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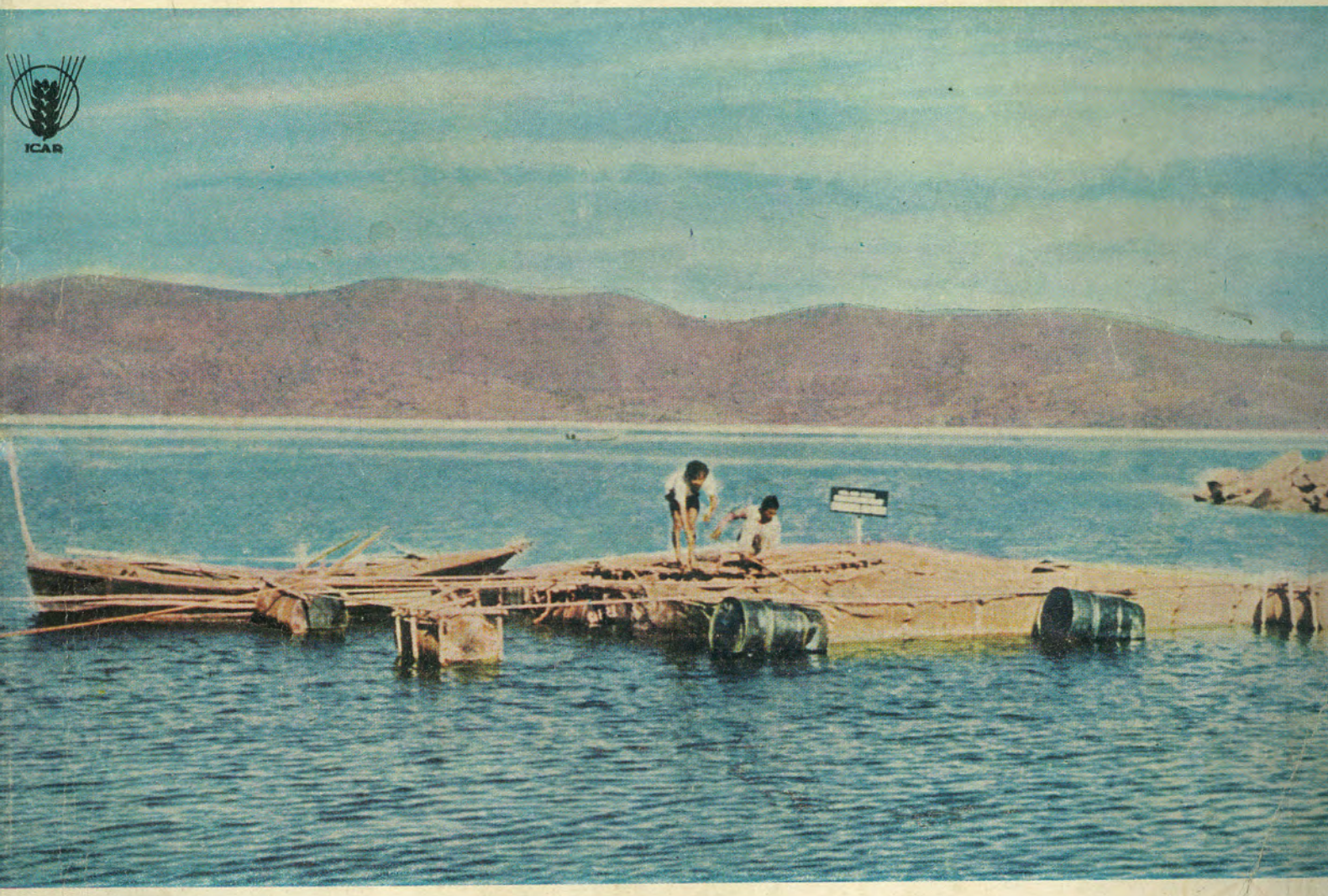

Annual report

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE BARRACKPORE

ANNUAL REPORT

1980

ICAR

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
(Indian Council of Agricultural Research)
BARRACKPORE, WEST BENGAL
INDIA

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ANNUAL REPORT 1980
CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
BARRACKPORE

HISTORY

The relevance of living aquatic resources in the nutrition of our everexpanding population was well recognised as early as 1947 when the Central Inland Fisheries Research Station was established in Calcutta under the Ministry of Food and Agriculture, Government of India. From a modest beginning as an interim scheme, the organisation has since grown to a leading national research institute in inland fisheries. Since the year 1959, the headquarters of Central Inland Fisheries Research Institute (CIFRI) is housed in its own buildings at Barrackpore, West Bengal. There are 37 research/survey centres spread across the country. CIFRI has come under the administrative fold of Indian Council of Agricultural Research in the year 1967.

OBJECTIVE

The objective of the Institute is to elucidate scientific principles to be applied for optimum utilization of our inland fishery resources.

ORGANISATION

The scientific work of the Institute is carried out under three Divisions and four Coordinated Projects.

(1) Freshwater Aquaculture Division :

Freshwater Aquaculture Research and Training Centre (FARTC) at Dhauli is the seat of this Division. FARTC is a modern fish farm complex with 800 scientifically designed ponds of different sizes. The Division is innovating new avenues in aquaculture practices. Thrust is mainly in the field of fish genetics and hybridization, fish nutrition, microbiology, ichthyopathology, fish health protection etc. Work under this Division is also carried out at Cuttack.

(2) Riverine and Lacustrine Division :

Conducts research to evolve suitable measures for the development of the riverine and lacustrine fisheries of the country involving their conservation and judicious exploitation. The Division has its headquarters at Allahabad with research centres at Srinagar, Bangalore, Buxar, Muzaffarpur, Gauhati, Bhagalpur, Tadepalligudem and Kakinada.

(3) Estuarine Division :

The Estuarine Division with headquarters at Barrackpore and research centres at Madras, Kakdwip, Bakkhali and Calcutta investigates on the various problems of capture and culture fisheries of finfish and shellfish in brackishwater lakes and estuaries in the country.

(4) Coordinated Projects :

There are four Institute-based Coordinated Projects *viz.* (i) Composite fish culture and fish seed production with the main centre at Dhauli (ii) Culture of air-breathing fishes (iii) Ecology and fisheries of freshwater reservoirs and (iv) Brackishwater fish farming with their main centres at Barrackpore.

(5) Other Centres :

The Operational Research Project Centre at Krishnagar and research centres at Khardah and Kalyani are under the direct control of the Director. Besides these, the radio isotope tracer laboratory, the Inland Fisheries Information Centre, the Extension Centre Technical Cell and Fisheries Economics and Statistics Centre are located at Barrackpore under the direct control of the Director. There are two Krishi Vigyan Kendra (one at Dhauli and the other at Kakdwip) and a Trainers' Training Centre at Dhauli functioning under the aegis of the Institute.

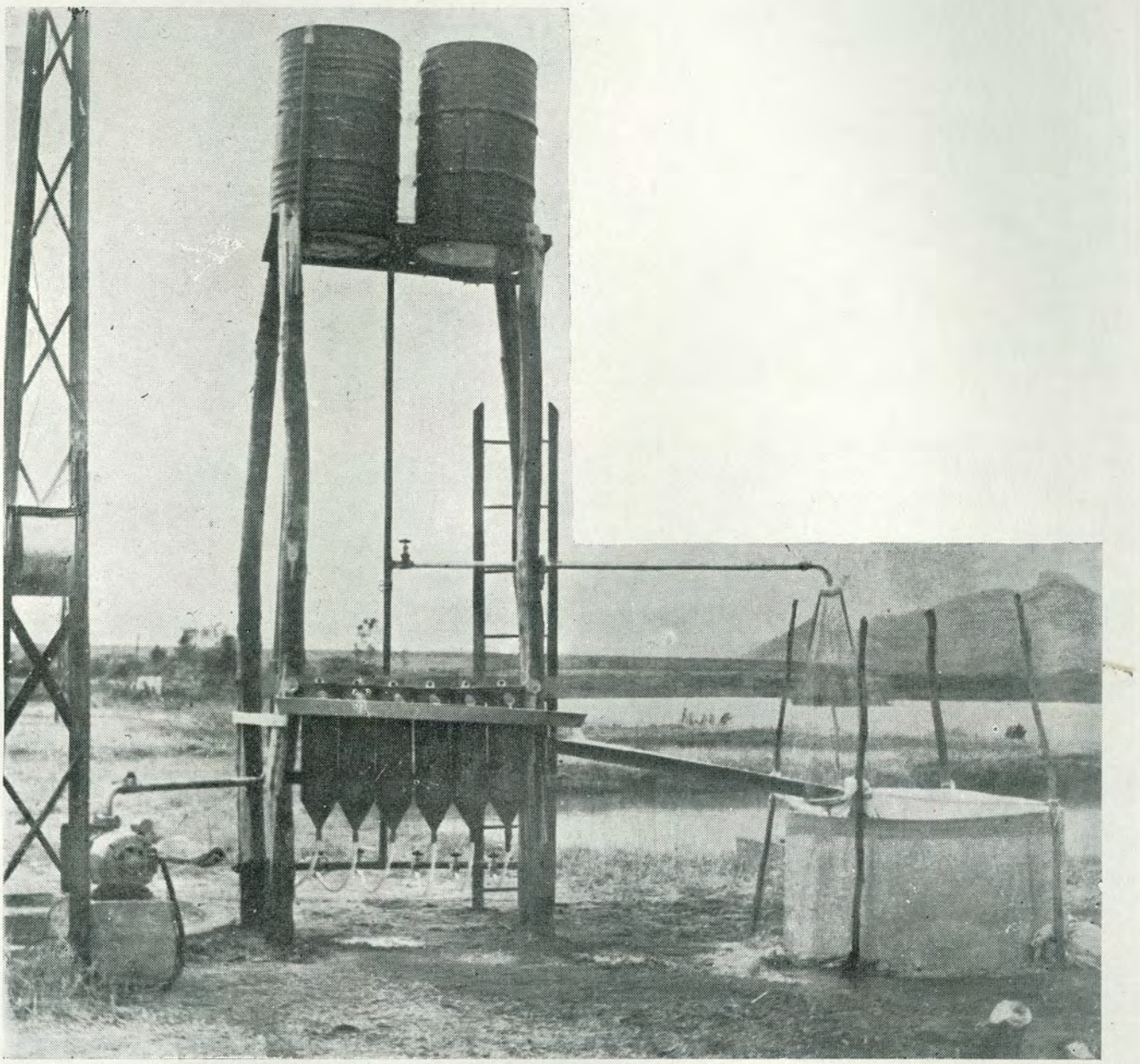
RESEARCH HIGHLIGHTS

New light on Catla :

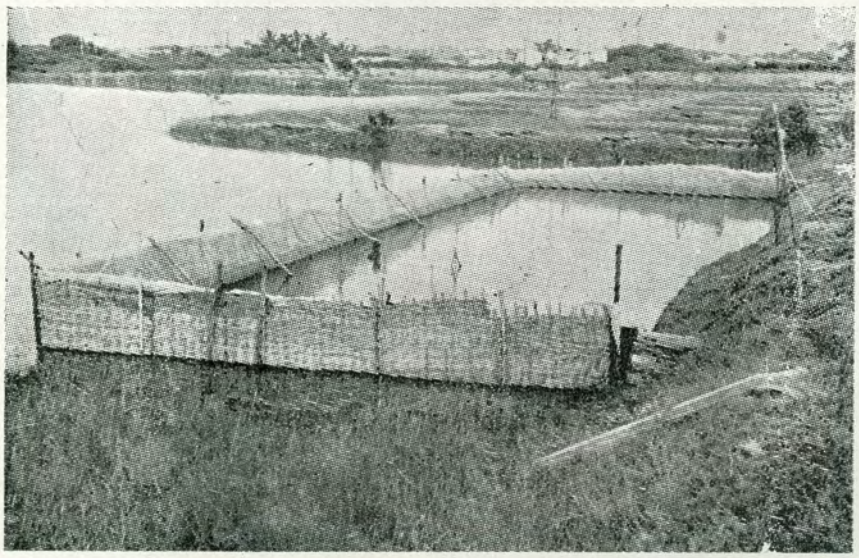
The existence of three distinct intraspecific populations of the Gangetic major carp *Catla catla* was discovered in Rihand Reservoir. Studies also revealed different feeding habits among these populations suggesting thereby that each has a specific ecological role to play. The three groups could be identified by the relative lengths of their pectoral fins. The one characterised by a medium pectoral fin (Pm) subsisted mainly on *Microcystis* and the one with a short pectoral (Ps) was a phyto-cum-zooplanktophage with feeding emphasis on phytoplankton. The population with long pectorals (Pl) consumed crustaceans (72.6%) as a major item of food. The discovery, apart from academic enlightenment opens up new horizons in reservoir management, in the country. These ecological populations are potentially useful in the ecosystem-oriented management practice wherein all niches are properly utilised by the stocked fishes.

Field Hatchery :

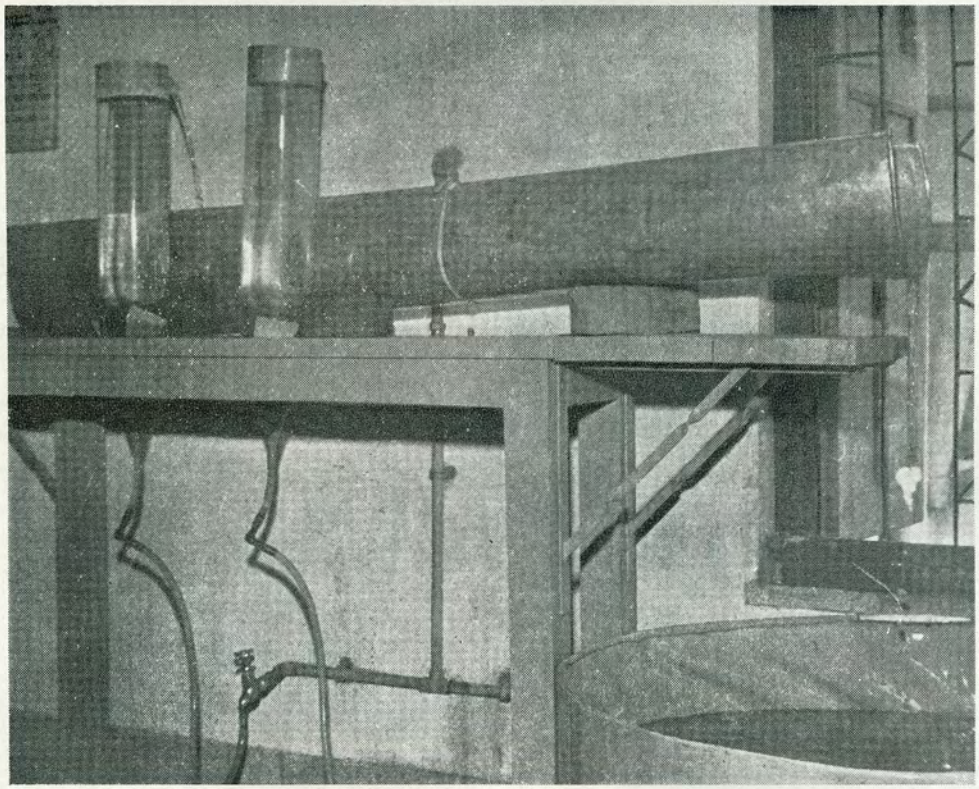
A new less expensive field hatchery has been developed at the Institute which can be easily installed in



Field hatchery developed at CIFRI and installed at the Poongar farm at Bhavanisagar (Tamil Nadu)



Nursery pen installed at Bhavani-sagar, where the fry rearing of carps were successfully demonstrated.



A view of the frog hatchery developed at CIFRI for efficient and quick hatching of commercially important frogs.

rural areas with locally available components. This field hatchery will go a long way in developing economically viable technologies in fish culture in rural India. The hatchery is installed in Bhavanisagar under the Coordinated Project on Composite Fish Culture and Fish seed Production

Two empty oil barrels function as the overhead tank in this hatchery. These barrels having a capacity of 200 l each are mounted on a platform supported by casuarina poles at a height of ten feet above the ground. Six G. I. hatchery jars each with a capacity to hold 2-2.5 lakhs of carp eggs are fixed on wooden planks attached near to the base of the poles. The open conduits of the jars drain to a plastic pool which acts as a spawnery. At required intervals, water is pumped to the overhead tanks with the help of a 0.5 h. p. electric pump.

The hatchery installed at Bhavanisagar costs only Rs 3,000/- The system can be expanded or reduced according to the requirements. The installation and operation of the hatchery need no special expertise.

Nursery pens :

Nursery rearing of *C. mrigala* and *Labeo fimbriatus* was conducted in pens installed in Poongar swamp adjoining Bhavanisagar reservoir. This experiment is a part of CIFRI's quest for an appropriate technique to overcom the twin problems of acute shortage of ground nursery and mounting demand for stocking materials. Fry of *C. mrigala* and *Labeo fimbriatus* were stocked in a 247.5 sq. m pen made of split bamboo and inside lined with nylon netting of $^1/_{32}$" mesh. The pen was fertilised with fresh cow dung @ 1 kg per sq. m. One kg of superphosphate was also used as fertilizer. Hatchlings were introduced at the rates of 26 lakhs/ha (*C. mrigala*) and 20 lakhs/ha (*L. fimbriatus*). The stock was thinned on the 30th day and rearing of the remaining seed continued for another 60 days duration. The initial harvesting of fry after 30 days gave a production of 7.85 lakhs/ha while that of fingerling 4.95 lakhs/ha with an overall survival of 27.1%. A total of 260 kg of feed was used during the 90 days of experiment.

Isolation of fish gonadotropin for hypophysation of carps in large scale :

Lyopholization was done of the second fraction of the fish pituitary extract for investigating the amino acid profile of fish gonadotropin. Different types of adenohypophyseal cells in the pituitary of pond bred common carp, rohu, silver carp and grass carp have been identifed with the aid of recent staining techniques. These studies will help in identifying the particular type of gonodotropin responsible for maturation of gonads (depending on the presence of gonadotropin cell types) and also the factors inhibiting the ovulation in Indian major carps.

Breeding and rearing of F_1 generation carp hybrids :

Catla male x rohu female hybrids of F_1 generation when induced bred produced 0.75 lakh spawn. The hybrid spawn on rearing in a 0.04 ha pond have attained an average size of 25 mm during 16 days.

About 16,000 hybrids of mrigal female x common carp male were successfully produced for the first time in India. Some of them reared in nursery pond had attained an average growth of 128.3 mm / 25.7 g in $3\frac{1}{2}$ months of rearing.

Production of early frogs, juveniles and adults of *Rana hexadactyla* :

About 25,000 tadpoles of *Rana hexadactyla* were produced during the year through spring and monsoon

breeding at the Cuttack Research Centre of the Institute. In a rearing experiment froglets (15 mm/0.5 g) of *R. hexadactyla* stocked @ 50,000/ha gave an estimated production of 1,450 kg as against a previous record of 1,225 kg/ha with provision for feeding and intensive care in 8 months period.

Seed production of magur :

Attempts to produce stockable material of air-breathing catfish, *Clarias batrachus* on mass-scale in simulated breeding grounds have been proved successful. A shallow pond (20 m × 18 m × 0.4 m) was suitably modified to simulate natural breeding conditions. A 0.8 m deep canal dug from one end of the pond to the other end served as the holding space for the brood fish.

Mature breeders of magur in the ratio 10 females : 16 males were introduced into the canal during early monsoon. Following flooding of the whole pond with fresh rain water, natural breeding took place in the pits provided in the pond. The advantage of this method of mass-scale production is that the breeding ground also serves as nursery pond. In the present experiment the hatchlings were harvested after about a month by reducing the water level when they had attained an average size of 48 mm.

Wastes as feed and fertilizer in fish ponds :

During the current year, efficacy of industrial, agricultural and municipal wastes were tested as feed and fertilizer in fish ponds. Eight organic wastes including distillary wastes, cattle urine, duckdroppings, cowdung and sewage sludge were utilized in both fresh and brackishwater pond. Among these, distillary waste, duck droppings and cattle urine were found to be superior to cowdung in releasing their nutrients to waterphase. Mineralization of all these wastes was enhanced in presence of MO+· The mixture of cowdung, poultry droppings, cottonseed wastes and distillary wastes gave promising results as fish feed with a protein content of 45% on ensiling for 10 days.

RESEARCH COLLABORATION WITH OTHER INSTITUTES

National level :

☐ The Pilot Project in collaboration with North Eastern Council and the Fisheries Dept., Manipur on the control of water hyacinth in the large (400 ha) Takmu Lake, Manipur has been successfully completed. The neat execution of the project once again demonstrated the technology for control of weeds in larger water bodies. This project has far reaching implications like manifold increase in the fish yield, comeback of the traditional *Trapa* (an economically important aquatic weed) harvest and a general awareness among planners and policy makers about the reclamation of weed infested water bodies in the north eastern region.

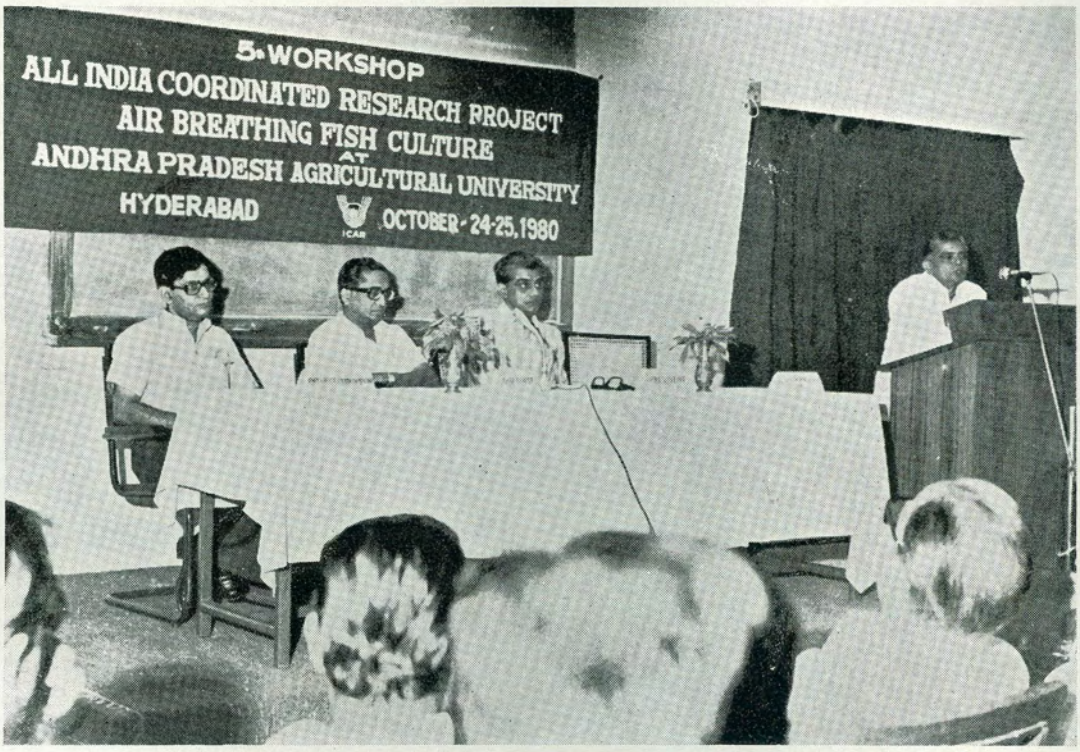
☐ At the Kalyani Research Centre, selective breeding and hybridisation studies on commercially important frog species of India have been taken up in collaboration with the Genetics Research Unit of the Zoology Department, University of Calcutta.

☐ The Institute continued its collaboration with various institutions and Governments through a network of centres under the All India Coordinated Projects. The Institute based Coordinated Projects were All India Coordinated Project on Composite Fish Culture of Indian and Exotic Fishes and Fish seed Production, Reservoir Fisheries, Air Breathing Fish Culture and Brackishwater Fish Farming. Our collaborators were the State Governments of Tamil Nadu, Andhra Pradesh, Karnataka, Maharashtra, West Bengal, Uttar Pradesh, Haryana, Bihar, Assam, Gujarat, Orissa, Madhya Pradesh, Goa and three Agricultural Universities *viz.*,

Summer Institute participants in the biochemistry laboratory of CIFRI

Participants of the Summer Institute on a field trip at Bashirhat. They are trained in taking water and plankton samples.

Dr. A. V. Natarajan, Director gives certificate and gift books to a participant of the Summer Institute.



Dr. A. Appa Rao, Director of Research, Andhra Pradesh Agricultural University welcomes the delegates of the 5th workshop on air breathing fish culture Hyderabad.

Pandit Sukh Ram (fourth from left) Hon'ble Minister for Agriculture, Himachal Pradesh with Dr. Natarajan at Simla on the occasion of sixth workshop on reservoirs.

Dr. A. V. Natarajan, Director CIFRI ; Pandit Sukh Ram, Hon'ble Minister for Agriculture, Himachal Pradesh and G. P. Dubey (from left to right) engaged in a discussion.

Kerala Agricultural University, Andhra Pradesh Agricultural University and Tamil Nadu Agricultural University. A total of 30 centres functioned under these projects.

International level :

Consequent to the arrival of consultants pertaining to the fields of fish nutrition and feed technology, fish genetics and hybridisation, fish diseases and parasite control, the research work under these specific fields has considerably been progressed. The consultants also imparted training to CIFRI staff in their respective fields. The laboratories for research work on fish genetics, fish nutrition, feed technology, fish pathology and environmental monitoring are being established with specialised equipments imported with FAO/UNDP funds.

IMPORTANT EVENTS

Summer Institute :

A summer Institute on "Brackishwater Culture and Capture Fisheries" was conducted at Barrackpore from 3 July to 2 August 1980 under the directorship of Dr. A. V. Natarajan. Dr. (Mrs.) T. Rajyalakshmi, Mr. B. N Saigal and Mr. K. K. Ghosh were the Associate Directors. Twentyfive candidates from different Universities, Agricultural Universities, ICAR Institutions, State Fisheries Departments and other ogranisations participated. More than 80 lectures were delivered by the scientists of the Institute and experts from outside. The participants were taken to the farms at Kakdwip and Bashirhat for practical demonstrations.

Fifth workshop on air-breathing fish culture :

The Fifth workshop of All India Coordinated Project on Air-breathing Fish Culture was held during October 24-25, 1980 at the Andhra Pradesh Agricultural University, Rajendranagar, Hyderabad. About seventy delegates representing the Government of India, Indian Council of Agricultural Research, Agricultural Universities, State Departments of Fisheries and private entrepreneurs attended the workshop. Speaking on the occasion, Dr. A. V. Natarajan, Director, CIFRI pointed out that effective extension activities by the state agencies can go a long way in popularising the technologies developed by the scientists. The workshop in its deliberations emphasised the need for intensification of research on low-input fish culture technologies, assessment of seed in nature, induced breeding of air breathing fishes, large-scale pen and cage culture experiments in the large derelict water bodies and formulation of cheap nutritionally balanced feed along with studies on the pesticide toxicity during the coming years.

Dr. A. Appa Rao, Director of Research, Andhra Pradesh Agricultural University welcomed the delegates and Dr. P. V. Dehadrai, Project Coordinator, Air Breathing Fish Culture Project proposed a vote of thanks.

Sixth workshop on reservoirs :

The two day deliberations of the sixth workshop on All India Coordinated Project on the Ecology and Fisheries of Freshwater Reservoirs was inaugurated by Sri Sukh Ram, Minister for Agriculture, Himachal Pradesh on 25 December 1980 at Simla. Speaking on the occasion, Sri Sukh Ram said that the employment potential of the state could be doubled if all the 41,000 ha of reservoir in the State was developed on scientific lines.

Dr. A. V Natarajan, Director, CIFRI in his key-note address, said that the research and management gaps in reservoir fisheries were sought to be bridged through the Coordinated Project. He opined that by adopting scientific management practices, yield from Indian reservoirs could be augmented to 2 lakhs tons thereby

generating an additional income of Rs. 100 crores and also providing employment for 70,000 people.

Sri G. C. Negi, Director of Animal Husbandry welcomed the delegates and the fifty one fishery scientists who participated in the workshop. The workshop recommended (1) suspension of stocking programme for mirror carp (2) monitoring of silver carp in regard to recruitment and stock accretion and (3) a new programme for Govindsagar lake including the observance of a closed season from 15 June to 15 August with a view to improving the stock structure of economic fishes.

New premises at Dhauli :

The office of Freshwater Aquaculture Research & Training Centre has been shifted to the new laboratory buildings at Dhauli. New research programmes have been initiated especially in the fields of fish genetics, fish nutrition and feed technology, fish pathology and fish culture economics whereas some of the ongoing programme have been modified and strengthened with interdisciplinary units to form part of RAS Project (Network of Regional Aquaculture in Asia).

Construction of FARTC laboratory building consisting of 31 laboratory rooms of 9×6 m, one computer room of 9×6 m, one conference room of 15×6 m and one library of 20×6 m totalling approximately 3,400 sq. m floor area has been completed. Besides this, the civil construction of the auditorium and aquarium is also completed. Construction of 110 quarters for staff and trainees hostel is progressing.

The front section farm comprising of two reservoirs, one of 2·5 ha and the other of 2·2 ha area, 21 rearing ponds of 0.1 ha each, 102 nursery ponds of 0.02 ha each and 253 experimental ponds of 0.006 ha each is nearing completion. In addition to these, construction is in progress for another 58 nursery ponds and 26 rearing ponds in the middle sector of the farm. The hatchery design was prepared. The campus road measuring about 2 km has been completed. About 800 trees have been planted along the campus road.

EXTENSION AND NATION BUILDING ACTIVITIES.

The Extension Section continued to be busy during the year. Over four hundred student/trainees from various Universities/Institutions were apprised of the various activities of the Institute and the scientific concept of inland aquaculture. About three hundred fish farmers were given adequate advices on different problems encountered by them. Eighteen extension lectures were delivered by the scientists on various occasions responding to the calls from various development agencies Films on induced breeding and composite fish culture were screened for the benefit of a large number of people interested in aquaculture. During the year, eleven extension pamphlets, nine in Bengali and two in English were brought out. Field visits by the scientists to render advice on fish culture problems on the spot were a regular activity of the Section.

Training programme :

The following short-term training courses were organised during 1980

- ☐ Three courses on 'Controlled breeding of common carp' were conducted at Kalyani in which 53 flood affected farmers underwent the training.
- ☐ A one-day training course was organised for 25 trainee extension officers, Dept. of Fisheries, Government of W. Bengal.
- ☐ One hundred and fifty one fish farmers underwent training through three training courses organised at Chanditola & Kolaghat, both in W. Bengal.

- A-5 day training course was conducted for four fish farmers at coordinated research project centre at Kulia, Kalyani from 15. 7. 80 to 19. 7. 80. The course was on 'Breeding and culture of carp'.
- A one-day course was organised for seventy six fish farmers at Belgharia, on composite fish culture and magur culture.
- In collaboration with Workers' Education Centre at Chanditala, a five-day training course 'on Inland Aquaculture' was organised from 2. 12. 1980 in which 40 fish farmers underwent the field training.

Fish Farmers' Days :

The Extension Section organised/participated in the following five Fish Farmers' Days :

—at Basirghat, in prawn farming, on 31. 5. 80.

—at Kolaghat, in modern aspects of aquaculture, on 3. 6. 1980

—at Seakhala, in composite fish culture, on 31.10.1980

—at Chandirampur, in freshwater aquaculture, on 25. 2. 1980 and

—at Nilgunj, in composite fish culture, on 27. 2. 1980.

During these days, the scientists held discussions with the farmers on problems they encountered in their pisciculture venture.

Exhibitions :

During the year, the Section organised four exhibitions, one each at JARI, Nilgung ; CIFRI, Barrackpore ; Bantala, Calcutta and Cochin, Kerala.

Besides, the Institute also undertook five demonstration programmes at different places in various aspects of breeding of Indian and exotic carps.

The Lab to Land Programme of the Institute in 31 centres covering 408 farm families continued to be coordinated by the Section. The Section brought out a manual on the farm families under the Lab to Land Programme as a ready reckoner.

LAB TO LAND PROGRAMME

The Lab to Land Programme initiated during 1979 in commemoration with Golden Jubilee of ICAR was continued in 1980. The Institute continued the transfer of technologies developed at the Institute in fish breeding, raising of fry, fingerlings and table size fishes, fry transport, nursery pond management, weed control, air-breathing fish culture and integrated culture systems. More extension pamphlets were issued and the vol. II of the Golden Jubilee Souvenir was published.

At Barrackpore :

The Extension Section continued the Institutes' Lab to Land Programme at the Headquarters covering 47 farm families in the District of Hooghly, 24-Parganas and Midnapur. About 20 million fry of Indian major carps were produced under the programme. Fish production ranging from 1,000—2,939 kg/ha/5 months was obtained from ponds under composite fish culture. Monoculture of magur yielded a gross production of 3,481.41 kg/ha/6 months. Demonstration on various fish culture technologies continued.

At Dhauli :

Members of eighty one familes belonging to the scheduled caste and landless labourers were trained in fish culture practices and fish seed production. They produced about 1.7 million common carp seed. These fish farmers are now reported to be in a position to carry out fish culture operation on scientific lines on their

own. The inaugural function of the Lab to Land Programme was held on 13. 7. 1980 which was attended by a number of youth and farmers.

At KVK/TTC :

The Lab to Land Programme of KVK/TTC, Kausalyagang is progressing in 17 centres in nine villages falling within a radius of 15 km of the Centre. The technologies selected for the transfer to the fish farmers were :—

Rearing of brood fishes
Common carp breeding
Rearing of fry & fingerlings
Composite fish culture and
Integrated fish culture and livestock farming

The harvesting of the pond under the integrated fish culture at Nakhaurpatna was inaugurated by Shri Kuauria Majhi, Hon'ble Minister for Fisheries, Govt. of Orissa on 23rd November, 1980.

At Madras :

The second experiment under the programme was initiated during February 1980. A total of 7,000 prawns, mostly *Penaeus indicus* was stocked in the pond in Donirevu after poisoning and clearing the pond. Tilapia and mullets were introduced in the same ponds in May, 1980.

At Cuttack :

The Centre continued the Lab to Land Programme through the transfer of technologies developed at the Institute. Demonstration and field training were undertaken in fish breeding, fish seed raising, fry transport, pond management, raising of fingerlings in paddy plots along with high yielding paddy varieties and aquatic weed control in villages under Reghunathpur, Salepur, Tawgi, Biridi and Barang blocks. Production achieved and monitary returns from the ponds proved to be much higher than the returns realised earlier. The benefits derived by fish farmers have generated considerable interest in other local pond owners also.

At Kakdwip :

Fourteen fish farming families have been adopted under this programme. Demonstrations on brackish-water fish culture on scientific lines were made in the farmers' ponds.

At Kalyani :

In commemoration of the Lab to Land Programme, a training course of induced breeding of frogs and frog hatchery techniques was organised in May-June, 1980. 1.2 million hatchlings and tadpoles were released in the nature in 1980. For the benefit of public the Calcutta Doordarshan demonstrated the methodologies in frog farming developed by this Centre. AIR also gave wide coverage of the programme.

LIBRARY & DOCUMENTATION

During the year under report 465 books, 52 reprints, 66 miscellaneous publications and 1100 issues of periodicals were added to the library of the Institute. 40 foreign and 48 Indian journals were subscribed during the year and in addition to this, library received 150 foreign and Indian journals either as gratis or in exchange. The present library holdings inclusive of the year's arrivals comprise 4,678 books, 3,812 reprints (received as gratis or in exchange), 2,053 miscellaneous publications excluding the bound and loose issues of journals, pamphlets, maps, departmental publications etc. The

A training programme in induced breeding of frog was arranged at Kalyani in connection with the Lab-to-Land programme. The seed produced during the training programme is being released into the Dhaokardah Beel at Kalyani.

Dr. B. B. Pakrasi was given a warm farewell on his retirement. The Director, scientists and other members of CIFRI family with Dr. Pakrasi.

total expenditure during the year 1980-81 amounted to Rs. 1,23,732 81.

Besides maintaining exchange relationship with 414 institutions and orgnizations, 13 new exchange relationships were established during the year. "Accession List" for the period July to December, 1978 & January-June, 1979 were brought out and circulated.

Fifty one technical and non-technical queries from India and abroad were attended to by the Library and Documentation Section. The Institute supplied 120 issues of journals and publications to INSDOC, Delhi ; Nissat—Insdoc Regional Centre, Calcutta ; National Institute of Oceanography (CSIR), Dona Paula, Goa ; Department of Zoology, University of Delhi, Delhi ; Central Institute of Fisheries Education, Bombay ; Department of Zoology, Punjab University, Chandigarh; Indian Institute of Management, Ahmedabad ; Dr. V. S. Krishna Memorial Library (University Central Library), Andhra University, Waltair etc. on inter-library loan service.

During the year 38 reports on progress of research were compiled and sent to ICAR. 92 scientific papers on different aspects of inland fisheries by the scientists of the Institute were published. Besides, departmental publications i e., Annual Report for the year 1978 ; Bulletins No. 31 & 32 entitled "Manual of brackishwater aquaculture in India" ; and "The status of paddy-cum-fish culture in India" ; Miscellaneous contributions No. 15 & 16 entitled "Methodology for soil and water analysis in brackishwater culture system" and "Taxonomy and key to the identification of the commercially important penaeid prawns of India" : Bibliography of Indian Fisheries, Vol. 14 (4), 1975 ; Souvenir : In commemoration of the ICAR Golden Jubilee year 1979, Part II ; CIFRI Brochure (Issued on the occasion of ICAR Regional committee II meeting held at CIFRI, Barrackpore on 6 October, 1980) ; Summer Institute Volume on brackishwater capture and cultur fisheries (Barrackpore 3 July - 2 August 1980), 5th Workshop Report on All India Coordinated Research Project on Air Breathing Fish culture held at Andhra Pradesh Agricultural University, Rajendranagar, Hyderabad on 24-25 October, 1980 ; 6th Workshop Report on All India Coordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs held at Simla, H. P. on 25 & 26 November, 1980 ; Accession Lists No. 1-6, 1979 : CIFRI News Bulletin Nos. 2-4, 1979 and Contents Lists No.1-5, 1978 were compiled and published.

HONOURS, AWARDS, ETC.

Sri G. N. Saha, Scientist-2 was awarded Dhiru Morarjee Memorial Prize for his article entitled "Techniques of pond fertilisation and use of fertilisers in freshwater aquaculture for increased fish production" appeared in *Fertiliser News*, November 1979. The award is instituted by M/s Fertilisers Association of India, New Delhi.

Sri S. P. Ayyar, Scientist-2 who is on deputation to Mauritius under the Indian Technical and Economics Cooperation Programme (ITEC) has been given an extension of his deputation for a period of one year w. e. f. July 15, 1980.

Sri V. K. Unnithan, Scientist-1 of the Institute was awarded Ph. D. degree by the University of Udaipur, Udaipur.

Sri G. N. Chattopadhyay, Scientist-1 was awarded Ph. D. degree by the Bidhan Chandra Krishi Viswa Vidyalaya, Kalyani during the year.

Sri P. K. Ghosh, Scientist-S was awarded ICAR Senior fellowship for conducting research for Ph. D. degree.

Sri K. Raman, Officer-in-charge, Madras Centre of CIFRI was nominated by the Tamilnadu Government as a member of working group for formulating the sixth five year plan for fisheries in Tamil Nadu.

TRAINING :

Shri T. Ramaprabhu, Scientist-2 was deputed to USA to undertake a study and research on 'Problems of aquatic weed control' under the IDRC Research Associate Awardship for a period of one year w. e. f. September 11, 1980.

Sri Ajoy kumar Ghosh, S-1 and Sri D. N. Swamy, S-1 underwent a short-term training Programme in 'Micro biological studies of sewage-fed fishes' at the Department of Agricultural Microbiology, Tamilnadu Agricultural University, Coimbatore, during 9-30, June, 1980.

Sri Kuldeep kumar, T-4, TTC at Kausalyagang underwent a training programme on 'Live-stock management' at TTC, NDRI, Karnal during January 15—February 13, 1980.

S/Shri P. K. Pandit, George John, N. A. Reddy, C. S. Purushothaman, S. Ayyappan, K. Suresh and Dr. V K. Unnithan underwent a two months training in agricultural research management at NAARM, Hyderabad. During the year these scientists, recruited under the ARS scheme of ICAR, successfully completed the four months rural orientation course at the following agencies :

Scientist	Period of Course	Voluntary Agency
Shri P. K. Pandit	19. 2. 80 - 20. 6. 80	Lok Siksha Parishad Ramakrishna Mission Ashram P. O.— Narendrapur, 24-Parganas, West Bengal
Shri George John	26. 2. 80 - 25. 6. 80	Tamil Nadu Board for Rural Development, 13, Radhakrishna St., T. Nagar, Madras-600 017
Shri N. A. Reddy	9. 6. 80 - 10. 10 80	Asian Institute of Rural Development 7/A, Ratnavilasa Road, Basavanagar, Bangalore-560 004
Shri K. Suresh	26. 5. 80 - 30. 9. 80	Do
Shri C. S. Purushothaman	23. 2. 80 - 23. 6. 80	Mitra Niketan, P. O. Vellanad, Trivandrum 695 543
Sri S. Ayyappan	6. 6. 80 - 5. 10. 80	All Kerala Association for Rural Development Service, Nalanchira, Ebenezer, Trivandrum-695 015
Dr. V. K. Unnithan	5. 5. 80 - 18. 9. 80	Seva Mandir, Udaipur-313 001 Rajasthan

CONFERENCES AND SYMPOSIA

The scientists of the Institute participated in many conferences, symposia and seminars during 1980 and presented their research findings and exchanged views with the delegates. List of scientists who participated and presented papers in such gatherings is furnished below :—

Conf/Symp. etc.	*Place*	*Title of the paper presented*	*Authors*
Symposium on "Coastal Aquaculture" held during 12-18 January, 1980	Central Marine Fisheries Research Inst., Cochin	24 papers on coastal aquaculture	Scientists of this Institute
Seminar on "Integrated Rural Development" held on 8th & 9th March 1980.	OUAT, Bhubaneswar	Integrated rural development through pisciculture.	V. R. P. Sinha
ICAR Regional Committee Meeting No. 4 held on 21st & 22nd April 1980,	Ranchi	—	V. R. P. Sinha
Annual Workshop of the "All India Coordinated Project on National Demonstrations" held on 24th to 26th March, 1980.	Pondicherry	1. Integrated farming incorporating fish-cum-live stock. 2. Paddy-cum-fish culture.	A. V. Natarajan & B. K. Sharma A. Ghosh & Kuljeet K. Bhanot
Symposium on "Utilization of Animal Resources of Orissa" held during 22nd & 23rd March, 1980.	Utkal University, Bhubaneswar	Preliminary observations on the use of bleaching powder as fish toxicant for preparation of nursery ponds.	N. K. Tripathy *et al.*
,,	,,	Preliminary studies on benthic fauna of nursery ponds treated with mahua oilcake and bleaching powder for successful rearing of carp fry.	Radheyshyam *et al.*

Conf./Symp. etc	*Place*	*Title of the paper presented*	*Authors*
Symposium on 'Utilization of Animal Resources of Orissa" held during 22nd & 23rd March, 1980.	Utkal University Bhubaneswar	A study on the abundance of plankton in nursery ponds treated with different toxicants.	N. K. Tripathy *et al.*
Seminar on "State level Fisheries Cooperative Societies" held during 19th & 20th April, 1980.	Digha, W. B.	—	Attended by U. Bhaumik
Seminar on "Coastal and Inland Fish Culture Development in Tamil Nadu" held on April 25, 1980.	Tamil Nadu Agricultural University, Tuticorin	Aquaculture development in the Pulicat lake area - Prospects and problems.	K. Raman
Conference on "Environmental Biology : Pollutants *vis-a-vis* Aquatic Life" held in April, 1980.	Muzaffarnagar U. P.	Toxicity of some organic biocides to the freshwater fish *Cyprinus carpio communis* Linn.	D. N. Singh *et al.*
Seminar on "Some Aspects of Inland Aquaculture in Karnataka "held on 14th & 15th July, 1980.	College of Fisheries, Mangalore	Recent experiments in composite fish culture in Karnataka.	B. V. Govind
,,	,,	Scope of utilising tanks in Karnataka for increasing fish production.	B. V. Govind
,,	,,	Recent experiments in air-breathing fish culture in Karnataka.	V. K. Murugesan
Summer Institute on "Brackish-water Capture and Culture Fisheries" held during July 3—August, 2, 1980	CIFRI, Barrackpore	77 lectures were delivered	Scientists of this Institute.
Workshop on "Betel leaf" held on 29th June, 1980.	Dariala, Midnapore, W.B.		Attended by P. Das & P. K. Pandit.

Conf./Symp./	*Place*	*Title of the paper presented*	*Authors*
Seminar on Fish Culture held on August 10, 1980.	College of Agriculture, Viswa Bharati University, Santiniketan. W. B.		P. Das
Third Workshop of KVK/TTC held in August, 1980.	Krishi Vigyan Kendra Pondicherry	—	Attended by B. N. Singh & C. Selvaraj
Summer Institute on "Advanced Statistical Methodology as Applied to Animal Science" held during July—August, 1980.	Indian Agricultural Statistics Research Institute, New Delhi..	—	Attended by A. K. Roy, & H. C. Karmakar
Workshop on "Krishi Vigyan Kendra" held during 19-22 August, 1980.	Pondicherry	—	Attended by D. D. Halder
"International Conference on Wetlands" held during 10-17 September, 1980.	New Delhi	—	Attended by K. L. Sehgal
Workshop on "Mussel Farming" under the auspices of UNDP/ICAR and a National Workshop on "Algal System" held during 3–4 Oct. 1980.	Madras	—	Attended by the scientists of Madras Research Centre.
13th Annual Convention of the Indian Society of Agricultural Chemists held during 27–28 November, 1980.	Bidhan Chandra Roy University of Agriculture & Technology, Kalyani.	Studies on redox potential for indicating pollution in brackish-water impoundments	S. C. Thakurta & G. N. Saha
,,	,,	Relationship of water soluble calcium and magnesium ion concentration to water salinity of brackishwater ponds of West Bengal, India.	G. N. Chattopadhyay & H. C. Karmakar.

Conf/Symp etc.	*Place*	*Title of the paper presented*	*Authors*
5th Workshop on "All India Coordinated Research Project on Air-breathing Fish Culture of CIFRI" held on 24 & 25 October, 1980.	Andhra Pradesh Agricultural University, Rajendranagar, Hyderabad	—	Organised by CIFRI
6th Workshop on "All India Coordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs held on 25 & 26 November, 1980.	Simla	—	- do -
Seminar on "Fisheries Extension" held on 8-10 December, 1980.	Central Marine Fisheries Research Institute, Cochin	CIFRI's contributions in technology generation, verification, educati on and dissemination in inland fishery sector.	Attended by A. V. Natarajan P. V. Dehadrai P. Das & B. N. Saigal
Seminar on "Biological Transformation of Nutrients in Soil"	Calcutta	—	Attended by G. N. Saha
FAI Silver Jubilee Seminar on "Fertilizer Technology"	Delhi	—	do
Seminar-cum-Fish Farmers' Day on "Sewage-fed Fisheries" held during 12-13 December, 1980.	Bantala 24-Parganas	—	Attended by R. N. Pal, P. Roy, R. K. Banerjee, U. Bhaumik & B. Roy.

VISITORS

Many distinguished visitors and scientists from different parts of the country and abroad visited the Institute and its regional centres. They were taken round the research laboratories, and demonstration centres to apprise them of the achievements of the Institute.

Among the visitors, the names of the following merit a mention :—

Arudpragasan, K D.	Prof. & Head of Department of Zoology, University of Colombo, Colombo.
Bahai, Syamsul	Vice Admiral, Indonesian Ambassador to India.
Balasuriya, L K. S. W.	Freshwater Fisheries Station, Rambodagalla, Sri Lanka
Balerao, D. R. (Dr.)	Deputy Director-General (AS), ICAR, New Delhi.
Behura, B. K. (Dr.)	Head, Department of Zoology, Utkal University, Bhubaneswar.
Bourma	Sr. Official, LAOS/PDR.
Chatterji, K. K.	Asst. Agricultural Information Officer, Directorate of Agriculture, W. B. Calcutta.
Chaudhuri, S. D. (Dr.)	Special Consultant, Asian Development Bank, Dacca.
Coche, A. (Dr.)	FAO Consultant, FAO, Rome.
Crafford, John (Sir)	Adviser to the President, World Bank, New York.
Crance, Johnie H.	USAID/Philippines, US Embassy, Manila.
Das, B. B.	Lutheran World Service, Calcutta.
Desai, D. K.	Prof., Indian Institute of Management, Ahmedabad.
Dick, Paul S. (Dr.)	Asst. Education Adviser (Science), The British Council Division, Calcutta.
Fijan, N. (Dr.)	FAO Consultant, FAO, Rome.
Ghose, Partha (Dr.)	Science Officer, The British Council Division, Calcutta.
Glude, J. (Dr.)	U. N. Consultant, FAO, Rome.
Goutam, O. P. (Dr.)	Director-General, ICAR. New Delhi.
Gupta, V. K.	Professor, Indian Institute of Management, Ahmedabad.
Haque, A. K M.	Associate Professor of Geography, Dacca University, Dacca.
Harding, Peto, D. G.	Fisheries Expert to Bangla Desh, Dacca, Bangla Desh.

Joshi, A S. (Dr.)	Curator, Museum of Arthropoda, Puns.
Keo, S. Peng	Sr. Official, LAOS PDR
Kidd, D. W. (Dr.)	KVK/TTC on Dryland Agriculture, Hyderabad.
Macintosh, D. J. (Dr.)	Institute of Aquaculture, University of Stirling, Scotland, U. K.
Mahalingasivam. R. (Dr.)	Deputy Director, National Planning, Ministry of Finance & Planning, Sri Lanka.
Majhi, K.	Minister of State for Fisheries, Orissa.
Makamura, R. (Dr.)	Sr. Research Scholar, California Polytechnique State University. U. S. A.
Marriott, Man	Grimsby College of Technology, South Humberside, England.
Nair, P. K. Vasudevan	MLA & Chairman, P. U. C., Kerala.
Pandey. H. K. (Dr.)	Director, Central Rice Research Institute, Cuttack, Orissa.
Panigrahi, C.	M. P., New Delhi.
Poddar, B. N.	Joint Secretary (Fisheries), Govt. of W B., Calcutta.
Prasad, C. (Dr.)	Deputy Director General (Edn), ICAR, New Delhi.
Raghuprasad, R. (Dr.)	Asst. Director General (Fisheries', ICAR, New Delhi
Rahman, Lutfur (Dr.)	Associate Professor, Bangladesh Agricultural University, Mymensingh.
Ranga, N. G.	M. P., New Delhi.
Rao, G. S. N. (Dr.)	FAO, Rome
Rao, C. K. S.	Development Officer (Fisheries, ARDC), Calcutta.
Rasmy, K.	Sr. Official. LAOS PDR
Ray, T. K. (Brig.)	Lutheran World Service, Calcutta.
Routhberd, S. (Dr)	Scientist, Dor, Israel.
Sharma, C. S	Additional Secretary, ICAR, New Delhi.
DeSilva, Sena S.	Prof. of Zoology, University of Colombo, Colombo.
Sivaraman, B.	Chairman, Planning Commission, New Delhi.
Sperber, O. (Dr.)	Fisheries Expert, Bangla Desh.
Sreenivasan, R.	Joint Director of Fisheries, Govt. of Tamil Nadu, Madras.
Srivastava, U. K. (Dr.)	Professor, Indian Institute of Management, Ahmedabad.
Tayamen, M. M.	Bureau of Fisheries & Aquatic Resources, Quezon City, Philippines.
Thankhiew, D. R. (Dr.)	Reader, Dept. of Zoology, School of Life Sciences, North Eastern Hill University, Shillong.

Thayaparan, K.	Director (Inland Fisheries), Ministry of Fisheries, Sri Lanka.
Urasaki, Hiroshi (Dr.)	Department of Biology, Nipon University, School of Medicine, Itqbqshi Tokyo.
Vansovanh, V.	Senior Officials, LAOS PDR
Vong, I.	Sr. Official, LAOS PDR
Yan, Chen Foo (Dr.)	Coordinator RAS/76/003, Bangkok.

FINANCE :

The provision of funds for the financial year April 1980 to March 1981 was as under :—

Non-plan	:	Rs. 1,03,97,000
Plan	:	Rs. 74,00,000
Total	:	Rs. 1,77,97,000

Against the above provision, the expenditure from 1. 4. 1980 to 31. 12. 1980 was as follows :—

Non-plan	:	Rs. 84,76,531.08
Plan	:	Rs. 28,44,092.50
Total	:	Rs. 1,13,20,623.58

PROGRESS OF RESEARCH

Research in hand :

Project 1 : Optimum per hactare production of fry, fingerlings and fish in culture fishery operations.

Problem : 1.1.1.1. Rearing of Indian major carp fry to fingerlings.

Personnel : C. Selvaraj, S. N. Datta, S. Jena and A. N. Mohanty.

Duration : 1980-82

Location : Cuttack

Fry of Indian major carps were stocked in two nursery ponds at the rates of 1.0 and 2.0 million per hectare separately, the species ratio being catla 1 : rohu 1 : mrigal 1. Fed on supplementary feed daily at the rate of weights equivalent to the initial body weight, the fingerlings registered final average growth of 7.97 and 5.37 g in catla, 10.00 and 8.00 g in rohu and 12.50 and 11.11 g in mrigal at 1 and 2 m/ha stocking densities respectively. The ponds received urea twice a month, total urea applied during the three months rearing being at 90 kg/ha. No phosphatic fertilizers were applied.

Problem : 1.1.2 2 Composite culture of Indian and exotic carps to raise marketable fish.

Personnel : R. D. Chakraborty, P. R. Sen, N. G. S. Rao, S. Jena and S. R. Ghosh.

Duration : From 1977-continuing

Location : Cuttack

The experiments with six carp species conducted in two farm ponds were wound up at the end of 2 years in May, 1980. Management measures adopted were phased

stocking of fishes keeping in view the volume of water in ponds, daily provision of suplementary feed including weeds, periodical fertilization with intermittent harvesting and replenishment of harvested species. Poaching of fish greatly affected the results and no conclusion could be drawn.

A new experiment has been initiated in two farm ponds (0.04 ha and 0.05 ha). Initial stocking was done in June 1980 at 1000/ha later raised to 10,000/ha in November 1980. The three Indian major carps and three exotic carp species are combined in the ratio of C1 : R 2 : M 1.5 : Sc : 2.5 : Gc : 1.5 : Cc : 1.5. Fertilization is being done with provision of daily feed including weeds. Estimated production recorded at 80% survival of fishes stocked was around 600 kg/ha at the end of the first month of culture.

Problem No. 1. 1. 2. 3 : Culture of Indian major carps.
Personnel : S. R. Ghosh, M. A. V. Lakshmanan, S. Jena and N. G. S. Rao.
Duration : 1980-83
Location : Cuttack

Experiment on rearing of catla, rohu and mrigal at the combined stocking density of 5000 fingerlings/ha in the ratio of C4 : R 3 : M 8 is in progress in two ponds. With daily feeding and fertilization, estimated production is 875kg/ha in one at the end of 2 months and 2307 kg/ha in the other at the end of 8 months culture respectively.

Problem No. 1. 21 : Management of carp nursery ponds.
Personnel : P. R Sen and D. K. Chatterjee
Duration : From 1977-continuing
Location : Cuttack

Two sets of experiments were conducted in Killa Fish Farm for raising rohu and catla spawn to fry stage. Spawn of rohu and catla were stocked at the rate of 3.75 million/ha and treated with manganese and cobalt chloride (1 mg+ 0.01 mg/day/fish). In case of rohu 73.33% survival was obtained with the treatment as against 45.33% in the control. In the case of catla, survival of fry was 59.33% in the control as against 45.33% in the treatment. Cobalt and manganese in combination appear to be not effective in enhancing the survival of catla fry.

Problem No. 1. 29 : Comparative study of the efficacy and economics of available fish poisons of plant origin.
Personnel : S. Jena, M. A. V. Lakshmanan, A. N. Mohanty and C. Selvaraj.
Duration : 1975 to 1980
Location : Cuttack

The laboratory studies indicated that a dose of 5-10 mg/l tamarind seed husk powder was effective in obtaining a total kill of a wide variety of fishes within 12 hours.

Field trials could not be taken due to unavailability of husk powder in large quantity.

Problem No. 1. 34 : Observations on possibilities of fish culture in jute-retted pond water.
Personnel : B. N. Saigal, Amitabha Ghosh, S. K. Saha, V. K. Unnithan, K. S. Banerjee and A. R. Choudhury
Duration : 1976–1981
Location : Barrackpore

Four specises of fishes were stocked in a jute-retted pond in Village Patulia, West Bengal in the month of September. Growth is being monitored. Plankton composition and water quality are studied at fortnightly intervals. Preliminary observations suggest that silver carp and catla grow well compared to others *viz.*, rohu and mrigal.

Problem No. 1.40 : Comparative efficiency of organic manures on the fertilization of pond soils.

Personnel : D. K. Chatterjee and K. C. Pani

Duration : 1976-80

Location : Cuttack

Treatments with various organic manures *viz.*, cow-dung, polutry manure, mustard oil cake and compost (*Pistia*) at three rates (300,600 and 1200 kg/ha) and pond soil having 1.67% organic carbon showed that all these manures helped in improving the total alkalinity and dissolved inorganic phosphate of water, more with the highest rate of treatment.

Problem No. 1. 42 : Statistical relationship between the inputs and fish production in composite fish culture.

Personnel : M. Rout

Duration 1977-80

Locstion : Cuttack

Economic optimal model derived from the two variables of inputs and production characterised the highest level or production at 1. 37.

Problem No. 1.43 : Seasonal changes in the fat content in the flesh of Indian and exotic carps

Personnel : N. K. Tripathy, V. R. P. Sinha & R. Paul Raj

Duration : 1977-1982

Location : Dhauli

Monthly sampling of fishes were made to study the seasonal fluctuation in the fat content of the flesh of different species of carps. Experiments were conducted to study the effect of dietary fat on the growth and body fat content of fry and fingerlings of carps.

Problem No. 1. 44 : Studies on ecological changes in newly constructed ponds and their management.

Personnel : D. K. Chatterjee, S. Jena and K. C. Pani

Duration : 1977-1982

Location : Dhauli

Inorganic fertilizers (N+P) in combination with organic manure (cowdung) recorded higher primary production compared to separate treatments with phosphorus, nitrogen+phosphorus and organic manure (cowdung) in newely constructed ponds at Dhauli.

Problem No. 1.45 : Culture of *Mystus seenghala* and *M. aor.*

Personnel : N. G. S. Rao and S. R. Ghosh

Duration : 1980-1983

Location : Cuttack

For want of experimental material, the planned programme could not be carried out.

Problem No. 1. 48 : Alternative cheap sources of protein for carp fry and fingerlings

Personnel : P. R Sen, N. G. S. Rao and D. K. Chatterjee

Duration : 1979-1982

Location : Cuttack

Seven commercially available compounded feed mixture with waste vegetable ingredients combined with byproducts of milk processing were tried on rohu fingerlings. Amul Special Milk Ration proved to be the best in terms of growth of test fish and conversion followed by Godrej High Protein diet.

Problem No. 1. 49 : Monoculture of Indian major carps catla, rohu and mrigal.

Personnel : N. G. S. Rao, P. R. Sen, R. D. Chakraborty, N. G. S. Rao and D. K. Chatterjee

Duration : 1980–1982

Location : Cuttack

An experiment with rohu has been initiated in November 1983 in four ponds of 0.04 ha area each. Stocking density is 3000/ha. In one, only supplementary feed is provided. In another fertilizer alone are applied. In the third pond both feed and fertilizers are employed. Rohu's performance in combination with catla and mrigal with feed and fertilizers is tried in the fourth pond.

Sampling trend indicates that rohu's performance has been better with fertilizers treatment possibly influenced by the ecology of that pond which highlights the role of pond ecology in fishery management.

Project No. 2 : Induced fish breeding

Problem No. 2.8 : Induced breeding of important cultivated fishes (other than carps).

Personnal : G. V. Kowtal, R. K. Jana, S. D. Gupta & A. K. Sahu.

Duration : 1974–80.

Location : Cuttack

Two sets of *P. pangasius* were subjected to hypophysation and the females received two injections of homoplastic pituitary extract at 12 hourly interval. One of the female responded readily to stripping. The eggs were released freely and measured 1.3 mm on an average. Attempts to fertilize them failed as the males were found to be in advanced stage of resorption.

During July three sets of *N. chitala* were administered two doses of homoplastic pituitary extract at 6 hourly intervals but they did not respond favourably.

Problem No. 2.9 : Study of the process of maturation, ovulation and resorption of gonads in Indian major carps.

Personnel : G. V. Kowtal, R. K. Jana and S. D. Gupta.

Duration : 1974-80

Location : Cuttack

Eggs of fishes (catla, rohu and mrigal) injected with pituitary extract were preserved during ovulation along with those which did not breed. They are being sectioned for comparison with ova in stage IV and V collected before hypophysation.

Problem No. 2.10 : Pituitary-gonad relationship in free-spawning and non-free-spawning carp.
Personnel : H. A. Khan & V. R. P. Sinha
Duration : 1977–1981
Location : Cuttack

Histological preparations of pituitary gland and gonads were made from *L. rohita* collected during resting, maturation, spawning and post spawning phases. In the pituitary, basophil cells were found to be inactive during maturation and spawning phases but with limited activity during resting phase. In the post spawing phase the basophil cells got vacuolated and lost their contents.

In order to localise gonadotropins and to differentiate them from other type of basophils, some experiments were conducted with *L. rohita*. The fish under study was administered sex steroid hormones, chemicals etc. to exert stress on the fish so as to bring changes in the cellular contents of the adenohypophyseal cells. Further studies on the histology of pituitary cells and gonads are in progress.

Problem No. 2.11 : Effect of hormones, vitamins and feed on maturity of carps.
Personnel : S. D. Gupta and H. A. Khan
Duration : 1977-80
Location : Dhauli

Steriod hormones like hydrocorticosone acetate (ROUSSEL) and testosterone propionate (CIBA) were tried on rohu at various doses keeping a suitable control. Hydrocorticosone acetate doses ranged from 30 to 80 mg/kg body wt. of fish and it was also tried with minimal dose of pituitary extract @ 2 mg+30 mg of hormone/kg body wt. of fish. The other hormone (Testosterone propionate) was tried in the range of 20 to 50 mg/kg body wt. of fish + small dose of pituitary extract *i. e.*, 2 mg/kg body wt. None of these hormones alone or in combination of pituitary extract could help the fish to breed whereas, in control, breeding of fish with carp pituitary was normal.

Problem No 2.12 : Activities of interrenal and chromaffin tissue during the process of maturation of gonads of Indian major carps from still and running water.
Personnel : R. C. Das and H. A. Khan
Duration : 1978-81
Location : Cuttack

Histological preparations of interrenal tissue were made from *Labeo rohita* collected from river and pond respectively during resting, maturation, spawning and post-spawning phases. It was observed that the interrenal cells were very much active during the maturation and spawning phases, whereas, they were less active during resting phase. In the post spawning phase, the interrenal cells were in the regressing stage. This indicates that the hormone secreted by the inter-renal cells of rohu plays an important role in the maturation process of the gonads. Further studies are in progress.

Problem No. 2.13 : Studies on the factors responsible for multiple spawning of carps
Personnel : R. M. Bhowmick and S. K. Sarkar
Duration : 1978-1982
Location : Dhauli

Four sets of mrigal and one set of rohu bred by hypophysation during the month of June were released back in the pond for second maturity. These spent specimens were fed with supplementary feed (rice bran and ground nut oil cake) at the rate of 5% of body weight and treated with antibiotics which helped them in maintaining the proper state of health. These treated specimens matured for a second time within an interval of 53-70 days and were bred successfully by hypohysation for 2nd time during the same season, thus producing 4.05 lakhs of fish seed in the first spawning and 2.60 lakhs in the second spawning total being 6.65 lakhs of seed.

Problem No. 2.14	:	Studies on interrelation between thyroid and gonads of the indigenous major carps.
Personnel	:	A. K. Sahu and H. A. Khan
Duration	:	1979-1982
Location	:	Cuttack/Bhubaneswar

Experiments were conducted to observe whether thyronin alone or in threshold combination with pituitary extract could induce spawning in rohu. Fishes injected with 4-5 mg thyronin and 4-5 mg thyrosin+2 mg pituitary extract gave negative results. The controls injected with carp pituitary extract bred.

Pituitary, gonad and kidney of both bred and non-bred fish were collected and fixed for histological studies.

Thyroid follicles were located in the kidney of rohu and mrigal and also along the ventral aorta in case of catla.

Problem No. 2. 15	:	Biochemical changes associated with the gonadal cycle in certain freshwater carps
Personnel	:	R. Paul Raj
Duration	:	1979-1981
Location	:	Dhauli

Gonads, muscle and liver from a few mature *Labeo rohita* and *Cyprinus carpio* were collected and were analysed for total dry matter, moisture level and crude fat. In both the species increased accumulation of nutrients were found in the gonads during the pre-spawning phase. Studies on the crude proteins, crude fat, glycogen and energy levels of the gonads are being initiated.

Problem No. 2.16	:	Seasonal changes in the hypothalmohypophyseal complex in relation to reproduction in some freshwarer Indian major carps and exotic carps
Personnel	:	S. K Sarkar, R. M. Bhowmick & B. R. Datta
Duration	:	1980-1983
Location	:	Dhauli

Pituitary glands and gonads of carps under different maturity stages were collected and preserved for further studies.

Project No. 3 : Reservoir Fisheries

Problem : 3.8.	:	Fisheries of peninsular tanks. Introduction and propagation of less known cultivable species.
Personnel	:	B. V. Govind, P. K. Sukumaran, S. L. Raghavan & M. F. Rahman
Duration	:	1979 to 1982
Location	:	Bangalore

The farm-grown *Puntius pulchellus* brooders showed non-synchronisation of maturity stages between sexes which interfered with induced breeding experiments. The observations with reference to the above and related biological aspects, however, will continue.

Encouraging results on the growth rate of less known culturable species of fishes have been obtained. The average length, weight and net increment recorded during the period of observation for diferrent species are as follows (rearing period Sept, '79 to Dec. '80)

Species	Initial	Final	Net increment
	TL (mm)/Wt. (g)	*TL (mm)/Wt. (g)*	*TL (mm)/Wt. (g)*
Cirrhinus cirrhosa	32/0.7	213/111.0	181/110.3
Labeo fimbriatus	30/0.7	289/382.0	259/381.3
Pangasius pangasius	198/54.0	245/135.0	47/81.0

A survey of the Western Ghat rivers near Mangalore was carried out to procure specimens of *Puntius thomassi* for their culture in tanks. The investigations are being continued.

Problem : 3.13 : Composite fish culture of Indian and exotic carps in tanks simulating long seasonal irrigational tanks

Personnel : S. L. Raghavan, M. F. Rahman & S Ayyappan.

Duration : 1979 to 1980

Lacation : Bangalore

Composite fish culture experiments were conducted in ASC tank and ITI tank.

Physico-chemical properties of water

The water in both the tanks was generally muddy. Turbidity was below 100 ppm throughout. The water temperature recorded higher values during the months of March, April and May. No particular pattern of seasonal variations was observed with regard to chemical factors. The pH was mostly alkaline in both the tanks. Higher values of dissolved oxygen were observed during the months of April and May. Wide variations were observed in carbondioxide in the water of ASC tank and high values were recorded during January and February. The peak value of carbonate alkalinity in ASC tank was recorded in the month of December, and during May in ITI tank. The highest value of bicarbonate alkalinity (200 ppm) was recorded during April in ASC tank and 308 ppm in ITI tank in May. Both the tanks were similar with regard to variations in hardness and specific conductivity.

The nitrate and phosphate were in low quantities, often being in traces. The silicate content ranged upto 15.17 ppm in ASC tank and uniformly high values were recorded till June. Iron content was higher in ASC tank than in the other.

The soil remained slightly acidic in ASC tank, while it fluctuated in ITI tank. The specific conductivity was quite low in the soil of the tanks. The overall nutrient status was poor.

Plankton :

In both ASC and ITI tanks, predominance of zooplankton over phytoplankton in terms of number was observed. The average zooplankton composition in the collections worked out to be 60%.

In ASC tank, the plankton numbers ranged from 239 to 7985 units/l and the settling volume varied between 0.003 and 0.035 ml/l. The maximum quantity was observed during the month of June. The phytoplankton comprised of Myxophyceae, Chlorophyceae and Bacillariophyceae. Rotifers (*Brachionus* spp.) cladocerans (*Bosmina* spp.+*Moina* spp.), copepods (*Diaptomus* spp.) and their larval forms formed the bulk of zooplankton.

Plankton volume ranged between 0.002-0.026 ml/l and the number varied from 70 to 2000/l in the ITI tank with a peak in the month of April. *Microcystis* sp. and *Spirogyra* spp. deminated among phytoplankton, while zooplankton encountered were mostly rotifers and copepods.

Littoral and benthic organisms :

In ASC tank, the density of organisms ranged from 1 to 47 units/m^2 by number and 0.002 to 8.17 g/m^2 by weight. The organisms observed were insects (*Notonecta, Nepa,* May fly nymphs, dragon fly mymphs and mosquite larvae).

In ITI tank, the density of organisms ranged from 1 to 144 units/m^2 by number and 0.007−2.864g m^2 by weight. The organisms observed were insects (*Ranatra, Nepa, Notonecta, Gerris,* May fly nymphs, dragon fly nymphs and mosquito larvae) and molluscs (*Amnicola* spp.).

Fish stocking and production :

In the ASC tank, a total of 1539.22 kg of fish comprising of catla, rohu, mrigal, common carp and grass carp was harvested during the period under report In ITI tank, 701.83 kg of fish viz., catla, rohu, mrigal and common carp were netted out.

ASC tank was manured with 150 kg pigdung and 750 kg cowdung per month and in the ITI tank, 1500 kg of kitchen refuse was applied. The following growth measurements were recorded in ASC tank after about a month of stocking.

Species	Average length (mm)	Average weight (g)
Catla catla	160.83	67.92
Labeo rohita	105.00	17.31
Cirrhinus mrigala	102.40	15.00
Cyprinus carpio var. *communis*	102.20	21.00

Further, catla and rohu showed an average length and weight of 217.4 mm, 156.0 g. and 130.1 mm, 37.2 g. respectively during sampling carried out after about 2½ months of stocking.

Problem 3.14 : Ecology and fishery development of Gulariya reservoir

Personnel : A. G Jhingran, S. K. Wishard, K. P. Shrivastava, S. N. Mehrotra, D. N. Singh and R. K. Dwivedi

Duration : 1976 to 1980

Location : Gularia, Allahabad Distt.

Hydrology :

The physico-chemical characters of the Gulariya reservoir water revealed an increasing trend in water temperature from winter to summer months (25.0 - 28.0°C) while the transparency showed a fluctuation from 11.0 to 40.0 cm. pH values, which had shown a rising trend (7.8 - 8.4) till May, indicated a sharp decline (7.4) in June. Dissolved oxygen values were high in winter (7.8 ppm) as compared to summer months (5.12 ppm), while free CO_2 , which was absent from January to May, appeared in June (4.6 ppm), Calcium++ ion concentration showed similar fluctuation (19.6-26.2 ppm) as observed during the previous year (20.0 to 28.0 ppm). The nitrates (0·08 to 0.12 ppm) were always in higher concentration than phosphates (0.05 to 0.1 ppm). The silicates showed higher values in winter (8.2 to 9.2 ppm) than summer months (6.4 to 8.2 ppm). Gross production and net production values ranged between 68.75-137.5 and 50.0 to 125 0 mg C/m^3/hr respectively while the respiration was estimated to vary between 12.5 to 25.0 mg C/m^3/hr. Almost similar trend had been observed in respect of productivity levels during the previous year.

Plankton :

The average plankton production from the reservoir was estimated as 59564 u/l (1.2 ml/m^3) as against the 1075 u/l (0.45 ml/m^3) observed during the previous year. The maximum (13,495 u/l) and minimum plankton densities (799 u/l) were recorded in the months of May and June respectively.

Phytoplankton consistently dominated (84.6%) over zooplankton. Amongst the phytoplankters, Myxophyceae (39.9%) was the dominant form followed by Chlorophyceae (36.3%) Bacillariophyceae (8.2%) and Desmidaceae (0.6%). The zooplankton were dominated by rotifers (9.1%) followed by copepods (5.1%) protozoans (1.1%) and cladocerans (0.19%). Maximum abundance of zooplankters (1668 u/l) was recorded in May while the minimum (162 u/l) was observed in January.

Species of *Microcystis, Oscillatoria, Nostoc, Spirogyra, Pediastrum, Ankistrodesmus, Navicula, Nitzschia, Amphora, Gyrosigma, Synedra* etc. were commonly encountered among the phytoplankton while the zooplankton was represented by *Keratella* sp. *Diaptomus* sp. *Cauthocamptus* sp , *Cyclops* sp. and nauplii.

Macrobenthic fauna

The macrobenthic fauna of the reservoir varied from 18484 u/m^2 in January to 2992 u/m^2 in May. There was practically no significant change in the benthic population from the previous year as the water level of the reservoir had gone down to the minimum during both the years.

The benthos were dominated by insect larvae (55.9%) followed by oligochaetes (34.6%) and gastropods (9.4%). It was remarkable that the chironomid larvae alone contributed 34.6% to the insect larvae population. The most common species encountered in different groups were *Aulodrilus pleuroseta* (Oligochaetes), *Chaoborus* sp., *Chironomus* sp. (insect larvae), *Melanoides tubercedatus* and *Viviparus bengalensis* (gastropods).

Stocking :

A total of 69,500 major carp fingerlings were stocked in the reservoir, of these 197 fingerlings were tagged with internal anchor type tags.

Eleven tagged specimens (8 catla and 3 mrigal) stocked in the reservoir during 1979 were recorded during commercial fishing operation in 1980

Commercial fishing :

The fishing rights of the reservoir were leased, fetching a revenue of Rs. 33,000/- (Rupees thirty three thousand only), as against the amount of Rs. 8,000/- (Rupees eight thousand only) paid for the year by the Institute to the State Fisheries Department, Govt. of U. P.

A total of 60.93 quintals of fish comprising 4836.00 kg (79.37%) of major carps, 875.500 kg (14.37%) of catfishes, 312,500 kg (5.13%) of major carps, 62.500 kg (1 02%) of murrels and 6.500 kg (0.11%) of fresh water eels, were harvested from the reservoir with the multimeshed gill nets, drag nets and traps by the commercial fishing parties during a course of 33 days of actual fishing operations.

Labeo rohita (31.09%), followed by *C. mrigala* (22.10%), *L. calbasu* (13.63%), *C. catla* (12.55%), and *M. seenghala* (9.90%) dominated the catches. Among the minor carps *P. sarana* was the dominant form while the murrels and eels were represented by *C. marulius* and *M. armatus*.

The highest percentage of major carps (79.37%), with the size range, *C. mrigala* (407-667 mm), *C. catla* (407-582 mm) and *L. rohita* (407-595 mm) clearly indicated the impact of stocking on the major carp production in the reservoir.

The work on the research project was discontinued after 30th June 1980 with the expiry of lease as per agreement between the Institute and the U. P. Government.

Problem 3.15 : *Ecology and fisheries of Peninsular tanks*
Personnel : B. V. Govind, P. K. Sukumaran, S. Ayyappan, S. L. Raghavan, M. F. Rahman
Duration : 1979 to 1984
Location : Bangalore

Investigations could not be pursued due to complications regarding the ownership and fishing rights.

Problem 3.16 : *Ecology of Puntius dorsalis* (*Jordon*),
Personnel : P. K. Sukumaran
Duration : 1979 to 1982
Location : Bangalore

Studies on the biology of *Puntius dorsalis* (Jordon), are being carried out regularly, with fortnightly collections of specimens.

The gut contents comprised mainly of phytoplankton and zooplankton with stray occurrence of insects and nematodes. The forms of phytoplankton observed were *Oscillatoria* spp. *Anabaena* spp *Closterium* spp. *Pediastrum* spp, and *Navicula* spp. Among zooplankton, *Brachionus* spp. and copepods were recorded.

The length-weight relationship for *P. dorsalis* collected during the year worked out to log W=log 0.03294+ 2.5055 log L.

The mature male and female fish could be distinguished and the sex ratio was male : female : : 1 : 1. 18. Other detailed studies such as fecundity analysis and ova diameter measurements are in progress.

Problem 3.17 : *Culture of fish in 'Pens' fixed in Peninsular tanks*

Personnel : S. Ayyappan, B. V. Govind, S. L. Raghavan, M. F. Rahman

Duration : 1980 to 1984

Location : Bangalore

This project has in view the maximisation of fish yield in short duration, circumventing the lack of nursery space on land. To start with, common carp and silver carp in the ratio of 8 : 1 were reared from fry to fingerling stage. The cage (synthetic cloth enclosure of 10.56 sq. m.) has been floated in Sankey tank, Bangalore. Fry of common carp (2,000) and silver carp (250) were stocked on 4. 10. 1980, the stocking rate being 21.3 lakhs/ha. This phase of the experiment was carried out for a period of three months. Artificial feed comprising of dried silkworm pupae (60%), rice bran (24.7%), ground nut oilcake (10%), soyabean flour (5%) and mineral mix (0.3%) was given daily at a rate of about 20% of the body weight. The crude protein content of the feed was 50.97%.

Weekly observations on the physico-chemical conditions of water on plankton in the cage and the tank and on periodic measurements of the growth rate of stocked fish were carried out.

The physico-chemical conditions of water in the cage was not very different from that of the tank water. Plankton inside the cage was richer, compared to the tank. Phytoplankton had a slight edge over the zooplankton.

At the end of the three months culture period the common carp showed a survival rate of 97.5%, and silver carp 88%. The fish yield was 2.424 kg/sq.m. amounting to a production of 24.24 t/ha/3 months. In the usual farm practices of fry rearing, at a stocking density of about 10 lakhs/ha, common carp were reported to have attained an average final weight of 8 g. in three months. As compared to this, the average weight of 12 g attained during the present investigation even at a higher stocking density of 21.3 lakhs/ha, is worth reporting.

Project No. 4 : Riverine carp spawn prospecting and collection techniques

Problem 4.5 : Yearly variation in the quality and quantity of spawn of the river Yamuna and rearing and culture of spawn

Personnel : K. P. Srivastava, Ravish Chandra, P. K. Dwivedi, R. K. Tyagi and N. K. Srivastava

Duration : 1972—Continuing

Location : Allahabad

Spawn prospecting investigations were conducted in a stretch of R. Yamuna at and around Madhauka centre for a period of 47 days from 5th July. During the period, the river experienced three floods touching peaks at 3.39 m, 4.91 m and 4.15 m. The spawn was available in three spurts lasting for 28 hrs, 186 hrs and 82 hrs respectively. A total of 10,150 ml of spawn (*c* 50,75,000 hatchlings) was collected with the help of 5 standard spawn collection nets, as against 467 ml (*c* 2,33,500 hatchling) of the previous year i. e. 1979. The first, second and third spurts contributed 3075 ml (30.3%), 5675 ml (55.9%) and 1400 ml (13.8%) to

the total spawn collection of the season. The catch per net/hr was estimated at 21.9 ml, 6.2 ml and 3.4 ml respectively for the three spurts.

Microscopic analysis of the spawn samples revealed that the spawn collected during the investigations was of desirable quality (i. e. major carps constituting more than 10% in the total). The percentages of major carps, minor carps and others were estimated at 56.7%, 34.9% and 8.4% respectively. The percentage of major carps in the first, second and third spurts were 53.4% ; 51.9% and 64.7% while those of minor carps were 39.4%, 32.7% 32.7% for others, these values were estimated at 7.2% 15,4% and 2.6% respectively.

Average quality as determined by rearing the spawn was determined as 70.8%, *C. mrigala, C. catla, L. rohita* and *L. calbasu* contributing 27.8%, 20.8, 12.8 and 10.0% respectively. Minor carps respresented by *L. bata* and *Puntius* sp. constituted 27.1% and others, represented mostly by spawn hatchlings, was estimated as 2.1%.

The seasonal indices of quantity and quality were estimated at 1969.6 ml and 70.8% respectively.

Experiments for seggregation of spawn were conducted and an attempt was made to observe the escape of the hatchlings and their retention through different mesh sizes. It was observed that total escape had occured when the iron netting sieves of the 1/8", 1/10", 1/2" and 1/6" meshes were tried. Finer meshed sieves (1/20", 1/24", 1/30") were used in subsequent experiments.

Project No. 5 : Brackishwater fish farming

Problem 5.17 : Brackishwater shellfish culture in Madras region

Personnel : K. Raman. S. Srinivasagam, K. Gopinathan, M. Sultana, P. M. A. Kader and S. Krishnan
Duration : 1978-1980
Location : Madras

In the feed mixture fish meal+rice bran+tapioca, raising the fish meal content to 60% gave slightly better growth in *P. indicus*. Laboratory experiments with *P. semisulcatus*, *P. indicus* and *M. monoceros* showed the preference of the first species to higher salinities. Twelve, fourteen and sixteen ppt salinity grades were found to give better growth and survival in *P. indicus*.

Juveniles of *Scylla serrata* (12-56 mm, av. 30.3 mm/ 6.2 g) reared in a small pond with trash fish meat as supplementary feed showed a monthly growth of 39.8 mm/17.0 g. Eggs of *Thalamita crenata* hatched out into pre-zoea and first zoea stages in laboratory jars in 5-8 days. Crab juveniles were transported in open containers over distances of 20-56 km (1-4 hrs duration) with 55-100% survival. Monthly survey of crabs, fish and prawn seed in a few selected estuarine areas was made.

Problem 5.18 : Oyster-cum-fish culture
Personnel : K. V. Ramakrishna, R. D. Prasadam, G. R. M. Rao, M. Kaliyamurthy, K. O. Joseph & S. Krishnan
Duration : 1979-1984
Location : Madras

Spats attached during December 1979 after growing to a size of 80 mm ht/58 mm length (in 8 months) perished during August 1980. Those fallen in March 1980 had grown to 20-47 mm ht/16-48 mm length by September. Percentage survival was 46%. Fresh spat

fall was there in September and October. The October spat had grown to a height/length of 10/16 mm by November. Fishes, crabs and prawns were periodically collected from oyster boxes/trays. Projected production per ha amounts to 57.8 t.

Problem 5.28 : Fluctuations in the fishery of Pulicat lake, its seed resources and transport.
Personnel : K. Raman, G. R. M. Rao, K. V. Ramakrishna, R. D. Prasadam, S. Radhakrishnan, C. P. Rangasamy, M. Kaliyamurthy, S. Srinivasagam, K. Gopinathan, M. Sultana, K. O. Joseph, P. M. A. Kadir and S. Krishnan
Duration : 1975-1980
Location : Madras

The bar mouth remained open throughout the year getting shifted northwards as usual. A second opening further south was excavated by local fishermen. The total catch was estimated as 1198 873 t showing a decline of over 200 t from the previous year. Prawns contributed 49.69% and mullets 19.76%.

Ingress of young fish showed a gradual improvement over last year whereas, that of prawns in general was poor. An area for chanos fry was located between Annamalaicheri and Sunambukulam. Velon net samples from the centres around the lake were regularly collected and analysed. Chanos fry and fingerlings as well as mullet fry were transported in open containers over distances of 60 km and 30 km/respectively ($2\frac{1}{2}$ hrs and 1 hr respectively) with very little mortality (5% and 2%).

Problem 5.37 : Crop rotation under prawn-cum-fish culture
Personnel : N. K. Das, N. M. Chakrabarti and D. Sanfui
Duration : 1976–1980
Location : Kakdwip

The research project on the crop rotation under prawn-cum-fish culture was initiated from the year 1976 to increase the yield from the same ponds by changing the species stocked according to the ecological conditions favourable to them.

In 1980, work could be taken up only for a limited period due to the silting of the ponds. According to the available data, the highest production was 1179.3 kg/ha/yr from *P. monodon* in 3 crops and 1185.0 kg/ha/yr from mixed culture of brackishwater prawns in 4 crops. through the improved culture techniques evolved, are the best so far reported from any brackishwater farm in India. The researches carried out in the project opened up the possibilities of increased production through scientific culture process even from the common farmers' ponds.

Problem 5.38 : Culture of *Lates calcarifer*
Personnel : D. D. Halder, P. K. Ghosh, D. Sanfui, N. K. Das and H. C. Karmakar
Duration : 1978-1980
Location : Kakdwip

An experiment on the culture of *Lates calcarifer* was initiated in a 0.02 ha pond at the end of March '80 at a stocking density of 3000/ha. The initial size of the stocked population was 231 34 mm/170.85 g. At the beginning of October, this pond was harvested and the harvest size was found to be 360.10 mm/565.35 g., with the survival rate 93.33%. The pond recorded a yield of 1583.00 kg/ha/190 days.

An experiment on stocking density 3 nos/litre, 4 nos/litre, 5 nos/litre and 6 nos/litre was arranged in 3 randomized complete blocks. The experiment was continued for 15 days in the laboratory. The initial size of the population ranged from 6.4—8.1 mm. The survival rate varied between 22.4—90.0%. Statistical analysis of the results showed that mean survival observed in stocking density 3 nos/litre was significantly higher than 4 nos/litre and 5 nos/litre. The latter two were significantly better than 6 nos/litre.

Problem 5.40	:	Mullet culture
Personnel	:	K. Singh, N. M. Chakrabarti, R. K. Chakraborti and A. K. Roy
Duration	:	1976-1980
Location	:	Kakdwip

A pond of 0.8 ha was stocked in 31st March, 1980, with *L. parsia* 3 600 nos (@ 4,500/ha) with an average size of 35.67 mm/0.75 g and *L. tade* 360 nos (@ 4,500/ha) with an average size of 214.13 mm/95.53 g. The overall stocking density was 49,500/ha and the ratio was 1 : 10. Sampling was made in November, 1980 and the size attained by *L. parsia* and *L. tade* was 128.40 mm/20.75 g and 248.13 mm/153 85 g respectively. The gross production of *L. parsia* and *L. tade* from the pond in November, 1980 was estimated to be 537 5 kg/ha/7 months with an estimated survival of 80% and 41.6% respectively.

Under the sub-problem nursery rearing of mullets, a statistically designed experiment was initiated with *L. parsia* fry with varying densities (0.5, 0.75, 1.0 and 1.25 lakh/ha) with two replicates for each density in the brackishwater ponds each of area 0.02 ha for 30 days for studying the effect of stocking density on growth and survival of *L. parsia* fry. Effect of density on both growth and survival was observed to be nonsignificant. However best growth of 1.595 g and av. survival of 83.97% was recorded at a stocking density of 1 lakh/ha.

In the second quarter another statistically designed experiment was conducted with three number of supplementary feed along with control with two replicates for each treatment to study the effect of feed on growth and survival of *L parsia* fry. In general both survival and growth were better in all treated ponds compared to control. Feed of wheat flour+fish meal (1 : 1) and rice bran+fish meal (1 : 1) gave an average growth increment of 4.465 g and 4.007 g respectively in a period of 45 days which was found to be significantly different from other feed mixture and control. Feed of rice bran+fish meal (1 : 1) gave an average survival of 51.87% which was observed to be best among all other treatments and significantly better than control.

Monoculture of *L. parsia* has been initiated in two ponds of .02 ha each with a stocking density of 50,000/ha. The experiment is in progress.

Nursery rearing of *L. tade* has been initiated in four ponds of 0.02 ha each with an equal stocking density of 50.000/ha, with an initial size range of 17–25 mm. The experiment is in progress.

Problem 5.47	:	Utilization of municipal, agricultural and industrial wastes in aquaculture.
Personnel	:	R. K. Banerjee, P. Ray, S. C Banerjee, S. K. Mondal, N. N. Majumder and S. K. Chatterjee
Duration	:	1977-1980
Location	:	Calcutta

Work is progressing

Problem 5.51	:	Ecology of brackishwater impoundments.

5.51. 1 : Role of redox potential in relation to dissolved gases, organic matter, iron, and manganese.

Personnel : S. C. Thakurta, G. N. Saha, S. C. Banerjee, A. C. Banerjee, N. N. Mazumder, S. P. Ghosh and B.B. Das

Duration : 1980-83

Location : Calcutta

Drying and ploughing resulted in a higher level of redox potential (+70 to −10 mv) till March. Non dried, non-ploughed *Adhir Bheri* showed a lower redox potential (+10 to 20 mv). However, negative values of redox, as high as −200 to −300 mv, were obtained when algal decomposition took place in summer months in both the bheris.

Problem 5.51.3 : Estimation of total bio-mass in relation to physico-chemical conditions of soil and water

Personnel : S. C. Thakurta, G. N. Saha, A. C. Banerjee, S. C. Banerjee, N. N. Mazumder, S. P.Ghosh and B. B. Das

Duration : 1980-1983

Location : Calcutta

The monthly average bio-mass of the dried and ploughed bheri ranged between 130 mg/sq m and 250 mg/sq m where salinity, pH, alkalinity, phosphate (PO_4) and nitrate-nitrogen varied between 9.4 and 36.9‰, 8.2 and 9.0, 84 and 240 ppm, trace and 0.63 ppm, and 0.05 and 0.2 ppm respectively.

The monthly average bio-mass of the non-dried and non-ploughed bheries ranged between 40 mg/sq m and 175 mg/sq m where salinity, pH, alkalinity, phosphate (PG), and nitrate nitrogen varied between 9.54 and 37.8%, 8.2 and 8.6. 110 and 240 ppm, trace and 0.5 and 0.2 ppm respectively.

pH of soil of the former bheri was 6.8 compared to 7.2 of the latter.

Problem 5.52 : Fertilization of brackishwater impoundments

Personnel : G. N. Saha, H. Singh, S B. Saha, S. P. Ghosh and B B. Das

Duration : From 1978 (Continuous)

Location : Calcutta

The effect of phosphorus fertilizers (Single superphosphate) alone and in combination with nitrogen fertilizers (urea) on the growth and survival of *Penaeus monodon* in brackishwater bheris was studied. Phosphorus alone proved to have better fertilizing effect when the survival (70%) of *P. monodon* was compared to the combined effect (60% survival) of urea and phosphorus.

Problem 5.54 : Survey of Nutrient status of soils of intertidal regions of lower Sunderbans

Personnel : G. N. Chattopadhyay, R. K. Chakraborti and P. R. Das

Duration : 1978-1980

Location : Barrackpore

Soil samples collected from different brackishwater areas of Bakkhali and Kakdwip, Raidighi, Canning and Basirhat regions were analysed for different physico-chemical properties to know the nutrient status of these soils under perennial tidal inundation, seasonal tidal

inundation and uninundated condition of mangrove swamps. Analyses of the samples, so far done, showed the E. C. values of the soil to range between 6.0 to 9.1 mmhos/cm under perennial tidal inundation, between 6.1 to 8.8 mmhos/cm under seasonal inundation and between 5.7 to 6.1 mmhos/cm in uninundated mangrove swamps. The pH of the soil under these three groups ranged between 7.6 to 8.1, 7.8 to 8.4 and 7.4 to 8.0 respectively. Available nitrogen status of these soil ranged from 6.3 to 8.4, 5.6 to 7.0 and 6.3 to 10.5 mg/100 g soil in these three inundation groups and were considered to be lower in comparison to the values generally obtained for freshwater ponds. Available phosphorus values were moderately higher ranging from 2.8 to 5 6, 2.1 to 3.5, and 2.8 to 4 8 mg/100 g soil respectively.

Studies on the fish food organism production potentials of the collected soils have been carried out under laboratory conditions, *Oscillatoria* sp. was cultured in different soils for 30 days under uniform conditions and the production of the algae ranged from trace to 60.5 mg/sq cm area of the soil (moist weight).

Problem 5.57 : Induced breeding of penaeid prawns
Personnel : D. D. Halder, P. Ravichandran, N. C. Basu, B. Basak and R. K. Chakraborti
Duration : 1978-1982
Location : Kakdwip

Under the sub-project on induced maturation, 17 adult female *P. monodon* were ablated and reared in brackishwater ponds. All the ablated prawns showed a little sign of maturity excepting one which developed into late mature stage but died when kept for spawning in the plastic pool owing to the mechanical failure of the aeration system.

Problem 5.58 : Intensive culture of fish food organisms and techniques for preesrving algae and zooplankters for culture and feed

Personnel : A. C. Nandy, S. K Majumder, G. N. Chattopadhya and P. R. Das, D. D. Halder, N. C. Basu, M. R. Sinha P. K. Saha
Duration : Continuing
Location ; Barrackpore

Sub-problem I : Intensive culture of fish food organism

Mass culture of the diatoms, *Chaetoceros calcitrans* (6 million cells/ml/7 days) has been successfully achieved in yard experiments by using TMRL fertilisers from an initial inoculum of 64×10^4 cells/ml in each case. By using guillard and Ryther's nutrient solution maximum cell density of 15 million cells/ml/7 days of brackishwater green algae, *Chlorella virginica* had been attained from an initial inoculum of 58×10^4 cells/ml.

A simple yet effective method was evolved for large scale production of Wet yeast (2 billion cells/ml/3 days) by utilising cheap commercial NPK fertilisers.

Large scale production of the rotifer, *Brachionus plicatilis* (48,000 units/litre/5-7 days) was attained by using $100 \times 10_3$ cells of Wet yeast/rotifer/day from an initial inoculum of 15 units/litre.

Laboratory and yeard experiments have been done for mass production of viable cysts of the brine shrimp, *Artemia* salina and the hatchability of the produced eggs was about 95%.

Sub-project II : Techniques for preserving algae and zooplankters for culture and feed

As an algal harvesting procedure, pH adjustment with sodium hydroxide effected rapid and almost complete harvesting (98% of the test species *Chaetoceros calcitrons*) compared to alum and lime treatment. Average 25-30 gm of dried algal powder has been achieved from 20 litres of culture at a concentration of 10-15 million cells/ml.

Problem 5.60 : Standardization of transport techniques of commercially important brackishwater prawn and fish seed.
Personnel : H. Singh, G. N. Saha and S. K. Chatterjee
Duration : 1979-80.
Location : Calcutta

While transporting 500 nos. of *Penaeus monodon* per litre of water for a period of 20 hours, chloral hydrate proved to be a better sedative compared to tertiary amyl alcohol because of non-mixtural property of the alcohol in water.

Rate of oxygen consumption of early juvenile of *P. monodon* was also tested Early juvenile, measuring 11-13 mm, consumed 0.02 mg O_2 /hour.

In an open hundy 500 fry (17-25 mm) of *Liza parsia* could be transported for a period of 4.5 hours with the survival rate of 82%.

Problem : 5.62 Multiple cropping of *Penaeus monodon* and mullets in low saline ponds at Bakkhali
Personnel : S. M. Pillai, P. K. Ghosh, K. Singh. R. K. Chakraborti and A. K. Roy.
Duration : 1979-1981.
Location : Bakkhali

An experiment was initiated in a pond (0.25 ha ; stocked with mullet : prawn (1 : 2) at a stocking density of about 50,000/ha in the last week of May. Among mullets *L. parsia* constituted about 99.32% of stock and attained an average size of 85.35 mm/7.142 g from an initial size of 30 mm/1 g in about 4 months. *P. monodon* could not be caught from the pond during sampling. It is apprehended that *P. monodon* might have died due to heavy rainfall during the culture period. The estimated standing stock of *L. parsia* alone (assuming 80% survival) comes around 24.440 kg in experimental pond.

Problem 5 63 : Culture of *Penaeus monodon*
Personnel : P. Ravichandran, R. K. Chakraborti. H. C. Karmakar, D. Sanfui, A. K. Roy and S. M. Pillai
Duration : 1979-1981
Location : Kakdwip

Sub-project a : Improvement of culture pond management practice

Pond rearing experiment :

Rearing experiments were conducted in two 0.12 ha and six 0.02 ha ponds. In the first phase of the experiment, culture was carried out under different stocking densities for different duration. The results are presented overleaf :

Table—1

Sl. No.	Stocking density no/m²	Duration (Days)	Initial length weight mm/gm	Final Length/ weight mm/gm	Survival rate %	Total yield kg/200 m²	*P. monodon* alone	Total production kg/ha crop
1	2.5	109	50.66/1.0	106.0/9.0	25	2.77	1.11	138.50
2	1.5	110	95.0/6.4	142.8/34.6	42	6.5	4.4	325.0
3	2.5	76	45.0/0.5	135.18/26.8	38	6.96	5.09	348.0
4	1.5	111	86.5/4.0	138.0/32.2	48	6.2	4.65	310.0
5	2.0	82	48.0/0.6	130.0/24.7	50	7.12	4.93	356.00
6	4 5	79	15.0/0.02	119.2/12.29	37.5	5.78	4.18	289.00
7	1.0	28	119.20/12.3	135.18/17.6	79.0	4.38	4.38	219,00
8	3.55	86	15.0/0.02	116.6/14.3	27.6	6.05	3.0	302.50
9	7.0 (multiple stocking)	112	15.0/0.02	132.3/20.3	51.7	7.12	4.92	356.00
10	4.7	88	15.0/0.02	122.05/14.05	33.8	2.8	2.31	140.0
11	4.8	144	15.0/0.02	119.5/15.75	2.03	6.9	1.75	345.0

The production rate of *Penaeus monodon* in farm ponds have gone down during the period under report due to the following reasons. (a) The pond bottom level has risen due to silting and the water retentive capacity of the dykes have gone down due to seepage. Low water level associated with high temperature led to poor growth and survival. (b) Unwanted fishes and prawns entered the culture ponds through the holes in the dykes and the competition for space and food interfered with the experimental result.

Sub-project b : Effect of ecological factors on the growth and survival of penaeid prawns.

Laboratory experiments :

a) A statistically designed Laboratory experiment was conducted on the effect of lime application on the growth and survival of *P. monodon*. It was observed that application of lime @ 100 kg/ha resulted in best growth and no significant difference was observed for survival rate in different treatments.

b) The rate of oxygen consumption of *P. monodon* of different size groups were studied. The effect of O_2 tension on the rate of O_2 consumption was also studied. It is observed that the amount of O_2 consumed increased with the increase in body weight.

Field observation :

An experiment on the effect of different combinations of fertilization on the growth and survival of *P. monodon* was conducted, in six ponds of 0.02 ha. Work in this regard is in progress.

Sub-project c : Estimation of Production

Experiment was conducted to estimate prawn and fish population of small bodies of water (0 02 ha) in brackishwater by marking and subsequent recapture of prawn and fish. For marking prawn, *Penaeus monodon*, thin alluminium plate each having 20 mm length and 3 mm breadth were fixed loosely in eye stalk and for mullet, *L tade* was clipped. No side effect was recorded in tagging or clipping. Rate of recapture for *P. monodon* was observed poor. While *L. tade* showed satisfactory result in estimating population with a standard error of 5.33 whereas *P. monodon* showed a standard error of 8.50. Known population of 100 nos of each species were stocked in a 0.02 ha pond to evaluate two standard methods of estimation of population *viz.*, i) Mark—recapture method, ii) Multiple mark—recapture method. The former was suitable for estimating *L tade* population and the estimated population deviates from the actual population by 3 and 2% respectively. But multiple mark-recapture method was found more suitable for estimation of *P. monodon*.

Population then estimated by mark-recapture method and the estimated population deviated from actual population by 10% in case of multiple-recapture method and 66% in case of mark capture method. To test uniformity of capture probability in different size classes of *P. monodon* and *L tade* X^2 test was used and it was observed that the increase in size among mark and unmarked prawn and fishes during recapture did not differed significantly.

Problem 5.65 : Induced breeding of brackishwater fishes in Madras

Personnel : K. V. Ramakrishna, R. D. Prasadam, G. R. M Rao, S. Radhakrishnan, M. Kaliyamurthy, C. P. Rangasamy, K. O. Joseph and S. Krishnan

Duration : 1979–1984

Location : Madras

Induced breeding of *Liza macrolepis* (3 sets with pituitary injection and 1 set without), *Mystus gulio* (1 set) and *Sillaga sihama* (3 sets) were tried without success.

Problem 5.66 : Studies on nutrition of penaeid prawns, *P. monodon* and *P. indicus* and the palaemonid prawn, *M. malcolmsoni*

Personnel : (Mrs) T. Rajyalakshmi, N. A. Reddy, S. M. Pillai, A. Hazra, N. N. Sarkar and H. Singh

Duration : 1979-1982

Location : Calcutta and Barrackpore

Of the three feed (A, B, & C) composed and experimented, feed B proved better when growth increment by 39.39 mg was registered. However, the experiment could not be continued further as the nutritional values of the feeds composed could not be analysed due to practical difficulties.

Composition of Feed B was : Soyabeen powder 25%, Molluscan meal 55%, Wheat powder 15%, Vitamin mix 2%, Calcium phosphate 2%, and Brewers' yeast 1%.

Problem 5.67 : Cultivation of Derris plants for increasing the rotenone content of the plant

Personnel : P. R. Das
Duration : 1979-1981
Location : Barrackpore

Field experimentation on the cultivation of Derris plants, collected from saline soils of Sunderbans, in almost non saline soil at Barrackpore showed about 80% survival of the plants during monsoon. Acclimatization of the Derris plants in non-saline soil were done initially with sodium chloride at 10 g/m². One thousand ppm of Gibberellic acid indicated good vegetative growth of the plants while cycocel at 100 ppm showed better development of the root system.

Problem 5.68 : Pen and cage culture of fishes and prawns in the shallow areas of Pulicat lake
Personnel : R. D. Prasadam, G. R. M. Rao, M. Kaliyamurthy, C. P. Rangasamy, M. Sultana, K. V. Ramakrishna and K. Raman
Duration : 1980-1982
Location : Madras

Pens and cages made of different materials such as bamboos, casuarina poles, velon nettings, polythene webbing etc. are fabricated and fixed in the lake for initiating the experiments under different sub-projects. Few pens were stocked and the rest kept ready for stocking shortly. Stocking materials also have been collected and kept in nursery ponds. Biological studies on chanos, cat fishes, perches, clupeids and *Hemirhamphus* were continued.

Problem 5.69 : Pen culture of *Penaeid* prawns, *P. indicus*, *P. monodon* and *P. semisulcatus* in coastal waters of Chilka Lake
Personnel : (Mrs.) T. Rajyalakshmi, P. Ravichandran
Duration : One Year (1980)

Pen culture of *P. monodon* on a pilot scale was undertaken at Chilka Lake during February-June 1980. Pens (25 and 50 sq. m.) made of split bamboo mats with an inner lining of 3 mm nylon mesh were stocked with *P. monodon* @ 50 nos./sq. m. An average growth increment of 31 g was achieved in two months. The production was estimated to be 1000 kg/ha in two months with average final weight of 40 g and survival rate of 50%.

Project 6 : Freshwater prawn culture

Problem 6.2 : Breeding and culture of *Macrobrachium malcolmsonii*
Personnel : K. V. Rao, K. J. Rao & K. S. Rao
Duration : 1976 to 1980

Experiments on the culture of *M. malcolmsonii* were continued in the three ponds of approximately 0.1 ha each at Badampudi fish farm near Tedepalligudem in Andhra Pradesh. Mixed culture of the species in all the ponds with selected species of fish like catla, rohu silver carp and grass carp was carried out. Due to extreme adverse conditions during the summer of 1980 only one crop of prawn could be raised. Juveniles of *M. malcolmsonii* (average size 38.7 mm/0.5 g) were obtained locally from Escape no. 1 on Eluru Irrigation Canal at Badampudi itself. At the end of one year of the experiment, a production of 2.7 t/ha of fish and 410.1 kg/ha of prawn (in a single crop) from pond I 893 kg/ha of fish and 429.7 kg/ha of prawn from pond II and 2.25 t/ha of fish and 415.4 kg/ha of prawn from pond III could be obtained.

Problem 6.5 : Culture of *Macrobrachium birmanicum Choprai in freshwater ponds*
Personnel : J. C. Malhotra, Shri Prakash, D. R. Kanujia and H. P. Singh
Duration : 1977 to 1982
Location : Muzaffarpur

Ponds were stocked with 5000 juveniles of *M. birmanicum choprai* collected from River Ganga during July—October 1980. Feed given was a mixture of ground nut oil cake and maize flour in the ratio 2 : 1. Three centres in river Ganga viz., Tarighat, Buxar and Srihaghat were surveyed for availability of the juveniles of *Choprai*. Shooting nets, drag nets and hapas were used.

Problem 6.6 : Seed production of the giant fresh water prawn *Macrobrachium rosenbergii*
Personnel : M. Subrahmanyam & D. R. Rao
Duration : 1978 to 1980
Location : Kakinada

The fifth generation prawns did not attain maturity and almost all of them died due to severe summer in May '80, Laboratory reared second generation seed were grown to maturity by July 1980 and this material formed the brood stock for rearing experiments. Few wild females also were introduced initially to supplement the laboratory stock.

The maintenance of brood stock in the laboratory was perfected and a procedure for continuous supply of berried females was developed by stocking juvenile prawns from time to time and removing the older females.

Rearing trials in the commercial tank could not be undertaken due to spoilage of rearing medium.

Culture of *Artemia* and tubificid worms was continued, *Artemia* culture was spoiled due to the severe summer and the same recovered by October. Worm culture was successfully maintained throughout the year.

A total of 27,918 seed were produced till the end of November. Among them 24,194 were distributed to farmers.

The target fixed for the year could not be met as no experiment was successful during the second half of the year due to water spoilage. Consequently, the economics of seed production also could not be evaluated in the commercial tank.

Prawn production in farmer's ponds under Lab to Land programme ranged from 208-290 kg/ha.

Problem 6.7 : Development of artificial feeds for rearing the larvae of commercially important palaemonid prawns
Personnel : K. Janaki Ram and P. S. C Bose
Duration : 1978-1980
Location : Kakinada

A series of outdoor and indoor trials were conducted on rearing the larvae of prawns, *Macrobrachium rosenbergii* and *M. malcolmsonii* on various diets like mussel's meat, plankton, organic detritus, silkworm pupae, milk protein, caked blood and certain slaughter house products. The open yard trials were made in plastic pools of about 300 l capacity. In one such trial with *M. malcolmsonii* few larvae survived for a period of about 40 days reaching 7th to 8th stage on the same feed.

Problem 6.8 : Rearing techniques for the palaemonid prawns

Personnel : T. Rajyalakshmi, S. M. Pillai, N. A. Reddy and N. N. Sarkar
Duration : 1979-1981
Location : Calcutta

A hatchery has been set up. Field trips were conducted to different places of prawn landing centres, both at the upper and down stretches of the Hooghly river. Live breeders of *M. rosenbergii* and *M. malcolmsonii* were procured and transported to laboratory with and without oxygenation. They were then acclimatised to laboratory conditions under aeration, in rearing tanks.

Problem 6.9 : Culture of Commercially important fishes and freshwater prawns in pens and Cages in Kolleru lake, A. P.
Personnel : K. V. Rao, K. J. Rao, T. S. Rama Raju and K. S. Rao
Duration : 1980-'85
Location : Kolleru lake, A. P.

Survey was conducted in the lake to identify suitable areas to install pens and cages for culture experiments. The lake during summer exists in the form of drains and canals only surrounded by low lying depressions, The lake is fully infested with aquatic forms, the dominant forms being *Hydrilla, Vallisnaria, Eichhornia, Ipomoea, Pistia* etc.

The area between Kalakurru and Bedayadlagadi in the Western sector of the lake about 12 Km. from the district headquarters Eluru, was found to be suitable for pen and cage culture experiments.

A pen of 10×10×3 m dimensions made of bamboo split matting laced with the help of the coir rope was installed in the lake at Kalakurru with the aid of wooden and bamboo poles. The pen was stocked with 1,200 fingerlings of rohu, silver carp and grass carp in the ratio of 3 : 1 : 2 during the last week of December. The average size of the fingerlings at the time of stocking was rohu 160.0 mm/12 g, silver carp 116.0 mm/12 g and grass carp 100.6 mm/10 g. Supplementary feeds like rice bran and groundnut oil cake (1 : 1) and plants like *Hydrilla, Ipomoea* are being provided. The experiment is in progress.

Project No. : Estuarine and brackishwater lake fisheries

Problem 8.1 : *Brackishwater fish and prawn seed prospecting of the Hooghly-Matlah estuarine system.*
Personnel : K. K. Bhanot, H. S. Majumder & R. N. De
Duration : 1968-1980
Location : Barrackpore

Investigations were carried out to determine the seasonal abundance of brackishwater fish and prawn seed in the coastal areas at Digha. A small creek was located arising near the main coast. Collection were made with the help of standard shooting net from this creek on the day of highest tide of each fortnight. The observations have revealed distinct seasonal abundance of the commercially important fish and prawn seed around the coast of Digha. The peak availability of *Penaeus indicus, Macrobrachium rude, Metapenaeus monoceros, M. brevicornis, Palaemon styliferus, P. flumicola, Liza parsia, L. tade* and *Sillaga panijus* and their sizes in mm (in parentheses) were recorded per net per hour as, 26 (20-40), 540 (14-48), 80 (15-34), 182 (20-65) 72 (21-50), 164 (14-34), 36 (26-32), 24 (30-40) and 24 (30-65) respectively. The species were available in varying quantities throughout the year. The peak period of abundance were noted during October. *M. brevicornis* was obtained in large numbers during December.

The tidal variation was noticed from 4-8 feet in the small creek and tidal influence was felt upto a distance of *C.*5 kms. where the creek ends. The temperature, dissolved oxygen and salinity have been seen to vary from 31.5 to 26.5°C, 4.00 to 4.86 ppm and 7.8 to 25.65 ppt. respectively.

Problem 8.7 : *Reproductive biology of cultivable brackishwater fishes.*
Personnel : K. K. Bhanot
Duration : 1975-1981
Location : Barrackpore

Studies have been made on *Sillago panijus* and *Scatophagus argus.* It has been observed that *S. panijus* at a length of 320-350 mm weight of 300-400 g has fully mature eggs. Such specimens were not available in the estuaries. However, the same were obtained in dead condition from the offshore areas *C.*5-6 kms away from the coast.

In the case of *S. argus* measuring 110 mm, only left lobe of the ovary has been observed and the right one was completely reduced. The ova size was of 2 micrometer divisions.

Problem 8.11 : Studies on prawn seed catch in W. Bengal based on sample census.
Personnel : G. C. Laha, S. K. Mondal, H. C. Karmakar, P. B. Das and B. B. Das
Duration : 1978–1982
Location : Calcutta

Data were collected by observation and enquiries made from prawn seed traders / wholesalers / agents. Sixteen assembling/fishing centres were covered in lower Sunderbans (Kakdwip, Nischintapur, Kulpi, Dharani, Taldi, Bibiabad, Hatbere, Nazat, Heengalgunge, Baruhat, Par Hasnabad, Itindagha Sangrampur, Sandeshkhali and Andharmanik) and Midnapore (Ghantal) district. Abundance of *P. monodon* was recorded for a period of three months (March-May), *M. rosenbergii* was abundantly available in April in Ghantal. One thousand to two thousand early juveniles of *P. monodon* were collected per unit effort compared to 14,000 early juveniles of *M. rosenbergi.*

Project 9 : Selective breeding and hybridization

Problem 9.4 : Hybridization of carps with required reference to cytogenetical features of the hybrids
Personnel : R. K. Jana and H. A. Khan
Duration : 1977–1982
Location : Dhauli

Catla (male) Rohu (Female) F_1 hybrids have been produced and total hybrid spawn produced was 0.75 lakhs. These hybrid spawn were stocked in a prepared nursery pond (0.04 ha). After 16 days rearing the hydrid fry attained an average size of 25 mm.

Problem 9.7 : Breeding of selected stock of grass carp and silver carp
Personnel : S. B. Singh, B. K. Mishra, R. K. Dey, P. V. G. K. Reddy and H. K. Muduli
Duration : 1977-1981
Location : Cuttack

"Shoot" specimens of grass carp and silver carp were selected and stocked in two experimental ponds along with equal numbers of the normal progeny of the same fish. Fishes are fed with supplementary feed and weeds. The experiment is in progress.

Problem 9.7.1 : Studies on morphology, growth and maturity of the hybrid between grass carp female and silver carp male

Personnel : P. V. G. K. Reddy
Duration : 1978 till completion
Location : Cuttack

Hybrids of the above cross were produced successfully. The F_1 progeny of the cross between grass carp female and silver carp male produced in 1977, matured in 1980 and attempts are being made to breed them.

Problem 9.8 : Hybridization between *Labeo rohita* X *C. carpio*, *Cirrhinus mrigala* X *C. carpio*, *C. catla* X *H. molitrix*

Personnel : G. V. Kowtal and S. D. Gupta
Duration : 1977-80
Location : Cuttack

16,100 hybrids of mrigal male X common carp female were produced for the first time. Some of them reared in nursery ponds attained an average growth of 128.3 mm/25.7 g in 3½ months of rearing.

Very few nos of rohu female X common carp male and Catla female X common carp male hybrids were produced and they survived for 3 days

Incidental to various experiments 48.42 lakh spawn were produced, of which 3.9 lakhs of spawn was produced under "Lab to Land" programme at 3 centres.

Project 10 : Fish farm designing

Problem 10.2 : Studying seepage losses in ponds

Personnel : C. Saha, M. D. Mantri, C. D. Sahoo and S. L. Kar
Duration : Dhauli

Study of seepage loss in 5 newly dugout nursery ponds was investigated and it was observed that when canal water supply was closed, the average total loss of water from the ponds was 30 cm per month. The difference of water table was observed as 110 cm between the monsoon and the summer in dug wells at Dhauli.

Laboratory tests were conducted in specially prepared G. I. sheet drums. Experiments were conducted to see the effect of soil compaction over seepage loss. It was observed that seepage loss can be reduced by about 60 percent in sandy loam soil with 20 percent compaction, while only 25 percent seepage loss can be reduced with 10 percent compaction.

Project 11 : Economics in fishery investigations

Problem 11.10 : The evaluation of existing infrastructural base in relation to institutional finance, marketing and legislation for propagation of Aquaculture in West Bengal

Personnel : S. Paul and H. K. Sen
Duration : 1979-1981
Location : Barrackpore

In pursuance of work plan the work continued for the second year i. e. 1980. The following are the interim findings :

Marketing : The existing marketing set up does not pose a serious threat to culture fisheries as the producers' share in consumer's price is substantially higher when compared to their counterparts in capture fisheries.

Cooperative societies are yet to make their presence felt as they have no regulated catchment. Most of the fish farmers interviewed hardly reported any difficulty except some of them keenly felt the need for market regulation.

Institutional Finance : The objective of aquaculture being expansion of existing enterprises or creation of new ventures the possibilities of capital formation within the sector are not very bright in near future. Therefore, the reliance has to be placed on institutional finance—a neglected area so far. The lack of knowledge of lending agencies of the standards of aquaculture production operation has been one of the main difficulties faced by banks in formulating effective credit norms. The initial reluctance of lending institutions continues to be there partly due to subsistence character of operations and partly to unbankable schemes.

Market Regulation and Leasing Rights : Fish markets have not been brought under any comprehensive regulation. The implications of recently passed fish dealer's Licensing Order covering 24-Parganas, Howrah and Calcutta are being closely examined.

The existing leasing rights do not create a favourable investment climate. It is imperative that greater tenurial security is afforded so that duration of lease is well linked with the repayment schedule of commercial banks. The Government should also standardise lease documents in consultation with financing bodies at the appropriate levels so as to make them acceptable.

Problem 11.11 : Economic analysis of experimental pilot scale and large scale freshwater aquaculture operations in India
Personnel : M. Ranadhir, B. R. Shirsat, S. N. Mohanty and M. Rout
Duration : 1980-1983
Location : Dhauli

Collection of relevant data relating to farm construction costs input prices, price realization at different points and marketing aspects of fish was done. These will be analysed after sufficient data is gathered.

Problem 11.12 : Economic feasibility study of a well laid out fish farm with dependable water supply and determination of minimum economic size of farm
Personnel : B. R. Shirsat, M. Ranadhir, Dilip Kumar and M. Rout
Duration : 1980-1982
Location : Dhauli

For the purpose of the study, some well planned fish farms in Orissa and Bihar were identified and necessary data from the progressive fish culturists on input use, price realization at different points, fish marketing etc. were collected. Data on current input prices, prices of fish at farm gate and at fish market level were also maintained regularly. Attempts have been made to derive a minimum economic size of a fish farm based on survey data from existing fish farms, price structure of inputs at current levels, farm gate price of fish etc.

Problem 11.13 : Economics of the use of different sources of water in undrainable ponds
Personnel : M. Rout, C. Saha, M. Randhir and B. R. Shirsat
Duration : 1980-1982
Location : Dhauli

Local survey have been undertaken to find out the cost of pumping water into undrainable fish ponds through various methods.

Problem 11.14 : Cost-price structure of Aquaculture in Eastern Region of India

Personnel : S. Paul and H. K. Sen
Duration : 1980–1982
Location : Barrackpore

This study was undertaken in March 1980. Comprehensive data on cost constituents are being collected in respect of West Bengal, Orissa, Assam and Bihar. On the basis of preliminary investigations it is observed that in recent years order of increase has been the highest in the price of fish feed particularly oil cakes followed by chemical fertilizers whereas fish prices have relatively gained less thereby necessitating further improvement in yield rates.

Project 12 : Exotic fish culture

Problem 12.5 : Techniques for large-scale production of grass carp and silver carp seed.
Personnel : S. B. Singh, R. K. Dey, P. V. G. K. Reddy and H. K. Mudili (N. G. S. Rao from June, 1980)
Duration : 1974-1981
Location : Cuttack

In spite of sufficient rainfall, water temperature in the ponds did not come down to the required level for induced breeding of silver carp and grass carp. Only after the setting in of conducive environmental factors could the breeding of these chinese carps taken up late in the season. The highlight of 1980's breeding programme has been the recording of natural releasing of eggs by grass carp in a number of sets tried.

Incidental to research, about 2.5 lakhs of grass carp and 2 lakhs of silver carp spawn were produced.

Problem 12.6 : Compatibility and competition between silver carp and Indian major carps.
Personnel : B. K. Mishra, S. R. Ghosh and H. K. Muduli
Duration : 1975-80
Location : Cuttack

A field experiment of six months duration was carried out in four ponds of 0.04 ha each. Silver carp and mrigal were stocked at the combined density of 5000 fingerlings/ha in the ratio of Sc 2 : M 3 in two ponds and C 2 : M 3 in the other two ponds, No feeding and fertilization were done. Silver carp produced no perceptible adverse effect on mrigal.

Problem 12.7 : Optimum production of fingerlings and fish of exotic species under Composite fish culture.
Personnel : S. B. Singh, B. K. Mishra, R. K. Dey, P. V. G. K. Reddy, S. R. Ghosh and H. K. Muduli
Duration : 1976-80
Location : Cuttack

Fingerling rearing experiment could not be taken up for want of rearing space.

An experiment on the culture of silver carp, grass carp and common carp in combination at 3000 fish/ha stocking density in the ratio of 4 : 3 : 3 respectively has been initiated. Only weeds are being provided to grass carp and no artifical feeding and fertilization are being done.

Problem 12.8 : Maturity of grass carp with different feeds.
Personnel : R. K. Dey
Duration : From 1978 to completion of project
Location : Cuttack

An experiment had been initiated in four rearing ponds. In each pond, 20 grass carp females were stocked and fed with *Hydrilla* in one, pulse waste in another, *Hydrilla*+pulse waste in the third and *Hydrilla*, pulse waste and Vitamin E at the rate of 5 mg/fish/day in the last pond. The effect of different feeds on maturity of grass carp was studied in 1980 breeding season. It was observed that *Hydrilla* and *Hydriia*+ pulse waste+Vitamin E successfully induced optimum maturity condition in grass carp females as reflected by their response to hypophysation.

Project 13.16 : Cold water fish culture

Problem 13.16	:	Biology, breeding and culture of Schizothoracid fishes
Personnel	:	V. K. Bali, Shyam Sunder, R. K. Langer
Duration	:	1978 to 1982
Location	:	Harwan, Srinagar

Detailed biological studies were undertaken on *Schizothorax longipinnis*. The main findings are as follows :—

Age and Growth :

Ninety three specimens were examined and age determination was done from hard parts like otolith, operculum and vertebral disc. The specimens fell under age groups 1+ and 6+. The ring formation was found to occur in the months of June and July, when the fish was under feeding and breeding stress. The females grow faster than males. However, in the juvenile phase growth was uniform.

Food and Feeding :

Eighty specimens were examined for their gut contents which indicated 2-100% decayed organic matter ; nil—75% sand and mud ; algae (mainly diatoms) nil to 54% and Zooplankton nil to 31%. The sand and mud; as well as decayed organic matter maxima occured during May to July. Monthly observations during the year indicated that the guts are $\frac{1}{2}$ to $\frac{3}{4}$ full upto March. From May to July guts were either empty or with trace of food. The fish started feeding again with $\frac{1}{4}$ and $\frac{1}{2}$ gut full during August and September.

Maturity and fecundity :

Forty seven specimens measuring 240-431 mm total length and 160-950 g in weight were analysed for maturity studies. The females reached 4th stage by December and showed partial diapause during winter months and ova remained more or less in the same stage upto March. Thereafter rapid development and fully ripe oozing specimens started appearing from early June to end of July.

Breeding :

In April, two mature specimens of *Schizothorax niger* obtained from Dal lake (110-227 mm in total length and 45-97 g in weight) were stripped by dry method. The incubation period ranged between 10-15 days having a temperature range of 12.5-17.5°C. The rate of survival upto early fry stage was 55%. In June, six mature specimens of *Schizothorax esocinus* (350-720 mm in total length and 800-1,500 g in weight) were also stripped at the Telbal stream. Approximately 50,000 eggs were kept for incubation at Harwan hatchery with running water system. The incubation period lasted for about 15-20 days at a temperature range of 15—18°C. A survival of 40% was obtained in this case upto early fry stage. Three mature specimens of *Schizothorax curvifrons* were also bred by stripping method and the fertilization percentage was 70-75. The incubation period lasted for 8-13 days and a survival of 30% was recorded upto early fry stage.

During mid June two mature specimens of *Schizothorax plagiostomus* (290-380 mm in total length and 230-500 g in weight) were bred by stripping at Sindh stream. All the 1500 fertilised eggs obtained were kept

for incubation lasting for 8-12 days at stage. For lack of fry rearing space at Harwan farm only the fry of *Schizothorax esocinus* was reared further.

Fry rearing :

After initial feeding in the hatching troughs at Harwan hatchery with dried skimmed milk+egg yolk (1 : 1) and a pinch of salt for 2-3 times a day for about a fortnight, 2500 fry of *Schizothorax esocinus* were stocked in mud pond (3 m^2 area) and in a cage in the 3rd week of June. The pond was initially fertilized with cow-dung. Daily feeding was done with silk worm pupae powder+ mustard oil cake+wheat/rice bran (1 : 1 : 1). This feed was also supplemented with the daily ration of cladocerans cultured separately. The main natural planktonic forms recorded in the pond water were diatoms. Chlorophyceae and Protozoa. The results of various feeding trials conducted between June and August are tabulated below :—

Sl. No.	Treatments	STOCKED			REMOVED			Survival %
		Date	Nos.	Size-range (mm)	Date	Nos.	Size-range (mm)	
1.	Cage (1×0.75×0.75 m) in running water with natural food	17.6.80	50	9-12	17.8.80	26	15-40	52.0
2.	Kacha ponds (3 M^2) with +natural food +M. O. C.+ † S. W. P. † Plastic pools.	,,	250	,,	23.6.80	Washed away		
	i) With cladocerans	,,	300	,,	17.7.80	80	15-25	26.6
	ii) ,, ,,	,,	200	,,	,,	70	,,	35.0
	iii) ,, ,,	,,	100	,,	,,	70	15-30	70.0
	iv) With periphyton+cladocerans	,,	200	,,	,,	150	15-35	75.0
	v) With periphyton+cladocerans	,,	50	,,	,,	40	15-35	80.0
	vi) With M. O. C.+W. B. †	,,	50	,,	27.6.80	All died during the period.		
	vii) With M. O. C.+W. B.+S. W. P.	,,	50	,,	23.6.80	—do—		
	viii) With algae	,,	50	,,	17.7.80	20	14-13	40.0
	ix) With Isabgol (Plantogo sp) seed Periodically M.O.C.+W.B.)	,,	50	,,	1.7.80	All died during the period.		

† M. O. C.=Mustard oil cake ; W. B.=Wheat bran ; S. W. P.=Silk worm pupae.
However some of the feeding trial experiments were modified within a month and subsequent results given in table below :

Sl. No.	Treatments	STOCKED Date	STOCKED Nos.	STOCKED Size-range (mm)	REMOVED Date	REMOVED Nos.	REMOVED Size-range (mm)	Survival %
1.	Kacha pond (1.5M²) with natural food+ cladocerans+M. O. C.+W. B	17.7.80	110	25-35	9.9.80	Not Counted		31-45
2.	Plastic pools							
	i) With M. O. C.+S. P. W.+W. B.	,,	110	15-25	,,	53	15-30	48
	ii) With Cladocerans	,,	110	,,	,,	68	20-40	62
	iii) ,, ,,	,,	20	25-35	,,	17	32-45	85
	iv) With periphyton+cladocerans	,,	10	20-25	,,	10	35-45	100

In some feeding experiments as a paste of mustard oil cake and wheat bran supplemented with common salt and cobalt chloride (as growth promoter) was given but no appreciable growth was recorded. Minced liver with salt was also tried but it caused only turbidity in the experimental container. In October and December also feeding trials were continued but no appreciable growth was recorded.

Problem 13.20 : Standardisation of rearing techniques of brown trout and rainbow trout from Swimup fry to fingerlings

Personnel : K. K. Vass, H. B. Singh, V. K. Bali (Central Fisheries) and Bashir Ahmed (J & K Fisheries)

Duration : 4 years

Location : Harwan, Srinagar, Laribal

Brown trout :

Having achieved success in rearing the brown trout fry continously for ten months last year, the work was further continued. This year two new feeds were formulated with a view to increasing the crude protein level in the feeds. In previous years encouraging results were obtained with feed having 31% protein content. This year feeds with higher levels were formulated. The main ingredients used for formulation were fishmeal, silkworm pupae, mustard oil cake feeding oil, wheat bran and vitamin-cum-mineral mixture. The chemical analysis of two feeds is given below :—

FEED A

Moisture	=	4.43%
Crude protein	=	35.0%
Crude fibre	=	0.51%
Ether Extract	=	6.54%
Nitrogen Free Extract	=	29.55%
Ash	=	23.97%

FEED B

Moisture	=	2.76%
Crude protein	=	48.12%
Crude fibre	=	1.92%
Ether Extract	=	10.62%
Nitrogen Free Extract	=	24.74%
Ash	=	11.84%

The energy content of two feed is 2309 calories/kg for feed A and 3056 calories/kg for feed B. This year also fry were reared for 10 months under the farm conditions.

At the start of experiment fry with length range 17-20 mm and weight 80-100 mg, were stocked in small ponds of 2.5m². Initially they were fed with minced liver. Later on, a mixture of wet and dry (1 : 1) feed was administered for a month. From mid June onwards, fry were put exclusively on artificial feeds. Feed A was tried in eight ponds and similarly feed B in another set of eight ponds.

In about 300 days of rearing period, the fry attained an average length of 75 mm (50-100 mm) with Feed—A and to 100 mm (60-150 mm) with Feed—B. Similarly from an average weight of 90 mg (80-100 mg) the fry grew to 8.5 g (2-15 g) with Feed—A and to 16 g (2-30 g range) with Feed—B. Compared to last year the growth this year has been much better with both the feeds. Further, at the end of experiment with feed—A, about 60% of the fingerlings were more than 5g in weight. While with feed—B only 54% of the fingerlings were above 6 g. Further, in feed—A, the biggest size group was between 13-15 g while with feed—B, this size group was between 10-30 g in weight. The weight to weight feed conversion ratio was in 2.1 : 1 in case of feed—A and 1 8 : 1 in case of feed B. The feed efficiency was 50% and 55% in the two feeds respectively. Overall survival ranged between 30-35% and maximum mortality occurred during the early phase, due to rapid fluctuations in water temperature. The protein efficiency ratio calculated for feed A came to 1-82 while feed B it was 1.45.

Rainbow Trout

A total of 198 swim-up fry were stocked in two nursery ponds with 99 in each pond on 30.4.1980. The initial average length and weight of fry were 25 mm and 0.125 g. The fry were fed 4-5 times a day at the rate of 6.6 percent body weight with dry feed. Since the stock was extremely thin the comparative studies on two feeds could not be taken up. Initially the fry were fed on wet feed for one month. After 200 days of rearing (average 85 mm) and weight 3-10 g (7 g everage). The total survival recorded this year was 30-35%. There was also some unaccounted loss.

Problem No. 13. 21 : Cold water fish culture
Personnel : K. L. Sehgal and C. B. Joshi
Duration : 1980-1981
Location : Govindsagar Reservoir, Bilaspur

Work is to be initiated

Problem 13.22 : *Rearing of brown and rainbow trout fingerlings to table size*
Personnel : Shyam Sunder, H. B. Singh, Usha Moza, G. N. Bhat, N. A. Jan (J. & K. Fisheries) and Dr. K. K. Vass
Duration : 1979 to 1981
Location : Laribal

On account of non-availability of ponds from J & K Fisheries, the work could not be taken up during 1980. However, the work on brown trout which was taken up in June 1979 was concluded.

Brown trout fingerlings (150-190 mm in total length and an average weight being 38 g) were reared in two ponds @ 130 fish/pond, at Harwan farm for 380 days with pelletised feeds containing 28% crude protein in one pond and a newly formulated feed with 47.0% crude protein in the second pond.

The average increase in weight per fish recorded was 165 g (215-315 mm in total length) in pond one with a feed conversion factor of 3.53 and 328 g (245-360 mm in total length) in second pond with a feed conversion factor of 1.75.

The ingredients used in the newly formulated feed having 47% protein were all locally available i. e. silk-

worm pupae, wheat middlings, yeast and vitamin.

The water quality during the period of rearing was studied. Temperature was 4.4°C—20.2°C, pH 7 2-7 4, dissolved oxygen 7.7-10.5 ppm ; total alkalinity 56-65 ppm and silicates varied between 0.03-0.05 ppm.

Project 14 : Riverine and estuarine fish catch statistics

Problem 14.1 : *Fish catch statistics of middle and lower stretches of Ganga River System*

Personnel : S. J. Karamchandani, R. A. Gupta, G. N. Srivastava, Balbir Singh, R. K. Tyagi, D. N. Srivastava, A. K. Laal, R. C. Singh, A. Sarkar, B. L. Pandey, P. K. Chakraborty.

Duration : From 1968 (to continue)

Location : Middle and lower stretches of Ganga River Systems (Based at Allahabad)

The total fish landing at Daraganj, Sadiapur, Buxar, Bhagalpur and Lolgola contres were estimated to be 44.81, 115.43, 17.41, 110.93 and 48.49 t respectively during the period December 1979 to November 1980.

In the middle river stretch, the fish catches at Daraganj and Sadiapur centres exhibited an increase by 16.6% in the current year in comparison to the previous year, the increase being largely due to rich landings of catfishes and miscellaneous fishes.

In the lower river stretch, the fish landings at Bhagalpur registered an increase by 20.97% and at Lalgola an increase by 137.55% in the current year as compared to the preceding year.

The data on length frequency of eight commercially importaut species were collected from Sadiapur fish landing centre. The mean length of these species for the year 1980 are presented along with their respective mean lengths of the years 1967, 1974, 1975, 1977 and 1979 in Table.

Table

Species	Main lengths (in mm)					
	1980	1979	1977	1975	1974	1967
C. mrigala	480	466	587	692	586	483
C. catla	572	562	691	805	750	595
L. rohita	450	672	530	694	614	567
L. calbasu	670	438	456	454	466	403
M. aor	470	472	481	434	517	512
M. seenghala	530	522	473	552	523	533
W. attu	590	553	565	464	574	599
H. ilisha	420	433	381	473	353	328

Problem 14.14 : *Comparative study of fisheries and ecology of river Ganga and 'Kol' at Bhagalpur*

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

Duration : 1979-1981

Location : Middle stretch Ganga River system

Hanumanaghat on R. Ganga

Studies relating to the physico-chemical characteristics of water and primary productivity were undertaken,

Air and water temperatures range from 17.0°C (Feb.) to 31.75°C (June) and 18.25°C (Jan.) to 30.5°C (Aug.) respectively. Secchi disc transparancy varied between 4.5 (Aug. & Sept.) and 41.0 cm (May). Free CO_2 was absent throughout the year except in August (3.08 ppm) and October (5.28 ppm). Dissolved oxygen ranged from 5.36 (Sept.) to 8.18 ppm (Apr.) ; pH : 7.6 (Feb.) to 8.45 (Mar.) ; Carbonate alkalinity : nil (Oct.) to 34.38 ppm (Apr.) bi-carbonate alkalinity : 112-97 (May) to 183.36 ppm (Feb.) , tatal alkalinity : 130.35 (May) to 205.20 ppm (Nov.) nitrate : 0.28 (June) to 1.10 ppm (July & Oct.) silicats : 11 0 (May) to 20.4 ppm (Jan.) ; iron (ic) : 0.015 (Jan.) to 0.06 ppm (Sept.) ; dissolved organic matter : 6.09 (July) to 10.56 ppm (Aug.) ; chloride : 23.99 (Aug.) to 63.155 ppm (Jan.) and specific conductivity $10^2 \times 1.992$ (Aug.) to $10^2 \times 4.30$ micromhos/cm² at 25°C (Jan.).

Gross and net primary production were in the ranges 6.25 (Sept.) to 90.63 mg C/hr (May) and 13.28 (Sept.) to 81.56 mg C/m³/hr (May) respectively. Community respiration varied between 9.156 (July) and 39.544 mg C/m³/hr (Aug.).

Plankton : Study at Hanumanaghat on R Ganga :

In the river Ganga at Hanumanaghat to peaks of plankton were noticed, one in March (656 u/l) and another in May (1067 u/l). The phytoplankton and zooplankton peaks were also observed during the same period. The minimum plankton density was observed from June to September, with the lowest value in September (12 u/l). The turbidity value was very high during this period. Among rotifers *Keratella* and among cladocerans *Bosmina* sp. and *Ceriodaphnia* sp. were dominant.

Sirighat 'Kol'

Sirighat 'Kol' exists only between the months November to June. In July it gets connected with the main river Ganga with flood water incursion and remains as a part of the river till October, Domestic sewage from a part of the city of Bhagalpur comes and emits itself at Manikaakar Ghat, about 1 km above Sirighat. The pollutional effect of this domestic sewage and the potentialities of fish production in this water body, 'Kal' was assessed by way of physico-chemical characteristics of water primary production and plankton at three stations, viz. Manikarghat main sewage (A. O. F.) Maniksarkarghat confluence (O. F.) and at Sirighat.

Physico-chemical characteristics :

(monthly average values mentioned)

No drastic pollutional effects could be detected. There was a slight fall in D. O. at O. F. region which however picked up at Sirighat. No appreciable changes could be noticed in pH. CO_2 decreased.

Problem 14.15 : *Fish population studies of Brahmaputra river at Gauhati*

Personnel : M. Choudhury, R. K. Singh, V. Kolekar & Y. S. Yadav

Duration :

Location : Gauhati

Catch statistics : During the period under report a total of 12.7 t of fishes were estimated to have been landed at Uzanbazar (4.3) and Fancy bazar (0.4) landing centres in Gauhati. The highest and lowest landings were recorded during April and December respectively at both the centres. Since the project has been suspended from June, there is no further record of the catch.

Cat fishes (27.49%) dominated the catch, followed by Miscellaneous (26.85%), Major carps (18.83%), Hilsa (16.40%), Minor carps (8 27%) and Prawn (2.16%) at Fancy bazar while at Uzanbazar, Miscellaneous (39.08%) dominated the catch, followed by Cat fishes (20.94%), Minor carps (17.82%), Hilsa (15.10%), Major carps (5.97%) and prawn (1.09%).

The length frequency data revealed the folowing mean length and ranges in regard to some selected fishes.

Species	Mean length (mm)	Lowest group	Highest group
L. rohita	842	500-550	1050-1100
C. catla	905	700-750	1000-1050
C. mrigala	861	700-750	950-1100
W. attu	1021	750-800	1100-1150
M. seenghala	1049	750-800	1300-1350

Hydrological observations : Physico-chemical characteristics of water were studied. The air temperature, water temperature, transparency, pH, dissolved oxygen, carbon dioxide, bicarbonate, nitrate nitrogen, ammonical nitrogen, dissolved organic matter, electrical conductivity and oxygen saturation % ranged from 18.5 to 26.0°C, 20.0 to 24 5°C, 37.5 to 60.0 cm., 7.1 to 8.0, 6.8 ppm 5.0 to 6.0 ppm., 33.6 ppm., 120.0 to 185 umhes/cm and 82.3 to 88.1 respectively. Dissolved oxygen, bicarbonate, pH, NO_3—N, conductivity and O_2 saturation % showed high values during the months of January, February and March, while air and water temperature, turbidity, dissolved organic matter and NH_4—N showed high values in April. This is because of the inflow of water due to the melting of snow in the upper reaches of the river.

Plankton : The average monthly occurrence of plankton during the period was 10 u/1, which consisted of phytoplankton alone. Bacillariophyceae (5 u/1) was followed by Chlorophyceae (4 u/1) and blue green algae (1 u/1).

Bacillariophyceae and Chlorophyceae were maximum during April (9 u/1) and February (8 u/1) and minimum during March (1 u/l) among the phytoplankton.

The common genera observed were *Spirogyra, Ulothrix, Navicula, Tabellaria Oscillatoria, Phormidium*, etc.

Problem 14.16 : Pilot Survey to evolve sampling methodology for estimating inland resources and total catch of fish in West Bengal

Personnel : S/Shri K. K. Ghosh, O. P. Kathuria, (IASRI), S. K. Raheja, (IASRI), A. Srivastava (IASRI), P. M. Mitra, A. Chowdhury, R. N. De, A. K. Roy, N. D. Sarkar, N. C. Mondal and A. R. Paul

Duration : 1978-1981

Location : Barrackpore

The Survey revealed that during April to December in the 100 ponds covered by the sample, a total of 736 pond-days had fishing out of 27408 pond-days, corresponding to only 2.7% of total. The survey also covered physical observations in 3078 pond-days, i. e. 11% sampling. The actual observation of catches were on 291 pond-days, which accounted for 40% of total fishing pond-days.

The high incidence of nil catch (97.3%) made physical observation difficult. An overall analysis showed that the pilot sample of 9 months from April to December, with a sampling rate of 11% missed all catches in a month in a pond in 13% cases, partially covered catches in 11% cases and did not miss any catch in 74% cases.

The date of actual catches as recorded by observations or by enquiry for missed catches are to be analysed at IASRI computor centre, when one year period is over in March 1981. The basic inventory data of the ten selected clusters are presently under analysis at IASRI, New Delhi.

Problem 14.17 : Assessment of wanton distruction of early juveniles of commercial species in upper Hooghly estuary

Personnel : S. K. Mondal, G. C. Laha, and P. B. Das

Duration : 1980–1982

Location : Calcutta

The stretch covered during the period of assessment was 60 km *i. e.* between Dumurdah and Purbasthali. The stretch has been divided into three regions—north, south and intermediate, according to tidal influence and inventory of crafts and gears. Mostly chatjal and binjal are being operated in the stretch from September and November respectively. Though destruction of fish fry and prawn (juveniles) has been recorded in Khamargachhi (south), Malatipur (intermediate), and Guptipara (north) yet the extent of destruction is yet to be assessed.

Project 15 : Fish pathology

Problem 15.2 : Investigations on the parameters of fish blood to monitor fish health in culture fishery operations

Personnel : R. K. Dey & B. K. Mishra

Duration : 1980-1983

Location : Dhauli

Blood sample were collected from rohu, catla, mrigal, silver carp and common carp. Identification of different types of blood cells on staining was made. Investigations on the parameters of blood are in progress.

Project 15 : Fish Pathology

Problem 15.3 : Studies on the microbial activity on treatment of organic manure and subject to feed resources of fish culture ponds

Personnel : D. N. Swamy, R. N. Pal and K. Suresh

Duration : 1980-1983

Location : Barrackpore

The work could not be initiated as no microbiological laboratory could be established for want of space at Barrackpore.

Problem 15.4 : Histopathology of diseased fishes

Personnel : K. Suresh and R. N. Pal

Duration : 1980-1985

Location : Barrackpore

During the period Shri K. Suresh was on training ; as such the material collected is yet to be examined thoroughly.

Problem 15.5 : Isolation of bacteria causing fish diseases
Personnel : R. N. Pal and D. N. Swamy
Duration : 1980-1985
Location : Barrackpore

Staphylococcus is isolated from heart, hapatopancreas and intestine of *Penaeus monodon* and preserved in "The process Development and Analytical Control Research Laboratory", Calcutta. The bacterium causes a typical disease of its host when approximately 30% of the same gets affected. Straptomycin was found to be effective in controlling the disease.

Project : 16 Weed Control

Problem 16.3 : Evaluation and evolution of herbicide formulation
Personnel : S. Patnaik and K. M. Das
Duration : From 1980 till continuing
Location : Cuttack

In yard trials grannular formulation of 2,4-D ethyl ester didnot yield encouraging results with doses 5,10 and 20 kg/ha against *Hydrilla verticillata.*

Problem 16.13 : Studies on aggressive capacity, viability and perennation of reproductive bodies of noxious aquatic weeds
Personnel : S. Patnaik and K. M. Das
Duration : 1978-1980
Location : Cuttack

The observations on natural infestation indicate that *Jussiaea repens* were with flowers and fruits during January to March and young plants were observed sprouting on the pond margin during monsoon period. The water ferns *Salvinia cucullata* and *Azolla pinnata* were observed growing actively during July to September and sporocarp formation was noticed during January to March. The water qualities like pH, total alkalinity, dissolved phosphates and nitrates were recorded during the study period.

Project : 17 Frog farming

Problem 17.7 : Development of hatchery complex for Indian commercial frog species
Personnel : A. K. Mondal and S. C. Mondal
Duration : 1977—continuous
Location : Kalyani

In the 1980 season a record production of about 1.7 million hatchlings of *R. tigrina* and *R. crassa* was obtained, out of which altogether 1.2 million early tadpoles were released in the nature on the occasion of the World Environment Day. However, the maximum production observed on a single day was about 0.2 million hatchlings.

It is evident that the frog hatchery technique as developed ensures higher percentage of hatching of eggs and high survival of hatchlings and their augmented production. Even some-what bad eggs which normally would not have developed or hatched in trays, had shown normal hatching in the hatchery. The circulating water inside the hatchery jars was having dissolved oxygen 4.8 ppm, carbon dioxide 80 ppm and bicarbonate alkalinity 380 ppm.

Problem 17.8 (a) : Nursery management for Indian commercial frog species
Personnel : A. K. Mondal and S. C. Mondal
Duration : 1974 to 1982

In a 16-day period of field rearing experiment conducted in five hapas (size : 2M × 1M × 1M ; water level maintained at 0.4 M depth) fitted in a pre-prepared field nursery pond and each stocked with 480 Nos. 2-day-old tadpoles of *Rana tigrina* (stocking density—0.6 million/ha) and regularly fed with fresh silkworm pupae powder, in addition to zooplankton, their final survival to metamorphic and early frog stages in three hapas was 331 (68.9%), 345 (71.87%) and 351 (73.1%) respectively. The experiments in the other two hapas got vitiated as their stiches gave way. The pond was poisoned with mahua oil cake and subsequently manured with ammonium sulphate/urea, bone meal and muriate of potash for the steady growth and maintenance of the zooplankton bloom. The experiment clearly revealed that use of silkworm pupae powder as feed not only induced extra-ordinary growth in tadpoles but also increased their survival through control of cannibalism. The reduction of the period of metamorphosis to only 16 days, instead of one month as generally observed in the nature, tends to prove the effectiveness of ecdysone present in silkworm pupae even in amphibian metamorphosis. Further experiments in this direction are being taken up.

Problem 17 9 (a) : Mono-culture of *Rana hexadactyla*
Personnel : A. K. Mondal and S. C. Mondal
Duration : 1974-82
Location : Kalyani

One pond provided by the Directorate of Fisheries, West Bengal was duly reclaimed and poisoned, but production experiment could not be taken up in it since the fund sanction was not made for fencing of the pond to prevent escape of frogs. Laboratory experiments are In progress on rearing of early frogs of *R. hexadactyla* with tubificid worms. Excellent breeding of the blue bottle and the house fly and one Cyclorrhaphan fly and very healthy growth of their maggots were obtained in a medium containing raw cowdung, bone meal and mustard oil cake. They serve as excellent feed for carnivorous species of frogs and cat fish.

Problem 17.10 (a) : Studies on the digestive enzymes of *Rana hexadactyla* from Bengal
Personnel : A. K. Mondal
Duration : 1980-83
Location : Kalyani, Calcutta

Work has been initiated. Already tadpoles and early frogs have been produced and along with the adults they are maintained under proper husbandry conditions to take up digestive enzyme analysis. Feeding trials with silkworm pupae and their natural food are already in progress in order to shorten the period of metamorphosis of tadpoles.

Problem 17.11 (a) : Selective breeding and hybridization between frog species of commercial importance
Personnel : A. K. Mondal and S. C. Mondal
Duration : 1980-1985
Location : Kalyani, Calcutta

Induced hybridization between *Rana tigrina* and *R. crassa* was carried out successfully during 1980, and their hybrids were produced. The developmental stages of the hybrids have been preserved and compared with those of the parent species, which revealed not much significant changes. The hatching percentage was found to be more or less the same when compared to that of the parent species. The hatchlings did not show

any morphological deformity. Period of metamorphosis remained more or less the same. Certain differences in the mouth apparatus, particularly the tooth rows, were observed Tail tips, gills, liver, kidney, spleen and intestine were used for chromosomal studies. The somatic number in the hybrids was 26. Banding pattern of the chromosomes of hybrids and parents is being studied.

Problem : 17.13 : Optimum per hectare production of early frogs, juveniles and adults of *Rana hexadactyla*

Personnel : C. R. Das and K. C. Pani

Duration : 1978-1982

Location : Cuttack

25,000 tadpoles of *R. hexadactyla* were produced through spring and monsoon breeding.

Tadpoles of *R. hexadaclyla* were reared at stocking densities of 25,000 ; 50,000 and 75,000/ha recorded production of 75%, 65% and 50% metamorphosed early frogs (froglets).

In a .002 ha rearing enclosure an experiment conducted with early frogs with av. size of 15 mm/. 5g at a stocking density of 50,000/ha recorded a production of 1,450 kg/ha in 8 months time providing sufficient food and intensive care.

In an adult frog rearing experiment conducted in a .018 ha rearing enclosure, juveniles of *R. hexadactyla* with an size of 52.1 mm/21.1 g and stocking density of 7,500/ha recorded a production of 425 kg/ha in one year.

Project 18 : Sewage fed Fisheries

Problem 18.1.6 : Production of carps in mixed culture operation with sewage effluents.

Personnel : Apurba Ghosh, Smt. K. K. Bhanot, S. K. Saha, G. P. Bhattacharya and B. Ghosh

Duration : 1977-1981

Location : Khardah

Composite culture of carps was initiated in a 0.17 ha pond. The pond was initially fertilised with 4,30,000 litres of domestic sewage effluents and was stocked with Indian major carps, common carp and silver carp in the ratio of catla 1 : rohu 2.5 : mrigal 2.5 : common carp 2 : silver carp 2 at a stocking density of 15,000 fingerlings/ hactare. Major carps were stocked in August while silver carp and common carp were stocked in October. No supplementary feed or fertilizer was given to the fishes except for fertilising the pond with domestic sewage effluents.

The average size of fishes at the time of stocking was rohu 106.00 mm/13.6 g, mrigal 118.2 mm/15 g, catla 98.3 mm/30.6 g, silver carp 96 5 mm/10 g and common carp 93.4 mm/15g. A production of 3,078 kg/ha/yr was obtained. The size attained by fishes at the time of harvesting was-catla 307.5 mm/475 g, rohu 271.2 mm/ 250 g, common carp 300.4 mm/525 g, silver carp 220.00 mm/150 g and mrigal 243.9 mm/140 g.

Eichhornia was provided in one corner of the pond to facilitate natural breeding of common carp in the pond. The fishes were profusely breeding in the first week of February. *Eichhornia* plants with adhering eggs were taken for hatching in freshwater ponds and about one lakh fifty thousand spawn was produced. Some eggs had naturally hatched in the sewage fertilized pond and at the time of final harvesting of the pond 20 kg fry of common carp was also obtained.

Range of chemical characteristics of the pond during the culture period varied as under

Temperature	— 28.6°C-31.2°C
pH	— 7.5-8.6
DO	— 0.9-5.2 ppm
Total alkalinity	— 224-466 ppm
CO_2	— nil-36.4 ppm
Chloride	— 75-160.0 ppm
NO_2-N	— nil-0.06 ppm
NO_3-N	— 0.01-0.52 ppm
NH_3-N	— traces-3.4 ppm
Phosphate	— 0.32-4.03 ppm
COD	— 6.4-48.2 ppm
5 days BOD at RT	— 3.2-47.6 ppm
Specific conductivity	— 327 $x10^6$–1220 $x10^6$ mhos
Total solids	— 340-1070 ppm

After harvesting, the pond was excavated upto 2½ feet. Fertilisation was done using 10.2×10^5 litres of domestic sewage effluents and diluted proportionately with rain water in the ratio of 1.1. The stabilised pond was stocked with fingerlings of catla, rohu, mrigal, common carp and silver carp at a stocking density of 18,000/ha and in the species ratio of 1 : 1 : 1 : 1 : 1 in July/August. Periodic fertilisation using domestic sewage effluents were continued in the post stocking phase by monitoring the oxygen balance of the pond. At the time of stocking catla was 88.6 mm/10.4 g and 178.2 mm/66.5 g ; rohu 155.5 mm/52 3 g ; mrigal 84.7 mm/5.2 g and 184.7 mm/60 g ; common carp 113.7 mm/ 30 g and silver carp 257.9 mm/156.2 g. In four months of rearing silver carp has grown to 417.7 mm/770 g, catla 272 5 mm/303 g, rohu 280.9 mm/281.0 gm and common carp 194.4 mm/164 g by December 1980.

Spawn rearing :

Three lakh spawn of common carp was reared in two nurseries (0.03 ha each). After five days of spawn stocking 200 litres of raw sludge was given in the nursery 1. Another 56 kg was put after 20 days. Feeding was done with mustrad oil cake and rice bran in 1 : 1 ratio at 10% body weight. Total nitrogen in the sludge was 0.36%, available P_2O_5 was 52.6 m/100g and organic carbon was 1.2%. About 1 lakh spawn and fry of common carp thus reared were used for stocking purposes. In nursery II, 75 kg of dried sludge was applied after six days of spawn stocking.

Fry rearing :

In May 1980, a 0.076 ha pond was fertilised using 4.5×10^4 litres of primary treated sewage effluent by sedimentation which was later diluted in the fish pond with freshwater in the ratio of 1 :2 (sewage : water). After application of lime, the fish pond was allowed to stabilize to restore normal oxygen concentration and turn predominently aerobic. Fry of common carp, silver carp and catla were stocked in the ratio of 7 : 2 : 1 at a stocking density of 60,000 ha. After stocking duck weeds *i e. Spirodela* sp. were allowed to grow to prevent algal bloom in highly nutritive media in presence of solar energy. Phytoplankton and zooplankton ranged between 115-197/litres and 349–362/litres respectively. *Chlorella* and *Cyclops* were the dominant genera. Physico-chemical characteristics of the pond water during May-June were as follows : pH 7.8-8.0 : DO 1.2-2.3 ppm ; total alkalinity 324-274 ppm ; CO_2 18.4 26-0 ppm ; NH_3-N 2.8 –1.08 ppm ; PO_4 3.51—5.2 ppm and BOD 69.0—47.4. Fishes were reared for forty five days and harvested by repeated netting. Final harvesting of common carp was done by letting in sewage water and thereby depleting the oxygen content of pond water. After compiling the length/weight data of the fishes, the following growth was recorded :

Common carp	51.68 mm/10 g to 95.77 mm/20 g
Silver carp	164.25 mm/45 g to 257.9 mm/153 g
Catla	143.0 mm/37.5 g to 178.2/45.0 g

The gross and net production achieved was 2736 kg/ ha and 1618 kg/ha respectively within 45 days of rearing.

Problem 18. 1. 10 : The ecology and control of common parasitic diseases in fishes reared in sewage-fed fish culture.

Personnel : Ajoy Kumar Ghosh and Sukumar Saha (Sukumar Saha upto 13. 7. 1980)

Duration : 1977-1980

Location : Rahara

Investigations on the parasitic diseases of Indian major carps, silver carp and common carp cultured in the sewage-fed ponds were carried out during the period under report. Myxosporidian infection on catla and mrigal was recorded. The prophylactic measure was undertaken to combat the infection. Therapeutic compounds like Mg SO_4 and Na Cl (1. 5 : 3. 5) were tried in the laboratory to find out the efficacy of the compound in controlling the disease caused by Myxosporidia. Further trials are to be made to confirm the present findings. Silver carp in the experimental ponds was found to have infection on the skin. Bacteria may be the causative organism of this infection. Major carps and common carp were found to be infested with *Argulus* sp. in the sewage-fed ponds. The parasites were collected and made to breed in the laboratory condition with a view to control them effectively, at the early stage of infestation.

Problem 18. 1. 11 : Paddy-cum-fish culture in freshwater

Personnel : S. K Saha, K. R. Naskar, Apurba Ghosh, (Mrs.) K. K. Bhanot and B. K. Saha

Duration : 1979-1982

Location : Khardah

'Jaladhi 2' was directly sown @ 80 kg/ha in the paddy plot. Perimeter canal was fertilised with 11. 1 tonnes of cowdung. Fishes were stocked @ 3,000/ha in the species ratio of catla 1. 5 : rohu 4 : mrigal 3 : silver carp 0.3 : magur 0.7 and prawn 0.5.

Kharif paddy was harvested in December and a production of 422.6 kg/ha was achieved. For rabi cultivation of paddy 'Ratna' was cultivated by traditional agriculture methods and a production of 3640 kg was obtained making a total of 4062 kg/ha from the crops.

Fishes were fed with mustard oilcake at 2% body weight. Harvesting was done by applying 400 kg of mahua oil cake. A production of 259.7 kg/ha/yr was obtained.

Physico-chemical characteristics of water varied as under :

Temperature	28. 6-31. 0°C
pH	7. 7-8. 4
DO	2. 2-4. 8 ppm
CO_2	nil-6.0 ppm
Total alkalinity	110-324 ppm
NO_2	nil-traces
NO_3-N	traces 0.03 ppm
NH_3-N	0.0-0.16 ppm
PO_4	0.3-0.918 ppm
COD	3.1-10.0 ppm
Chloride	60-123.0 ppm

Perimeter canal was fertilised with six tonnes of cowdung. No fertilisers were applied in the main plot for cultivation of Kharif paddy. *Saru kutia* (local and indigenous variety) selected from flooded fields of Moyna subdivsion of Midnapore district was selected for cultivation instead of Jaladhi. Seed bed was prepared and 25 days old seedlings were transplanted in the plot. But, before the seedlings could establish roots the monsoon had set in and paddy could not be cultivated in Kharif season. To take advantage of the whole sheet of water, the system was stocked at a higher stocking density of 5,000/ha

with catla, rohu, mrigal, silver carp and common carp to test the efficacy of alternate system of paddy and fish cultivation. At the time of stocking catla was 92.45 mm/ 6.0 g. rohu 102.83 mm/14.g mrigal 84.4 mm/5.2 g, silver carp 257.9 mm/156.2 g. In four months of rearing silver carp had grown to 417.8 mm/767.5 g, catla 304 mm/447.7 g, rohu 247.2, mm/207.0 g, mrigal 234.2 mm/152.5 g, and common carp 216 mm/200 g. Sixty numbers of grass carp were stocked which have grown to over one kg. 2000 numbers of post larvae of *Macrobrachium rosenbergii* were also stocked. Feeding was done with mustard oil cake and rice bran in 1 : 1 ratio at two percent body weight.

Composting of aquatic weeds by aerobic and anaerobic process in excavated pits and piles to be utilised as fertiliser in the integrated system.

Composting of water hyacinth *(Eichhornia sp.)* were tried under both aerobic and anaerobic condition in the field and laboratory. For quick composting of water hyacinth it was mixed separately with urea, cow-dung and sewage sludge in separate chambers keeping a control of experiments. The main objective of the study is to determine a suitable C/N ratio which enhances composting and produces rich compost, to be used in the integrated farming system. It was observed that water-hyacinth when mixed with cow-dung gave better result as compared to sewage-sludge and chemical manure. Physical and chemical parameters of the compost pits particularly the fluctuations of the temperature, the pH level and the biological succession of algae were studied and recorded for comparison. The temperature during the period of study ranged between 23°C and 34°C, pH between 6.0 and8.4. The macro-and micro-flora and fauna observed to occur in such compost were *Nostoc* sp. *Oscillatoria* sp., *Spirogyra* sp. *Rhizoclonium* sp., *Zygonema* sp., *Sphaeroplea* sp., *Microcystis* sp., Diatom *Draparnaldiopsis* sp., *Rivularia* sp. and *Phyllobium* sp. Some fungi were also observed to be growing on the compost. Mites, annelids and molluscs were also present.

The manurial status of compost in respect of macronutrients *i.e.*, N. P. K. were found to be moderately high. The plastic pools were used for rearing Indian major carps and tilapia in the yard experiments. The water quality and algal productivity of the ponds in relation to applications of compost were also determined.

In paddy cultivation, during rabi season the compost was utilised as a fertilizer in small plots to compare its efficacy in relation to cow-dung and sewage. The production of paddy in plots fertilized with compost was 5200 kg./ha.

In addition to this, *Eichhornia* compost was utilized in vegetable cropping system under integrated fish-farming involving aqua-culture and agriculture.

Project 19 : Hilsa Fisheries

Problem 19.8 : Culture of Hilsa in confined freshwater

Personnel : J. C. Malhotra, Peer Mohammed, P. M. Sherif, K. L. Shah, S. K. Sarkar, B. K. Banerjee, S. P. Singh, Ranji Tewari, K. K. Bhanot & S. B. Saha

Duration : 1974-1981

Location : Allahabad/Barrackpore

Investigations under the project were carried out in the river Narmada and in the pond of the State Fish Farm at Ukai in the State of Gujarat.

Artificial fecundation : Experiments on the artificial fecundation of *Hilsa ilisa* (Ham,) were carried out in the river Narmada at Bharbhut. The population of hilsa which breed in the estuariue arers of the river was used in the experiments. This year also artificial fecundation was successfully achieved through the 'wet'

method of stripping and the percentage of fertilisation ranged from 90 to 95.

Transport of fertilised eggs : The fertilised eggs thus produced were transported, successfully, in the 18 litre capacity sealed polythene bags under oxygen. About 1.2 lakhs eggs were packed in each bag containing 6 litres of filtered well water and rest oxygen. They were transported to a distance requiring 8 hours to cover by road. The rate of transport mortality was estimated between 5 and 15 percent.

Hatching of the fertilised eggs : The fertilised eggs were hatched in nylon cloth hapas of size $2 \times 1 \times 2$m, fixed in a nursery pond and in the indoor hatchery with arrangements for continuous water flow. In the hapas fixed in the ponds the percentage of hatching varied between 50 and 60% while in the indoor hatchery due to accidental stoppage of water circulation all the fertilised eggs died.

Rearing of the hatchlings : 1.2 lakhs of the hatchlings in the size range of 2.5 to 300 mm were stocked in one nursery pond of dimensions, length 100 feet, width 50 feet, on 9. 9. 80.

Hilsa culture : The 5.5 to 3.0 mm long hatchlings stocked in another pond of the farm on 22. 8. 79 completed one year of life in the pond on 21. 8. 80 and the size range of the samples drawn on 16. 9. 80 was 108 to 220 mm. They have grown to an average length of 149 mm in the length range of 108 to 249 mm on 19. 12. 80 and are thriving well

To examine the possiblities to culture hilsa in association with Indian and exotic carp *Tilapia*, 25 pond-reared fingerlings of hilsa of average length 70 mm were released in December '79 in one nursery pond with arrangements for continuous water flow. Till 16. 9. 80 these fingerlings have grown to an average size of 177 mm in the length range of 165-180 mm and are thriving well.

Effect of commonsalt on hatching success : Experiments were also carried out to study the effect of common salt (Na Cl) on the hatching of fertilised eggs of hilsa. In addition to the confined water, with three concentrations of NaCl viz., 2.5, 5.0 and 10.0 ppm were used for the experiments. It was observed that the hatching percentage in the confined water ranged between 50-60% while in 2.5 ppm of NaCl concentration it varied between 80.85% and In 5.0 and 10.0 ppm it ranged between 70-80%. It could thus be stated that a little addition of NaCl probably enhances the hatching percentage.

Effect of salinity on hilsa hatchlings : Experiments were also carried out to assess the effects of salinity on the survival of hilsa hatchlings. Prepared saline water was used for the experiments. It was observed that in the control (salinity 0.0 ppt) the 70% of the hatchlings of size range 3.0 to 3.5 mm survived after 24 hours of the exposure while in 2 ppt salinity there was survival after 24 hours of exposure.

Problem 19.9 : Fluctuation in the hilsa fisheries of the Hooghly estuary

Personnel : D. K. De and H. S. Majumder

Duration : 1974-1981

Location : Barrackpore

Study of Gonadal maturity, fecundity and spawning behaviour of hilsa, *Hilsa ilisa* (Ham.) of the Hooghly estuary have been in progress.

The observation revealed that the larval availability of hilsa was nil at both the centres, Monirampur and Palta along the upper stretch of the Hooghly estuary during August to December.

Project 20 : Water Pollution Investigations

Problrm 20.5 : Investigations on the Ganga and

Yamuna river ecosystems to determine the biological indicators of water quality.

Personnel : S. N. Merhotra, A. G. Jhingran, S. P. Singh

Duration : 1974-80

Location : Allahabad

The impact of sewage discharge in the rivers Ganga and Yamuna were studied with special reference to water quality, benthos, plankton and fish fauna. Observations were restricted to three ponts viz., above outfall (AOE) outfall (OF) and below outfall (BOF). The studies revealed no appreciable difference in water temperature at the three points, the variation being 20.5—26.0°C. Transparency was usually low at the OF (30-34 cm) as compared to the points. pH was comparatively low at the OF (2.8 ppm). Alkalinity remained high (280-330 ppm) at the OF and hardness followed the trend of alkalinity maintaining high concentration at the OF (58-60 ppm). Nutrients like nitrate, phosphate and silicate were fairly rich at the OF. The OF areas were also rich in mineral ions like calcium (31-32 ppm) and Magnesium (4.5-6.0 ppm). Dissolved oxygen was invariably low (4.5-6.00 ppm) at the OF region.

Plankton :

Phytoplankton dominated over zooplankton at every point of the rivers Ganga and Yamuna. AOF region of both the rivers were dominated by Myxophyceae followed by Bacillariophyceae. The OF region was characterised by the presence of *Synedra* sp., *Microcystis* sp., *Oscillatoria* sp. and *Nitzschia* sp. The BOF area showed almost similar trend as represented in OF region. *Keratella* sp. and Nauplii were the zooplankton encountered.

Bottom biota :

The AOF area was represented by Molluscs in both the rivers. The OF area was dominated by chironomids and Oligochaetes. The BOF region was dominated by *Chironomus* sp. followed by *Tubifix* and Molluscs.

Fish fauna :

There was no difference in the quality of fish fauna available at the three points. The species usually encountered were *Puntius* sp., *G. chapra*, *A. morar*, *C. garua* and *R. rita*.

Problem 20.8 : Effects of pesticides on fish and fish food organisms

Personnel : R. S. Panwar, D. N. Singh, R. N. Seth and R. K. Tyagi

Duration : 1976 to 1980.

Location : Allahabad

Studies on toxicity of herbicide, 2, 4-D (Dichlorophenoxy acetic acid) were conducted on water flea, *Daphnia carinata* at 23.5° to 24.5°C water temperature for 24 hrs exposure period in dechlorinated tap water having pH 7.6, D.O. 6.8 ppm, total alkalinity 180·2 ppm and hardness 66 ppm. The observed lethal concentration for 24 hrs was 15 ppm. Bioassays were conducted with 2, 4-D using fry of *Cyprinus carpio* (length, 44 to 48.8 mm) at 31-32°C water temperature under continuous flow system and *Labeo rohita* (length, 48 to 52 mm) at 31 to 32.5°C water temperature under static and continuous flow system for 96 hrs exposure period. The physico-chemical studies of water used in the experiments showed the values of pH ranging between 7.2 to 7.6, dissolve oxygen from 6.8 to 7.2 ppm, and values of total alkalinity and hardness varying between 210—214 ppm and 60—70 ppm respectively. In lethal concentration (55 ppm) the fishes were found in a distressed condition.

Examination of T. S. of liver, intestine and kidney of *Labeo rohita* for histopathological studies revealed that

exposure of fish to 0.005 ppm of DDT for 45 and 60 days resulted in the following changes.

i) In the liver, 45 days exposure resulted in deformation in the polygonal shape of hepatic cells alongwith surface irregularities and appearance of vacuoles. It was significant to note that areas nearer to blood vessels were more severely damaged. None of these changes were observed in control.

ii) In intestine, 45 days exposure resulted in vacuolation in the epithelial lining of the villi. Subsequent exposure for 60 days resulted in degeneration of the epithelial cell with deshapsd villi having numerous vacuoles and empty blood vssels.

iii) In kidney, the haemopoitic cells were damaged in 45 days exposure period. The renal epithelial cells were ruptured and showed vacuolation, swelling and surface irregularities and shrinkage in renal epithelial cells were also seen.

Problem 20. 9 : The impact of pesticides on respiratory metabolism and energy utilization in aquatic animals

Personnel : Peer Mohmmed, M. A. Khan, S. N. Mehrotra, R. A. Gupta, P. M. Sherif

Duration : 1972 to 1980

Location : Allahabad

Experiments were performed to study the routine metabolism in *Cirrhina mrigala* (Hamilton) fingerlings. In *C. mrigala* (av. wt. 15.0 g) the routine metabolic rate was estimated to be 100 mg/kg/hr at 30±0.5°C and 105 mg/kg/hr at 35± 0.5°C. From the results, it was clear that the temperature difference (30-35°C) did not influence much on the routine metabolic rate.

Experiments were performed to find out the hypoxic tolerance in *C. mrigala* fingerlings. It was found that *C. mrigala* (av. wt. 3.1 g) could tolerate upto 0.82 mg O_2/1 at 30±0.5°C. In *Catla catla* (av. wt. 4.1 g) the low ambient oxygen tolerance was estimated to be 0.62 mg O_2/1 at 25± 0.5°C.

To study the ecophysiological characteristics of fish, some experiments were conducted to find out the under tolerence tolerance limit. The results revealed that *C. mrigala* (av. wt. 3.3 g) and *Labeo rohita* (av. wt. 3 8 g) could tolerate upto 39. 8°C and 39.2°C respectively. From the results obtained, the upper temperature tolerence difference between the species was evident.

The effects of sublethal DDT (0.02 ppm) on total carbohydrates, protein and fat in *L. rohita* were also studied. *L. rohita* (av. wt. 5.3 g) were exposed to 0.2 ppm DDT at room temperature (31-32.5°C) for 24, 48 and 96hrs. Fish were not fed during the period of four days. After the required exposure period, specimens were fixed in TCA and prepared for biochemical analyses.

C. mrigala fry of equal size (av. length 1.0 cm) were exposed in different concentrations of ammonia (from 1.0 to 3.75 ppm) at 30°C. It was noticed that there was no mortality in 1.0, 1.5, 1 75 and 2.0 ppm for 24 and 48 hours, and the percentage of mortality recorded was 10. 18, 20 and 30% respectively in 72 hours. The percentage of mortaliry increased from the lowest concentration tested (1.0 ppm) and 50% mortality was recorded in 2.5 ppm) within 72 hours.

In 60 days exposure the damaged area of haemopoitic cells became wider as observed from faintly stained areas. Epithelial cells bordering the glomerulus were ruptured and shrunken resulting in the shrinkage of glomerulus. The nuclear changes after 60 days exposure resulted in vacuolation and extrution which indicated severe damage to kidney. None of the changes were seen in the control set. Fishes viz. *Cyprinus carpio.*,

L. rohita and *Puntius* sp. were also exposed to 0.005 ppm of BHC and DDT for 75 days.

Problem 20.10 : Pollutional effect of industrial wastes on aquatic ecosystem

Personnel : R. S. Panwar, D. N. Singh, K. Chandra and R. A. Gupta

Duration : 1977 to 1981

Location : Rihand Reservoir

Investigations conducted during 1980 revealed that the industrial wastes of the Kanoria Chemicals Ltd. (manufacturing caustic soda, bleaching powder and gammaxane) released in the Rihand reservoir were characterised by high contents of free chlorine (3191.4 ppm) chlorides (4356.0 ppm) and sodium (1900 ppm). Conductance was 12,690 micromhos/cm. pH was found to range between 6.5 and 7,2 during pre-monsoon and monsoon and between 4.6 and 6.8 during postmonsoon season.

Water samples collected at the outfall indicated maximum chlorine (280.8 pp), chlorides (386.8 ppm), conductance (1200.4 micro-mhos/cm) and sodium (502 ppm) during pre-monsoon period. Dissolved oxygen was found nil during postmonsoon period. During pre-monsoon and monsoon periods the water temperature fluctuated from 28.5-30.5°C respectively and transparency from 11.5 cm to 17.5 cm and pH from 6.35 to 8.0. Free chlorine was estimated as 0.84 to 15.2 ppm at 20 m distance from the outfall. The water showed fairly alkaline character (60 to 80 ppm). Hardness ranged from 52 to 60 ppm. Free chlorine was absent in other stations (50 m, 100 m, 200 m, 400 m and 800 from the outfall). Other parameters viz. chlorides, hardness, total alkalinity and dissolved oxygen ranged from 8.91 to 35.5 ppm, 17.90 to 60.00 ppm, 19 to 76 ppm and 5.4 to 7.6 ppm respectively.

pH of the soil at the outfall region showed 6.8 to 7.2. Chloride content at outfall ranged from 70 to 81.5 mg/ 100 gm soil.

The toxic effect of the effluent was indicated by total absence of plankton upto station no 2 (20 m away from outfall) during premonsoon and monsoon seasons and at station no. 1 (outfall) during monsoon season. A total of 1531, 13795 and 1156 organisms/litre of water was recorded duriog premonsoon, monsoon and post-monsoon seasons respectively. Phytoplankton was represented mainly by blue green algae (*Oscillatoria* sp and *Anabaena* sp.) during premonsoou period. *Mcrocystis* sp. was found in abundance during monsoon period. Copepod (*Cyclops* sp and *Diaptomus* sp) and a few rotifers (*Keratella* sp) were the main zooplankters present during the year. Mortality of fishes viz. *C. mrigala, N. chitala, C. reba, Clupisoma* sp. *Mystus* sp. etc. was observed in sizable quantity.

Bottom boita was absent upto 100 meter from out fall.

Laboratory experiments conducted with 1.4% combined effluent showed 100% mortality of fingerlings of *Labeo rohita* in 24 hrs. exposure period.

Problem 20.11 : Environmental pollution in the Hooghly estuary with reference to heavy metals disposed through industrial waste waters

Personnel : B B. Ghosh and M. M. Bagchi

Duration : 1977-1981

Location : Barrackpore

During this year, heavy metal concentration in various test materials was analysed by Atomic absorption spectro-photometer in place of conventional chemical method. Presence of zinc was indicated in the industrial effluent (discharged into the Hooghly estuary) of

rayon (0.55-8.25 ppm), paints & varnishes (0.10-0.25 ppm) industries. 0.20-2.90 ppm and 0.20-0.60 ppm Cr was noticed in the effluent of tannery and paints & varnishes respectively. The zinc concentration level was 0.10-2.50 ppm, 0.00-0.25 ppm, 0.00-0.60 ppm and 0.00-0.30 ppm in the receiving estuarine water near the outfall of rayon at Nayasarai, rubber at Sahagunj, paints & varnishes at Shalimar and Garifa respectively, while it was 2.80-10.50 ppm in the bottom sediment, which resulted in bioaccumulation of zinc (8.60-9.60 ppm) in non-migratory fish like gobid, *Glossogobius giuris* (60-72 mm ; 1.9-3.6 gm), collected near the outfall by tow net operation. Chromium in surface water was 0.20-2.00 ppm near Baranagar and fluctuated within 8.00-8.3 ppm at Shalimar and Garifa.

The more acidic character of the rayon effluent in summer (pH 3.0-3.8) compared to monsoon (pH 4.0-6.4) resulted in more concentration of Zn in the effluent in summer (5.10-8.25 ppm) than in monsoon (0.10-1.05 ppm) which was also reflected by the presence of more zinc content in the receiving water upto a stretch of 600 m below the outfall in summer (0.15 ppm) compared to above the outfall showing almost absence of zinc. Unlike this, tannery effluent showed more concentration of Cr. in monsoon (0.20-2.90 ppm) compared to summer (0.30-0.50 ppm) which might be due to lower pH in monsoon (8.0-8.2) than summer (7.9-9.4.) However, hardness in various effluents was considerably lower in summer (87-300 ppm) than monsoon (160-420 ppm) which was also reflected by the indication of lower hardness in summer (42-280 ppm) around all the outfall areas compared to monsoon condition (70-320 ppm). The metal toxicity is likely to be more intensified in summer particularly around tannery outfall showing considerable low hardness in summer (42-130 ppm) compared to monsoon (70-210 ppm).

Problem 20.13 : Effect of supernatant waste water on the fisheries of Kulti estuary

Personnel : P. Ray, R. K. Banerjee, A. B. Mukherjee, S. B. Saha, N. N. Mazumder and S. K. Chatterjee

Duration : 1978-82

Location : Calcutta

Extensive suruey done in the Kulti estuary, receiving Calcutta municipal wastes, reveals that a strrtch of 55 km *i. e.* between Beliaghata and Kharibari in the north and Bermazore in the south, gets polluted where dissolved oxygen values were recorded between nil and 1.87 ppm during the tidal phases. Plankton production was found to be very poor though during monsoon months primary productivity ranged between 20 and 24 mg $C/M^3/hr$. In case culture experiment, the extent of pollution was denoted by the mortality of *Cirrhinus mrigala* fingerlings within four hours. However, the fingerlings (av wt 5 g) could withstand the toxicity for a period of 10 days when D. O. of ambient water was maintained at 5 ppm.

Problem 20. 14 : Aquatic pollution in the Hooghly estuary with reference to Haldia Oil Refinery complex.

Personnel : M. M. Bagchi, B. B. Ghosh and S. K. Majumder

Duration : 1978—1981

Location : Barrackpore

During this year, pollution in the Hooghly estuary due to Haldia. Oil Refinery complex was studied and characterisation of the treated oil refinery effluent was done, which indicated a pH variation from 6.8 to 8.2, DO from nil to 2.7 mg/1, BOD from 36 to 102 mg/1. oil from 5 to 18 mg/1 and hardness (as $Ca\ Co_3$) from 440 to 540 mg/1.

The estuarine water, 0.5 km above to 0.5 km below the outfall of Haldia oil refinery discharge point, was also studied, which indicated a variation of temperature from 30.5°C to 34°C, pH from 8.2 to 8.4, DO from 5.4

to 6.1 mg/l, chloride from 153 to 15936 mg/l, total alkalinity from 72 to 148 mg/l, specific conductivity from 1319 to 10831 millimhos/cm and oil in traces.

Quantitative analysis of plankton was carried out at three sampling zones in the Hooghly estuary around the Haldia Oil Refinery Complex, viz (i) o.5 km above the outfall ; (ii) near the outfall and (iii) o.5 km below the outfall. The analysis has shown that diatoms were encountered in all the centres, the dominant species being *Coscinodiscus* followed by *Synedra*. During low tide condition from April to June, the phytoplankton particularly *Coscinodiscus* ranged 160-480 no./l above the outfall zone, nil-160 no./l near the outfall and 120-160 no./l below the outfall zone. Absence of zooplankton was noticed in the entire zone, excepting single record of nauplii (160 no./l) during the high tide condition in the zone below the outfall.

Static toxicity bioassay experiments were conducted on the treated oil refinery effluent using fish fry of rohu and zooplankton (*Daphnia lumholtzi*) as test animals at room tamperature. 72 hr LC 50 value was found to be 75% by volume of the effluent for rohu. The experiment conducted with the zooplankton (*Daphnia lumholtzi*) indicated no mortality within 48 hrs, 50% mortalty within 96 hrs in 3% by volume of the effluent.

The above study indicated that the pollution effect was not significant from chemical point of view, while the treated effluent showed toxic action on rohu and *Daphnia* during the bioassay studies and phytoplankton number was reduced near the outfall & below outfall zone when compared with above the outfall zone.

Problem 20.15 : Studies on the pollution in Buckingham canal and its effect on the confluent estuarine ecosystems

Personnel : K. O. Joseph, K. Raman, K. V. Ramakrishna, G. R. M. Rao, S. Radhakrishnan and M. Kaliamurthy

Duration : 1979-1982

Location : Madras

Hydrobiological samp'es were collected from 8 sampling poiuts, 6 from Buckingham canal and one each from Adyar and Ennore estuaries. Centres within the city were heavily polluted. During summer due to closure of bar mouth, Adyar and Ennore also exhibited pollution characteristics. Dead fish were observed at Ennore. The condition improved after the opening of the sand bar. The flushing of the canal with the collent water from the Ennore thermal station started in late October has eased the pollution load in all the city centres except Kotturpuram. Plankton and bottom fauna were collected and studied. The fauna were poorly represented in the collections from the polluted centres.

Problem 20 16 : Impact of fertilizer factory wastea on the hydrobiology of river Ganga

Personnel : Krishna Chandra, S. N. Mehrotra G. N. Srivastava and Balbir Singh.

Duration : 1979 to 1983

Location : Allahabad

The IFFCO—factory which will discharge its wastes in the Ganga functioned from 10th October, 1980 for a week and closed then after. Fight sampling stations were selected for the study viz. station No. 1 at the factory Gate (effluent discharge point), station No. 2 at the Mogarsan tank Station No. 3 at the Bairagya Mallah, station No. 4 at the confluence point (outfall, at Dumduma), Station No. 5, 100 M below the outfall, station No. 6, 50 M across the out-fall ststion No. 7, 200 M away from outfall and Station No. 8, 800 m away from the outfall.

The effluents collected during the course of investigation were characterized by high ammonia values ranging from 110.60 to 112.20 ppm, pH values between 8.2 and 8.4 and alkalinity values ranging from 300 to 580.0 ppm chloride contents from 3465 to 58.41 ppm and oils.

The water temperature fluctuated from 27.5 to 32.0°C. At other points (Stn. 2 to 8), pH ranged from 7.8 to 8.2. Other parameters viz., D. O., chloride, hardness, alkalinity and specific conductance ranged from 6.0 to 8.4 ppm, 33.6 to 35.64 ppm, 114 to 124 ppm, 230 to 310 ppm. and 59.75 to 65.79 micromhos/cm respectively. Free ammonia and carbon dioxide content were absent in the samples analysed.

Diurnal variations pertaining to temperature, pH, free carbondioxide and dissolved oxygen were also observed during the course of study. Water temperature varied from 29.5 to 32°C indicating lowest value at 06 hrs. (8.0) and free carbon dioxide was not present in measurable quantities. Dissolved oxygen indicated high values (8.4 ppm) in the noon 12.00 hrs whereas the lowest value (3.6 ppm) was recorded at 24.00 hrs. The primary productivity of Ganga water as determined by light and dark bottle technique was of moderate order (30 mg $C/m^3/hr$).

Prepolluted soils of IFFCO Nallah, Bairgya Nallah and Ganga soil indicated pH values 7.62, 7.64 and 7.28 respectively. Organic carbon contents of the same was estimated at 0.0746 mg/100 g soil, 0.0848/100 g. soil, and 0.0242 mg/100 g. soil respectively. The mechanical analysis of IFFCO Nallah soil showed clay (25%) silt (20%) and sand (55%) respectively. Mechanical analysis of Bairgya Nallah soil showed clay (22%), silt mainly sand (55%) respectively. In Ganga soil mainly sand dominated and silt and clay were not present in measurable quantities. Further analyses of soil are in progress.

Surface and vertical haul samples for plankton were collected. The average total plankton population in surface collection was found to be 700 u/l, whereas total population in vertical haul was 630 u/l.
Phytoplankton was represented by chlorophyceae (*Zygoeia, Pediastrum, Scendesmus, Ulothrix, Spirogyra,* and *Polyenystis*), Myxophyceae (*Merinoedra, Oscillatoria*), Bascillariophyceae (*Gyrosigma Navicula, Nitzchia* and *Synedra*) and Desmidiaceae (*Desmidium, Cosmarium* and *Staturastrum*) Amongest Zooplankton, ton, rotifers were represented by *Brachionus* and *Keratella,* copepodes were represented by *Cyelops* and cladocerans were represented by *Diaptomus.*

The bottom biota population was represented by gastropods, bivalves and chironomids. In the month of November, 1980, mass mortality of fishes (approximately 50 quintals as per information collected from local fishermen and villagers) at a stretch of 16 km from IFFCO Gate to Bairgya Nallah was reported due to toxic wastes discharged for a week only from IFFCO complex, Allahabad. The dead fishes were major and minor carps, catfishes and murrels. Gastropods, bivalves and insects were also found in dead condition at different stations (Stn. 1 to 4). The impact of pollution was indicated by total absence of bottom biota in stations 4, 5 and 6.

Project : 21 Fisheries of river basins

Problem 21. 1 : Ecology and development of *Mans* in Gandak Basin

Personnel : V. R. Chitranshi, H. P. Singh & D. Kapoor

Duration : 1798—1982

Location : Muzaffarpur.

Hydrology : Bahmapura or Sikenderpur *Mans* : During this year air temperature ranged from 18.0°C-32.0°C

and water temperature from 16.5°C to 31.0°C Transparancy was clear to 306.0 cm and pH was 6.5—8.0. Free carbondioxide, total alkalinity and dissolved oxygen showed comparatively high values than the previous year. The values from January to August 1980 varied between nil to 20.0 ppm, 155 to 610 ppm and 1.6 to 14.0 ppm respectively. The gross and net organic carbon production fluctuated between 62.5 to 187.5 mg. C/m^3/hr and 31.25 to 125 0 mg. C/m^3/hr respectively. The respiration value ranged from 37.5 to 75.0 mg C/m^3/hr.

Manika Man : The air and water temperatures ranged from 23.0°C to 37.0°C and 25.0°C to 33.0°C. The transparancy was clear to 296.0 and pH was from 6.5 to 8.4 The range of free carbondioxide was nil to 15.0 ppm. The highest value of total alkalinity (127.5 ppm) was in August and D.O. (16.0 ppm) in May and June. Gross and net organic carbon ranged from 62.5 to 116.66 mg. C/m^3/hr and 31.25 to 62.5 mg C/m^3/hr. Respiration value was 18.75 to 75.0 mg C/m^3/hr.

Plankton : The average plankton production of Brahmapura Man was 3411.5 u/l and of Manika Man was 2168.5 u/1. In both the cases phytoplankton had an edge over zooplankton. *Ceratium, Volvox, Spirogyra. Pediastrum, Coelosphaerium, Oscillatoria, Chetophora, Cladophora, Clostarium, Tabellaria Fraglilaria, Cyclotella, Microcystis, Spirulina, Cosmarium, Penium* and *Navicula* were the coustituents of phytoplankton. Nauplius was the dominant item among zooplankton. Others were *Cyclops, Daphnia, Arcella, Brachionus, Keratella, Anaeuropsis, Triarthra, Polyarthra* and *Diaptomus.*

Bottom biota : For both the *Mans* small molluscan shells formed the bulk of bottom biota. Oligochaetes and Chironomids were also recorded.

Macrovegetation : The *Mans* were infested with floating and submerged weeds like *Eichhornia, Enhydra, Najas Ceratophyllum, Potamogeton, Hydrilla* etc. *Nelumbo, Calderia, Nymphae* and *Nymphoides* were also present.

Fisheries : The major carps were *C. catla, C. mrigala, L. rohita,* and *L. calbasu* and air-breathing fishes were *H. fossilis N. notopterus, Channa* spp. etc.

Project : 22 Fish culture in running water

Problem 22.2 : Catfish culture in running water
Personnel : S. P. Singh, J. C. Malhotra, R. N. Seth and Ramji Tewari
Duration : 1974 to 1981
Location : Allahabad

Assessment of catfish seed resources : Assessment of seed resources of *M. seenghala* and *M. aor* was done, in river Ganga in a stretch of about 5 km around Mehadaurighat, 3 km around Shikuti and 5 km around Sirsa from March to June. The formation of ideal breeding grounds of the fish in the stretch was adversely affected due to the abnormal shrinkage of the river.

A total of 5800 nos of *M. Seenghala* hatchlings/fry (size range 10-30 mm) were encountered.

Assessment in Gulariya reservoir was done once in May and June when breeding pits were located but no hatchlings were encountered. *M. aor* hatchlings were not encountered.

Rearing of hatchlings of *M. Seenghala*

The rearing of hatchlings of *M. Seenghala* was done in floating nylon cages (1×1×1 m) in river Ganga. The hatchlings/fry were transported in open plastic bucket, and were given acriflavin bath. Fish were fed with chironomid egg mass for the first five days and thereafter semi boiled trash fish was also used. Chironomid egg mass was discontinued after the hatchlings were observed to feed on semi boiled trash fish @ 5% of body weight. Rearing in cages continued in the flooded

river. The hatchlings (150 nos) of average size 15 mm (size range 10-30 mm) attained an average length of 130 mm (size range 115-154 mm) in 170 days. In other two experiments with stocking rate of 100 and 60 nos, the hatchlings of average size of 30 mm (size range 25-40 mm) attained 150 mm (size range 125-170 mm) and 234 mm (size range 191-266 mm) respectively in 150 days.

Problem 22.3 : Cage culture in lentic waters
Personnel : R. K. Sexena. M. A. Khan, N. K. Srivastava, B. D. Saroj
Duration : 1976-1981
Location : Gularia

With a view to provide dried plankton as food to the young hatchlings of carps to be reared in the cages, this year experiments to culture plankton in plastic pools were carried out. The stock for inoculation was raised in two glass jars. A maximum of 50,000 u/l comprising *Cyclops* sp. (90%) and *Brachionus* sp (10%) was attained in six weeks time. The material thus obtained was inoculated @ 50.000 u/l, in each of three plastic pools containing concentrations of 1000 ppm and 1500 ppm of RCD in pools 1 & 2 and 700 ppm of GOC in pool 3. A peak of phytoplankton (diatoms) of 4,29,000 u/l, 4,03,600 u/l and 10,700 u/l were recorded in pools 1,2 and 3 respectively in about 5 weeks time. This was followed by zooplankton peak of 4,500 u/l (*Cyclops* sp. 34% and *Brachionus* sp 28%) in pool 1 12,550 u/l in pool 2 and 1,500 u/l in pool 3.

Problem 22.5 : Fish culture in running water pond
Personnel : K. L. Shah and Balbir Singh
Duration : 1980-1985
Location : Karnal

Work to be initiated.

Problem 22.6 : Nutritional and biochemical studies of captive carps
Personnel : P. M. Sherief, Peer Mohamed and, R. K. Sexena
Duration : 1979 to 1983
Location : Allahabad

Four cage reared catla (about 4 year old) and two rohu were dissected upon and samples of blood, liver, gonad and muscles were preserved for biochemical studies.

a) Seasonal biochemical variations in blood, gonad, liver and muscles of captive carps and reservoir carps :

Biochemical analysis of blood, gonad, liver and muscle, obtained from 3 male specimens (IV stage of maturity) of cage reared catla (length range 450-460 mm) collected during June 1980, showed average water contents in gonad, liver and muscles to be 79.5%, 71.45% and 73 5% respectively. The levels of protein, cholesterol, sodium and potassium in serum were 5.0 g/100 ml, 98 mg/100 ml, 193 mg/100 ml and 52 mg/100 ml respectively. The specimens of catla of identical size range from the reservoir for comparison were not available.

b) Effect of stocking density in blood constituents of caged carps : The experiments planned could not be completed as the fishes from all the cages escaped into the reservoir due to severe damage done to the cages by turtles.

Project : 23 Bundh breeding

Problem 23.1 (a) : Breeding of major carps through "Canal Breeding Technique"
Personnal : G. N. Mukherjee, Ravish Chandra S. O. Karamchandani G. N. Srivastava & K. C. Srivastava
Duration : 1977 to 1982

Location : Allahabad

Successful breeding of major carps (*L. rohita* and *C. mrigala*) was achieved through *Canal Breeding Technique* during the investigations carried out in 1980 monsoon season at Baniganj in tne District Chhatarpur of Madhya Pradesh thereby confirming the findings of the year 1977 when said technique was evolved for the first time in village Basehera near Allahabad.

The canal breeding experiments were done in a specially designed breeding complex constructed adjacent to an irrigation canal which was fed by the Benisagar reservoir. The investigations were initiated on 26th June, 1980 when major carp brooders were used in the following sex ratio (males : females).

L. rohita 8 : 5 and *C. mrigala* 4 : 4.

The second consignment of brooders were experimented with on 28th June, 1980 when the sex ratio tried was

L. rohita 9 : 6 and *C. mrigala* 5 : 2 (males : females).

Liming @ 200 to 250 kg. per hectare was done two days prior to the breeding experiments to create alkaline condition within the 'breeding chamber' which presumably added to the favourable conditions inducing breeding of major carps. The breeding took place during 30th June 1980 when the air and water temperature recorded 27.5°C and 28.0°C respectively, while a rise in the pH value from 7.0 to 7.6 was noticed with a transparency of about 8 cm. During the experiments a piece of hassian cloth was spread on the hard stony bottom at the inlet of the chamber for minimising the sound of the gushing water. About 21.5 litres of eggs of rohu and mrigal, numbering *c.* 3.4 lakhs were collected from the eastern and north-eastern breeding grounds where the depth of water ranged from 22.5 cm to 37.5 cm. The fertilisation rate of the eggs was 100%.

Problem 23.1 (b) : Bundh breeding of major carps

Personnel : S. K. Wishard, S. N. Mehrotra and Balbir Singh

Duration : 1974 to 1981

Location : Allahabad

Spawning of major carps was successfully achieved in the Chhatarsaal Dry Bundh near Nowgong (M.P.). Spawners comprising 13 pairs of catla, 17 pairs of rohu and 3 pairs of mrigal were released in the bundh on the eve of 2nd July 1980 when the weather was cloudy and the average depth of water in bundh was 0.82 m. Intermittant rainfall followed and spawners displayed occasional activities for about 6 hrs. Spawning occured in the night of 3/4. 7.80. Average depth of water in bundh was recorded as 1.2 m when the spawning activity ceased. Over 200 lakhs eggs were collected and transferred to hatching 'hapas' and 88% eggs were found fertilized.

Physico-chemical condition of water at the time of spawning was characterized by a fall in water temperature from 30°C (a day before) to 29°C, pH from 7.0 to 6.6, total alkalinity from 33 to 22 ppm, Ca+ from 3.4 to 2.0 ppm, Mg+ 0.28 to 0.22 ppm, total hardness from 19.6 to 14.6 ppm, Cl from 10.8 to 7.2 ppm and sp. conductivity from 33.8 to 28.8 micromhos and an increase in the value of free CO_2 from 4.6 to 8.2 ppm, DO from 5.8 to 6.1 total iron from 4.6 to 6.2 ppm and zeta potentia from 47.5 to 49.0 mv (due to colloidal particles).

Very heavy spawning was observed in Dhubela wet bundh on 12 July 1980 after heavy rainfall in the catchment area from 0900 hrs to 14.30 hrs. Sex-play commenced soon after the downpour and congregation of spawners was sighted at the western periphery of the bundh. Actual spawning commenced at about 01.00 hrs when the water temperature was 28°C, pH 7.0, total alkalinity 106 ppm, Ca+, Mg+ and total iron, 17.0, 2.0 and 0.34 ppm respectively, total hardness 76.0 ppm, Cl 10.0 ppm, turbidity 100 ppm, free CO_2 10.6 ppm, D. O. 6.8, sp. conductivity 256 micro mhos and zeta potential —61.5 mv.

Increasing negative zeta values indicated negative biasing of the environment probably essential for spawn-

ing. Two to three degree fall in the water temperature, a neutral pH and disolved oxygen above 6.0 ppm have also been found conducive for mojor carp spawning.

Project 24 : Freshwater aquaculture in urban andnear urban areas

Problem 24.1 : Intensive rearing of Indian and exotic carps in recirculatory filtering system

Personnel : A. V. Natarajan, K. L. Sehgal, Kuldip Kumar and D. Nath

Duration : 1978-1980

Location : CIFRI Campus, Barrackpore

During the year under report, spawn rearing of *L. rohita* and *C. mrigala* was carried out separately in RFS culture units @ 10 million/ha. The hatchlings in 20 days of rearing attained an average length of 35 mm in case of *L. rohita* and 40 mm in case of *C. mrigala* with respective survival of 80% and 70%. The early fry were fed on formulated mash containing defatted soyabean (60%), fish meal (20% with crude protein level 25%), rice bran (10%), mustard oilcake (5%), wheat starch (5% used as binder) and poultry vitamin-mineral premix @5 g/kg feed. The crude protein level of the mash was 30%. The rate of feeding was 8-10% of body weight given at every two hours. The water circulation was for short duration.

For rearing of fingerlings of *Cyyrinus carpio,* fry (12 mm) were stocked @ 10 lakhs/ha. After 34 days of rearing, fry had grown to an average length of 75 mm with 70% survival. The fry were fed on formulated mash and crumbles @ 8-10% body weight every two hours from sunrise to sunset. The feed conversion ratio achieved was 1 : 2. The water recirculation was effective for six hours/24 hours.

Rearing of *L. rohita* fry for 30 days at stocking density of 5.0 lakh/ha gave survival rate of 98%. The average size attaining 86 mm from initial length of 23 mm during this period. Compared to this, in case of *Catla catla* rearing of fry (27 mm) for 39 days @ 4.2 lakh/ha stocking density attained an average length of 79 mm with 73.2% survival. The fry of both species were fed on compound mash and crumbles @ 8-10% body weight four times daily with an interval of 3 hours.

Among exotic carps, silver carp fry attained an average length of 86.0 mm in 32 days rearing from initial length of 23.0 mm at stocking density 5.0 lakh/ha. The fry were fed on the same diet as catla and rohu and the conversion ratio achieved was 1 : 1.3.

Problem 24.4 : Freshwater aquaculture in urban and near urban areas

Personnel : A. V. Natarajan, K. L. Sehgal and K. Kumar

Duration : 1980-1982

Location : Barrackpore

Trials on induced breeding of Indian carps in RFS pond were initiated in July 1980. The brood stock of *L. rohita* and *C. mrigala* weighing 800-1500 g were produced locally. The brood fish were injected with pituitary extract at a dose of 3-8 mg/body weight and released in floating net cloth hapas. The ratio of female to male was 1 : 2. The fish bred 4-6 hrs. after giving second dose of pituitary extract. The RFS system was operated for 4 hrs. after second injection and the hapa containing injected fish was kept near the site of the water fall. The success of breeding ranged 90-100% and rate of fertilisation was 90-96%. The experiments were conducted at water temperature of 29-31° C.

The fertilised eggs were incubated in specially designed floating incubation chambers (1.5 x 1.0 x 1.5m) made of 1/40" nylon mesh framed in aluminium pipe framework.

Each chamber of cage was fitted with two round mesh cloth hatching trays and in each tray 40,000 eggs were spread in a single layer. The RFS was put into operation for about 8 hrs/day during incubation period. The percentage of hatching ranged 80-84% and the hatchlings after 3 days of rearing in the cages were released into the pond.

Project 25 : Beel Fisheries

Problem 25.1 : Pen culture and study of Ecology and fishery management of a selected beel in Assam

Personnel : Y. S. Yadava, M. Choudhury, R. K. Singh & V. Kolekar

Duration : 1978-1981

Location : Dighali beel, Assam

A. Catch statistics :

Fishing in the Dighali beel started during the month of October. A total of 1387 kg of fish were estimated to have been caught from the beel during the period under report.

The composition of the various species caught from the beel is as follows : Live fishes (457 kg ; 32.95%) dominated the catch followed by *W. attu* 332 kg (23.94%), *N. notopterus* 325 kg (23.43%), *L. rohita* 102 kg (7.35%), miscellaneous 56 kg (4.04%), *C. catla* 52 kg (3.75%), *L. bata* 30 kg (2.16%), *C. mrigala* 11 kg (0.79%), prawn 9 kg (0.65%), *M. seenghala* 8 kg (0.58%) and *N. chitala* 5 kg (0.36%).

B. Hydrological observations :

Hydrological parameters of the beel were collected sector-wise for analysis. Water quality of the pen installed in the beel was also studied simultaneously and the observations, recorded, are as follows :

Parameters		*Beel range*	*Cage range*
Air temperature	°C	23.5-37.0	23.5-36.5
Water temp.	,,	22.0-30.5	22.0-30.5
Transperency	cm	25.0-109.0	— —
pH		5.1-8.3	5.2-8.2
D. O.	ppm	2.0-10.8	2.2-6.8
CO_2	,,	1.5-28.0	2.0-20.0
HCO_3	,,	24.0-59.0	29.0-49.2
Fe	,,	Trace-0.10	Trace-0.68
NH_4-N	,,	0.01-0.36	0.04-0.20
NO_3-N	,,	0.15-1.00	0.15-1.10
Phosphorus	,,	Trace-0.176	Trace-0.176
Chloride	,,	4.0-6.0	4.0-5.6
Silica	,,	6.0-8.0	5.6-6.8
Dissolved org. matter	,,	6.0-174.4	12.0-68.0
Electric conductivity (m mhos/cm)		42.0-125.0	50.0-120.0
O_2 saturation	%	22.8-142.7	28.6-125.0

C. Plankton analysis :

Average monthly abundance of plankton was 913 u/1, which consisted 775 u/1 of phytoplankters and the rest of zooplankters.

Chlorophyceae (320 u/1), Myxophyceae (11 u/1) and Desmidaceae (61 u/1) dominated among the phytoplankton and copepods (60 u/1) was followed by rotifers (38 u/1), protozoans (28 u/1) and cladocerans (12 u/1), among the zooplankters.

The common genera observed were *Spirogyra, Mougeotia, Ulothrix, Chodatella, Navicula, Synedra, Tabellaria, Surirella, Oscillatoria, Nostoc, Cosmarium, Desmidium, Micrasterias,* etc. among the phytoplankton and *Filinia, Brachionus, Lecane,* Nauplius, *Cyclops, Ceratium, Eudorina,* etc., among the zooplankton.

D. Macrobenthos :

The average monthly occurrence was found to be 311 Nos/m^2. It consisted of molluscs (119 nos/m^2), annelids (93 nos/m^2), insect larvae (45 nos/m^2).

The common organisms recorded were *Vivioarus* sp. *Gyraulus, Amnicola, Helisoma, Nais simplex, Tubifex, Chironomus* larvae, *Cyzicus* etc.

E. Pen culture—

The common carp fingerlings stocked in the nylon pen attained a length of 171 mm on 23. 10. 80. Initial average length was 106 mm. Thus an increment of 65 mm was observed during the 10 months.

Periodical checks were made on the fishes under pen culture for detection of infection or diseases. No infection was detected.

Problem 25. 2 : Ecology and fisheries of beels
Personnel : S. B. Saha, A. V. Natarajan, and V. Pathak
Duration : 1980-1982
Location : Kalyani

Survey was conducted in the beel to observe general ecology including physico-chemical characteristics of soil and water, productivity, plankton, benthos and aquatic vegetation.

Project 26 : Energy flow in aquatic ecosystem

Problem 26. 1 : Studies on the energy flow in different aquatic ecosystems
Personnel : A. V. Natarajan, V. Pathak & B. Lal
Duration : 1980-1982
Location : Barrackpore

Five different ecotopes have been taken for the study to trace out the pathway of energy transformation and to draw trophic dynamic models of productivity in different ecosystems. The various ways of influx of energy i.e., autotrophic, allochthonous and chemosynthetic are being studied. Studies in one such system-'a beel' have shown that the energy fixed by microorganisms through autotrophic photosynthesis is only 2500 cal/m^2/day and large amount of energy is fixed by the macrovegetation. Studies on energy transformation through different trophic levels and pathways of utilisation of energy in varions ecosystems are in progress.

Project 27 : Radio tracer technique in aquaculture

Problem 27. 1 : Estimation of primary productivity of freshwater reservoirs, ponds and swamps using C-14 technique.
Personnel : Babu Lal
Duration : 1979-1982

Location : Barrackpore

^{14}C—labelled sodium bicarbonate (Na H ^{14}C CO_3) ampoules were procured from the isotopes groups of Bhabha Atomic Research Centre, Trombay, Bombay. Experiments were conducted *'in situ'* in four reservoirs, *i. e.* Bhavanisagar. Nagarjunasagar, Rihand and Govindsagar. Average net column production of Bhavanisagar reservoir was estimated to be about 325.55, 235.23 and 402.22 mg C/m²/12 hrs in lentic, intermediate and lotic sectors respectively. Whereas in the Moyar range of the same reservoir which is the confluence of the two rivers, Bhavani and Moyar, the average net primary production was observed to be about 586.28 mg C/m²/12 hrs.

In Nagarjunasagar reservoir the production was observed to be about 545.65, 255.25 mg C/m²/12 hrs, in the lentic and intermediate, of the reservoir respectively.

Rihand reservoir showed lower range of column production i. e. 145.55 to 272.28 mg C/m²/12 hrs, whereas higher range of production (558.45 to 680.65 mgC/m²/12 hrs) was observed in the Govindsagar reservoir.

Problem 27. 2 : Studies on transformation and fate of applied nitrogenous fertilizers in freshwater ponds and swamps using ^{15}N

Personnel : Babu Lal & V. Pathak

Duration : 1980-1982

Location : Barrackpore

Several fish ponds under various research projects were surveyed for collection of soil samples. Bottom soil samples of the deeper fish ponds could not be collected due to the standing crops and stagnant water, Swamps containing derelict water in the low lying and water logged areas were selected for conducting the experiments on nutrient balance.

Project 28 : Adaptive research in fish culture

Problem 28.1 : Low cost fish culture in village ponds

Personnel : R. M. Bhowmick, C. Selvaraj, P. L. N. Rao, S. L. Kar, Radheyshyam, S. K. Sarkar, B. R. Datta, C. S. Purushothaman, Kuldeep Kumar and J. P. Verma

Duration : 1980-1983

Location : Dhauli

In order to evaluate the level of fish production in village ponds with low level of inputs, a pond of 0.75 ha, situated at Nakhurpatna village was selected and prepared by repeated netting to remove the previous stock of fish as well as other unwanted fishes. The pond was stocked at a low stocking density of 3500/ha with fry of catla, rohu, mrigal, grass carp and common carp in August. 1980. Water and plankton quality was checked at regular intervals. Sampling of fish has indicated a satisfactory growth of all the species indicating the natural production potentiality of the village ponds.

Problem 28.2 : Utilization on domestic/kitchen ponds for fish culture

Personnel : Radheyshyam, B. N. Singh, P. L. N. Rao, B. B. Satpathy, J. P. Verma, Kuldeep Kumar, B. R. Datta and S. K. Sarkar

Duration : 1980–1983

Location : Dhauli

Initial work was started to introduce fish culture in semiderelict domestic water holdings in the villages.

Problem 28.3 : Impact of training in scientific fish culture by KVK/TTC in adopted villages

Personnel : B. R. Datta, Kuldeep Kumar, Radheyshyam, B. N. Singh and C. S. Purushothaman

Duration : 1982-1982

Location : Dhauli

Work has been initiated. Necessary proforma has been prepared and the survey work has been undertaken in different specified conditions.

Project 29 : Fish nutrition and feed technology

Problem 29.1 : Amino acid profile and proximate composition of conventional fish feeds

Personnel : R. Paul Raj, B. N. Singh and P. R. Sen

Duration : 1980-1982

Location : Dhauli

Proximate composition analysis of a few locally availiable fish feed ingredients has been done, Data on the proximate composition and essential amino acids profile of a few feed stuffs were also collected from the published literature with a view to preparing feed composition tables.

A pelleted feed was formulated using ground nut oil cake, rice bran, fortified with vitamin premix and calcium carbonate and its acceptability to carp fingerlings (rohu) has been tested.

Problem 29.2 : Aminoacid requirement of Asiatic carps, rohu, *L. rohita*, catla, *Catla catla*, mrigal, *C. mrigala*, silver carp, *H. molitrix* & *C. idella*

Personnel : B. N. Singh, P. R. Sen and R. Paul Raj

Duration : 1980-1984

Location : Dhauli

Two test diets have been formulated with the following composition.

Diet (1) Skim milk 50%, tapioca starch 20% cellulose powder 15%, vitamins (fat and water soluble) and minerals (trace elements) 1% and amino-acid mixture 14%.

Diet (2) Aminoacid mixture 48%, white dextrin 18%, shark liver oil 2%, mustard oil 7%, vitaminised cellulose powder 9%, minerals mixture 4%, cellulose powder 2% and carboxymethyol cellulose 10%.

Project 30 : Cat fish culture

Problem 30.1 : Poly culture of *P. pangasius* and *Mystus* spp.

Personnel : B. N. Saigal, K. Kumar, A. Ghosh, M. J. Bhagat & K. S. Banerjee

Duration : 1980-1983

Location : Barrackpore

Work could not be started due to the unavailability of ponds.

Project 32 : Rural aquaculture project

Problem 32. 1 : Use of biogas slurry as fish feed

Personnel : M. L. Bhoumick and S. P. Rai

Duration : 1980-1981

Location : Barrackpore

Preliminary studies on the determination of food and energy values of different combinations of feed prepared with slurry were undertaken.

Problem 32. 2 : Use of tobacco and tea waste as fish toxicants
Personnel : M. L. Bhoumick, S. P. Rai and J. G. Chatterjee
Duration : 1980-1981
Location : Barrackpore

Determination of the duration of toxicity and the effects on the phisico-chemical and biological qualities of water and soil are in progress.

Problem 32. 3 : Biochemical and nutritional studies on silver carp and grass carp and formulation of compounded feed for intensive culture

Personnel : Amsuman Hazra and S. D. Tripathi
Duration : 1980-1981
Location : Barrackpore

Preliminary observations were made on a variety of rations prepared from cheaper and conventional feed ingradients.

Problem 32. 4 : Effect of cation and anion exchange capacity, pH and type of clay minerals on fertility of fish ponds
Personnel : D. Nath, S. P. Rai, and J. G. Chatterjee
Duration : 1979-1981
Location : Barrackpore

Soil and water conditions of ponds in different regions are studied in respect of pH, organic carbon, available total nitrogen, available phosphate CEC of soil, free calcium carbonate and mechanical analysis of soil.

Problem 32. 5 : Use of rock phosphate and basic slag in pond fertilisation

Personnel : S. P. Rai, M. L. Bhoumick and D. Nath

Duration : 1980-1982

Location : Barrackpore

Release of phosphate from basic slag and purulia rock phosphate to a level (0.58 ppm) satisfactory for plankton and fish production has been observed during experiments with acid soil base. Changes in soil reaction towards a neutral pH have also been observed during the present experiments. Experiments with dolomite as liming material at 600 kg/ha have also given encouraging results in raising soil pH from 5.4 to 6.2 in ten days.

Coordinated research projects.

Problem CFCSP 1. 1 : Composite Fish Culture and Fish Seed Production

Personnel : (CIFRI centres) R. D. Chakraborty, H. A. Khan, D. V. Pahwa, M. Y. Kamal, R. M. Rao, K. N. Krishnamurty, M. Sinha, P. M. Mathew, J. B. Rao, D. N. Mishra, B. C. Tyagi, P. K. Aravindakshan, A. Mukherjee, D. P. Chakraborty, P. K. Saha, B. K Singh, P. C. Mahanta, and P. N. Jaitly

Location	:	Badampudi, Gauhati, Ranchi Karnal, Poona, Bhavanisagar. Jaunpur, Kalyani
Period	:	1971-1984

Problem CFCSP 1. 2	:	Composite Fish Culture & Fish Seed Production
Personnel	:	R. D. Chakraborty, H. A. Khan, N. Sukumaran,
(Centrally sponsored centres)		H. L. Bhatia, R. L. Thawait, P. C. James, V. R. Khadse, A. S. Purani, S. A. Kadri P. V. Rao, N. Ramanathan
Location	:	Kausalyagang, Godhra, Durg, Tuticorin
Period	:	1976 to 1984

a. *Composite fish culture*

The composite fish culture experiments in the centrally sponsored centres resulted in the following production. At the Kausalyagang centre with six species it was 1312 kg/ha/10 months using both organic and inorganic fertilizers employing 5 species (no grass carp). In one experiment it was 1350/12 months and 1896/11 months using organic fertilizers only. At the Durg centre the pond provided with fertilizer and feed yielded 2487 kg/11 months; the one in which fish pond received fertilizers alone, fish production was 2276 kg/ha/11m and the one using feed alone gave fish yield of 1149 kg/ha/11m. At Godhra one year experiments yielded fish @ 2204 and 2029 kg/ha/yr. At Tuticorin, ponds fertilized and fish fed with artificial feed yielded productions of 2347 kg/ha/167 days and 2979 kg/ha/194 days (higher stocking density).

b. *Fish Seed Production*

Total fish seed production at the centres were 1,08,28,600 comprising Indian major carps and exotic carps. Seed from Tuticorin centre (79-80) included one lakh spawn of *L. fimbriatus*, and from Kausalyagang one lakh spawn of *L. calbasu*. At Godhra, catla was successfully bred for the first time. At Tuticorin, grass and silver carps were bred for the first time.

Problem CFCSP 6	:	Biology and role of grass carp, *Ctenopharyngodon idella* in monoculture
Personnel	:	K. K. Sukumaran & K. Gopal Rao
Duration	:	1977-1980
Location	:	Dhauli

Rearing of fry and fingerlings was undertaken. Observations were made on the growth and brood fish care. Work is in progress.

Problem CFCSP 10	:	Operational Research on Composite Fish Culture and Integrated Livestock-Fish Farming
Personnel	:	B. K. Sharma, M. K. Das, S. R. Das, S. P. Rai and D. Narayanaswami
Location	:	Krishnagar
Period	:	1973 to 1983

Work is in progress

Problem CFCSP 11	:	Biology of silver carp, *Hypophthal michthys molitrix* (C & V) and its performance in composite fish culture
Personnel	:	B. K Sharma
Location	:	Krishnagar and Khardah
Period	:	1975 to 1982

Work is under progress.

Problem CFCSP 18 : Fish nutrition
1. Protein, carbohydrate and vitamin requirements of certain Indian major carps in relation to temperature

Personnel : B. N. Singh, V. R. P. Sinha
Duration : 1977-1980
Location : Dhauli

Work is under progress.

Problem CFCSP 19 : Use of some cacti as piscicide
Personnel : Dilip Kumar
Duration : 1977-1980
Location : Dhauli

Plants of the group Euphorbiaceae having piscicidal nature were identified and collected from local sources near Dhauli and also from W. Bengal. For making these species available throughout the year, cuttings from each species were planted and maintained so that they can be used as and when needed.

Problem CFCSP 21 : Composite fish culture and fish seed production

Personnel : M. Sinha & P. K. Saha
Location : Barrackpore
Period : 1979 to 1982
Work done :

1) The fish was bred successfully this year also.

2) It was observed that the fish grow to an average size of 350 g during the course of a year. During first 5-6 months of rearing it attains an average weight of 300 g indicating a better possibility of production in multiple stocking and multiple harvesting. The fish showed good average monthly increment in weight (29.28 g/month) even in the absence of weed. With weed av. monthly increment in weight ranged from 31.45-35.00 g/month. This indicates the possibility of being able to culture the fish both in presence and absence of submerged weeds.

3) The work on maturity and fecundity of the fish is in progress. The work could not be completed for want of sufficient mature fish which were stolen in dacoity.

4) One pond was stocked during the year with a view to study its production potential in multiple stocking and multiple harvesting. The experiment was vitiated due to dacoity and as such no conclusion could be drawn.

Problem CFCSP 25 : Magur culture under field conditions

Personnel : P. Das, B. Roy, U. Bhowmick, B. K. Banerjee, P. K. Pandit and S. N. Sar

Duration : 1980

Location : Pond at Bali in Howrah District

An adaptive research on low-cost feed for magur culture was taken up in 1980. A pond (0.17 ha) stocked with magur at a density of 47465 nos./ha and fed with compost of cowdung, mustard oilcake and groundnut oilcake mixed in a ratio of 30 : 1 : 1 yielded a net production of 2886.76 kg/ha/6 months. The retrieval was at 62.48%. The cost of production of Magur fish worked out to be Rs. 4.75 per kg. The new feed was acceptable to the fishes which was confirmed by the good growth and survival of fishes. The cost of the feed in the present experiment was 25.3% only of the total expenditure against 55.5% in the recommended feed of animal origin. The experiment with low cost feed for magur indicates a probability of quicker mass adaption of the technology by the rural farmers.

Problem CFCSP 26 : Impact of field demonstration in adoption of scientific carp culture technology

Personnel : P. Das, U. Bhowmick, B. Roy, S. N. Sar, P. K. Pandit, and B. K. Banerjee

Duration : 1980

Location : 50 demonstration ponds under Extension section

The level of adoption of composite fish culture in a scale of 100 was found to vary between 50 to 95%. Amongst different extension communication sources roles played by mass media, personal cosmopolite sources, personal localite sources and training were 40.69, 34.60, 14.86 and 9.85% respectively. In addition to various information sources age, qualification occupation and experience of the farmers were found to have a bearing on the acceptance or rejection processes. Among others, the role played by State Extension Officers were found to be insignificant against a very significant role by the scientists of CIFRI. The insignificant role by State Extension Officers may be due to less involvement in work, scarce visit or even low credibility. It has been felt that the credibility can be enhanced through effective training etc.

Problem ABF 1 : All India Coordinated Research Project on air-breathing fish culture

Personnel : P. V. Dehadrai, S. K. Mukhopadhyay, P. K. Mukhopadhyay, D. Kumar, B. Venkatesh, S. C. Pathak, M. P. Singh Kohli, N. K. Thakur, S. K. Munnet, V. K. Murugesan and P. Kumaraiah

Location : Barrackpore, Patna, Gauhati, Bangalore

Period : 1971 to 1983

Work done :

Stocking material of magur and singhi were produced through hypophysation at Patna and Gauhati centres of the project besides locating new potential seed collection centres for magur at Ranchi and Mangalore, *Channa marulius* at Bangalore, Shimoga, Chickmagalur and Mandya and singhi at Bangalore, Darbhanga Madhubari and Koti divisions of North Bihar. Magur was successfully bred in simulated breeding ground at Khardah centre. Magur and singhi could be bred as early as during April and May by exposing them to extended photoperiod of 14-16 hours per day. Success was also achieved in producing hybrids between *Heteropneustes* male and *Clarias* female. Laboratory studies on effect of feed on gonad revealed that feed with animal protein resulted in better gonadal growth over feed with plant protein. Diets rich in fat content resulted in poor gonadal gorwth.

Monoculture of magur under semiintensive culture yielded production, ranging from 3266 kg/ha/5 months to 4212 kg/ha/11 months. A production of 5042 kg/ha/yr was achieved under mixed culture of magur and singhi at Gauhati centre. Low input culture technology of magur and singhi was successfully demonstrated in West Bengal with production ranging from 2034 kg to 2380 kg/ha in 4 months of magur and 1432 kg to 1792 kg/ha in 4 months of singhi. The ultimate evidence of the biochemical pathways involved in assimilation and conversion of nitrogen from urea into aminoacids has been traced through mass spectrometric studies using 15N urea. Preliminary studies on the effects of sublethal malathion on gonads indicated that magur exposed to 0.5 ppm malathion for 40 days accumulated malathion in trace quantities in the testis. Histological studies indicated slight necrosis in the structure of seminal vesicle.

Problem 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

Personnel : P. K. Mukhopadyay, P. V. Dehadrai and A. P. Mukherjee

Location : Barrackpore, Calcutta

Duration : 1978-1982

In continuation of the earlier studies on this aspect, investigations about the effect of 0.5 ppm malathion in ambient water on the activities of mitochondrial ATP-ase (Mg^{++}– and Na+—K+—Mg^{++} dependent) from liver and gill tissues of *Clarias* revealed a significant lowering of activities of the enzymes in experimental groups of fishes compared to controls. This indicated that toxicity of malathion was related to disruption of oxidative phosphorylation in tissues besides causing inhibition of brain acetylcholinesterase activity and some other cellular biochemical reactions.

Measurement of the distribution of major phospholipids and fatty acids in liver tissue of *Clarias* (exposed to 0.5 ppm malathion) was carried out. The phospholipids - sphingomyelin, phosphatidyl choline, lysophosphatidyl choline, phosphatidyl ethanolamine and cardiolipin (know to be responsible for characteristic and vital properties of cell membranes) revealed not much change in their level in experimental fish when compared to controls. The essential fatty acids in liver were also quantified by gas chromatography and the results revealed significant alteration in their makeup in experi mental groups of fishes from controls.

Preliminary studies conducted on the effects of malathion on reproductive functions in the fish following exposure to sublethal concentration of malathion (0.5 ppm in the present study) involving assessment of the level of bio-accumulation of the pesticide in gonads & histological observations of the tissue revealed that when exposed to the compound for forty days at 0.5 ppm level, testis accumulated malathion in trace quantity unmeasurable on chromatogram scale. Light microscopic studies of testis also indicated some minor changes in the cellular architecture of the tissue. In view of the recent restrictions imposed on the use of a number of organochlorine pesticides the carbamate pesticides and especially carbofuran (2,3 dihydro-2,2 dimethyl-7 benzofuranyl methyl carbamate) find wide range of agricultural applications. Acetylcholinesterase inhibiting activity of carbofuran and its additional biochemical effects though after suspected have not been investigated in detail particularly in the commercially important food fishes.

Problem ABF 3 : Comparative studies on the gonadal development of *Clarias batrachus* and *Heteropneustes fossilis* under induced maturity and natural maturity

Personnel : S. K. Mukhopadhyay, B. Venkatesh P. V. Dehadrai and Dhirendra Kumar

Location : Barrackpore and Kalyani

Duration : 1980 to 1981

Exposure of cat fish to long photoperiod from the month of February, 1980 advanced the formation of large mature yolk ova. Mature singhi were obtained in the month of April and magur in May. Singhi were induced bred with the injection of one year old carp pituitary extract at the rate of 100-150 mg/kg body weight in the aquarium in the month of April. All the eggs died before hatching. In the fishes which were induced bred during May to August, natural fertilization occurred. The eggs obtained from such females always hatched into normal fry. Sometimes singhi brooders which bred partially and reinjected with carp pituitary next day, successfully spawned.

Histological preparations of maturing ovary and testis of *Ciarias batrachus* and *Heteropueustes fossilis* have been done and are under study to determine abnormalities if any under induced maturation. Sperm mobility in relation to different media have been studied. Induced breeding of *Heteropneustes fossills* by hyyophysation was conducted during breeding season. Success have been achieved in obtaining hybrids between the male *H. fossilis* and female *C. batrachus* in the month of June.

After a preliminary assessment on the dose-response relationships and determination of 96 hr. LC 50 of carbofuran for *Clarias* the fish was exposed to 0.5 ppm carbofuran for thirty days. Activities of some key enzymes involved in ammonia detoxification and energy metabolism were markedly altered in the fish. Studies on the bio-accumulation in various tissues indicated presence of carbofuran in gills, liver, intestine and testis, light microscopic studies also showed disturbances in normal tissue architecture of testis of the fish.

Impairment of intestinal transport processes was observed from significant decrease of Na^+, K^+,— ATPase in intestine of the fish following carbofuran treatment.

Further studies on the rate of 14C—lysine incorporation in tissue preteins, 3H-thymidine incorporation in nucleic acids, membrane confirmation are underway to establish a rationale on the effect of the pesticide on metabolism *viz-a-viz* toxicity.

Problem ABF 14	:	Investigations on the possibilities on NPN utilisation by the catfishes, *Clarias* and *Heteropneustes*
Personnel	:	P. V Dehadrai & P. K. Mukhopadhyay
Location	:	Barrackpore, Calcutta
Duration	:	1978 to 1981

Synthetic test diets containing different levels of urea were fed to *Clarias batrachus* and *Heteropneustes fossilis* and the effect on growth, body composition, certain cell components and enzymes from different tissues have been studied. The fate of the non-protein nitrogen in the body was also determined by isotopic studies. In contemplating the extent of non-protein nitrogen (NPN) utilisation by the two fishes, three approaches were mainly followed. The first one involved feeding NPN supplemented diet to the fish and noting the adventage of its inclusion in terms of weight increment in a specified period of time. The second one was that of evaluating quantitatively some enzyme catalysed reactions of intermediary metabolism and the third one concerning the fate of NPN in the system through the location of 15N within the vital tissues of the organism by mass spectrometry. Three sets of experiments were conducted after the last Workshop (December, 1978).

Growth recorded in *C. batrachus* and *H. fossilis* fed on NPN supplemented diets were comparable with those of standard test diet fed fishes. When 50% protein of the standard test diet was replaced by urea supplying equivalent nitrogen, growth performance was found to be exceedingly well compared to groups fed on standard test diet. Activities of two hepatic enzymes - aspartate and alanine aminotransforase remained unchanged in 3% urea diet fed fishes compared to controls showing normal liver function in respect of amino acid metabolism and consequently adaptations to dietary urea. The activity of liver glucose 6 phosphatase was found to be increased in urea fed fishes with respect to controls.

This indicated increased gluconeogenesis in maintaining an increased blood glucose level in NPN fed fishes. Alkaline phosphatase activity remained unaltered in liver tissue of the fish with NPN-diet treatment. Liver arginase activity did not change in 3% NPN fed fishes compared to control but it should be an increasing trend in 7% NPN diet fed fishes ; alkaline phosphatase however, did not show and change in the urea diet fed fishes. The enhanced urease activity as recorded with 3% diet clearly indicated urea utilisation by the two species.

Incidentally in contrast to enzyme activities no significant alterations in the level of certain vital physiological indices in blood *viz.*, total protein, free aminoacids (both essential and nonessential) urea, glucose and total ascorbic acid could be noticed which may be ascribed to be due to the effect of NPN ingestion. Analyses of the chemical compsition of fish fed with urea supplemented diet did not indicate any discernible change in the content of protein (Total N x 6 25), fat (petroleum ether (40°-60°) extractable), moisture and ash compared to control diet fed fish. Preliminary mass spectrometry studies of benzamide (formed after passing NH_3) produced in he distillation of sulphuric acid digested protein samples from liver and muscle tissues of fish fed on NPN-diet) into benzoyl chloride dissolved in benzene (chilled) also support the above observations.

Problem ABF 18 : Feed formulation for air-breathing cat fishes *Clarias batrachus* and *Heteropneustes fossilis*
Personnel : B. Venkatesh, D. Kumar, P. K. Mukhopadhyay
Location : Barrackpore
Duration : 1980-81

Various feed ingredients were screened for their suitability as the major protein component in the catfish feed. Fish meal, meat meal, dried silk worm pupae, gobar gas slurry, poultry dropping, rice bran and wheat flour have been selected for formulating practical catfish diet. Laboratory experiments are underway to evaluate the efficacy of the formulated feed combinations. Techniques of DNA and RNA extraction and estimation in the muscle and liver tissue of *C. batrachus* and *H. fossilis* have been standardised.

Problem ABF 16 : Semiintensive cnlture of *Clarias batrachus* and *Heteropneustes fossilis* using organic waste.
Personnel : Dhirendra Kumar, B. Venkatesh and S. K. Mukhopadhyay
Duration : January, 1980 to December, 1980
Location : Khardah

Two experiments on magure culture at different stocking densities of 1,05,000 and 45,000 fishlets per ha. were carried out in 0.04 ha pond using mixture of carcass meal, damaged rice and wheat bran having protein content of 44%, 6.48%and 20% respectively. Under high density culture, a production of 1,129 kg/ha/5 months was obtained with a survival rate of 42.7%. Under low density culture, a survival rate of 77% and a production of 265 kg/ha/ of silver carp of average weight 530 g was obtained in 90 days.

Singhi fingerlings of average weight 5.9 g were reared in a 0.04 ha pond at a stocking density of 1,59,000/ha using mixture of gobar gas slurry, poultry droppings and damaged rice/wheat bran as supplementary feed. The average total nitrogen content of gobar gas slurry and poultry dropping was 2.5% and 1.8% respectively. Production at the end of 5 months culture was 1898 kg/ha with a survival rate of 47.3%

Problem R-1 : Ecology and Fisheries of Freshwater Reservoirs
Personnel : S. D. Tripathi, G. K. Bhatanagar, Ch. Gopalakrishniah, Y. Rama Rao, V. R. Desai, M. Ramakrishniah, A. Mathew, B. P. Gupta, Smt. S. Sivakami, V. V. Sugunan, Smt. G. K. Vinci, B. C. Jha, D. K. Kaushal, N. P. Srivastava, V. Pathak, V. K. Sharma, S. N. Singh, M. D. Pisolkar, K. K. Agarwal, A. K. Likka
Duration : From 1971 - continuing
Location : Nagarjunasagar, Bhavanisagar, Rihand, Ranchi and Bilaspur

Bhavanisagar Reservoir (Tamil Nadu) :

A total of 253.7 t (68.7 kg/ha) of fish was landed as against 197.8 t (51.3 kg/ha) during the corresponding period last year. The increase in yield is accounted for the increase in fishing effort during the current year, the catch/unit effort being 1.03 kg/50 m net length. *L. calbasu* (31.85%) was the dominant fishery, followed by *M. aor* (19.8%), *W. attu* (11.0%), *L. rohita* (5.1%) and *C. mrigala* (3.9%). *P. dubius*, *L. fimbriatus* and *L. bata* also contributed substantially to the landings.

Experimental fishing, using 60-300 mm meshed surface gill nets, gave an average catch of 36.0 kg/day in the lotic sector followed by Moyar (21.1 kg/day). intermediate (20.3 kg/day) and lentic (11.5 kg/day) sectors. Maximum catch (31.5 kg/day was) obtained in April followed by December (31.1 kg/day). *L. bata* contributed 22.2% followed by *M. aor* (20.5%), *L. calbasu* (18.9%), *P. sarana* (7.9%), *P. dubius* (7.1%), *W. attu* (6.2%), *C. catla* (5.2%), *C. mrigala* (4.2%) and *L. rohita* (3.2%). *P. dorsalis* and *Ompok bimaculatus* along with a few others also formed substantial catches. Mesh selectivity studies indicated that *C. catla* was selective for 260-300 mm, *C. mrigala* 120-160 mm, *L. rohita* 120-170 mm, *L. calbasu* 130-140 mm and *L. bata*, *P. dubius* and *P. sarana* 70-100 mm meshed nets. Experimental fishing clearly indicated that certain populations in the reservoir, of which *L. bata* is the most important, remain underexploited.

Studies on the biology of *L. calbasu* indicated that some individuals in the larger size groups above 601 mm breed twice an year.

2,69,083 fingerlings (61.8-100.4 mm) comprising *C. mrigala* (89.0%), *L. fimbriatus* (10.96%) and *C. catla* (0.04%) were stocked in the reservoir by the state department.

Experiments on raising of carp seed in an improvised pen (0.025 ha) constructed by enclosing a shallow area in the Poongar swamp by bamboo mats and provided with an inner lining of nylon neeting (1/32" and 1/16"), gave a production of 0.78 million fry and 0.49 million fingerlings/ha during the first and 0.5 million fingerlings/ha during the second experiment. The survival was 27.8 and 10% respectively during the first and second experiments, low survival during the second experiments being due to nonthinning of the advanced fry.

Getalsud Reservoir, Ranchi (Bihar) :

Studies on the ecology of the reservoir indicated the presence of a thermocline in February, March and April in the lentic sector. Biogenic chemical stratification in respect of pH, dissolved oxygen and carbon dioxide was also noted in the lentic sector during April, May and June. Thermocline and biogenic chemical stratification did not occur in other sectors probably on account of the low depth. Sharp changes in chemical parameters such as pH, dissolved oxygen, carbondioxide and bicarbonate were noted during diurnal studies in the lentic sector in June indicating greater photosynthetic activity than during other months. Primary productivity values indicated that the intermediate sector (net production 62.5-350 mg C/m^3/day) was the most productive followed by the lotic sector (nil-325.50 mg C/m^3/day).

Average planktonic abundance and total standing crop was the highest in the lotic sector (0.668 ml/m^3 and 1,304.991 units/m^2) followed by the intermediate (0.553 ml/m^3 and 622.753 units/m^3) and lentic (0.722 ml/m^3 and 365,018 units/m^3) sectors. Phytoplankton predominated throughout the year with Myxophyceae as the main constitutent except during January in the lotic and intermediate sectors when Bacillariophyceae was most abundant.

Benthos abundance varied from 58-974 units/44.73-930.73 mg/m^2 in the lotic sector, 67-303 units/76.96-1145.73 mg/m^2 in the intermediate sector and 58-414/23.09-246.75 mg/m^2 in the lentic sector.

150,000 fry and fingerlings of Indian major carps were stocked in the reservoir by the State Fisheries Department.

Govindsagar Reservoir, Bilaspur (Himachal Pradesh)

A total of 932 t (89.62 kg/ha) of fish was landed during the year comprising *C. carpio* (33.6%), *L. dero* (25.4%), *L. rohita* (12.7%), *H. molitrix* (11.0%), *C. catla* (9.3%), *C. mrigala* (5.5%), *T. putitora* (1.8%) and *M. seenghala* (0.67%). The landings in the different zones were for the first time found to be proportional to the water area in each zone, being 27.4% in Lunkhar Khad with 26% of water area 41.0% in lentic (Zone II) with 42% of water area and 31.6% in Intermediate and lotic (Zone III) with 32% of water area. However, a qualitative change with pronounced emergence of *C. carpio*, *L. dero* and *H. molitrix* and a marked decrease in the dominance of *C. catla, L. rohita* and *T. putitora* has been noted when compared to the mean landings for the preceding four year (1976-79) period.

Studies on the fishing effort have indicated that 900 gill nets would give a production of 90 kg/ha.

Limnological investigations have indicated the presence of three distinct water masses in the reservoir which could be delimited by temperature, alkalinity and conductivity. Beas waters are influencing the limnological profile of the reservoir to a great extent. 139 genera of algae and 17 genera of zooplankton have been recorded. Planktonic abundance ranged from 177-2,588 units/l (average 1380 unit/l) and 0.01-5.1 ml/m^3) average 2.6 ml/m3).

While *Tendipes, Chaoborus, Dorylaimus* and *Limnodrilus* were the dominant benthic organisms, Bacillariophyceae followed by Chlorophyceae dominated the periphytic community.

Experiments on cage culture of silver carp are in progress.

Nagarjunasagar Reservoir (Andhra Pradesh)

The total landings (167.2 t) of Nagarjunasagar comprised *P. pangasius* (29.4%), *M. aor* (17.0%), *L. fimbriatus* (15.5%), *S. childrenii* (11.0%), *M. seenghala* (5.8%), *L. calbasu* (5.2%), *C. catla* (2.6%), *T. Khudree* (2.5%), *W. attu* (2.1%), *C. mrigala* (1.6%) *L rohita* (0.9%) and miscellaneous species (7.4%).

Length-weight relationship was estimated for the following species :

L. calbasu : Log W = −5.1765 + 3.10454 Log L (Immature fish)
Log W = −5.8862 + 3.37829 Log L (Adult fish).

T. khudree : Log W = −4.99568 + 3.10809 Log L (males)
Log W = −5.19695 + 3.09386 Log L (females)

S. childrenii : Log W = −5.72721 + 3.20533 Log L

M. seenghala : Log W = −6.68787 + 3.47545 Log L (males)
Log W = −5.43619 + 3.01815 Log L (females)

Growth studies using scales as age indicators have shown that *L. calbasu* attains 237, 327,408, 474,535 and 570 mm respectively at 1 to 6 years of age and *Tor khudree* attains 188, 283, 356, 422, 482 and 528 mm respectively at 1 to 6 years of age. Studies on cleithrum have revealed that *S childrenii* attains 267, 329, 375, 425, 516, 596 and 640 mm respectively at 1 to 7 years of age. Annular rings on the pectoral spines of *M. seenghala* have shown that it attains 364, 510, 627 and 721 mm at ages 1 to 4 years respectively. While *L. calbaus* has a single short spawning season extending from July to Septembre, *S. childrenii* has two spawning seasons extending from May to September and again around February. An extended spawning season from April to August is indicated for *M. seenghala.*

Growth equations have been estimated for the following species :

C. catla : $lt = 1239 \left[1 - e^{-0.27\,(t+0.65)}\right]$

L. rohita : $lt = 1201 \left[1 - e^{-0.24(t+0.008)}\right]$

C. mrigala : $lt = 1202 \left[1 - e^{-0.22(t+0.83)}\right]$

L. fimbriatus : $lt = 812 \left[1 - e^{-0.22(t+0.6929)}\right]$

P. pangasius : $lt = 936 \left[1 - e^{-0.20(t-0.85}\right]$

M. aor : $lt = 860 \left[1 - e^{-0.23(t+0.551)}\right]$

L. fimbriatus attains 265, 370, 461, 540 and 587 mm at age 1 to 5 years respectively and 2 to 4 years age groups contribute maximum to the commercial landings. *P. pangasius* attains 302, 415, 510, 595, 658 and 704 mm at ages 1 to 6 years respectively, the landings revealing maximum contribution by 3 to 5 years age groups. *M. aor* attains 257, 387, 480, 558 and 620 mm at ages 1 to 5 years respectively, age groups III and IV contributing maximum to the catches.

Studies on reproduction and recruitment indicated the presence of prawns (*M. lamarrei*) and trash fish only in the drag net collections. An experiment on pen culture is in progress.

An interesting finding is the presence of two morphologically distinguishable populations of *L. calbasu* one with long pelvics touching the anal and the other with short pelvics. Biological studies on these populations are in progress.

Rihand Reservoir (Uttar Pradesh) :

A total of 107 t (3.5 kg/ha) of fish was landed in 7 months of fishing. With a fishing effort of 76 units/day the catch/net/day was only 0.33 kg as against 0.730 kg with 47 units/day last year indicating a fall in the fishery probably due to the failure of catla breeding in earlier years. Diversification of the gear indicated both a qualitative and quantitative change in fish landings in that operation of a drag net not only improved the landings of *C. mrigala*, *W. attu*, *S. silondia*, and *N. chitala* but also landed C. *marulius*, *P. sarana* and *N. notopterus*, species so far unknown in the commercial fishery.

Experimental fishing with smaller meshed gill nets (20-150 mm mesh bar) indicated dominance of *S. silondia* (35.62%) in the intermediate sector in March and that of *L. calbasu* (52.83%) followed by *L. rohita* (13.36%) in the lotic sector and *C. mrigala* (28.31%) followed by *L. calbasu* (26.0%) in the intermediate sector in July. The catches ranged from 0.004 kg/net/hr in March in the intermediate sector to 0.060 kg/net/hr in July in the lotic sector.

Detailed biological studies on the three ecological populations of *C. catla* have revealed that *Catla* with the longer (P_l) and medium (P_m) pectorals were identical in growth both in length and weight which was faster than that of *Catla* with short pectoral (P_s), However, the annual growth was the maximum in case of *Catla* (P_s) followed by *Catla* (P_s) and (P_l) indicating that while *Catla* (P_l) and (P_m) grow faster in length, *Catla* (P_s) grows faster in weigth which is also carroborated by its higher girth-length ratio. It is also interesting to note that the three ecological populations of Rihand reservoir are faster growing than the Catla population of R. Yamuna. Food and feeding habits of the Rihand *Catla* also indicate the suitability of stocking reservoirs dominated by *Microcystis* with the seed of *Catla* (P_m and P_s).

PROJECT COMPLETED IN 1980

Project 1 : Optimum per hectare production of fry, fingerlings and fish in culture fishery operations

1.21 Management of carp nursery ponds

1.29 Comparative study of the efficacy of fish toxicants of plants origin available in Orissa and its neighbouring, states.

1.35 Short-term rearing for raising fish fingerlings with single crop of paddy.

1.40 Comparative efficiency of organic manures on the fertility of pond soil.

Project 3 : Reservoir fisheries

3.14 Ecology and fishery development of Gulariya Reservoir.

Project 5 : Brackishwater fish farming

5.28 Fluctuations in the fishery of Pulicat Lake, its seed resources and transport.

5.37 Prawn and prawn-cum-fish culture.

5.54 Survey of nutrient status of soils of intertidal regions of lower Sunderbans.

5.69 Pen culture of penaeid prawns, *P. indicus*, *P. monodon* and *P. semisulcatus* in costal water of Chilka Lake.

Project 6 : Freshwater prawn culture

6.2 Breeding and Culture of *Macrobrachium malcolmsonii*

Project 12 : Exotic fish culture

12.6 Compatibility and competition between silver carp and Indian major carps.

12.7 Optimum production of fingerlings and fish of exotic species under composite cultures.

Project 14 : Riverine and estuarine fish catch statistics

14.14 Comparative study of fisheries and ecology of river Ganga and 'Kol' at Bhagalpur.

Project 16 : Weed control

16.13 Studies on aggressive capacity, viability and perennation of reproductive bodies of noxious aquatic weeds.

Project 20 : Water pollution investigations

20.5 Investigations on the Ganga and the Yamuna river eco-systems at Allahabad to determine the biological indicators of water quality.

Co-ordinated Projects :

CFCSP-6 Biology and role of grass carp, *Ctenopharyngodon idellus* in composite fish culture.

CFCSP-18 Fish nutrition. 1. Protein, carbohydrate and vitamin requirements of certain Indian major carps in relation to temperature.

CFCSP-19 Use of some cactii as piscicides.

ABF-16 Semi-intensive Culture of *Clarias batrachus* and *Heteropneustes fossilis* using organic wastes.

PROJECT MERGED/SUSPENDED

1.1.1.1 Rearing of Indian major carp fry to fingerlings for optimum survival and growth under different stocking densities.
(Merged with project 1.55)

1.1.2.2 Composite culture of Indian and exotic carps to raise marketable fish,
(Merged with project 1,54)

1.25 Intensive culture of fish food organisms.
(Merged with project 5.58)

1.33 Studies on detection of digestive enzyme complex of freshwater culturable food fishes.
(Suspended)

1.42 Statistical relationship between the inputs and fish production in composite fish culture.
(Merged with project 1.54)

1.48 Alternative protein source for carp fry and fingerlings.
(Merged with project 29.2)

1.50 Fortifying conventional feeds as per amino acid requirement of carps.
(Merged with project 29.3)

2.7 Isolation of fish gonadotropin for hypophysation of carps in large scale.
(Merged with project 2.17)

2.11 Effect of hormones in hypophysation of carps in large scale.
(Merged with project 9.7)

4.1 Location of new spawn collection centres and assessment of their potentiality.
(The work is being done under Co-ordinated Project)

4.2 Standardisation of spawn collection technique.
(The work is being done under Co-ordinated Project)

5.3 Experimental trials of model brackishwater fish farm in lower sunderabans
(wild and selective stocking).
(Work programme transferred to Brackishwater Experimental Fish Farm Unit, Kakdwip).

5.19 Studies on the optimum salinity in brackishwater ponds for increased fish production.
(Merged with project 5.26)

5.21 Fish and prawn seed resources at Pulicat Lake.
(Merged with project 5.50)

5.23 Experimental culture of brackishwater fish food organisms in the laboratory and field.
(Marged with project 1.25)

5.24 Effect of hormones on the growth and photosynthetic behaviour of plankters.
(Work programme transferred to project 5.23)

5.24 (a) Effect of hormones and trace elements on fish food organisms.
(Merged with 1.47)

5.32 Culture of edible portunid crabs.
(Merged with project 5.17).

5.35 Culture of *Chanos chanos*
(Merged with project 5.37 and completed in 1980).

5.36 Collection and rearing of *Penaeus monodon* seed for stocking and supply.
(Merged with 5.41)

5.39 Intensive culture of *Penaeus indicus* in association with penaeid prawns.
(Merged with 5.37)

5.43 Physico-chemical characteristics of the soil around the out-fall area of various industries with special reference to the growth of benthic population.
(Merged with project 20.3)

5.46 Floculating colloidal soil suspensions in impounded water of low salinity.
(Merged with project 5.47)

5.50 Location, collection assessment of resources, acclimatisation and transport of brackishwater fish and prawn seed.
(Merged with project 5.28)

5.56 Development of compounded feeds in relation to the nutritional requirements of *P. monodon* and other prawns.
(Merged with project 5.66)

5.59 Studies on the role of organic matter and redox potential in maintaining nutrient status of brackishwater pond soils.
(Merged with project 5.51)

5.61 Studies on the ecology of brackishwater ponds with special reference to culture of commercial penaeid prawns.
(Merged with project 5.63)

5.64 Estimation of standing crop and evaluation of supplementary feed for brackishwater fishes at different stages of growth.
(Merged with project 5.38)

6.3 Freshwater prawn fishery of the middle stretch of the Ganga.
(Work programme transferred to project 14.1)

CFCSP-23 Oxygen requirement of fish biomass in composite fish culture
(Merged with project 1.53)

CFCSP-24 Study of the causative organisms of parasitic fish diseases in integrated fish farming ponds
(Merged with project CFCSP-10)

CFCSP-25 Adaptive experiment of semi-intensive magur culture under field conditions.
(Suspended)

CFCSP-26 Impact of field demonstration in adoption of scientific carp culture technology.
(Merged with 33.1)

ABF-10 Studies on the effect of photoperiod and temperature on the gonadal maturity of *Clarias batrachus* (Linn.)
(Merged with project ABF-3)

6.4 To study the biology and production of prawn in the lower stretch of the Ganga
(Merged with project 14.1)

7.1 Induced breeding of murrels

7.2 Breeding of *Anabas*, *Clarias* and *Heteropneustes*
(Work being done under Coordinated Project)

8.4 Brackishwater prawn seed prospecting of the Hooghly-Matlah and Rupnarayan estuarine systems
(Merged with project 8.1 and completed in 1979)

9.5 Studies on maturity of catla-rohu of F2 generation
(Merged with project 9.4)

9.7 Breeding and selected stocking of grass carp and silver carp
(Merged with project 2.18)

12.5 Techniques for large-scale production of grass carp and silver carp seed
(Merged with project 2.18)

12.8 Maturity of grass carp with different feeds
(Merged with project 2.18)

14.2 Fish catch statistics of the lower stretch of the Ganga river system
(Work merged with 14.1)

16.2 Control of algae in fish ponds
(Work combined with project 16.7)

19.7 Appraisal of the present status of Hilsa fishery of the lower stretch of the Ganga river system
(Merged with 14.1)

19.9 Fluctuations in the hilsa fisheries of Hooghly Estuary
(Merged with project 31.2)

22.4 Pen culture in lentic waters
(Merged with project 25.1)

25.1 Pen culture and study of ecology and fishery management of a selected beel in Assam
(Merged with project 25.3)

RESEARCH CONTEMPLATED

The following are the new projects to be taken up in the year 1981.

1.52 Economic methods of increasing yield of crops in ponds.

1.53 Effect of water level on fish production.

1.54 Investigation on increasing fish production particularly in non-drainable ponds.

1.55 Nursing of fry and fingerlings.

1.56 Studies on the ecology of freshwater swamp and newly constructed ponds.

2.17 Quantitative analysis of gonadotropin in common carp pituitary at different sexual stages for induced breeding.

2.18 Techniques of rearing and maintaining of brood fish of carps for large-scale production of seed.

3.18 Ecology and fishery development of a small reservoir.

3.19 Studies on the limnology and productivity of McPherson lake, Allahabad.

5.70 Controlled breeding and development of hatchery techniques for brackishwater shrimps and fishes.

5.71 Influence of salinity on the growth and survival of penaeid prawn in brackishwater impoundments

5 72 Fertilizer-soil-water interaction in brackishwater impoundments.

5.73 Studies on the metabolism of *Penaeus monodon* in relation to moulting cycle and environmental factors.

9.9 Establishment and maintenance of the living gene pool of Indian major carps to collect the different land races, elaborate practical marking systems, propagate for renewal of populations in every five years.

9.10 Production of polyploid and androgenetic fish populations in Indian major carps and common carp.

9.11 Artificial gynogenesis and hormonal sex reversal of silver carp and grass carp. Intraspecefic hybridization of silver carp and grass carp with crossing gynogenetically inbred female and male lines

9.12 To develop practical methods of artificial gynogenesis and hormonal sex reversal of common carp.

9.13 Artificial gynogenesis in Indian major carps.

29.5 On the morpho-histological and histochemical observations of the digestive system of *Catla catla* and *Labeo* spp. in relation to different feeds.

13.24 Ecology and energy flow studies in Sar (Kashmir)

14.18 Fisheries of Kolleru Lake and its connected waters.

15.6 Investigation on diseases of Indian major carps caused by parasites and malnutrition.

15.7 Investigations on histopathological changes in the kidney and liver of Indian major carps and its relation to diseases.

15.8 Development of primary cell cultures and fish cell lines from Indian major carps for virological studies.

15.9 Investigations on the bacterial diseases of major carps and their treatment.

16.15 Studies of the toxic effect of algicides on fish and consequences of their periodic application on fish pond ecology.

16.16 Effect of aquatic weed infestation on loss of water in different aquatic ecosystems and their interference with storage and flow conditions.

19.10 Research and development of technology of commercial scale production of hilsa (*Hilsa ilisha*) seed.

20.17 Impact of thermal wastes on the ecology of Rihand Reservoir.

25.3 Comparative study of ecology and fishery management of two adjacsent beels *viz.*, Tamranga and Dhil in Assam.

29.3 Fortifying conventional feeds with available high grade protein as per protein requirement of carps.

29.4 Studies on digestive physiology of Indian major carps.

31.2 Fisheries resources of the Hooghly System with special reference to Hilsa.

32 7 Studies on lyophobic and lyophilic colloids in relation to fish production.

33.1 Formulalion of training courses for extension workers.

CFCSP-27 Hatching, rearing and transport of carp eggs, spawn and fry with the help of low cost inidigenous materials suitable for rural set up.

ABF-19 Paddy-cum-air-breathing fish culture.

ABF-20 Cytogenetics of air-breathing fishes.

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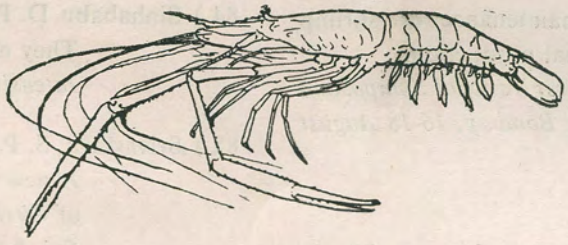
Role of aquaculture in rural development in India *Souvenir : In Commemoration of the ICAR Golden Jubilee Year, CIFRI, Barrackpore*, pt. 2 : 135-138

92) Vass, K. K., H. S. Raina & Shyam Sunder, 1979.
On the breeding behaviour of *Schizothorax niger* Heckel in Dal lake. *J. Bombay nat. Hist. Soc.*, **76** (1) : 179-184

93) Verghese, P. U., 1978.
Potentials of brackishwater prawn culture in India. *Proceedings of the First National Symposium on Shrimp Farming, Bombay*, 16-18 August, 1978 : 189-203



PERSONNEL

Retirement :

Shri B. B. Pakrasi, S-3 retired from service on 31. 1. 1980 on attaining the age of superannuation.

Dr. S. B. Singh, S-3 voluntarily retired from the services of the Institute on 31. 5. 1980.

Resignation :

Sarvashri M. V. Gupta, S-2, S. S. Mupid, Jr. Clerk and Sinha Sarkar, Messenger resigned from service on 12. 4. 1980, 4. 8. 1980 and 30. 6. 1980 respectively.

Promotion :

The following members of staff were promoted to the next higher grade during the year :—

Name	Present Grade	Promoted to
Shri B. B. Ghosh	S-1	S-2
Shri J. G. Chatterjee	S	S-1
Shri A. K. Roy	S	S-1

Grant of advance increments :

The following members of staff have been granted advance increments as mentioned against their names :—

Name	Designation	Increment
Shri M. Rout	S-1	One
Shri H. C. Karmakar	S	Two
Shri R. K. Tyagi	S	,,
Shri M. Chowdhury	S	,,

Appointments :

The following appointments were made during the year :—

Name	Designation
Shri L. M. Nandi	Senior Administrative Officer
Shri A. N. Mukherjee	Accounts Officer
Shri Manik Chandra Pal	Driver

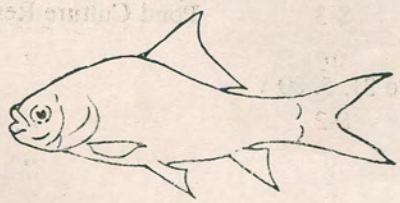
Name	Designation
Shri Nanda Dulal Saha	Supporting Grade I
Shri Joy Dev Kumar Patra	,,
Shri Amoy Kumar Barri	,,
Shri Sailendra Nath Nan	,,
Shri Mahendra Balmiki	,,
Shri V. Nayak	,,
Shri U. Satyanarayana	,,
Shri Kishore Dalvi	,,
Shri Balkrishan Balmiki	,,
Shri Pashupati Das	,,
Shri Patit Paban Haldar	,,
Shri Rohitosh Kumar Kanthal	,,
Shri Netai Som	,,
Shri Bhimann Naskar	,,
Shri Gopal Chandra	,,
Shri Hiralal Singh	,,
Smi. Anjali Rani Dutta	Carpenter
Shri P. K. Samanta	Chainman
Shri Ram	Fisherman
Shri Santosh Kumar Biswas	Carpenter
Shri Ataulla	Fisherman
Shri S. Rayak	,,

Transfers :

The following transfers were made during the year :—

Name	Designation	From	To
Dr. T. Rajyalakshmi	S-2	Barrackpore	Calcutta
Shri P. R. Sen	S-2	Cuttack	Dhauli
Shri P. L. N. Rao	S-1	Bhadrak	Dhauli
Shri S. N. Mohanty	S-1	—	Bhubaneswar
,, P. K. Chakraborty	,,	Kakdwip	Lalgola
,, D. Narayanaswamy	,,	Calcutta	Barrackpore
,, K. Suresh	,,	Calcutta	Dhauli
,, C. B. Joshi	,,	Dehradun	Bilaspur
Dr. S. M. Pillai	,,	Kakdwip	Barrackpore
Shri K. L. Shah	,,	Bhagalpur	Karnal
,, H. P. Singh	,,	Muzaffarpur	Bilaspur
,, L. H. Rao	,,	Bangalore	Kakinada
,, B. C. Tyagi	,,	Jaunpur	Karnal

	Name	Designation	From	To
Shri	A. K. Roy	S-1	Kakdwip	Khardah
,,	S. K. Mondal	,,	Calcutta	Kakdwip
,,	R. K. Jena	,,	Cuttack	Dhauli
,,	S. N. Datta	,,	Cuttack	Bhubaneswar
,,	B. K. Mishra	,,	Cuttack	Bhubaneswar
,,	V. Pathak	,,	Nagarjunasagar	Barrackpore
,,	D. R. Kanaujia	S	Bhadrak	Buxar
,,	J. G Chatterjee	,,	—	Barrackpore
,,	H. C. Karmakar	,,	Kakdwip	Calcutta
,,	R. K. Dey	,,	Cuttack	Dhauli
,,	A. Hazra	,,	Kakdwip	Barrackpore
,,	S. N. Sar	SRA	Ahmadpur	,,
,,	P. V. G. K. Reddy	T-4	Cuttack	Dhauli
,,	G. C. Sahoo	T-2	Cuttack	Bhubaneswar
,,	D. P. Verma	T-1-3	Gauhati	Jaunpur
,,	J. P. Mishra	T-1	Tadepalligudem	Allahabad
,,	Harihar Das	Driver	Kakinada	Dhauli
,,	B. Kahali	,,	Bhagalpur	Bhubaneswar
,,	M. C. Pal	,,	Bhagalpur	Kakdwip
,,	Paras Ram	Fisherman	Bilaspur	Karnal



Staff :

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 Special Grade	Freshwater Aquaculture Research & Training Centre.	Dhauli
Shri H. A. Khan	S-2	,,	,,
,, M. Ranadhir	,,	,,	,,
,, P. R. Sen	,,	,,	,,
,, C. Saha	S-1	,,	,,
Dr. R. Paul Raj	,,	,,	,,
Shri B. R. Shirsat	,,	,,	,,
,, S. N. Mohanty	,,	,,	,,
,, P. L. N. Rao	,,	,,	,,
,, Dilip Kumar	,,	,,	,,
,, K. Suresh	,,	,,	,,
,, R. K. Jana	,,	,,	,,
,, George John	,,	,,	,,
,, S. D. Gupta	,,	,,	,,
,, S. N. Dutta	,,	,,	,,
,, B. K. Mishra	,,	,,	,,
,, R. C. Das	,,	,,	,,
,, R. K. Dey	S	,,	,,
,, R. D. Chakraborty	S-3	Pond Culture Research Unit	Cuttack
Dr. S. B. Singh	,, (up to 31. 5. 80)	,,	,,
Shri S. Patnaik	S-2	,,	,,
,, N. G. S. Rao	,,	,,	,,
,, T. Ramaprabhu	,,	,,	,,
,, G. V. Kowtal	S-1	,,	,,
Dr. C. R. Das	S-1	,,	,,
Shri M. Rout	,,	,,	,,
,, D. K. Chatterjee	,,	,,	,,
,, S. Jena	,,	,,	,,
,, A. K. Sahoo	,,	,,	,,
,, S. R. Ghosh	,,	,,	,,

Name	Designation	Section	Place
Shri V. Ramachandran	FS	Pond Culture Research Unit	Cuttack
,, M. A. V. Lakshmanan	,,	,,	,,
,, K. K. Sukumaran	,,	,,	,,
,, Apurba Ghosh	S-2	Sewage-fed Fisheries	Rahara
,, Ajoy Kumar Ghosh	S-1	,,	,,
Smt. K. K. Bhanot	,,	,,	,,
Shri K. R. Naskar	,,	,,	,,
	Riverine & Lacustrine Division		
Shri J. C. Malhotra	S-3	Allahabad Research Centre	Allahabad
Dr. A. G. Jhingran	,,	,,	,,
,, Ravish Chandra	S-2	,,	,,
,, G. N. Mukherjee	,,	,,	,,
,, R. S. Panwar	,,	,,	,,
Shri R. A. Gupta	S-1	,,	,,
,, M. A. Khan	,,	,,	,,
Dr. M. Peer Mohammed	,,	,,	,,
Shri S. N. Mehrotra	,,	,,	,,
,, Balbir Singh	,,	,,	,,
,, D. N. Singh	,,	,,	,,
,, S. P. Singh	,,	,,	,,
,, G. N. Srivastava	,,	,,	,,
,, K. P. Srivastava	,,	,,	,,
,, R. K. Saxena	,,	,,	,,
,, S. K. Wishard	,,	,,	,,
,, S. J. Karamchandani	JFS	,,	,,
,, R. K. Dwivedi	S	,,	,,
Dr. Krishna Chandra	,,	,,	,,
Shri R. N. Seth	,,	,,	,,
,, R. K. Tyagi	,,	,,	,,
Dr. K. K. Vass	S-2	Coldwater Fisheries Unit	Srinagar
Shri Shyam Sundar	S-1	,,	,,
Dr. H. S. Raina	,,	,,	,,
Smt. Usha Moza	,,	,,	,,
Shri V. K. Bali	,,	,,	,,
,, K. V. Rao	S-1	K. G. Unit	Tadepalligudem
,, K. J. Rao	,,	,,	,,
,, D. S. Murthy	JFS	,,	,,
Dr. M. Subrahmanyan	S-2	Prawn Breeding Unit	Kakinada
Shri L. H. Rao	S-1	,,	,,
Dr. K. J. Ram	,,	,,	,,

Name	Designation	Section	Place
Shri A. K. Laal	S-1	Bhagalpur Research Centre	Bhagalpur
,, B. V. Govind	S-2	Tank Fishery Unit	Bangalore
,, S. Ayyappan	S-1	,,	,,
,, P. K. Sukumaran	S	,,	,,
,, V. R. Chitransi	S-1	Muzaffarpur Research Centre	Muzaffarpur
,, D. Kapoor	SRA	,,	,,
,, C. B. Joshi	S-1	Cold Water Fisheries Unit	Bilaspur
,, Y. S. Yadava	,,	Brahmaputra Survey Unit	Gauhati
,, M. Choudhury	S	,,	,,
,, [illegible]. Kolekar	,,	,,	,,
,, R. K. Singh	S	,,	,,
Shri D. R. Kanaujia	S	Buxar Research Centre	Buxar
Shri Sree Prakash (on study leave)	S	,,	,,
Shri B. L. Pandey	S-1	Lalgola Survey Centre	Lalgola
Shri P. K. Chakraborty	,,	,,	,,
,, A. V. P. Rao	,,	(on deputation)	

Estuarine Fisheries Division

Shri R. N. Pal	S-2	Calcutta Research Centre	Calcutta
,, G. N. Saha	,,	,,	,,
,, P. Ray	JFS	,,	,,
,, S. C. Banerjee	S-1	,,	,,
,, R. K. Banerjee	,,	,,	,,
,, S. C. Thakurta	,,	,,	,,
,, H. Singh	,,	,,	,,
,, S. K. Mondal	S	,,	,,
,, G. C. Laha	,,	,,	,,
,, S. Karmakar	,,	,,	,,
,, A. Chadudhury	SRA	,,	,,
,, A. C. Banerjee	,,	,,	,,
,, D. D. Halder	S-3	Kakdwip Research Cantre	Kakdwip
,, A. Sengupta (Upto 5. 6. 80)	S-1	,,	,,
Shri N. K. Das	,,	,,	,,
,, R. K. Chakraborty	,,	,,	,,
,, P. Ravichandran	,,	,,	,,
,, Kuldip Singh (Upto 31. 5. 80)	,,	,,	,,
Shri A. K. Roy	,,	,,	,,
,, H. C. Karmakar	S	,,	,,
,, N. M. Chakraborti	,,	,,	,,

Name	Designation	Section	Place
Shri P. K. Ghosh (On study leave)	S	Kakdwip Research Centre	Kakdwip
Shri K. Raman	S-3	Madras Research Centre	Madras
,, K. V. Ramakrishna	S-2	,,	,,
,, R. D. Prasadam	S-1	,,	,,
,, G. R. M. Rao	,,	,,	,,
,, C. P. Rangaswamy	,,	,,	,,
,, M. Kaliyamurthy	,,	,,	,,
,, S. Radhakrishnan	,,	,,	,,
,, S. Srinivasagam	,,	,,	,,
,, K. Gopinathan	,,	,,	,,
Smt. M. Sultana	,,	,,	,,
Shri K. O. Joseph	S	,,	,,
Shri K. K. Ghosh	S-2	Estuarine Section	Barrackpore
,, B. B. Ghosh	,,	,,	,,
,, K. K. Bhanot	S-1	,,	,,
,, A. C. Nandy	,,	,,	,,
,, M. M. Bagchi	,,	,,	,,
,, P. M. Mitra	,,	,,	,,
Dr. G. N. Chattopadhyay	,,	,,	,,
Shri J. N. Pal	S	,,	,,
,, S. K. Majumdar	,,	,,	,,
,, D. K. De	,,	,,	,,

Centres/Sections/Projects Directly under the Director

Shri P. Das	S-2	Extention Section	Barrackpore
,, U. Bhowmick	S-1	,,	,,
,, B. Roy	,,	,,	,,
,, P. K. Pandit	,,	,,	,,
,, B. K. Banerjee	,,	,,	,,
Shri B. N. Saigal	S-2	Library & Documentation Section	Barrackpore
Dr. V. K. Unnithan	S-1	,,	,,
Shri Amitabha Ghosh	S	,,	,,
,, M. J. Bhagat	,,	,,	,,
,, A. R. Cowdhury	,,	,,	,,
Dr. K. L. Sehgal	S-2	Technical Cell	,,
Shri Kuldip Kumar	S-1	,,	,,
,, S. Paul	S-1	Economics Section	,,
Dr. T. Rajyalakshmi	S-2	Prawn Breeding Project	,,
Shri S. M. Pillai	S-1	,,	,,
,, N. A. Reddy	,,	,,	,,

Name	Designation	Section	Place
Dr. M. L. Bhowmick	S-1	Rural Aquaculture Project	Barrackpore
Dr. S. P. Rai	,,	,,	,,
Shri D. Nath	,,	,,	,,
,, D. Naryanaswamy	,,	,,	,,
,, A. Hazra	S	,,	,,
,, J. G. Chatterjee	,,	,,	,,
Dr. Babu Lal	S-1	Radio-isotope Tracer Project	,,
Shri B K. Sharma	S-1	Operational Research Centre	Krishnagar
,, S. R Das	,,	,,	,,
,, K. M. Das	,,	,,	,,
Dr. A. K. Mondal	S-2	Kalyani Research Centre	Kalyani
Shri R. M. Bhowmick	S-3	KVK/TTC	Dhauli
Dr. B. N. Singh	S-2	,,	,,
Shri C. Selvaraj	S-1	,,	,,
,, C. S. Purushothaman	,,	,,	,,
,, N. C. Basu	S-1	,,	Kakdwip

Co-ordinated Projects :

Composite Fish Culture & Spawn Prospecting

Name	Designation	Section	Place
Dr. K. G. Rao	S-2	CFCSP	Bhubaneswar
Shri D. V. Pahwa	S-2	,,	Karnal
,, K. L. Shah	S-1	,,	,,
,, B. C. Tyagi	,,	,,	,,
,, J. C. Markandeya	,,	,,	,,
Dr. M. Y. Kamal	S-2	,,	Ranchi
Shri A. Mukherjee	S-1	,,	,,
,, P. N. Jaitly	S	,,	,,
,, R. M. Rao	S-1	,,	Badampudi
,, J. B. Rao	,,	,,	,,
,, K. N. Krishnamoorthy	S-1	,,	Bhavanisagar
,, P. K. Aravindakshan	,,	,,	,,
,, M. Sinha	,,	,,	Kalyani
,, D. P. Chakraborty	,,	,,	,,
,, P. K. Saha	S	,,	,,
Dr. P. M. Mathew	S-1	,,	Pune
Shri B. K Singh	S	,,	,,
,, D. N. Mishra	S-1	,,	Jaunpur
,, P. C. Mahanta	S	,,	Gauhati

Air-breathing Fish Culture :

Name	Designation	Section	Place
Dr. P. V. Dehadrai	S-3 (Special grade)	ABF	Barrackpore
,, S. K. Mukhopadhyay	S-1	,,	,,
Shri P. K. Mukhopadhyay	,,	,,	,,
,, D. Kumar	,,	,,	,,
,, B. Venkatesh	,,	,,	,,
,, S. C. Pathak	,,	,,	Gauhati
,, M. P. Singh Kohli	S	,,	,,
Dr. N. K. Thakur	S-1	,,	Patna
Shri S. K. Munnet	,,	,,	,,
,. V. K. Murugesan	S-1	,,	Bangalore
,, P. Kumaraiah	,,	,,	,,

Reservoir Fisheries :

Shri S. D Tripathi	S-3	Reservoir Fisheries	Barrackpore
,, V. Pathak	S	,,	,,
,, Ch. Gopala Krishnayya	S-2	,,	Nagarjunasagar
,, M. Ramakrishnaiah	S-1	,,	,,
,, V. V. Sugunan	,,	,,	,,
Smt. G. K. Vinci	,,	,,	,,
Shri G. K. Bhatnagar	S-2	,,	Ranchi
Dr. B. P Gupta	S-1	,,	,,
Shri S N. Singh	S	,,	,,
Dr. Y. Rama Rao	S-2	,,	Bilaspur
Shri B. C. Jha	S-1	,,	,,
,, H. C. Joshi	,,	,,	,,
,, D. K. Kaushal	S	,,	,,
,, V. K. Sharma	,,	,,	,,
,, M. D. Pisolkar	,,	,,	,,
,, V. R. Desai	S-1	,,	Rihand
,, N. P. Srivastava	S	,,	,,
Dr. Abraham Mathew	S-1	,,	Bhavanisagar
Smt. S. Sivakami	,,	,,	,,

The following members of staff (Technical) rendered their services during the year :

Liaision Officer

Tripathi, N. K.

Senior Artist T-5

Ghosh, J

Senior Library Assistant T-5

De, Anjali (Mrs.)

Overseer T-4

Bhattacharjee, P. N.

Artist Photographer T-4

Mazumdar, A. R.

Demonstrator T-4

Dutta, B. R.
Kumar, Kuldeep
Radheshyam
Sarkar, S. K.

Technical Assistant T-4

Das, P. B.
Das, P. R.
De, R. N.
Kar, S. L.
Mazumdar, H. S.
Raghavan, S. L.
Singh, R. C.
Ramaraju, T. S.
Rao, D. R.
Rao, K. S.
Reddy, P. V. G. K.
Saha, B. K.
Sarkar, S. K.
Mantri, Muralidhar

Technical Assistant T-II-3

Abdul Kadir, P. M.
Agarwal, K. K.
Basak, B.
Bhattacharjee, G. P.
Bose, P. S. C.
Chanda, Ram
Das, K. M.
Ghosh Bhaskar
Panigrahi, V.
Rahman, F.
Roy, A. K.
Sarkar, N. D.
Satpathy, R. C.
Srivastava, D. N.
Srivastava, N. K.

Artist T-II-3

Das, S. K.

Senior Library Assistant T-II-3

Das, Sukla (Mrs)

Photographic Assistant T-II-3

Ghosh, P. K.

Estimator

Sahoo, Chakradhar

Technical Assistant T-I-3

Banerjee, K. S.
Ekka, A. K.
Ghosh, S. P.
Mazumdar, N. N.
Mondal, N. C.
Paul, A. R.
Sarkar, Aloke
Saroj, B D.
Sen, H. K.
Verma, D. P.

Technical T-2

Krishnan. S.
Lakra, Camil
Langer, R. K.
Mishra, J. P.
Mohanty, A. N.
Muduli, H. K.
Sahu, G. C.
Sarkar, N. N.
Serangi, N.
Singh, M. P.
Sarkar, A.

Artist T-2

Dasgupta, P.

Electrician T-2

Chatterrjee, S. K.
Guin Narsing
Sadhukhan, B. N.

Mechanic T-II-3

Sathpati, R. C.

Mechanic T-2

Singh, Donald

Laboratory and Field Assistant T-1

Chatterjee, Swapan Kumar
Das, B. B.
Jain, Aloke Kumar
Krishnan, S.
Langer, R. K.
Mohanti, A. N.
Mondal, S. C.
Mishra, J. P.
Lal Bhai
Pani, K. C.
Saha, Sukumar
Sahoo G. C.
Saful, Debashis
Sarengi, N.
Singh, K. P.
Singh, M. P.
Tiwari, Ranjit

Sample Sorter T-4

Banerjee, A. K.
Gupta, S. K.
Moitra, S. C.
Nath, A. K.
Saha, K. P.
Saha, N. P.
Saha, R. D.

Senior Gestetner Operator T-1

Bhowmick, S. C.

Senior Binder T-1

Das, M. M.

Driver/Engine Driver/Launch Driver/Mini Bus Driver/Vehicle Driver T-2

Basmedaya
Das, S. C.
Negi, R. S.
Roy, R. M.
Saha, J. C.
Sothi, B. B.
Singh, R. N.
Tarai, D.

Driver/Engine Driver/Launch Driver/Mini Bus Driver/Vehicle Driver T-1

Bahadur, Suraj
Balmiki, R. L.
Biswas, N. C.
Chatterjee, U. K.
Das, K. L.
Ganesh K.
Ghosh, T. P.
Kahall, B.
Lal, Pasupati
Mazumder, A. K.
Deb, K. R.
Deo, Kishen
Dutta, K. K.
Das, Harihar
Norh, C. K.
Roy, B. B.
Singh, Badal Lal
Subramani, M. G.

Carpenter T-2

Bhattacharjee, S.

Plumber

Deb, S. K.

Pumpman T-1

Das, C. R.
Roy, N.

The following members of staff (Administrative) rendered their services during the year :

Senior Administrative Officer

Gupta, S. R. K. (upto 20. 12. 80)
Nandi, L. M. (from 20. 12. 80)

Accounts Officer

Deb, P. C. (up to 30. 9. 80)
Mukherjee, A. N. (from 25. 10. 80)

Assistant Administrative Officer

Roy, K. C.
Rajani, K. B.
Sthanapati P. K.

P. A. to Director

Lahiri, G.

Superintendent

Biswas, M. L.
Das, A. K.
Roy, M. R.
Datta, B. C.
Kanungo, P. C.
Sengupta, A. K.
Saha, S. C.

Assistant

Bhattacharjee, B. C.
Bose, S. K.
Chatterjee, B.
Das, T. P.
Dasgupta, S.
Mazumder, Sandhya
Roy, Bani
Baidya, N. H.
Das, C. C.
Choudhury, Nomita
Halim, Abdul
Roy, S. C.
Sarkar, A. C.
Shastry, N. K.
Shastry, S. P.
Zaidi, F. A.
Mahesh Prasad
Awadh, Sah
Neogi, M. M.
Banerjee, D. K.
Bose, D. C.

Stenographer

Banerjee, A. K.
Chakladar, H.
Ghosh, U. K.
Chakraborty, G. M.
Srivastava, R. C.

Junior Stenographer

Bhattacharjee, S.
Chatterjee, T.
Das, P. K.
Jena, P.
Sinha, R. C. P.
Prasad, P.
Roy, T. K.
Saha, A. K.
Sahoo, D. C.

Senior Clerk

Acharjee, D. K.
Baidya, D. N.
Banerjee, J. N.
Halder, S. R.
Kodandarman, I. N.
Mitra, N. K.
Rai, Jagdish
Majumdar, T. K.
Bhowmik, S.
Dey Sarkar, D, K.
Mukherjee, B. B.
Patra, J. C.
Pramanick, S. N.
Sarkar, H. L.
Singh, R. C. P.
Subrahamaniam, M.
Mukherjee, B. B.
Nath, H. K.
Ghosh, B. K.
Kar, S. K.
Mishra, L. P.
Singh, Kallu
Majumdar, Biplab
Das, Moloy Kr.
Sinha, S. S.
Mukherjee, R. R.
Nath, H. K.
Pramanick, S. K.
Prasad, Keshaw
Sarkar, S. K.
Sreedharan, T. K.
Sutur, H. B.

Junior Clerk

Banerjee, Anita
Behara, A. C.
Behera, R. C.
Bhagirathi, S.
Biswas, Manjulal
Bose, Samir Kumar
Chowdhury, Debesh
Das, B. K.
Dutta, P. K.
Ghosh, R. K.
Guriah, W.
Kumar, Surendra
Lahiri, P.
Mahato, R. N.
Mandal, S. P.
Mazumder, Sikha
Mupid, B. S.
Neogi, Anjali
Nath, Baij
Radhakrishnan, K.
Roy, J.
Roy, S. B.
Shah, Biswanath
Bhattacharjee, Mrinalini
Tikadar, S K,
Banerjee, Narayani
Behera, Kunja
Bala, M. K.
Biswas, A. B.
Biswas, P. K.
Chatterjee, D.
Chhotey Lal
Das, G. B.
Ghosh, P. K.
Ghosh, S. K.
Kachhap, M.
Kundu, N. R.
Lal, Ambika
Mandal, Bulbul
Manjhi, K.
Maranappan, S. K.
Murthy, P. B. V. S.
Panda, R. K.
Naik, N. C.
Raina, R. L.
Roy, Samir Kumar
Sarkar, B. K.
Nath, Kalipada
Srivastava, A. K.
Behera, P.

Supporting Grade IV

Chakraborty, K. L.
Jally, U. N.
Jally, H.
Burman, G. N.
Naik, J
Das, P. V. N.
Mewalal
Biswas, D. N.
Bhuyan, U
Sahu, D.
Bose, J. L.
Dalai, B
Samood
Dey, S. K.
Behera, B. N.
Das, K. P.
Dosad, R. B.
Prasad, K.
Samal, B.
Singh, D.
Das, C.
Jena, K. C.
Ramdeo
Biswas J. N.
Gangaram

Supporting Grade III

Barik, N.
Singh, C.
Varghese, P. V.
Manjhi, B.
Shyamal, B. R.
Panda, Lakshmidhar
Das, S K.
Pandey, C. K.
Bakshiram
Iruthiraj, M.
Raha, R. N.
Kotaiah, S.
Maranappan, S. K.
Mishra, P.
Naik, B.
Kujur, J. M.
Singh, Meher
Chakraborty, S. K.
Burman, M. S.
Barik, Dija
Prakash, B.
Das, Mosa
Bhoi, B.
Mondal, A. K.
Patra, A. M.
Burman, S. N.
Biswas, R. C.
Routh, H. K.
Baldevsingh, D. N.
Lal, Madan
Rao, Ch. Ganeswar
Bhuyan, N.
Behera, Trailokya
Behera, K. B.
Raikwar, Ramlal
Biswas, T. K.
Das, H. K.
Bhuloka, D.
Laluram
Munda, Budhram
Das, Antiram
Jana, Natabar
Gopal, K.
Shyamal, H. K.
Barik, S.
Bahadur, Nar
Sahu, D.
Behera, K. C.
Bahadur, Durga
Paramanik, H. K.
Behera, Alaka
Balmiki, Sitaram
Saha, N. K.
Naik, D.
Jally, Khetrabasi
Das, K. K.
Balmiki, S. C.
Apparao, B.
Behera, N.
Bose, M. R.
Chand, Mool
Mohanty, N. N.
Patnaik, S. R.
Sethi, P. C.
Jally, Aghur

Supporting Grade II

Boral, S. K.
Kishore, Jugal
Jangli
Maity, S. S.
Parbat, L. K.
Bhanja, B.
Behera, M.
Jadav, S. P.
Barik, D.
Chaki, S. N.
Narasappa, B.
Das, B. B.
Singh, S. S.
Narendra, G. C.
Sahoo, D. N.
Sahu, Gangadhar
Burman, S. N.
Tair, R. N.
Das, P. C.
Behera, Khalia
Bahadur, Tek
Pradhan, B.
Singh, Ramdeo
Ramalingam, M.
Singh, C. P.
Jena, N. C.
Mondal, G. C.
Burman, N. K.
Burman, S. S.
Chakraborty, S.
Mondal, S. C.
Balmiki, Kishanlal
Srinivssan, V. K.
Sundar, Ram
Manna, L. C.
Yadav, A. L.
Saha, P. C.
Biswas, Jagdish
Santra, Gangadhar
Biswas, S. C.
Mondal, N. K.
Raju, Kolludharma
Das, Jhantu Ranjan
Biswas, Hiralal
Sayalu, P.
Appanna, K.
Behera, K. B.
Bhoi, R. C.
Panda, Jagdish
Singh, P.
Bhau'a, D.
Burman, S. K.
Behera, Keshab
Ram, Japhu
Mondal, Biswanath
Balaraman, M.
Manickyam, P.
Burman, Balaram
Burman, H. S.
Burman, S.
Ram, Munshi
Samulu, L.
Das, Sitaram
Balmiki, Kartore
Bahadur, Bhim
Das, Gunadhar
Shaw, Gulab
Santram
Bhava, C. K.
Burman, H. K.
Dhanuk, Badlu
Nayak, B. K.
Das, Nikunjalal
Dehuri, Basudeb
Lal, Bideshi

Supporting Grade I

Sahoo, K. M.
Mondal, Bholanath
Mani, N.
Mondal, Kalashashi
Debroy, R. L.
Saha, Mohan Lal
Saha, Manoranjan
Bain, G. C.
Bose, Hiralal
Ghosh, A. C.
Bahadur, M. R.
Ram, Rajendra
Khalko, Joseph
Bose, Sankar
Karmakar S.
Sethi, P. K.

Pugalendhi, B.
Bairagi, Suklal
Ghosh, Pasupati
Bhoi, Shyama
Swain, Raghunath
Bahadur, Surja
Bijali, Amalya
Mallah, Munilal
Kachari, P. C.
Krishnappa, B. N.
Rajaratnam, R.
Mahendran, B.
Dhir, K. K.
Naik, G. C.
Pramanik, G. C.
Karkatta, Joseph
Saha, P. C.
Ray, Pradupta Kishore
Das, Mukti
Bahadur, Lal
Bahadur, Man
Bhoi, M. S.
Choudhury, Panchulal
Das, Balaram
Paria, J.
Bhol, R. K.
Das. Giridhari
Parida Satyananda
Kaliannan, K.
Mallah, Jai Nandan
Biswas, Manindranath
Biswas, Ashoke Kumar
Mondal, Nityananda
Govate, S. T.
Naik, M. B.
Seshanna
Sahni, Aghanu
Burman, Shatendra
Raj, Karam
Halder, L. K.
Jally, Baman
Mallah, Rajdhari

Biswas, A. K.
Behera, Chhakei
Ali, Munsur
Bhuyan Dhirendra
Bahadur, Sitaram
Paik, B. C.
Omprakash
Prasad, Lalta
Mahadeva, M.
Palanisamy, R.
Bahadur, Karna
Bahadur, Indra
Bahadur, Asta
Rao, G. Santa
Muchi, R. U.
Arumugam, P.
Khatua, Jadumani
Subbaiyan, K.
Bhattacherjee, A.
Kumhar, Kharban
Ghume, T. H.
Behera, Rama
Naik, Krishna Ch.
Behera, Debahari
Mollick, G. C.
Parida, Fakir
Behera, Rajkishore
Sahoo, Lakshmidhar
Krishnan, M. V.
Hazarika, B.
Mondal, Biswanath
Das, Krishori Mohan
Jana, Bibhuti Kr.
Sita
Yasiah, R.
Ramaswamy, A.
Biswas, Sukh Chand
Prasad, Ram
Singh, Maha
Semanta, Narayan C.
Mani, K.
Ningegowda, K.

Das, B. C.
Dukhran
Murugesan, A.
Das, B. C.
Karuppannan, P.
Mariappan, V.
Kemparasa, A.
Ram, Paras
Ringh, C. P.
Runadale, G. J.
Satyanarayana, U.
Bhuiya, N
Parida, Golekha
Jally, Kedar C.
Singh, Kuldeep
Snbramani, M.
Parida, Sridhar
Mahalick, Antaryami
Das, Rash Bihari
Parida, Judhistir
Barik, Basanta Kumar
Behera, Makunda C.
Rao, Medisethi C.
Samal, Chaitanya C.
Halder, Satyendra Nath
Mondal, Sachindra
Swain, Ramesh C.
Das, Parsuram
Bhoi, Bijaya
Das, M. C.
Samanta, P. S.
Balmiki, Khem Chand
Raju, A. Eswar
Dhanuk, Shyamlal
Balmiki, Iswar Ram
Rao, P. Nageswar
Patnaik, B.
Swain, Rajan
Nayak, Sripati
Shree Nath
Munsur Ali, S. K.

Lakshmi, Ram
Subramani
Biswas, A.
Bez, P. C.
Gowda, Maligc
Gangayya, A.
Bind, M. P.
Mukhia, J.
Dhibar, Gunadhar
Choudhusi, Umesh
Pramanik, P. C.
Anjanappa, M.
Subramaniam, K.
Prasad, Shitala
Bendre, S. S.
Bora, Bhabalu
Palai, Duryodhan
Betal, Sasadhar
Das, Jayaram
Jana, Gourhari
Mandal, Kalipada
Samal, Krushna C.
Khan, Rahmat
Das, Sudhakar
Gharami, Phani
Halder, Sital C.
Swain, Jatadhari
Naik, Sudarsan
Mohd. Yusuf Dar
Govindalal
Ram, Kawal Pati
Das, Dhaneswar
Parameshwar
Jena, Panchanan
Balmiki, Jagadish
Jena, N.
Nayak, P. K.
Swain, Pitamber
Behera, Dhanu
Halder, Hemlata

APPENDIX I

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
(I. C. A. R.)
BARRACKPORE : WEST BENGAL

Ministry/Department/Office of Central Inland Fisheries Research Institute, Barrackpore, West Bengal. Statement showing the total number of Government servants and the number of scheduled castes/tribes amongst them as on 1st January 1981.

Class	Permanent/ Temporary	Total No. of employees	Scheduled Castes	Percentage to total employees	Scheduled Tribes	Percentage to total employees	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Class I	Permanent	119	3	2.52%	—	—	—
	Temporary	93	8	8.60%	—	—	—
Class II	Permanent	35	2	5.71%	—	—	—
	Temporary	21	4	19.05%	1	1%	—
Class III	Permanent	135	33	24.44%	1	1%	—
	Temporary	79	12	15.19%	8	8%	—
Class IV	Permanent	2 1	49	23.22%	1	10%	—
	Temporary	170	35	20.59%	3	2%	—
Class V	Permanent	14	14	100%	—	—	—
	Temporary (Safaiwala)	5	4	80%	1	20%	—

ORGANISATION CHART OF
CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
BARRACKPORE-743101 WEST BENGAL

DIRECTOR

FRESHWATER AQUACULTURE DIVISION
Dhauli P. O: Kausalyagang
(Via) Bhubaneswar, Orissa

- Culture
- Fish Culture
- Control
- Chemistry
- Culture
- Farm Engineering
- Nutrition
- Pathology
- Hybridisation & Genetics

ESHWATER AQUACULTURE RESEARCH & TRAINING CENTRE
(Dhauli)

- Trainers' Training Centre (Fisheries)
- Rahara Research Centre

ESTUARINE FISHERIES DIVISION
47/1 Strand Road
Calcutta-7

- Esturaine Fisheries
- Hilsa Fisheries
- Water Pollution
- Statistics
- Plankton Culture

CALCUTTA RESEARCH CENTRE

- Bakkhali Reserch Centre
- Kakdwip Research Centre
- Barrackpore Research Centre
- Madras Research Centre

RIVERINE & LACUSTRINE FISHERIES DIVISION
24, Pannalal Road
Allahabad 2 (U. P.)

- Riverine Fisheries
- Hilsa Fisheries
- Reservoir Fisheries
- Statistics
- Water Pollution

ALLAHABAD RESEARCH CENTRE

- Srinagar Research Centre
- Tadepalligudem Research Centre
- Kakinda Research Centre
- Buxar Research Centre
- Bangalore Research Centre
- Bhagalpnr Research Centre
- Gauhati Research Centre
- Mans Research Centre, Muzzaffarpur

- Uluberia Survey Centre
- Raidighi Survey Centre
- Port Canning Survey Centre
- Pulicat Survey Centre
- Lalgola Survey Centre

ALL INDIA COORDINATED RES

COMPOSITE FISH CULTURE AND FISH SEED PRODUCTION
Dhauli P. O. Kausalyagang
(Via) Bhubaneswar, Orissa

Subcentres

- Kalyani (West Bengal)
- Badampudi (Andhara Pradesh)
- Bhavanisagar (Tamil Nadu)
- Jaunpur (Uttar Pradesh)
- Karnal (Haryana)
- Pune (Maharashtra)
- Ranchi (Bihar)
- Gauhati (Assam)
- *Godhra (Gujarat)
- *Tuticorin (Tamil Nadu)
- Kausalyagang (Orissa)
- *Durg (Madhya Pradesh)

AIR-BREATHING FISH CULTURE IN SWAMPS
Barrackpore (W. B.)

Subcentres

- Gauhati (Assam)
- Patna (Bihar)
- Bangalore (Karnataka)
- *Palair (Andhra Pradesh)
- *Kalyani (West Bengal)

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