% of light.

Energy budget at producer level from chlorophyll studies : Chlorophyll studies in these beels also reflected low concentration of phytoplankton. Chlorophyll content ranged from 5.1 to 19.2 mg/m³ which is equivalent to 255.0 to 960.0 mg/m² of phytoplankton carbon or 2,910 to 10,945 cal/m² of phytoplankton energy. Chlorophyll content of the three dominant macrophytes, *Hydra verticellata*, *Ceratophyllum demersum* and *Najas* sp was also estimated. Out of the three, *Najas* contains maximum chlorophyll followed by *Hydrilla* and then *Ceratophyllum.*

Studies on detritus and bottom energy : Organic detritus at the bottom was of high order in all the three beels. The calculated value ranged from 262.5 to 368.2 g/m² on dry weight basis which is equivalent to 257.25 to 361.84 K cal/m² of detritus energy. The high energy resource of organic detritus (25.72 to 36.2 $\times 10^5$ K cal/ha) at the bottom can be utilized only through detritus chain.

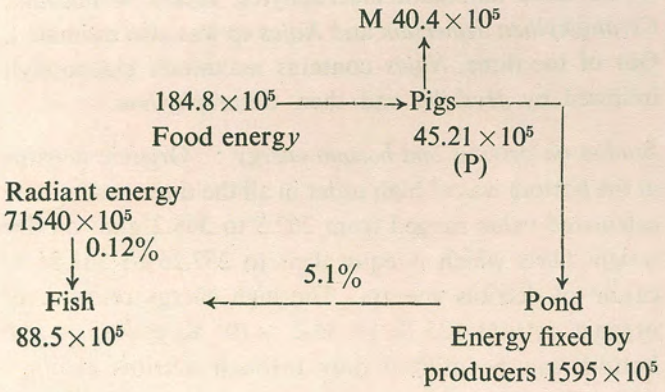
Energy flow model in beel ecosystem : The model suggests that the gross ecological efficiency (ratio of energy input to energy output), was 0.293% and the flow of energy was mainly through detritus chain. Against 44.06×10^7 K cal/ha/yr of energy fixed by producers, the energy output as fish was 12,92, 160 K cal/ha/yr.

Energy flow model in pig-cum-fish-culture system : From the energy model it was observed that 46.6% of the energy given to pig asfeed was assimilated by it and the remaining 53.4% was excreted as faecal matter. About 24.4% of feed energy or 52.2 % of the assimilated energy (A) was used for their growth. 22.2% of food energy or 47.8% of assimilated energy was used for their metabolic activity. The energy equation for pigs used in the experiment is given below.

$$\frac{184.8\times10^5}{C} = \frac{45.21\times10^5}{P} + \frac{10.47\times10^5}{M} + \frac{99.0\times10^5}{F+U}$$

C=Food energy
P=Growth energy
M=Energy lost as respiration
F+U=Energy lost as faecal matter.

Thus 45.21×10^5 K cal energy was obtained in addition to 88.5×10^5 K cal of energy as fish flesh from one ha area in a year. The total output from the system comes from 133.71×10^5 K cal/ha/yr. Thus 70% of the energy input (C) is obtained in two compartments which is unique in its nature. The complete energy diagram for the system is given below :



Project AN/B/4 : **Study of the sedimentation characteristics of the suspended silt load in the brackishwater pond and evolving the efficient mode of operation of the water gate.**

Personnel : A. Sengupta, A. K. Roy and D. Sanfui.

Duration : 1983-85

Location : Kakdwip.

Data has been collected on tidal height, tidal velocity and silt concentration at upper and bottom level of the creek at an interval of 10 minutes for complete tidal cycles in the spring tides of the months from July to December. The ranges of the tidal heights, tidal velocity and silt load concentrations of upper and bottom levels were 15-426 cm, 0-100 cm/sec., 0.349-1.9 g/lit., and 0.38-2.2 g/lit. The variation in silt load concentration was found to maintain certain relationship with the variation of tidal phase and velocity. On the basis of further readings different mathematical relationship between the current velocity and silt concentration in respect of time can be established to assess the total silt ingress in the farm ponds in a particular operation of tidal gate.

Project AN/B/5 : **Sex reversal studies in fishes**

Personnel : B. N. Saigal, V. V. Sugunan, G. K. Vinci, V. K. Unnithan, A. R. Chaudhury.

Duration : 1983-85

Location : Barrackpore

Two stocks of *Oreochromis mossambica* of av. size 12-15 mm and 25-30 mm were reared in separate tanks for rearing into brooders. After three months of rearing in December, the fishes attained av. size of 48 mm and 63 mm.

Project AN/B/6 : **Ecology and control of aquatic insects**

Personnel : Krishna Mitra and Kuldip Kumar

Duration : 1983-85

Location : Barrackpore

Survey of the fauna :

Survey of the insect fauna at Kalyani beel was made throughout the yeat at fortnightly interval. Simultaneously weather reports and water parameters were also taken.

Insects belonging to eight groups were available throughout the year. These are Hemiptera, Coleoptera, Diptera, Ephimeroptera, Lepidoptera, Odonata, Zygoptera, and Trichoptera. Of these Hemiptera was found to be the predominant group followed by Diptera, Coleoptera, Odonata, Zygoptera, Lepidoptera and Trichoptera. Among these, Hemiptera, Coleoptera, Odonata and Zygoptera were available throughout the year in abundance while others were either in small numbers or in traces.

In Hemiptera, there were specimens from seven families and all were available throughout the year. Taxa belonging to Belostomatidae, Pleaidae, Nepidae were abundant and their population was maximum during March to October. In addition taxa belonging to Notonectidae, Gerridae and corixidae awere also present but in small numbers.

Coleoptera was represented by a few beetles belonging to Dytiscidae, Amphizoidae, Curculonoidae and Hydrophylidae, of which two spcies belonging to Dytiscidae were found in abundance.

In Diptera Stratiomyiidae and Chironomidae were available throughout the year. Among others *Probazzia glabra* (Ceratopogonidae) were abundant during November and December. Besides, a few larvae and pupae belonging to Tetanoceridae, Anthomyiidae were also collected in small numbers.

In Ephimeroptera only one species each belonging to Beatidae and Caenidae were available throughout the year and their population was maximum during June to October.

Odonata and Zygoptera were also found to be well represented by several taxa throughout the year. Trichoptera and Lepidoptera are also found in sllma numbers from July onwards.

Biology :

Belostomatidae : In literature *Belostoma* species are reported as predaceous insects of the nursery pond. Biology of species of *Belostoma* was therefore carried out in the laboratory. It is observed that the female lays 57-133 eggs in cluster on the back of the male which nurse them until hatching. The eggs are creamish white in colour and elongated in shape, and take 5-7 days to hatch out during monsoon months. There are five nymphal moults and the total nymphal period ranges from 35-49 days. An adult usually lives 2-3 months but sometime even more. Mortality is maximum during initial stages due to high cannibalism. Further studies in the sexual behaviour are in progress.

Predatory efficency :

Experiments were conducted to note the predatory efficiency of this insect at all the different stages. It is observed that 1st and 2nd instar nymphs attack the eggs as well as newly emerged hatchlings when their movement are very slow. However, the 3rd, 4th and 5th instar nymphs are not seen to attack the young frylings of 3-6 days old or even larger frylings of 15-20 days old. The experiments were repeated after keeping the nymphs fasting for 1-2 days but no change in their behaviour is observed. On the other hand when gastropods are supplied along with the hatchlings the nymphs are seen to readily feed upon the gastropods which are very sluggish in nature. They are also seen to feed upon sluggish nymphs of dragon fly present in the medium. This finding is, however, contrary to the earlier observations of H. Chowdhury (Thesis) who claimed that this insectis highly predaceous on fish and they even feed upon advanced carps fry.

Project AN/B/7 : Microbial aspects of pollution in relation to different types of load in various aquatic ecosystems.

Personnel : R. K. Das, S.B. Saha and B.B. Gosh

Duration : 1983-87

Location : Barrackpore, Khardah and Gauhati

Studies on microbiology of nitrogen fixation, nitrification, denitrification and phosphate solubilization in ponds with recirculatory filtering system, (Barrackpore) Sewage-fed pond (Khardah) and Dhir beel (Assam) were initiated. In RFS ponds, the sump sediment has shown much higher concentration of micro-organisms than that of the pond thereby showing rapid decomposition of metabolites and bottom sediments during recirculation through the sump. The values observed are given below :

Recirculatory pond

Average Number

Bacterial population	—	3.13×10^2/ml of water
	—	3.0×10^3/g of the bottom sediment.
Nitrifying bacteria	—	1.0×10^2/ml of water
	—	1.0×10^2/g of the bottom sediment.
Denitrifying bacteria	—	1.0×10^2/ml. of water
	—	1.0×10^3/g of the bottom sediment.
Phosphate solubilizing bacteria	—	4.2×10^2/g of water
	—	1.4×10^5/g of bottom sediment.

Sump sediment

Bacterial population	—	3.9×10^6/g
Phosphate solubilzing bacteria	—	1.0×10^5/g
Denitrifying bacteria	—	7.0×10^5/g

Sewage-fed pond—S-1

Bacterial population	—	4.0/ml of the pond water
	—	7.0×10^5/g of the sediment
Nitrogen fixing bacteria (aerobic)	—	1.0×10^2/ml of the pond-water.
	—	2.4×10^6/g of the sediment
Denitrifying bacteria	—	1.0×10^2/ml of the pond-water.
	—	1.0×10^5/g of the sediment
Phosphate solubilizing	—	1.0×10^2/ml of the pond-water.
	—	3.0×10^5/g of the sediment

Dhir Beel (Assam)

Bacterial population	—	3×10^2/ml of beel water
	—	1.7×10^5/ml of the sediment
Nitrogen fixing bacteria	—	2×10/ml of water
	—	4.0×10^5/g of the bottom soil.
Dentrifying bacteria	—	1.0×10^2/ml of water
	—	1.0×10^6/g of the sediment
Phosphate solubilizing bacteria.	—	9.0×10^4/g of the sediment

Project AN/B/8 : **Development of an economical design of biological filter for effective filtration of waste water in recirculatory filtering system of fish culture.**

Personnel : A. B. Mukherjee and D. Nath

Duration : 1983-85

Location : Barrackpore

Submerged downflow type filter tank measuring 2.1 m × 1.8 m × 1.5 m has been designed and constructed. The filter unit consists of two separate chambers spaced at 30 cm apart. In the first chember consists of filtering unit and various components and the other chamber is for collection of filtered water. The influent or waste water percolates through the entire body of the filter and the filtered water forces up in the collection chamber and discharges as a thin sheet over the projecting flash-boards.

The filter tank has been built with sal wood with inside lining of galvanised iron sheets. Overburnt porous coke has been used as solid phase for filteration and

and to note its performance for growing nitrifying bacteria. The rate of filteration has been found to be 100 lit/min./m^2 and the head loss in filteration is 15 cms. Surface area of filter media is 1.34m^2 and the volume of filtering elements=0.72m^3.

Chemical analysis :

It has been observed that the model filter has been effective in removing free ammonia. Suspended insoluble solids presents in the sump water from where waste water has been drawn for filtrations, has been completely removed in the model filter. Dissolved oxygen and phosphate content seems to be modified in the filtered water than the pond water. Free carbon-dioxide has been lower in the filtered water than in the sump.

The physico-chemical conditions of sump water and the filtered water from the filtration tank are as under :

	DO (ppm)	pH	Total alkalinity (ppm)	Free CO_2 (ppm)	Phosphate (ppm)	Free ammonia (ppm)	Temp.	Si.	N.	Insoluble residue	Odour
Sump water	6.0	7.4	220	8.0	Trace	0.58	25°C	12.0	0.80	6 mg / 100 ml.	slight
Water received after filtration in the biological filter	6.4	7.6	220	6.0	0.02	nil	25°C	12.0	0.72	nil	nil

Project AN/B/9 : **Devicing efficient methods of aeration for raising the level of dissolved oxygen in sewage-fed fish ponds.**

Personnel : A. Sengupta, A. C. Banerjee and J. R. Das.

Duration : Two years (starting in May, 1983)

Location : Rahara (West Bengal)

Six designs for aerating system of RRC farm ponds by exploiting source of wind energy with the aid of vertical and horizontal axis wind mills have been prepared and contacts have been made with the Institure of Engineering and Rural Technology, Allahabad for getting the supply of wind mills free of cost. After installation the operations to increase DO levels for prawn culture and quick stabilisation of sweage-fed ponds will be taken up.

Project AN/B/10 : **Rotifers as biological indicators of pollution in Ganga River system and its tributaries.**

Personnel : A. K. Laal and A. Sarkar

Duration : Three years (1984-86)

Location : Middle stretch of river Ganga (Kanpur, Varanasi, Bhagalpur, Samastipur and Hayaghat).

Literature on the subject was collected for preparation of bibliography.

Project AN/B/11 : **Genetic characteristics of carp hybrids.**

Personnel : S. K. Mukhopadhyay and S. K. Saha.

Duration : 1983.

Location : Rahara (W. Bengal)

In order to study the genetical identity of the carp hydrids the rohu male X mrigal female and their reciprocal cross hybrids have been procured and are being reared. Muscle protein have been extracted at different pH, and serum have also been collected from the fingerlings of mrigal male X rohu female hybrid. The same will be subjected to polyacrylamide gel electrophoresis.

Project AN/A/1 : **Fisheries Extension : Training need of fish farmers.**

Personnel : P. Das, D. D. Halder, U. Bhaumik P. K. Pandit and B. K. Banerjee.

Duration : 1983

Location : Barrackpore

A study on training needs of fish farmers were undertaken in 2 districts of West Bengal *viz.*, Hooghly and Howrah, selected by randomised technique. A total of 139 fish farmers of above districts were interviewed with structured schedule. The age of the fish farmers varied between 18 years and 59 years. Aquaculture was the primary occupation of 53.9% of the farmers in the sample, while it was the secondary occupation for the 46% farmers. 67% of the fish farmers were dependent on lease ponds and 33% of fish farmers were having own ponds. 65% fish farmers were experienced in scientific fish culture whereas, 70% of the fish farmers underwent training on pisciculture and 65% witnessed the demonstrations on modern fish culture.

It appears that all the farmers after receiving training did not adopt scientific fish culture though 57.55% desired to continue pisciculture on modern lines and 26.6% likes to initiate. Ofcourse cent percent farmers opined that for getting higher productions training is a must in all modern technologies of aquaculture.

The study reveals that 48.20% of the farmers are in favour of training for 10 to 15 days period and course should be both theoritical and practical oriented. 94.96% farmers preferred the venue in village atmosphere and 84.89% farmers favours rainy season as the best time to receive training. 69.78% farmers desires that stipend is a must for trainees whereas, 64.74% farmers opine less than 25 years is the best age to receive trainings. The course contents should be simple and brief as per 79.13% farmers.

The study also reveals that 53.2% farmers feel that demonstration is an ideal extension method through which they benefit considerably. The combined methods of extension are favoured by 46.76% of the farmers which is also comparable with agriculture extension studies. As the fish farmers belong to the poorer community 98.56% of them desire financial help to adopt/continue scientific aquaculture. For adoption of scientific fish culture alongwith training, financial help is also essential as a tool for motivating the poor fish farmers, as is indicated in the study.

Project AN/A/2 : **Dissemination of information in inland fisheries.**

Personnel : B. N. Saigal, V. V. Sugunan, G. K. Vinci, A. R. Chaudhury, M. J. Bhagat, V. K. Unnithan, Anjali De and Sukla Das.

Duration : 1982-84

Location : Barrackpore

Based on scientists' profile pertaining to about 200 scientific and technical personnel of the Institute, hundreds of articles, published in various publications received at the Institute in 1983, were screened. The relevant papers were notified to the scientists concerned in the prescribed proforma after identifying the proper users. The feedback received from scientists are properly documented for analysis.

Over 200 cards prepared during the year are added for the Central Information File.

Problem AN/A/4 : **Role of frogs as predators of paddy pests.**

Personnel A. K. Mondal, S. K. Wishard and S. C. Mondal.

Duration 1983-1988

Location : Kalyani

Work programme was not carried out during the year.

Project AN/A/5 : **Culture of *Artemia salina***

Personnel : K. L. Sehgal and S. K. Majumder

Duration : 1983-84

Location : Barrackpore, Digha

For the first time field trials of hatching, rearing and cysts formation of *Artemia salina* in salterns were carried out at Digha during June 1983. The salterns ware initially filled up with sea water drawn from the adjoining creek. The depth of water in each saltern was maintained between 28-43 cm. Inoculation of laboratory reared cysts of *Artemia salina* was done in each saltern having salinity of 33 ppt, pH 6.5 and water temperature 32 °C. The hatching of cysts started after 37 hours of inoculation and was complete after 72 hours resulting in 50% of hatching.

Out of the four salterns, hatching was observed only in one saltern. The shrimp was reared for 27 days at a temperature of 33.39°C, and were fed on rice bran extract prepared by soaking rice bran over-night in water and squeezing out the extract in a coarse cloth. Palm leaves were spread along the perimeter of the salterns to provide shade to the shrimp against heat. During the rearing period of 27 days there was a gradual increase in the salinity due to evaporation reaching to 80 ppt after 23 days of rearing. From 24-27 th day the shrimp started producing cysts at 75-80 ppt salinity and water temperature between 35.0-37.0°C. The cysts were found floating in the direction of the prevailing wind and were collected on a polythene sheet to keep it free from mud. Due to onset of rains the salinity started coming down and hence the experiment had to be closed. This initial trial gave 15 g of cysts which were sun-dired and stored for further trials.

Project AN/A/6 : **Development of suitable extenders and Cryoprotectants for storage of fish spermatozoa using cryogenic techniques.**

Personnel : B. I. Sundararaj (late), S. V. Goswami, V. Lamba (Delhi University) and Kuldip Kumar (CIFRI).

Duration : Three years

Location : Barrackpore

Experiments on cryogenic preservation of spermatozoa of carps and mullets were carried out during June-August, 1983. Fresh milt diluted with extenders and cryoprotectants was dispensed into 0.5 ml straws after providing equilibration time ranging from 2-20 mts. Sperms in sealed straws were precooled in liquid nitrogen vapours (-196°C) and were put into a canister well immersed in a cryogenic container.

In all, five extenders were tested in varying proportions with cryoprotectant. These are blood sera, urea-egg yolk citrate, Ringer's solution, 189 M and 251 M. The table summarises all the details of the experiments.

189 M was found to be the best exteder in terms of post thawing motility and fertilising capacity. Spermatozoa of *L. rohita* were found to be motile upto 10 days in extender 189 M and upto 5 days in urea-egg yolk citrate.

TABLE—Motility score of carp treated with various extenders/cryoprotectants.

Date	Expt No	Fish	No. of straws filled	Equilibration time (mts.)	Ratio of diluent and semen	Extender/ cryoprotectant tried and their ratios	MOTILITY SCORE										REMARKS
							1 mt	'30 mts	1 day	2 day	3 day	4 day	5 day	6 day	6 day	7 day	9 day	10 day	
3.6.83	I	*L. rohita*	7	10	1:4	Urea-egg	—	60%	40%	—	30%	—	10%	—	—	—	—	—	
27.3.83	II	*C. catla*	4	5	1:4	Yolk 80:20 DMSO (1:1)													
						189 M / DMSO 1:9	50%	30%	20%	—	10%	—	—	—	—	—	—	—	
25.7.83	III	*L. rohita*	10	2	1:4	189 M / DMSO 1:9	80%	80%	80%	80%	60%	40%	—	40%	40%	40%	40%	40%	
30.7.83	IV	*L. rahita*	10	2	1:4	189 M / DMSO 1:9	60%	—	40%	40%	40%	—	—	20%	—	—	20%	—	
		C. mrigala	8	10	1:4	Urea-egg Yolk DMSO	nil	—	—	—	—	—	—	—	—	—	—	—	Blood came out along with milt and contaminated the content.
11.8.83	V	*Liza tade*	4	4	1:4	189 M / DSMO 1:9	nil	—	—	—	—	=	—	—	—	=	—	—	Milt was very thick like a paste and didn't dissolve in the diluent.
20.8 83	VI	*L. rohita*	8	5	1:4	189 M Ringer's sol 252, Blood sera	50%	50%	—	—	30%	—	—	—	—	—	—	—	
		Silver carp	6	10			nil												
		Grass carp	6	15			nil												
		C. mrigala	4	20			nil												
7.9.83	VII	*L. rohita*	7	5	1:4	189 M	Semen coagulated												
		S. carp	4	7	1:4														

The maximum motility score was 80% in the former case against 40% in the latter. The other three extenders viz. blood sera, Ringer's solution and 251 M however, did not prove upto the mark and require further combination and corroborative trials. Dimethyl sulfoxide (DMSO) was used as cryoprotectant in all the trials as it penetrates the cells rapidly and is most effective during slow freezing. Fertility evaluation tests conducted by taking 1 ml of sperms of 5 ml ova showed the fertilisation rate of 20.7% and 13.8% of the sample preserved for 2 and 6 days respectively.

However, the milt collected during late August i. e. at the close of the spawning season was mostly inactive and showed minimal activity. The thawed content coagulated into a soft jelly like mass. Since such coagulation has been reported to be caused due to higher proportion of cryoprotectant in the diluent as such studies were planned to estimate the precise requirement of cryoprotectant : extender ratios but work could not be completed this year due to non-availability of sufficient number of ripe male brooders.

Project CP/CFCSP-1 : **All India Co-ordinated Project on composite fish culture and fish seed production (Institute-based centres).**

Personnel : S. D. Tripathi, D. V. Pahwa, M. Y. Kamal, R. M. Rao, M. Sinha, J. B. Rao, M. Kaliyamurti, D. N. Mishra, K. L. Shah B. C. Tyagi, P. K. Aravindakshan, A. Mukherji, P. L. N. Rao, M. P. Singh Kohli D. P. Chakraborty, B. K. Singh and P. N. Jaitly.

Duration : 1971-1984

Location : Dhauli, Badampudi, Gauhati, Ranchi, Karnal, Pune, Bhavanisagar, Jaunpur, Kalyani.

COMPOSITE FISH CULTURE

Excepting West Bengal (Kalyani) and Tamil Nadu (Bhavanisagar) Centres which were hit by severe draught and the Andhra Pradesh (Badampudi) Centre, which was affected both by heavy rains followed by a cyclone, the work at the centres made satisfactory progress.

Andhra Pradesh Centre (Badampudi) : The 10th set of experiments, intiated in two 0.12 ha ponds on 30th April, 1983 was vitiated on account of heavy rains in August followed by cyclone during September. After the floods the ponds were prepared again and the 11th set of experiments initiated in November, 1983 with a 5 and 6 species combination at 5,000 fingerlings/ha. The objective of the experiment is to compare the growth of induced bred catla and rohu with that of seed collected from river Godavari and also study the growth performance of *L. calbasu* vis-a-vis mrigal and common carp.

Assam Centre (Gauhati) : The 6th set of experiments on composite fish culture with 3 and 6 species combinations, initiated in two 0.25 ha ponds, in December-January (1982-83) were wound up. A net production of 2082 kg/ha/7 months was registered with the 3 species combinations (Stocking density 4,400 / ha ; catla 30 : mrigal 40) whereas, the 6 species combination resulted in a lower production of 1,998 kg/ha/7 months (Stocking density 6,400 fingerlings/ha ; catla 25 : rohu 18.75 : mrigal 25 : silver carp 9.37 : common carp 18.75 : grass carp 3.12).

The 7th set of experiments was initiated on 1 September, 1983 with 3 species combination at a stocking density of 5,000 and 6 species combinatin at a stocking density of 6,000 fingerlings/ha.

Bihar Centre (Ranchi) : The 7th set of experiment, initiated in two 0.1 ha ponds in September, 1982 at a stocking density of 5,000 fingerlings/ha (silver carp 25, catla 10, grass carp 10, rohu 15, common carp 20, mrigal 20) is still in progres as the fish is not yet marketable.

Haryana Centre (Karnal) : The 12th set of experiments, initiated in 3 ponds on 30 April, 1983 at 4,500 fingerlings/ha has resulted in a production of 7,328 kg/ha/8 months with the 6 species combination at a cost of Rs. 3.86/kg. The other two ponds with a 5 species combination (without grass carp) registered a production of 3,543 and 3,120 kg/ha/8 months at a production cost of Rs. 6.04 and Rs. 6.41/kg respectively.

Maharashtra Centre (Pune) : The 12th set of experiments, initiated in December, 1982 in two 0.31 ha ponds at 10,000 fingerlings/ha (catla 4 : rohu 12 : mrigal 21 : common carp 30 : silver carp 20 : grass carp 13) and 8,000 fingerlings/ha (catla 4 : rohu 10 : mrigal 31 : common carp 30 : silver carp 25) resulted in a production of 9,251 and 7,556 kg/ha/yr respectively. The production with the 6 species combination has registered a fall of about 1,000 kg/ha owing to improper species combination.

Tamil Nadu Centre (Bhavanisagar) : The 10th set of experiments initiated in a single pond (0.375 ha) on 31 January, 1983 had to be wound up in April, 1983 on account of low water level. A production of about 200 kg/ha/2½ months was registered with six species combination comprising catla 29, silver carp 6, rohu 20, grass carp 25, mrigal 15 and common carp 25.

The ponds are under major repairs and no further work has been possible at the Centre. Due to the failure of both the south-west and north-east monsoon, no seed production programme could be taken up.

Uttar Pradesh Centre (Jaunpur) : The 11th set of experiments on composite fish culture is in progress in 5 ponds stocked at 5,000 fingerlings/ha with 5 and 6 species combination. The rearing period has been extended from 9 months to 1 year and repeated harvesting/replenishment is resorted to achieve increased production. Observations on the growth of *Tor tor* in two ponds have indicated that the growth is extremely slow even during the second year of its life. The role of synergism is being tested in one of the ponds where grass carp forms the main component (50%), the other 5 species *viz.* catla, rohu, mrigal, common carp and silver carp being 10% each. A production of 1,250 kg/ha is already obtained from this pond in 6 months. No feed has been used in this experiment excepting for some fertilizers required for ecological corrections.

The use of small sized yearlings resulted in a production of 4,937 kg/ha/yr with the 6 species combination (catla 5, rohu 10, mrigal 15, silver carp, 30, grass carp 20, and common carp 20) at 5,000 fingerlings/ha. The experiment has clearly indicated that large sized brood stock can be raised in very small ponds (0.07-0.10 ha).

West Bengal Centre (Kalyani) : The 8th set of experiments was vitiated due to repeated dacoities. Severe drought condition did not permit any further experimentation excepting on monoculture of common carp which also resulted in a low production of 553 kg/ha/5 months. The experiment was severely affected by low water levels. Another experiment on low input technology using grass carp as the main component was also vitiated in March, 1983 when the pond was forcibly harvested by the dacoits.

FISH SEED PRODUCTION

A total of 214.51 lakhs seed comprising of 8.45 lakhs catla, 63.65 lakhs rohu, 96.53 lakhs mrigal, 3.12 lakhs silver carp, 0.24 lakhs grass carp and 47.22 lakhs common carp was produced at the Institute based—centres. The details are :

Name of the Centre	*Catla*	*Rohu*	*Mrigal*	*Silver carp*	*Grass carp*	*Common carp*	*Total*
Karnal	0.05	15.05	7.28	0.12	—	4.7	22.50
Gauhati	0.25	9.75	62.95	0.05	—	—	73.00
Badampudi	—	5.00	1.00	1.55	0.55	—	7.60
Kalyani	—	—	—	—	—	—	—
Ranchi	—	—	—	0.05	—	3.325	3.375
Pune	1.05	0.60	6.0	0.60	0.09	25.0	33.34
Jaunpur	7.10	33.25	19.30	0.75	0.10	14.20	74.70
Bhavanisagar	—	—	—	—	—	—	—
T o t a l	8.45	63.65	96.53	3.12	0.24	47.225	214.515

Project CFCSP 1.2 : **All India Coordinated Project on Composite Fish Culture and Fish Seed Production (Centrally sponsored centres).**

Personnel : S. D. Tripati, K. K. Ghosh, N. Sukumaran, M. K. Rehman, H. L. Srivastava, H B. Dava, V. R. Khadse and S. K. Sahoo.

Duration : 1970-Continuing

Location : Dhauli, Kansalyagang, Lingda, Durg and Tuticorin.

COMPOSITE FISH CULTURE

Gujarat Centre (Lingda) : The first experiment on polyculture of Indian major carps in two large (0.5 ha each) ponds initiated on 22 November, 1982 was concluded in December, 1983 after 13 months' rearing. The ponds were stocked at 5,000 fingerlings/ha in the proportion of catla 30, rohu 30, mrigal 40. A production of 2,556 and 2,660 kg/ha/13 months was registered from the two ponds, the survival rate being rather low (50-66%).

Madhya Pradesh Centre (Durg) : No work has been possible at the centre on account of non-availability of a large pond required for the proposed experiment.

Orissa Centre (Kausalyagang) : The 7th set of experiments in two 0.22 ha ponds with 3 and 5 species combinations, initiated in January 1983 at 4,000 fingerlings/ha with (i) catla 20, rohu 40, mrigal 40 and (ii) catla 10, rohu 30, mrigal 30, sliver carp 20 and common carp 10 are in progress. Fish above 1 kg in weight have been harvested and replenished.

Tamil Nadu Centre (Tuticorin) : Severe drought conditions hampered the progress of work at this centre as well as the on-going experiments in 4 ponds had to be wound up in April and May. A production of 2,534 kg/ha/162 days, 2,746 kg/ha/171 days, 2,980 kg/ha/168 days and 3,455 kg/ha/190 days was registered from ponds stocked at 5,250, 5,250, 7,500 and 5,250 fingerlings/ha. The species proportion in the pond stocked at 7,500 fingerlings / ha was catla 26.68, rohu 20, mrigal 26.68, common carp 20, grass carp 3.3, milk fish 3.3 while the other three ponds stocked at 5,250 fingerlings / ha had catla 28.6, rohu 19.0, mrigal 23.8, common carp 19.0, grass carp 4.76, milk fish 4.76.

Offseason spawning of mrigal was achieved at the Tuticorin Centre during December, 1983 when two sets were induced bred resulting in a production of about 1 lakh spawn, the hatching rate being very low (22%). This is for the first time that the Indian major carp has been spawned during December anywhere in the country.

FISH SEED PRODUCTION

A total of 79.65 lakhs spawn comprising 16.53 lakhs catla, 25.16 lakhs rohu, 9.95 lakhs mrigal and 28 lakhs common carp was produced at the Centrally-sponsored centres as detailed below :-

Name of the Centre	*Catla*	*Rohu*	*Mrigal*	*Silver carp*	*Grass carp*	*Common carp*	*Total*
Tuticorin	2.0	1.5	3.0	—	—	—	6.50
Kausalyagang	13.75	13.50	—	—	—	26.0	53.25
Lingda	0.785	10.165	6.95	—	—	2.0	19.90
T o t a l	16.535	25.165	9.95	—	—	28.0	79.65

Project CFCSP-10 : Operational Research Project on Composite Fish Culture and Integrated Fish-cum-Livestock Farming

Personnel : B. K. Sharma and Manas Kumar Das

Duration : 1977-85

Location : Krishnagar (W. Bengal)

During the year under report the work could be initiated only after the rainy season as the water level in the ponds was very low due to unprecedented drought conditions which prevailed in district Nadia during the year 1982.

Composite Fish Culture in large water bodies

Experiments on composite fish culture were taken up in three ponds with waterspread area of 1.5 ha, 2.3 ha and 2.3 ha at Anjana Fish Farm Krishnagar Nadia, Experiments conducted during the ealier years in these ponds using organic manures, inorganic fertilizers and fish feed yielded fish productions ranging from 3000 to 4000 kg/ha/yr with 4-6 species combinations. During these experiments it was observed that fish feed not only pushed up the input cost of fish culture but its application also in such large ponds was found to be cumbersome and time consuming.

To overcome this constraint the experiments during the year under report were reoriented by eliminating the use of fish feed and application of rock phosphate and urea only.

The three ponds were poisoned with mahua oil cake @250 ppm in the months of June/July 1983. As the ponds were heavily infested with submerged weeds (*Hydrilla*) grass carp fingerlings were stocked to eradicate the weeds in the month of July 1983. The grass carp were harvested in Sept., 83 by which time they completely eradicated *Hydrilla* from all the ponds. The ponds were then stocked with 3, 4 and 6 species combination of Indian and exotic carps. Manuring was done in the 3 ponds at monthly intervals.

R I Pond : The pond was stocked in the month of November 1983 with rohu, catla, mirgal at a stocking density of 4000 fingerlings/ha and with species ratio of C40, R30, M15, Cc15 (common carp still to be stocked).

R II Pond : The pond was stocked in the month of November, 1983 with rohu, catla, mrigal at a stocking density of 4000 fingerlings/ha with species ratio of C40, R30, M30.

R III Pond : The pond was stocked in the month of November 1983 with rohu, catla, mrigal, grass carp, silver carp at a stocking density of 7,400 fingerlings/ha at a species ratio of C20, SC20, R30, M10, Sc10, Cc10 (common carp yet to be stocked).

The experiments are in progress. Good growth of fish was observed during monthly sampling.

Integrated fish-cum-livestock farming :

Experiment cum demonstration trials of fish cum livestock farming using the wastes of pigs, poultry (litter) and ducks were conducted during the year under report.

Fish cum duck farming : 25 ponds ranging in water area from 0.1 ha to 0.3 ha owned by farmers were selected for fish cum duck farming in village Chandirampur (Kalyani district), Nadia. The work, however, could be initiated only in 13 ponds as the water accumulation in rest of the ponds was not sufficient, because of unprecedented drought conditions which prevailed in the area, during the year 1982 and semidrought condition during the year under report.

The ponds were prepared and stocked at stocking density of 6000 fingerlings/ha with species ratio of C25 : Sc15:R20:M30:Cc 10 (common carp still to be stocked). Along with fish, ducks were also raised on these ponds at stocking densities ranging from 200—300 ducks/ha. No fish feed or pond fertilizers were used. The experiments are in progress.

Fish cum pig farming : The production trial cum demonstration of fish cum pig farming was initiated in a 0.1 ha pond in the premises of Morning Star College during the year under report. The pond was stocked with 6 species of fish at a stocking density of 600 fingerlings/ha with species ratio of Sc 15 : C25 : M20:Cc10 : Cc10 : R20, The pig excreta was recyled in the pond in daily doses ranging from 5-10 kg/day. The experiment is in progress.

Fish cum poultry farming : Experiments in earlier years were conducted on fish cum poultry farming by recycling the excreta of poultry kept in cages. This system of keeping birds in cages is not very much prevalent in West Bengal. The poultry birds are normally raised under litter system which result in production of huge quantities of poultry litter in the villages. As such the experiment during the year under report was initiated in November 1983 in a 0.1 ha pond by recycling the poultry litter in the fish pond. The pond was stocked at a density of 6000 fingerlings/ha with species ratio of C25: Sc15:M20:R20:Cc10:Gc10. Poultry litter was recycled on daily basis @ 5 kg/day. The experiment is in progress.

Project ABF-18 : **Feed formulation for** *Clarias batrachus* **and** *Heteropneustes fossilis.*

Personnel : P. Das, M. Y. Kamal, P. K. Mukhopadhyay and P. K. Pandit.

Duration : 1980-84

Location : Barrackpore

Investigations were undertaken to formulate a balanced supplementary feed for *Clarias batrachus* starting from cheaply and abundantly available ingredients. Studies on effects of varying quality of protein on growth and certain biochemical responses in blood and tissues of *Clarias batrachus* were conducted using fish meal, blood meal and meat meal as the principal protein sources in three different feed combinations (isonitrogenous) against a control semipurified test diet comprising casein and gelatin as the protein source. The objective of the study was to formulate a balanced compounded supplemntary feed for the fish. Foremost consideration was given to the protein component in this study for obvious reasons. The experimental feeding trial was started in cement cisterns on 4-7-83 and continued for a period of 120 days. The trial indicated that fish meal and meat meal were almost equally effective in promoting gwowth in *Clarias batrachus*. Blood meal, however, proved to be less efficient in this regard. The biochemical investigations showed that intestinal protease activity (expressed as OD570 mg/protein/hr) was maximum (6.40) in fish meal diet treatment followed by meat meal (5.20) and blood meal (4.00). The control group showed activity of the order of 6.25. Protein synthesis in liver tissue

measured in terms of 14C-leucine incorporation indicated that incorporation (counts per minute/mg protein) was of the order : Control group 6483.0; meat meal diet fed group, 5890.5 ; fish meal diet fed group, 5683.5 ; and blood meal diet fed group, 2070.2. 14C leucine was injected to the fish @ 100 μCi/kg body weight.

Blood collected from fish fed with different diets as mentioned above were anylsed colorimetrically for haemoglobin level. The haemoglobin level was of the following order :

Diet treatment	*Haemoglobin level (g/100 ml)*
Control	7.6
Fish meal containing diet	8.6
Meat meal ,,	8.0
Blood meal ,,	7.2

The blood serum collected by centrifugation of whole blood was analysed for total protein and total free amino acids. Protein level in both fish meal diet and meat meal diet treatment showed 14.4 mg/ml blood while blood meal diet treatment showed 11.2 mg/ml and control group of fish showing 13.2 mg/ml protein.

Total amino acids in blood serum were of the order : Control diet treatment = 416 mg/ml, fish meal diet treatment = 408 mg/ml, meat meal diet treatment = 352 mg/ml and blood meal diet treatment = 312 mg/ml.

Project ABF-19 : **Paddy-cum-air-breathing fish culture.**

Personnel : P. Das, P. K. Pandit and M. Y. Kamal.

Duration : 1981-83

Location : Barrackpore

The work was conducted in collaboration with Operational Research Project, Pundooah.

During the pre-kharif seasons, the paddy variety 'Pankaj' was planted in 3 plots at Dhamacin village under Pandua Block of Hooghly distirct, West Bengal. *Clarias batrachus* and *Heteropneustes fossilis* were introduced in the paddy plots to observe the compatibility and growth under paddy field environment. The pesticide, carbofuran was applied to check the paddy pests. Fishes were sampled to examine the bio-accumulation level of the pesticide in muscle tissue. Paddy plants and field soil were also studied for pesticide residues. The study indicated traces of pesticides in the soil and fish tissue but not in paddy plants under gas liquid chromatography analysis.

On 3-11-83 plankton sample was taken from each plot. A total of 25 litres of water was filtered through plankton net and were analysed from the three plots. Phytoplankton was dominant in all the plots. In the 1st plot feed (fish meal) was given and the total amount of plankton was 0.7 cc and the number encountered/cc were *Ulothix* (453), blue green algae (320), *Spirogyra* (286), *Volvox* (140), *Pinnularia* (26). The zooplankton were represented/cc by cyclops (46), *Brachionus* (40), nauplius (27). Crustacean parts (287), plant matters and bivalve larve (40) were also found. From the 2nd plot, without feed, a total volume of 1.3 cc. plankton was obtained. The phytoplankton/cc were represented by *Ulothrix* (374), blue gree algae (unidentified) (240), *Spirogyra* (153), *Volvox* (146), *Pinnularia* (33), *Closterium* (27) and *Mycrocystis* (20). The zooplankton were represented by nauplius (86), *Brachionus* (60), *Moina* (47) and *Cyclops* (40). The protozoa (201), crustacean parts (200) and plant matters (173) were also found in the sample.

In the control plot the plankton volume was 3.5 cc where blue green algae (900) was the main form followed by *Microcystis* (35) and *Pinnularia* (10). Amongst zooplankton nauplius (110), *Cycloys* (90) and *Brachionus* (90) were encountered. Plant matter (330) crustacean parts (190), protozoan (35) and bivalve larvae (35) were also found from this plot.

Project/CP/ABF-1 : All India Co-ordinated Project on Air-breathing Fish Culture in Swamps.

Personnel (CIFRI) : P. Das, M. Y. Kamal, P. K. Mukhopadhyay (Barrackpore), S. K. Munnet (Gauhati), D. Kumar (Patna) and S. P. Ayyar, V. K. Murugesan and P. Kumaraiah (Bangalore).

Duration : 1971-1985.

Location : Barrackpore, Patna, Bangalore, Gauhati, Kalyani, Hyderabad.

PATNA CENTRE

Induced breeding : Two sets of magur brooders were injected with homoplastic pituitary @ 6 mg/100 g body weight and were released in the breeding plots. Another set was given injection @ 4 mg/100 g and was released in plastic pool. The former sets bred while the latter did not respond. Of the 37 sets injected with carp pituitary extract @ 6-20 mg/100 g and released in ponds and plastic pools, none bred. After giving pituitary doses varying from 6 to 10 mg/100 g body weight, 8 sets of singhi were released in breeding pits and 3 sets in plastic pools. Fish in the pits did not breed while two sets in plastic pools bred yielding about 20,000 eggs with 100% fertilization. The other set did not breed even after a second dose. Mass-scale breeding of *C. batrachus* was observed during monsoon months in a 2414 m^3 rennovated plot at BAU campus, Ranchi, under simulated breeding conditions. A total of 59 sets of brood fish were employed and 1,576 fishlets were later recovered from the plots.

Seed survey : It seems that seed of magur and singhi come to markets of the wastern zone of North Bihar in meagre quantity from late September or early October. At Darbhanga, the seed arrives at market from the middle of November and the brooders from April. The survey revealed that magur seed in bulk quantities is available in some parts of Chhotanagpur Division, i. e., in the southern parts of Singhbhum District and whole of Ranchi district.

Transportation of fry and fingerlings of C. batrachus : 226 fry and 1,350 fingerlings of magur were transported from Ranchi to Patna (16 hours) under oxygen packing. The mortality was as low as 0.88% and 0.37% for fry and fingerlings respectively. Another consignment of 15 kg seed was sent to Patna from Gumala by train in November in a GI drum with perforated lid. During the transportation and storage period of 75 hours, the mortality was only 13.36 %.

Monoculture of singhi : Three sets of monoculture experiments with singhi stocked @ 30,000/ha were conducted. One lot was fed with fish meal + deoiled rice bran + groundnut oil cake + minerals (1 : 6.5 : 2 : 0.5). Another lot was fed initially with a mixture of rice bran + cow dung (1 : 1) followed by mustard oil cake and cow dung (1 : 1) and then rice bran and minerals. The third one was kept as control. Maximum production obtained was from the second pond i. e., 529.64 kg/ha/123 days. The fishes had grown from 10.5 to 22.2 g with a survival rate of 70.48%. Cost of production worked out to be Rs. 11.88/kg of fish.

BANGALORE CENTRE

Seed raising of magur : Sixty three magur hatchlings (7-8 mm size) raised in 7 m^2 cistern grew to 93-113 mm (av. wt. 8.1 g) in 85 days with survival of 58.7%. In another experiment 225 fry were raised in the cistern which showed a poor growth rate coupled with a poor rate of survival (19% in 44 days). The fry were fed on mustard oil cake + cow dung (1 : 1).

Seed prospecting : An eight km stretch of river Thunga near Shimoga was surveyed for seed of *C. marulius*. From the stretch a total of 4,543 fry were collected during May-June, 1983. A new potential seed collection centre for *C. marulius* was located in the river Hagari near Hagari bommanahalli in Bellary district from where 500 fry were collected from a single brood.

Breeding : Experiments on hypophysation of *C. batrachus* resulted in spawning in five sets. Percentage of fertilization and hatching was low.

Culture : Magur seed (122.2 mm/114 g) were stocked in three 0.05 ha ponds @ 30,000, 1,00,000 and 1,00,000/ha . They were fed with chickmash after binding with wheat flour (7% w/w) @ 1.5 to 3% of body wieght of the stock. For the last 120 days, chickmash was fortified with 13% fish meal. After a rearing period of 220 days, the gross production obtained was 1509.000, 2842.400 and 2661.134 kg/ha respectively from the three ponds The average final weight and the percentage of survival at the low stocking density was 55.6 g/fish and 90.47 respectively. At the higher stocking density in the other two ponds, the average final weight was 40 g per fish with 67-71% survival.

Feed formulations : Six different feeds were formulated for singhi using the following ingredients (1) rice bran, (2) groundnut oil cake (3) fish meal, (4) dried animal blood, (5) dried cow manure and (6) commercial agrofeed. The feed formulations were experimented upon fingerlings of singhi. In the six combinations formulated, the one with dried cow manure + rice bran + animal blood (3 : 1 : 1) gave the best result with a growth increment of 6.5 g. Detailed results are given in the table no. 5.

Boiled and minced blood when given as feed, found to be more effective for *Clarias datrachus* than for *H. fossilis*. The growth performance with this feed for *Clarias* was found to be 51.25% in 90 days whereas, it was only 22.50% for *Heteropneustes*.

Fish seed transportation : 19,000 fingerlings of magur (122.2 mm/11.4 g) were transported by rail in 10 round galvanised iron containers each of 100 litre capacity from Howrah to Hagaribommandhalli (Bellary dist.) covering a distance of 1922 km in 51 hours. Water was partially replaced after 34 hours. On arrival of the consignment at the farm the mortality rate was observed to be 33%.

Tagging experiments on murrel fingerlings : 355 fingerlings of *C. marulius* (65-120 mm) were tagged with loop type external tag fixed in the body with the help of a hypodermic syringe at the caudal region above lateral line. The tags were fabricated at the centre using a letter embossing gun. The tagged specimens were maintained in a cistern. The mortality was negligible in the course of a 60 days observation period. However specimens excepting 20 shed their tags cutting dorsal edge of the body. None developed any infection.

GAUHATI CENTRE

Fish seed production : Induced breeding of magur, singhi and koi could be achieved using homoplastic and heteroplastic pituitary glands. Instances of sympathetic breeding have been recorded in magur and singhi.

Monoculture of H. fossilis : *H. fossilis* was stocked in a 0.05 ha pond @ 25,540/ha may were reared for a period of 226 days. The final harvest showed a survival of 74.66%, but with a growth of only 10.8 g (size range, 20-102 mm). A production of 612.2 kg/ha/7 months was obtained. The low production rate was attributed to improper supplementary feeding, high rate of mortality low stocking density, etc.

In another experiment, singhi were stocked @ 40,000/ha. The initial weight was 8.0 g (5-10 g) and length 104.8 mm (82-137 mm). The stocking was done on 2-12-83 and the experiment is under progress. The algal bloom occurred in the pond during the initial stage, but was successfully controlled by introducing 9 nos. of silver carp.

Monoculture of magur : In a 0.02 ha pond the experiment on monoculture of *C. batrachus* was initiated on 28-12-83. A total of 600 nos. of magur were stocked in parts (30,000/ha). The experiment is under progress.

Mixed culture of air-breathing fishes : In another pond of 0.02 ha area, the experiment on mixed culture of three species viz., *C. batrachus*, *H. fossilis* and *A. testudineus* was initiated on 1-12-83 at a stocking ratio of 1 : 1.5: 2 for the above three species. The stocking density was @ 45.000/ha.

Mixed culture of air-breathing fishes with carps : The experiment was intiated in a nursery pond of 0.03 ha in Ulubari fish farm, Gauhati. Pond was treated with

lime @ 800 kg/ha before stocking. Organic and inorganic manure also was resorted. Catla, rohu and silver carp (1 : 1. 5 : 3) and magur, singhi and koi (1 : 1.5 : 2) were stocked @ 5,000 nos./ha and 40,000/ha. respectively. Supplementary feed comprising rice bran and mustard oil cake (1 : 1) and trash fish meal and rice bran (1 : 1) are being given to carps and air-breathing fishes respectively. Harvesting and production assessment will be done in July, 1984.

Cage culture : Cage culture of magur, singhi and koi was started in six nylon cages of 2 × 1 × 1 m installed at Ulubari fish farm premises. Stocking density in all the cages was 50 fish/m2, the fishes are fed with fish meal and rice bran @ 10% of the body weight, The fishes were affected by fungal disease resulting in mortality. The disease was controlled by KM_nO_4 and formaline treatment.

ANDHRA PRADESH CENTRE

Seed survey : Seed of *Channa striata* and *C. punctata* were collected from Wyra reservoir, Palair reservoir, middle reaches of River Palair and a perennial tank at Kodada. Peak period of availability was August and September. In the perennial tank at Kodada *C. striata* seems to breed in other months too since the fry of the species were collected during January, 1984. The relevant details are given in Table No. 6.

Seed rearing : Early fry of *C. striata* and *C. punctata* (0.1 g av.) were successfully reared in aquaria employing zooplankton as feed. Fry of *C. striata* weighing 1.0 g were reared to 18.6 g in three months time in cement nurseries at a stocking density of 3.4 lakhs/ha with a survival of 63%. In another experiment, fry of 1.1 g were reared to 9.3 g fingerlings in 3½ months with a survival of 92%. Stocking density was as high as 13 lakhs/ha. Tadpoles were given as initial diet, followed by minced meat of trash fishes, in both the above cases.

Culture experiments : Four monoculture expriments were conducted with *Channa striata*. The details are given below :

Expt. No.	*Stocking density*	*Period of rearing*	*Initial/size/(g)*	*Final/size/(g)*	*% of survival*
I.	6,250 / ha	190 days	6.4	142.2 (68-420)	80
II.	15,000 / ha	145 days	18.6	158.6 (89.6-244.6)	80
III.	20,000 / ha	120 days	9.3	9.5 (27.3-45.3)	—
IV.	—	120 days.	—	(6-15)	—

Minced meat of fresh trash fish was given @ 10% body weight in experiment No. 2 ; a combination of plant and a nimal origin feeds @20% of body weight was given in the 3rd set ; a mixture of groundnut oil cake and rice bran (1 : 2) was given in the IVth set ; and no supplementary feed was provided in the first case. The experiment reveals that animal component must be an essential component of murrel feed.

KALYANI CENTRE (WEST BENGAL)

In view of the acute drought conditions the ponds have remained completely dry and there being no alternative source of water, the work programme could not be taken up during the period of this report. Non filling of the vacant posts at the centre by the Department of Fisheries, West Bengal has been an added handicap for the working of the centre.

BARRACKPORE

(Work shown under projects A.B.F/18 and A.B.F/19)

Project CP/R-1 : **All India Coordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs.**

Personnel : B. V. Govind, Ch. Gopalakrishnayya, Y. Rama Rao, G. K. Bhatnagar, V. R. Desai, C Selvaraj, K. Gopinathan, H. P. Singh, M. Ramakrishnaiah, B. P. Gupta, A. Mathew, B. C. Jha, S. N. Singh, D. K. Kaushal, M. D. Pisolkar, N. P. Srivasthava, V. K. Sharma, V. Kolekar, K. O. Joseph, A. K. Ekka, K. K. Agarwal, K. S. Banerjee (*All at CIFRI Centres*) M. A. Varghese, K. A. Pota, M. G. Shaw, K. R. Khan (*All at centrally sponsored Ukai Centres*)

Duration : 1971 onwards

Location : Nagarjunasagar (A. P.), Bilaspur (H.P.), Pollachi (Tamil Nadu), Rihand (U.P.), Ranchi (Bihar), Ukai (Gujarat), Kangsabati (W. Bengal).

Nagarjunasagar : Maximum water level was in October at 179.375 m. The average water spread area was 23,356 ha. Total inflow and outflow were more than last year.

Reservoir water was generally warmer during this year over last year. The temperature ranged between 20.75°C (January) and 40.81°C (May). Total rainfall was more than last year.

Standing crop of plankton was 0.451 ml/m³. *Pediastrum* was the dominant plankton. Zooplankton dominated.

Total yield from Sagar camp of lentic sector was less at 26.9 t than that of last year. Catfishes contributed to 94.4% of which *P. pangasius* was the major contributor with 41.60 % of total catches.

Experimental fishing from 14-11-83 with nets of mesh bar ranging from 60 to 100 mm, yielded one *L. rohita* (2.950 kg) and one *M. punctatus* (2.200 kg) in 70 mm mesh bar only.

Govindsagar : The average water level during this year (484.027 m) was less than that of last year 488.046 m-12 month's average). However, the inflow during this year (643.586 million m³) was more than that of last year (615.152 million m³) and the outflow (594.440 million m³) was less than last year (635.843 million m³). Thus, the water retention was more during this year in the reservoir. The rainfall during this year for the period January to September amounted to 1782.20 mm as against 1167.00 mm of last year for 12 months. Total catch during this year was estimated to be 418 t and was less than that of last year (554.6 t). The annual per hectare production was 44.1 kg as against 53.3 kg of last year. The decrease was mainly due to the observance of closed season during June and July. From the commercial nets it was observed that the dominant *L. dero* (33.7% of total catch) was mainly obtained from the nets of meshes 85-95 mm (mesh bar approx. 42 to 47 mm) and ranged between 270-540 mm in total length. Similarly the next important *C. carpio* (26.38%) of total catch was caught in nets of meshes 85-125 mm and ranged between 360-425 mm and then third dominant silver carp was caught in 175-205 mm and ranged between 515-810 mm indicating their respective mesh selectivity.

Getalsud reservoir : Rainfall during this year was 1315.21 mm. Natural recruitment of catla, rohu, mrigal and calbasu was indicated by the occurrence of young ones in the drag net catches. *Wallago attu* was recorded for the first time. *C. mrigala* dominated (54.25%) in the experimental fishing catches followed by *L. rohita* (10.6 %), *C. catla* (10.3%) and *L. calbasu* (7.4%). Catch/unit of effort was maximum in case of 75 mm bar nets

(3007.8 g/50 m net) followed by 50 mm bar (895.2 g/50 m net) and 65 mm bar nets (653.3 g/50 m net).

Rihand reservoir : Commercial fishery by gill nets and drag nets done for 3 months (Sept. 15th to Dec. 15th) yielded about 20t, of which gill nets contributed to 18.6t (92.2%) and the rest by drag nets. Gill net catches comprised mainly of *C. catla* (92%) and others and drag nets mainly of *N. chitala* (66%) followed by *C. catla* (9%), *S. silondia* (7.6%), *W. attu* (6.9%), *L. rohita* (3.5%) and others.

Aliyar reservoir : The reservoir exhibited wide fluctuation in average capacity from 1.474 to 50.460 million m^3 with an average of 19.340 million m^3 and in area from 58.93 ha to 508.64 ha with an average of 256.530 ha.

The total fish yield computed for the year was 21,909.8 kg and the average catch per unit of effort/day was 8.84 ranging from 3.83 kg to 18.04 kg, *C. mrigala* dominating the catches with 46.92% followed by *C. carpio* 21.57%, *C. catla* 11.64% and *L. rohita* 7.89%.

Only *Tilapia mossambica*, *Ompok* spp. and *Puntius carnaticus* breed in the reservoir. Hence the reservoir has been stocked with fingerlings of *C. catla* (66,800), *L. rohita* (1,54,250), *C. mrigala* (79,245), *C. carpio* (2,05,000) and *L. fimbriatus* (16,500) and some of these were clipped of their dorsal fin for further studies.

A total of 37 species of fishes were identified in the reservoir. *Ompok malabaricus* and *Ompok bimaculatus* as well as *Puntius filamentosus* and *P. mahecola* were found to be having distinct features as to deserve a separate species status.

The fish production of the reservoir was computed to be 67.62 kg/ha/yr.

Vallabhsagar reservoir : The average level of the reservoir was 92.683 m and the average area was 25,912.488 ha. Spawn and hatchlings collected in lotic sector when reared comprised of mrigal (71%) and puntius (13%) and others. There was a phenomenally high illegal fishing of breeders amounting to 381.265 t during the monsoon.

Total yield as obtained from Societies' records amounted to 72.168 t, of which 73.92 % (53.347 t) was contributed by *C. catla*, 13.83% (11.242 t) by *C. mrigala* and 4.66% (3.363 t) by *L. rohita*. The railway bookings, however, totalled to an yield of 1072.367 t of fresh fish. The estimated production was 29.4 kg/ha/yr.

The occurrence of *Hilsa ilisha* fingerlings in this reservoir in all sectors indicates its possible natural recruitment since it is reported to have been stocked in in 1979 only (5000 nos.)

Project CP/BFF-1 : **All India Coordinated Research Project on Brackishwater Fish Farming.**

Personnel (CIFRI) : Apurba Ghosh, K. M. Das, Amitabha Ghosh, A. Hajra, M. L. Bhowmick, N. K. Das, R. K. Chakraborti, S. K. Mondal G. N. Chattopadhyay, P. K. Chakraborty and R. N. De.

Location : Barrackpore, Kakdwip, Canning (Institute-based Centres) ; Keshpur, Vytilla, Goa, Kakinada, Madras (Centrally Sponsored Centres).

Kakdwip : At Kakdwip a production of 332.5 kg/ha of *P. monodon* could be achieved in about 4 months time. Regular harvesting of *P. monodon* from a bigger pond (0.4 ha) at Kakdwip has been initiated and about 25% of the stock has been harvested by the end of December, 1983.

Post larvae of *P. monodon* grew to an av. size of 99.7 mm/8.3 g when stocked @ 50,000/ha in a 0.02 ha pond in five months.

Barrackpore : Studies on the morpho-histology and physiology of the digestive tract of *Mugil parsia* has been initiated. The RLG was found to range between 2.07 and 2.60. AB (2.5) positive mucous cells have been found to be present throughout the gut but gizzard like stomach responded faintly to AB. Amylase was found to be present throughout the length of the G. I. tract. The pH of the different is of the alimentary canal ranged from neutral to slightly alkaline.

Keshpur, Orissa : *P. indicus* juveniles (7,200) and post larvae (4200) were collected from Rushikulya river mouth during the month of May 1983. 30,400 juveniles (20-35 mm) and 1,400 post larvae of *P. indicus* were collected from the same point during June. In addition 1000 fry of *Chanos chanos* were also collected. During the month of September post-larvae (1,800) and early juveniles (1,200) of *P. monodon* could be collected from Chilka lake mouth and transported to Keshpur fish farm for rearing.

Monoculture of *P. indicus* (25-30 mm), taken up in 4 ponds of 0.06 ha each in the month of May with a stocking density of 40,000/ha is being continued.

Another monoculture experiment with *P. indicus* in a 0.4 ha pond at a low stocking density of 20,000/ha has also been initiated.

Vytilla Centre (Kerala) : *Chanos chanos*, *Mugil cephalus* and *Liza parsia* (1.5, 1.5, 1) were stocked in two ponds @ 4,000/ha in October, 1982. In one of the ponds supplementary feeding with groundnut oil cake and wheat bran (1 : 1) @ of body weight is being given to fishes while the culture in other pond is carried out without artificial feeding. The standing crop of fish in the two ponds after 11 months rearing have been estimated as1,905kg/ha and 2,047 kg/ha in the ponds with and without supplementary feeding respectively.

Penaeus indicus (25 mm) and *Chanos chanos* were stocked @ 20,000/ha and 500/ha respectively in a pond during March, 1983. A production to the tune of of 241.8 kg/ha and 96.4 kg/ha was obtained after 3 months of rearing. The average growth attained by prawns was 124 mm/15 g with a retrieval percentage of 72.14.

Ela Dauji (Goa) : A production of 271.50 kg of fish could be obtained when a 0.16 ha pond stocked with *C. chanos*, *M. dussumeirei* and *E. suratensis* @ 4,000 ; 10,000 and 6,000/ha, was harvested after about 8 months of culture. This production corresponds to about 1629 kg/ha/yr.

A production to the tune of 700 kg/ha was obtained from another 0.16 ha pond when the fish was harvested after about 8 months of culture. The species combination in this pond was *C. chanos*, *M. dussumeirei* (6,000/ha each) and *E. suratensis* 2,000/ha.

Biculture of tiger shrimp and milk fish at a stocking density of 20,000/ha and 150/ha respectively was carried out in a pond of 0.88 ha. The estimated production after after 6½ months was 71.00 kg/ha of *P. monodon* and 60 kg/ha of *C. chanos*.

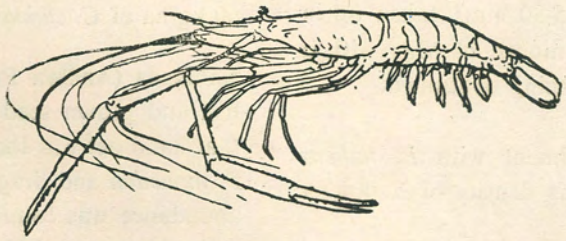
Kakinada (Andhra Pradesh) : Survey on brackishwater fish and prawn seed along the Kakinada bay indicated that hand net was the most suitable gear for collection of *P. monodon* and drag net for *C. chanos* seed. *C. chanos* abundance was found to be higher than previous years. A production of 225 kg/ha/120 days was obtained from monoculture of *P. monodon* (30-40) mm stocked @ 20,000/ha. Experiments on biculture of fish and prawn with or without fertilization are being carried out. In an experiment with *P. monodon* (15,000/ha) and *C. chanos* (1,000/ha) 190 kg of prawn and 350 kg of fish could be hervested afeter 120 days.

Santhome Fish Farm (Madras) : 80,000 *Penaeus indicus* juveniles, when stocked in a 1.14 ha pond, attained average size of 80.5mm/4 g after 30 days of rearing. Management measures included feeding the prawns with supplementary feed comprising 40% trash fishes, 20% GOC, 32% rice bran and 8% pelleted feed @ 10% of body weight.

In another pond of 0.1 ha *Chanos chanos* were stocked @ 5,000/ha. The rearing experiment is in progress.

In two other ponds (0.1 ha each) juvenile prawns (27 mm/5 g) were stocked @ 50,000/ha. In one pond where fertilizers were applied the growth attained by the prawn after 45 days was 88.9 mm/6.2 g while in the pond without fertilization the growth recorded was 71.18 m/3 g.

□



RESEARCH PROJECTS COMPLETED

The following research projects were completed during the year 1983.

11.14	Cost-price structure of aquaculture in Eastern Region of India.
33.2	Impact on the subsidy on the growth of aquaculture.
CFCSP-21	Biology of *Puntius gonionotus* in composite fish culture ponds.
ABF-13	Some aspects of toxicity and metabolism of malathion and carbofuran in the air-breathing catfish *clarias batrachus* in relation to its culture in paddy fields.
ABF-20	Cytogenetics of air-breathing fishes.

RESEARCH PROJECTS CONTEMPLATED

The following new research programmes have been taken up during 1984 :

FA/B/7	Certain physiological aspects of reproduction in carps with special reference to isolation of gonadotropin.
FA/A/30	Large catfish culture : *Pangasius* culture.
FA/A/31	Development of cultural methodology for *Puntius ticto* and *Puntius sophore*.
FA/A/32	Non-seasonal and seasonal breeding of Indian and exotic carps.
FA/A/33	Breeding and cluture of peninsular carps and nonpredaceous catfishes in combination with Gangetic and exotic carps.
FA/A/34	Integrated farming system : Aquaculture integrated with paddy cultivation in Orissa region.
FA/A/35	Breeding and nursery managment of endemic hilsa, *Hilsa ilisha*.
FC/B/7	Investigations on factors relating to decline in fishery of the rivers Ganga and Yamuna.
FC/B/8	Water pollution investigations in Rihand reservoir.
BF/B/7	Investigations on heavy metal contamination in estuarine enviroment in Madras region.
BF/B/8	Ecology of tropical mangrove woodlands in Sunderbans.
BF/A/13	Breeding and seed production of *Penaeus indicus* and other Penaeid prawns.
BF/A/14	Studies on the development of compounded feed for brackishwater prawn and fishes.
BF/A/15	Culture of *Lates Calcarifer* in oxidation ponds using *S. mossambica* as forage fish.
BF/A/16	Genetic engineering by chromosome manipulation : Production of induced gynogenetic and polyploid individuals in pearl spot.
BF/A/17	Heritability studies and predicted response to selection for genetic gain and growth of pearl spot, *Etroplus suratensis*.
BF/A/18	Paddy-cum-brackishwater fish farming.
AN/B/10	Rotifers as biological indicators of pollution in Ganga river system and its tributaries.

AN/A/6	Development of suitable extenders and cryoprotectants for long-term storage of spermatozoa using cryogenic techniques.
AN/A/7	Culture of commercially important inland molluscs.
AN/A/8	Control of stem-borer in paddy fields with high yielding variety using magur as bio-agent.
CP/CFCSP-28	All India Coordinated Research Project on Composite Fish Culture and Fish Seed Production : Statistical evaluation of factor effects on growth and survival of fishes under composite fish culture.

CENTRE-WISE LIST OF NEW AND MERGED PROJECTS

Division/Centre	*New Code No.*	*Reference to Code No. of* **1982**
FRESHWATER AQUACULTURE DIVISION		
Dhauli/Cuttack	FA/B/1	1.44, 1.56
	FA/B/3	29.4, 29.5, 29.8
	FA/B/4	2.10, 2.12, 2.14, 2.19.
	FA/B/5	9.4, 9.7.1, 9.8, 9.17.
	FA/A/1	2.11, 2.18, 9.7, 12.5, 12.8, 9.15.
	FA/A/8	1.58, 1.59, 1.60, 1.61
	FA/A/15	29.1 29.2, 29.6
	FA/A/16	New
	FA/A/17	9.11, 9.14
	FA/A/18	15.6, 15.8, 15.9, 15.10.
	FA/A/20	16.3, 16.15, 16.16
	FA/A/21	16.17
	FA/A/28	11.11, 11.12, 11.13, 11.15.
	CP/CFSCP-1.1	CFCSP-1.1
	CP/CFCSP-1.2	CFCSP-1.2
KVK/TTC **Kausalyagang**	FA/A/29	28.1, 28.2, 28.3
RIVERINE AND LACUSTRINE DIVISION		
Allahabad	FA/A/2	30.3
	FA/A/6	23.1a
	FA/A/7	New
	FC/B/3	19.12
	FC/B/4	14.1
	FC/B/6	20.8, 20.9, 20.10, 20.16. 20.17.
	FC/A/2	3.18, 3.19
Bangalore	FA/A/13	3.17, 3.20
	FC/A/1	3.8, 3.15, 3.15.1
	CP/ABF-1	
Bhagalpur	FC/B/2	14.14
	FC/B/4	14.1
Bxuar	FA/A/26	6.5
Gauhati	FC/A/3	25.3
	CP/CFCSP-1.1	CFCSP-1.1
	CP/ABF-1	ABF-1
Kakinada	FA/A/22	6.6
	FA/A/23	6.10, 6.11
	FA/A/24	6.7
Lalgola	FC/B/4	14.1
Muzaffarpur	FC/A/5	21.1, 21.2, 21.3

Srinagar	FC/B/1	13.24
	FA/A/4	13.20, 13.25
	FA/A/9	13.26
Tadepalligudem	FA/A/14	6.9
	FA/A/25	6.2
	FC/B/5	14.18

ESTUARINE FISHERIES AND BRACKISHWATER AQUACULTURE DIVISION

Barrackpore	BF/B/2	5.77, 5.78
	BF/B/3	31.2
	BF/B/4	8.1
	BF/B/5	New
	BF/B/6	20.18, 20.19, 20.20, 20.21.
	BF/A/2	19.10, 19.11, 19.13
	BF/A/10	15.5, 18.1.10
	BF/A/11	New
Kakdwip	BF/B/1	5.51, 5.52, 5.71, 5.72.
	BF/A/1	5.38, 5.40
	BF/A/5	5.57, 5.62, 5.63, 5.66, 5.73
	BF/A/12	New
	AN/B/4	New
Madras	BF/A/4	5.65
	BF/A/7	5.74, 5.75, 5.76
	BF/A/8	5.18
	BF/A/9	5.68
Puri	BF/A/3	5.70
	BF/A/6	5.79

PROJECTS AT OTHER CENTRES

Barrackpore	FA/A/5	24.1, 24.4
	FA/A/11	1.34
(Other than estuarine projects)	FC/A/4	25.2, 25.2a
	FC/A/6	New
	AN/B/1	26.1, 26.2
	AN/B/2	27.1, 27.2
	AN/B/3	5.67
	AN/B/5	9.16
	AN/B/6	35.1
	AN/B/7	New
	AN/B/8	New
	AN/A/1	New
	AN/A/2	34.1, 34.2
	AN/A/3	New
	AN/A/5	New
	CP/ABF-1	ABF-1
	CP/ABF-18	ABF-18
	CP/ABF-19	ABF-19
Kalyani	FA/B/6	17.10a
	FA/A/27	17.7, 17.8a, 17.9a, 17.11a.
	AN/A/4	17.15
	CP/CFCSP-1.1	CFCSP-1.1
Krishnagar	CFCSP-10	CFCSP-10
Rahara	FA/B/2	New
	FA/A/10	18.1.12,18.1.13
	FA/A/12	18.2. 1, 18.2.2
	FA/A/19	18.1.14
	AN/B/9	New
Badampudi, **Bhavanisagar**, **Karnal**, **Pune**, **Jaunpur**	CP/CFCSP-1.1	CFCSP-1.1
Bilaspur	FA/A/3	13.21
	CP/R-1	R-1
Rihand, **Pollachi**, **Nagarjunasagar**	CP/R-1	R-1
Ranchi	CP/R-1	R-1
	CP/CFCSP-1.1	CFCSP-1.1
Patna	CP/ABF-1	ABF-1

3. PUBLICATIONS

The following papers were published by the staff of the Institute during the year 1983.

Banerjee, R. K. & K. V. Srinivasan (1983).
Composted urban refuse and primary sweage sludge as a fish pond manure. *Agricultural Wastes*, **7** : 209-219.

Chattapadhyay, G. N. & M. N. Saha (1980).
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CIFRI PUBLICATIONS

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Reports :—

1. CIFRI Annual Report, 1983
2. Report, 5th Workshop, AICRP on Brackishwater Fish Farming, 8-9 March, 1983, Barrackpore.
3. Report, 7th Workshop, AICRP on Ecology and Fisheries of Freshwater Reservoirs 1, 9-10 March, 1983, Barrackpore.
4. Final Report, 1971-1981 ; All India Coordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs ; **Rihand Sub-centre** (Inland Fisheries Research Information Series, No. 2).
5. Final Report, 1971-1981 ; AICRP on Ecology and Fisheries of Freshwater Researvoirs ; **Nagarjunasagar Centre** (Inland Fisheries Research Information Series, No. 3).

Lecture Notes :—

6. Lecture notes on composite fish culture and its extention in India.
   (Lectures delivered to Senior Aquaculturists form Asia and Pacific Region during their visit to Regional Lead Centre of ICAR—UNDP/FAO Project, FARTC of CIFRI, Orissa).

Bulletin :—

7. Récent advances in studies on acute diseases of fishes. By R. N. Pal. (Bulletin No. 35)

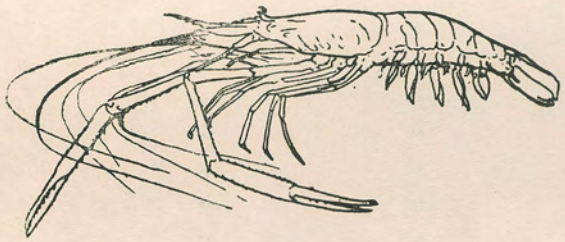
8. Pattern of energy flow in freshwater tropical and subtroipcal impoundments. By A. V. Natarajan and V. Pathak. (Bulletin No. 36).

Brochure :—

9. Rural prosperity through aquaculture—A profile of CIFRI's pioneering role in development of production techlonogies in aquaculture.

Serials :—

10. Indian Fisheries Abstracts, **18** (1-4), 1979.
11. Content List, 1-12, 1981.
12. CIFRI Newsletter **5** (3-6) 1892 and**6** (1-2), 1983.



4. PERSONNEL

The following Scientists rendered their services to the Institute during the year :

DIRECTOR

Dr. A. V. Natarajan

Freshwater Aquaculture Division

Name	*Designation*	*Section*	*Place*
Dr. V. R. P. Sinha	S-3 (Per. Gr.) Head & Project Director FARTC	FARTC	Dhauli
Shri H. A. Khan	S-2	,,	,,
,, M. Ranadhir	,,	,,	,,
,, C. Saha (on study leave)	,,	,,	,,
,, K. K. Sukumaran	,,	,,	,,
,, D. V. Pahwa	,,	,,	,,
,, D. K. Chatterjee	,,	,,	,,
,, M. Rout	,,	,,	,,
,, R. K. Jana	,,	,,	,,
,, K. K. Ghosh	,,	,,	,,
Shri R. C. Das	S-1	,,	,,
,, George John	,,	,,	,,
,, D. Narayanaswami	,,	,,	,,
,, B. K. Mishra	,,	,,	,,
,, Dilip Kumar	,,	,,	,,
,, R. K. Dey	,,	,,	,,
,, A. K. Sahoo	,,	,,	,,
,, S. N. Mohantry	,,	,,	,,
,, S. Jena	,,	,,	,,
,, P. V. G. K. Reddy	,,	,,	,,
,, B. R. Sirsat	,,	,,	,,
,, S. Patnaik	S - 2	,,	,,
Dr. T. Ramaprabhu	,,	,,	,,
Dr. C. R. Das	,,	,,	,,
Shri N. G. S. Rao	,,	,,	,,
,, S. D. Gupta	S - 1	,,	,,
,, S. R. Ghosh	,,	,,	,,
,, S. N. Dutta	,,	Paddy cum-fish culture	Cuttack
Dr. S. K. Mukhopadhyay	S - 2	Sewage-fed Fish Culture	Rahara
Shri Ajoy Kumar Ghosh	S - 1	,,	,,
Dr. G. N. Chattopadhayay	,,	,,	,,

Name	*Designation*	*Section*	*Place*
Shri A. K. Roy	S - 1	Sewage-fed-Fish Culture	Rahara
,, A. K. Dutta	,,	,,	,,
,, S. K. Saha	,,	,,	,,
Smt K. K. Bhanot	,,	,,	,,
Shri K. R. Naskar	,,	,,	,,
,, N. M. Chakraborty	,,	,,	,,
,, P. K. Saha	,,	,,	,,
,, P. K. Chakraborty (Posted at Canning)	,,	,,	,,

Estuarine Division

Name	*Designation*	*Section*	*Place*
Dr. T. Rajyalakshmi (on deputation)	S - 3	—	—
Shri B. B. Ghosh	S - 2	Estuarine Section	Barrackpore
,, R. N. Pal	,,	,,	,,
,, K. K. Bhanot	,,	,,	,,
,, S. B. Saha	S - 1	,,	,,
Dr. H. C. Joshi	,,	,,	,,
Shri M. M. Bagchi	,,	,,	,,
,, P. M. Mitra	,,	,,	,,
,, M. K. Mukhopadhyay	,,	,,	,,
,, D. K. De	,,	,,	,,
,, S. K. Mazumdar	,,	,,	,,
,, J. N. Pal	,,	,,	,,
,, G. N. Saha	S - 2	Calcutta Research Centre	Calcutta
,, S. C. Thakurta	S - 1	,,	,,
,, R. K. Banerjee	,,	,,	,,
,, A. C. Nandy	,,	,,	,,
,, Hardial Singh	,,	,,	,,
,, H. C. Karmakar	,,	,,	,,
,, S. C. Banerjee	,,	,,	,,
,, G. C. Laha	,,	,,	,,
,, A. Chaudhuri	SRA	,,	,,
,, A. C. Banerjee	,,	,,	,,
,, D. D. Halder	S - 3	Kakdwip Research Centre	Kakdwip
Dr. M. L. Bhowmick	S - 2	,,	,,
Shri N. K. Das	S - 1	,,	,,
,, R. K. Chakraborty	,,	,,	,,
,, S. R. Das	,,	,,	,,
,, S. K. Mondal	,,	,,	,,

Name	*Designation*	*Section*	*Place*
„ P. K. Ghosh	S - 1	Kakdwip Research Centre	Kakdwip
„ G. V. Kowtal	S - 2	Puri Research Centre	Puri
„ P. Ravichandran	S - 1	„	„
„ B. Venkatesh	„	„	„
Dr. S. M. Pillai	„	„	„
Shri N. A. Reddy	„	„	„
„ K. Raman	S - 3	Madras Research Centre	Madras
„ K. V. Ramakrishna	S - 2	„	„
„ A. V. P. Rao	„	„	„
„ R. D. Prasadam	„	„	„
„ M. A. V. Lakshmanan	F.S.	„	„
„ G. R. M. Rao	S - 1	„	„
„ S. Radhakrishnan	„	„	„
„ C. P. Rangaswami	„	„	„
„ S. Srinivasagam	„	„	„
„ K. Gopinathan	„	„	„
Sm. M. Sultana	„	„	„
Shri K. O. Joseph	S	„	„
„ S. N. Sar	„	Digha Survey Centre	Digha

Riverine & Lacustrine Division

Name	*Designation*	*Section*	*Place*
Dr. A. G. Jhingran	S - 3	Allahabad Res. Centre	Allahabad
„ G. N. Mukherjee	S - 2	„	„
Shri Ravish Chandra	„	„	„
Dr. R. S. Panwar	„	„	„
Shri S. P. Singh	„	„	„
Dr. M. Peer Mohamed	„	„	„
Shri M. A. Khan	S - 1	„	„
„ S. K. Wishard	„	„	„
„ R. K. Sexana	„	„	„
„ K. P. Srivastava	„	„	„
„ G. N. Srivastava	„	„	„
„ Balbir Singh	„	„	„
„ S. N. Mehrotra	„	„	„
„ R. A. Gupta	„	„	„
„ D. N. Singh	„	„	„
„ R. N. Seth	„	„	„
„ R. K. Tyagi	„	„	„

Name	*Designation*	*Section*	*Place*
,, R. K. Dwivedi	S - 1	Allahabad Res. Centre	Allahabad
Dr. K. Chandra	,,	Buxar R. Centre	Buxar
Shri D. R. Kanujia	,,	,,	,,
,, Shri Prakash	,,	Bhagalpur Res. Centre	,,
Dr. A. K. Lal	,,	,,	,,
,, B. L. Pandey	,,	,,	,,
,, S. K. Sarkar	,,	,,	,,
Dr. S. P. Rai	,,	Muzaffarpur Res. Centre	Muzaffarpur
,, V. R. Chitranshi	,,	,,	,,
,, D. Kapoor	,,	,,	,,
Dr. (Smt.) S. Sivakami	,,	Bangalore Res. Centre	Bangalore
Shri S. Ayyappan	,,	,,	,,
,, P. K. Sukumaran	,,	,,	,,
,, K. V. Rao	,,	Tadepalligundem Res. Cen.	Tadepalligundem
,, K. J. Rao	,,	,,	,,
,, D. S. Murty	JFS	,,	,,
Dr. M. Subramanyam	S - 2	Kakinada Res. Centre	Kakinada
,, L. H. Rao	S - 1	,,	,,
,, K. J. Ram	,,	,,	,,
Shri Y. S. Tadava	,,	Gauhati Res. Centre	Guahati
,, M. P. Singh Kohli	,,	,,	,,
,, R. K. Singh	,,	,,	,,
,, M. Chaudhuri	,,	,,	,,
,, S. K. Munnet	,,	,,	,,
,, V. Kokelar	S	,,	,,
,, A. R. Choudhury	S - 1	Lalgola Surv. Centre	,,
Dr. K. K. Vass	S - 2	Coldwater Res. Unit	Srinagar
Shri Shyam Sunder	S - 1	,,	,,
Dr. H. S. Raina	,,	,,	,,
Smt. Usha Moza	,,	,,	,,
Shri C. B. Joshi	,,	,,	Bilaspur

Sections/Projects Directly under Director's Control :

Name	*Designation*	*Section*	*Place*
Shri P. Das	S - 3	Extension Section	Barrackpore
,, U. Bhowmick	S - 1	,,	,,
,, P. K. Pandit	,,	,,	,,
,, B. K. Banerjee	,,	,,	,,
,, B. N. Saigal	S - 2	Library & Documentation Section	,,
,, V. V. Sugunan	S - 1	,,	,,

Name	*Designation*	*Section*	*Place*
Smt. G. K. Vinci	S - 1	Lib. & Doc. Section	Barrackpore
Shri Amitabha Ghosh (on study leave)	,,	,,	,,
Dr. V. K. Unnithan	,,	,,	,,
Shri M. J. Bhagat	,,	,,	,,
Dr. K. L. Sehgal	S - 2	Technical Cell	,,
Shri Kuldip Kumar	S - 1	,,	,,
,, H. S. Mazumder	,,	,,	,,
Dr. (Mrs.) K. Mitra	,,	,,	,,
Shri P. R. Sen	S - 2	Hilsa Breeding Unit	,,
,, D. Nath	S - 1	,,	,,
,, A. Hajra	S	,,	,,
,, S. Paul	S - 1	Economics Section	,,
Dr. Babulal	,,	Radio isotope Lab.	,,
Dr. V. Pathak	,,	,,	,,
Shri B. K. Sharma	S - 2	Operational Research Project	Krishnagar
,, M. K Das	S - 1	,,	,,
Dr. A. K. Mondal	S - 2	Frog Culture Unit	Kalyani
Dr. B. N. Singh	,,	KVK/TTC	Dhauli
Dr. N. K. Thakur	,,	,,	,,
Shri C. Selvaraj	,,	,,	,,
,, C. S. Purushothaman	S - 1	,,	,,
,, J. G. Chatterjee	,,	KVK	Kakdwip

Coordinated Projects

Composite Fish Culture and Fish Seed Production

Shri S. D. Tripathi	S - 3	CFCSP	Dhauli
Dr. K. G. Rao	S - 1	,,	,,
Shri M. Sinha	S - 2	,,	Kalyani
Shri D. P. Chakraborty	S - 1	,,	,,
,, D. N. Mishra	,,	,,	Jaunpur
,, A. Mukherjee	,,	,,	,,
,, P. N. Jaitly	S	,,	,,
,, M. Kaliyamurthy	S - 1	,,	Bhavanisagar
,, P. K. Aravindakshan	,,	,,	,,
,, P. L. N. Rao	,,	,,	Pune
,, B. K. Singh	S	,,	,,
,, K. L. Shah	S - 1	,,	Karnal
,, B. C. Tyagi	,,	,,	,,
,, R. M. Rao	S - 2	Badampudi	,,
,, J. B. Rao	S - 1	,,	,,

Air-breathing Fish Culture

Name	*Designation*	*Section*	*Place*
Dr. M. Y. Kamal	S - 3	ABF	Barrackpore
Shri P. K. Mukhopadhyay	S - 1	,,	,,
,, R. K. Das	,,	,,	,,
Dr. S. C. Pathak	S - 2	,,	Gauhati
,, Direndra Kumar	,,	,,	Patna
Dr. S. P. Ayyar (on deputation)	S - 2	,,	Bangalore
Shri V. K. Murugesan	S - 1	,,	,,
,, P. Kumaraiah	,,	,,	,,

Reservoir Fisheries

Shri B. V. Govind	S - 3	Reservoir Fisheries	Nagarjunasagar
,, Ch. Gopalakrishnayya	S - 2	,,	,,
,, M. Ramakrishniah	S - 1	,,	,,
,, G. K. Bhatnagar	S - 2	,,	Ranchi
Dr. B. P. Gupta	S - 1	,,	,,
Shri S. N. Singh	,,	,,	,,
Dr. Y. Rama Rao	S - 2	,,	Bilaspur
Shri B. C. Jha	S - 1	,,	,,
,, M. D. Pisolkar	,,	,,	,,
,, D. K. Kaushal	,,	,,	,,
,, V. K. Sharma	,,	,,	,,
Shri V. R. Desai	S - 2	,,	Rihand
,, N. P. Srivastava	S - 1	,,	,,
Dr. Mathew Abraham	,,	,,	Bhavanisagar

The following members of staff (Technical) rendered their services during the year :

Liaison/of/Officer :
Shri N. K. Tripathi

Senior/Training/Assistant—T-6 :
Shir N. C. Basu
Dr. S. K. Sarkar
Shri J. P. Verma
,, S. L. Kar
,, B. B. Satpathy
,, A. K. Chattopadhyay

Overseer—T-5 :
Shri P. N. Bhattacharjee

Demonstrator—T-5 :
Shri B. R. Dutta
,, Kuldeep Kumar
,, Radheshyam

Senior Artist—T-5 :
Shri J. Ghosh

Assistant Librarian—T-5 :

Smt. Anjali De

Artist—T-5 :

Shri S. K. Das

Technical Assistant—T-4

Shri P. B. Das
„ R. N. De
„ S. L. Raghavan
„ T. S. Ramaraju
Shri K. S. Rao
„ R. C. Singh
„ D. R. Rao
„ B. K. Saha
Shri N. K. Srivastava

Artist Photographer—T-4 :

Shri A. R. Mazumder

Sernior Library Assistant—T-4 :

Smt. Sukla Das

Photographic Assistant—T-4 :

Shri P. K. Ghosh

Estimator—T:4 :

Shri Chakradhar Sahoo

Draftsman—T-4

Shri M. D. Mantri

Technical/Assistant—T-II-3

Shri P. M. Abdul Kadir
„ M. F. Rahman
„ K. S. Banerjee
„ S. P. Ghosh
„ N. C. Mondal
„ Aloke Sarkar
„ H. K. Sen
„ P. S. C. Bose
„ Bhaskar Ghosh
„ N. D. Sarkar
Shri K. K. Agarwal
„ N. N. Sarkar
„ A. K. Ekka
„ N .N. Mazumdar
., A. R. Paul
„ B. D. Saroj
„ G. P. Bhattacharjee
„ Ram Chandra
„ A. K. Roy
„ D. N. Srivastava

Technical Assistant—T-I-3

Shri D. P. Verma
Shri G. C. Sahoo

Artist—T-I-3

Shri P. Dasgupta

Electrician—T-I-3

Shri B. N. Sudhukan

Mechanic—T-I-3

Shri R. C. Satpathy

Technical Assistant—T-2

Shri S. Krishnan
„ R. K. Langer
„ A. N. Mohanty
„ N. Sarangi
„ Ramji Tiwari
„ B. B. Das
„ Sukumar Saha
„ K. P. Singh
Shri Camil Lakra
„ J. P. Mishra
„ M. P. Singh
„ S. K. Chatterjee
„ K. C. Pani
„ D. Sanfui
„ S. C. Mondal

Mechanic—T-2

Shri Donald Singh

Electrician

Shri S. K. Chatterjee
Shri N. Guin

Senior Gestetner Operator—T-I-3

Shri S. C. Bhowmick

Senior Binder—T-I-3

Shri M. M. Das

Driver Engine/Lannch/Mini Bus— T-1:3

Shri Ranjit Singh
Shri B. B. Seth

Driver Engine/Launch/Mini Bus—T-2

Shri Surja Bahadur
„ N. C. Biswas
„ U. K. Chatterjee
„ K. R. Deb
„ K. K. Dutta
„ Badal Lal Singh
„ Basmadaya
„ R. S. Neogi
„ J. C. Saha
„ R. N. Singh
„ A. K. Majumdar

Shri M. G. Subramani
„ K. L. Das
„ T. P. Ghosh
„ S. C. Das
„ T. M. Roy
„ D. Tarai
„ R. L. Balmiki
„ Kishen Deo
„ Harihar Das
„ P. Lal

Pump Man—T-2

Shri N. C. Roy
Shri C. R. Das

Dark Room Assistant—T-2

Snri R. K. Halder

Driver/Engine/Launch/Mini Bus—T-1

Shri K. Ganeshan
„ M. C. Pal
„ D. Borgoyary
„ Ch. S. Rao
„ C. K. Nath

Shri B. B. Roy
„ B. K. Bahura
„ R. Tarai
„ B. Kahali

Laboratory and/Field Assistant—T-1

Shri M. C. Pal
„ R. Tarai

Shri Aloke Kumar Jain
„ Bhai Lal

Sample Sorter—T-1

Shri A. K. Banerjee
„ S. C. Moitra
„ R. D. Saha

Shri S. K. Gupta
„ K. P. Saha
„ N. P. Saha

Plumber—T-1

Shri S. K. Deb

Carpenter—T-1

Shri S. K. Biswas

Senior Administrative Officer

Shri L. M. Nandy

Accounts Officer

Shri A. N. Mukherjee

Assistant Administrative Officer

Shri K. C. Roy
Shri K. B. Rajaani

Superintendent

Shri M. L. Biswas
„ A. K. Das
„ M. R. Roy

Shri P. C. Kaunungo
„ A. K. Scngupta
„ S. C. Saha
„ B. C. Dutta

Assistant

Bhattacherjee, B. C.
Bose, S. K.
Das, T. P.
Dasgupta, S.
Mazumder, Sandhya
Roy, Bani
Baidya, N. H.
Das, C. C.
Choudhury, Namita
Halim, Abdul

Roy, S. C.
Sarkar, A. C.
Sarkar, N. K.
Shastry, S. P.
Zaidi, F. A.
Mahesh Prasad
Awedh, Sah
Neogi, M. M.
Banerjee, D. K.
Bose, D. C.

Senior Stenographer

G. Lahiri

Stenographer

Banerjee, A. K.
Chakladar, H.
Chakraborty, G. M.
Ghosh, U. K.
Sinha, R. C. P.
Srivastava, R. C.

Junior Stenographer

Bhattacherjee, S.
Chatterjee, T.
Das, P. K.
Jena, P.
Prasad, P.
Roy, T. K.
Saha, A. K.
Sahood, D. C.

Senior Clerk

Baidya, D. N.
Banerjee, J. N.
Bhowmick, S.
Das, Moloy Kr.
Dey Sarkar, D. K.
Ghosh, B. K.
Halder, S. R.
Kar, S. K.
Kodandraman, I. N.
Majumdar, Biplab
Majumdar, T. K.
Mishra, L. P.
Mitra, N. K.
Mukherjee, B. B.
Sutur, H. B.
Mukherjee, R. R.
Nath, H. K.
Patra, J. C.
Pramanick, S. K.
Pramanick, S. N.
Prasad, Keshau
Rai, Jagdish
Sarkar, H. L.
Sarkar, S. K.
Singh, Kallu
Singh, R. C. P.
Sinha, S. S.
Sreedharan T. K.
Subrahmanian, M.

Junior Clerk

Banerjee, Narayani
Banerjee, Mrinalini
Behari, A. C.
Behari, Kunj
Behari, Purnachandra
Chakraborty, Amita
Chhotey Lal
Das, B. K.
Das, Jayashree
Ghosh, P. K.
Behari, R. C.
Bhagirathi S.
Biswas, A. B.
Biswas, Manjulal
Biswas, P. K.
Bose, Samir Kumar
Chatterjee, Dipankar
Chowdhury, Debesh
Das, G. B.
Dutta, P. K.
Ghosh, Samar Kumar
Kachhap, M.
Kundu, N. R.
Lal, Ambika
Mandal, Bulbul
Manju, K.
Majumdar, Anita
Maranappan, S. K.
Mazumder, Sikha
Mupid, B. S.
Naik, N. C.
Nath, Baij
Panda, R. K.
Rao, K. S.
Raina, R. L.
Roy, S. B.
Srivastava, A. K.
Ghosh, R. K.
Gurish, W.
Kumar Surendra
Lahiri, P.
Mahato R. N.
Mandal, S. P.
Mondal, A. B.
Murthy, P. B. V. S.
Neogi, Anjali
Nath, Kalipada
Rao, G. S.
Roy, J.
Roy, Samir Kumar
Shan, Biswanath
Tikadar, S. K.
Sadaverte, N.

Supporting Grade - IV

Behera, B. N.
Bhuyan, U.
Biswas, D. N.
Biswas, J. N.
Bose, J. L.
Burman, G. N.
Chakraborty, K. L.
Dalai, B.
Das, C.
Das, P. N. V.
Das, K. P.
Dey, S. K.
Singh, D.
Dosad, R. B.
Gangaram
Jally, H.
Jally, U. N.
Jana, K. C.
Mewalal
Naik, J.
Prasad, K.
Ramdeo
Sahood, D.
Samal, B.
Samood Majhi, B.

Supporting Grade-III

Apparao, B.
Bahadur, Nar
Bahadur, Durga
Barik, N.
Barik, Dijia
Barik, S.
Balmiki, Sitaran
Burman, M. S.
Burman, S. N.
Bose, N. R.
Chakraborty, S.K.
Das, S. K.
Das, Mosa
Das, H. K.

Balmiki, S. C.
Baldevsing, D. N.
Bakshiram
Behera, K. B.
Behera, K. C.
Behara, Alekha
Behera, Trailokya
Behera, N.
Bhoi, D.
Bhuloka, D.
Bhuyan, N.
Biswas, T. K.
Kotaiah, S.
Lal, Madan
Mishra, P.
Mondal, A. K.
Muuda, Budhram
Mohanty, N. N.
Naik, B.
Naik, D.
Panda, Lakshmidhar
Pandey, C. K.
Patra, A. M.
Paramanik, H. K.
Patnaik, S. R.
Prakash, B.
Das, Antiram
Das, K. K.
Gopal, K.
Iruthiraj, M.
Jana, Natabar
Jally, Khetrabasi
Jally, Aghur
Raha, R. N.
Raikwar, Ramlal
Routh, H. K.
Rao, Ch. Ganeswar
Singh, C
Kujur, J. M.
Lajuram
Shyamal, B. R.
Singh, Meher
Shyamal, H. K.
Sahoo, D.
Saha, N. K.
Sethi, P. C.
Varghese, P. V.

Supporting/Grade-II

Appanna, K.
Bahadur, Bhim
Bahadur, Surja
Bahadur, Tek
Balmiki, Khem Chand
Bahadur, Sitaram
Boral, S. K.
Bhoi, Shyama
Barik, D.
Bhanja, B.
Burman, S. N.
Behera, Khalia
Burman, Niranjan Kr.
Burman, Sudhangshu
Behera M.
Behera, K. B.
Bhoi, R. C.
Bhania, D.
Burman, S. K.
Behera, Keshab
Balaraman, M.
Burman, Balaram
Burman, H. S.
Burman, Sudhangshu
Balmiki, Kattore
Bhava, C. K.
Lal, Bideshi
Maity, S. S.
Balmiki, Krishanlal
Biswas, Jagdish
Biswas, S. C.
Biswas, Hiralal
Bose, Jiralal
Biswas, Manindranath
Biswas, Ashoke Kr.
Burman, M. K.
Biswas, A. K.
Bhuyan, Dhirendra
Behera, Rajkishore
Bhaskar Bhoi
Chakraborty, Sarabandu
Chaki, S. N.
Das, P. C.
Das, B. S.
Das, Sitaram
Das, Jhantu Ranjan
Das, Giridhari
Das, Nikunjalal
Das, Dhaneswar
Dhanuk, Shyamlal
Dehuri, Basudeb
Jangli
Jena, N. C.
Jadav, S. P.
Jally, L.
Jana, Bibhuti Kr.
Kishore, Jugal
Kaliannan, K.
Krishnan, M. V.
Hazarika, B.
Sayalu, P.
Somulu, L.
Swain, Raghunath
Sahoo, Lakshmidhar
Mondal, Gokul Chandra
Mondal, S bal Chandra
Manna, L. C.
Mondal, Biswanath
Maniekyam, P.
Mondal, Niranja Kr.
Malleh, Jai Nandan
Mondal, Biswanath
Narendra, G. C.
Narasappa, B.
Parbat, L. K.
Pradhan, B.
Panda, Jadish
Parida, Sridar
Parida, Fakir
Das, Gunadhar
Tair, R. N.
Parameshwar
Ramalingam, M.
Ram, Japhu
Ram, Munshi
Reju, Kolludharma
Raju, A. Eswar
Singh, S. S.
Sahoo, D. N.
Sahu, D. N.
Singh, Ramdeo
Sahoo, G.
Singh, C. P.
Srinivasan, V. K.
Sundar, Ram
Saha, P. C.
Singh, P.
Shaw, Gulab
Sahoo, K. M.
Yadov, A, L.

Supporting Grade-I

Anjanappa, M.
Ali, Munsur
Arumugam, P.
Dhan, Maya
Dutta, Anjali Rani
Debroy, R. L.

Ali, S. K. Munsur
Bain, G. C.
Behera, Chhakei
Bahadur, Karna
Bahadur, Indra
Bahadur, Asta
Bahadur, Mina Rani
Bose, Sankar
Bairagi, Suklal
Bijali, Amalya
Bhattacherjee, Ashutosh
Behera, Debahari
Biswas, Suk Chand
Biswas, A.
Bez, P. C.
Choudhury, Panchulal
Bind, M. P.
Bahadur, Lal
Bahadur, Man
Bhoi, M. S.
Bhol, R. K.
Burman, Shatendra
Bendra, S. S.
Balmiki, Jagadish
Behera, Dhanu
Bhuiya, N.
Boro, Bhabalu
Betal, Sasidhar
Barik, Basanta Kr.
Behera, Makunda Charan
Bhoi, Bijaya
Balmiki, Iswar Ram
Krishnapada, B. N.
Karkatta, Joseph
Khatua, Jadumani
Kumar, Kharban
Karuppanna, P.
Kemparas, P.

Dhir, K. K
Dhibar, Gunadhar
Das, Mukti
Das, B. C.
Dukran
Das, B. C.
Das, Rash Bihari
Das, Nayaram
Das, Sudhakar
Das, Parusuram
Ghosh, A. C.
Ghosh, Pusupati
Gowda, Malige
Ghume, T. H.
Choudhsi, Umesh
Chatterjee, Rupali
Gangayya, A.
Govata, S. T.
Gharami, Phani
Gonvidalal
Halder, L. K.
Halder, Sital Chandra
Halder, Hemlata
Halder, Satyendra Nath
Jally Burman
Jena, Gourhari
Jena, Panchanan
Jena, N.
Jelly, Kedar Chandra
Khalko, Jeseph
Karmakar, Sarbananda
Kachari, P. C.
Pugalendhi, B.
Paik, B. C.
Prasad, Laita
Palanisamy, R.
Pramanik, G. C.
Prasad, Ram

Kemparas, A.
Khan, Rahmat
Lakshim, Ram
Mondal, Bholanath
Mani, N.
Mondal, Kalashashi
Mahadeva, M.
Mondal, Godhli
Mallah, Munilal
Muchi, R. U.
Mollick, G. C.
Mani, K.
Mukhia, J.
Mallah, Rajdhari
Murugesena, A.
Mariappan, V.
Mahalick, Antaryami
Mondal, Kalipada
Mohd. Yusuf Dar
Mondal, Sachindra
Naik, G. C.
Naik, Krishna Ch.
Ningegowda, K.
Naik, Sudarsan
Nayak, P. K.
Nayak, Sripati
Omprakash
Subramani
Samal, Krusnna Chandra
Seshanna
Sahni, Aghanu
Subramaniam, K.
Singh, C. P.
Samanta, Pr. Sekhar
Singh, Kuldeep
Swain, Ramesh Chandra
Shree, Nath
Yasiah, R.

Paria, J.
Parida, Satyananda
Paramanik, P. C.
Prasad, Shitala
Parida, Y.
Parida, Golekha
Palai, Duryodhan

Parida, Judhistir
Patnaik, B.
Rao, G. Santa
Ram, Rajendra
Rajendrnam, R.
Ramaswamy, A.
Roy, Pradupta Kishore
Raj, Karam
Ram, Paras
Runadala, G. J.
Rao, Medisethi Chandra
Ram, Kawal Pati
Rao, P. Nageswar
Saha, Mohan Lal
Saha, Manoranjan
Sethi, P. K.
Samanta, Narayan Ch.
Sita
Singh, Maha
Saha, P. C.
Subbaiyan, K.
Sahni, Aghanu
Satyanarayanu
Subramani, M.
Swain, Jatadhari
Swain, Pitamber
Samal, Chaitanya Charan
Swain, Ranjan
Mahendran, S.

APPOINTMENTS :

The following appointments were made during the year :

Name	*Designation*	*Centre*
Dr. K. L. Sehgal	Scientist-3	Barrackpore
Shri B. V. Govind	Project Coordinator (Reservoirs Fisheries).	Nagarjunasagar.
Dr. M. Y. Kamal.	Project Coordinator (Air breathing fish Culture).	Barrackpore
Shri K. K. Sukumaran.	Scientist-3	FARTC, Dhauli.
Smt. Lekha Sanfui.	Training Assistant (Home Science)	KVK/TTC, Kausalyagang.

PROMOTIONS :

The following scientific personnel were promoted to the higher grades on recommendation of ASRB.

Name	*Designation*		*W.e.f.*
	From	*To*	
Shri D. K. Chatterjee	S-1	S-2	1-07-1980
Shri M. Rout	S-1	S-2	1-07-1980
Shri P. K. Saha	S	S-1	1-07-1980
G. C. Laha	S	S-1	1-07-1980
Shri M. Choudhury	S	S-1	1-07-1980
Dr. M. L. Bhowmick	S-1	S-2	1-07-1980
Shri A. K. Ghosh	S-1	S-2	1-07-1980
Shri S. B. Saha	S-1	S-2	1-07-1980
Shri K. K. Bhanot	S-1	S-2	1-07-1980
Shri K. L. Shah	S-1	S-2	1-07-1980
Shri G. R. M. Rao	S-1	S-2	1-07-1980
Shri D. Kapoor	S	S-1	1-07-1980
Shri N. P. Srivastava	S	S-1	1-07-1980
Shri B. K. Singh	S	S-1	1-07-1980
Shri V. K. Sharma	S	S-1	1-07-1980
Shri A. R. Chowdhury	S	S-1	1-07-1980

The following scientists were given advance increments as given below :

Shri K. O. Joseph	S	Three	1-7-1980
Shri S. K. Wishard	S-1	One	1-7-1980
Shri V. Kolekar	S	One	1-7-1980

The following Technical personnel were promoted on recommendations by the assessment committee.

Shri Kuldip Kumar	T-4	T-5	1-7-1983
Shri B. R. Dutta	T-4	T-5	1-7-1983
Shri Radheshyam	T-4	T-5	1-1-1983
Shri G. C. Sahoo	T-2	T-1-3	1-1-1983
Shri S. C. Bhowmick	T-2	T-1-3-	1-1-1983
Shri S. C. Mondal	T-1	T-1	1-1-1983
Shri M. M. Das	T-2	T-1-3	1-7-1983
Shri Ranjit Singh	T-2	T-1-3	1-7-1983
Shri B. B. Sethi	T-2	T-1-3	1-7-1983
Shri Pashupatilal	T-1	T-2	1-1-1983
Shri A. K. Majumder	T-1	T-2	1-1-1983
Shri C. R. Das	T-1	T-2	1-1-1983
Shri R. K. Halder	T-1	T-2	1-7-1983
Shri Benu Kahali	T-1	2 increments	1-1-1983

TRANSFERS

The following transfers were made during the year.

Name	*From*	*To*
1. Shri K. K. Ghosh (S-2)	Barrackpore	Dhauli
2. Shri D. V. Pahwa (S-2)	Dhauli	ICAR, Delhi
3. Shri S. Patnaik (S-2)	Cuttack	Dhauli
4. Shri S. K. Wishard (S-1)	Kalyani	Allahabad

APPENDIX—I

Central Inland Fisheries Research Institute (I.C.A.R.) Barrackpore, West Bengal.

Statement showing the total number of ICAR servants and the number of scheduled castes and scheduled tribes amongst them as on 1st. January, 1984.

Group Class	*Permanent / Temporary*	*Total No. of employees*	*Scheduled caste*	*Percentage to total employees*	*Scheduled tribes*	*Percentage of total employees*
Gr. A. (Cl. I)						
(i) Other than lowest rung of Cl. I	Permanent	102	1	1%	—	—
(ii) Lowest rung of Cl. I		71	7	10%	—	—
(i) Other than lowest rung of Cl. I.	Temporary	—	—		—	—
(ii) Lowest rung of Cl. I		35	3	9%	—	—
Gr. B. (Cl. II)	Permanent	20	2	10%	—	—
	Temporary	5	4	80%		20%
G. C. (Cl. III)	Permanent	200	36	18%	4	2%
	Temporary	61	10	16%	6	10%
Gr. D. (Cl. IV)	Permanent	300	50	17%	10	3%
excluding sweepers.	Temporary	91	37	41%	3	3%
Gr. D. (Cl. IV) Sweepers	Permanent	17	14	82%	—	—
	Temporary	2	1	50%	1	50%

APPENDIX II

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE (ICAR) : BARRACKPORE : WEST BENGAL

Address List of Research/Survey Centres

(*As in July* 1984)

Research/Survey Centre	*Telegram/ Telephone*
1. **Central Inland Fisheries Research Institute,** Barrackpore-743 101, West Bengal.	Fishsearch 53-161
2. (a) **Allahabad Research Centre,** Central Inland Fisheries Research Institute, 24, Pannalal Road, Allahabad-211 002, U. P.	Fishsearch Allahabad-2 52-245
(b) **National Bureau of Fish Genetic Resources (ICAR),** B-209, Mehdauri Colony, Taliyargang, Allahabad-211 002 (U. P.)	Fishbureau Allahabad-2
3. **Badampudi Centre of AICRP on Composite Fish Culture,** Central Inland Fisheries Research Institute, Badampudi Fish Farm, P.O. Badampudi, Tadepalligudem Taluq, West Godavari Dist., A.P., Pin-534 412	
4. **Bakkhali Research Centre,** Central Inland Fishereis Research Institute, Bakkhali, 24 Parganas Dist., West Bengal.	
5. **Bangalore Research Centre,** Central Inland Fisheries Research Institute, No. 51, 8th Cross Road, 7th Main, Malleswaram, Bangalore-560003 (Karnataka).	Fishsearch Bangalore-3 36 6610
6. **Bhagalpur Research Centre,** Central Inland Fisheries Research Institute, Khanjarpur, Beatson Road, Bhagalpur-812 001 (Bihar).	1385
7. **Bhavanisagar Centre of All India Co-ordinated Project on Composite Fish Culture,** (CIFRI) P.O. Bhavanisagar, (Via) Erode, Pin-638 451, Tamil Nadu.	
8. **Bilaspur Centre of AICRP on Reservoir Fisheries,** (CIFRI), Roara Sector, Bilaspur-174 001 (Himachal Pradesh)	
9. **Buxar Research Centre,** Central Inland Fisheries Research Inst , 1/644, Sidhanathghat, Buxar-802 101, Bihar.	

10. **Calcutta Research Centre,**
Central Inland Fisheries Research Inst.,
47/1 Strand Road, Calcutta-700 077,
West Bengal

11. **Paddy-cum-Fish Culture Unit,**
Central Inland Fisheries Research Institute,
C/o. CRRI, Cuttack,
Orissa.

12. **Digha Survey Centre,**
Central Inland Fisheries Research Institute,
Digha, Midnapur Dist., West Bengal.

13. **Freshwater Aquaculture Research and Traing Centre,**
Central Inland Fisheries Res. Inst.,
P.O. Kauslayagang, Dhauli,
(Via) Bhubaneswar-751 002 (Orissa)
Aquaculture
Bhubaneswar
53084

14. **Gauhati Research Centre,**
Central Inland Fisheries Research Institute,
Natun Sarania, Gauhati-781 003,
Assam
23831

15. **Jaunpur Research Centre of AICRP on Composite Fish Culture, CIFRI,**
House No. 334, Husainabad,
Near Collectorate, Jaunpur-222 002,
Uttar Pradesh.

16. **Kakdwip Research Centre,**
Central Inland Fisheries Research Institute,
Kakdwip-743 347, 24 Parganas,
West Bengal.
Fishsearch
Kakdwip
72

17. **Kakinada Research Centre,**
Central Inland Fisheries Research Institure,
16-23-1, Sambamurthi Nagar,
Kakinada-533 001, (A. P.)

18. **Kalyani Research Centre,**
Central Inland Fisheries Research Institute,
B/11/226, Central Avenue East,
Kalyani, Nadia (W.B.).

19. **Kranal Central of AICRP on Composite Fish Culture,** CIFRI,
Govt. Fish Seed Farm,
P.O. Saidapura (CSSRI),
Karnal-132 001, Haryana.
3382

20. **Krishnagar Operational Research Centre,**
Central Inland Fisheries Research Institute,
Anjana Fish Farm, Shaktinagar,
Krishnagar-741 102, Dist. Nadia,
West Bengal.

21. **Krishi Vigyan Kendra,**
Central Inland Fisheries Research Institute,
P.O. Kakdwip-743 347
Dist. 24 Parganas, West Bengal.

22. **Krishi Vigyan Kendra TTC Matsya,**
Central Inland Fisheries Research Institute,
P.O. Kausalyagang,
(Via) Bhubaneswar-751 002 (Orissa)

23. **Lalgola Survey Centre,**
Central Inland Fisheries Research Institute,
Lalgola, Dist. Murshidabad,
West Bengal, Pin - 741 148.

24. **Madras Research Centre,** Ulnadmeen
Central Inland Fisheries Research Institute, Madras
1, Karaneeswarar Koil Street,
(Near All India Radio) Mylapore,
Madras-600 004.

25. **Muzaffarpur Research Centre,**
Central Inland Fisheries Research Institure,
House No. 113, Ward No. 27,
Damnchak, Muzaffarpur-842 001,
Bihar.

26. **Nagarjunasagar Centre of AICRP on Reservoir Fisheries,** (CIFRI,) 2617
P.O. Viyajapuri South,
Nagarjunasagar Dam,
Andhra Pradesh, Pin-522 439.

27. **Patna Centre of AICRP on on Air-breathing Fish Culture,** (CIFRI), 26286
Mithapur Fish Farm,
Patna-800 001, Bihar.

28. **Pollachi Centre of AICRP on Reservoir Fisheries,** (CIFRI,)
10, Chakrapani Iyer Street,
Venketeswara Colony,
Pollachi-642 001 (Tamil Nadu).

29. **Port Canning Survey Centre,**
Central Inland Fisheries Research Institute,
Post Canning, 24 Parganas,
West Bengal.

30. **Pulicat Survey Centre,**
Central Inland Fisheries Research Institute,
Pulicat, Chinglepet Dist.,
Tamil Nadu.

31. **Pune Centre of AICRP on Composite Fish Culture,** CIFRI,
C/o. Asst. Director of Fisheries,
Sadasiv Sadan,
873, Bhandarkar Institute Road,
Daccan-Gymkhana, Pune-411 004,
Maharashtra.

32. **Puri Research Centre,**
Central Inland Fisheries Research Institute,
No. 12, MIG Quarters, Water Works Road, Puri-752 002 (Orissa).

33. **Ranchi Centre of AICRP on Composite Fish Culture and Reservoir Fisheries,**
Central Inland Fisheries Research Institute,
Doranda Fish Farm, P.O. Hinnoo,
Ranchi-834 002 (Bihar)

34. **Rahara Research Centre,**
Central Inland Fisheries Research Institute,
8, Station Road, Khardah,
Dist. 24 Parganas, West Bengal.
Pin-743 186.

35. **Raidighi Durvey Centre,**
Central Inland Fisheries Research Institute,
Raidighi, 24 Parganas (W.B.)

36. **Rihand Centre of AICRP on Reservoir Fisheries,** CIFRI,
C/o. Asstt. Director of Fisheries,
Rihand, P.O. Turra ,Dist. Mirzapur,
Uttar Pradesh. Pin-231 221.

37. **Srinagar Research Centre,**
Central Inland Fisheries Research Institute,
Harwan, Srinagar-191 123,
K a s h m i r.

Fishsearc
Srinagar

38. **Tadepalligudem Research Centre,**
Central Inland Fisheries Research Institute,
4-11-3, Subbaraopeta, Tadepalligudem,
West Godavari Dist., Andhra Pradesh,
Pin-534 107.

39. **Uluberia Survey Centre,**
Central Inland Fisheries Research Institute,
Uluberia, Dist. Howrah,
West Bengal.

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