Central Inland Fisheries Research Institute : Barrackpore

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

1985

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ANNUAL REPORT

1985

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE

(Indian Council of Agricultural Research)

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ANNUAL REPORT 1985

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE

BARRACKPORE

BRIEF HISTORY 1

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

MANDATE 2

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

ORGANISATION 3

To meet the above objectives, the Institute's organisational set up was accordingly structured. It has 3 Divisions, *viz.* (*i*) Riverine & Lacustrine Division, (*ii*) Estuarine Fisheries and Brackishwater Aquaculture Division, and (*iii*) Freshwater Aquaculture Division. The Riverine and Lacustrine Fisheries Division based at Allahabad works on capture fisheries relating to rivers, lakes, reservoirs, beels, etc. This Division also gives emphasis on ecology of these water bodies and studies relating to water pollution and aquatic productivity. The Estuarine Fisheries and Brackishwater Aquaculture Division with its present headquarters at Barrackpore studies all aspects relating to ecology and management of fisheries of estuaries and lagoons. This Division also works on brackishwater aquaculture for which necessary infrastructure facilities have been developed at Kakdwip. The Freshwater Aquaculture Division located now at Dhauli works on all aspects of pond culture. The Rahara Research Centre concentrates on fish culture in sewage-fed waters and paddy-cum-fish culture and the Kalyani Centre on breeding and culture of frogs. In addition, the Institute has Extension Section at Barrackpore, KVK on brackishwater fish farming at Kakdwip and KVK/TTC on freshwater aquaculture at Dhauli, Kausalyagang and one Operational Research Project at Krishnanagar. Library & Documentation Section, Extension Section, Administrative, Accounts, Audit, Stores and other sections also function at the Headquarters.

The four All-India Coordinated Projects *viz.* Composite Fish Culture and Fish Seed Production, Air Breathing Fish Culture in Swamps, Reservoir Fisheries, and Brackishwater Fish Farming have been completed during 1985. After the reorganisation consequent to the closure of Coordinated Project Centres, the Institute has 24 Research Centres and 9 Survey Centres apart from the KVK at Kakdwip and KVK/TTC at Dhauli.

IMPORTANT ACHIEVEMENTS 4

OFF-SEASON BREEDING OF SILVER CARP — SUCCESS REPEATED

Silver carp, *Hypopthalmichthys molitrix* was once again subjected to successful breeding as early as by middle of March. A total of 8,000 healthy spawn was obtained consequent to the breeding experiments. These are being reared in the farm nursery.

Altogether 8 sets of silver carp weighing between 1.0 and 2.5 kg were experimented. Pituitary extract was administered to these brooders @7 mg/kg and 12 mg/kg body weight as priming and resolving doses respectively. Instant success occurred in two cases. One set of brooders yielded 30,000 viable eggs with 85% fertilization. Hatching rate was recorded as 60%. In the second set, the hatching rate observed was only 30%. Hatching took place at a water temperature of 30-31°C. In the other six sets, though fertilization took place, the embryonic development ceased after 6-8 hrs of fertilization.

It was observed that the breeding operation had been more successful when done in breeding chamber installed in room under controlled temperature. In this set of experiments, the favourable temperature observed was 28-29°C. Dissolved oxygen level ranged from 4.0 to 4.8 ppm.

Proper brood fish care with balanced nutrition and their exposure to increased photoperiodicity resulted in early maturity and breeding in these carps. The brood fishes were stocked @2,000-3,000 kg/ha. In addition to providing supplementary feed comprising groundnut oil cake+rice polish (1:1 ratio) and fed @ 2-3% of the weight of stocked fishes, a good plankton bloom was maintained in the pond. Water column was kept at 2.5-3.5' to enhance the photoperiodicity and minimise the water temperature between surface and bottom.

CIFRI has succeeded in off-season breeding of this carp in previous year also. The repeated success during the current year assures the viability of the proposition beyond doubt.

A MAJOR BREAKTHROUGH IN SHRIMP PRODUCTION TECHNOLOGY: A NEW ACHIEVEMENT IN BRACKISHWATER SHRIMP CULTURE

Central Inland Fisheries Research Institute has achieved a major breakthrough in evolving a new shrimp production technology based upon a new feed formulation developed by the Institute. The formulated feed is based upon diverse sources of animal protein, plant protein, essential amino-acids, essential fatty acids, growth promoting substances, minerals and vitamins. Four experiments were conducted in experimental plots and harvesting was done in one of them which gave a production of 1.5 tonne/ha in 7 weeks time. This is a spectacular production rate and opens up new production possibilities for shrimp export. The technology here is based upon tiger shrimp seed, formulated feed and aeration system. Studies in other experiments were interrupted by rains but the growth so far indicated similar production possibilities. Large-scale experiments and demonstrations will be organised after the monsoon.

CAGE CULTURE: A NEW CIRCULAR DESIGN FOR THE CAGE

A circular net cage for culture of carps/air-breathing fishes has been designed at the Bangalore Centre of CIFRI. The net cages can be profitably used for seed raising and culture of these fishes in large or derelict water bodies from where the retrieval is difficult. This cage has three components—the cage frame formed of iron conduit pipes, the synthetic nets and the floats.

The system will be free floating and can be positioned in any open water by anchoring. The cages being circular in shape minimise the wave effect and fishes faces least obstruction in movement inside the cage. These cages can be equally effective in seed rearing as well.

CIFRI'S PROGRESS IN CULTURE OF GIANT AFRICAN SNAIL, *ACHATINA FULICA*

Giant African snail *A. fulica* recorded an impressive growth when reared at improvised terraria at CIFRI, Barrackpore. The snails raised on kitchen refuses comprising spinaches, ash gourd, ridge gourd, brinjal and an assortment of vegetables at the rate of 5% of body weight—attained 74 mm/61.6 g in 150 days with cent per cent survival. *Achatina*, though normally regarded as an agricultural pest is edible and commands an attractive foreign market. According to MPEDA, there is a demand for 20,000 t of edible molluscs in France alone.

MAJOR ACHIEVEMENT IN PRODUCTION OF PULSES AND OIL SEEDS IN DRY LAND CONDITION UNDER DEMONSTRATION PROGRAMME OF KRISHI VIGYAN KENDRA

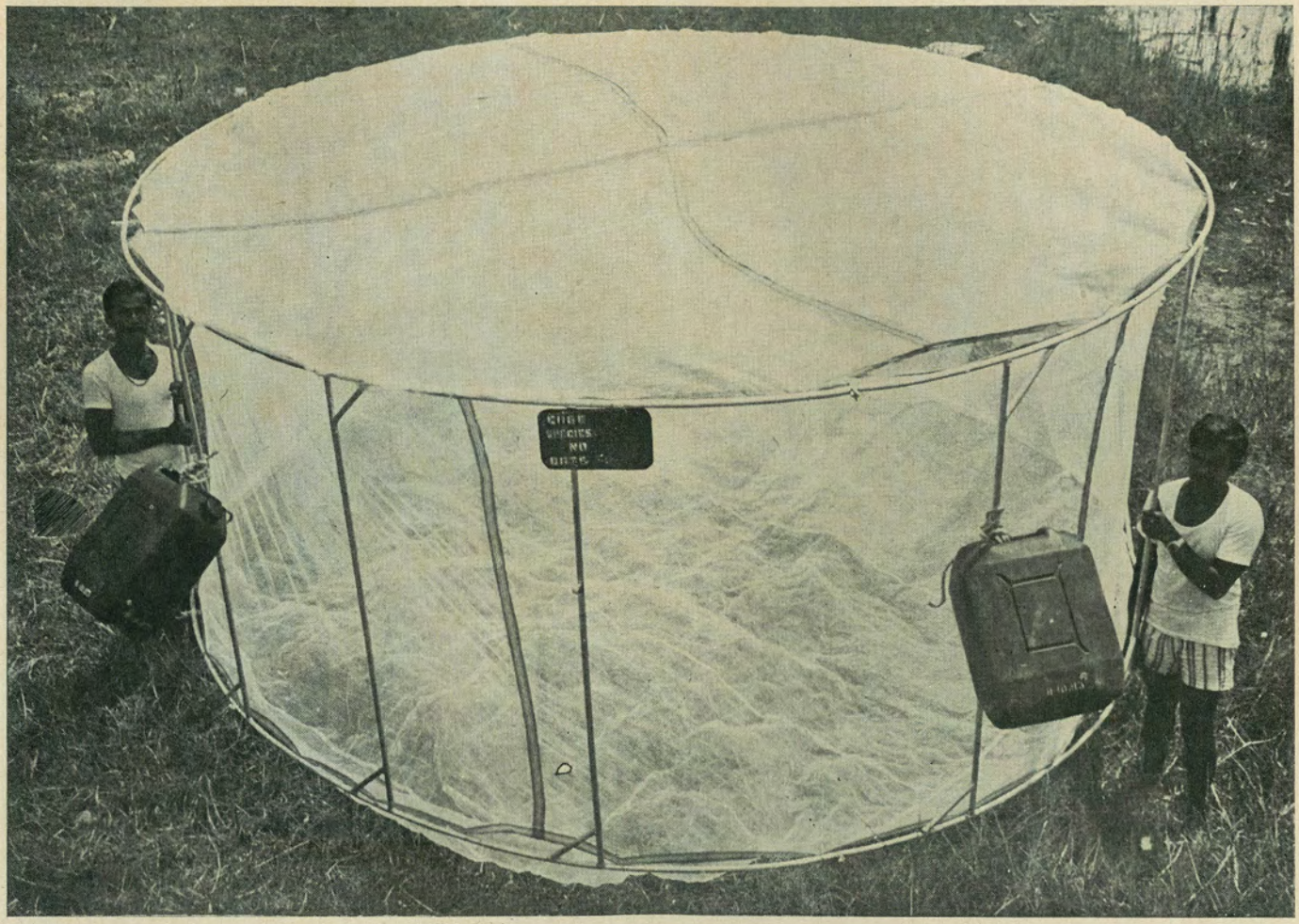
The CIFRI has taken up demonstration programme in pulses and oil seeds through KVK in Lower Sunderbans, and the efforts met with resounding success.

The production of pulses *Cajanas cajan* and *Phascolus mungo* have increased from 2.0 to 6.0 q and 3.0 to 7.5 q/ha with the use of varieties like B7 and T51 respectively. Similarly the yield of oil seeds have also gone up with a production of *Brassica campestris* (Mustard tor, variety B-9), *B. juncea* (Mustard rai, var. B-85), *Sesamum indicum* (var. B-9) and sun flower (var. E_c 68414) increased from 3.0-7.5 q/ha, 4.0-9.0 q/ha 6.0-12.0q/ha and 6.0-9.0q/ha respectively.

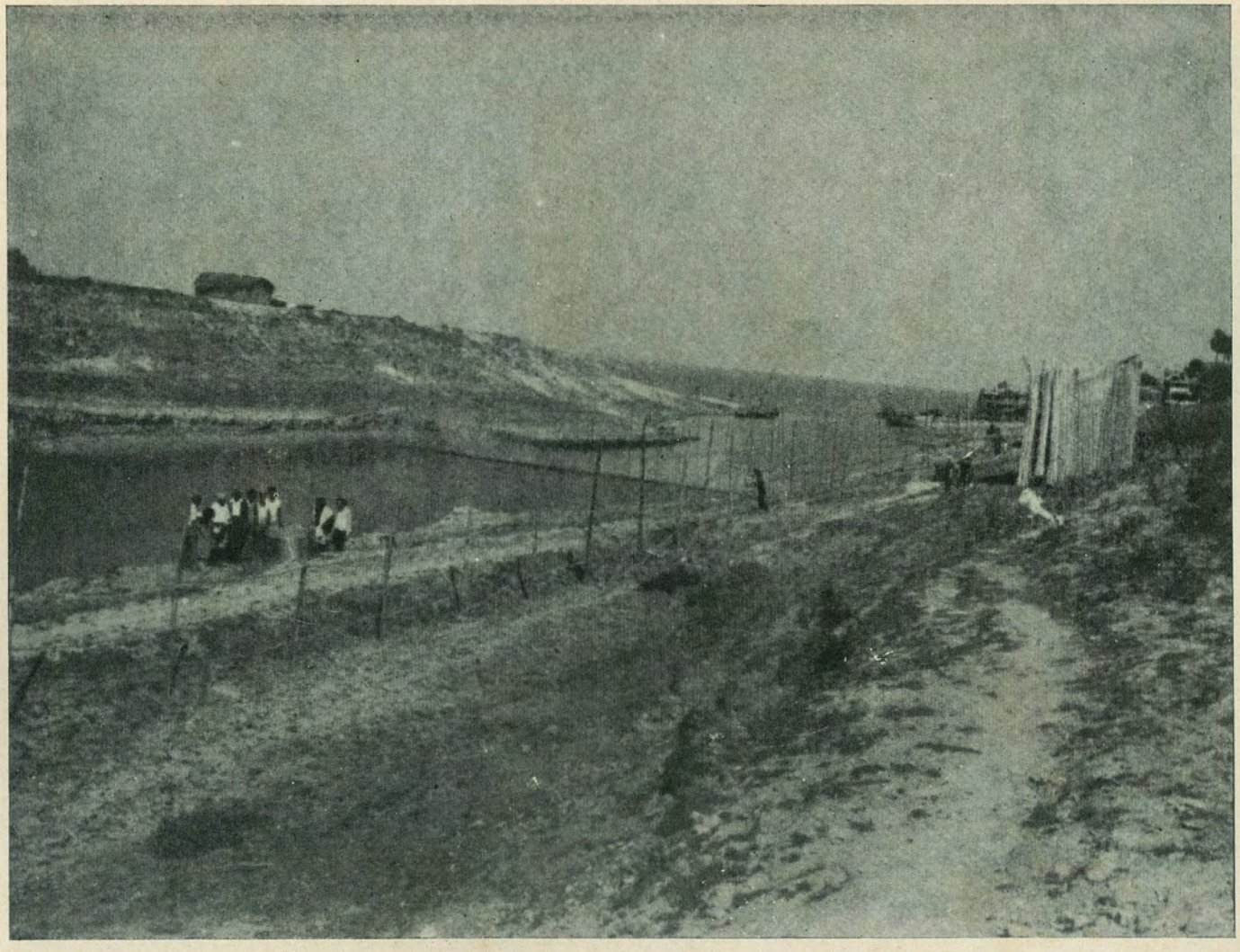
The programme has already generated great interest among the local farmers of Sunderbans.

HIGH DENSITY FRY REARING OF MRIGAL

In a significant breakthrough achieved at the Rahara Research Centre of the Institute, a technology to rear 11-17 million fry of *C. mrigala* per hactare per crop of 15 days was developed. The technology comprises application of poultry manure @ 5 tonnes/ha to generate high density zooplankton followed by application of sumithion @ 2.5 ppm to kill off selectively the larger zooplankton and make available only smaller zooplankton for the tender spawn. Feeding of the spawn was done for the initial two days with microencapsulated chicken egg feed @ 5% of the initial body weight. These package of measures resulted in a very high percentage of survival leading to a production in the range of 11-17 million fry/ha/crop of 15 days rearing. This new technology paves the way to augment seed production in the country with very limited seed farm facilities.



The new circular net cage designed and fabricated at Bangalore centre of CIFRI. The net is ideally suited for carp and air-breathing fish rearing in large, derelict or open waters. The net is effective in seed raising as well (Report on page 4)



Pen culture in sewage-fed channel at Bhagalpur. The bamboo pen with an area of 0.1 ha area gave a net production of 157 kg. of carps in just three months. Supplementary feeding, fertilization, etc. were totally avoided during the culture reducing the cost to minimum.

BREEDING OF RIVERINE CATFISH, *WALLAGO ATTU*

The Institute has succeeded for the first time in breeding the riverine catfish, *Wallago attu* at its Bangalore Research Centre during the last breeding season. This is the first ever successful attempt to breed this highly prized catfish which reaches giant size in rivers. The fish which is in high demand in Northern and Western parts of the country is at present caught from rivers and reservoirs. Successful breeding of *W. attu* under captivity paves the way for its commercial seed production and culture technology.

ENVIRONMENTAL IMPACT OF DEVELOPMENT ON GENE STOCK AND FISHERIES OF GANGA RIVER SYSTEM: URGENT NEED FOR RECRUITMENT MANAGEMENT AND REGULATORY MEASURES

A careful examination of the catch, catch structure and other parameters of Ganga fisheries reveal unmistakable trends of continuing decline of Indian major carps *viz.* catla, rohu and mrigal and a corresponding increase and dominance of minor carps, carp minnows and other uneconomic varieties. In some of the centres like Allahabad and Bhagalpur the uneconomic miscellaneous fishes form around 50 to 60% of the total catch. There is a firm indication that the major carp gene stock may be progressively eliminated from the system. Much of this is due largely to environmental perturbation arising from the large-scale abstraction of water to the tune of one-fifth of the total run off, irrigation waste waters carrying pesticides and fertilizers, sewage and industrial efflux, hydraulic structures, etc. besides elevated fishing efforts in the Ganga River System.

The riverine spawn over the years has deteriorated in quality with a predominance of minor carps; and the quantity of riverine spawn in Ganga is 50% of what is obtained in Yamuna.

The present ecological scenario demands regulatory measures. It is absolutely necessary to enforce a ban on the collection of spawn from River Ganga with a view to resuscitating the fast dwindling major carp fishery. This implies a ban on collection of eggs, spawn, fry and fingerlings of major carps from the Ganga River System.

□

COLLABORATION 5

NATIONAL

- Scientists of FARTC and Faculty members of the Orissa University of Agriculture and Technology exchanged various technical information on inland aquaculture on several occasions.

- Shri H. A. Khan, Scientist, S-3 of FARTC worked as counterpart of FAO/UNDP consultant on cytogenetics.

- Report on the water hyacinth infestation problems in the Choona Bhatti Tank of Bhopal (M.P.) and in various villages of Nadiad, Gujarat were prepared after surveying the areas on request from respective States.

- Shri S. D. Tripathi presented a scheme on fish culture to the Department of Science and Technology for Women which has been approved and is being operated by KVK/TTC of the Institute at Kausalyaganj.

- Dr. N. K. Thakur, Scientist, S-3 of KVK visited Air-breathing Fish Farm at Amranga, Assam for the spot survey and gave his report and suggested corrective measures to make the farm productive and purposeful.

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

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

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

- Viswa Bharati University, Santiniketan in collaboration with CIFRI worked on certain physiological aspects of reproduction in carps with special reference to radio immuno assay and isolation of gonadotropin.

- Similar collaboration was extended by U.P. Fisheries Department to CIFRI in the project breeding and culture of the masheer, *Tor putitora* at Bhimtal.

- The four All-India Coordinated Projects based at the Institute continued to work in close liaison with 15 States/Agricultural Universities till 31.3.85.

- Induced breeding experiments of *Labeo rohita* with partially purified fish gonadotropin, synthetic LHRH and LHRH+fish gonadotropin was undertaken with Zoology Department, Viswa Bharati University.

- Bangalore Centre carried out composite fish culture experiments in a tank at ASC Centre (South), Bangalore.

INTERNATIONAL

- Freshwater Aquaculture Research and Training Centre(FARTC) of CIFRI at Dhauli continued its activities as a joint venture by ICAR and FAO/UNDP. Three scientists received advance training in various aspects of carp culture in USA & Canada under the FAO/UNDP Fellowship programme.

- Senior aquaculturists from various countries under training at NACA Lead centre from Manila were given a 16-day intensive training on carp culture at FARTC, Dhauli.

□

MANPOWER DEVELOPMENT 6

- **Dr. A. V. Natarajan,** Director, CIFRI visited several places of fisheries interest in Thailand, Malaysia and Indonesia during 10 July-24 July 1985. The tour was sponsored by FAO/ UNDP under country programme IND/75/031 'Intensification of Freshwater Fish Culture and Training.

- **Dr. V. R. P. Sinha,** Head, FARTC, Kausalyagang and National Project Director, FAO/ UNDP project also had a study tour programme for 15 days to Thailand, Malaysia and Indonesia under the above programme sponsored by FAO/UNDP.

- **Shri S. Patnaik,** Scientist at FARTC, Dhauli, completed FAO/UNDP sponsored six-months (Jan.-June, 1985) training programme on *utilisation of aquatic weeds for biomass production and biological control of aquatic weeds through fishes* at the University of Florida, USA.

- **Mrs. K. K. Bhanot,** Scientist took advanced training in *fish feed technology* for 2 months at the University of Washington, USA.

- **Shri A. K. Sahu,** Scientist was trained for 6 months (1.8.'85 to 31.1.'86) on *reproductive physiology* at the Marine Science Research Laboratory, Mennorial University of New Foundland, Canada.

- **Dr. P. K. Mukhopadhyay and Dr. V. Pathak,** Scientists at Barrackpore attended about a fortnight (13-31 March, 1985) training course on *Safety aspects in the research applications of ionising radiation* at the Division of Radiological Protection, BARC, Trombay.

- **Shri R. K. Das,** Scientist at Barrackpore attended one month (3.5.85 to 2.6.1985) course in *different techniques in microbiology* under Prof. S. K. Mazumdar (Food Technology and Biochemical Engineering) at Jadavpur University.

- **Shri Radhyeshyam,** T-4, took about 2 months (Feb & March '85) training on *pond microbiology* under the consultancy service of Dr. J. Olah at FARTC, Dhauli.

- **Shri C. Selvaraj,** Senior Scientist at Pollachi Centre underwent a 6 days (24—30 April, 1985) training course on *Instrumentation and Methodology in Fishing Gear Investigations* at CIFT, Cochin.

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- The Academy of Environmental Biology, India has bestowed on **Dr. A. V. Natarajan,** Director, CIFRI its **Honorary Life Fellowship** at the General meeting held at Aurangabad on 22.12.84, for his singular services and outstanding contribution to the field of fishery sciences and aquatic ecology.

- **Dr. G. N. Chattopadhyay,** Scientist at Rahara Centre of CIFRI won the US $ 500 prize of the *"Review of the year competition 1984"* conducted by the International Centre for Living Aquatic Resources Management, Manila, Philippines, for his review article entitled *Chemistry of brackishwater fish pond soils with special reference to India.*

- **Shri A. K. Chattopadhyay,** T-6 at KVK, Kakdwip was awarded the Degree of *Doctor of Philosophy* by Viswa Bharati University for his thesis entitled *Efficacy of herbicides to control weeds and reduce their competition for nutrients in transplanted rice.*

- **Shri C. P. Rangaswamy,** Scientist at Madras Centre has been awarded *Ph.D. degree* from Shri Venkateswara University, Tirupati for his thesis *Impact of endosulfan toxicity on some physiological properties of the blood and aspects of energy metabolism of a freshwater fish, Tilapia mossambica (Peters).*

- **Shri K. R. Naskar,** Scientist has been awarded *Ph.D. degree* by University of Calcutta for his thesis on *Floristic studies of the District 24-Parganas, West Bengal (India) with special reference to the mangrove vegetation of Sunderbans.*

- **Shri M. D. Pisolkar,** Scientist at Pune has been awarded *Ph.D. degree* by University of Poona for his thesis entitled *Fishery and biology of Tor tor (Ham.) from Govindgarh lake, M.P.*

- **Shri M. Ramakrishnaiah,** Scientist at Eluru Centre has been awarded Degree of *Doctor of Philosophy* by Andhra University for his thesis entitled *Studies on the fishery and fish productivity and on the biology of Mystus aor (Ham.) of Nagarjunsagar reservoir in Andhra Pradesh.*

- **Shri S. N. Mohanty** has been awarded Degree of *Doctor of Philosophy* from the Sambalpur University, Orissa. Title of his thesis is *Autecology of Rana tigrina (Daud).*

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EXTENSION AND NATION BUILDING ACTIVITIES

Various centres of the Institute participated in extension programme of the Institute. The activities were spearheaded by the Extension Section based at Barrackpore; KVK/TTC, Kausalyagang; KVK, Kakdwip; and the Lab to Land Programme centres.

BARRACKPORE CENTRE

Following were the major programmes of the Extension Section of the Institute at Barrackpore.

Advisory Services: The advisory services of the Section was extended through discussions, letters, farm visits, etc. to 175 farmers, 26 Government agencies, 7 educational institutions, several private entrepreneurs, voluntary agencies, bank officials, etc.

Visitors briefed: Arrangements were made to impart information on CIFRI's activities and the recent advances in inland fisheries research and development, to over 700 visitors to the Institute. Filmshows, field visits, discussions, lectures, demonstrations, etc. constituted the programme. The visitors included 138 trainee officials, 145 students, 386 farmers, 23 fisheries extension personnel, 14 Government officials and 18 foreign dignitories.

Training: A total of seven training courses were conducted by the Section during the year. The clientele consisted of fish farmers, bank officials, fisheries extension personnel, etc.

Talks: Twenty extension lecturers were delivered by the extension scientists. Ten of them were on aquaculture in general, six on fish diseases, three on composite fish culture and three on integrated farming.

Group discussions: The scientists of the Section participated in five group discussions with the fish farmers. 90 fish farmers were benefited by these discussions.

Fish Farmers' Days: The Institute conducted four Fish Farmers' Days participated by a total of 443 farmers.

Exhibitions: CIFRI participated in three *gramin melas* and two educational exhibitions with its extension exhibits. Several thousand visitors and students visited CIFRI pavilions.

Publications: Thirteen extension manuals in English and two popular articles in Bengali were released during the year. (Listed under Institute's publication list.)

FARTC, DHAULI: Training, study tours and short visit programmes for farmers, national and international trainees, scholars, students, officials and visitors were organised during the year. A total of 14 disciplines related to inland aquaculture were covered under this programme in which a total of 297 persons were benefited.

LALGOLA: A series on extension lecturers were delivered to the advanced fish farmers from Berhampur (W.B.) District Training Centre and trainees sponsored by Block Development Office, Lalgola.

KAKDWIP: More than 500 persons associated were trained in modern techniques for collection and transport of brackishwater fish and prawn seed.

MADRAS: Two weeks training in induced maturation of penacid prawn through ablation of eye stalk was imparted to officials of Gujarat State Fisheries Department.

PURI: Fisheries Officers of Tata Chemicals Limited, Gujarat were trained in induced maturation of penaeid prawns. Several agencies were provided advisory services on breeding and culture of penaeid prawns.

TRAINERS' TRAINING CENTRE, KAUSALYAGANG

The centre functions with the objective to impart in-service training to the trainers/teachers of various non-degree level institutions dealing with fisheries. The training programmes of Trainers' Training Centre are aimed at providing a sound extension base to the trainees through field oriented programmes with a thorough background on the theoritical aspects of the subject.

During the period under report 8 courses were offered by the Centre. The details of the training are tabulated below:

On-campus TTC training programme during the period of January, 1985 to December, 1985

Sponsoring Authority	No. of trainees trained	Duration	Courses offered
Deptt. of Fisheries, Govt. of Orissa	19	3 months (1.12.84-28.2.85)	Composite fish culture, fish seed production & integrated fish farming
Orissa Fish Seed Dev. Corporation	8	2 months (1.3.85-30. 4.85)	-do-
Deptt. of Fisheries, Govt. of Orissa	17	3 months (1.3.85-31.5.85)	-do-
R. Jha College, Sitamarhi, Bihar	1	2 months (5.6.85-2.8.85)	-do-
Deptt. of Fisheries, Govt. of Orissa	6	3 months (1.6.85-31.8.85)	-do-
Deptt. of Fisheries, Govt. of Arunachal Pradesh	4	3 months (15.6.85-15.9.85)	-do-
Lutheran World Service, Calcutta, West Bengal	3	12 days (8.7.85-19.7.85)	-do-
Deptt. of Fisheries, Govt. of Orissa	19	3 months (1.10.85-31.12.85)	-do-

Fish breeding & Fish Seed raising: Incidental to training programmes, the trainees of the Centre have produced 17.5 lakh spawn of Indian major carps. The Centre has supplied/ sold over a lakh fish fry and fingerlings worth over Rs. 16,040/- during the year.

KRISHI VIGYAN KENDRA, KAUSALYAGANGA

Though this Kendra has been serving as a prime centre for piscicultural training and extension in this region, conforming to the norms, it is envisaged to develop into a composite training centre including other disciplines of agriculture sector and allied fields as well. The centre organised several training courses during the year as listed below:

Training activities	DISCIPLINE					
	Fisheries		Home Science		Agronomy	
	No. of courses offered	No. of farmers trained	No. of courses offered	No. of farm women trained	No. of courses offered	No. of farmers trained
On-campus	10	143	7	79	—	—
Off-campus	8	162	20	222	12	229

The training courses in agronomy were under the Prime Minister's New 20-Point Programme in which 6 courses each on production of pulses and oilseeds were offered in collaboration with the Department of Agronomy, Orissa University of Agricultural Technology, Bhubaneswar.

Incidental to the training programme on fish breeding and fish seed production during the period under report, a total of 37.15 lakh spawn of Indian and exotic major carps was produced at the Instructional Farm of the Kendra. The seed were reared to fry and fingerlings and sold to farmers, agencies, etc.

Lab to Land Programme: (Separately mentioned.)

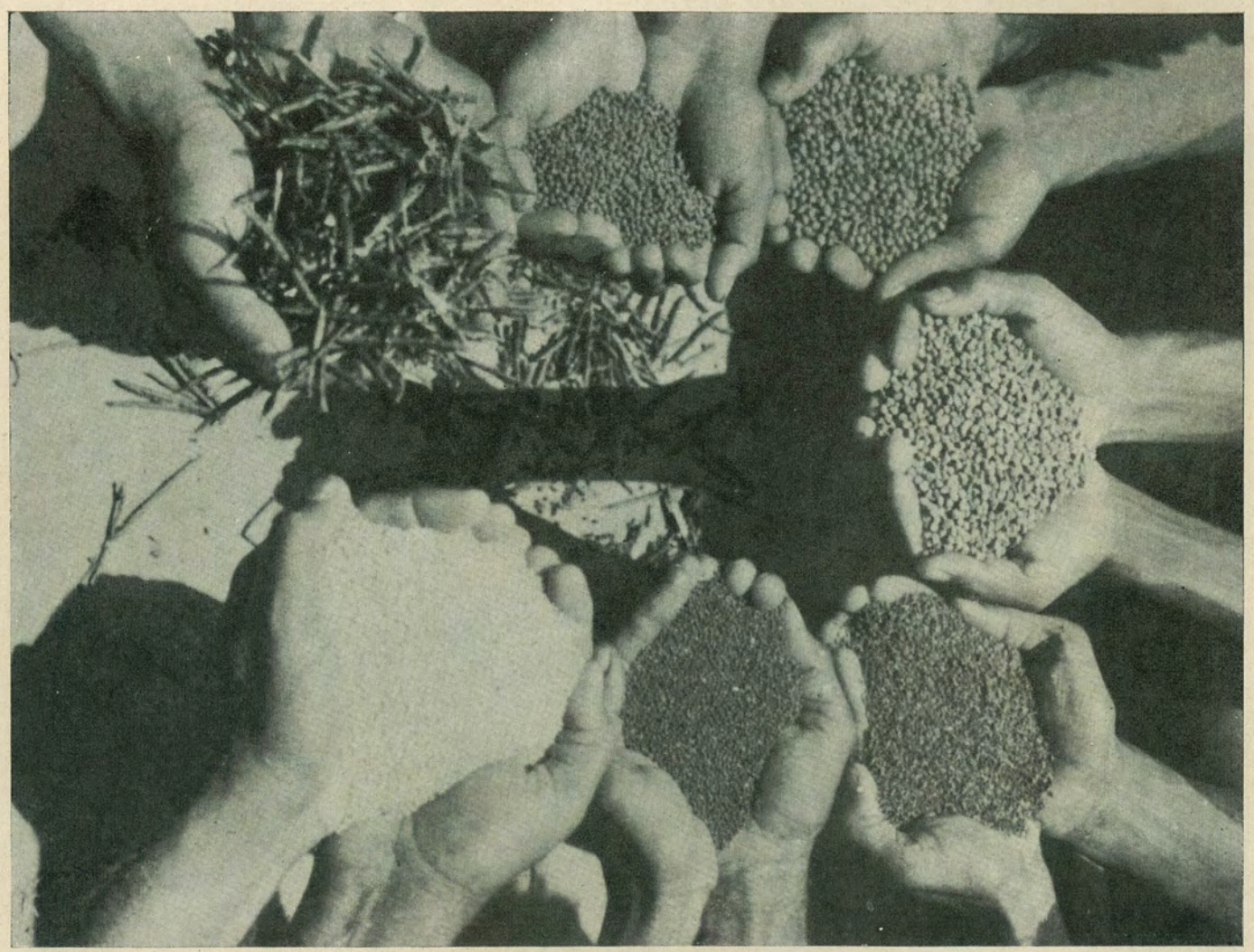
KRISHI VIGYAN KENDRA, KAKDWIP

The KVK Kakdwip is a composite centre having a multi-disciplinary approach in its activities integrating aquaculture, agriculture, agroforestry system and home science. In addition to imparting technical know-how to farmers and extension workers, the centre also conducts original research relevant to the area. Integration of agroforestry with aquacultures (report, project BF/A/19) offseason breeding of Indian major carps, testing the relative performance of various salt resistant varieties in the area and rice-cum-fish farming in brackishwater (report, project BF/A/12) are some of the activities in these lines.

The centre conducted 73 training courses during the year incorporating 1,028 trainees. The break-up of the courses are outlined below:

A team of tribal farmers sponsored by Govt. of Gujarat were trained by CIFRI in several aspects of carp culture. In the picture, the participants are shown to place feed trays in carp culture ponds at Rahara farm.

Fish seed raising in paddy plots. Under the supervision of CIFRI extension scientists, farmers at Kalyanbati (West Bengal) raised fish seed along with paddy fetching additional income. Harvest is in progress in one of the plots.



The Krishi Vigyan Kendra of CIFRI at Kakdwip under its demonstration programme attained substantial improvement in production rates of pulses in dry land condition at Sunderbans. The programme has already generated great interest among local farmers.(Report on page 4)

The KVK, Kakdwip conducts training programme in aquaculture, agriculture and horticulture involving several farmers and unemployed youth of the locality. Prof. R. N. Basu of Calcutta University leads one of the participating teams in to a demonstration plot of 'knol khol'.

Training courses organised by KVK, Kakdwip during the year 1985

Area		Crop production		Horticulture		Fisheries		Home Science		Total	
Duration		(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)
1 day	On-campus	—	—	—	—	—	—	—	—	—	—
	Off-campus	2	27	3	160	12	200	3	52	20	439
2-6 days	On campus	8	78	5	50	7	70	5	42	25	237
	Off-campus	11	101	—	—	10	180	2	25	23	306
7-15 days	On-campus	1	10	—	—	2	20	2	16	5	46
	Off-campus	—	—	—	—	—	—	—	—	—	—

(*a*) = Number of training courses conducted; (*b*) = No. of participants.

The Kendra also motivates youth to take up agriculture/aquaculture on scientific lines. Four rural youth forums were organised in the area with a total membership of 240. The Kendra arranged 12 informative film shows during the year.

Lab to Land Programme: (Separately mentioned.)

LAB TO LAND PROGRAMME

The third phase of Lab to Land Programme initiated in June, 1984 continued at the 6 centres of the Institute covering 600 families. 83 of them are landless families, 437 marginal families, and 80 small families. A total of 10·170 ha of brackishwater and 179·616 ha of freshwater area are covered under this programme.

BARRACKPORE CENTRE: The extension section has adopted 100 families in Chanditala and Nilgunj areas of West Bengal. The fish production in the 1st set of experiment (1984-85) of this phase ranged from 2,270-4,350 kg/ha/yr. About 9 lakh spawn of Indian major carps and 12 lakh spawn of common carp were produced by the farmers under the guidance of the extension scientists.

The brackishwater aquaculture section transferred technologies of paddy-cum-brackishwater prawn and fish culture to 23 families and paddy-cum-freshwater aquaculture to 2 families. Under freshwater system from the traditional monocropped paddy plots, an average yield of 2.6 t kharif paddy, 2.2 t rabi paddy and 793 kg of fish and prawn were harvested per ha in an year. Similarly, from monocropped brackishwater paddy plots, 2.4 t kharif paddy, and 800 kg of fishes and prawns per ha per year was obtained indicating a 50% increase in paddy yield and 100% increase in fish yield.

TTC, DHAULI: The centre has adopted 100 families at 35 centres. The technologies of fish seed production, composite fish culture and integrated livestock-fish farming are trans-

ferred under this programme. The unemployed youth of three villages were grouped into two clubs and two fishermen's cooperatives to undertake fish culture in fallow waterbodies. Under composite fish culture, the production range was 1300-3600 kg/ha/yr. 12.8 lakh spawn of major carp were produced by the adopted farmers during the year.

KVK, DHAULI: One hundred farm families in 17 villages have been adopted by the Kendra. The fish culture demonstrations conducted in these villages in Puri District of Orissa since 1979 resulted in a fish yield ranging from 983 to 3680 kg/ha/yr with an average of 1796.32 kg/ha/yr. This indicates about 5-6 fold increase from the yield obtained earlier by these farmers on their own. The cost of production worked out to be Rs. 6.26 per kg fish on an average basis. Integration of horticulture with aquaculture is becomming more popular in the area.

KVK, KAKDWIP: The IIIrd phase of the programme is in progress with 200 farm families under its fold. The farmers are being trained in crop production, freshwater aquaculture, brackishwater fish & prawn rearing, paddy-cum-fish culture and horticulture.

FARTC, DHAULI: Aquaculture technologies comprising composite fish culture, fish seed rearing and integrated fish farming have been demonstrated in 26 ponds covering a total area of 4.5 ha in 11 villages. Fifty farm families have been adopted by the centre.

In all 9 field training courses were organised during the year to train 441 persons consisting of 137 practising farmers, 116 farm women, 173 farm youth and 15 agricultural labourers.

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LIBRARY AND DOCUMENTATION SERVICE 9

LIBRARY

Research and development activities of the Institute is ably supported by the expanding services of CIFRI Library. In addition, the library extends its service to any research worker or developmental agency in the country on request. Scholars from Universities and other Institutes also frequent to this library. The library maintains an active relationship with leading national and international agricultural research information centres.

During the year 11 new exchange relationships were established which would further strengthan the information flow to this library. By the beginning of the year CIFRI had already established a relationship with about 254 foreign and Indian research establishments to receive their journals either on an exchange basis or in gratis. This is over and above the 56 foreign and 66 Indian journals subscribed during the year.

In 1985, 223 books, 93 reprints, 79 miscellaneous publications and over 1500 loose issues of periodicals were added to the library holdings. At the end of the year the literature assets of the library read as follows: Books 5689, reprints 4024, maps 686, miscellaneous publications 2368. The library preserves an attractive collection of pamphlets,. bulletins, brochures, thesis, photocopies and a core of grey literature. An amount of Rs. 2,46,294.27 was spent on books, periodicals, etc. during the year.

REPROGRAPHY SERVICES: The Section maintains an active unit for photography and reprography services. Photographs, reprints and photocopies were supplied to the research personnels at headquarters and outstations of the Institute free of cost.

The Section also maintains a duplicating (cyclostyling) and binding unit to serve the various units of the Institute.

TECHNICAL REPORTS: About 160 technical and non-technical queries from India and abroad were attended to by the staff of the Section. In addtioin, 38 reports on progress of research were compiled and sent to ICAR. 70 research papers of the scientists were processed for publication in various journals during the year.

INFORMATION

SELECTIVE DISSEMINATION OF INFORMATION: This highly personalised service initiated in 1982 continued through out the year. Interest profiles of about 200 research personnel of CIFRI were updated and the incoming documents were scanned to identify prospective users.

ABSTRACTING SERVICES: Informative abstracts of papers on Indian fisheries appeared in various journals during the year were prepared and brought out in the quarterly publication of the Section **Indian Fisheries Abstracts.** Six issues were released during the year.

CONTENTS LISTS: Covering the relevant titles of research papers in various journals,

this is an internal information service of the Institute. Four bimonthly issues were released by the Section in 1985.

CIFRI NEWSLETTER: Four bimonthly CIFRI Newsletter were published by the Section in 1985, intending to serve a large section of clientele comprising research workers, farmers, extension personnel, etc.

RESEARCH PROJECT FILES: Annual progress reports of over 90 research projects and the contribution of about 200 scientists during the current year were recorded in as many Primary Project Files and Scientists' Files. Research progress monitoring and proper recording of the research results is one of the major responsibilities of the Section.

PUBLICATIONS

The following departmental publications were released by the Section during the year.

1. Annual Report, 1983 & 1984
2. Indian Fisheries Abstracts, **21**(3-4), 1982 & **22**(1-4), 1983
3. CIFRI Newsletter, **7**(5-6), 1984 & **8**(1-2), 1985
4. Report 6th Workshop, All India Co-ordinated Research Project, Brackishwater Fish Farming at Barrackpore, 25th January, 1985.
5. Final Report 1973-1981, All India Co-ordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs Getalsud. Inland Fisheries Research Information Series 4, March, 1984, CIFRI Barrackpore.
6. Bulletin No. **37.** Scope for scientific and commercial fish farming in West Bengal. by A.V. Natarajan.
7. Bulletin No. **38.** Fisheries Research and development in Thailand, Malayasia and Indonesia—a study tour report. 10 July—24 July, 1985. by A.V. Natarajan.
8. CIFRI'S Research Project Programmes 1985.
9. The scope and limitations of introducing bighead carp (*Aristichthys nobilis*) in inland waters of India—by A.G. Jhingran.
10. Training in Brackishwater Aquaculture, 11th-20th June 1979.

CIFRI Aquaculture Extension Manual, New Series

11. **No. 1.** Package of practices for increasing carp seed production by P. Das & M. Sinha.
12. **No. 2.** Package of practices for increasing production in carp culture ponds. by V.R.P. Sinha *et al.*
13. **No. 3.** Package of practices of increasing production of air-breathing fishes. by P.V. Dehadrai, *et al.*
14. **No. 4.** Package of practices for increased production in rice-cum-fish farming system. by Apurba Ghosh, *et al.*
15. **No. 5.** Package of practices for increasing production in fish-cum-livestock farming system. by B.K. Sharma, *et al.*
16. **No. 6.** Package of practices for increased production in rice-cum-fish cultivation in coastal paddy fields. by Apurba Ghosh, *et al.*
17. **No. 7.** Package of practices for increasing production in Brackishwater fish and shrimp culture. by Apurba Ghosh, *et al.*
18. **No. 8.** Package of practices for using domestic sewage in carp production. by Apurba Ghosh, *et al.*
19. **No. 9.** Identification and control of commonly occurring diseases in freshwater aquaculture. by R.N. Pal & A.K. Ghosh.
20. **No. 10.** Aquaculture technologies.

CONFERENCES, SYMPOSIA, ETC 10

The following are the important Meetings/Workshop organised by the Institute during 1985.

- VIth Workshop on All India Coordinated Project on Brackishwater Fish Farming, 25th January, 1985.
- Annual Staff Research Council Meeting of CIFRI, 22-24 January 1985.
- 7th Local Management Committee Meeting of KVK/TTC, Kausalyagang, Dist. Puri held on August 21, 1985.
- KVK Local Management Committee Meeting held on 7.8.85 at Kakdwip.

The scientists of the Institute participated in various conferences/symposia/seminars and meetings held during 1985 wherein they presented their research findings and exchanged views with the delegates. List of scientists who participated/presented papers in such gatherings is furnished below:

Conferences/ Symposia	Organized by	Papers presented	Authors/ Participants
1	2	3	4
"First Orientation-cum-Training Programme on Prosperity Through Rice" (23-30 January, 1985)	International Rice Research Institute, Los Baros, Manila	—	V. R. P. Sinha
Meeting of Senior Statisticians of ICAR Projects and Institutes (28-30 January, 1985)	IASRI, New Delhi	—	K. K. Ghosh
Meeting of the Department of Science & Technology (January 1985)	New Delhi	Scheme on "Science & Technology for Women"	S. D. Tripathi & P. Das
National Seminar on Agricultural Library and Information Service (4-7 February, 1985)	Bidhan Chandra Krishi Viswa Vidyalaya, Mohanpur, W.B.	—	V. V. Sugunan, Anjali De, Sukla Das
National Seminar on Biology of Algae (8-10 February, 1985)	University of Pune, Poona	Recycling of organic nutrients from sewage effluents through the culture of fish food organisms	K. R. Naskar & Apurba Ghosh
"Consolidation 84" (14-2-85)	Rural Welfare Society, Diamond Harbour	—	U. Bhaumik

Conferences/ Symposia	Organized by	Papers presented	Authors/ Participants
1	2	3	4
Workshop on "Estuarine Ecology" (February, 1985)	Zoological Survey of India at Berhampur, Orissa	Review on Macrura	T. Rajyalakshmi
Workshop on "Prospects for Agro-Based Industries in West Bengal" (18 February, 1985)	Bengal Chamber of Commerce and Industry Calcutta	Scope for scientific and commercial fish farming in West Bengal	A. V. Natarajan
International Symposium on Medicinal Aromatic and Spice Plants (23-26 February, 1985)	Directorate of Cinchona & other Medicinal Plants Mungpoo, Darjeeling	Identity of some Medicinal plants from the tidal mangrove forests of Sunderbans in West Bengal	K. R. Naskar
		Medicinal plants from the district 24-Parganas	D. N. Guha Bakshi & K. R. Naskar
Seminar on Upgradation of Technology and Quality Control in the Sea Food Industry (25 February, 1985)	Marine Products Export Development Authority, Calcutta	—	A. V. Natarajan & P. Das
National Symposium on Pure and Applied Limnology: Retrospect and Prospect (18-20 April, 1985)	Department of Botany, Dr. H. G Vishwa Vidyalaya, Sagar	Trophic structure and energy flow in different aquatic ecosystems	A. V. Natarajan & V. Pathak
		Seasonal variation of periphyton in a freshwater beel of Bengal	Kuldip Kumar
		The trophicity and saprobity of the river Ganga and its ox-bow lake in relation to community sewage waste impact	A. K. Laal, S. K. Sarkar & A. Sarkar
		Limnological constraints in fisheries development from a turbid reservoir in the context of Rihand reservoir (U.P.)	V. R. Desai *et al*
Seminar on Fisheries Training for Rural Development (10-11 April, 1985)	G. B. Pant University of Agriculture and Technology, Pantnagar, U.P.	Prospects of intensive aquaculture in rural areas	S. D. Tripathi
		Role of fisheries extension in rural development	P. Das *et al.* & Attended by P. K. Pandit
Seminar on Present Status of Prawn Farming in India (8-9 May, 1985)	Marine Products Export Development Authority, Bhubaneswar, Orissa	Present status of brackishwater shrimp farm management technology in India	A. V. Natarajan V. R. P. Sinha, P. Das, K. Raman & Apurba Ghosh

Conferences/ Symposia	Organized by	Papers presented	Authors/ Participants
1	2	3	4
And Meeting on the Action Plan Recommendation Committee (Extension Part)	-do-	Discussion on prawn farming	P. Das
National Workshop on Formulation of Brackish-water Fisheries Project for International Funding (13-14 May, 1985)	Indian Institute of Management of Ahmedabad at Madras	Penaeid shrimp production possibilities under traditional and intensive culture systems in India	A. V. Natarajan
State Level Fisheries Seminar (16 July, 1985)	Sobuj Sona, FFDA, Nadia at YMCA, Ranaghat	Lectures delivered	P. Das, U. Bhaumik & P. K. Pandit
Symposium on Aquaculture of Carp and related Species (2-5 September, 1985)	Institute National de la Recherche Agronomique, Department of Hydrobiologic, Paris	Integrated carp farming in Asian Country Synergistic approach in carp polyculture with grass carp as a major component	V. R. P. Sinha S. D. Tripathi & D. N. Mishra
National Seminar on Man and Environment	National Environment Science Academy, Avadh University, Faizabad	Pesticide residue in the Hooghly estuary and some fish ponds in the Sunderbans region of West Bengal	H. C. Joshi
2nd Fisheries Development Committee Meeting of Tungabhadra Board for the year 1985-86 (12-13 September, 1985)	Tungabhadra Board	—	S. P. Ayyar
4th National Workshop on Krishi Vigyan Kendra (6-8 October, 1985)	KVK, The United Planters Association of South India, Coonoor, Tamil Nadu	Status paper of Trainers' Training Centre Status paper of Krishi Vigyan Kendra (Kakdwip)	B. K. Sharma, N. K. Thakur, Lekha Sanfui
National Symposium on Environmental Biology (21-23 November, 1985)	Dept. of Biosciences Mangalore University, Mangalore & Academy of Environmental Biology, Muzaffarnagar	An approach to environmental impact study in the Kakinada Bay	T. Rajyalakshmi
International Conference on Ganga Basin Exposition (28-30 November, 1985)	Indian Centre for Public Health & Environment, Dept. of Env. Sci. & Tech. & Central Pollution Control Board, Calcutta	Technoeconomic aspects of sewagefed fish culture —A case study of Sunderban waste recycling	Apurba Ghosh
Symposium of the Academy of Experimental Biology (21-23 November, 1985)	Academy of Experimental Biology, Mangalore	Economic and environmental considerations of a coastal ecosystem—a case study in respect of Sunderbans, West Bengal	A. V. Natarajan & Apurba Ghosh

Conferences/ Symposia	Organized by	Papers presented	Authors/ Participants
1	2	3	4
International Conference on Population Mapping (13-15 December, 1985)	Atlas Mapping & Thematic Organisation, National Atlas, Calcutta	Population pressure on the tidal mangrove swamp forests in Sunderbans—its causes and problems	K. R. Naskar
17th Biennial Conference of the Home Science Association of India (14-16 December, 1985)	Bhubaneswar	Experiences on Home Science Training organised for rural women in Puri District (Orissa) by KVK, Kausalyagang	Lekha Sanfui
National Seminar on Soil Conservation and Watershed Management (17-18 September, 1985)	Indian Association of Soil & Water Conservationists, New Delhi	Possibilities or rice-cum-brackishwater aquaculture in high rainfed coastal saline soils (Abstract)	G. N. Chattopadhyay, *et al.*
National Seminar on Biology, Utilisation Conservation of Mangrove (18-20 November, 1985)	Shivaji University, Kohlapur	Studies on rice-cum-brackishwater aquaculture in reclaimed mangrove areas of Sunderbans (Abstract)	Apurba Ghosh, *et al.*
National Seminar on Pollution Control and Environmental Management	National Environmental Engineering Research Institute, Nagpur	Pesticide residue monitoring in the Bhagirathi-Hooghly stretch of Ganga River System	H. C. Joshi
National Seminar on Pesticide Residues and Environmental Pollution	Sanatan Dharm, P. G. College, Muzaffarnagar	DDT residues in fish in Hooghly estuary	H. C. Joshi
All India U.G.C. Seminar on Environmental Sciences and Warmwater Fish Culture	M. J. College, Bettiah (Bihar)	Chronic toxicity of DDT to *Tilapia mossambica*	H. C. Joshi, M. K. Mukhopadhyay & P. K. Mukhopadhyay

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VISITORS 11

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

Acharya, R. M. (Dr.)	..	Deputy Director General (AS), ICAR, New Delhi
Alam, Syed Shamsul	..	A. G. M., Bangladesh Krishi Bank, Dhaka
Alikunhi, K. H.	..	Adviser (Aquaculture) & Fishery Consultant, Maharashtra Govt. Prawn Hatchery Project, Bombay
Bandhopadhyay, S. (Dr.)	..	Asstt. Professor, Dept. of Aquaculture Engineering, Indian Institute of Technology, Kharagpur
Banerjee, S. (Dr.)	..	Fishery & Ecology Research Unit, Dept. of Zoology, Calcutta University, Calcutta
Basu, B. (Dr.)	..	Head of the Dept. of Zoology, R. P. M. College, Uttarpara, Hooghly
Bensouesan (Mr.)	..	FAO, Rome
Borgoham, P. N. (Dr.)	..	Officer-in-Charge, Institute of Farm Management, Rani, Gauhati
Bose, K. C. (Prof.)	..	Former V. C. & Head, Dept. of Zoology, Ranchi University, Ranchi
Bunthiang	..	Chief, Livestock, Alopen Province
Catling, H. D.	..	IRRI, Manila, Philippines
Chatterjee, S. L.	..	I.A.S., Secretary to the Govt. of Orissa, Bhubaneswar
Chaudhary, C. S.	..	Fisheries Officer, Rajasthan Tribal Area Development Coop. Federation, Pratap Nagar, Udaipur
Cockcroft, Lawrence	..	Booker Agriculture International, London
Dantwala, M. L.	..	Indian Society of Agricultural Economists, Bombay
Das, Nepal Chandra	..	Hon'ble Minister of State, Panchayat, C.D. & Fisheries, Assam
Das, R. C. (Dr.)	..	Dean, Extension Education, OUAT, Bhubaneswar
Datta, Amal	..	M.P. (Lok Sabha), Parliament House, New Delhi
Datta, N. C. (Dr.)	..	Reader, Fishery & Ecology Research Unit, Dept. of Zoology, Calcutta University, Calcutta
Dhar, P.	..	Fisheries Officer, Institute of Farm Management, Rani, Gauhati
Dhendup, Tenzing	..	Incharge, Fisheries, Fish Seed Production Centre, Gayegphug, Bhutan
Dholakia (Prof.)	..	Indian Institute of Management, Ahmedabad, Gujarat

Dika, B. K. (Prof.)	..	Cotton College, Gauhati
Dutta, A. B. (Dr.)	..	Head, Dept. of Zoology, Vidyasagar College, Calcutta
Fugler, Charles M. (Dr.)	..	Frog Culture Specialist, FAO/UNDP Project
Goswami, U. C. (Dr.)	..	Reader, Zoology Department, Gauhati University, Gauhati
Guha, Sailes (Dr.)	..	Head of the Department of Zoology, Serampore College, Serampore, West Bengal
Halder, Manoranjan (Prof.)	..	M.P. & Member of I.C.A.R. Governing Body, New Delhi
Haq, S. H.	..	Fishery Extension Officer, Along, Arunachal Pradesh
Hiltibran, Robert C.	..	Illinois Natural History Survey, Urbana, Illinois 1801, U.S.A.
Huke, Robert E. (Dr.)	..	International Rice Research Institute, Manila, Philippines
James, P. S. B. R. (Dr.)	..	Director, C.M.F.R.I., Cochin
Jhingran, V. G. (Dr.)	..	Former Director of C.I.F.R.I., Dehra Dun, U.P.
Justice (Mr.)	..	North Carolina University, U.S.A.
Kaushik, D. (Dr.)	..	Director of Fisheries, Haryana, Chandigarh
Khamsing	..	Chief, Livestock, Company, Vientian
Khan, Ch. Shakrullah	..	Hon'ble Minister of State for Fisheries, Haryana, Chandigarh
Kindo, L.	..	I.A.S., Director, Dept. of Fisheries, Govt. of Orissa
Luke, Alexander	..	I.A.S., Commissioner of Fisheries, Fisheries Department, Gandhinagar, Gujarat
Maakan, T. R.	..	FAO, Regional Office, New Delhi
Maharathi, P. K.	..	M.L.A., Pipili, Puri, Orissa
Maji, Chandi C. (Dr.)	..	I.C.A.R., New Delhi
Manichand (Mrs.)	..	Chief, Provincial Agriculture Service, Long Pha Bang, Lao
Mendiratta, A. L.	..	F.A.O. Regional Office, New Delhi
Mitra, G. N. (Dr.)	..	Honorary Fishery Adviser to the Govt. of Orissa, Cuttack
Mohsin, Mir Md.	..	Sr. Faculty Member, Bangladesh Krishi Bank, Jessore
Murdach, George (Dr.)	..	Booker Agriculture International, London
Murray, Kuth R.	..	Aquacultural Engineering Department, Wesiot Watt University, Edinburgh
Nair, Santha Sheela (Mrs.)	..	Director of Fisheries, Govt. of Tamil Nadu & Managing Director, Tamil Nadu Fisheries Development Corporation Ltd., Madras
Nair, T. K. A.	..	Chairman, M.P.E.D.A., Cochin
Naylor, Ernest (Prof.)	..	Head, School of Animal Biology, University College of North Wales, Bangor, U.K.
Palit, A. K.	..	Chief Secretary to the Govt of Assam, Gauhati
Pande, H. K. (Dr.)	..	Director, C.R.R.I., Cuttack

Paola, A.	..	F.A.O., Rome
Prasad, A. B.	..	Prof. & Head, Dept. of Botany, Mithila University, Darbhanga
Prasad, C. (Dr.)	..	Dy. Director General, I.C.A.R., New Delhi
Qasim, S. Z. (Dr.)	..	Secretary, Department of Ocean Development, Govt. of India, New Delhi
Rahman, Alibur	..	Dy. G.M., Bangladesh Krishi Bank, Rajshahi
Ray, T. K. (Brg.)	..	Lutheran World Service, Calcutta
Roy, D. J. (Dr.)	..	Zonal Coordinator, LLP-Zone II, B.C.K.V.V., Mohanpur, W.B.
Satyanarayan, T. N.	..	Asst. Director of Fisheries, Fisheries Department, Gandhinagar, Gujarat
Sethon	..	Fishery Technician, Xiengkuang
Shafiquiddin, Syed	..	A.G.M., Bangladesh Krishi Bank, Sylhet
Shang, Y. (Dr.)	..	F.A.O. Consultant
Sharma, A. P. (Dr.)	..	Asstt. Professor, G. B. Pant Agricultural University, Pantnagar, U.P.
Sharma, Y. S. R. K. (Prof.)	..	Department of Botany, Banaras Hindu University, Banaras
Shastri, R. N.	..	Director of Fisheries, Govt. of Karnataka, Bangalore
Silas, E. G. (Dr.)	..	Former Director, C.M.F.R.I., Madras
Singhi, P. C.	..	I.A.S., Director of Animal Hunbandry & Fisheries, Rajasthan
Singh, Panjab	..	Asstt. Director-General, ICAR, New Delhi
Somai	..	Chief, Fish Seed Farm, Champasa
Srinivasan, R.	..	General Manager, T. N. Fisheries Development Corporation Ltd., Madras
Srivastava, U. K. (Dr.)	..	Indian Institute of Management, Ahmedabad, Gujarat
Sundermurthy	..	Fisheries Training Centre, Madras
Thomsathith	..	Chief, Fishery Service, Directorate of Livestock, Vientian, Lao
Venkatraman, S. K. (Dr.)	..	Fisheries Training Centre, Madras
Wijmans, Philip	..	Barneveld Agricultural College, Barneveld, Holland
Yadav, J. S. P. (Dr.)	..	Chairman, A.S.R.B., New Delhi
Yonker, Michael P.	..	Aquatic Farms Ltd., Kaneettu, Hawaia, U.S.A.

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FINANCE 12

The provision of funds for the financial year 1985-86 was as under:—

Non-Plan	: Rs.	2,09,18,000/-
Plan	: Rs.	10,00,000/-
Total	Rs.	2,19,18,000/-

Against this provision, the expenditure from 1.4.85 to 31.12.85 was as follows:—

Non-Plan	: Rs.	1,56,13,978/-
Plan	: Rs.	20,49,505/-
Total	Rs.	1,78,63,483/-

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CENTRE-WISE LIST OF ONGOING PROJECTS 1985

BARRACKPORE	FA/B/7	BF/A/15
	FA/A/11	BF/A/17
	FA/A/36	BF/A/18
	FC/A/4	BF/A/20
	FC/A/6	AN/B/1
	BF/B/3	AN/B/5
	BF/B/5	AN/B/6
	BF/B/6	AN/B/7
	BF/B/8	AN/B/8
	BF/A/2	AN/A/5
	BF/A/10	AN/A/6
	BF/A/11	AN/A/7
	BF/A/14	AN/A/8
ALLAHABAD	FA/A/2	FC/B/7
	FA/A/26	FC/B/8
	FA/A/35	FC/A/2
BANGALORE	FA/A/13	FC/A/1
	FA/A/33	FC/A/7
BHAGALPUR	FC/B/7	
BHIMTAL	FA/A/3	
BILASPUR	FC/A/7	
BUXAR	FC/B/7	
CALCUTTA	BF/B/2	
CANNING	BF/A/20	BF/B/3
CUTTACK	FA/A/34	

DIGHA	BF/B/3	
FARTC, DHAULI	FA/B/1	FA/A/17
	FA/B/3	FA/A/18
	FA/B/4	FA/A/20
	FA/B/5	FA/A/21
	FA/A/1	FA/A/28
	FA/A/8	FA/A/30
	FA/A/15	FA/A/31
	FA/A/16	
GAUHATI	FC/A/3	FC/B/9
KAKDWIP	BF/A/1	BF/A/12
	BF/B/1	BF/A/19
	BF/A/5	AN/B/4
KAKINADA	FA/A/22	FA/A/23
KALYANI	FA/B/6	AN/A/4
	FA/A/27	CP/CFCSP-10
KARNAL	FA/A/37	
KRISHNAGAR	CFCSP-10	
KVK/TTC, KAUSALYAGANG	FA/A/29	
LALGOLA	FC/B/7	
MADRAS	BF/B/7	BF/A/9
	BF/A/4	BF/A/13
	BF/A/7	
MUZAFFARPUR	FC/A/5	
PATNA	FC/B/7	
POLLACHI	FC/A/7	
PUNE	FC/A/7	
PURI	BF/A/3	BF/A/6
RAHARA	FA/B/2	FA/A/19

	FA/A/10	FA/A/32
	FA/A/12	BF/A/2
		AN/B/9
RAIDIGHI	BF/B/3	
RIHAND	FC/A/7	
SRINAGAR	FA/A/4	FC/B/1
TADEPALLIGUDEM	FA/A/14	FC/B/5
ULUBARIA	BF/B/3	

RESEARCH PROJECTS MERGED DURING 1985

1. FC/B/2 : Fisheries of 'Kol' at Bhagalpur
2. AN/B/10 : Rotifers as biological indicators

} Merged with FC/B/7

3. BF/B/4 : Seed abundant and recruitment of fishes and prawns in Hooghly-Matlah Estuary — Merged with BF/B/3
4. FA/A/25 : Culture of *M. malcolmsonii* near Kolleru Lake — Merged with FA/A/14

ONGOING PROJECTS

PROJECT FA/B/1 : ECOLOGY AND PRODUCTIVITY OF FISH CULTURE PONDS

Personnel : V. R. P. Sinha, P. K. Saha, S. Ayyappan, C. S. Purushothaman and Radheyshyam.

Duration : 1983 to 1988.

Location : FARTC, Kausalyagang.

Studies on rural undrainable fish ponds: The basic production-related ecological processes were quantified in the rural undrainable fish ponds around FARTC, which included primary production, community respiration and sediment oxygen consumption. The gross primary production levels calculated using the three-point oxygen method in the 18 rural ponds ranged from 1.76 to 4.39 g C/m²/d. The community respiration values were in the range of 1.66-4.69 g C/m²/d, and the net production was low (10.03 to 1.35 g C/m²/d). With fish production level of 2.8 to 15.8 kg/ha/d at stocking densities varying from 2,800 to 7,000/ha, the average fish production efficiency worked out to 2.49. A low correlation ($r=0.15$) between primary production and fish production indicated the importance of allochthonous organic enrichment in these ponds.

The sediment oxygen uptake values varied between 0.39 and 3.39 g O_2/m²/d, being in the low ranges of 5.14-29.74% of gross primary production and 5.34-29.95% of community respiration. The chemical and bacterial oxygen uptakes formed major portions of the total

sediment oxygen consumption (15.53-100.00% and 0.0-77.27% respectively) and the animal uptake was negligible. The differences between the actual and potential uptake rates were considerable. The organic-rich deep sediment layers were observed to be playing a limited role in the community metabolism of these ponds. Having measured the significance of mechanical disturbance and bioturbation on increased oxygen consumption, measures like bottom raking and enrichment of benthic fauna were suggested for improved sediment-water interactions.

Monitoring of ponds with different levels and methods of organic manuring: Two sets of six ponds (0.02 ha) with different application methods (daily as spray and fortnightly in heaps) and increasing levels of cowdung were monitored for diurnal fluctuations of dissolved oxygen, primary production and sediment oxygen consumption, plankton, bacterioplankton and aerobic heterotrophic bacterial populations, bottom biota and macrophyte decomposition for a period of three months.

No significant differences were observed in the chemical parameters except in phosphate-phosphorus and inorganic nitrogen levels in water, which were slightly more in the ponds where cowdung was applied daily than fortnightly. Increasing levels of cowdung application did not show much variations. It was also observed that after poisoning the ponds with bleaching powder, total alkalinity, calcium and phosphorus levels of water increased to some extent and then gradually declined. The gross primary production and sediment oxygen consumption values ranged from 1.85-8.11 g $C/m^2/d$ and 0.35-3.51 g $O_2/m^2/d$ respectively. The total plankton counts varied from 16-5,036/l, the dominant phyteplankton being *Volvox, Eudorina, Pinnularia, Pediastrum, Melosira* and zooplankters comprising *Asplanchna, Brachionus, Keratella, Diaptomus* and *Cyclops.* The bacterioplankton counts varied from 1.05×10^6/ml to 2.29—10^3/ml. The ranges of aerobic heterotrophic bacterial counts in the water and sediment were 0.73×103 to 1.65×10^3/ml and 36.88×10^4/g wet weight respectively. The bottom biota showed a steep increase with increasing quantities of cowdung and comprised only chironomid larvae in the initial stages (1,415-25,889/m^2).

The average daily decomposition rates of water hyacinth leaves ranged from 0.89 to 2.84% of the initial weight. The detritus-associated respiration levels in the dominant tropical aquatic macrophytes, viz., *Eichhornia, Salvinia, Hydrilla, Najas* and *Ceratophyllum* were measured, along with their decay rates in manured fish ponds. Five states of decomposition ranging from fresh leaves to detritus were indentified for the purpose. The oxygen requirement was observed to increase in the first stage of decay followed by a gradual stabilization. While it was in the low ranges of 0.26-0.44 mg O_2/g/h in case of *Salvinia*, high values of 0.12-2.31 mg O_2/g/h were noticed for *Najas.* The decay rates were greater in bottom incubated macrophytes than at the surface. The respiration levels depended on the type of foliage, biomass, composition and decay patterns of the macrophytes.

PROJECT FA/B/2 : ECOLOGY OF SEWAGE-FED FISH PONDS

Personnel : G. N. Chattopadhyay, A. C. Nandy, N. M. Chakrabarty, and B. Ghosh

Duration : 1983-1986

Location : Rahara (W. Bengal)

The nutrient level of pond was observed to increase immediately after the application of sewage effluent into the pond and decreased gradually till next treatment. After the appli-

cation of sewage effluent into the pond a bloom of phytoplankton started appearing. The bloom reached a peak within 5-7 days. Afterwards it retarded gradually. During the period phytoplankton dominated over zooplankton and was represented by algae belonging to class Myxophyceae and Chlorophyceae. Phytoplankton production gradually supported zooplankton production. Among zooplankters, rotifers were the dominant forms followed by copepods and cladocerans. The study of biota revealed that blood worms (*Chironomus* sp.), sludge worms (*Tubifex* sp.) and gastropod molluscs were the dominant forms among macroinvertebrates.

PROJECT FA/B/3 : STUDIES ON DIGESTIVE PHYSIOLOGY OF CARPS

Personnel : B. N. Singh, K. K. Bhanot, K. Kumar, D. N. Swamy and C. R. Das

Duration : 1981 to 1987

Location : FARTC, Kausalyagang.

The digestibility of protein, lipid and energy was studied in rohu fingerlings for various feeds formulated. The feeds were pelleted, dried and were fed to fingerlings in plastic pools under laboratory conditions. The crude protein, lipid, ash and energy content of feed No. 1 (fishmeal pellet) was 36.3%, 13.8%, 32% and 2,774.8 k cal/kg respectively. The crude protein, lipid, ash and energy of feed No. 2 (groundnut oilcake pellet) was 40.9%, 15.8%, 7.5% and 4,593.6 k cal/kg respectively. The studies conducted on rohu fingerlings have shown that digestible protein in fish meal is about 68%. The digestible energy of fish meal ranged between 45.8-54.1%. The digestible energy of groundnut oil cake in rohu fingerlings was 43.3%. The digestible lipid in conventional carp feed (GOC+RP 1:1) in pelleted diet was 62.1%. However, digestible lipid in conventional carp feed when fed in moist form without any cooking was higher (72.1%). The lipid digestibility in pelleted experimental feed No. 3 (FM+GOC+RP+YP+$CaHPO_4$+Salt+TM+Vit. mix in ratio 20 : 40 : 33 : 5 : 1.5 : 0.3 : 0.1 : 0.1) with a crude protein content of 29.2% was 64.9%. The digestibility of lipid in moist experimental feed No. 4 (composition same as in feed No. 3) was 65.4%. The lipid digestibility in experimental feed No. 3 and 4 was unaffected by pelletisation.

The intestinal pH of adult mrigal varied between 5.6 and 7.0 at various sections. The intestinal pH of rohu fingerlings was found to range from 6.4 to 6.8.

The efficiency of pelleted and moist diets on growth of rohu fingerlings was studied in laboratory conditions. The following two feeds (*a & b*) were pelletised in California Pellet Mill and 2 feeds (a1 & b1) with same composition were experimented in moist condition.

(a) & (a1) Experimental feed—FM+GOC+RP+YP+$CaHPO_4$+Salt+TM+Vit.mix (20 : 40 : 33 : 5 : 1.5 : 0.3 : 0.1 : 0.1)

(b) & (b1) Conventional carp feed—GOC+RP (50 : 50)

FM=Fish meal. RP=Rice Polish, GOC=Groundnut oil cake, $CaHPO_4$= Calcium dibasic phosphate, TM=Trace mineral mixture, YP=Yeast power, Vit. Mix=Vitamin mixture.

The crude protein content of experimental pelleted feed (a1) and moist feed (a2) was 29.2%. The lipid content of feeds a1 and a2 was also similar (14.03%). The crude protein content of conventional pelleted feed (b1) and moist feed (b2) was 26.1%. The lipid content of feed b1 and b2 13.1%. The feeding experiment with above four feeds was continued for

83 days. The fishes were fed at the rate of about 5% of their body weight. The water temperature varied between 26-32°C. Each diet was fed in replicate.

The total increase in wet weight of rohu fingerlings feeding on pelleted experimental diet (a1) was 15.0 g. The total increase in weight of rohu feeding on moist experimental diet (a2) was 10.1 g. The total increase in weight of rohu feeding on conventional pelleted diet (b1) was 15.5 g and those of rohu feeding on conventional moist diet was 9.2 g. This study clearly shows that pelleted feed gives 48-68% higher rate of growth as compared to moist feed.

The protein requirements of catla fry using synthetic casein diet was studied in laboratory conditions. The crude protein content of six complete casein diets tested varied between 26.3-52.6%. The calculated gross energy of the diets was between 284-402.7 k cal/100 g feed. The protein to energy ratio of the diet was 92.5-130.6 mg protein/k cal energy. Each diet was fed to 2 replicate groups and increase in weight of fish was recorded. The results obtained in the above mentioned study have shown that catla fry (15-25 mm) require about 47% crude protein for their optimal rate of growth. The conversion rate obtained with this feed was 5.0. The protein efficiency ratio (PER) of this feed was 0.42 and feed efficiency was 19.9%.

PROJECT FA/B/4 : **ENDOCRINOLOGICAL STUDIES OF ASIATIC CARPS INHABITING RUNNING AND CONFINED WATERS**

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

Duration : 1983 to 1988

Location : FARTC, Kausalyagang

Attempts were made to hypophysectomise and gonadectomise common carp through an oral approach and an incision in the abdomen respectively for studying the effect of removal of pituitary on the gonadal maturity and *vice-versa*. The operated fishes did not survive.

PROJECT FA/B/5 : **CYTOLOGICAL, MORPHOLOGICAL AND BIOLOGICAL INVESTIGATION ON CARP HYBRIDS**

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

Duration : 1984-1986

Location : FARTC, Kausalyagang

Rohu-catla hybrid fingerlings were stocked along with rohu, catla, mrigal, silver carp and grass carp in 8 ponds (0.08 to 0.1 ha). Stocking density was 5,000/ha and percentage of hybrid fishes stocked was 5. Initial average weight range of hybrid fingerlings was 42.5 g to 70 g. After six months of rearing growth of the hybrid fishes varied between 227 g and 1,800 g and survival 5% and 100%.

Karyological studies of grass carp-silver carp hybrid has shown that the screened hybrids were diploid with $2n=48$ as the parent spp. In the case of grass carp only metacentric and sub-metacentric chromosomes were observed. Silver carp showed the presence of two pairs

of sub-telocentric chromosomes besides metacentric and sub-metacentric types. The hybrid with metacentric and sub-metacentric pairs appears to inherit one pair of sub-telocentric chromosomes from the male parent (silver carp).

PROJECT FA/B/6 : **STUDIES ON THE DIGESTIVE ENZYMES OF *RANA TIGRINA* AND *R. HEXADACTYLA* FROM BENGAL**

Personnel : A. K. Mondal, S. C. Mondal and Prof. J. J. Ghosh (University of Calcutta)

Duration : 1980-86

Location : Kalyani

The frogs were fed with silkworm pupae powder & natural food, adult moth, trash fish, etc. and their digestibility was studied. The frogs thus reared showed excellent growth.

PROJECT FA/B/7 : **CERTAIN PHYSIOLOGICAL ASPECTS OF REPRODUCTION IN CARPS WITH SPECIAL REFERENCE TO PURIFICATION AND ASSAY OF GONADOTROPIN**

Personnel : P. K. Mukhopadhyay, Amitabha Ghosh and V. K. Unnithan (All from CIFRI); Samir Bhattacharya and Arun Roy (Both from Visvabharati University).

Duration 1984-86

Location : Barrackpore/Santiniketan

Seasonal variation in the contents of total protein, total cholesterol, ascorbic acid, total lipid and moisture were done in liver, gonad and blood serum of *Cirrhina mrigala* at different stages of maturity. None of these parameters showed any definite trend in fluctuations in these preliminary observations. The serum gonadotropin at various stages of maturity were studied. The results obtained are presented below:

Maturity stage	Male		Female	
	GSI	Serum GtH ng/ml	GSI	Serum GtH ng/ml
Immature, maturing I & II	less than one	N.D.	less than ten	N.D.
Maturing III	2.1	N.D.	16	N.D.
Mature	4.0	27	18	220
After administration of pituitary extract —3 mg/kg wt	—	1,500	—	*
After spawning	—	170	—	58
Reabsorbing stage	—	—	—	2,250

*Could not be done due to sample spoilage. N.D—Not detectable.

Gonads of males and females of different stages of maturity were preserved for histological studies. Data on gonado-somatic index have also been collected.

PROJECT FA/A/1 : BROOD STOCK MAINTENANCE, BREEDING OF INDIAN AND EXOTIC CARPS AND REARING OF FRY AND FINGERLINGS

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

Duration : 1982 to 1987

Location : FARTC, Kausalyagang

Prospective spawners of Indian major carps and Chinese carps of 2-3 years age were stocked at the rate of 1200 to 1500 kg/ha in 8 ponds each of 0.1 ha in combination and singly and reared. The fishes were fed with formulated feed (GOC+RB+fish meal+multivitamins, vitamins E and C and trace elements) at a protein level of 30% in four experimental ponds and with conventional feed of groundnut oil cake and rice bran at a protein level of 20-22% in 4 control ponds and fed at the rate of 3% of the body weight of stocked fishes and the grass carp were fed in addition 20 to 25% of their body weight with aquatic weeds daily.

When they were utilised for induced breeding, 100% success was achieved in rohu, catla and mrigal fed with formulated feed compared to 82%, 100%, 100% respectively in those fed with conventional feed. In the case of silver carp 45.4% success was observed in both the cases.

By injecting Hoe 766 Vet+Progesterone, rohu could be induced to breed this year also. However HCG when tried in a few sets of rohu did not yield positive results, even after getting a low priming dose a week before actual breeding experiments and subsequently getting the usual doses.

A total of 3.0 million hatchlings of Indian major carps and Chinese carps and catla, rohu hybrids were produced.

Fry rearing: Catla spawn was reared in newly dug-out nurseries after manuring with poultry dropping. At the rate of 1.5 to 3.75 mi/ha, the percentage of survival ranged from 45 to 75%. In the case of rohu, stocking density ranged from 1.5 to 7.5 mi/ha and in mrigal from 1.5 to 6.0 mi/ha. A complete picture of the survival in these species could not be obtained due to the merging of the nurseries on account of heavy rains. In silver carp under low density of stocking of 1.0 mi/ha, only 35% survival could be obtained. Only conventional feed of powdered groundnut oil cake and rice bran were tried as supplementary feed.

Fingerlings rearing: Fry to fingerling rearing with four species combination in four rearing ponds each of 0.1 ha at a stocking density of 1.25 lakhs/ha was concluded after a period of 3 months rearing. In two ponds, catla, rohu, mrigal and grass carp were stocked in the ratio of 3:3:3:1 respectively and in the other two ponds with silver carp, rohu, mrigal and grass carp in the same ratio as mentioned above. The overall survival in the first combination was 56.8% and in the second combination, 62.8%. Comparatively low survival was due to the presence of murrels in all the ponds, which migrated from the adjacent swampy area to the experimental ponds.

PROJECT FA/A/2 : BREEDING AND CULTURE OF COMMERCIALLY IMPORTANT CATFISHES

Personnel : S. P. Singh, A. G. Jhingran, R. N. Seth, G. N. Srivastava, G. N. Mukherjee, S. K. Wishard, K. Chandra and N. K. Srivastava.

Duration : 1982 to 1986.

Location : Allahabad

Culture of *M. seenghala*: During the culture of *M. seenghala* in the 0.05 ha pond at Yusufpur, the forage fishes, mainly comprising *Amblypharyngodon mola*, *Puntius ticto*, *P. sophore* and *Oxygaster bacaila* bred profusely round the year forming a sizeable population in the pond. The forage fishes in different size ranges, served as the main food for the growing seenghala. Supplementary food was not provided during the culture period. Seenghala encountered during June 1985 were observed to have attained a size range between 500 mm/700 g and 600 mm/2000 g. The pond was manured by cowdung @ 50 kg/month. The fishes thrived well in the pond.

Breeding of *M. seenghala*: Two spurts were observed during the year. The first spurt commenced in early March when formation of breeding pits (*Thalas*) in the pond was observed. The eggs were noticed in the *Thalas* on 14.3.85. This spurt continued till late May. The second spurt of breeding commenced in June and continued till July 1985. No breeding pits could be located thereafter due to heavy rain. The total number of breeding pits located were 23, harbouring 300-600 nos. of seenghala hatchlings/fry (size range: 8-30 mm) per pit.

The breeding pits were in two different sizes, 18-25 and 55-65 cm diameter. The smaller pits were formed probably by the offsprings of 1983 breeding and the larger ones by their parents. The breeding pits were reused for the second spurt of breeding.

Artificial pits were earthen gamlas having a diameter of 60 cm and depth of 35 cm at centre; coated with pond mud. These were partially embeded at the bottom. Breeding did not take place in such pits.

Assessment of seed resources of *M. aor*: Attempts were made to locate the breeding pits of *Mystus aor* in 10 km stretch of river Ganga around Allahabad. The breeding pits encountered during the survey harboured hatchlings of *M. Seenghala.* The hatchlings of *M. aor* were not encountered during the assessment.

Culture of *C. garua* **and** *E. vacha*: The culture of previous stock was continued till June 1985 (301 days) after which there was sudden mortality at the onset of monsoon on 27.6.85.

550 fingerlings of *C. garua* and *E. vacha* were collected from rivers Ganga and Yamuna in August early September 1985 of which 400 fingerlings, caught with Darwari net did not survive. The remaining 150 fingerlings (av. 55.7 mm/1.5 g) were transported to village Laknipur near Allahabad in an open container with 100% survival. These fingerlings were stocked in a 0.3 ha pond. Regular feeding @ 10% of body weight was done with supplementary feed comprising rice bran (50%), G.O.C. (10%), fish meal (20%), maize powder (14%), molluscs (5%), minerals (0.8%), vitamins (0.2%) and dolphin oil (in traces). In 107 days they grew to an av. 67.3 mm/16.2 g.

Large number of fingerlings of *C. garua* and *E. vacha* were available in River Yamuna, but for a very brief period, depending upon the flood condition of the river and discharge rate of a sewage nalas. The collection with dragnet is easy but survival is almost nil due to injuries and stress.

PROJECT FA/A/3 : **BREEDING AND CULTURE OF MAHSEER (*TOR PUTIORA*) AND MIRROR CARP AT KUMAON HILLS, U.P.**

Personnel : C. B. Joshi

Duration : 1982-1987

Location : Bhimtal (U.P.)

Compared to the previous two years, there was a sharp decline in the landings of mahseer brooders during July-September. Availability of female brooders was scarce. Hence stripping was done using only five brooders. A total of 19,920 fertilized eggs were obtained (5,596 nos/kg female). The rate of fertilization was 68-100%. The total incubation period under running water conditions at a temperature range of 23.5-26.5°C found to range from 58-154 hrs. The process of yolk absorption lasted from 3 to 7 days. The survival rate from egg to fry stage was 22.64%.

A total of 748 fingerlings (36-52 mm) raised in a nursery pond in a period of $4\frac{1}{2}$ months were stocked in the Bhimtal lake. Survival rate from fry to fingerling stage was 26%. Mustard oil cake, rice bran and wheat middlings were provided @ 2% of the body wt. during the rearing period. 3,500 fingerlings obtained from 1984 breeding experiment also were released in Bhimtal and Naukuchial lakes during the year.

PROJECT FA/A/4 : **SEED PRODUCTION AND CULTURE OF SCHIZOTHORACID FISHES (*SCHIZOTHORAX NIGER & SCHIZOTHORAICHTHYS ESOCINUS*) IN KASHMIR**

Personnel : K. K. Vass, Shyam Sunder, H. B. Singh & Usha Moza

Duration : 1983-1986

Location : Srinagar

Experimental seed production and procurement: Only a limited number of brooders of *Schizothorax niger* could be procured. Due to dry spell this year brooders of *Schizothoraichthys esocinus* could not be procured. *S. niger* brooders were bred by stripping. The fertilized eggs were incubated in hapas and trays under the lake conditions at different stocking densities ranging between 500-3000 eggs for 0.1 m^2 area to study the impact on survival. The rate of fertilization ranged between 95-98%. A range of 50-90% survival was obtained from egg to early fry stage under various treatments. The water temperature during incubation ranged between 10-20°C. The survival was significantly high (80-90%) when eggs were stocked @ 500/m^2. Physico-chemical conditions of ambient water were also studied.

Digestive physiology and Experimental feeding on artificial diet in laboratory: The qualitative enzymatic study from the gut of different fishes, ranging in weight from 60-

400 g and 160-250 mm in total was undertaken during the period. Study revealed the presence of four enzymes viz. Invertase, Amylase, Lipase and Trypsin from the different portions of the gut. Their rates of activity were studied.

The laboratory feeding experiments were tried on the fry with diets containing both plant and animal matter. It was observed that fry responded more to plant food.

Fish seed transportation experiments: The experiments on transportation of *Schizothorax niger* fry were conducted with various densities and size groups for different time intervals and under different treatments. It was observed that the results were better with treatment having, stream water+anesthesia+atmospheric air. The mortality was least (7.5%) when the small fry (15-25 mm) were stocked @ 50/litre. Similarly the bigger fry (35-50 mm) stocked @ 25/litre exhibited low mortality rate of 8.5%.

PROJECT FA/A/8 : INCREASING FISH PRODUCTION IN DRAINABLE AND NON-DRAINABLE PONDS

Personnel : V. R. P. Sinha, N. G. S. Rao, C. R. Das, G. R. M. Rao, K. J. Ram, S. Ayyappan, C. S. Purushothaman, P. K. Saha and H. K. Muduli

Duration : 1983-1988

Location : FARTC, Kausalyagang

An experiment of 6 months duration has been conducted in 8 ponds (4 ponds of 0.1 ha each and 4 ponds of 0.08 ha each) to study the impact of variations in methods of application of manures and fertilizers on the nutrient turnover and fish production in undrainable ponds. The ponds were initially treated with bleaching powder. Doses of both organic and inorganic fertilizers were scheduled on the basis of organic carbon, pH, available nitrogen and phosphorus content of the initial soil samples.

Indian major carps, exotic carps and hybrids (rohu×catla) were stocked at a density of 5,000 fingerlings/ha in the ratio, Catla 1.5 : Rohu 2.0 : Mrigal 2.5 : Silver carp 2.5: Grass carp 1.0 : Hybrids 0.5.

The four treatments tried in the ponds in duplicate were:

(*i*) Cowdung application at fortnightly intervals;

(*ii*) Spray application of cowdung on alternate days;

(*iii*) Provision of inorganic fertilizers in bags for gradual leaching; and

(*iv*) Pond bottom raking for improved mineralisation of organic matter and increased sediment-water interactions.

Soil and water samples of all the 8 ponds were collected quarterly and fortnightly respectively. Soil pH was in the range of 6.5-7.4. Very little change in the organic carbon content was observed except for the treatment No. 4 (bottom raking) where it was reduced to half of the initial values. Available nitrogen and phosphorus contents of all the ponds were found to have increased. In case of phosphorus, the increase was two-fold.

Physico-chemical properties of water of all the ponds did not show much difference. Dissolved oxygen level was in the range of 2.4-14.0 ppm (at 8.00 A.M.), total alkalinity,

56-264 ppm, pH 7.4-8.5. Phosphorus level was almost same for all the ponds, ranging from traces, to 0.10 ppm. But the total inorganic nitrogen content on an average was more (average 0.123 ppm) in treatment No. 4 (bottom raking) compared to that of other ponds (ranging from 0.04 to 0.074 ppm).

The range of basic ecological and microbial processes measured at monthly intervals (July-December 1985) were as follows:

Aerobic heterotrophic bacterial counts	: 1.28-157.07 $\times 10^3$/ml water and 0.70-15.03 $\times 10^6$/g weight of the sediment.
Denitrifying bacteria	: 1-125/ml water and 55-1400/g sediment.
Gross primary production	: 0.63-15.75 g C/m^3/d.
Net primary production	: -4.52-10.22 g C/m^3/d.
Respiration	: 0-16.50 g C/m^3/d.
Sediment oxygen consumption	: 0.68-4.55 g/m^2/d.
Macrophyte decomposition	: 0.01-2.10% loss dry weight/d (surface) and 1.10-2.80% loss dry wt/d (Eichhornia).

Harvesting has been completed from three ponds. The survival and fish production were 63.2% and 1261.8 kg/ha/6 months from the first treatment, 61.6% and 1087.1 kg/ha/6 months from the 3rd treatment and 58.6% and 728.2 kg/ha/6 months from the 4th treatment. The harvesting in the remaining ponds is in progress.

PROJECT FA/A/10 : CULTURE OF FISHES IN SEWAGE-FED PONDS

Personnel : P. R. Sen, S. K. Mukhopadhyay, A. K. Datta, S. K. Saha, A. K. Roy, N. M. Chakrabarti, B. K. Saha, G. P. Bhattacharya and B. Ghosh

Duration : May 1983-April 1988

Location : Rahara (West Bengal)

Fingerlings rearing: Four ponds were stocked with carp fingerlings @ 5000/ha and the species composition was catla 15%, rohu 30%, mrigal 15%, silver carp 30% and grass carp 10%. Uniform stocking and fertilization were adopted in all the four ponds.

The BOD level of pond water remained between 9 and 45 ppm. Other chemical parameters like nitrogen, phosphate, DO, CO_2 and pH ranged between trace and 2.25 ppm, 0.11 and 3.5 ppm, 1.5 and 5.4 ppm, nil and 39.0 ppm, 7.2 and 8.5 ppm respectively.

After three months of rearing the estimated production of off-season fingerlings in two ponds and stunted fingerlings in two ponds at 80% level of survival works out to 161.0 kg and 190.5 kg and 819 kg and 947.5 kg per hectare respectively. The performance of all the species excepting mrigal appears to be highly satisfactory in all the ponds. The work is in progress.

Spawn rearing: Experiments on spawn rearing under varying combinations gave the following results:

Expt. No.	Species adopted	%	Total stocking density/ha	plot size (ha)	Rearing period (days)	% of survival
I	Silver carp	100	2.3	0.035	13	85.0
II	Rohu	16	162.1	0.06	15	61.6
	Mrigal	84				69.4
III	Catla	100	33.7	0.04	15	60.0
IV	Silver carp	2.5	97.5		12	72.7
	Rohu	97.5				91.3
V	Rohu	100	92.5	0.04	10	69.8

Spawn rearing under very high stocking density: A nursery pond was stocked with mrigal spawn @ 37.5 million/ha. The nursery was prepared with the routine process followed by manuring with poultry droppings (@ 5t/ha) and application of organo-phosphate (Sumithion @ 0.25 ppm). Supplementary feed (rice polish and groundnut oil cake) was provided at a rate of 25% of the initial body weight of the spawn besides the microencapsulated feed @ 5% of the initial body weight of spawn. A survival of about 30% was obtained after 15 days of rearing.

Rearing of prawn (*Macrobrachium rosenbergii*): Two identical ponds (0.04 ha each) were stocked with *M. rosenbergii* @ 1000 nos./ha. In one pond the prawn attained an average growth of 118.93 mm/13.33 g in one and 122. 43 mm/15.83 g in other pond within a period of 44 days.

Haematology: Haematological examination of blood taken from gills of carps in sewage-fed ponds is under progress.

Estimation of fish population: Tagging experiments were conducted in two sewage-fed fish culture ponds with an area of 0.31 ha and 0.17 ha respectively. Clipping and sampling was done in the first pond using mark-recapture method followed by the second one using multiple mark-recapture method.

In first pond after clipping two sampling were done. It is revealed that from the sampling date that the error percentages of population estimates on two occasions varied between 10.60 and 17.49 for silver carp, 20.72 and 21.01 for catla, 25.91 and 26.20 for rohu, 6.56 and 25.99 for grass carp, 50.98 and 65.85 for mrigal and for all species combined together it was 13.81 and 22.56 per cent.

While in the second pond only mrigal was estimated and in 2nd and 3rd sample estimated mrigal were calculated as 165 and 246 respectively with a standard error of 81 and 126 respectively. Percentage of error for second and third sample works out to 48.80 and 51.20 respectively.

Studies on parasites: Ectoparasites (*Argulus* sp.) was noticed in March-April 1985 in two brood tanks. In one pond, the grass carp was most affected followed by rohu, mrigal, silver carp, catla and punti while in other pond, mrigal was the prime infected species followed by rohu. The copepod was also found to attach on the carapace of prawns.

Pond was treated with lime @ 150 kg/ha in two instalments. A dip treatment of 5 mg/l common salt and 0.5 mg/l $KMnO_4$ was done followed by pond treatment of 0.4 ppm gammexene (WDP). This process was repeated twice at an interval of 15 days resulting a check in growth of parasite. Removal of parasite eggs by fixing bamboo poles in the pond also helped in reducing the parasitic population considerably.

PROJECT FA/A/11 : ECOLOGY OF FISH CULTURE IN JUTE-RETTED WATERS AND PROSPECTS OF AQUACULTURE IN THEM

Personnel : B. N. Saigal, V. V. Sugunan, R. K. Das, G. K. Vinci, V. K. Unnithan & M. J. Bhagat

Duration : 1983-85

Location : Barrackpore

Study was continued in the jute-retted pond (0.07 ha) at Khardah which was stocked with 720 (@ 10,286 nos./ha) fingerlings of carp. The stocking ratio was catla 5 : Rohu 2.5 : Mrigal 1 : Silver carp 2 : Java punti 0.5. Stocking was done on 20.11.84 and harvest was done on 15.5.85.

The pond was prepared with 80 kg of mahua oil cake. A total of 100 kg of mustard oil cake was given as feed during 3-5th months. The growth and yield of the fishes are noted below:

Species	Stocking rate	Av. initial size (mm)	Av. final weight (g)	Total yield (kg)
L. rohita	175	4.5	230	33.350
C. catla	315	5.0	460	120.060
C. mrigala	70	4.0	230	12.420
H. molitrix	120	8.0	640	64.000
P. javanicus	40	6.0	510	19.380
	720			249.210

Physico-chemical characteristics of water: The following were the values recorded during the years (till May '85):

pH 7.2-8.2

D.O 2.24-7.2 ppm

CO_2 Trace—10.0 ppm

HCO_3 282-324 ppm

NH_4N 1.12-1.68 ppm

NO_3-N 0.120-1.96 ppm

PO_4-P 0.10-0.30 ppm

Microbiological studies: (Results are shown under the Project AN/B/7.)

Plankton and benthos: The phytoplankton was represented mainly by *Scenedesmus, Oscillatoria, Rivularia, Synedra* and *Amphora* and zooplankton mainly comprised *Moina, Daphnia* and *Cyclops.* The density of plankton varied between 8 and 3, 100 units/litre during the study. The benthic organisms encountered during the year were dominated by chironomids, *Lamellidens marginensis* and *Viviparus bengalensis.*

Detritus formed the main item among the food of the fishes (37-65% in major carps, 20-39% in silver carp and 12-32% in *P. javanicus*). Molluscs formed 34-48% of gut contents in *Puntius.*

PROJECT FA/A/12 : PADDY-CUM-FISH CULTURE

Personnel : A. K. Datta, S. K. Mukhopadhya, K. R. Naskar, S. K. Saha, A. K. Roy, N. M. Chakrabarti, G. P. Bhattacharya and B. B. Das

Duration : September 1982-June 1985

Location : Rahara (West Bengal)

Experiments were conducted in 3 types of plots and the results were as follows:

Perimeter canal plot (0.018 ha): The freshwater giant prawn *Macrobrachium rosenbergii* were stocked, at a sex ratio of 1.0 ♂ : 2.18 ♀ in a renovated paddy plot, @ 18,000 nos./ha alongwith Punti (*P. javanicus*) @ 500 nos/ha in December 1984. The plot was further stocked with catla @ 500 nos./ha in January and bata (*L. bata*) @ 2,500 nos/ha in March 1985. The average weight at stocking was 7.5 g for male and 4.25 g for female prawn, 17.5 g for bata, 29.1 g for punti and 185.8 g for catla. The prawn attained an average weight of 85.0 g for male and 25.0 g for female specimens while bata, punti and catla attained an average weight of 75.3, 350.0 and 487.0 g respectively within a period of 10-11 months.

Plankton in this plot was as high as 2.1 ml/50 l of water in September and as low as 0.25 ml/50 l of water in July. The average sedimentation volume of plankton during January to December was recorded as 0.995 ml/50 l of water. Phytoplankton dominated (88.4%) except in July and August when zooplankton dominated (av. 69.2%). The dominated phytoplankters encountered were *Spirogyra* sp., *Anabaena* sp., *Melosira* sp., *Navicula* sp. while zooplankton were mainly represented by *Cyclops* sp., nauplii of *Cyclops, Diaptomus* sp., *Brachionus* sp. and *Cypris* sp.

Chironomid larvae, oligochaetes, insects and molluscs were the common forms of bottom fauna. The values ranged from 24 to 154 nos./sq.m. Periphyton were represented by *Stigeoclenium* sp., *Spirogyra* sp., *Rhopalodia* sp., *Closterium* sp., *Selenastrum* sp. among algae, *Vorticella* sp., *Epistylia* sp. among colonial individual at the end of stalk and ciliates (*Bursaria* sp.).

During rabi season, a total quantity of c. 200 kg (@ 2.22 t/ha) of Ratna paddy was obtained from the paddy grown area (0.09 ha). Kharif paddy was destroyed and consumed completely by punti (200 g) within 2 months of sowing.

About 2,000 nos. of plantain (Kabli variety) was harvested from the dyke of this plot.

Bilateral plot (0.38 ha): This plot having two symmetrical ponds (0.07 ha each) at the two opposite ends, was stocked in March 1985 with punti (*P. javanicus*) at a density of 2,000 nos./ha and bata (*L. bata*) @ 12,500 nos./ha, the respective size during release being 136.27 mm/41.89 g and 133.4 mm/20.7 g. The fishes attained an average weight of 117.5 g and 52.5 g respectively within a period of 10 months. The hundred kg of fish was obtained so far through partial harvesting.

From the paddy growing area of this plot (0.24 ha) a total quantity of 1,700 kg of Ratna paddy (7.089 t/ha) was harvested during rabi season. The kharif paddy was destroyed by Java punti. The dyke of this plot yielded 8,000 numbers of banana.

The peak period for the plankton was recorded in September (1.8 ml/50 l of water)

and a lean period in July and December (0.3 ml/50 l of water.) The average plankton volume during January to December was recorded as 1.1 ml/50 l of water. The dominant forms of phytoplankton were *Scenedesmus, Padiastrum, Spirogyra, Microcystis, Melosira, Pinnularia* and *Clostrium, Gyrosigma, Oscillatoria, Euglena* and *Phacus* were also recorded. Zooplankters were dominated by *Diaptomus, Cyclops, Brachionus,* etc. It has been observed that the phytoplankton (88.3%) dominated over zooplankton (11.7%) throughout the period except in July when zooplankton (64%) contributed the lion's share amongst plankton.

Monolateral system (0.03 ha): Experiment was initiated in the plot having a ditch (0.003 ha) at one end, with a view to raising of carp fingerling in paddy plots where water can be retained only for 3-5 months during monsoon. The plot was stocked with fry of mrigal and rohu (1 : 1) at a density of 1 lakh/ha in September. After 3 months of rearing mrigal attained an average size of 113.6 mm/17.5 g from 29.0 mm/1.2 g while rohu showed an average size of 108.4 mm/20.6 g from an initial size of 17.9 mm/0.4 g. The retrieval of the two species was recorded as 39.7 and 8.93% indicating the production (in number) of 18.7 and 4.5 thousand/ha.

The kharif paddy was transplanted but was spoiled after 3 months of plantation due to sepage from adjacent water areas.

Studies on the periphyton revealed that *Bursaria* sp., *Lacrymaria* sp., among ciliates and *Spirogyra* sp., *Stigeoclonium* sp., *Vorticella* sp., *Scenedesmus* sp. and different diatoms among algae were the common form.

In all the cases, both aqua- and agri-crop were raised mainly with treated sewage water and a minimum utilisation of inorganic fertilizer to the paddy grown area. Physico-chemical features of these plots are given in the table.

Table : Ranges of physico-chemical values of the paddy-cum-fish culture plots

Parameters	Perimeter plot		Bilateral plot		Monolateral plot
	Treated sewage water	Plot water	Treated sewage water	Plot water	Plot water
Temperature (°C)	19.5-30.0	20.0-32.0	20.0-28.5	18.0-31.0	19.5-33.5
pH	6.5-7.2	7.4-8.2	6·4-6.9	7.2-8.4	7.2-8.4
D.O (ppm)	nil	1.8-4.4	nil	2.5-5.8	0.96-2.4
CO_2 (ppm)	12.0-51.4	nil-25.0	16.4-36.5	nil-12·5	
Total alkalinity (ppm)	288.0-364.0	130.0-200.0	250.0-432.0	96.0-174.0	85.0-176.0
NH_3 (ppm)	1.12-8.4	trace-1.98	0.95-18.2	trace-0.48	
NO_3 (ppm)	0.14	trace-0.008	0.04-0.32	trace-0.016	
PO_4 (ppm)	3.6-9.6	trace-1.06	1.06-9.6	0.15-0.95	trace-0.14
5 day BOD (ppm)	120.0-188.0	18.0-35.0	120.0-370.0	7.8-21.0	

PROJECT FA/A/13 : CAGE CULTURE OF CARPS IN TANKS

Personnel : S. P. Ayyar, P. Kumaraiah, P. K. Sukumaran, S. L. Raghavan and M. F. Rahman

Duration : 1983-86

Location : Bangalore

Common carp rearing: Fingerlings of common carp (123 mm/24.5g) were stocked in two cages (10 m^{-2} each) at a density of 50 and 100 per sq.m. After 8 months of rearing the fish attained 181 mm/124 g and 158.7 mm/56 g respectively. Rice bran and groundnut oil cake (1 : 1) mixture was provided daily. Survival rate was 72% and 54% and the yield was worked out to be 4.68 kg m^{-2} and 2.12 kg m^{-2} in the first and second cages.

Murrel rearing: Two new types of cages were designed and fabricated, one for murrels and other for carps. *Channa marulius* were reared in circular net cages (underwater volume 5 m^3) for a period of 160 days. At a stock density of 200 fingerlings per 5 m^2 cage, they grew from 155 mm/26 g to 177.1 g with a survivel rate of 98%. The net production was 5.912 kg m^{-2}. Fed with fresh trash fish @ 10-12% body wt, the food quotient was 2.503 on dry wt. basis of the feed and wet biomass gain by the stock.

Culture of carps: *Labeo rohita* was reared along with *Cyprinus carpio* var. *communis* in 1 : 5 ratio in a floating cage of 36 m^2 with 1.25 m water depth. Stocking density was 40 nos./m^{-3}. In over a month's time *C. carpio* grew from 2.01 g to 8.44 g and *L. rohita* from 5.32 g to 9.20 g. Deoiled rice bran, groundnut oil cake and minced goat's blood (3 : 1 : 1) fed daily @ 5% of the biomass of the stock formed the supplementary feed. The experiment continues.

Culture of tilapia: An experiment on the culture of tilapia in floating cages was initiated on 27.12.85.

PROJECT FA/A/14 : CULTURE OF COMMERCIALLY IMPORTANT FISHES AND PRAWNS IN CAGES, PENS AND TRENCH TYPE PONDS IN KOLLERU AREA

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

Duration : 1984-86

Location : Eluru/Tadepalligudem

Culture experiment was undertaken in two trench type of ponds at Chanamulli, each measuring 3.5 ha. In a partial harvest, the average size of fish removed after 12 months period was observed to be 750 mm/3,608 g for catla, 477 mm/1,348 g for rohu, 563 mm/2,142 g for mrigal and 613 mm/2,667 g for grass carp.

Mixed culture: Experiment on mixed culture of *Macrobrachium malcolmsonii* with selected species of carps was conducted in two ponds at Badampudi fish farm. Stocking was done in 1st week of January 1985 @ 3,000 fingerlings/ha. Prawn (7,250 nos./ha) were stocked in one of the ponds in the first week of March. Supplementary feeding was given to the fish and prawn daily @ 2% of the body weight of fish and 5% body weight of prawn.

The feed consisted of groundnut oil cake+rice bran in the ratio 1 : 1. The ponds were treated with cowdung and lime @ 10 t/ha/yr and 500 kg/ha/yr in monthly split doses. Harvesting was done in the first fortnight of June itself in view of the shifting of the centre. The details of the experiment and results are as follows:

	Pond I			Pond II	
	Catla	Rohu	Prawn	Silver carp	Rohu
Stocking rate	3,000/ha (fish) 7,250/ha (prawn)			3,000/ha (Total)	
Stocking ratio	1 : 3 : 10			1 : 3	
Stocking size (mm)	125-176	110-155	20-30	70-110	110-155
Average final size/wt (mm/g)	214/262	277/260	110 mm	323/360	253/220
Survival (%)	92.1	91.3	—	75.0	60.2
Total production (kg/ha)	656.2 (fish) 10.4 (prawn)			755.5	

PROJECT FA/A/15 : FISH SEED FORMULATION AND NUTRITIONAL BIO-ENERGETICS OF ASIATIC CARPS

Personnel : S. D. Tripathi, D. N. Swamy, S. N. Mohanty and Kuldeep Kumar

Duration : April 1983 to 1987

Location : FARTC, Kausalyagang

Studies on protein deposition in the flesh of rohu fry fed on three different feeds have indicated the deposition of 23.27% protein in flesh of fry fed on a mixture of blood meal, rice bran and groundnut oil cake (1 : 3 : 6, 28% protein) as against 21.82% in fry fed on groundnut oil cake, *Salvinia* powder and sugar waste (8 : 1 : 1, 29% protein). The groundnut oil cake and rice bran (1 : 1) having a protein content of 20.36% has shown a deposit of 14.54% only.

Proximate analyses of the muscle and alimentary canal of grass carp fed on conventional diet having 17.99% protein in pond ecosystem showed that the descaled muscle had 76.54% moisture, 59.63% protein and 26.09% fat (on dry weight basis) while the empty alimentary canal had 77.5% moisture, 17.74% protein and 8.7% fat.

Laboratory studies on the protein requirements of rohu fingerlings using 30%, 35%, 40% and 45% dietary protein level in feeds comprising fish meal, groundnut oil cake, rice bran fortified with vitamins, minerals and trace elements indicated the best trend in growth at 40% level.

PROJECT FA/A/16 : GENETIC IMPROVEMENT OF CULTURABLE CARPS THROUGH SELECTION

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

Duration : 1983 to 1988

Location : FARTC, Kausalyagang

Hybridization between female common carp and male rohu was achieved for the second time and between female common carp and male mrigal for the first time. The progeny so obtained are being reared. Morphometric measurements of common carp×rohu hybrid produced in 1984 and parent species were studied and it was observed that the hybrid attained intermediate characters. During a period of 18 months' rearing, the hybrid did not show any sign of maturity, whereas common carp matured after 3 months. Chromosomal and biochemical studies of the hybrid are in progress. Similar studies on common carp×mrigal hybrid are also being taken up.

In addition to above, research work was conducted (*i*) on chromosomal investigations of above hybrids by means of usual techniques in rohu; (*ii*) erythrocyte size analyses to determine ploidy in rohu, common carp and their hybrid; and (*iii*) determination of non-specific proteins in rohu and mrigal by means of acrymidal disc electrophoresis.

Further, techniques of marking of fish with chemical dyes have been standardised. An experiment on marking of rohu and catla fingerlings was conducted in two experimental ponds for a period of 6 months. Both the species were marked with M-procian blue stain and fin clipping. In case of clipped fishes recovery of catla ranged between 68 and 84% as against 73.3-89.3% in normal (control fish) and that of clipped rohu between 24-28% as against 42-52% in non-clipped (control fish) in two ponds. The growth of the marked species was comparable to normal ones. In catla and rohu fingerlings, chemical dye was prominent upto 6 and 3 months of rearing respectively. In rohu breeders which were injected with procian blue two years back the mark is still prominent.

PROJECT FA/A/17 : PRODUCTION OF GYNOGENETIC, ANDROGENETIC AND POLYPLOID POPULATIONS OF INDIAN AND EXOTIC CAPRS

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

Duration : 1983 to 1986

Location : FARTC, Kausalyagang

Polyploidy: Four experiments were conducted to induce polyploidy in catla and rohu by administering heat/cold shock to fertilized eggs. For producing triploids, thermal shocks were administered 4-5 minutes after fertilization and tetraploid progeny was obtained by exposing the fertilized eggs to shock after 25 minutes but before onset of first cleavage. The resultant progeny was reared separately for assessing ploidy level by karyotyping and erythrocyte nuclear measurements. Induction of polyploidy by exposing the eggs of rohu to various concentrations of Cytochalasin-B resulted in production of mosaics.

Gynogenesis: 165 gynogenetic rohu hatchlings obtained are being reared for study of

various traits. All homozygous gynogenetic progeny of rohu was obtained by heatshocking the haploid zygotes just before first cleavage.

Androgenesis: Several batches of freshly ovulated eggs of Asiatic carps were subjected to UV irradiation and subsequently fertilized with normal sperm of closely allied species followed by heat/cold shock administration to the haploid zygotes for restoration of diploid status. Haploid syndrome was observed when irradiated mrigal eggs were fertilized by normal sperm of grass carp. Many of the hatchlings were deformed and a few normal ones could be reared for about 3 days in the laboratory.

PROJECT FA/A/18 : FISH DISEASES AND THEIR CONTROL

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

Duration : 1983 to 1988

Location : FARTC, Kausalyagang

A total of 232 nos. of diseased fish specimens collected from various sources were examined in detail covering pathoanatomical, histopathological, microbial and parasitic aspects of the diseases. Nine cases of fish epizootics caused by bacterial septicaemia, gill hyperplasia, myxosporidiasis, argulosis and mycosis were investigated.

In order to evaluate the effect of water quality in terms of pond organic load upon gill hyperplasia in common carp, a field designed experiment was conducted in 12 ponds (0.02 ha each) treated with six different doses of raw cowdung and stocked with common carp fry showing gill hyperplasia. Hyperplasia of gill caused heavy mortality in all the ponds hence no significant relation could be established between the pond organic level of gill hyperplasia.

Saprolegniasis in rohu was detected and diagnosed. This pathogen was isolated from diseased carps and cultured in the pure form in the plates. Different culture media were tested for its growth and the same is being cultivated. Trichodinasis, argulosis and ichthyophthiriasis could be successfully treated. For myxosporidiasis, effective prophylactic measures were suggested to prevent the spread of the disease. Various chemicals and drugs were tested to find suitable cure methods for parasitic, fungal and non-communicable diseases of carps.

EPC, BF-2 and FHM cell lines have been successfully implanted in the lab and are being sub-cultivated in MEM with 10-20% foetal calf serum. These cell lines are now passing through passage nos. 163, 144 and 104 respectively. The cell lines are being maintained at 25°C and used for diagnostic virology.

During the year under report, 91 bacterial strains have been isolated from diseased carp specimens and investigated for detailed biochemical characterisations. The most common among them were strains of *Aeromonas hydrophila* causing septicaemia in silver carp, catla and other carp species. Several strains of *hydrophila* have also been tested for their drug sensitivity to plan suitable prophylactic and treatment measures against septicaemia caused by this pathogen. Several bacterial strains have also been isolated in pure culture from specimens suffering from gill hyperplasia which await confirmation for their possible pathogenic role.

Histopathological observations on the bacterial septicaemia caused by *Aeromonas hydrophila* ssp. *hydrophila* in silver carp causing anaemia, emaciation and haemorrhagic lesions on the body were made. Focal necrosis and severe oedema were seen in liver sections of the diseased specimens causing disruption of the hepatocyte lines. Significantly high levels of haemosiderin pigments were demonstrated in the liver and ovary sections of the sick fish. Acute tubular necrosis in the focal area of the kidneys was noticed with pycnotic nuclei of the tubular epithelial cells and debris within the tubular lumen.

Histopathological observations on the gill hyperplasia in the fry and fingerlings of carps, especially common carp, revealed hyperplasia of the gill filaments of the affected carps leading to lamellar fusion and the development of the apical carps as well as necrotic or advance degenerative processes. In addition, the gill filaments were frequently found to be shortened significantly reducing the functional surface areas of the organ.

Haematological observations were made on the haematocrit values of the infected and healthy specimens of Indian major carps and Chinese carps. The haematocrit value of the silver carp infected by bacterial septicaemia was 27.63 as compared to the healthy specimen of the same fish having 34.50.

PROJECT FA/A/19 : CULTURE OF ALGAE AND AQUATIC WEEDS USING SEWAGE WATERS

Personnel : A. C. Nandy, N. M. Chakrabarti, R. K. Banerjee, B. K. Saha, B. Ghosh, K. R. Naskar, S. K. Saha and B. B. Das

Duration : November 1983-December 1988

Location : Rahara (West Bengal)

Culture of fish food organisms: Large scale production of *Spirulina* spp. was successfully achieved in yard with commercial NPK ferlilizer fortified with sodium bicarbonate for carbon source at a dosage of 5.15/litre. The algal yield was 10-15 g/m^2/day. Mass culture of green alga, *Chlorella virginica* (10-15 million cells/ml) was achieved with Scenedin mix at 300 mg/litre.

Bioassay: A feeding experiment was conducted with the cultured *Spirulina* sp. in the laboratory. Coefficient of digestion of feeds prepared with powdered alga *Spirulina platensis* alone and *Spirulina* mixed with groundnut oil cake and rice polish in varying proportions was studied by feeding *Cyprinus carpio,* twice a day for 30 days. The test fish were of the same parentage and age group (30-38 mm/245-698 mg). Feeding was done at 10% of their body weight. The test fishes fed only with *Spirulina* powder indicated the maximum growth. All the feeds were well digested by the fish and *Spirulina* (100%) feed showed better utilization.

Culture of algae with sewage: *Wolffia arrhiza, Lemna perpusilla* and *Spirodella polyrrhiza* were cultured in separate cement cisterns taking primary treated sewage effluent as source of organic nutrients. Within 200 days, *W. arrhiza* harvest was 1,450 kg and 580 kg from two separate 180 sq. m. cisterns in 100% and 75% sewage effluent respectively. The production of *L. perpusilla* and *S. polyrrhiza* were 650 kg and 325 kg respectively within the same period taking 100% sewage effluent in each cistern.

Their efficacy as fish feed was studied in carp culture cisterns. *W. arrhiza* was much

efficient as fresh carp feed in the fry and fingerling stages of grass carp, *P. javanicus, C. carpio,* rohu and mrigal. But in the later stages it was recorded that only grass carp, *P. javanicus* and *C. carpio* relished these weeds throughout their life.

Possibilities were also studied to culture grass carp, rohu and mrigal at a high stocking density of 56,000 fry/ha feeding only with duckweeds. The overall survival was above 90%. The growth increment for grass carp, rohu and mrigal were from 4.5 g/79.4 mm to 47.5 g/157 mm, from 0.75 g/39.3 mm to 27.5 g/130 mm and from 3.0 g/67.5 mm to 27.5 g/150 mm respectively in 80 days. The estimated total production of carp was 1,490 kg/ha in 80 days.

In another experiment, rohu (Av. 40 g) and mrigal (Av. 30 g) were reared on *W. arrhiza* and *S. polyrrhiza* (2 : 1 ratio). The growth increment during the first 40 days were 2 g/day for rohu and 0.7 g/day for mrigal. The final size attained after 130 days of rearing was 203.3 g by rohu and 72.4 g by mrigal. Survival rate recorded was 92% for rohu and 99% for mrigal at a stocking density of 11,000/ha. Growth rate retarded after a size of 100-150 g for rohu and 40-50 g for mrigal.

Feed trial experiments for carps were also conducted in two 180 sq. m. cisterns stocked with 74 and 140 fishes and the net production was 643 kg/ha and 965 kg/ha respectively in 150 days. These fish were supplied with *W. arrhiza* at the rate of 80% of their initial body weight for the first 50 days and 50—60% of their body weight for the next 100 days. The growth rates were calculated as : rohu 1.0 g and 1.6 g, mrigal 0.4 g and 0.6 g, javapunti 0.7 g and 0.8 g, common carp 0.85 g and 2.0 g, grass carp 1.6 g and 2.5 g, silver carp 3.6 g and catla 4.9 g per day. The overall growth increments for those fishes were not satisfactory as bigger sized fishes were stocked initially. Moreover heavy *Argulus* sp. infection in these cisterns also hampered the growth of the fishes.

PROJECT FA/A/20 : STUDIES ON AQUATIC WEED MANAGEMENT

Personnel : S. Patnaik, T. Ramaprabhu, D. N. Swamy and K. M. Das

Duration : 1983 to 1986

Location : FARTC, Kausalyagang

The observations on the pond where water hyacinth was introduced showed a biomass increase of 40 g/sq.m./day for *Eichhornia* and 22 g/sq.m./day for *Hydrilla.* The rapid growth of *Hydrilla* and appearance of *Salvinia* and *Nymphaea* checked the growth of water hyacinth in the pond.

The oxygen production in surface water of three ponds having *Hydrilla* in one, *Salvinia* in the second and weed free condition in the third were recorded to be 9-12 mg/l, 2-5 mg/l and 3-8 mg/l respectively. The increase of oxygen level from morning to mid-day was 120% in *Hydrilla* pond, 26% in *Salvinia* pond and 48% in weed-free pond. The oxygen level in all the three ponds decreased by 10-15% from mid-day to 5 P.M.

In laboratory study of biomass spatial relationship, the space occupied by submerged weeds like *Hydrilla* ranged from 0.89 to 1.8 cc/g, *Najas* from 0.8 to 1.35 cc/g and *Nechamandra* from 0.88 to 1.09 cc/g in different weight groups of plants studied. The net rate of oxygen production was higher in *Hydrilla* followed by *Najas* and *Nachamandra* due to spatial differences.

The analysis for protein done in some aquatic plants dried and powdered showed 22.4% in *Hydrilla verticillata,* 20.3% in *Najas indica,* 19.9% in *Ottelia alismoides* and 17.4% in *Nechamandra alternifolia,* all collected from Kausalyagang area.

PROJECT FA/A/21 : USE OF AMMONIA IN FISHERY MANAGEMENT

Personnel : T. Ramaprabhu, S. D. Tripathi, D. K. Chatterjee, D. N. Swamy, S. Jana and K. M. Das

Duration : 1982 to 1985

Location : FARTC, Kausalyagang

The soil of four nurseries (0.02 ha) with a water depth of 70-90 cm treated with ammonia at 2.5-5.0 kg/pond showed considerable increase in the concentration of exchangeable ammonium nitrogen but only a slight increase in nitrate-nitrogen suggesting that a greater part of ammonia applied in the pond was absorbed by the soil because of low water depths and its mode of application at the bottom. The concentration of ammonium and nitrate-nitrogen before treatment was 5.0-7.0 mg/100 g and 1.3-3.1 mg/100 g respectively but it was found to be 3.6-19.7 mg/100 g and 1.9-10.2 mg/100 g respectively after one month of treatment.

Though ammonia application in ponds with low water levels is effective in killing the bottom dwelling fish populations, it is coupled with high build up in the soil and also temporary retention which is also obvious from the fact that instead of building up a concentration of 50-60 ppm, the concentration of ammonium nitrogen in the four ponds ranged from 6-14 ppm only. Absorption by soil was indirectly advantageous owing to its fertilising effect and also in greater release of phosphorus from the soil as is obvious from its low concentration (1.4-1.6 mg/100 g) before treatment and a higher concentration (1.6-2.4 mg/100 g) after treatment.

PROJECT FA/A/22 : SEED PRODUCTION OF THE GIANT FRESHWATER PRAWN *MACROBRACHIUM ROSENBERGII*

Personnel : M. Subrahmanyam and J. B. Rao

Duration : 1977-1987

Location : Kakinada (A.P.)

Mass scale seed production: A total of 30,659 prawn seed were produced during the year (indoor production—7,468 and outdoor production—23,191).

Production of gravid females was successful this year despite rise in salinity of the groundwater employed for culturing them in the 24' plastic pool.

A total of 19,096 seed were distributed to the private and Government farms. A sum of Rs. 320/- was realised through sale of seed to private farmers and the same was deposited to the Council's account.

Demonstration and training: A training programme was conducted to the trainees

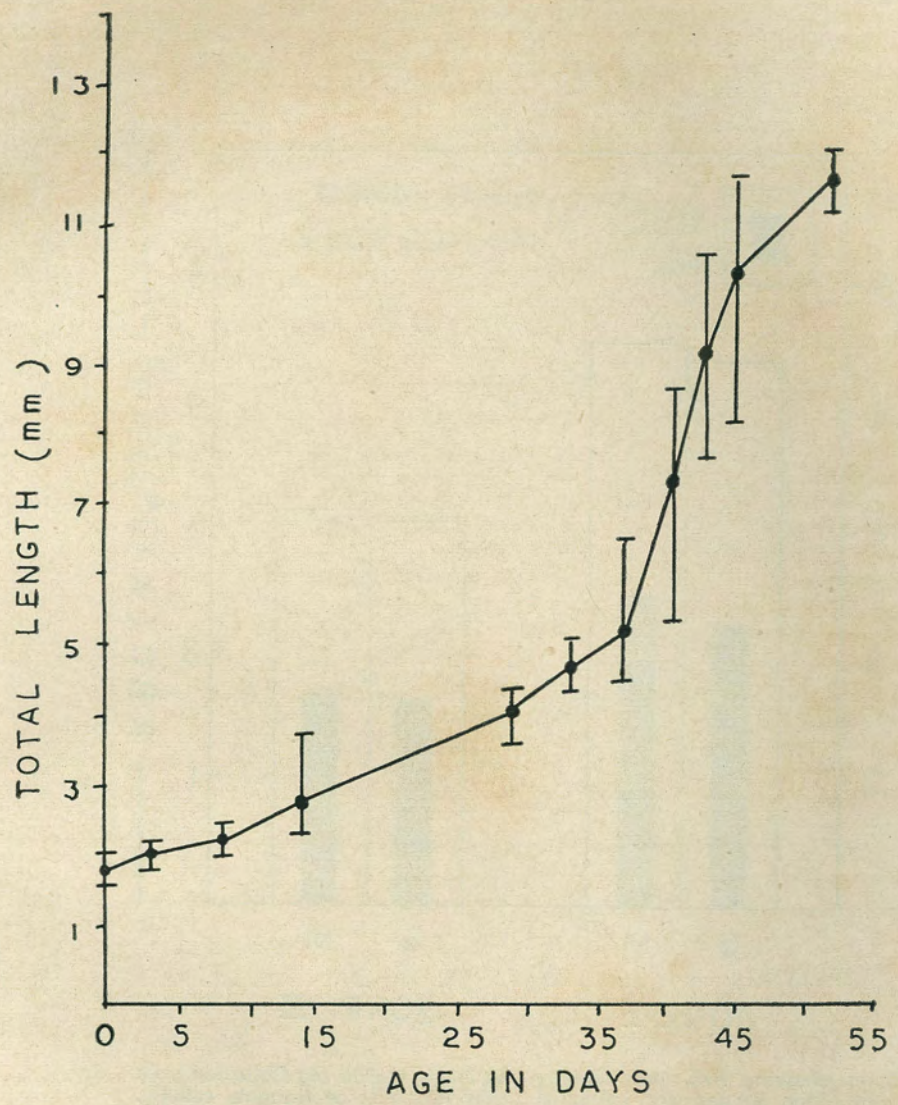
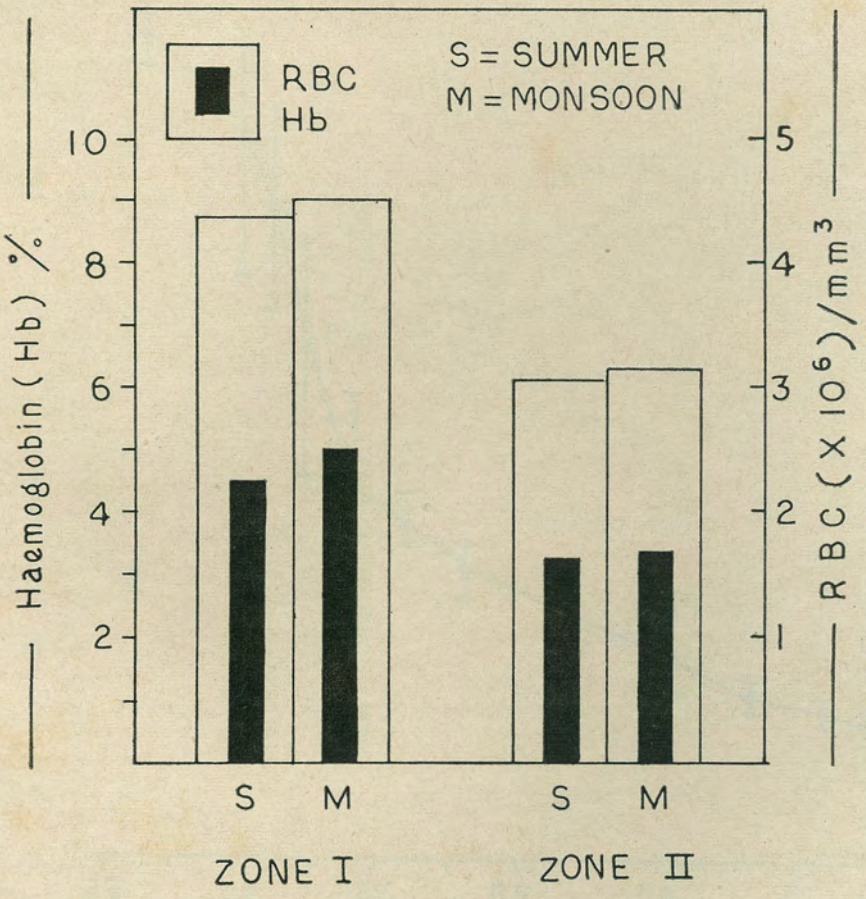


FIG. 1. GROWTH OF ZOEA I TO POSTLARVAL STAGE OF Macrobrachium malcolmsonii IN THE LABORATORY.



Histogram showing RBC and haemoglobin levels in *Rita rita* Collected from industrial (Zone II) and non-industrial zones (Zone I) of Hooghly estuary. (Report on page 78)

Hatchlings survived for a maximum period of 15 days attaining matazoea stage. Rice polish sieved through organdi cloth was provided as food for the young ones and to aid diatom production. The temperature ranged between 24°C and 28°C in August and 22°C and 26°C in October.

At Allahabad, five berried females hatched in plastic pools under constant aeration. Two plastic pools contained matured freshwater and three had 20% saline water. Egg custard and half boiled fish were provided in pool nos. 1 and 2 but larvae survived for 20 and 15 days only. In pool No. 3 an active protein anabolic preparation was provided and survival was up to 20 days. In the 4th pool a feed comprising fish flesh, groundnut oil cake and rice polish in equal proportion and vit A, D and B complex (1%) was provided to the developing larvae and in the 5th, only matured green water was used. Post-larval (post-mysis and meta-zoeal stages) were recorded in both the pools but survival did not exceed 22 days.

At Buxar, mature females collected from river Ganga were stocked in plastic pools and fed with broken rice and broken maize. Berried females were obtained till October end at 25-29°C. Larval rearing was also tried in floating muslin/polyester cloth containers in plastic pools. In 20% saline water fed with plankton and egg yolk, the larvae did not survive more than 8 days. In 30% saline water with protein anabolic feed, larvae grew to post-mysis stage with developed uropods, differentiated telson, budding pleopods and rostrum with 2 teeth. They died on 19th day due to power failure.

In glass jar experiments, best survival was obtained at 20% salinity (10-50% range) at 28±2°C. In plastic pool (3' dia) provided with airlift pump and biological filter, larvae survival was up to 7-14 days at 10-30% salinity.

At Buxar 12 larval rearing experiments were conducted. Sea water mixed with freshwater, containing sea-froth, black salt, rock salt, soil salt, etc. egg custard, goat bone marrow and brain, tubificid worm, goat blood, zooplankton, yeast tablet, dried prawn powder, *Artemia* nauplii, etc. the larvae attained 3rd-5th stage in 22-23 days surviving period. In another experiment 2nd stage was obtained after 7 days. A few attained 3rd stage in 20 days while others remained in 1st and 2nd stages.

PROJECT FA/A/27 : BREEDING, HYBRIDIZATION, HATCHERY AND NURSERY MANAGEMENT AND CULTURE OF COMMERCIALLY IMPORTANT FROG SPECIES OF INDIA

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

Duration : 1983-86

Location : Kalyani

Several sets of *Rana tigrina* and *Rana crassa* were bred. A few million tadpoles were raised and released in nature. During this year also a high rate of survival (over 60%) of tadpoles was obtained in the nursery. The nursery was further expanded during the year and facilities improved.

PROJECT FA/A/28 : ECONOMIC INVESTIGATIONS ON CARP CULTURE AND AIR BREATHING FISH CULTURE IN INDIA

Personnel : M. Ranadhir and M. Rout

Duration : 1980 to 1988

Location : FARTC, Kausalyagang

An attempt was made to evolve individual production function for each of the six species of carps in the culture system from the total input-output data. The production functions explained 63% of output variation in catla, 81% in rohu, 60% in mrigal, 85% in silver carp, 86% in grass carp and 67% in common carp. These individual production functions for each species are being used in optimizing economic returns particularly in view of different market rates for these six species.

Centrewise data for input-output relationships of composite fish culture and air breathing fish culture have also been recorded for working out production functions pertinent to a region so that region-specific economic conclusions could be drawn.

PROJECT FA/A/29 : ADAPTIVE RESEARCH IN FRESHWATER AQUACULTURE

Personnel : B. K. Sharma, S. K. Sarkar, S. L. Kar, Kuldeep Kumar, N. Sarangi, N. K. Thakur, C. S. Purushothaman, B. B. Satpathy, J. P. Verma, B. R. Datta and Radheyshyam

Duration : 1983 to 1987

Location : KVK/TTC, Kausalyagang

Under the programme of village and farm family survey, a total of 103 villages and 75 farm families were surveyed during the period under report in Balianta, Balipatna and Bhubaneswar blocks of district Puri.

A study was made with a view to assess the impact of piscicultural training imparted at the Kendra to the trainees from its operational areas. A total of 12 villages of Puri district was randomly selected and data in respect of 217 trainees, giving 100% coverage to the trainees in each village, was gathered on the basis of personal contact. The findings helped considerably in restructuring of courses and training programmes organised at the Kendra. The results of the study are summarised below:

Category of trainees	Total no.	% in total
Who have adopted pisciculture as their major profession	11	5.07
Who are making use of it as their part-time profession	115	53.00
To whom it helped in securing some job	37	17.05
Who have started their own business related to fisheries	2	0.92
Who are not making any use of it	52	23.96

PROJECT FA/A/30 : CATFISH CULTURE : CULTURE OF PANGASIUS AND MYSTUS SP.

Personnel : N. K. Thakur, G. R. M. Rao, B. R. Dutta, B. B. Satpathy and J. P. Verma

Duration : 1984 to 1989

Location : FARTC, Kausalyagang and KVK/TTC, Kausalyagang

BREEDING AND CULTURE OF *PANGASIUS* sp.

Maintenance of brood stock: Observations on the food habits of brood stock indicated that molluscs constituted their most preferred food item. Fishes kept in ponds having greater population of molluscs revealed better condition of health compared to those where molluscs were relatively less.

Some of the specimens (247-349 mm length) were kept in plastic pools under laboratory conditions did not accept food of any type and preferred to stay straved during the entire period of study. One of the specimens died after 85 days with its shrunken belly. Following this, all the specimens were released back into ponds.

Trials on induced breeding: The oozing condition in males was reached in the month of May itself but the females were not fully ripe then. In order to accelerate gonadal maturity in females, 3 females in the size range of 467 to 623 mm were administered a preparatory dose of carp pituitary extract at the rate of 8 mg/kg body weight of the receipient and released in a nursery pond having an average water depth of 75 cm. After a fortnight, instead of picking up the condition, the specimens looked frail with frayed fins and barbels.

Second attempt was made in which fishes were selected directly from the rearing ponds. The attempt, however, did not meet with success. The ovary was very feebly developed, accounting for only 6.83% of the total weight of the fish. The weight of ripe ovary in *Pangasius pangasius* has been reported to range from 16 to over 26% of the total weight of the fish.

CULTURE OF *MYSTUS* sp.

Several fishing locales around Cuttack (Jobra, Jagatpur and Ayathpur) and Dhauli along the courses of rivers Mahanadi and Daya respectively were surveyed to find out the availability of juveniles of *Mystus* spp. Some juveniles of *Mystus seenghala* and *M. aor* were seen in the catches but they were not found in abundance.

PROJECT FA/A/31 : DEVELOPMENT OF CULTURAL METHODOLOGY FOR *PUNTIUS TICTO* AND *P. SOPHORE*

Personnel : K. K. Sukumaran, S. Jena, D. K. Chatterjee and H. K. Muduli

Duration : 1984 to 1986

Location : FARTC, Kausalyagang

Four nursery ponds each of 0.02 ha were stocked with *Puntius ticto* and *Puntius sophore* uniformly at the rate of 40,000/ha in December 1984. Two ponds were treated with both

organic manure and inorganic fertilizers and the other two ponds with inorganic fertilizers and provided supplementary feed of groundnut oil cake and rice bran keeping the total nitrogen and phosphorus applied equal in all the ponds.

The gross production obtained in the two ponds treated with organic manure and inorganic fertilizers was 496.5 kg/ha/10 months (*Puntius* spp. 304.5 kg + other fishes 192.0 kg) and 537.5 kg/ha/10 months (*Puntius* spp. 326.5 kg + other fishes 211.0 kg). In the other two ponds where supplementary feed and inorganic fertilizers were provided the gross production was 441.7 kg/ha/10 months (*Puntius* spp. 321.7 kg + other fishes 120.0 kg) and in the second pond the same was 622 kg/ha/10 months (*Puntius* spp. 331.5 kg + 290.5 kg other fishes). Young ones of *Puntius* spp. were observed in all the ponds in the month of April indicating their breeding in March/April.

PROJECT FA/A/32 : NON-SEASONAL AND SEASONAL BREEDING OF INDIAN AND EXOTIC CARPS

Personnel : S. K. Mukhopadhyay, A. K. Datta, P. R. Sen, S. K. Saha, A. K. Roy, N. M. Chakrabarti and G. P. Bhattacharya

Duration : March 1984-December 1986

Location : Rahara (West Bengal)

Brood fishes were maintained at the rate of 1,500-2,000 kg/ha in brooder pond. Among the management measures taken, water column of brood tanks was maintained at a level of 2.5 to 3.5 m to enhance the photoperiodicity and water temperature between surface and bottom. Feeding was done with groundnut oil cake+rice polish (1 : 1) and banana leaves and horticultural wastes for grass carp.

OFF-SEASON BREEDING

Induction of spawning with LHRH formulation: Experiments were conducted during April-May 1985 on 6 sets of *H. molitrix*, 7 sets of *C. mrigala* and 10 sets of *L. rohita* out of which 3 sets of *H. molitrix*, 4 sets of *C. mrigala* and 3 sets of *L. rohita* responded. Viable spawn (44,850) could be produced only from *C. mrigala*. A total number of 1.15 lakhs of eggs could be produced from *H. molitrix*.

Breeding trials with fish pituitary extracts: Experiment trials were taken up from March to 1st week of June with 12 sets of *H. molitrix*, 17 sets of *C. mrigala* and 9 sets of *L. rohita*. A total number of 8,100, 9,21,500 and 56,000 spawn could be obtained from *H. molitrix*, *C. mrigala* and *L. rohita* respectively.

SEASONAL BREEDING

Induced breeding experiments were conducted during June to August 1985 with three Indian carps—*C. catla*, *L. rohita*, *L. bata* and two exotic carps *H. molitrix* and *C. idella*. A total number of 4,00,000 catla spawn, 16,66,500 rohu spawn, 500 bata spawn, 9,000 silver carp spawn and 45,000 grass carp spawn were produced.

Plankton and bottom macrofauna of brood fish pond were studied. The range of plankton sedimentation in 50 litres of pond water varied between 0.8 ml and 2.5 ml. Phytoplankton dominated over zooplankton throughout the year except in July-August.

Dipteran larvae, oligochaete worms and gastropod molluscs formed the main bottom fauna.

PROJECT FA/A/33 : **BREEDING AND CULTURE OF PENINSULAR CARPS AND NON-PREDACEOUS CATFISHES IN COMBINATION WITH GANGETIC AND EXOTIC CARPS**

Personnel : S. P. Ayyar, P. K. Sukumaran, P. Kumaraiah, S. L. Raghavan and M. F. Rahman

Duration : 1984-86

Location : Bangalore

Survey and seed collection: Breeders of *Puntius pulchellus* were available in Ranibennur in Chobaduga district and Shringeri in Chickmagalur district. Cast net was found to be best suited for breeder collection. Gonads were partially mature in November-December. Six hundred and twenty fry of *P. pulchellus* collected from Tunga river near Shimoga were reared to fingerlings and stocked in A.S.C. tank alongwith major carps.

Collection of *Wallago attu* breeders: Survey was conducted in Mysore, Bellary and Tumkur districts of Karnataka for the breeders of *W. attu.* Breeders collected by *alivi vala* (shore seine) and cast net were found best suited for breeding. Large number of *W. attu* (1.2-3.75 kg) in 3rd and 5th stages of maturity were encountered during May-July in commercial catches from Tungabhadra Reservoir. Spent fishes appeared in the catches from July. Large number of breeders migrating upstream were observed in the River Sharavathi near Bidurmatta in the middle of June.

Breeding of *Wallago: attu*: (Reported under Important achievements.)

Spawning of carps and catfishes using LHRH formulation: Altogether 13 sets of carps and 2 sets of *W. attu* were administered Hoe 766 vet for breeding. The experiments were conducted in two phases. The details are given in the following table.

Table: Treatment Results of Hoe 766 vet (H) and Progestorone (P) for artificial induction of spawning in carps and catfishes.

Experiments	Species of fish	Injection doses (range, if any) (ml kg^{-1} =body weight)					
		No. of sets	First injection with (H) to females alone	Second injection		Success spawning (%)	Range in fertilization (%)
				females with (P)	males with (H)		
First phase (17-6-85 to 27-6-85)	*C. mrigala*	8	0.2-0.4	0.2	0.1	62.5	5 to 87
	L. rohita	1	0.4	0.2	0.1	Nil	—
	W. attu	2	0.3	0.2	0.1	100	35 to 80
Second phase (16-7-85 to 18-7-85)	*C. mrigala*	3	0.3-0.4	0.2-0.3	0.1	33.3	75
	L. rohita	1	0.3	0.3	0.1	Nil	—

PROJECT FA/A/34 : INTEGRATED FARMING SYSTEM: AQUACULTURE INTEGRATED WITH PADDY CULTIVATION IN ORISSA REGION

Personnel : S. N. Datta, N. K. Tripathy (from CIFRI) and S. Rajamani, (from CRRI)

Duration : 1984-88

Location : Cuttack

Brood stock maintenance: With a view to intensify breeding and standardise the techniques, brood stocks of magur, *Clarias batrachus*; singhi, *Heteropneustes fossilis*; koi, *Anabas testudineus*; and spotted murrel, *Channa punctatus* were maintained in different cement cisterns with diet manipulation. All the four species attained maturity in the cisterns.

Seed production through controlled breeding: Koi and spotted murrel were bred naturally in different cisterns. Singhi was bred through hypophysation using carp pituitary extract. Breeding of magur was done within bamboo matting enclosures erected in specially prepared paddy plots. A total of 25,500 advance fry comprising of singhi, magur, koi and spotted murrel were raised in cement cisterns and plastic pools.

Seed rearing in paddy plots: Controlled breeding (on plot) and subsequent short-term ($4\frac{1}{2}$) months seed rearing of magur in renovated fields cropped with high-yielding rice cultivar CR1018 in Kharif season could boost up farm returns to about 2-fold over mono-cropping of rice. Grain and fish yielded a combined production of 4.07 t/ha fetching Rs. 9,372.00 in which grain contributed Rs. 4,884.00 and fish Rs. 4,488.00. During the entire period of rearing, the fishes were fed daily with low-cost feed items, minced fish offal and raw cowdung.

PROJECT FA/A/35 : BREEDING AND NURSERY MANAGEMENT OF ENDEMIC *HILSA ILISHA* (HAM.)

Personnel : Ravish Chandra, R. K. Saxena, S. K. Wishard, S. N. Mehrotra, D. R. Kanaujia, D. P. Verma, B. D. Saroj and Ramji Tiwari

Duration : 1984-86

Location : Allahabad and Buxar

Availability of hilsa was monitored during the monsoon floods in Ganga River. Hilsa appeared in the commercial catches on the third week of June 1985. At Buxar market hilsa specimens measured between 300 and 525 mm, the maximum being of 525 mm/1.90 kg.

Regular fishing with 'Kamel'—a purse net, commenced between Chause and mouth of Thora river near Buxar in the middle of September. The spawning run was shortlived and comprised oozing males (250-380 mm) and imature females. A few specimens of females (450-500 mm) were degutted on regular intervals to ascertain the maturity condition. Gonads were not found beyond VIIth stage of maturity. Availability to hilsa by 'Kamel' was very poor during two floods in the River Ganga between 29.9.85 and 13.10.85. The spawning

run became very feeble in the second week of October and comprised stray specimens of males.

Artificial fecundation by stripping was not successful. Ripe ovary of a few fishes were operated out and milt was applied. Fertilization did not take place. A nursery pond (0.04 ha) was prepared and spawn collected from the river during October-December are being reared. A few are also being reared in glass jars and plastic pools.

PROJECT FA/A/36 : NUTRITIONAL STUDIES ON THE DEVELOPMENT OF FORMULATED FEED FOR CULTIVABLE AIR-BREATHING FISHES

Personnel : D. D. Halder, A. Hajra, K. M. Das and V. V. Sugunan

Duration : 1985-88

Location : Barrackpore

A variety of fish feed ingredients were collected and three feed formulations were worked out. A control feed containing 33% protein was also compounded. The ingredient composition of the feeds were as follows:

Ingredients	Control	Feed-I	Feed-II	Feed-III
Fish meal	31.2 g	—	—	—
Rice polish	31.9 g	20.1 g	20.8 g	14.07 g
Groundnut oil cake	31.9 g	20.1 g	20.8 g	14.07 g
Slaughter-house offal	—	54.8 g	—	52.8 g
Active sludge	—	—	53.4 g	14.06 g
Mineral mixture	4.0 g	4.0 g	4.0 g	4.0 g
Vitamin mixture	1.0 g	1.0 g	1.0 g	1.0 g

The feeds were converted into pellets and bioassay experiments were conducted at 5% level in cement cisterns. The growth performance for a 28-day trial at the water temperature range of 27-28°C showed that in both the *Clarias batrachus* (12.1 cm/13.0 g) and *Anabas testudineus* (7.5 cm/8.1 g) two feeds (F-I and F-II) showed better performance over the control feed. *Clarias* fed with the diets F-I, F-II and F-III registered 29.57%, 21.24% and 26.39% growth over the initial weight respectively while those fed the control feed registered 23.42% gain during the same period.

Anabas fed with F-I, F-II and F-III however, had registered a percent gain of 29.69, 15.00 and 23.38 respectively over the initial weight against the control feed registering 20.12% gain during the same period of bioassy (28 days).

Feeding was continued after growth studies for a week more during which period quantitative collection of faecal matter was done for digestibility studies.

Studies showed that out of the ingredients tried, slaughter-house offal can be successfully employed as a protein rich component of animal origin in both *Clarias* and *Anabas* to replace fish meal.

PROJECT FA/A/37 : CULTURE OF NON-AIRBREATHING LARGE CATFISHES

Personnel : B. N. Saigal, K. L. Shah, B. C. Tyagi and D. N. Mishra

Duration : September 1985 to 1990

Location : Karnal (Haryana)

Preliminary survey of different canals in Karnal district was carried out to find out the availability of seed of *Wallago attu* and *Mystus seenghala.* Brood fishes and fingerlings were collected and are being reared in ponds.

PROJECT FC/B/1 : ECOLOGY OF MOUNTAIN LAKES

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

Duration : 1983-1986

Location : Srinagar Research Centre of CIFRI

Fishery limnology of coldwater Wular lake: The water temperature at different stations of sector-I ranged from 7-28°C, water was usually turbid with secchi disc transparency within 15-70 cm. The hydrogen ion concentration for the water column during different seasons ranged from 3.5 to 12.5 ppm, carbon dioxide was nil to 8.8 ppm, total alkalinity 90-150 ppm. At sector-II, a surface heating of 1-2°C during summer was noticed.

Average surface gross primary productivity of different sites of sector-I ranged from 30-140 $mgCm^{-3}$ hr^{-1}. The range for bottom water was 20-80 $mgCm^{-3}$ hr^{-1}. At sector-II the surface water production ranged from 40-110 mg Cm^{-3} hr^{-1} ; the bottom production ranging from 40-130 $mgCm^{-3}$ hr^{-1}.

Phytoplankton density ranged from 17 to 38×10^3 units/l in sector-I while in sector-II the density was much lesser. At sector-II, a vertical stratification of phytoplankton was indicated in two stations. The dominant forms were *Navicula, Amphora, Fragilaria, Microcystis* and *Oscillatoria.*

Among zooplankton, little variation was noticed in their density within different stations of sector-II; the density being 70-110 units/l at surface and 95-140 units/l at the bottom. At different stations of sector-II the surface zooplankton density ranged from 120-150 units/l and at bottom from 175-270 units/l. Rotifera formed the dominant group represented by *Keratella, Platyias, Brachionus* and *Notholca.* Copepods and protozoans were the other groups represented in the zooplankton.

The main fishery in the lake was constituted by *Schizothorax curvifrons, S. niger, S. esocinus* and *S. plagiostomus* among the indigenous variety and *Cyprinus carpio specularis* and *Cyprinus carpio communis* from the exotic variety. At the Nusoo landing site of sector-I, the average catch was estimated at 1.5 kg/man/hr, in which exotic carp formed 70% and *Schizothoracid* only 30%.

The seasonal experimental fishing done at different stations of sector-I indicated the average catch range of 600-1,250 g/man/hr during first half and 750-1,500 g/man/hr during the second half of the year. During different seasons the average catch composition was

80-90% exotic carps and 10-20% endemic carps. The total length and weight of the carp fish in the catches ranged between 125-370 mm and 65-625 g respectively.

At sector-II, Wutlab, the main fishery was constituted by *Cyprinus carpio specularis, Cyprinus carpio communis, Schizothoriachthys esocinus, Schizothorax longipinnis, S. curvifrons* and *S. micropogon.*

From the commercial catches it was observed that each fisherman on an average caught 4-8 kg of fish and the catch per man/hour worked out 425-850 g. In terms of fish biomass 175-450 g of fish landed daily which would increase by 3-4 folds in winter seasons. The experimental fishing at this sector recorded a catch range of 800-1,500 g/man/hr with 70-90% contributed by exotic carps. In this sector lot of *Gambusia affinis* was recorded towards littoral zones during summer months.

The Schizothoracid group of fishes exihibit spawning migration into Madhumati stream from sector-I between April to June. The seed resources of stream are comparatively higher than Erin which also feeds Wular lake from this sector. At Madhumati the mixed spawn of *Schizothoraichthys esocinus, Schizothorax curvifrons* and *Schizothroax micropogon* ranged in density between 20-350 fry/m^{-2} (15-30 mm size group) and between 25-120 fry/m^{-2} (20-50 mm size) at different stretches of the stream.

PROJECT FC/B/5 : FISHERIES OF KOLLERU LAKE AND ITS CONNECTED WATERS

Personnel : K. V. Rao, Ch. Gopalakrishnayya, M. Ramakrishnaiah, K. S. Rao and T. S. R. Raju

Duration : 1982-86

Location : Eluru/Tadepalligudem (A.P.)

The annual fish yield (Jan.—Dec. '85) from Kolleru Lake was estimated to be 2,026.9 tonnes as against 2,129.1 tonnes in 1984, thus registering a decline of 4.80% over that of 1984. Akivedu centre accounted for higher production (53.1%) followed by Eluru (32.5%) and Bhimavaram (14.4%). Higher catches were in May 1985 (242.14 t) and lowest in December '85 (107.31 t).

An examination of the catches from the lake revealed that catfishes, perches, prawns and murrels formed the major constituents in the fishery contributing 88.95% to the total annual yield followed by carps (5.69%). Each of the above groups contributed 33.14% (catfishes), 28.24% (perches), 16.24% (prawns) and 11.33% (murrels) respectively.

The annual landings of the important species from different groups of fish with their contribution to the total yield of the lake are given below:

Heteropneustes fossilis	26.77%	*Labeo rohita*	2.23%
Anabas testudineus	26.35%	*Wallago attu*	2.03%
Metapenaeus monoceros	12.49%	*Clarias batrachus*	1.81%
Channa striatus	10.03%	*Macrobrachium malcolmsonii*	1.44%
Mystus gulio	2.45%	*Catla catla*	1.29%
		Penaeus monodon	0.80%

PROJECT FC/B/7 : **INVESTIGATIONS ON FACTORS RELATING TO THE DECLINE IN FISHERY OF THE RIVERS GANGA AND YAMUNA**

Personnel : A. G. Jhingran, Ravish Chandra, R. S. Panwar, K. P. Srivastava, R. A. Gupta, G. N. Mukherji, S. P. Singh, M. Peer Mohamed, R. K. Saxena, S. K. Wishard, S. N. Mehrotra, M. A. Khan, Balbir Singh, G. N. Srivastava, R. N. Seth, R. K. Dwivedi, R. K. Tyagi, D. Kapoor, N. K. Srivastava, D. N. Srivastava, B. D. Saroj, Ramchandra, K. S. Banerji, J. P. Mishra, Bhailal, D. R. Kanaujia, Dhirendra Kumar, M. P. Singh, A. K. Laal, B. D. Pandey, S. K. Sarkar, A. Sarkar and A. R. Chowdhury

Duration : 1985 to 1989

Location : Allahabad

Fish catch statistics of the selected stretch of rivers Ganga and Yamuna: During the period under report a survey of river Ganga from Kanpur to Varanasi was done for the identification of fish assembly centres. Within this stretch one centre at Kanpur, three points at Fatehpur, four points at Allahabad, two points at Mirzapur, one point at Meja Road, two centres at Chunar and one centre at Varanasi could be identified. On the basis of landings Kanpur, Fatehpur, Allahabad and Varanasi can be categorised as the centres of high activity and rest as the centres of low activity.

In the stretch down to Varanasi, Buxar, Patna, Bhagalpur and Lalgola fish markets were chosen as the sampling units for the estimation of landings.

The total estimated fish landings at Sadiapur (Allahabad), Buxar, Bhagalpur, Patna and Lalgola are depicted in Table 1. As compared to the preceding year Sadiapur landings registered a decline of 15.9%. A drastic decline of 46% was noticed in the landings of *L. calbasu.*

Table: Fish landings (t) from River Ganga estimated from selected assembling centres.

Species	Centres				
	Allahabad	Buxar	Patna*	Bhagalpur	Lalgola
C. mrigala	7.62	0.53	0.41	1.06	0.21
C. catla	2.68	0.72	0.73	2.60	0.49
L. rohita	2.04	0.88	0.33	0.81	0.25
L. calbasu	23.53	1.13	0.003	0.42	0.30
Major carps	**35.87**	**3.26**	**1.473**	**4.89**	**1.25**
M. aor	11.16	2.22	1.07	3.67	2.27
M. seenghala	8.60	1.32	0.46	2.12	1.18
W. attu	2.57	1.87	3.02	16.47	1.28
Large catfishes	**22.33**	**5.41**	**4.55**	**22.26**	**4.73**
H. ilisha	1.71	2.60	0.13	0.18	20.53
Miscellaneous	65.48	15.48	18.93	35.21	29.66
Total	**125.39**	**26.75**	**25.083**	**62.54**	**56.17**

*For the period September to December 1985.

Rest all the species maintained almost the same level. The production decreased by 37.86% at Bhagalpur and 10.7% at Lalgola when compared with the preceding year.

Data on catch per unit of effort were collected from Kakrahaghat fishing area in river Yamuna near Allahabad. Average catch per boat were estimated at 3.5 kg for gill nets, 40.0 kg for small dragnets and 1.40 kg for hook line fishing.

Natural breeding of *Hilsa ilisha:* The studies revealed only scanty breeding around Allahabad, both in Ganga and Yamuna. Hilsa fingerlings in bulk quantity was available at Buxar in April 1985.

Observations on the quantitative and qualitative variation of the riverine carp spawn/fry/fingerlings: Investigations were conducted for a period of 38 days from 23rd July to 29th August 1985 to study the quantitative and qualitative abundance of the carp spawn in a stretch of river Yamuna around Madhauka near Allahabad. During the period of observations three floods were experienced but the spawn was available in the 1st two floods, mostly in the rising phases and a total of 3,135 ml (*c* 15.67 lakhs) of spawn was collected.

During the 1-28 August the river at Chillighat near Allahabad experienced two floods and in three spurts a total of 813 ml (*c* 4.06 lakhs) of spawn and about 2,000 number of early carp fry were collected. The seed was available mostly in the rising phases of the floods.

A total of 410 ml (c. 2.05 lakh) hatchlings were collected in shooting nets during 10 July-20 August at IInd and IIIrd of the four floods experienced at Mauzipur, Patna.

Ecological studies: Pollutional areas of River Ganga in the vicinity of Kanpur were surveyed. The sewage at Ranighat, the main discharge point was found to be neutral in reaction (pH 7.0), while chloride content was fairly rich (86 mg/l) with rich concentration of soluble salts (792 micromhos/cm). The total phosphate was 15.8 mg/l.

Plankton: At O.F. region, the plankton was found to be rich (2,800 u/l) and was dominated by diatoms (98.5%). Zooplankton was totally absent. At Bharioghat (O.F. region) organic detritus was present along with dead zooplankton whereas the zooplankton formed 25% of the total planktonic population at the O.F. region of Jajmau where tannery effluents are discharged.

The impact of composite effluent discharged by IFFCO, Phulpur, manufacturing urea on the ecological spectrum of River Ganga near Allahabad was characterised by chlorides (38.5-40.5 mg/l), alkalinity (340.0-360 mg/l), hardness (156.0-160.0 mg/l), conductance (1,018-1,056 micromhos/cm) and fairly alkaline pH (8.5).

Although the toxicity of the composite effluent gradually declined, the impact of toxic wastes was still noticed in the surrounding areas of the O.F. at Dumduma in River Ganga where no fish could be encountered excepting some minor weed fishes.

The quality of soil showed high content of heavy metals *viz.,* arsenic and chromium at IFFCO nallah.

The impact of toxic wastes was noticed upto 500 m from the O.F. region in river Ganga where plankton and benthic populations were sparsely distributed.

Ecology of River Ganga and *Kol* at Bhagalpur: The Kol was influenced by community waste. River Ganga at this region exhibited polluted condition during monsoon season. But the average annual values of physico-chemical parameters showed oligotrophic trend.

Phytoplankton community was comprised of algae of oligo and polysaprobic varieties. In monsoon the phytoplankton (36 u/l) and zooplankton (35 u/l) were the poorest qualitatively and quantitatively. Primary production was only to the level of 44.84 mgC/m^3/hr. The presence of *Difflugia, Monostyla* and *Arcella* and fungi indicated that the river gets contaminated with industrial and municipal wastes. Assiduous higher concentration of phytoplankton population was exhibited in outfall and below outfall zones. Cladoceran succession in outfall zone showed definite pattern.

Pen culture in *Kol*: Fish production to the tune of 203 kg from 0.1 ha in 3 months without the application of fertilizer, manure and supplementary feed was obtained from pen culture.

Rotifers as biological indicators: Amongst the rotifers, *Brachionus rubens, B. anagularis, B. forficula, B. calcyflorus, B. havanaensis, Horaella* sp., *Filinia* sp. and *Polyarthra* sp. were collected from the wastes of tannery and silk spun industries. Physico-chemical features of the effluents also were studied.

PROJECT FC/B/8 : WATER POLLUTION INVESTIGATIONS IN RIHAND RESERVOIR

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

Duration : 1984-85

Location : Allahabad

Impact of chemical wastes on Rihand reservoir: The industrial wastes released into Rihand reservoir by M/s. Kanoria Chemicals were characterised by low pH (4.6), high values of chlorine (26 to 29.5 mg/l), chlorides (860 to 890 mg/l), alkalinity (950 to 986 mg/l), sp. conductance (1,198 to 2,106 micromhos/cm), hardness (118 to 120 mg/l), besides nil DO. The studies revealed that the concentration of combined wastes were less as compared to earlier observations wherein more than 100 mg/l of free chlorine was recorded, sometimes with heavy fish mortality.

Impact of thermal wastes on Rihand reservoir: The heated wastes of Renusagar Power Co. was characterised by high water temperature (48.5°C), sp. conductance (310 to 445 micromhos/cm), low pH (6.2 to 6.3), alkalinity (22 to 28 mg/l), chloride (70.5 to 72.5 mg/l) and dissolved silica (10.5 to 11.5 mg/l). The impact of thermal wastes noticed up to 1,000 m away from the outfall, which was devoid of any benthic population in contrast to earlier observations where impact was noticed up to 500 m.

PROJECT FC/B/9 : INVESTIGATION ON FACTORS RELATING TO DECLINE IN FISHERY OF THE RIVER BRAHMAPUTRA AND ITS MAJOR TRIBUTARIES

Personnel : D. N. Singh, Y. S. Yadava and M. Choudhury

Duration : October 1985-September 1990

Location : Gauhati

Records of earlier survey have shown a steady decline in the fishery of the middle and lower stretch of the river. The causative factors for the decline are being investigated with

a major thrust on the industries established on the bank of the river and its tributaries. Thirteen major industries releasing effluents into the system have been identified, besides scores of smaller units which are mainly concentrated in Guahati and adjacent areas.

PROJECT FC/A/1 : ECOLOGY AND FISHERY MANAGEMENT OF PENINSULAR TANKS

Personnel : S. P. Ayyar, P. Kumaraiah, P. K. Sukumaran, S. L. Raghavan and M. F. Rahman

Duration : 1983-86

Location : Bangalore

Physico-chemical conditions of water: Monthly observations on the hydrobiological parameters of Yelahanka (area : 120 ha), Bandematta (area : 20 ha) and Lalbagh (12 ha) tanks were made. The range in physico-chemical conditions of water are given in the Table.

Table : Range in hydrological conditions of Yelahanka and Bandematta and Lalbagh tanks during 1985

		Yelahanka tank	Bandematta tank	Lalbagh tank
Physical conditions				
Temperature °Celsius		21.75-28.0	23.7-28.75	21.5-28.5
Turbidity	mg l^{-1}	Less than 100	Less than 100	300-500
Colour		Colourless to reddish	Colourless to reddish	Greenish
Chemical factors				
pH		7.3-8.75	7.7-9.0	9.75-10.25
Dissolved oxygen	mg l^{-1}	2.48-11.60	4.4-8.4	3.31-7.90
Free-carbon dioxide	-do-	Nil-11.00	Nil-20.00	Nil
Carbonate alkalinity	-do-	Nil-32.00	Nil-32.00	44.7-150.8
Bicarbonate alkalinity	-do-	52.0-102.00	80.0-152.0	49-160
Hardness	-do-	40.0-80.0	56.0-88.0	63-95
Nutrients				
Nitrate	-do-	*Tr-0.05	*Tr-0.075	Tr-0.22
Phosphate	-do-	Tr-0.0288	Tr-0.0495	0.003-0.037
Silicate	-do-	Tr-0.030	Tr-0.035	Tr-0.64
Iron	-do-	Tr-0.050	Tr-0.10	Tr-0.154
Primary production				
Gross primary production $mgCm^{-3}/hr$		29.17-291.65	104.16-603.13	93.75-351.56

*Tr=traces

Plankton: In Yelahanka tank the volume of plankton ranged from 1 to 4 ml/m^3 and number from 28,000, 13,35,000/m^3. In Bandematta tank the volume of plankton ranged from 1 to 5 ml/m^3 and the number from 12,000 to 7,48,000/m^3. In Lalbagh tank, phyto-plankton dominated over zooplankton throughout the period of study. The volume of plankton ranged from 5 to 85 ml/m^3 and the total number from 109,000 to 52,98,000/m^3. Qualitative studies of the plankton in all the three tanks were conducted in detail and the various phyto and zooplankton available in these tanks were also listed.

Littoral fauna: The density of littoral fauna in Yelahanka tank varied from 1 to 93 units/m^2 by numbers and from 0.004 to 1.991 g/m^2 by weight. The organisms encountered were aquatic insects (dragonfly nymphs, damselfly nymphs and mayfly nymphs, *Ranatra elongata, Cybister* spp.), molluscs (*Lymnea* spp. and *Gyraulus* spp.), prawns (*Macrobrachium* spp. and *Caridinia* spp) and fish (*Puntius ticto* and *Gambusia affinis*).

The littoral fauna in Bandematta tank ranged from 1 to 35 units/m^2 by numbers and 0.004 to 17.153 g/m^2 by weight. The organisms encountered were aquatic insects (dragonfly nymphs, mayfly nymphs, *Ranatra elongata* and *Corixa* spp.), molluscs (*Lymnea* spp.), prawns (*Macrobrachium* spp.) and fishes (*Puntius ticto, P. dorsalis* and *Gambusia affinis*).

In Lalbagh tank the density of littoral fauna in the tank ranged from 1 to 12 units/m^2 (0.077 to 0.774 g/m^2 by weight). The organisms encountered were insects (*Notonecta glauca, Nepa* sp., *Anisops sardea,* dragonfly nymphs, mayfly nymphs *Ranatra elongata, Belostoma* sp. water spider) and fish young ones.

Fishing: Fishing conducted in Bandematta tank by the lease between 24th April and 2nd May 1985, yielded on an average 10.0 kg of fish/day comprising of *L. rohita, C. mrigala* and *C. carpio* var *communis.* The weight of each of the above species, ranged from 1.0-2.0 kg (rohu), 1.5-2.0 kg (mrigal) and 0.500-0.750 kg (common carp). In addition to the above, fishes indigenous to the tank like *Puntius sarana, P. chela, Garra* spp. and *Chela* spp. were also harvested ranging from 2.0 to 4.0 kg in total weight/day.

In Lalbagh tank, air-breathing fishes such as *Clarias batrachus, Heteropneustes fossilis, Channa striatus* and *Channa punctatus* and a few of stocked (earlier years) *Cyprinus carpio* var *communis* form the existing stock. The catfishes dominate. First stocking in the year 1984 was done in the tank on 16 October, with 4,000 fingerlines (86.4 mm/6 g) of *L. rohita,* 24,400 fry (2.3 g) of *C. mrigala* and 9,700 (2.5 g) of *L. rohita* was stocked on 6th December. Again stocking was done in 1985 with 1,779 fingerlings (145.0 mm/57.19 g) of *C. carpio* on 11 July and with 10,000 *C. catla* (1.9 g) and 10,000 *Hypothalmichthys molitrix* (1.85 g) on 14 August respectively. The stocking density works out to 4,990 fish/ha. It was kept at a higher side in view of small size of the seed, depleted hygeine of the tank water and presence of a few predatory fishes therein.

Till 31 December 1985, a total harvest of 502.080 kg fish (including dead fish) was harvested. The fishing was done by operating 250 m gillnets in the mesh range of 60 to 110 mm for 15 days (2 to 3 men for 4 to 5 hrs a day). As per the fish catch data, a production of 41.840 kg/ha has been obtained in 1985.

Survey and collection of hydrobiological data in Linganamakki, Byramangala, Nalliguda, Tippuganahalli reservoirs and Ulsoor lake were initiated and preliminary reports have already been prepared.

PROJECT FC/A/2 : **ECOLOGY AND FISHERY MANAGEMENT OF SMALL RESERVOIRS/LAKES IN ALLUVIAL ECOSYSTEM**

Personnel : A. G. Jhingran, K. P. Srivastava, S. N. Mehrotra, R. K. Dwivedi, M. A. Khan, R. A. Gupta and Ram Chandra

Duration : 1983-1985

Location : Allahabad

In Bachhra reservoir plankton population ranged between 144 u/l and 1,286 u/l and on an average the phytoplankters and zooplankters constituted respectively 59.4 and 40.6% of the total population.

Periphytic flora fluctuated within a range of 700 to 77,777 units/cm^2 maximum being in the month of May.

Macrobenthic fauna of the reservoir ranged between 1,320 in June to 3,364 units/m^2 in March and was dominated by insect larvae (71.4%) followed by annelids (15.3%) and molluscs (13.3%).

Experimental fishing in the reservoir was initiated with the help of multi-meshed nylon gill nets (dimension: 30 m $\times$ 2 m) one day each in June and July for a period of 12 hours during the night. A total of 18.880 kg of fish, comprising 10.665 kg (56.6%) of major carps, 5.415 kg (28.6%) of minor carp, 1.150 kg (6.1%) of catfishes and 1.650 kg (8.7%) of feather—backs were caught.

Natural breeding of major carps was observed in the reservoir for the 1st time on 14th of July. About 30 litres (1 lakh) fertilized eggs, comprising 80% of major carps were salvaged.

A cyclone of severe intensity on 14th of May caused a heavy fish mortality.

PROJECT FC/A/3 : **BEEL FISHERIES: ECOLOGY AND FISHERIES OF DHIR BEEL IN ASSAM**

Personnel : Y. S. Yadava and M. Choudhury

Duration : September 1981-85

Location : Guahati

The studies on limnology and productivity vis-a-vis problems and potentialities of Dhir beel (Dhubri district) were undertaken to obtain detailed information on beels, particularly those having a functional link with the river Brahmaputra. Studies pertaining to the ecology and fisheries of the beel was completed in March 1985 and the final report of the project was prepared during the year. Highlights of the information are presented below:

Dhir beel (90°51′ E long and 26°25′ N lat), with a waterspread area of 689 ha at L.S.L., lies 230 km north-west of Guahati on N.H. 31. Relatively weed-free, this lacustrine beel has a live connection with the river Brahmaputra through a channel.

Soil pH varied within a narrow range with an average of 5.4 $\pm$ .486. Moderate organic

carbon (0.965%±0.247), total nitrogen (0.089 ppm±0.025), soil conductivity (0.203 u/mhos/cm±0.102) and high available phosphorus (14.8 ppm±6.25) were the soil characteristics of the beel.

The *in situ* pH of the beel water ranged from 6.0 to 7·6 and nutrients tended to display moderate concentration, although the average total alkalinity remained by and large low (30 mg/l).

The spatial and temporal distribution of plankton in the beel was characterized by moderate to low concentration and dominated by phytoplankton (83% of the total population). Chlorophyll-a studies further reflect upon the low plankton concentration, ranging form 5.8 to 11.5 mg/m^3 (average 7.94 mg/m^3). High values of community coefficient (>60) and percentage similarity coefficient (>40) indicated homogeneity in the plankton population which is also supported by the high values of diversity indices.

The macrophyte biomass ranged from 155 to 351.76 g/m^2 (dry wt.) with an average of 302.4 g/m^2 and the average value of macrophyte energy works out to be 1209.6 K Cal/m^2.

The rate of energy transformation through phytoplankton ranged from 281.42 g C/m^2/yr in 1983 to 306.24 g C/m^2/yr in 1984 while energy transformation rate of macrophytes was of the order of 296.74 g C/m^2/yr and 1057.04 g C/m^2/yr respectively. Thus the autotrophic energy input in the beel was mainly by macrophytes.

The beel is rich in respect of organo-phosphate solubilizing bacteria and this is due to the high content of bottom detritus, originating from the profuse amount of macro-vegetation which releases water soluble phosphate during their microbial decay. The rate of protein decomposition per 15 days shows that it increases gradually form surface to the bottom and becoming maximum at the soil-water interface, where the density of micro-organisms is highest.

The annual mean production of biotal organisms was 3,462 nos m^{-2} and organic detritus estimated from unit area of the beel bottom amounted to 47.5 to 285.0 g m^{-2} (average 167.0 g m^{-2} dry wt.).

The annual fish production of the beel varied from 121 m tons during 1982 to 78 m tons in 1983 and then 108 m tons in 1984. Annual floods and submerged vegetation are important factors governing the quantitative change in fish catch from the beel. The period October-February fetches maximum catch while May-August contribute minimum. *G. chapra,* miscellaneous species, Indian major carps and catfishes dominate the fishery of Dhir beel. *L. rohita* and *W. attu* are the most abundant species among Indian major carps and catfishes respectively. Besides gillnets and dip nets, 'Katal fishing' and 'Banas fishing ' are the popular fishing methods used in the beel.

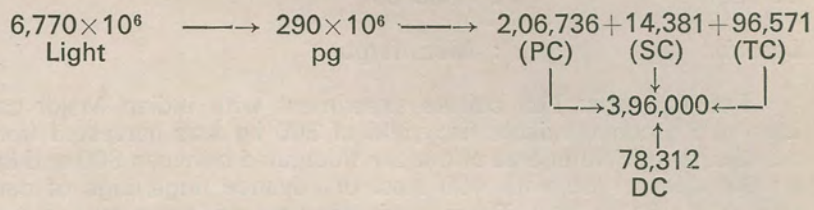
Besides the river site adjoining the beel as a prospective spawn collection zone, spawn investigations also revealed with a degree of certainty, that the beels themselves, in the process of inundation, serve as spawning area of the major carps.

The occurrence of both juvenile (32 to 80 mm) and adult (up to 520 mm) *Hilsa* in the beel during May to September envisages considerable prospect of its fishery and establishes the lentic adaptibility of the species.

The pen-culture experiment conducted in two identical pens of 0.15 ha each in Dhir beel had to be discontinued due to political disturbances in the area. The fishes recorded

an average increment of 105.0 g from the date of stocking (22.11.82) to the date of last sampling (February 1983).

The flow of energy in the beel is mainly by the grazing chain and the flow chart is given below:



The recommendation part of this project has not been framed, pending complete analysis of the data.

PROJECT FC/A/4 : ECOLOGY AND FISHERY MANAGEMENT IN BEELS OF WEST BENGAL

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

Duration : April 1980 to December 1986

Location : Barrackpore

Studies were continued in Media beel up to June 1985 and work started afresh in Kulia beel from January 1985 after it got refilled after the monsoon of 1984.

Observation related to various physico-chemical parameters of water, soil, productivity, organic detritus, benthos and distribution of aquatic macrovegetation were continued.

Bottom soil was slightly acidic to neutral in reaction with high available nitrogen and phosphorus level. Water was rich in alkalinity, hardness and nutrients like nitrates and phosphates. Primary production was contributed both by macrophytes and phytoplankton, the contribution of macrophytes being more. Among phytoplankton, about 70 to 80% of the primary production was contributed by nannoplankton.

In Kulia beel plankton production was much higher with a higher fish yield indicating beneficial effect of sun drying of the beel bottom for one year. Growth of aquatic macrovegetation was also not so dense. Mainly floating *Eichhornia* was present in bulk quantity. In Media beel plankton distribution was comparatively poor as the beel was mostly choked with macrophytes indicating macrovegetation oriented photosynthetic and other nutrient cycles.

The Kulia beel was stocked @ 8,000 fingerlings/ha (mrgial 6: rohu 5: catla 5). Fifteen thousand advanced fingerlings of grass carp (6-8") were also stocked to utilize the macrovegetation. The total annual yield was 30,697 kg or 1,023 kg/ha.

Gut content analysis indicated detritus as the main food item. The fishes adapted bottom feeding due to shallow depth (1-2 m) and availability of decomposed vegetable matters which was in plenty. Benthos were mainly represented by gastropods, tubificids and chironomid larvae.

PROJECT FC/A/5 : ECOLOGY AND FISHERIES OF OX-BOW LAKE IN GANDAK BASIN

Personnel : S. P. Rai, V. R. Chitranshi and R. C. Singh

Duration : 1983-86

Location : Muzaffarpur

Pen Culture: Pen culture experiment with Indian Major carps was repeated in Kanti Lake and a commendable fish yield of 300 kg was harvested from a pen (40×20 m) in six months period. Water area of the pen fluctuated between 600 and 800 m^2. The pen was stocked on 6th June, 1985 with 450 Nos. of advance fingerlings of catla, rohu and mrigal in the ratio (C7 : R12 : M6). These seeds were reared in the nursery pen (25×25 m). Fishes were fed with a mixture of rice bran and mustard oil cake (2 : 1) at 5-10% of the body weight. In six months culture period catla, rohu and mrigal attained an average weight of 1,100, 800 and 750 g from their initial average weight of 166, 75 and 102 g respectively.

35.4 kg of fish consisting of rohu, mrigal and calbasu was harvested from the other nursery pen (25×25 m). Only one calbasu (300 g) out of 85 stocked was caught in the gill net. The average weight attained by rohu and mrigal in six months period were 420 and 500 g respectively.

Physico-chemical properties of water: The atmospheric and water temperature ranged from 18-31°C and 18-32°C, depth from 1.5-4.0 m and transparency 150-325 cm. Negative redox potential (−12 mv) and low dissolved oxygen (2.4 ppm) in June resulting from decomposition of aquatic weeds indicated the reducing and unhygenic condition of water phase. Observation on the rate of carbon fixation and chlorophyll concentration of phytoplankton is indicative of highly poor status of primary producer. Fertility status of the water appeared to be poor.

PROJECT FC/A/6 : ECONOMICS OF FISHING—A CASE STUDY OF SELECTED RESERVOIRS

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

Duration : 1983-86

Location : Barrackpore

The work was partially completed in 1984 in respect of reservoirs namely Ukai, Nagarjunasagar and Pollachi. During 1985 the coverage of the study was extended to reservoirs like Rihand, Bhavanisagar, Upper Aliyar, Sholayar, Pillor and Uppar. Data of economic significance were collected, tabulated, processed and interpreted. On the basis of preliminary evidence the following interim findings may merit attention.

(*i*) Small reservoirs, say less than 4,000 ha are relatively better managed and this is well reflected in gainful employment at levels far above subsistence.

(*ii*) Biological aspects management such as stocking, stock manipulation and mesh selectivity were found to be influencing output per unit of area. Annual average catch was recorded at levels: 3,00,000 kg in Bhavanisagar, 1,643 to 4,316 kg in Upper Aliyar, 491 to

3,300 kg in Sholayar, 4,000 kg in Pillor and 20,000 to 1,20,000 kg in Uppar reservoir; the corresponding catch per unit area being 81 kg/ha in Bhavanisagar, 27.75 kg/ha in Upper Aliyar, 4.7 kg/ha in Sholayar, 17 kg/ha in Pillor and 130 kg/ha in Uppar.

(*iii*) Most of the reservoirs particularly the large ones revealed a state of disguised unemployment or underemployment. For instance, in Rihand reservoir 27,700 fishermen netted out an annual average crop of 111 tonnes valued at Rs. 16,65,000 which did not even cover half of the depreciation costs of fishing inventory, viz. boats and nets. As against this Bhavanisagar afforded gainful employment to 80 fishermen who netted out an annual average crop of 225 tonnes of fish valued at Rs. 22,50,000. After meeting annual costs (fixed and variable) and royalty obligation of Rs. 5,80,000 the net income flow per fisherman approximated to Rs. 11,500.

(*iv*) The remunerativeness of fishing in reservoir was found closely related to management of ecosystem rather than basic productivity of the reservoir based on data collected so far.

PROJECT FC/A/7 : ECOLOGY AND FISHERIES OF FRESHWATER RESERVOIRS

Personnel : B. V. Govind, G. K. Bhatnagar, V. R. Desai, C. Selvaraj, P. L. N. Rao, V. K. Murugesan, M. Kaliamurty, P. K. Aravindakshan, Mathew Abraham, K. Gopinathan, H. P. Singh, D. K. Kaushal, V. K. Sharma, M. D. Pisolkar, N. P. Srivasthava, B. K. Singh, K. O. Joseph and K. K. Agarwal

Duration : 1985-1990

Location : Bangalore, Bilaspur, Pollachi, Nagarjunasagar, Pune, Rihand and Ranchi

The studies on ecology and dynamics of fish stocks in various reservoirs in the country were continued during the year.

Aliyar reservoir, Pollachi: The reservoir exhibited a fluctuation of 16.33 m in its water level. The total inflow was 3,879 cumecs and outflow 7,384.59 cumecs.

The mechanical composition of the reservoir basin soil revealed that sand content was less, while that of clay was more in lentic sector soil compared to that of lotic sector. The soil was slightly acidic in reaction, low in available P and medium in available N and Organic carbon.

A slight increase in nutrient content of reservoir water was during the second half of the year except for phosphate which showed a declining trend. Depth profile studies showed that thermal stratification was absent. However, chemical stratification in respect of dissolved oxygen, pH, specific conductivity and bicarbonate was observed.

The plankton of the reservoir comprised mainly of *Microcystis* and other phytoplankters occasionally observed included *Mougeotia, P. simplex, Staurastrum* and *Synedra*. Numerically phytoplankters together formed 89.7% of the total plankton. Zooplankton formed the rest of 10.3% only and mainly was represented by rotifers and copepods. There was no sectoral variations in the composition of the plankton. Of the three sectors the lotic sector with 15.29 ml/m^3 had the maximum abundance of plankton followed by the intermediate sector (12.7 ml/m^3) and the least the lentic sector (7.82 ml/m^3). The average standing crop of plankton for the whole reservoir was 10.28 ml/m^3.

The primary productivity studies in reservoir showed that the average gross production ranged from 0.224 to 0.675 g C/m^2/day while the average net production from 0.206 to 0.431 g C/m^2/day.

The bottom macro-fauna of the reservoir was composed purely of oligochaetes, *Chironomus* larvae and *Chaoborus* larvae. The reservoir was having an average standing crop of 279 units/m^2 and 2.19 g/m^2 during the report period.

Periphytic organisms collected from the intermediate and lentic zones of the reservoir were studied qualitatively and quantitatively.

Two more species of fishes have been recorded raising the total number of species recorded so far to 45.

Studies on the reproduction and recruitment revealed that practically there is no auto-stocking of major carps and hence their fishery has to be supported by artificial stocking of their fingerlings.

The biological studies of the important species viz., *C. catla, L. rohita, C. mrigala, C. carpio, L. fimbriatus* and *L. calbasu* were carried out during the period. The data collected on the length-weight relationship, food and feeding habits, maturity and fecundity estimates of different species are presented. Various aspects of biology of some trash fishes like *P. filamentosus, P. mahecola, M. malabaricus, D. jerdoni, G. giuris,* etc. were studied.

There was a record landings of 27,661.750 kg of fish, resulting in a record yield of 85.12 kg/ha. There was an increase in the catch/unit effort also (6.02 kg). *C. catla* contributed the maximum (31.96%) to the total production.

The reservoir was stocked with fingerlings of *C. catla* (14,368), *L. rohita* (12,527), *C. mrigala* (13,708) and *C. carpio* (12,243).

Two ponds were stocked with yearlings of catla, rohu, mrigal, silver carp, grass carp and common carp. The breeders were given intramuscular *injection* of HCG to accelerate their maturation. The cost of production of fingerlings up to 100 mm for stocking purposes worked out to be Rs. 39.50 per one thousand. The recovery of clipped and tagged specimens revealed the phenomenal growth rate of catla to the tune of 14.7 to 18.1 g/day and common carp 11.4 g/day and poor growth of rohu and mrigal in the reservoir.

Nagarjunasagar reservoir, A.P.: The fish yield during January to March 1985 (the centre was closed on 1.4.85) was 23.983 t. Among species caught, *M. aor* dominated (7,442 kg—31.03%) followed by *P. pangasius* (4,953 kg—20.65%), *M. seenghala* (2,334 kg—9.73%), *L. fimbriatus* (2,081 kg—8.68%), *S. childrenii* (1,708—7.12%), *C. catla* (1,117 kg—4.66%), *L. calbasu* (1,053 kg—4.39%) and others. Experimental fishing during the period indicated that 70 mm mesh was most efficacious followed by 60 mm.

At the instance of DVC authorities, a survey and assessment of the fisheries reservoirs and potential of Tilaiya, Konar, Panchat and Maithon reservoirs were made in July and expert advice was given to DVC authorities on fishery management in these reservoirs.

Govindsagar reservoir (Himachal Pradesh): Soil samples of lotic sector was alkaline in nature (pH 8.75). The organic carbon (0.26-0.30%) was poor indicating poor nutrient status of the soil.

The water temperature varied from 11.5-31.0°C. The transparency ranged from 45-117 cm. A strong thermal stratification in lotic zone during August and September 1985 was observed. During these months chemical stratification also was noticed. Detailed physicochemical characteristics of the water was recorded during the year.

The gross and net organic carbon production fluctuated between 375-1,815 mgC/m^3/day and 225-1,312 mgC/m^3/day respectively. Highest value was in September and lowest in November. The respiration value fluctuated between 180 and 900 mgC/m^3/day.

The studies showed a poor standing crop of macrobenthos during the year. The average density was 79 u/m^2 with 0.060 g/m^2 biomass. Density was maximum during November-December. The maximum abundance was at 10 m depth. The benthos were absent at 2 m, 25 m and 35 m depth.

Detailed biology of the three varieties of *Cyprinus carpio* collected from the reservoir was done. The fish preferred decayed organic matter. Myxophyceae was completely absent in the gut of fish below 100 mm whereas, molluscs occurred in only above 400 mm size groups. Condition factor Kn was least in July (0.90) and maximum in March (1.29).

For the length-weight relationship $W=5.59\times10^{-4}$ L 2,4173, the correlation constant ranged from 0.8442-0.9823. Von Bettanffy's equation derived for *Tor putitora* of the reservoir was : Lt=2,447 ($_1$-e—0.0374 (t—1.4856). The equation for *Labeo rohita* was : Lt=886 ($_1$-e—0.1919 (t—1.0199).

The length-weight relationship of *Catla catla* was:

W=10—6×6.3L3.1549177(r=0.9291).

The diet of catla consisted mainly of copepodes and cladocernas while the gut contents of *L. dero* mainly comprised of mud and sand (60%) and algal matters.

The total fish landings from the reservoir was recorded to be 532.9 t during the year. Adding 20% more on account of poaching and spoilage, the gross production was equivalent to 61.4 kg/ha/yr. Silver carp accounted for 49.5% of total landings, common carp 20.21%, *Labeo dero* 19.84%, catla 5.43%, *Tor* 1.53%, rohu 1.44% and *C. reba* 0.88%. Of the three varieties of common carp variety *communis* accounted for 84%, *specularis* 13% and *nudus* 3%.

The period June-July were observed as closed season. Maximum landings was in May (47%).

Rihand reservoir (U.P.): As the centre was closed w.e.f. 1.4.85 the progress report pertains to a period of 3 months only from January to March. The average reservoir water level declined from January (260.21 m) to March (256.47 m). Commercial fishing from January to March, conducted using gill nets only, yielded a total fish catch of 12,390.00 kg. The monthly catch increased from 496.0 kg (Jan.) to 8,915.0 kg (Mar.) with the increase in fishing effort. The importance of catfish observed in January and February, was replaced by that of carp fishery in March. In the overall catch (in terms of weight), *C. catla* was the most dominant (56.50-72.28%) followed by *S. silondia* (3.20-17.40%), *Mystus* spp. (4.54-8.50%), *W. attu* (3.99-6.12%), *B. bagarius* (0.99-8.06%), *N. chitala* (0.80-15.07%), *C. mrigala* (2.99-5.83%) and *L. calbasu* (0.60-2.25%). The subdued percentage of *C. catla* in this year also has again pointed out the depletion in its fishery.

Getalsud reservoir, Ranchi: The centre was closed on 01.04.85. The fish yield during the 1st quarter was 5,788 kg. Mirror carp dominated in the catches.

PROJECT BF/B/1 : **ECOLOGY AND PRODUCTIVITY MANAGEMENT OF BRACKISHWATER PONDS**

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

Duration : 1983-87

Location : Kakdwip, West Bengal

At Rangafala, stocking was initiated during October 1984 and continued till January, 1985, With 1.13 million seed, 1,358.7 kg of *P. monodon* was harvested by November (1.2 kg/1,000 post-larvae). Total yield was 322.1 kg/ha/8 months. Maximum salinity was 15.0 ppt during May.

At Kakdwip farm ponds, range of production varied from 224.0 kg/ha/2 months to 400.0 kg/ha/4 months. Ecological parameters of Rangafala farm and that of some Kakdwip experimental farm were studied.

The oxygen budget of the prawn culture was studied. It was observed that DO started dropping from 14.16 hrs and reached minimum at 00—02 hr. By recirculating the bottom layer of water one hour through a pump, DO level could be improved by 2 ppm. The DO was maintained above 5 ppm.

Effect of change in salinity on the survival of *P. monodon* post-larvae after direct stocking from riverine collection or during monsoon rains was experimented in the laboratory. It was observed that within a range of 5 to 30 ppt, there is no effect of sudden change in salinity on the survival of post-larvae.

Analysis of plankton samples for Rangafala and Kakdwip ponds indicated that numerical abundance of plankters varied from 127 to 210 nos./l at Kakdwip and from 65 to 137 nos./l at Rangafala fisheries. Maximum population was observed during the summer months. At the onset of monsoon, there was a sharp depletion in the plankton density.

Studies on the periphyton development on substrate at different layers showed that maximum density per unit surface area was at 40 to 60 cm water depth. At 80 cm and below it was practically nil.

PROJECT BF/B/2 : **ECOLOGY AND MANAGEMENT OF BHERIES**

Personnel : G. N. Saha, S. C. Thakurta, G. C. Laha, A. C. Nandy, M. K. Mukhopadhya, P. B. Das and S. K. Chatterjee

Duration : 1982-1986

Location : Calcutta

Studies were made on ecological variations of important chemical parameters and management of selected bheries under different saline zones viz. (Kharibari, Deganga and Rajarhat (low saline) Haroa, Kulti and Hasnabad (madium saline) and Golabari and Sandeshkhali (high saline). Range and average values of chemical parameters of behri water showing variations between zonal bheries are given below:

Zonal bheries	Temp. (°C)	pH	P_2O_5 (ppm)	NO_3- (ppm)	D.O. (ppm)	Salinity (ppm)	T. alk. (ppm)	Ca (ppm)	Mg (ppm)
Low saline	21.7-32.1 (29.4)	7.3-7.6 (7.4)	0.04-0.41 (0.13)	0.05-0.42 (0.17)	4.6-8.6 (6.2)	0.08-13.5 (4.5)	96.0-188.0 (132.0)	30.0-230.0 (131.0)	85.0-650.0 (407.6)
Medium saline	22.6-31.0 (29.0)	7.4-7.7 (7.6)	0.04-0.45 (0.17)	0.02-0.60 (0.32)	2.6-7.8 (6.0)	1.2-17.8 (9.1)	94.0-188.0 (135.0)	90.0-275.0 (174.0)	170.0-910.0 (669.0)
High saline	20.4-30.8 (28.8)	7.2-7.4 (7.3)	0.01-0.23 (0.11)	0.2-0.36 (0.13)	4.8-8.8 (6.6)	6.5-36.9 (22.9)	78.0-164.0 (90.3)	120.0-380.0 (245.0)	210.0-1,670.0 (1,197.0)

The above data revealed that there was a striking variations in chemical factors like salinity, total alkalinity, calcium and magnesium between bheries under different saline zones, while other factors like temperature, pH, P_2O_5, NO_3-N, DO showed only narrow variations between the zonal bheries. Salinity of bheri waters was recorded higher this year than that of the previous year due to less dilution on account of low pricipitation.

The primary production was maximum in high saline bheri (290 mg C/m^3/hr) compared to low 163 mg C/m^3/hr and medium saline bheries (159 mg C/m^3/hr). Benthic fauna in low, medium, and high saline bheries ranged from 93-1,083, 433-837 and 237-437 units/m^2 respectively. The population was mainly represented by *Asellus* sp., *Gammerus* sp. and *Astacus* sp. Tubificid worms and chironomid larvae were encountered more in medium saline sewage polluted bheri at Kulti.

Fish and prawn (*P. monodon*) production were recorded higher in high saline bheries 1,542.0 kg/ha/yr than that in low 565.0 kg/ha/yr, and medium saline bheri 554.0 kg/ha/yr. It appears from the study that high saline bheries are more productive.

PROJECT BF/B/3 : ECOLOGY AND FISHERIES OF HOOGHLY MATLAH ESTUARINE SYSTEM

Personnel : B. N. Saigal, P. M. Mitra, H. C. Karmakar, D. K. De, M. K. Mukhopadhyay, M. M. Bagchi, S. B. Saha, H. S. Majumder, A. Chowdhury, R. N. Dey, S. N. Sar, A. K. Roy, N. D. Sarkar, N. C. Mandal, A. R. Paul, S. P. Ghosh, N. N. Mazumdar, N. P. Saha, A. K. Banerjee, G. C. Laha and P. B. Das

Duration : 1983-88

Location : Barrackpore

Sample Survey for estimation of catch and effort: Estimated total landings amounted to 26,043.2 t during the period November 1984-October 1985.

Zone-wise and month-wise catch structure: A catch of 24,103.7 t i.e. 92% of the total fish landings were recorded from the lower estuary, while 2.8% and 3.1% yield came from the upper estuary (Zone-I) and Rupnarayan tributary (Zone-IV) respectively. Zone-wise disposition of fish catch in different months is presented in Table 1.

Species composition: *Trichiurus* spp., *Harpodon nehereus and Pama pama* constituted the dominant fishery in the entire estuarine zone accounting for nearly 12,431.4 t being (47.7%) of the total fish landings. However, barring winter fishery *Hilsa ilisha* constituted the dominant fishery in the estuary contributing 1,024.6 t being 16% of the total catch excluding winter fishery as against 1,977.2 t during the corresponding period of the preceding year showing thereby a decrease of 952.6 t. The landings of hilsa in 1982-83 was 1,295.8 t. The low catch of hilsa compared to 1983-84 was mainly due to very poor winter catch at Digha. The catch of hilsa was also low in the upper and middle stretches of the estuary as compared to 1983-84. Of the hilsa landings 667.2 t were contributed during monsoon period (July to October 1985) against 787.1 t during monsoon of the preceding year. Like last year the striking feature of the monsoon fishery of hilsa has been the dominance of large sized fishes in the length range of 31.0 to 53.0 cm representing 3rd, 4th and 5th year age group with a mean length of 38.1 cm, while the length range in the monsoon of 1984 was 34.5 to 59.3 cm with a mean length of 48.5 cm. Most of ths fishes of the above size range

TABLE 1: Zone-wise total catch (in t) in different months

Zones	Nov. 84	Dec. 84	Jan. 85	Feb.	March	April	May	June	July	August	September	Oct.	Total **	%
I (Upper estuary-Nabadwip to Calcutta)	77.2	45.3	23.5	38.8	68.7	63.6	85.0	59.8	55.5	77.8	77.2	54.3	726.9	2.79; 11.35 *
II (Mid estuary-Calcutta to Diamond harbour)	18.5	14.3	11.5	28.1	33.5	40.3	51.1	64.9	60.5	22.2	26.7	28.4	399.8	1.54; 6.24 *
III (Lower estuary)	7,732.9 (802.4) *	5,035.5 (645.5) *	7,924.6 (505.6) *	354.9	126.7	56.3	56.9	95.4	177.4	486.8	397.7	758.5	24,103.7 (4464.3) *	92.55; 69.71 *
IV Rupanarayan	85.5	56.1	43.9	136.9	79.7	49.5	74.1	30.0	30.6	24.0	119.8	82.6	812.7	3.12; 12.69 *
Total	7,914.1 (983.6) *	6,051.2 (761.2) *	8,003.5 (584.5) *	558.7	308.6	209.7	267.1	250.1	324.0	610.8	621.4	923.8	26,043.2 (6,403.7) *	
%	30.39; 15.36 *	23.24; 11.89 *	30.73; 9.13 *	2.15; 8.72 *	1.18; 4.82 *	0.81; 3.28 *	1.03; 4.17 *	0.96; 3.90 *	1.24; 5.06 *	2.35; 9.54 *	2.38; 9.70 *	3.55; 14.43 *		

*Excluding winter fishery;
**The zonal totals do not tally exactly due to rounding off in the monthly figures.

were in advanced stages of maturity. Abundance of young hilsa caught by bagnets in upper and middle stretches of the estuary was estimated separately for the first time. During November 1984 to October 1985, 115.5 t of young hilsa, weighing from 2.5 to 40 g was estimated to have been captured by bagnets in upper and middle stretches of the estuary. In terms of numbers it comes to about 26.4 million. Fish and prawn which contributed the bulk catches are presented in Table-2.

Table 2 : Contribution of dominant fish species and prawns (in t) to the total estuarine fish catch during November 1984 to October 1985

Name of the species	Contribution to total catch	% in the total catch	Contribution to total catch excluding winter fishery	% of col. 4
(1)	(2)	(3)	(4)	(5)
Hilsa ilisha	1,066.8	4.1	1,024.6	16.0
Pama pama	3,501.4	13.4	288.1	4.5
Setipinna spp.	2,269.7	8.7	227.4	3.6
Polynemus paradiseus	278.2	1.1	216.5	3.4
Trichiurus spp.	4,818.3	18.5	7.3	0.1
Harpodon nehereus	4,111.7	15·8	247.1	3.9
Tachysurus jella	584.8	2.3	261.6	4.1
Stromateus cinereus	193.2	0.7	186.7	2.9
Prawns	2,323.4	8.9	788.4	12.3

Effort and CPUE pattern of different hilsa gears and bagnet: Total bagnet effort as well as CPUE in all the zones were lesser in 1985 than that of the last year, the percentage decrease in effort being 37, 14 and 20 in upper, mid-estuary and Rupnarayan tributary respectively. Zone-wise, total hilsa catch, effort, CPUE by different hilsa gears in 1982-83, 1983-84 and 1984-85 are presented in Table-3. Zone-wise total bagnet effort and average CPUE in 1983-84 and 1984-85 are presented in Table-3.

Winter migratory bagnet fishery: The total estimated winter bagnet fish landings during mid-October 1984 to middle February, 1985 amounted to 19,639.5 t with an average CPUE of 130.4 kg. The important species contributing to the fishery in order of abundance are: *Trichiurus* spp. *Harpodon nehereus, Pama pama, Setipinna* spp., prawns. These species alone account for 78.7% of the total winter bagnet fishery. *H. ilisha* with a total contribution of 22 t (av. size 15.8 cm) formed only a negligible component of the winter bagnet fishery.

The total winter bagnet fishery if taken into account forms about 247% of the total catches from the Hooghly-Matlah estuarine system whereas it accounted for only 40-50% a decade ago. The bagnet fishery during the period 1984-85 is almost 5 times more than that of the period 1970-71 to 1976-77. This rise may be attributed mainly to the deployment of mechanised boats, larger numbers of bagnets under operation and involvement of more number of fishermen in recent years specially in Bakkhali and Jamboodwip (upper and lower) areas.

Table 3: Zonewise total hilsa catch, effort, CPUE by different hilsa gears in 1983-84 and 1984-85

Zone	Gear	Catch (kg)		Effort (net-tides)		CPUE (kg)	
		1983-84 (Nov-Oct)	1984-85 (Nov-Oct)	1983-84 (Nov-Oct)	1984-85 (Nov-Oct)	1983-84 (Nov-Oct)	1984-85 (Nov-Oct)
I	Purse	29,785	12,462	1,27,321	60,221	0.23	0.21
	Drift	1,53,179	72,073	5,07,703	2,75,085	0.30	0.26
	Set-gill	39,319	18,680	38,949	16,542	1.01	1.13
	Bag	39,339	61,750	—	—	—	—
II	Drift	3,18,471	1,44,627	1,90,527	1,87,879	1.67	0.77
	Bag	6,841	12,664	—	—	—	—
III	Drift	10,85,337	4,75,470	—	—	—	—
	L. seine	—	1,08,590	—	—	—	—
IV	Drift	2,86,893	71,500	1,60,322	1,42,896	1.79	0.50
	Bag	18,038	41,074	—	—	—	—
Total		19,77,202	10,18,890*				

*A negligible quantity (5664 kg) of hilsa is captured by other nets in zone I.

Ecological investigations in the Hooghly Estuary: Freshwater zone in the Hooghly estuary was found up to Uluberia (0.007-0.042 ppt salinity) after which gradual increase in salinity was reflected at Nurpur (0.021-1.421 ppt) and gradient salinities were observed at Kakdwip (max. 18.32 ppt). Higher salinity values were observed at Digha (max. 33.663 ppt) and Canning (max. 31.000 ppt). The pH ranged from 7.8-8.5, DO from 4.8-10.8 ppm, turbidity from 85-766 units, total alkalinity from 60-124 ppm, salinity from 0.007-33.663 ppt, specific conductivity from 171-49,324 micromhos/cm, hardness from 52-5,300 ppm, nitrate from Tr-0.06 ppm, phosphate from Tr-0.2 ppm and silicate from Tr-25.2 ppm in the Hooghly-Matlah-Rupnarayn estuarine ecosystem. Hydrobiological studies were conducted at 6 sampling centres namely Frazergunj, Bokkhali, Sagar, Kalisthan, upper and lower Jamboo in the lower Sunderbans during the winter peorid. The water quality variations were 8.0-8.5 pH, 5.8-11.5 ppm DO., 85-212 units turbidity, 18,930-32,580 ppm total solids, 78-96 ppm total alkalinity, 10.830-27.075 ppt salinity, 17,998-35,427 micromhos/cm sp. conductivity, 2,050-4,600 ppm hardness, Tr-Tr nitrate, Tr-0.12 ppm phosphate and 3.9 ppm silicate respecrively.

Primary productivity studies indicated low organic production in the mid-stretches of the Hooghly estuary at Nawabganj lying in the industrial belt (GP : 3.12-62.5 mg C/m^3/hr; NP : nil 23.12 mg C/m^3/hr) and comparatively higher production in the upper stretch (GP : 5.47-70.31 mg C/m^3/hr; NP : 3.12-60.90 mg C/m^3/hr) between Farakka in Medgachi and also in the lower stretch (GP : 31.25-78.12 mg C/m^3/hr; NP : 15.62-48.44 mg C/m^3/hr) between Uluberia and Kakdwip. Highest value was recorded in the marine zone at Digha (max. GP : 83.36 mg C/m^3/hr; max. NP : 62.52 mg C/m^3/hr). At Port Canning (Matlah estuary, maximum GP : 78.12 mg C/m^3/hr max. NP : 40.62 mg C/m^3/hr) and at Kolaghat (Rupnarayan estuary, max. GP : 78.12 mg C/m^3/hr; max. NP : 46.87 mg C/m^3/hr) were also recorded.

Soil characteristics in the entire stretch studies indicated a variation of pH from 7.0-7.3, organic carbon (%) from 0.024-0.680, total nitorogen (%) from 0.018-0.082 and C/N ratio from 3.7-15.1 respectively.

Studies on plankton and benthic populations: The details of plankton concentration and species dominance in different zones have been worked out. Availability of the phytoplankton *Coscinodiscus* sp. and *Melosira* sp. could be used to demarcate the brackishwater and marine zone of the lower estuary. Bivalve larvae were abundantly available in the coastal waters around Frazerganj, Bakkhali and lower and upper Jamboo complex. Gradual decline in benthotic population was noticed with the increase in salinity of the estuary. In the upper zone the organism contributing the benthos were tubificid worm, polycheate worm and few grastropod species.

Biological investigation on *Hilsa ilisha*: The fish attains an average length of 189 mm in its first year, 261 mm in its second year, 344 mm in its third year, 420 mm in its fourth year and 463 mm in its fifth year.

Detailed investigation taken during October-November, 1985 below and above the Farakka Barrage and in the feeder canal have indicated that the migratory *Hilsa ilisha* are escaping through the fish lock gates provided in the Farakka Barrage and also some of the bays of the barrage, upstream the river Ganga. The escape of fish upstream through the sluice gates of the feeder canal could not be observed. Probably three tier system of the sluice gates and the turbulance created near the gates hinders the escape of fish upstream in the reservoir area.

Estuarine fish and prawn seed prospecting: Exploitation of natural resources of the estuarine fish and prawn seed was done at three different centres of Hooghly estuary viz. Uluberia, Noorpur (both freshwater zones) and Frazerganj (marine zone).

Important cultivable species of prawn and fish seed like *Penaeus monodon, P. indicus* and *Liza parsia* were available alongwith other seeds at Frazerganj. The maximum number of prawn and fish seed collected per shooting net per hr in samples at Frazerganj were *P. monodon* (200), *P. indicus* (216) *Metapenaeus brevicornis* (2,240), *Liza parsia* (32) *Eleutheronema tetradactylum* (16). Comparatively lesser number of prawn and fish seeds were observed in the samples collected from Noorpur and Uluberia. The important species were *M. brevicornis* (43/net/hr), *M. monoceros* (20/net/hr), *Macrobrachium rude* (32/net/hr) and *M. Mirabilis* (22/net/hr). Prior to the construction of Farakka barrage, Noorpur and Uluberia were considered as most potential seed prospecting centres.

PROJECT BF/B/5 : DIGESTIVE PHYSIOLOGY OF BRACKISHWATER FISHES AND PRAWNS

Personnel : K. M. Das and Amitabha Ghosh

Duration : 1983-1985

Location : Barrackpore

Liza parsia: Investigations on the morphohistology and physiology of the alimentary canal of *Liza parsia* fry (30 mm) have indicated that the relative gut length (RLG) was 1.1. Protease, amylase and lipase activities were recorded in the liver, intestine and intestinal caeca. In the liver of *L. parsia* fry, protease activity was higher (547 U) compared to that

of the adult (482 U). Amylase and lipase activity however, did not show any such significant change in fry and adult.

A set of statistically designed feeding experiments was conducted in cement cisterns where *L. parsia* (52 mm/2.0 g) as test species was fed with *Wolffia* (fresh), *Wolffia* compost as feeds against a control diet (Rice bran : groundnut oil cake 1 : 1). The best growth was observed in the fishes fed with fresh *Wolffia* ($P<0.05$). The amylase activity increased in fishes fed with *Wolffia* (fresh) while lipase and protease activities did not show any appreciable change. Histological studies did not reveal any noticeable change in experimental fishes.

Lates calcarifer: Studies on the morphohistology and physiology of the digestive tract of adult *Lates calcarifer* has been completed. The RLG at different stages did not indicate much difference. No marked changes in the histology of the alimentary canal in fishes ranging from 163 to 300 mm could be noticed. PAS and AB (2.5) mucous cells were found to be present all along the length of the alimentary canal with maximum concentration in the anterior intestine and intestinal caeca were found to be very long and mucosa lined with columnar epithelial cells interpersed with mucous cells. The wall of the stomach was found to be highly muscular. Lipase activity was recorded in the stomach, intestine, intestinal caeca and hepatopancreas with highest activity in the hepatopancreas (237 U/mg protein/hour). Protease and amylase activities were reported earlier.

Penaeus monodon: Studies on the morphohistology and physiology of the digestive organs of *Penaeus monodon* indicated that hepatopancreas forms the principal organ of digestive enzymes activity. Histological preparations showed that the hepatopancreas consisted of strands of cell forming narrow channels. Protease is active only in neutral and alkaline pH. The optimum activities of protease (742 U), amylase (960 U) and lipase (315 U) per mg protein per hour were recorded at pH 8.0, 7.0 and 7.0 respectively. Histologically, the intestine is lined by columnar epithelial cells and does not appear to have any secretory function.

PROJECT BF/B/6 : **STUDIES ON THE EFFECT OF INDUSTRIAL AGRICULTURAL AND METROPOLITAN WASTES ON THE ESTUARINE ENVIRONMENT AND ADJOINING IMPOUNDMENTS IN WEST BENGAL**

Personnel : B. B. Ghosh, M. K. Mukhopadhyay, H. C. Joshi, M. M. Bagchi, A. Hajra, U. Bhowmick, P. K. Pandit, R. K. Banerjee, B. N. Saigal, R. N. Pal, A. K. Banerjee, K. P. Saha and R. K. Das

Duration : 1983-86

Location : Barrackpore

WATER QUALITY MONITORING OF THE HOOGHLY ESTUARY

Physico-chemical characteristics and primary productivity: The estuarine water quality in the Hooghly estuary along the stretch between Nabadwip and Kakdwip was characterised by 22.8-34.0°C temperature, 7.5-8.4 pH, 2.8-8.0 mg/l dissolved oxygen (DO), 0.007-18.32 ppt salinity, 16-176 mg/l total alkalinity as $CaCO_3$, 48-3,275 mg/l hardness as $CaCO_3$, 4.2-152.0 mg/l BOD, 85-866 units turbidity and 167-34,652 micromhos/cm sp.

conductivity. Comparative results of the physico-chemical investigations and primary productivity are further elucidated in the following table:

Zone	pH	DO (mg/l)	BOD (mg/l)	Primary productivity (mg C/m³/hr)	
				Gross	Net
Industrial	7.5-8.4 (av. 8.1)	2.8-8.0 (6.1)	7.7-152.0 (48.2)	3.12-62.52 (33.69)	nil-41.68 (12.56)
Non-industrial	8.0-8.5 (av. 8.3)	6.6-8.0 (7.5)	4.2-9.6 (6.7)	41.68-78.12 (58.4)	15.62-48.44 (36.0)

Heavy metals: Average zinc, chromium and copper concentration in the industrial stretch of the Hooghly estuary was found to be 0.176, 0.101 and 0.05 mg/l respectively, whereas in the non-industrial stretch significant concentrations of these metals were not encountered. Zinc level was highest (1.06 mg/l) at the outfall of rayon factory near Kuntighat and chromium was highest (0.588 mg/l) at the outfall of Dunlop Rubber and Cyclerim factory near Sahagunj.

IMPACT OF POLLUTION ON THE BIOTA

Plankton: Impact of industrial effluent on the planktonic fauna was marked by the reduction in its density by 76, 49, 47 and 35% respectively near the outfalls of tannery, pulp & paper, rayon and paints and varnish industries. The planktonic population recovered remarkably by 200% below the outfall region of pulp and paper industry near Hajinagar where high density of *Spirogyra* sp. and *Cyclops* sp. was observed.

Benthos: Presence of benthic organisms like tubifex (52-76 no./m²), *Plurocera* sp. (6-16 no./m²), *Lymnea* sp. (2-4 no./m²), *Gyraulis* sp. (2-3 no./m²) and *Neoplanorbis* sp. (2-4 no./m²) indicated organic pollution in the outfall region near Hajinagar. Benthic population was greatly affected near the discharge point of paint & varnish factory as its density was very low (10-20 no./m²) as compared to that in the non-industrial stretch (10-70 no./m²). Presence of *Gammarus* sp. and *Acetus* sp. indicated absence of organic pollution in the lower stretch of the estuary around Nurpur.

Fish health: Like previous year, this year's observation on fish health confirmed the ill health of *Rita rita* in the industrial zone as indicated by condition factor (CF)-1.134, Hb-2.6% and RBC-1.77×10^6/mm³. In the upper non-industiral stretch, condition of fish was much better as indicated by CF-1.298, Hb-6.33% and RBC-2.39×10^6/mm³.

Bioaccumulation of heavy metals and pesticides in fish: Significant high levels of zinc have been recorded in the tissue organs of fishes in the industrial zone as evident from 293 mg/l Zn in gills of *H. ilisha* and 236 mg/l Zn in kidney of *Rita rita.* In the non-industrial stretch, maximum Zn level recorded was 35 mg/l in the liver of *H. ilisha.*

TOXICOLOGICAL EXPERIMENTS

Metals: Salinity showed synergestic effect on the combined acute toxicity of Cu, Zn & Cr (1 : 1 : 1) to *Cyclops* sp. as evident from the LC_{50} (24 hrs) value in freshwater (0.463

mg/l) and saline water (0.397 mg/l). Acute toxicity of Cr to *O. mossambicus* increased when the pH of the test medium was lowered from 7.9 to 7.0. Long-term exposure of Cu, Zn and Cr in combination (1 : 1 : 1) at the level of 2 mg/l to *O. mossambicus* resulted in slower growth rate of the fish.

Pesticides: Bioassay experiments with *O. mossambicus* (2.5-3.5 cm) showed LC_{50} values for 24, 48, 72 and 96 hrs for methyl parathion as 0.62, 0.45, 0.36 and 0.25 mg/l respectively. Fishes exposed to methyl parathion above 1.0 mg/l excreted long slimy threads indicating direct effect on their digestive tracks.

DEGRADATION OF EKALUX (QUINOLPHOS) IN PADDY FIELDS

More than 90% of Ekalux (quinolphos) disappeared within 7 days from the water phase and 11 days from the soil phase in the water-logged paddy fields.

POLLUTION STUDIES IN THE KULTI ESTUARY

Sampling spots in the Kulti estuarine complex were fixed at Bantala and Gushighata on the storm water channel, Minakha, Malancha and Kalinagar on the downstream and Kharibari and Beliaghata on the upstream of the Kulti estuary.

The soil bed of the entire stretch under observation has been found to be inconsistent in its chemical nature. The channel bed is of peaty nature with organic matter level as high as 43.5% having C/N ratio ranging from 13-21. At Gushighata, the bed is loamy in texture. The estuarine bed varies from sandy loam to sandy clay in texture. The C/N ratio varied between 11 and 18.

During summer phase, water temperature of the entire stretch remained between 35 and 45°C. The BOD of the channel water varied between 90 and 240 mg/l, while the estuarine water maintained the BOD range between 10 and 97 mg/l.

During rainy season, the turbidity of water of the entire stretch remained between 1,000 and 3,000 units. The BOD of channel water was 80-200 mg/l and of the estuarine water, 40-100 mg/l. In the winter, water temperature of the entire stretch varied between 20-25°C and BOD remained between 20-300 mg/l.

The heavy metals viz., Zn, Cr & Cu were detected at each of the sampling spots. The ranges were Zn-0.023 to 0.084 mg/l, Cr-0.032 to 0.16 mg/l and Cu-0.01 to 0.069 mg/l.

The entire bed of the stretch is found to be disturbed continually by the tidal action and thereby stable rate of microbial decomposition might be disturbed. The toxic effect of heavy metals is reflected from the relatively low BOD value compared to the total organic matter reserve.

Study of bacterial population in different regions of the Kulti estuarine complex showed quite high values of Total Plate Count ($2\text{-}5 \times 10^6$) near Bantola and Malancha. The estuarine bed between Bantola and Malancha was devoid of benthic organisms.

PROJECT BF/B/7 : **INVESTIGATIONS ON HEAVY METAL CONTAMINATION IN ESTUARINE ENVIRONMENT IN MADRAS REGION**

Personnel : K. O. Joseph, K. Raman, M. A. V. Lakshmanan, S. Radhakrishnan & P. M. A. Kadir

Duration : 1984-87

Location : Madras

Water sediment and biological samples were collected from Pulicat, Adyar, Ennore estuaries to estimate the accumulation of heavy metels in soft tissues.

Samples were collected from six centres along the stretch of Tungabhadra River during February 1985 to study the impact of effluents from Harihar Polyfibres Ltd. and GRASIM factories. D.O. in water dropped in the outfall area to 2.0-3.2 ppm compared to 6.2 ppm above and 4.8-5.8 ppm below the outfall. Total alkalinity was 240-300 ppm at the outfall compared to 110 ppm above and 160-180 ppm below. Zn concentration was 1.20-1.60 μg/ml at the outfall and 0.8 μg below the outfall. Cr was detected at the level of 0.04 g/ml near outfall of HPF. Fish obtained below the outfall areas had an accumulation of 60.0-68.0 μg Zn/g dry wt of flesh.

PROJECT BF/B/8 : **ECOLOGICAL STUDIES ON TROPICAL MANGROVE VEGETATION OF WESTERN FRINGE AREAS OF SUNDERBANS**

Personnel : Apurba Ghosh, M. L. Bhowmik, K. R. Naskar, G. N. Chattopadhyaya, P. K. Chakraborti and R. N. De

Duration : 1984-1989

Location : Barrackpore/Canning/Kakdwip

During ecotypic survey and site selection initiated in 1984, 10 species of mangrove halophytes from Bamauer Abad Char, 6 from Kalinagar, 4 from Nazat in Sandeshkhali Block (I); 5 from Malancha, 4 from Ghusighata in Minakhan Block; and 34 from Basanti-Gosaba Blocks were identified. Among the halophytes of Jharkhali, *Rupia maritime* in fisheries impoundments enriched productivity. Likewise, *R. maritime* and *Avicennia officinalis* when occurred elsewhere also in fisheries water improved the habitat by way of encouraging periphyton. During 1985 detailed studies of three stretches in Sunderbans *viz.,* Gosaba-Sajinakhali, Minakhan-Malancha and Kakdwip-Bakkhali stretches were undertaken.

Vegetation: In Gosaba-Sajinakhali stretch, river bank and ridge forests comprised *Avicennia* spp., *Exceocaria* sp., *Tamarix* sp., *Rhizophora* sp., *Bruguiera* sp., *Sonneratia* spp., *Xylocarpus* spp., *Thespesia* sp., *Aegiolitis* sp., *Ceriops* sp., etc. While river flats slopes had herbavious *Porteresia* sp., *Suaeda* sp., *Phragmites* sp. Sajinakhali and Sudhannyakhali forests also had *Avicennia* spp., *Bruguiera* sp., *Derris* sp., *Ceriops* sp., *Exceocaria* sp., *Phoenix* sp., *Rhizophera* sp. and *Suaeda* spp.

After denudation by people, the patches of mangrove at Minakhan had *Crinum* sp., *Clerodendrum* sp., *Sonneratia* sp., *Acanthus* sp., and *Avicennia* sp.; *Exceocaria* sp., *Acanthus* sp., *Sonneratia* sp., etc. at Malancha. Similarly Kakdwip-Bakkhali stretch had *Exceocaria* sp.,

Aegiceras sp., *Acanthus* sp., *Tamarix* sp., *Derris* sp., *Proteresia* sp., *Sercobolus* sp., *Phoenix* sp., *Clerodendrum* sp., *Crinum* sp., *Ceriops Suaeda* sp., *Ipomoso* sp. and *Solanum* sp.

Plankton: During autumn, plankton in Gosaba-Sajinakhali was 390.6-2,746.8 u/l with 63.70-82.95% phytoplankton commonly represented by species of *Lyngbya, Coscinodiscus. Pinnularia, Gyrosigma* and *Nitzschia,* while *Oedogonium, Enteromorpha, Rhizoclonium* and *Gomphonema* for Gosaba, *Anacystis* at Durgaduaniya, algal spore at Sudhannyekheli and *Cheotomorpha* and *Filinia* at Sajinakhali occurred exclusively. Minakhan-Malancha stretch had 1,400-26,200u/l of plankton with the domination of *Anabaena* sp., *Closterium* sp., *Amphora* sp. along with phytoplankter like, *Lyngbya* sp. and predominent zooplankters like, *Cyclops* sp., nauplii and *Brachionus* sp.

Bottom biota: Bottom biota of the Gosaba-Sajinakhali stretch was 812-5,643.6 u/m with dominating polychaetes and *Nitzschia* sp. at Gosaba; *Amphora* sp., *Lyngbya* sp., *Olivia* sp., *Ianthina* sp. at Durgaduaniya; *Gyrosigma* sp., *Oscillatoria* sp., *Lyngbya* sp. and *Nitzschia* sp. at Sajinakhali; and *Lyngbya* sp., *Gyrosigma* sp., *Oscillatoria* sp. polychaetes and sipunculids at Sudhannyakhali. The concentration of benthos in the Minakhan-Malancha stretch was 50,000 to 1,80,000 u/m^2, dominant phytobenthos being *Closterium* sp., *Lyngbya* sp., *Anabaena* sp., *Amphora* sp., *Nitzschia* sp., *Pinnularia* sp. and *Gyrosigma* sp. and zoobenthos being gastropods, nauplii, cyclopoid and herpecticoid copepods, *Gammerus* sp., soil nematodes, chironomid larvae, etc.

Prawns and fishes: Selected species of prawns and fishes being cultured at Minakhan-Malancha stretch. Scoop net collections was made for wildly occuring species in the Gosaba-Sajinakhali stretch to know the nature of these natural nursery beds amidst mangrove forest. From the stems of halophyte, pneumatophores and tide pools, *Lymnaea* sp., *Thiara* sp., *Thais* sp., nudibranchs, grasaids, etc. were collected while empty gastropod shell were found to harbour paguirid crabs. Fry of goboids (7-45 mm), *Sactophagus argus* (10 mm), scianaeids (8-16 mm) and mullets (11-15 mm) usually took refuge in these tidal pools along with shrimp species like, *Acetes indicus,* juvenile *Penaeus indicus* (25-39 mm), *Matapenaeus brevicornis* (12-34 mm), *Palaemon styliferus* (13 mm), and *Macrobrachium rude* (11 mm) mostly during autumn in varying concentrations zone-wise.

Soil and water qualities: Soil samples from the mangrove forest areas were collected for analysis. In water phase of tide pools, dissolved oxygen, pH and total alkalinity were 11.2 ppm, 7.3 & 100 ppm at Gosaba; 8.0 ppm, 7.4 & 102 ppm at Durgaduaniya; 7.2 ppm, 7.4 & 102 ppm at Sajinakhali; 4.8-8.8 ppm, 7.4-7.6 & 82-88 ppm at Sudhannyakhali; and 12.4 ppm, 7.2 & 108 ppm at Malancha.

PROJECT BF/A/1 : BREEDING AND CULTURE OF BRACKISHWATER FIN FISHES IN PONDS AND BHERIES

Personnel : M. L. Bhowmik, S. R. Das, D. Nath, H. Singh, R. K. Chakraborti, S. K. Mondal and D. Sanfui

Duration : 1983-88

Location : Kakdwip, West Bengal

Culture of mullets with/without prawns: Experiments on mullet culture started in two ponds (0.08 ha each) during November 1983 and were harvested after a rearing period of 15 months. Production from these ponds ranged from 550 to 670.0 kg/ha/yr. Besides

15.0 kg of misc. prawns from one pond and 21.0 kg from the other pond, 25 were also harvested during the monthly sampling.

In a second set of experiment initiated in the month of February 1984, production from 672.6 to 695.0 kg/ha/yr was obtained after 15 months of rearing. Better growth performance was observed in the experiment having 1 : 4 species ratio of *L. tade* : *L. parsia.* In all the cases survival of *L. parsia* was poor which varied from 40.85 to 41.83% whereas, survival of *L. tade* was between 80.0 and 82.6%.

Experiment conducted with mullets and prawns yielded very promising results. 4 ponds 30.02 ha each were stocked at 25,000ha, with *L. tade* : *L. parsia* : *P. monodon* as 2 : 3 : 5. These ponds gave a production range from 950.0 to 1,255 kg/ha/yr. In those ponds two crops of *P. monodon* of 3-4 months duration were raised alongwith one crop of mullets.

Analysis of plankton and periphyton were made from the experimental ponds, numerical abundance of plankton varied between 125 and 135 no./l.

Breeding and Earthenware hatchery management of mullets: 9 females of *L. parsia* weighing from 30 to 210 g each were experimented using carp pituitary glands @ 100 mg/kg body weight at a salinity ranging from 15 to 30 ppt. Successful spawning was observed in three sets of experiments. Development of the fertilized eggs could be observed upto 16 hrs only. Diameter of the fertilized egg was very small (0.7 mm).

Culture of pearl Spot *Etroplus suratensis* : In monoculture experiment of *Etroplus suratensis,* two ponds of 0.02 ha were stocked @ 7,500 fingerlings/ha with initial size of 93.1 mm/22.6 g to 102.4 mm/27.3 g. Fishes grew to 125 mm/55 g to 143 mm/78 g till the end of September 1985. Experimental ponds were flooded on 15.10.85 during the cyclone and the experiment was vitiated.

Hydrological studies of the ponds: Hydrological parameters, benthos and soil characteristics of ponds under this project was thoroughly investigated. Recommendation for liming and fertilization were made on the basis of anlytical data of soil and waters.

PROJECT BF/A/2 : BREEDING, CULTURE AND TRANSPORT OF *HILSA ILASHA* (HAM.)

Personnel : P. R. Sen, D. K. De and A. K. Datta

Duration : 1981-December 1985

Location : Barrackpore

Fortyseven thousand hatchlings were produced from two successful breeding experiment and 22,000 of hatchlings were transported to Barrackpore from Farakka in closed containers with oxygen pressure at a density of 1,000/l of settled river water in a transport duration of 14 hours with almost 100% survival rate. Hatchlings stocked in cemented tank were reared with supplementary feed. The hatchlings did not survive in cemented ponds.

PROJECT BF/A/3 : BREEDING AND NURSERY MANAGEMENT OF BRACKISH-WATER FISHES

Personnel : T. Rajyalakshmi, P. Ravichandran, S. M. Pillai, and A. N. Mohanty

Duration : 1980-1986

Location : Puri.

Breeding of mullets: Observations at Chilka lake mouth, even in November-December revealed that the occasional catch of *Mugil cephalus* females were in immature stage and the fishing effort at lake mouth was negligible for this species during its peak breeding season. Hence breeding could not be undertaken.

In January 1985, *Liza macrolepis* was bred on two occasions. In the first instance, the female fishes were bred with heteroplastic injection using carp pituiary glands. The size of the female was 500 mm/1.5 kg. The males (370 mm/600 g) were in oozing conditions. Dry method of fertilization was followed. However the eggs failed to develop.

In the second case, two partially spent females (430 mm/900 g to 399mm/600 g) collected from stick net catches were immediately stripped and eggs were feritilized with milt collected from males. The males used were in the size of 250mm/350g to 370mm/600g. The incubation period was 24-27 hours. A total of 1.32 lakh hatchlings were obtained and they survived for two days only.

Breeding of *Lates*: Fully mature specimens were located in a bar- closed, Balithotta Estuary, near Paradip. The size of the female fishes were 800-880mm/6.5-7.3 kg. A female of 880mm/ 7.3 kg was observed in mature condition. However, sampling done at Balugaon showed that fishes weighing 8-13 kg were caught from Chilka in January-February, but maturation could not be ascertained. Sexing the fishes by external characteristics was found impossible.

Culture of diatoms, *Artemia* and *Tubifex* were carried out under the Project.

PROJECT BF/A/4 : BREEDING AND SEED PRODUCTION OF BRACKISH-WATER FIN-FISHES.

Personnel : K. V. Ramakrishna, K. N. Krishnamurthy, M. A. V. Lakshmanan, and S. Krishnan

Duration : 1979-85

Location : Madras

Fiftyseven females of *Liza macrolepis* (160-200 mm/70-250 g) collected from commercial catches at Ennore bar mouth were injected with the extracts of carp pituitary glands, mullet pituitary glands and HCG, singly and in combination. A total of 120 males (size range-110-198 mm/40-80 g), 5-6 for each female, were also used. The first injection to the female was @ 20 mg of carp pituitary/kg, 2 mullet glands/fish and 1,000 IU of HCG/kg, the same being doubled for the 2nd injection. In another set, 5 mg of carp gland, 1 mullet gland and 100 IU of HCG/fish were given doubling the dose for the second injection whenever it was given. The males when injected were given only a priming dose at the rate given to females.

Fourteen females responded positively showing signs of well developed ovary and ready to ooze eggs in three instances. In one case 5 females were stripped using 5-6 males per

female. The fertilisation was poor and the fertilised eggs died after developing for 8-10 hours. In the second instance, eight females spawned without stripping, the fertilisation was 100%. All the fertilised eggs died due to ciliate attack after reaching "twitching stage".

In another instance one female spawned without stripping after the first injection. The female started spawning around 02.30 hrs. on 7th March and continued for some time. Fertilisation was 100%. The fertilised eggs were free and floating with a single oil globule. The development was normal in the well aerated and filtered brackishwater and hatching completed in 20 hrs. (approximately). The salinity was 27-28 ppt and temperature 24-26°C respectively. The hatching was about 90%. The yolk remained till the 3rd day trials and the larvae started feeding from the 5th day onwards.

A few feeding trials with green water (consisting of species of *Tetraselmis* and *Navicula*) egg custard, lab-lab, Brewar's yeast, soyabean milk and a combined feed of all these mixed together in equal proportions were made. After screening the above diets the fry were fed with a combined diet and *Brachionus* sp. They were found to feed voraciously. Mortality occurred on the 4th, 8th and 12th days, the highest being on the 8th day. After 22 days of rearing 32 fry survived from an estimated 80,000 present on the 8th day after hatching. Four fingerlings survived upto 9 months and have attained an average length of 130 mm. They are being reared in a plastic pool with aeration and feeding with lab-lab and groundnut oil cake.

Three year old *Bhetki* reared in cages were given promoter dose of HCG @ 120 IU/kg body weight for hastening maturation. A number of them died in floods. The surviving ones are being reared only *Sillago sihama* males were available in oozing condition at Ennore.

PROJECT BF/A/5 : BREEDING AND CULTURE OF PENAEID PRAWN IN PONDS AND BHERIES

Personnel : M. L. Bhowmik, S. R. Das, D. Nath, H. Singh, R. K. Chakraborti, S. K. Mandal and D. Sanfui

Duration : 1983-88

Location : Kakdwip, West Bengal

Culture of *P. monodon*: Availability of *P. monodon* seed during the first quarter of the year was very poor. Consequently only 5 ponds having water area of 0.02 ha/each were stocked during the end of February 1985. Abundance of postlarvae of *P. monodon* increased from April onwards and subsequently 6 ponds in the new farm and another 10 ponds in the old farm were stocked with postlarvae @ 30,000, 35,000, 40,000, 45,000 and 50,000/ha.

Three ponds stocked during February 1985 were harvested after 60 days rearing. Production from these ponds ranged from 224.0 to 250.0 kg/ha/2 months. Another two ponds were harvested during June 1985 after 120 days rearing and the production varied from 350 to 400.0 kg/ha.

From the ponds which were stocked during the month of April, 1985 a production ranging from 200 to 375.0 kg/ha in four months duration was obtained. Survival of *P. monodon* was 35 to 43% from these experiments.

Intensive culture of *P. monodon*: A set of intensive culture operations were set up

with *P. monodon* stocked at 1.5 lakhs/ha with a feed evolved by CIFRI. Oxygen budget of the ponds was maintained above 5 ppm by artificial aeration.

Two different sets of experiments were set up. One with juveniles and the other with postlarvae. From the pond stocked with juveniles production obtained was 1,491.5 kg/ha/60 days. Whereas, from the ponds stocked with postlarvae production ranged from 971.5 to 1,129.0 kg/ha/90 days duration. In all the ponds feed was supplied during the evening hours at 5 to 10% of the body weight of the stocked prawns. This is a record production so far obtained from monoculture of *P. monodon.*

Breeding of *P. monodon* in improvised hatchery: Induced maturation of *P. monodon* was attempted with five females weighing from 80-110 g/each. The prawns were reared in fibre glass tanks with artificially prepared saline water by adding common salt solution and in a range from 15 to 30 ppt. Common brackishwater molluscans flesh was supplied as food to the experimented specimens. The bilateral ablation technique was followed for induced maturation. First one eye and then after 7 days the other eye was ablated. All the ablated specimen showed gonadial maturation upto IV stage within 8-10 days of ablation. At the final stage all the matured female specimens died.

Hydrobiological studies of the experimental ponds: Ecological studies were conducted in 24 nursery ponds and 21 culture ponds. Recommendations on liming and manuring were made on the basis of the data obtained from the studies.

The important physico-chemical parameters of the prawn culture ponds is as follows: Transparency—20 cm., D.O. 5-10 ppm, pH 8.3-8.5 total alkalinity 150-160 ppm, free CO_2 Nil-2 ppm, nitrogen 0.4-0.5 ppm, phosphate 0.07-0.08 ppm, calcium 28-31 ppm, magnesium 4.0-6.0 ppm and salinity 4.6-4.7 ppt.

PROJECT BF/A/6 : BREEDING AND HATCHERY DEVELOPMENT OF *PENAEUS MONODON* AND OTHER SHRIMPS

Personnel : T. Rajyalakshmi, P. Ravichandran S. M. Pillai and A. N. Mohanty

Duration : 1982-1987

Location : Puri

Induced maturation of *Penaeus monodon* from Chilka lake and offshore areas of sea were undertaken through a series of experiments. Altogether 8 experiments were conducted, therein two being studied to understand the effect of photoperiodicity on induced maturation.

Two experiments were carried out using prawns, collected from trawler catches from Paradip. The size of the females ranged from 182-266 mm/55-130 g. All the prawns were bilaterally ablated. A few of them matured upto III stage, but failed to spawn.

Four experiments were conducted using Chilka prawns (40-160 g). A few attained III stage of maturity. Two prawns reached IV stage. Both the prawns spawned partially but the eggs were found unfertilized. Maturation and rematuration of Chilka prawn was achieved three times within a period of 54 days.

In two experiments photoperiod of 18 hours (3 AM to 9 PM) was maintained. The prawn were in the size group of 190-237 mm/62-137 g. In the first experiment, the prawns failed to show ovarian development and in the second set mass mortality was observed.

The prawns were fed with meat of freshwater bivalve in all the experimental sets. Continuous culture of *Tubifex, Artemia, Chaetoceros* and *Brachionus* were maintained in the hatchery as larval feed sources. Sustained culture of *Chaetoceros* using Potassium nitrate—50 ppm, Potassium dihydrogen phosphate—50 ppm, Sodium silicate—10 ppm, EDTA—10 ppm and Ferric chloride—2 ppm was maintained. Maximum density of culture was achieved at a salinity of 20-25 ppt. temperature of 28-32°C and pH of 8.2-8.8.

Two mature females of 236 mm/131 g and 267 mm/179 g released a total of 6 lakh eggs. A total of 56,000 nauplii were obtained (9.3% hatching) but heavy mortality was observed during the larval rearing cycle. As a result, only 17 nos. of post-larvae (P_5) could be raised.

Due to late monsoon and heavy influx of freshwater, percentage of mature prawn and prawn catch itself was low during October-November. Quite a number of prawns collected from Puri coast for maturation studies had *Bopyrus* infection and they all showed underdeveloped thelycum of petasma and lack of development of gonad. Hence larval rearing could not be undertaken during October-December.

As a part of the studies on the development of a maturation system, a tank with built-in biological filter was designed.

Almost all the parameters suitable for the hatchery system were standardised, *Viz.*, temperature—26-32°C, salinity 28-34 ppt, pH 8.1-8.2.

PROJECT BF/A/7 : **BREEDING AND SEED PRODUCTION OF PORTUNID CRABS *SCYLLA SERRATA* AND *PORTUNUS PELAGICUS***

Personnel : K. Raman, C. P. Rangaswamy, S. Srinivasagam, K. O. Joseph (till August '85), B. P. Gupta (from August '85) & S. Krishnan

Duration : 1982-85

Location : Madras

Brood stock of *Scylla serrata* collected from nature were reared in plastic pools with aeration and feeding. Unilateral eye stalk ablation was done on 39 crabs. After 21 days one specimen became berried and after an incubation period of 2 weeks released the larvae. The larvae died soon after hatching. In another case an eye-ablated specimen moulted after 16 days and on introduction of a male specimen mated with it for about 36 hours including premating embrace. However it did not become berried.

Ovigerous *Scylla serrata* collected from nature released larvae in four cases, the incubation period ranging between 5 & 13 days. The larvae could be reared to 2nd zoeal stage in two instances and 3rd zoeal stage in one case in 4-6 days. Different stocking densities (1 to 42/litre) and feed materials (egg custard, green water with *Tetraselmis/Chaetoceros,* green mussel meat suspension etc.) were tried. Ciliate infection preceded the mortality in all cases.

Ovigerous *Portunus pelagicus* released the larvae on two occasions. In one case an estimated 63,000 larvae hatched out were reared in plastic pools with egg custard as feed. The numbers dwindled at the 2nd zoeal stage and later perished due to ciliate infection. Repeated breeding was observed in this specimen after a lapse of 8 days. Mating did not take place. Unhatched eggs were shed after 12 days.

In another instance the eggs hatched out into an estimated 2,00,000 zoeae. They were distributed in different plastic pools @ 200/litre. Egg custard, crab and green mussel meat suspension were given as feed. Gradually by seventh day all larvae were dead to ciliate infection.

Ovigerous specimens of *P. sangiunolentus* (20-36 g) were collected from sea catches and kept in plastic pools with well aerated brackishwater. After 12 days the eggs hatched out into zoeal stages. They were fed on egg custard and green mussel suspension. They could be reared for 2 days only after which all died following ciliate infection.

A nylon hatching unit fixed in the backwater was tried for hatching the crab eggs. Barried *S. serrata* and *P. pelagicus* were released in this hatching unit. Unhatched eggs were liberated in 2-3 days.

PROJECT BF/A/9 : PEN AND CAGE CULTURE OF FISHES AND PRAWNS IN LAGOON ECOSYSTEM (PULICAT/ENNORE)

Personnel : R. D. Prasadam, K. V. Ramakrishna, K. Raman, K. N. Krishnamurthy, M. A. V. Lakshmanan, and B. P. Gupta

Duration : 1982-85

Location : Madras

For avoiding the loss of fish stock during floods, fingerlings were reared in closed cages fixed in protected area till the end of the monsoon and later transferred to the pens in the lake and reared till the next rainy season.

Fingerlings of *Mugil cephalus* and *Liza macrolepis* were collected from the Pulicat lake and stocked in three cages of 50 m^2 @ 1,40,000/ha.

In cages I & II supplementary feeding with groundnut oil cake and rice bran (1 : 1) @ 5% body weight daily was done while cage III was kept as control with natural food only. The experiment was conducted for 6 months at the end of which the following results were obtained:

	Initial size (mm/g)	Growth increment (mm/g)	Survival (%)	Production from cage (g)	Projected production per ha (g)
Cage I					
M. cephalus	101.88/13.60	36.64/14.4	6.14	618.5	123.7
L. macrolepis	57.77/2.31	58.62/14.36			
Cage II					
M. cephalus	94.96/10.56	23.94/4.92	30.9	1,353.0	270.6
L. macrolepis	57.77/2.31	40.82/11.48			
Cage III (control)					
M. cephalus	101.58/12.31	25.81/12.69	19.19	913.7	182.7
L. macrolepis	61.2/4.0	8.26/			

In spite of utmost care taken, heavy mortality occurred during the shifting and sampling and the experiment had to be terminated at the end of 6 months.

Cage culture of *Chanos chanos* was started in July '85 stocking fingerlings (78.06 mm/ 4.04 g) in a 70 m^2 velon cage at a very heavy stocking density of 2,90,000/ha. A mixture of groundnut oil cake and rice bran (1 : 1) @ 5% body weight every day was given as supplementary feed. At the end of 3 months they have shown an average increment of 61.84 mm/ 16.34 g. Later the stock have been distributed in 3 cages at a lower stocking density of 60,000/ha. The same feed mixture at an enhanced rate of 10% body weight is being provided in two cages and the third kept as control without artificial feed.

Under mixed culture, fingerlings of *Chanos chanos* (80.7 mm/60.0 g), *Liza macrolepis* (91.8 mm/10.0 g) and *Penaeus indicus* (90.5 mm/4.5 g) were stocked in the ratio 1 : 3 : 6 at a combined stocking density of 2,00,000/ha in a 500 m^2 velon pen fixed in the Pulicat lake. They were reared on natural food only. At the end of 4 months the average growth increments were 199.3 mm/194.0 g for *Chanos chanos* and 88.2 mm/ 90.0 g for *L. macrolepis*. *P. indicus* could not be recovered. The total stock recovered from the pen amounting to 4.6 kg were transferred to a closed velon cage inside a pond for safety during the monsoon. Other extraneous fishes, prawns and crabs which gained entry into the pen weighed 2.6 kg, thus the total production from the pen in 4 months amounted to 7.2 kg which worked out to 144.0 kg/ha/4 months.

Another experiment has been set up at Ennore in a small cage with the same species of fishes and prawns.

Three year old, cage reared *Bhetki* had grown to an average size of 365 mm/610 g. A few of them had exceeded 1 kg in weight. There was heavy mortality during the cyclone and floods. About 60 fingerlings of Bhetki (153.1 mm/50.0 g) were collected from Pulicat lake and are being reared in two cages. Live feed is being provided.

PROJECT BF/A/10 : FISH DISEASES IN BRACKISHWATER AND SEWAGE ECOSYSTEMS

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

Duration : 1980-86

Location : Barrackpore

The following bacteria pathogenic to both man and fishes were isolated during the year from sewage-fed ponds:

Escherichia coli, Klebsiella aerogenes, Vibrio parahaemolyticus, Proteus sp., *Aeromonas* spp., *Pseudomonas* spp., *Plesiomonas* spp. and *Providence* spp.

V. parahaemolyticus was found to have an association with chitin of *P. monodon.* The bacteria collected from chitin and muscle of the prawn was to the tune of 80 and 30 organisms per gram respectively. Frequency was more in summer and monsoon months. Under low oxygen level in water, *Puntius javanicus* fry were found more susceptible to *Pseudomonas* sp.

Most probable number (MPN) for the bacterial load was calculated from four sewage-

fed ponds in Titagarh. Coliform bacteria were highest in monsoon and lowest during post monsoon (September). A second peak was observed in November in one of the ponds.

Fishes were regularly collected from bheries and estuaries to observe the intensity and type of parasite infections. The observations are recorded in the tables.

Table : Parasitic infections in estuarine fishes, being cultured in 'bheries'

Host	Av. wt. (g)	Nos. examined	Nos. infected	Percentage of infection	Potozoa	Helminths	Crustacea
Liza parsia	15-40	65	25	38	*Trichodina*	—	*Ergasilus*
Lates calcarifer	100-300	40	12	30	*Tripartiella*	—	—
Liza tade	100-200	35	—	—	—	—	—
Eleutheronema tetradactylum	60-100	30	—	—	—	—	—
Mystus gulio	15-50	40	10	25	—	*Acanthocephalan*	—
Odontombliopus rubicundus	20-30	40	—	—	—	—	—

Table : Incidence of parasitic infections on fishes collected from Hooghly estuary

Host	Av. wt. (g)	Nos. examined	Infected	Percentage of infection	Parasite
Pangasius pangasius	100-150	20	5	25	Copepods
Sillago panijus	35-110	20	6	30	Helminth and copepods
S. phasa	40-60	30	8	26.6	Helminth
Therapon jarbua	60-80	15	—	—	—
Sciaena miles	20-50	60	30	50	Myxozoan Helminth and copepods
Odontombliopus rubicundus	10-15	40	10	25	Myxozoan
Polynemus paradiseus	20-50	50	35	70	Helminths
Coilia ramcarati	10-25	50	36	72	Helminths, copepods
Harpodon neherius	60-140	40	10	25	Helminth

Alitropus, an isopod parasite was recorded for the first time from Cirrhina mrigala. It was confirmed that 1 : 5,000 formalin could effectively be used as prophylaxis against monogenetic trematodes.

PROJECT BF/A/11 : ECONOMICS OF BRACKISHWATER FISH FARMING

Personnel : S. Paul and H. K. Sen

Duration : 1983-86

Location : Barrackpore

Due to wide divergence of cultural practices and consequent investment levels it was not possible to have comparable time-series data. Therefore, various prevalent systems *viz.* Paddy-cum-fish culture, paddy and fish culture, filtration and stocking and feeding farms were examined with the help of experimental as also field data. According to available data the following conclusions have emerged.

(*i*) Due to lower capital costs filteration and Paddy-cum-fish culture show a higher rate of return (ROI) *viz.* 82 to 140% as compared to stocking and feeding farm which give 40-50%.

(*ii*) Lumpiness of investment in brackishwater farming is necessary to determine a level of production that enables to reap external and internal economics of the scale. Chances of promotion of this activity are better in State sector since public investments are subjected to economic analysis and costs of both direct and indirect nature are accounted for.

(*iii*) Despite sustained domestic and overseas demand brackishwater farming is a highly localised activity in a few pockets in States of West Bengal, Kerala and Karnataka mainly due to higher capital requirements and technological gaps.

PROJECT BF/A/12 : ADAPTIVE RESEARCH IN FISH CULTURE IN HIGH SALINE BRACKISHWATER PADDY PLOTS

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

Duration : 1983-86

Location : Kakdwip (West Bengal)

Experiments were conducted in farmers' field at village Akshaynagar adopted by the KVK. Five varieties of paddy *viz.,* CSR-1, CSR-2, CSR-3, CSR-4 and SR26B were cultivated in combination with fishes/prawns in three replicates. Duration of cultivation (days) and grain yield (q/ha) for these were 132/28.8, 130/31, 128/29, 115/31.8 and 140/20 respectively. Soil nature was silty clay with pH 6.5 to 7.5 Ece 3-8 mmhos/cm, organic carbon 0.92%, available phosphorus 21.5 kg and available potassium 415 kg/ha.

The result of fish and prawn culture along with paddy for 5 months was as follows:

Species	Nos. stocked per ha	Av. size/wt at stocking (mm/g)	Size/wt at harvest (mm/g)	Survival (%)	Yield per ha (kg)
Penaeus monodon	5,000	34/0.53	151/38	45	145
Liza tade	2,500	38/1.2	147/40	20	42
L. parsia	2,500	35/1.2	133/48	20	44

Total 231 kg/ha 5 months

PROJECT BF/A/13 : BREEDING AND SEED PRODUCTION OF *PENAEUS INDICUS* AND OTHER PENAEID PRAWNS

Personnel : A. V. P. Rao, L. H. Rao, S. Radhakrishnan, K. O. Joseph & P. M. A. Kadir

Duration : 1982-85

Location : Madras

Studies on the breeding biology of penaeid prawns, *Penaeus indicus* and *Metapenaeus monoceros* from commercial catches were continued. Fully mature males and females of *P. indicus* were available during March to June and August-September while those of *M. monoceros* were observed in July-September. Based on the occurrence of spent and fully mature specimens, the spawning season of the latter species could be assumed as July-August.

Brood stock of *P. indicus* was built up at the Ennore hatchery by collecting specimens from the sea and rearing them in well aerated and filtered lake water after ablating the eye. Unilateral eye stalk ablation was done in 30 females and bilateral in 18. No success was achieved in bilateral ablation though signs of maturity were observed in a number of cases in 4 to 13 days. In unilateral ablation successful spawning of eggs and postlarvae production were possible in three cases.

Breeding was done mostly with gravid females collected from the sea. Eleven attempts were made and six of them were successful leading to a production of 1,41,680 postlarvae of *P. indicus.* From two of the three successful spawnings from eye ablated specimens a total of 18,020 postlarvae could be produced with survival rates of 25.2 and 40.9% from nauplius to P_2 stage. The survival rates for all the attempts ranged between 25.2 and 58.7% with an average of 41.4%. Whenever low survival or total mortality at protozoeal stages II & III occurred either failure of electricity or *Tetraselmis* culture due to cloudy weather.

The larval feeds tried were egg custard, *Chaetoceros affinis, Tetraselmis* sp. and *Brachionus plicatilis. Artemia* was not used in any of these experiments.

In algal culture, *Tetraselmis* sp. could be raised to cell densities of 3,48,000 per ml. and *Chaetoceros affinis* to 3.5×10^5 cells per ml. in yard cultures with filtered lake water enriched with crushed crab meat and modified F medium respectively.

PROJECT BF/A/14 : STUDIES ON DEVELOPMENT OF COMPOUNDED FEED FOR BRACKISHWATER PRAWN AND FISHES

Personnel : Ansuman Hajra and Apurba Ghosh

Duration : August 1983 to December 1985

Location : Barrackpore

A high production of 1,129 kg/ha/3 months was achieved in monoculture experiments of *P. monodon* in brackishwater culture ponds at Kakdwip, employing a specially prepared pelletised prawn feed and aeration. The feed contained perfectly balanced sources of nutrients

nated by *Anacystis* sp., *Crucigenia* sp., *Synedra* sp., *Lyngbya* sp. and *Cocconeis* sp. while predominant zooplankters were *Cyclops* sp. and nauplii of copepods, *Cypris* sp., *Brachionus* sp. and *Filinia* sp. Chironomid larvae and tubificid worms were the dominant benthic fauna while *Lyngbya* sp. and to some extent *Spirogyra* sp. formed the bulk of the benthic algal matrix which harboured molluscan fauna like *Vivipara* sp., *Pila* sp., *Thiara* sp. and *Indoplanorbis* sp.

Incidental to the pond culture trial 113.53 kg/ha of adult tilapia that escaped predation was harvested during 1985. To avoid any harm to normally grown *Lates* the larger ones which escaped previous harvesting were removed from the pond and they together with those removed for gut analysis feeding trials in aquaria and physiological observations constituted a total of 9.020 kg of *Lates i.e.,* 56 kg/ha only.

PROJECT BF/A/17 : **HERITABILITY STUDIES AND PREDICTED RESPONSE TO SELECTION FOR GENETIC GAIN IN GROWTH OF PEARL SPOT,** *ETROPLUS SURATENSIS*

Personnel : P. Das, M. L. Bhowmick, S. K. Mondal, P. K. Ghosh and U. Bhaumik

Duration : 1984-89

Location : Kakdwip

Fry of known parentage with average wt. of about 1.0 g were procured and reared in identical husbandry conditions in ponds at the farm.

Heritability was determined from the expansion of the variance of phenotypic variation using variance analysis. Heritability of weight at 10 months age was calculated as 0.1068. Individual selection at 10% was done using standard formula. The predicted response to selection was estimated to be 1.0 g in one generation.

PROJECT B/A/18 : **PADDY-CUM-BRACKISHWATER FISH FARMING**

Personnel : G. N. Chattopadhyay, Apurba Ghosh, P. K. Chakrabarti, R. N. De and Collaborating associates from CSSRI (A. K. Bandopadhyay & C. R. Biswas)

Duration : 1982-1987

Location : CSSRI plots, Canning

Studies were continued to assess the possibility of carrying out a short term brackishwater aquaculture in monocropped coastal saline soils during summer fallow months without affecting the subsequent kharif rice crop.

Culture: Brackishwater aquaculture was carried out in two 0.015 ha paddy plots of the CSSRI, Canning, during May-July to produce on an average, 357.167 kg/ha of brackishwater prawn and fish (*P. monodon* and *L. parsia*) in 68 days only. The combine stocking density was 30,000/ha at a ratio of 3 : 7 for prawn and fish. The increased soil salinity due to brackishwater aquaculture was successfully lowered down to around 4.0 mmhos/cm during kharif

paddy cultivation period and SR-26B variety was cultivated to achieve a production of 4,080 kg/ha. Along with rice a freshwater aquaculture was also carried out and an average yield of 631.700 kg/ha in 116 days was obtained. Another significant achievement of the aquaculture was the culture of *P. monodon* (in lieu of *M. rosenbergii*) in low saline to freshwater condition along with carps (*P. javanicus* and *L. bata*). The stocking ratio was 2 : 2 : 1 for prawn, bata and punti at a combined stocking density of 25,000/ha.

During kharif, the yield of vegetables was 10.67 t/ha from a dyke area of only 75m².

The study indicated that the monocropped coastal saline soils of high rain-fed areas may be converted into multicropped ones through suitable integration with brackishwater and freshwater aquaculture.

Biotic aspects: During summer crop *Brachionus* sp. and *Cyclops* sp. among zooplankton and *Cladophora* sp. among phytoplankton dominated. During kharif, *Cladophora* sp. disappeared to reappear again in winter. *Moina* sp. became dominant with *Brachionus* sp. and *Cyclops* sp. among the zooplankton. *Chlorella* sp., *Anacystis* sp., *Closterium* sp. and *Scenedesmus* sp. dominated among phytoplankters. In the initial phase of summer cropping, *Lymnaea* sp. constituted the major bottom macrofauna; in the midphase, *Thiara* sp.; and lastly *Vivipara* sp. Similarly during initial phase of kharif cropping, the predominant macrofauna was *Thiara* sp. which was replaced gradually by dipteran larvae, then by *Gammerus* sp., mysids and *Meretrix* sp. at the end.

PROJECT BF/A/19 : STUDIES ON AGROFORESTRY INTEGRATION IN FISH FARM PRODUCTION SYSTEM

Personnel : A. K. Chattopadhyay, J. G. Chatterjee, S. R. Das and D. Sanfui

Duration : 1985-1990

Location : Kakdwip (West Bengal)

Agroforestry system was integrated with fish farming system at KVK since June 1985. Preliminary studies have shown that the plant species *Leucaena leucocephala* and *Eucalyptus* hybrid are quite adaptable on the dykes of ponds. The species did not affect fish or rice production in farms. The root spread as well as shade was negligible during the year. The plants grew up to 1.2-1.5 m on pond dykes and 1.15 to 1.4 m in paddy fields. Fish production under integrated agroforestry fish production system was of the following order:

Species	Nos. stocked per hectare	Av. size/wt at stocking (mm/g)	Av. size/wt at harvest (mm/g)	Yield per ha/yr (kg)
C. catla	1,050	78/ 9.0	232/ 450	472.5
H. molitrix	1,750	95/10.0	270/ 700	1,225.0
L. rohita	2,100	100/10.0	240/ 250	525.0
C. mrigala	1,050	72/7.2	238/ 200	210.0
C. carpio	1,050	82/ 7.0	173/ 450	472.5
C. idella	10	85/11.0	315/1,500	15.00
				2,290.00

Under Agroforestry system integrated with paddy-cum-fish culture, yield of *P. monodon* was 144.40 kg and the yield of *Liza* spp. was 99.50 kg/ha/5 months. Of the four varieties of paddy cultivated, *viz.* SR-26B, CSR-2, CSR-3 and Ajirmal, CSR-3 gave a maximum yield of 30.50 q/ha in 130 days.

In both the fields, the soil was silty clay and pH was 7.0-8.0. Electrical conductivity was 4.0-7.0 mmhos/cm in paddy field and 1.0-1.5 mmhos/cm in pond soil.

PROJECT BF/A/20 : STUDIES ON BIOTIC AND ABIOTIC FACTORS IN AQUACULTURE SYSTEMS FED BY CALCUTTA SEWAGE

Personnel : Apurba Ghosh, G. N. Chattopadhyay, P. K. Chakrabarti, K. R. Naskar and Hardial Singh

Duration : May 1985-June 1986

Location : Barrackpore/Rahara/Canning

The project activities were conducted at Salt Lake, Calcutta, Bantala bheri at Bantala and Hundipota bheri near Bamanghata (c. 10 km away from Calcutta) to study the biotic and abiotic factors of Calcutta sewage-fed wetlands in relation to aquaculture. Samples were collected from different wetlands at different distances from the main sewage discharging point.

Distinct differences were observed in the chemical and biological properties of these wetlands depending on the distance from the main sewage discharging point. Nutrient concentrations, plankton populations and benthic fauna declined gradually as the dilution of the sewage effluents increased. D.O. values were lowerer in the near by pond (2.4 ppm) due to high organic load and increased to 7.2 ppm at a distance of about 10 km.

In the pond using untreated effluents, zooplankton population was dominated by *Asplanchna* sp. and *Filinia* sp. and phytoplankters by *Merismopedia* sp., *Cladophora* sp. and *Closterium* sp. In the pond where oxidised and diluted sewage was being used, the dominant zooplankter was *Brachionus* sp. and predominant phytoplankters were *Chlorella* sp. and *Lyngbya* sp. Average plankton densities at Captain's bheri, Bantala bheri and Hundipota bheri were 0.04, 0.02 and 0.02 cc/l respectively and the respective concentrations were 12,246, 29,558, 2,004 u/l.

The concentrations of benthic fauna in ponds receiving strong, medium and week sewage effluents were 16,638, 4,067 and 402 u/m^2 respectively. The occurrence of big and small molluscan shells, big and small acanthocephalans and tubificid worms were 4,029, 8,126, 1,063, 3,201 and 219 u/m^2 in Captain's bheri; 1,124, 2,171, 153, 619 and 48 u/m^2 in Bantala bheri and 93, 309, nil, nil, and nil u/m^2 in Hundipota bheri.

The aquatic macrophytes and the benthic flora from the Calcutta sewage-fed wetlands, starting from Tapsia to Nazat areas of Sunderbans were surveyed critically. It was noticed that, in the freshwater fisheries/impoundments *i.e.,* from Tapsia to Kulti lockgate, the main aquatic macrophytes are *Eichhornia* sp., *Lemna* sp., and *Spirodella* sp. as free floating forms, while the main marginal amphibious weeds were *Chenopodium* sp., *Jussia* sp., *Ammannia* sp., *Colocasia* sp., *Alocasia* sp., *Alternanthera* sp., *Enhydra* sp., *Ipomoea* sp., *Lipia* sp., *Scirpus* sp., *Panicum* sp., *Fimbristylis* sp. and some others.

On the other hand from Kulti to Nazat, these wetlands turned brackish as the branch river of Bidyadhari fed these wetlands. The halophytic flora in these wetlands were found

to be *Sonneratia caseolaris, Avicennia alba, Suaeda maritima, Exceocaria agallocha, Acanthus ilicifolius, Sesuvium portulacastrum, Crinum defixum* and *Clerodendrum inerme.* The dominant benthic algal flora in these sewage mixed brackishwater is *Enteromorpha tubulosa,* which is relished well by the mullets and penaeids.

PROJECT AN/B/1 : STUDIES ON ENERGY FLOW IN DIFFERENT AQUATIC ECOSYSTEMS

Personnel : V. Pathak

Duration : 1980-86

Location : Barrackpore

Work was conducted in Kulia beel, Kalyani (West Bengal) during the year. Radio-isotope C^{14} was used to separate the nannoplankton from other plankton and to trace the energy transformation. The beel got filled up after a dry spell of two years.

Rate of energy transformation through primary production: The rate of energy transformation by phytoplankton (total) ranged from 7,954 (July-August) to 22,534 cal/m^2/day (May-June) with photosynthetic efficiency 0.347 to 0.972%. The energy transformation rate by net plankton or megaplankton was within the range 1,163 cal/m^2/day (0.056% of light) to 4,718 cal/m^2/day (0.204% of light) while that by nannoplankton ranged from 6,177 to 17,280 cal/m^2/day (0.268 to 0.75% of light). Out of an average rate of 11,628 cal/m^2/day, net plankton contributed 2,757 cal/m^2/day while nannoplankton contributed 8,871 cal/m^2/day. Thus almost 64.7 to 90% of energy fixed through primary production was contributed by nannoplankton only. In addition to this 1,916 to 24,127 cal/m^2/day (Av. 14,261 cal/m^2/day) was fixed by aquatic macrophytes.

Chlorophyll—a and assimilation ratio: Chlorophyll content of net plankton ranged from 1.12 to 5.82 mg/m^2 (av. 3.21 mg/m^2) and that of nannoplankton from 2.50 to 7.65 mg/m^2 (av. 3.67 mg/m^2). The assimilation ratio (net energy fixed/chlorophyll) was 859 in case of net plankton and 2,417 in case of nannoplankton. This clearly shows that under similar light conditions nannoplankton can transform solar energy to chemical energy 2.8 times more than net plankton.

Detritus and bottom energy: Organic detritus at the bottom of the beel ranged from 441.5 to 819.6 g/m^2 (av. 604.5 g/m^2) and bottom energy 44.98×10^4 to 90.94×10^4 cal/m^2 (av. 61.11×10^4 cal/m^2). Thus the bottom energy of the beel after refilling was much higher than previous years.

PROJECT AN/B/4 : STUDY OF THE SEDIMENTATION CHARACTERISTICS OF THE SUSPENDED SILT LOAD IN BRACKISHWATER POND AND EVOLVING THE EFFICIENT MODE OF OPERATION OF WATER GATE

Personnel : A. Sengupta, A. K. Roy and B. B. Das

Duration : 1983-1985

Location : Kakdwip

The data on hydrodynamic phenomenon and silt load collected from Muriganga estuary during 1983-84 have been analysed and certain salient relationships have been established

between tidal time and tidal amplitude, current velocity, silt load concentration (both surface and bottom), tidal discharge and silt ingress. The investigation reveals a most important feature that the current velocity attains a peak value at a certain time before the tidal rise is maximum and it becomes nil at close proximity of maximum tidal height and the silt concentration also becomes minimum when current velocity is minimum. Discharge also becomes maximum at a certain tidal period before the tidal rise reaches its peak.

The grain size distribution analysis reveals that the grain of the suspended soil varied from 0.005 to 0.1 mm and the percentages of silt and sand are 98 and 2% respectively. The values for D_{50} and D_{60} are 0.062 mm and 0.045 mm respectively.

The results of the study will help to evolve the efficient mode of operation of water gates of brackishwater farm thus saving the farm from being defunct due to rapid silting up.

PROJECT AN/B/5 : CHROMOSOMAL GENETICS: PRODUCTION OF MONOSEX *TILAPIA*

Personnel : P. Das, M. K. Mukhopadhyay, K. M. Das and P. K. Pandit

Duration : 1984-86

Location : Barrackpore

In view of the last experiment indicating almost equal efficiency of methyltestosterone @ 30 mg/kg & 40 mg/kg feed in converting females into males, efficacy of the lower dose @ 30 mg/kg feed was confirmed through another experiment. The present experiment included 4 sets of hatchlings fed MT @ 30 mg/kg feed for a period of 40 days with one control. The feed was provided @ 20% of body weight as in the earlier experiment. The fishes were later reared in cemented tank with normal feed for further period of 80 days.

The external sexual characters later confirmed by gonadal examination confirmed production of 75% males in the experiment against about 50% males in the control. The growth rate in the present experiment also remained comparable to the earlier one indicating that the treated fish grew bigger than the untreated ones.

While the chromosomal studies revealed 22 pairs of diploid chromosomes, karyotypic studies showed the first pair as the 'marker' confirming the earlier observation.

PROJECT AN/B/6 : ECOLOGY AND CONTROL OF AQUATIC INSECTS

Personnel : Krishna Mitra and Kuldip Kumar

Duration : 1983-86

Location : Barrackpore

Aquatic insect fauna apart from Hemiptera is represented by several species belonging to different orders. Order Ephemeroptera is represented by 2 taxa *Ceanis* sp. and *Cleon* sp. of the family Beatidae. Odonata by 6 species of 3 different families. *Sympectrum* sp. *Pachydiplex* sp., *Urothemis signata* Rambur (Libellulidae). *Anax* sp. (Aeshnidae) and *Agrion*

sp. and *Enallagma* sp. (Coonagrionidae). Coleoptera is represented by 12 taxa belonging to 4 different families. These are *Canthydrus laotabilis, C. morshchai, Hydrocoptus subvittulus, Hydrovatus bonvouloiri, H. confertus, Errectes* sp. (family Dytiscidae); *Berosus indicus, Halochares* sp. *Regimbertia atenuatta, Sternolophus raffipes,* (family Hydrophilidae); *Dineutus* sp. (family Gyrinidae) and *Bagous* sp. (family Curculonoidae). Diptera is represented by 6 species of 6 different families, *Culex* sp. (Culicidae) *Tendipes* sp. (Tendipedidae), *Prabazvio* sp. (Heleidae), *Stratiomys* sp. (Stratiomyidae); *Tabanus* sp. (Tabanidae) and *Limnophora* sp. (Muscidae). *Lepidoptera* is represented by 2 species of *Nymphula* of the same family Pyralidae. Trichoptera had only one species *Leptocera* of the family, Leptoceroidae.

Population fluctuation biology, life history of *Diplonychus annulatun,* a predaceous bug of the pond is studied in detail. Increase in population was noticed during July and December in 1984 and during September and December in 1985, the maximum being 45 and 80/m^2 during 1984 and 1985 respectively.

The bug completes its life cycle in about in 53 days. There are five nymphal moults and each moult ranges from 7-25 days. The adult lives for about 3-8 months and over winters at this state. A female bug lays about 3-4 batches of eggs and each batch containing about 91-168 eggs. Incubation period is 8-9 days. The percentage of hatching varied from 21.3-78.5. The mating behaviour also was studied.

Predation: They predate upon a wide range of organisms like mosquito larvae, *Chironomous* larvae, *Anisops* sp.; *Micronecta* sp.; small snails, etc. The young nymph prefers mosquito larvae and fish hatchlings. The later instar nymphs prefer snails. The younger nymphs are more harmful than older nymphs and adults to fish hatchlings. The predatory efficiency was estimated as 9.9 hatchlings per nymph in 24 hrs.

PROJECT AN/B/7 : STUDIES ON AQUATIC MICROBIOLOGY OF SEWAGE-FED PONDS AND OTHER ECOSYSTEMS

Personnel : R. K. Das, S. K. Saha and A. Ghosh

Duration : 1983-87

Location : Barrackpore

Sewage-fed ponds: In a sewage-fed pond at Khardah farm, oxygen demand was estimated to be 0.01 ppm/hr. The heterotrophic bacteria was found to vary in the range of 7.1×10^4/g to 1.42×10^6 g of soil and 1.66×10^2/ml to 1.5×10^3/ml of water.

Phosphate solubilizing bacteria varied in the range of 8.0×10^5/g to 1.02×10^6/g of soil and 1.6×10/ml to 1.7×10^2/ml of water.

Aerobic nitrogen fining bacteria varied in the range of 1.2×10/ml to 2.2×10^5/ml of water and 6.0×10^4/g to 1.4×10^6/g of soil.

Denitrifying bacteria varied in the range of 1.3×10^6/g to 2.1×10^7/g of soil and 1.2×10^2/ml to 3.2×10^3/ml of water.

These results inaicate that denitrifying bacteria, heterotrophic bacteria and phosphate solubilizing bacteria are more active in sewage-fed ponds than aerobic nitrogen fixing bacteria.

The nitrate nitrogen concentration is quite high in sewage-fed ponds and the bottom soil is having partial anaerobic condition.

Phosphorus, being most dynamic nutrient, becomes easily fixed both in alkaline and acidic conditions needs solubilization through phosphate solubilizing bacteria and consequently its population was found to be higher than that of the aerobic nitrogen fixing bacteria.

Microbial consumption rate of phosphate was noted to be 0.009 ppm/hr. Since the optimum phosphate concentration is around 0.1 ppm to 0.2 ppm, based on the phosphate value of the sewage, the time for fresh application of sewage effluent can be determined.

In situ decomposition of cellulose and protein were studied by using filter paper (Whatman-1), as the source of pure cellulose and silk as the source of pure protein. In course of 15 days cellulose decomposition was noted to be 0.6% (at the surface water) to 20.0% at the soil-water interface. The highest rate of silk decomposition was noted both at the surface water (more oxygen availability) and at the bottom soil (more bacterial number). Hence, protein decomposition may be favoured both by oxygen availability and by higher bacterial number.

The range of physico-chemical parameters in the sewage-fed ponds varied as follows:

Pond No.	S-1	SF-1	S-3
pH	7.4	7.5-7.8	7.3-7.9
D.O. (ppm)	2.7-2.9	2.3-3.8	2.8-3.1
CO_2 (ppm)	16.0-26.0	7.0-10.0	12.0-21.0
HCO_3 (ppm)	120-130	140-190	138-220
CO_3 (ppm)	Nil	Nil	Nil
$NH_4 \pm N$ (ppm)	0.11-0.56	0.112-1.68	0.76-2.24
$NO_3 - N$ (ppm)	0.14-2.24	0.084-1.40	0.084-1.12
$PO_4 - P$ (ppm)	trace-0.25	trace-0.24	0.12-0.20

PROJECT AN/B/8 : **DEVELOPMENT OF AN ECONOMICAL DESIGN OF BIOLOGICAL FILTER FOR EFFECTIVE FILTRATION OF WASTE WATER IN RECIRCULATORY FILTERING SYSTEM OF FISH CULTURE**

Personnel : A. B. Mukherjee, D. Nath and R. K. Das

Duration : 1983-85

Location : Barrackpore

The design of projecting flash boards was slightly altered and the boards were filtered at three steps with 30 cm fall and fitted with the bio-filter at an angle of 60° to the vertical. The polluted water passing through filtering phase and collected in the filter chamber was allowed to flow over the projecting inclined flash boards as a thin sheet of water maintaining

almost gravity flow and splashed on the pond water surface from a clear height of 1.80 m. By adopting this system it was noted that the oxygen content of pond water (pond area 0.06 ha with a water volume of 720 cu m) could be increased from initial 7.4 to 8.2 ppm after 1 hour operation of the filter. The system has proved to be an effective and economical aeration device.

Various materials have been used as filtering media in the biofilter and best results have been obtained with over bunrt coke and molluscan shell. In each experiment heavy immobilization of bacteria has been observed on the filtering medium and these bacterial populations have been responsible in bringing about the sharp change in the quality of polluted water and filtered water. It has been observed that one time passage of the polluted water through the filter bed, increased its DO and pH, eliminated suspended matter and odour completely and reduced CO_2, bicarbonate, ammonium nitrogen, nitrate nitrogen and phosphate-phosphorous appreciably. Results have clearly indicated that such a system can be fruitfully utilized in pond water with pollutional problems.

PROJECT AN/B/9 : **DEVISING EFFICIENT METHODS OF AERATION FOR RAISING THE LEVEL OF DISSOLVED OXYGEN IN SEWAGE-FED FISH PONDS**

Personnel : A. Sengupta, R. K. Banerjee, A. K. Roy and B. B. Das

Duration : May 1983 to April 1985

Location : Rahara (West Bengal)

Four windmills have been installed at Rahara Research Centre and the foundation of another windmill at Kakdwip Research Centre for pumping canal water to the *M. rosenbergii* hatchery tanks has been completed. The distribution water storage tank for sprinkling water to the prawn pond has also been completed.

PROJECT : **POTENTIALITY OF DIFFERENT ORGANIC WASTE MATERIALS AS FISH FOOD MANURE BASED ON THEIR LOCAL AVAILABILITY**

Personnel : R. K. Banerjee, S. K. Saha, A. C. Nandy, B. K. Saha and B. Ghosh

Duration : 1985-1987

Location : Rahara (West Bengal)

City refuse collected from the local municipal dumping grounds was sieved through 5 mm sieve thoroughly mixed and the total nitrogen was estimated to be 1.08% and C/N ratio 27. The C/N ratio was narrowed down to 12.1 mixing with urea.

The waste was charged at the rate of 7,500 kg/ha as a basal dose in two 0.03 ha ponds and a control was kept. Subsequently treatment-I received two doses @ 2,500 kg/ha at an interval of 20 days. The stabilization period was estimated to be 25 days when rohu, mrigal and cyprinus fingerlings in the ratio 6 : 1 : 0.5 and the rate of 2,500 nos./ha were stocked. The average size/wt of the stocked fishes were rohu 101.0 mm/24.0 g, mrigal 187.7 mm/ 68.19 g and *Cyprinus carpio* 50.6 mm/6.8 g.

The water quality and fish growth observed in the ponds was as follows:

	Treatment I	Treatment II	Control
Water quality			
Temperature (°C)	28.0-35.5	28.0-35.5	28.0-35.5
pH		7-8	7.8-7.9
DO (mg/l)	7.5-8.0	1.0-4.6	5.4-6.7
Alkalinity (mg/l)	68.0-119.0	86.0-139.0	70.0-85.0
NH_3—N	0.94		0.02-0.08
PO_4 (mg/l)	0.98		0.02-0.08
BOD	21.5-32.0	20.4-55.0	8.0
Fish growth (g/mm)			
Common carp	69.87/101.4	75.2/102.4	
Rohu	54.0/90.6	103.5/123.47	182.67/158.8
Mrigal	131.8/82.3	91.81/66.8	81.8/71.05

PROJECT AN/A/4 : ROLE OF FROGS AS PREDATORS ON PADDY PESTS

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

Duration : 1983-87

Location : Kalyani

Six species of *Rana,* two species of *Bufo,* three species of microhylids and one species of *Rhacophorus* collected from nature and preserved in the laboratory were studied for their gut contents. The results obtained during the year confirmed the observations made in previous year.

PROJECT AN/A/5 : INTENSIVE CULTURE OF LIVE FISH FOOD ORGANISMS

Personnel : K. L. Sehgal and S. K. Mazumder

Duration : 1984-85

Location : Barrackpore

In continuation to the success in *Artemia* culture at Digha during 1984, this year research programme was intensified in larger area at Great Bengal Salt Factory, Dakshin Purosthampur near Contai, for mass production of *Artemia* cysts. In one acre of land four ponds were filled with sea water and then manured with cowdung (@ 10,000 kg/ha) for the growth of benthic algae. The natural food was supplemented by 'rice bran milk' as and when required. Seventy per cent of cysts hatched within 86 hours at 30°C (±1°C) temp. and 35 ppt. salinity. After

22 days of inoculation the new cysts started appearing in the ponds. Prior to harvesting of cysts, the experiment was suspended temporarily because of some unavoidable circumstances, which greatly affected the production. This year 240 gm of viable cysts was collected from a pond against 40 gm initial inoculum.

PROJECT AN/A/6 : DEVELOPMENT OF SUITABLE EXTENDERS AND CRYO-PROTECTANTS FOR STORAGE OF FISH SPERMATOZOA USING CRYOGENIC TECHNIQUES

Personnel : Kuldip Kumar (CIFRI) and S. V. Goswami (Delhi University)

Duration : 1983-85

Location : Barrackpore/Delhi University

During 1985 breeding season, trials on screening of extenders for cryofreezing of carp sperm were continued. Besides the earlier selected extenders (viz. M^a and urea egg-yolk). Egg-yolk citrate was also included in the study during these years. The ratios of semen : extender and extender : cryoprotectant were maintained at 1 : 4 and 1 : 9 respectively. DMSO was used as cryo-protectant.

In terms of post-thawing motility, egg-yolk citrate gave good results followed by Urea-egg-yolk and extender M^a. In case of *L. rohita* spermatozoa were found 60%, 40%, 20% motile after storage period 0-10 days. The respective motility ranges in case of *C. mrigala* and *C. catla* were 30-70% and 2-40% with the three extenders during the preservation period of 0-20 days respectively.

Besides cryopreservation, trials on preservation (diluted/undiluted) of semen at subzero degree temperature were also undertaken. Motility ranging from 30-90% was observed till 3-4 hours after collection of semen thereafter it gradually declined. However in case of semen diluted with extenders, the motility was remarkably low (Nil-20%).

PROJECT AN/A/7 : CULTURE OF COMMERCIALLY IMPORTANT INLAND MOLLUSCS

Personnel : G. K. Vinci, V. V. Sugunan and V. K. Unnithan

Duration : 1985-87

Location : Barrackpore

The snail hatchlings stocked in the previous year (August, 1984) of the size 5 mm (67 mg in wt) have grown to an average size of 82 mm (Av. wt 62.7 g) by April 1985. In the month of August/October, 1985 the snails bred under controlled conditions in the terrarium. The average egg size was 4 mm and the av. fecundity was 280.

A larger terrarium of the size 180×90×60 cm was prepared with gravel, soil and shade and the specimens were transferred to the larger one for breeding. The new stock is being reared in the terraria. The average size of the hatchlings when they were stocked in the month of August was 6 mm. They were fed daily with vegetable mix consisted of ashgourd+brinjal+ridgegourd in the proportion 3 : 1 : 1 @ 5% body wt. Crushed egg shells were given mixed

with feed once in a week. At the end of 3 months they have grown to an av. size of 42.42 mm/11.1 g without any mortality. The hibernation started in November; thereafter the feeding was ceased.

PROJECT AN/A/8 : CONTROL OF STEM BORER IN PADDY FIELDS WITH HIGH YIELDING VARIETY USING MAGUR AS BIOAGENT

Personnel : P. K. Pandit, U. Bhaumik and K. Mitra

Duration : 1985-86

Location : Barrackpore

The experiment was conducted during the rabi season in renovated paddy plots at Kalyanbati village under Chanditala block of district Hooghly. Ratna variety of paddy was transplanted in 4 plots (0.033 ha each) and magur was stocked at the rate 10,000 nos/ha with and without supplementary feed. The stem borer *Scirpophagus incertulas* attack was negligible in all the plots while *Dicladispa armigera,* a rice hispa, was recorded in great abundance. In all the plots under observation the growth of paddy plants and the paddy yield were higher than the adjacent plots where magur was not stocked. The fish productions obtained were 5 to 5.5 kg in plots without feed and 8 to 8.5 kg in 3½ months in which supplementary feed was provided.

PROJECT CFCSP/1.1 : ALL INDIA COORDINATED RESEARCH PROJECT ON COMPOSITE FISH CULTURE AND FISH SEED PRODUCTION (Institute-based Centres)

Personnel : S. D. Tripathi, K. K. Ghosh, R. M. Rao, J. B. Rao, M. Kaliamurthy, D. N. Mishra, K. L. Shah, B. C. Tyagi, P. K. Aravindakshan, A. Mukherjee, P. L. N. Rao, D. P. Chakraborty, B. K. Singh and P. N. Jaitly

Duration : 1971-1985

Location : Dhauli/Kausalyagang (Orissa), Badampudi (A.P.), Ranchi (Bihar), Karnal (Haryana), Pune (Maharashtra), Bhavanisagar (Tamil Nadu), Jaunpur (U.P.)

A Uniformity Trial was run at all the centres. The ponds were prepared using mahua oil cake at 2,500 kg/ha/m water while fertilizer dosages were determined based on the requirement of different centres to attain a level of 1% carbon and 30 mg and 5 mg/100 g of nitrogen and phosphorus respectively. The density of stocking and species proportion were the same at all centres. (5,000/ha, catla 1 : rohu 1 : mrigal 1.5 : silver carp 2.5 : grass carp 1 : common carp 2. Supplementary feed was provided at 2% of the body weight. Four ponds were taken at all the centres (with Ranchi as the only exception) one for each treatment viz. with fertilizer only, with feed only, with feed and fertilizer and the fourth pond serving as control. The results obtained at each centre are given below:

Assam Centre (Gauhati): The experiment could be conducted for 5½ months only from October, 1984 to March 1985. Since grass carp was not available, the stocking density was 4,500/ha but the species proportion remained the same as followed at other centres.

The production with fertilizer/feed/feed and fertilizer was 430, 448 and 421 kg/ha respectively as against 339 kg/ha 5½ months in the control pond, the cost of production being Rs. 0.31, Rs. 1.18, Rs. 1.32 and Rs. 0.38 respectively.

Andhra Pradesh Centre (Badampudi): The experiment was conducted for 6⅓ months from September, 1984 to March, 1985. A high production of 1,836 kg/ha was obtained with feed and fertiliser as against 1,636 kg with feed only, 1,091 kg with fertilizer only and 874 kg in control. The production in control pond indicates that it is easily possible to obtain 1,500-2,000 kg/ha/yr with proper pond preparation and adequate and balanced stocking with the 6-carp combinations.

Bihar Centre (Ranchi): Since only two ponds were available at this Centre, one was utilised as control and the other received both feed and fertilizer. The experiment lasted for about 6 months from October, 1984 to April ,1985. A production of 1,247 kg/ha was registered in the experimental pond as against 420 kg/ha in the control, confirming the poor soil conditions coupled with slow growth due to low water levels and temperatures.

A total of 1,05,000 common carp spawn was produced.

Haryana Centre (Karnal): The experiment was run for eight months from August, 1984 to March, 1985. A production of 3,306 kg/ha with feed and fertiliser, 2,369 kg/ha with feed only and 1,290 kg/ha with fertilizer only were registered as against 991 kg/ha in the control. A low production of 3,306 kg/ha compared with earlier records of 5-8 t/ha clearly shows the impact of the season, stocking density and proportions and low water levels owing to non-availability of tube-well or canal water. Fish growth is very poor during the prolonged winters at this centre.

A total of 7.8 lakhs common carp spawn was produced.

Maharashtra Centre (Pune): A production of 3,334 kg/ha was registered with feed and fertilizer as against 3,407 kg/ha with feed alone, 1,551 kg/ha with fertilizer alone and 538 kg/ha without feed and fertilizer (control) in a rearing period of 7 months and 10 days from august 1984 to March 1985. These results clearly show the contribution of feed at this centre where regular water replenishment is done every month. The present production rate as compared to 10,000 kg/ha/yr obtainined at the centre also shows that such a situation can be well exploited by high density stocking coupled with adequate feeding.

Tamil Nadu Centre (Bhavanisagar/Pollachi): In the absence of facilities either from the State Government or the Tamil Nadu Fish Seed Corporation, no work could be taken up at the centre.

Uttar Pradesh Centre (Jaunpur): A production of 3,061 kg/ha was registered in the pond which received the treatment with both feed and fertilizer as against 2,719 kg/ha with feed alone, 1,160 kg/ha with fertilizer alone and 732 kg/ha without feed and fertilizer in 9½ months' rearing from August 1984 to May 1985. The effect of winters on fish growth and production is obvious at this centre also.

In another experiment with grass carp as the major component (50%) and the other five species at 10% each, a production of 4,078 kg/ha was registered in 9 months' rearing as against 4,479 kg/ha in one year's rearing in the last experiment. Based on aquatic weeds/ terestrial grasses alone, as the only input, the technology is an effective low-cost technology which promises high yields with 1 kg fish from 6th month onwards, especially utilizing low and shallow ponds.

A total of 167.12 lakhs spawn of Indian and Chinese carps including 11,00,000 common carp spawn was produced at this centre.

PROJECT CFCSP/1.2 : ALL INDIA COORDINATED RESEARCH PROJECT ON COMPOSITE FISH CULTURE AND FISH SEED PRODUCTION
(Centrally sponsored Centres)

Personnel : S. D. Tripathi, K. K. Ghosh, N. Sukumaran, Md. Kaleemur Rahman, H. B. Dave, V. R. Khadse and S. K. Sahoo

Duration : 1971-1985

Location : Lingda (Gujarat), Tuticorin (Tamil Nadu)

Gujarat Centre (Lingda): In seven month rearing from August 1984 to March 1985, a production of 2,160 kg/ha was achieved with feed and fertilizer as against 1,640 kg/ha with feed alone, 1,580 kg/ha with fertilizer alone and 1,330 kg/ha without feed and fertilizer (control). The high rate of production from control pond is not clear. The experiment shows that high yield rates are possible at the Lingda Centre.

1.5 lakhs common carp spawn was produced.

Orissa Centre (Kausalyagang): In 6½ months' rearing a production of 962 kg/ha was obtained with feed and fertilizer as compared to 656 kg/ha with feed alone, 538 kg/ha with fertilizer alone and 419 kg/ha without feed and fertilizer (control). One of the reasons of low productivity was extremely poor growth of grass carp besides their low survival. Grass carp did not attain a weight of more than 60-90 g in different ponds.

A total of 34 lakhs common carp spawn was produced.

Tamil Nadu Centre (Tuticorin): A production of 2,350 kg/ha was achieved in 4 months' rearing with feed and fertilizer as against 1,822 kg/ha with feed alone and 1,707 kg/ha with fertilizer alone. The control pond registered a production of 79 kg/ha only. The cost of fish production was estimated to be Rs. 1.52 kg with feed and fertilizer, Rs. 1.51 with feed, Rs. 0.91 with fertilizer and Rs. 1.07 without feed and fertilizer which shows clearly how unmanaged ponds are not remunerative. The effect of high temperatures during winter months obtaining at this centre is reflected in good growth of fish and high production.

PROJECT CP/CFCSP-10 : OPERATIONAL RESEARCH PROJECT ON COMPOSITE FISH CULTURE AND INTEGRATED FISH-LIVESTOCK FARMING

Personnel : B. K. Sharma (till 7.3.85), M. Sinha (since 8.3.85), D. P. Chakraborty and N. K. Das

Duration : 1977 to 1986

Location : Kalyani/Krishnagar

(*i*) **Composite Fish Culture in Large water bodies:** Experiments initiated during last calendar year in three large water bodies (2.3, 1.5 & 2.3 ha), on composite fish culture without feed or chemical fertilizers yielded production @ 1,421.22 kg/ha.

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PERSONNEL 15

The following scientists rendered their services to the Institute during 1985.

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FRESHWATER AQUACULTURE DIVISION

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Shri K. K. Sukumaran, S-3
Shri H. A. Khan, S-3
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The following members of staff (Technical) rendered their services during the year:

Shri N. K. Tripathi, T-7	Liaison Officer
Shri N. C. Basu, T-7	Sr. Training Asstt.
Shri J. P. Verma, T-6	Sr. Training Asstt.
Shri B. B. Satpathy, T-6	Sr. Training Asstt.
Shri A. K. Chattopadhyay, T-6	Sr. Training Asstt.
Shri P. N. Bhattacharjee, T-5	Overseer
Shri B. R. Dutta, T-5	Demonstrator
Shri Kuldeep Kumar, T-5	Demonstrator
Shri Radheshyam, T-5	Demonstrator
Shri J. Ghosh, T-5	Senior Artist
Smt. Anjali De, T-5	Asstt. Librarian
Shri S. K. Das, T-5	Artist
Shri S. L. Raghavan, T-5	Technical Asstt.
Shri C. Sahoo, T-5	Estimator
Shri R. C. Singh, T-5	Technical Asstt.
Shri T. S. R. Raju, T-5	Technical Asstt.
Shri B. K. Saha, T-5	Technical Asstt.
Shri G. Pathak, T-5	Technical Asstt.
Shri M. D. Mantri, T-5	Draftsman
Shri P. K. Ghosh, T-5	Photographic Asstt.
Shri A. R. Mazumder, T-5	Artist Photographer

Dr. N. Sarangi, T-4 — Demonstrator
Smt. Sukla Das, T-4 — Sr. Library Asstt.
Shri P. B. Das, T-4 — Technical Asstt.
Shri R. N. De, T-4 — Technical Asstt.
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Shri M. M. Das, Senior Binder
Shri B. B. Seth, Driver
Shri N. C. Roy, Pumpman
Shri G. C. Sahoo
Shri P. Dasgupta, Artist
Shri R. C. Satpathy, Mechanic
Shri N. Guin, Electrician
Shri Ranjit Singh, Driver
Shri K. L. Das, Driver
Shri N. P. Saha, Sample Sorter

Technical Assistant, T-2

Shri S. Krishnan
Shri A. N. Mohanty
Shri B. B. Das
Shri K. P. Singh
Shri J. P. Mishra
Shri S. K. Chatterjee
Shri D. Sanfui
Shri B. B. Roy
Shri N. C. Biswas
Shri K. R. Deb
Shri Badal Lal Singh
Shri J. C. Saha
Shri A. K. Majumdar
Shri T. P. Ghosh
Shri T. M. Roy
Shri R. L. Balmiki
Shri Harihar Das
Shri R. K. Langer
Shri Ramji Tiwari
Shri Sukumar Saha
Shri Camil Lakra
Shri M. P. Singh
Shri K. C. Pani
Shri S. C. Mondal
Shri Surja Bahadur
Shri U. K. Chatterjee
Shri K. K. Dutta
Shri R. S. Neogi
Shri R. N. Singh
Shri M. G. Subramani
Shri S. C. Das
Shri D. Tarai
Shri Kishen Deo
Shri P. Lal

Shri C. R. Das, Pumpman
Shri N. P. Saha, Sample Sorter
Shri R. K. Halder, Dark Room Assistant
Shri R. D. Saha, Sample Sorter
Shri B. B. Roy, Driver
Shri B. Khali, Driver
Shri Bhailal, Field Asst.
Shri S. K. Deb, Plumber

Technical Assistant, T-1

Shri K. Ganeshan, Driver
Shri D. Borgoyary, Driver
Shri C. K. Nath, Driver
Shri R. Tarai, Driver
Shri M. C. Pal, Laboratory & Field Assistant
Shri Aloke Kumar Jain, Laboratory & Field Assistant
Shri A. K. Banerjee, Sample Sorter
Shri S. C. Moitra Sample Sorter
Shri M. C. Pal, Driver
Shri Ch. S. Rao, Driver
Shri B. K. Bahura, Driver
Shri U. N. Jally, Mike Operator
Shri S. K. Gupta, Sample Sorter
Shri K. P. Saha, Sample Sorter
Shri S. K. Biswas, Carpenter

The following members of staff of Administrative Section rendered their services during the year:

Senior Administrative Officer

Shri L. M. Nandy

Accounts Officer

Shri A. N. Mukherjee

Assistant Administrative Officer

Shri K. C. Roy
Shri M. L. Biswas
Shri K. B. Rajani
Shri K. B. Rajani
Shri P. C. Kanungo

Superintendent

Shri A. K. Das
Shri M. R. Roy
Shri B. C. Dutta
Shri A. K. Sengupta
Shri S. C. Saha

Assistant

Shri Bhattacherjee, B. C.
Shri Das, T. P.
Smt. Mazumder, Sandhya
Shri Baidya, N. H.
Smt. Choudhury, Namita
Shri Roy, S. C.
Shri Sarkar, N. K.
Shri Zaidi, F. A.
Shri Awedh, Saha
Shri Banerjee, D. K.
Shri Bose, S. K.
Shri Dasgupta, S.
Smt. Roy, Bani
Shri Das, C. C.
Shri Halim, Abdul
Shri Sarkar, A. C.
Shri Shastry, S. P.
Shri Mahesh Prasad
Shri Neogi, M. M.
Shri Bose, D. C.

Senior Stenographer

Shri Lahiri, G.

Stenographer

Shri Banerjee, A. K.
Shri Chakraborty, G. M.
Shri Sinha, R. C. P.
Shri Chakladar, H.
Shri Ghosh, U. K.
Shri Srivastava, R. C.

Junior Stenographer

Shri Bhattacherjee, S.
Shri Jena, P.
Shri Roy, T. K.
Shri Sahoo, D. C.
Shri Chatterjee, T.
Shri Prasad, P.
Shri Saha, A. K.

Senior Clerk

Shri Baidya, D, N.
Shri Bhowmick, S.
Shri Dey Sarkar, D. K.
Shri Halder, S. R.
Shri Kodandaraman, I. N.
Shri Majumdar, T. K.
Shri Mitra, N. K.
Shri Banerjee, J. N.
Shri Das, Moloy Kr.
Shri Ghosh, B. K.
Shri Kar, S. K.
Shri Majumdar, Biplab
Shri Mishra, L. P.
Shri Mukherjee, B. B.

Shri Sutur, H. B.
Shri Nath, H. K.
Shri Pramanick, S. K.
Shri Prasad, Keshav
Shri Sarkar, H. L.
Shri Singh, Kallu
Shri Sinha, S. S.
Shri Subrahmanian, M.
Shri Mukherjee, R. R.
Shri Patra, J. C.
Shri Paramanick, S. N.
Shri Rai, Jagdish
Shri Sarkar, S. K.
Shri Singh, R. C. P.
Shri Sreednaran, T. K.

Junior Clerk

Shri Balmiki, B. P.
Smt. Banerjee, Mrinalini
Shri Behari, Kunj
Smt. Chakraborty, Amita
Shri Das, B. K.
Shri Ghosh, P. K.
Smt. Bhagirathi, S.
Smt. Biswas, Manjula
Shri Bose, Samir Kumar
Shri Chowdhury, Debesh
Shri Dutta, P. K.
Shri Ghosh, R. K.
Shri Kundu, N. R.
Shri Lal, Ambika
Miss Mandal, Bulbul
Miss Manjula, A.
Smt. Majumdar, Anita
Shri Maranappan, S. K.
Smt. Mazumder, Sikha
Shri Mupid, B. S.
Shri Naik, N. C.
Shri Panda, R. K.
Shri Roy, J.
Shri Rao, K. S.
Shri Ratna, R. L.
Shri Srivastava, A. K.
Shri Tikadar, S. K.
Shri Ghosh, S. K.
Shri Debnath, R. R.
Miss. Talapatra, Swapna
Smt. Banerjee, Narayani
Shri Behari, A. C.
Shri Behari, Purnachandra
Shri Chhotey Lal
Miss. Das, Jayashree
Shri Behari, R. C.
Shri Biswas, A. B.
Shri Biswas, P. K.
Shri Chatterjee, Dipankar
Shri Das, G. B.
Shri Ghosh, Samar Kumar
Shri Kachhap, M.
Shri Kumar, Surendra
Shri Lahiri, P.
Shri Mahato, R. N.
Shri Mondal, S. P.
Shri Mondal, A. B.
Shri Murthy, P. B. V. S.
Smt. Neogi, Anjali
Shri Nath, Kalipada
Shri Nath, Baij
Shri Rao, G. S.
Shri Roy, Samir Kumar
Shri Rao, G. S.
Shri Ray, P. K.
Shri Saha Biswanath
Shri Bundu, S. K.
Shri Joarder, M. K.
Shri Guria, Wilson
Miss. Biswas, Sefali
Miss. N. Sadaverte

D. The following members of staff of supporting grade rendered their services during the year.

Supporting Grade IV

Shri Behera, B. N.
Shri Bhuyan, U.
Shri Biswas, D. N.
Shri Biswas, J. N.
Shri Bose, J. L.
Shri Burman, G. N.
Shri Chakraborty, K. L.
Shri Dalai, B.
Shri Das, C.
Shri Das, P. N. V.
Shri Das, K. P.
Shri Dey, S. K.
Shri Dosad, R. B.
Shri Gangaram
Shri Jally, H.
Shri Jana, K. C.
Shri Mewalal

Supporting Grade IV

Shri Naik, J.
Shri Prasad, K.
Shri Ramdeo
Shri Sahood, D.
Shri Samal, B.
Shri Samood Majhi, B.

Supporting Grade III

Shri Adhikari, A.
Shri Apparao, B.
Shri Bahadur, Nar
Shri Bahadur, Durga
Shri Barik, N.
Shri Barik, Dijia
Shri Barik, S.
Shri Balmiki, Sitaram

Supporting Grade III

Shri Burman, M. S.
Shri Burman, S. N.
Shri Bose, N. R.
Shri Chakraborty, S. K.
Shri Das, S. K.
Shri Das, Mosa
Shri Das, H. K.
Shri Balmiki, S. C.
Shri Baldev Sing, D. N.
Shri Bakshiram
Shri Behera, K. B.
Shri Behera, K. C.
Shri Behara, Alekha
Shri Behera, Trailokya
Shri Behera, N.
Shri Bhoi, D.
Shri Bhuloka, D.

Supporting Grade III

Shri Bhuyan, N.
Shri Biswas, T. K.
Shri Kotaiah, S.
Shri Lal, Madan
Shri Mishra, P.
Shri Mondal, A. K.
Shri Munda, Budhram
Shri Mohanty, N. N.
Shri Naik, B.
Shri Naik, D.
Shri Panda, Lakshmidhar
Shri Pandey, C. K.
Shri Patra, A. M.
Shri Paraminik, H. K.
Shri Patnaik, S. R.
Shri Prakash, B.
Shri Das, Antiram
Shri Das, K. K.
Shri Gopal, K.
Shri Iruthiraj, M.
Shri Jana, Natabar
Shri Jally, Khetrabasi
Shri Jally, Aghur
Shri Raha, R. N.
Shri Raikwar, Ramlal
Shri Routh, H. K.
Shri Rao, Ch. Ganeswar
Shri Singh, C.
Shri Kujur, J. M.
Shri Lajuram
Shri Shyamal, B. R.
Shri Singh, Meher
Shri Shyamal, H. K.
Shri Sahoo, D.
Shri Saha, N. K.
Shri Sethi, P. C.
Shri Varghese, P. V.

Supporting Grade II

Shri Appanna, K.
Shri Bahadur, Bhim
Shri Bahadur, Surja
Shri Bahadur, Tek
Shri Bahadur, R.
Shri Balmiki, Khem Chand
Shri Bahadur, Sitaram
Shri Boral, S. K.
Shri Bhoi, Shyama
Shri Barik, D.
Shri Bhanja, B.
Shri Burman, S. N.
Shri Behera, Khalia
Shri Burman, Niranjan Kr.
Shri Burman, Sudhangshu
Shri Behera, M.
Shri Behera, K. B.
Shri Bhoi, R. C.
Shri Bhania, D.
Shri Burman, S. K.
Shri Behera, Keshab
Shri Balaraman, M.
Shri Burman, H. S.
Shri Burman, Sudhangshu

Supporting Grade II

Shri Balmiki, Kattore
Shri Bhava, C. K.
Shri Lal, Bideshi
Shri Maity, S. S.
Shri Balmiki, Krishanlal
Shri Biswas, Jagdish
Shri Biswas, S. C.
Shri Biswas, Hiralal
Shri Bose, Jiralal
Shri Biswas, Manindranath
Shri Biswas, Ashoke Kr.
Shri Burman, M. K.
Shri Biswas, A. K.
Shri Bhuyan, Dhirendra
Shri Behera, Rajkishore
Shri Bhaskar Bhoi
Shri Chakraborty, Sarabandu
Shri Chaki, S. N.
Shri Das, P. C.
Shri Das, B. S.
Shri Das, Sitaram
Shri Das, Jhantu Ranjan
Shri Das, Giridhari
Shri Das, Nikunjalal
Shri Das, Dhaneswar
Shri Das, Ranjan
Shri Dhanuk, Shyamlal
Shri Dehuri, Basudeb
Shri Jangli
Shri Jena, N. C.
Shri Jadav, S. P.
Shri Jally, L.
Shri Jana, Bibhuti Kr.
Shri Kishore, Jugal
Shri Kaliannan, K.
Shri Krishnan, M. V.
Shri Hazarika, B.
Shri Sayalu, P.
Shri Somulu, L.
Shri Swain, Raghunath
Shri Sahoo, Lakshmidhar
Shri Sakuntala, B.
Shri Mondal, Gokul Chandra
Shri Mondal, S. Bal Chandra
Shri Manna, L. C.
Shri Mondal, Biswanath
Shri Maniekyam, P.
Shri Mondal, Niranja Kr.
Shri Malleh, Jai Nandnan
Shri Mondal, Biswanath
Shri Narendra, G. C.
Shri Narasappa, B.
Shri Parbat, L. K.
Shri Pradhan, B.
Shri Panda, Jadish
Shri Parida, Sridar
Shri Parida Fakir
Shri Das, Gunadhar
Shri Tair, R. N.
Shri Parameshwar
Shri Ramalingam, M.
Shri Japhuram
Shri Munshiram
Shri Reju, Kolludharma

Supporting Grade II

Shri Raju, A. Eswar
Shri Singh, S. S.
Shri Sahu, D. N.
Shri Sahoo, D. N.
Shri Singh, Ramdeo
Shri Sahoo, G.
Shri Singh, C. P.
Shri Srinivasan, V. K.
Shri Sundar, Ram
Shri Saha, P. C.
Shri Singh, P.
Shri Shaw, Gulab
Shri Sahoo, K. M.
Shri Yadav, A. L.

Supporting Grade I

Shri Anjanappa, M.
Shri Ali, Mansur
Shri Arumugam, P.
Ms. Dhan, Maya
Miss Dutta, Anjali Rani
Shri Debroy, R. L.
Shri Ali, S. K. Munsur
Shri Bain, G. C.
Shri Behera, Chhakei
Shri Bahadur, Karna
Shri Bahadur, Indra
Shri Bahadur, Asta
Mrs. Bahadur, Mina Rani
Shri Bose, Sankar
Shri Bairagi, Suklal
Shri Bijali, Amalya
Shri Bhattacherjee, Ashutosh
Shri Behera, Debahari
Shri Biswas, Suk Chand
Shri Biswas, A.
Shri Bez, P. C.
Shri Choudhury, Panchulal
Shri Bind, M. P.
Shri Bahadur, Lal
Shri Bahadur, Man
Shri Bhoi, M. S.
Shri Bhol, R. K
Shri Burman, Shatendra
Shri Bendra, S. S.
Shri Balmiki, Jagadish
Shri Behera, Dhanu
Shri Bhuiya, N.
Shri Boro, Bhabalu
Shri Betal, Sasidhar
Shri Barik, Basanta Kr.
Shri Behera, Makunda Charan
Shri Bhoi, Bijaya
Shri Balmiki, Iswar Ram
Shri Krishnapada, B. N.
Shri Karkatta, Joseph
Shri Khatua, Jadumani
Shri Kumar, Kharban
Shri Karuppanna, P.
Shri Kemparas, P.
Shri Dhir, K. K.
Shri Dhibar, Gunadhar
Shri Das, Mukti

Supporting Grade I

Shri Das, B. C.
Shri Dukran
Shri Das, B. C.
Shri Das, Rash Bihari
Shri Das, Nayaram
Shri Das, Sudhakar
Shri Das, Parusuram
Shri Ghosh, A. C.
Ms. Ghosh, Puspati
Shri Gowda, Malige
Shri Ghume, T. H.
Shri Choudhsi, Umesh
Shri Chatterjee, Rupali
Shri Gangayya, A.
Shri Govata, S. T.
Shri Gharami, Phani
Shri Gonvidalal
Shri Halder, L. K.
Shri Halder, Sital Chandra
Mrs. Halder, Hemlata
Shri Halder, Satyendra Nath
Shri Jally Burman
Shri Jena, Gourhari
Shri Jena, Panchanan
Shri Jena, N.
Shri Jelly, Kedar Chandra
Shri Khalko, Joseph
Shri Karmakar, Sarbananda
Shri Kachari, P.O.
Shri Pugalendhi, B.
Shri Paik, B. C.
Mrs. Prasad, Laita
Shri Palanisamy, R.
Shri Pramanik , G. C.
Shri Prasad, Ram
Shri Kemparas, A.
Shri Khan, Rahmat
Shri Lakshim, Ram
Shri Mondal, Bholanath
Shri Mani, N.
Shri Mondal, Kalashashi

Supporting Grade I

Shri Mahadeva, M.
Shri Mondal, Godhli
Shri Mallah, Munilal
Shri Muchi, R. U.
Shri Mollick, G. C.
Shri Mani, K.
Shri Mukhia, J.
Shri Mallah, Rajdhari
Shri Murugesena, A.
Shri Mariappan, V.
Shri Mahalick, Antaryam
Shri Mondal, Kalipada
Mohd. Yusuf Dar
Shri Mondal, Sachindra
Shri Naik, G. C.
Shri Naik, Krishna Ch.
Shri Ningegowada, K.
Shri Naik, Sudarsan
Shri Nayak, P. K.
Shri Nayak, Sripati
Shri Omprakash
Shri Subramani
Shri Samal, Krusnna Chandra
Shri Seshanna
Shri Sahni, Aghanu
Shri Subramaniam, K.
Singh, C. P.
Shri Samanta, Pr. Sekhar
Shri Singh, Kuldeep
Shri Swain, Ramesh Chandra
Shri Shree, Nath
Shri Yasiah, R.
Shri Paria, J.
Shri Parida, Satyananda
Shri Paramanik, P. C.
Shri Prasad, Shitala
Shri Parida, Y.
Shri Parida, Golekha
Shri Palai, Duryodhan
Shri Parida, Judhistir
Shri Patnaik, B.

Supporting Grade I

Shri Rao, G. Santa
Shri Ram, Rajendra
Shri Rajendrnam, R.
Shri Ramaswamy, A.
Shri Roay, Pradupta Kishore
Shri Raj, Karam
Shri Parasram
Shri Runadala, G. J.
Shri Rao, Medisethi Chandra
Shri Ram, Kawal Pati
Shri Rao, P. Nageswar
Shri Saha, Mohan Lal
Shri Saha, Manoranjan
Shri Sethi, P. K.
Shri Samanta, Narayan Ch.
Ms. Sita
Shri Singh, Maha
Shri Saha, P. C.
Shri Subbaiyan, K.
Shri Sahni, Aghanu
Shri Satyanarayanu
Shri Subramani, M.
Shri Swain, Jatadhari
Shri Swain, Pitamber
Shri Samal, Chaitanya Charan
Shri Swain, Ranjan
Shri Mahendran, S.
Shri Kahali, S.
Smt. Biswas, Mina
Shri Chakraborty, S. K.
Smt. Debi, Biramkala
Shri Das, D. K.
Shri Malakar, K. C.
Shri Dutta, M.
Shri Rajak, N.
Shri Bahadur, Raj
Shri Behara, Gangadhar
Shri Bhoi, Pahali
Shri Ghadei, B.
Shri Panika, Mahadeo

PROMOTION

On recommendation of the Agricultural Scientists Recruitment Board the following scientists of this Institute were promoted as shown below:

Name	Designation	Promoted to	W.E.F.
Dr. A. G. Jhingran	S-3	S-3 (Per. gr.)	1.1.84
Dr. P. Das	"	"	"
Dr. T. Rajyalakshmi	"	"	"
Shri Apurba Ghosh	S-2	S-3	1.7.82
Dr. A. K. Mondal	"	"	1.7.81
Dr. M. Subrahmanyam	"	"	1.1.84
Shri H. A. Khan	"	"	"
Dr. B. N. Singh	"	"	"
Dr. S. K. Mukhopadhyay	"	"	"
Mr. S. P. Singh	"	"	"
Dr. S. P. Ayyar	"	"	"
Shri C. Selvaraj	"	"	"
Shri Ravish Chandra	"	"	"

Name	Designation	Promoted to	W.E.F.
Shri A. V. P. Rao	S-2	S-3	1.1.84
Dr. C. R. Das	"	"	"
Shri K. K. Sukumaran	"	"	"
Dr. V. R. Desai	"	"	"
Dr. N. K. Thakur	"	"	"
Shri B. B. Ghosh	"	"	"
Shri S. Patnaik	"	"	"
Shri G. N. Saha	"	"	"
Shri K. K. Ghosh	"	"	"
Dr. K. G. Rao	S-1	S-2	1.7.80
Dr. K. J. Rao	"	"	1.1.84
Shri D. N. Mishra	"	"	"
Shri S. Srinivasagam	"	"	"
Shri R. K. Dey	"	"	"
Shri B. K. Mishra	"	"	"
Shri D. K. Kaushal	"	"	"
Shri M. D. Pisolkar	"	"	"
Shri K. Gopinathan	"	"	"
Smt. G. K. Vinci	"	"	"
Dr. H. A. Khan	"	"	"
Shri Balbir Singh	"	"	"
Shri G. N. Srivasthava	"	"	"
Shri Sreeprakash	"	"	"
Shri R. N. Seth	"	"	"
Dr. Amitabha Ghosh	"	"	"
Shri N. K. Das	"	"	"
Shri P. K. Pandit	"	"	"
Shri S. Ayyappan	"	"	1.7.84
Dr. George John	"	"	"
Dr. V. K. Unnithan	"	"	"
Dr. S. M. Pillai	"	"	"
Shri R. C. Das	"	"	"
Shri S. N. Mohanty	"	"	"
Shri A. K. Sahu	"	"	"
Dr. (Smt.) Usha Moza	"	"	"
Shri M. K. Das	"	"	"
Dr. K. R. Naskar	"	"	"
Shri R. K. Chakraborty	"	"	1.1.84
Shri M. M. Bagchi	"	"	"
Shri P. M. Mitra	"	"	"
Shri S. N. Mehrotra	"	"	"
Shri B. P. Gupta	"	"	"
Shri S. L. Thakurta	"	"	"
Shri A. K. Roy	"	"	"
Shri K. O. Joseph	S	S-1	1.7.82

The following members were promoted as below on the recommendation of the Assessment Committee.

Name	Designation	Promoted to	W.E.F.
Shri M. A. V. Lakshmanan	T-7	T-8	1.7.82
Shri N. C. Basu	T-6	T-7	1.1.84
Shri S. C. Moitra	T-2	T-1-3	1.1.85
Shri A. K. Banerjee	"	"	"
Shri B. K. Bahura	T-1	T-2	"

The following scientists were awarded advance increments as shown below:

Name	Designation	No. of advance increments	W.E.F.
Shri K. Raman	S-3	1	1.1.84
Shri D. D. Halder	"	1	"
Shri G. K. Bhatnagar	S-2	3	"
Shri R. D. Prasadam	"	3	"
Dr. M. Sinha	"	3	"
Shri K. N. Krishnamurthy	"	3	"
Shri K. V. Ramakrishna	"	2	"
Shri D. V. Pahwa	"	2	"
Shri R. M. Rao	"	2	"
Dr. R. K. Jana	"	1	"
Dr. R. S. Panwar	"	2	"
Shri B. L. Pandey	S-1	1 (1.1.83) & 2	1.1.84
Shri M. K. Das	"	3	1.7.83
Shri C. P. Rangaswamy	"	3	1.1.84
Shri S. N. Singh	"	3	"
Shri D. R. Kanaujia	"	3	"
Shri R. K. Dwivedi	"	2	"
Shri J. B. Rao	"	3	1.7.84
Smt. M. Sultana	"	2	1.1.84
Shri V. R. Chitranshi	"	2	1.7.84
Shri S. K. Mandal	"	3	"
Shri B. C. Jha	"	2	1.1.84
Shri S. S. Purushothaman	"	3	1.7.84

The following technical staff were awarded advance increments as shown below:

Name	Designation	No. of advance increments	W.E.F.
Shri J. P. Verma	T-6	2	1.1.85
Smt. Anjali De	T-5	3	1.1.84
Shri J. Ghosh	"	3	1.7.82
Shri P. Dasgupta	T-1-3	3	1.1.84
Shri Alok Sarkar	"	3	1.7.82
Shri Bhaskar Ghosh	"	3	"
Shri G. P. Bhattacherjee	"	3	"
Shri H. K. Sen	"	3	"
Shri P. M. A. Kadir	"	3	"
Shri S. P. Ghosh	"	3	"
Shri K. M. Das	"	3	"
Shri N. C. Mondal	"	3	"
Shri N. D. Sarkar	"	3	"
Shri N. N. Majumder	"	3	"
Shri A. R. Paul	"	3	"
Shri A. K. Roy	"	3	"
Shri D. P. Verma	"	1	"
Shri Ram Chandra	"	3	"
Shri D. N. Srivastava	"	3	"
Shri B. D. Saroj	"	3	"
Shri M. F. Rehaman	"	3	"
Shri P. S. C. Bose	"	3	"
Shri K. S. Banerjee	"	3	"
Shri R. C. Satpathi	"	3	"

Following appointments were made during the year 1985

Sl. No.	Name	Designation	Place of posting	Date of appointment
1	2	3	4	5
1.	Shri Salil Kumar Bindu	Jr. Clerk	KRC, Kakdwip	4.1.1985
2.	Miss A. Manjula	-do-	Tank Fisheries Res. Unit, Bangalore	18.1.1985
3.	Shri Sujit Kumar Ghosh	-do-	SAO's Cell Barrackpore	6.2.1985
4.	Miss Swapna Talapatra	-do-	Doc. Section Barrackpore	13.2.1985
5.	Shri Malay Kumar Joarder	-do-	Adm. Per. II Sec. Barrackpore	14.2.1985
6.	Miss Sefali Biswas	-do-	Doc. Section Barrackpore	14.2.1985
7.	Shri R. R. Debnath	-do-	Stores Section Barrackpore	15.2.1985
8.	Dr. P. K. Das (deputation from Govt. of Orissa)	Medical Officer (Auxiliary)	FARTC of CIFRI Dhauli	28.1.1985
9.	Shri Sridhar Kahali	S.S. Grade I	Dhauli	3.1.1985
10.	Shrimati Mina Biswas	-do-	Barrackpore	28.1.1985
11.	Shri Suresh Kumar Chakraborty	-do-	Kakdwip	31.1.1985
12.	Shrimati Biramkala Debi	-do-	Barrackpore	2.5.1985
13.	Shri Dilip Kumar Das	-do-	Barrackpore	25.5.1985
14.	Shri Kartick Ch. Malakar	-do-	Barrackpore	27.5.1985
15.	Shri Manabendra Dutta	-do-	Kakdwip (NBFGR)	25.5.1985
16.	Shri Naginder Rajak	-do-	Muzaffarpur	28.5.1985
17.	Shri Raj Bahadur	-do-	Allahabad (NBFGR)	1.6.1985
18.	Shri Gangadhar Behera	-do-	Dhauli	17.6.1985
19.	Shri Pahali Bhoi	-do-	Dhauli	17.6.1985
20.	Shri Bauribandhu Ghadei	-do-	Dhauli	17.6.1985
21.	Shri Mahadeo Panika	-do-	Dhauli	21.1.1985

Retirements during 1985

Sl. No.	Name	Designation	Place of posting	Date of retirement
1	2	3	4	5
1.	Shri K. P. Das	Mike Operator	Estuarine Division, Barrackpore	31.3.1985
2.	Shri S. K. Gupta	Sample Sorter (T-1-3)	Barackpore	31.12.1985
3.	Shri J. C. Saha	Driver (T-1-3)	Barrackpore	31.12.1985
4.	Shri Ganga Ram	S.S. Grade IV	Extension Section	31.8.1985 Retired voluntarily

Resignation

Name	Designation	Date of acceptance
Shri H. K. Sardar	Junior Clerk	25.11.1985

TRANSFERS

The following members of CIFRI were transferred during the year

Name	Designation	From	To
Shri B. V. Govind	S-3	Nagarjunasagar	Bangalore
Dr. T. Ramaprabhu	S-3	FARTC, Dhauli	Bangalore
Shri R. A. Gupta	S-3	Barrackpore	Allahabad
Shri Ch. Gopalakrishnayya	S-3	Nagarjunasagar	Eluru
Dr. M. Ramakrishnaiah	S-2	Nagarjunasagar	Eluru
Shri C. Saha	S-2	FARTC, Dhauli	Barrackpore
Shri C. B. Joshi	S-2	Bilaspur	Bhimtal
Shri D. Nath	S-2	Barrackpore	Kakdwip
Shri K. V. Rao	S-2	Tadepalligudem	Eluru
Dr. G. N. Chattopadhyay	S-2	Rahara	Barrackpore
Shri V. K. Murugesan	S-2	Patna	Pollachi
Shri S. K. Mandal	S-1	Kakdwip	Barrackpore
Shri V. R. Chitranshi	S-1	Muzaffarpur	Patna
Shri P. K. Ghosh	S-1	Kakdwip	Calcutta
Shri A. Chowdhury	S-1	Calcutta	Barrackpore
Shri B. C. Jha	S-1	Bilaspur	Muzaffarpur
Shri V. Kolekar	S-1	Rihand	Pune
Shri T. S. R. Raju	T-5	Tadepalligudem	Eluru
Shri K. S. Rao	T-5	Tadepalligudem	Eluru
Shri N. C. Mondal	T-I-3	Ulubaria	Diamond Harbour
Shri Subba Rao	Jr. Clerk	Tadepalligudem	Eluru
Shri S. K. Maranappan	Jr. Clerk	Pollachi	Madras
Shri S. Prasad	Jr. Stenographer	FARTC, Dhauli	Madras
Shri L. Somulu	SSG-II	Tadepalligudem	Eluru
Shri K. D. Raju	SSG-II	Tadepalligudem	Eluru
Shri S. Kotaiah	SSG-III	Nagarjunasagar	Eluru
Shri B. Sayalu	SSG-II	Nagarjunasagar	Eluru
Shri P. N. Rao	Safaiwala	Tadepalligudem	Eluru
Shri B. T. Rao	Watchman	Tadepalligudem	Eluru
Shri A. Kishaiah	SSG-I	Tadepalligudem	Eluru

Name	Designation	From	To
Shri N. K. Burman	Fisherman	Kalyani	Rahara
Shri K. P. Ram	Fisherman	Ranchi	Muzaffarpur
Shri S. C. Burman	Fisherman	Allahabad	Krishnagar
Shri S. P Sastry	Assistant	Nagarjunasagar	Eluru
Shri K. Mani	Jr. Clerk	Nagarjunasagar	Eluru
Shri A. Gangaiah	SSG-I	Nagarjunasagar	Eluru
Shri U. Satyanarayana	SSG-I	Nagarjunasagar	Eluru
Shri S. Jaan	SSG-I	Nagarjunasagar	Eluru
Shri P. Achaiah	SSG-I	Nagarjunasagar	Eluru
Shri Bakshi Ram	Lab. Boy	Bilaspur	Bhimtal
Shri Japhu Ram	Fisherman	Srignagar	Bhimtal
Shri Sant Ram	Fisherman	Srignagar	Bhimtal
Shri N. K. Das	Watchman	Digha	Calcutta
Shri L. Prasad	Watchman	Jaunpur	Muzaffarpur
Shri Lakhi Ram	Watchman	Muzaffarpur	Karnal
Smt. B. Sakuntala	Messenger	Rahara	Barrackpore

- Dr. M. Y. Kamal, S-3 was relieved of his duties of CIFRI on 31.5.85 to join duties at ICAR Headquarters, New Delhi.
- Shri K. K. Ghosh, S-2 at FARTC, Dhauli joined CIFE, Bombay on his appointment to the grade S-3.
- Dr. George Jhon S-2 at FARTC, Dhauli Joined CMFRI, Cochin on 29.11.85 on an interinstitutional transfer.
- Shri Satpal Singh, Jr. Clerk was relieved of his duties at CIFRI, Barrackpore to join Central Institute for Research on Goats, Mathura.
- Shri R. K. Singh, Scientist has been relieved of his duties at CIFRI on 9.8.85 to join Central Rice Research Institute, Cuttack on an interinstitutional transfer.

□

APPENDIX I

Ministry/Department/Office of the Central Inland Fisheries Research Institute (I.C.A.R.), Barrackpore, West Bengal. Statement showing the total number of government servants and the number of Scheduled Castes and Scheduled Tribes amongst them as on 1st January, 1986.

Group/Class	Permanent/ Temporary	Total No. of employees	Scheduled Castes	Percentage of total employees	Scheduled Tribes	Percentage of total employees	Remarks
Gr. A (Cl.I) Parmanent—							
(*i*) Other than lowest rung of Cl.I		112	3	3	—	—	
(*ii*) Lowest rung of Cl.I Total		61	5	8	—	—	
Temporary—							
(*i*) Other than lowest rung of Cl.I			—	—	—	—	
(*ii*) Lowest rung of Cl.I		35	3	9	—	—	
Gr. B (Cl.II)	Parmanent	20	2	10	1	5	
	Temporary	5	4	125	1	20	
Gr. C (Cl.III)	Permanent	197	35	18	4	2	
	Temporary	72	13	18.6	7	10	
Gr. D (Cl.IV) Excluding sweepers	Permanent	298	50	15	10	3	
	Temporary	123	46	39	3	3	
Gr. D (Cl.IV) Sweepers	Permanent	16	13	81	—	—	
	Temporary	2	1	50	1	50	

APPENDIX II

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
(ICAR) : BARRACKPORE : WEST BENGAL

Address List of Research/Survey Centres

Research/Survey Centre	Telegram/Telephone
1. **Central Inland Fisheries Research Institute,** Barrackpore-743 101, West Bengal.	Fishsearch 53-161 53-322
2. **Allahabad Research Centre,** Central Inland Fisheries Research Institute, 24, Pannalal Road, Allahabad-211 002, U.P.	Fishsearch Allahabad-2
3. **Bakkhali Research Centre,** Central Inland Fisheries Research Institute, Bakkhali, 24-Parganas Dist., West Bengal.	
4. **Bangalore Research Centre,** Central Inland Fisheries Research Institute, No. 51, 8th Cross Road, 7th Main, Malleswaram, Bangalore-560 003, (Karnataka).	Fishsearch Bangalore-3 36-6610
5. **Bhagalpur Research Centre,** Central Inland Fisheries Research Institute, Khanjarpur, Beatson Road, Bhagalpur-812 001, (Bihar)	1385
6. **Bhimtal Research Centre,** Central Inland Fisheries Research Institute, Bhimtal, Dist. Nainital, U.P., Pin-263 136.	
7. **Bilaspur Research Centre,** Central Inland Fisheries Research Institute, Roara Sector, Bilaspur-174 001, Himachal Pradesh.	

Research/Survey Centre	Telegram/Telephone
8. **Buxar Research Centre,** Central Inland Fisheries Research Institute, 1/644, Sidhanathghat, Buxar-802 101, Bihar.	
9. **Calcutta Research Centre,** Central Inland Fisheries Research Institute, 39, Rabindra Sarani, (3rd Floor), Calcutta-700 073, West Bengal.	
10. **Canning Survey Centre,** Central Inland Fisheries Research Institute, R. N. Tagore Road, Canning-743 329, West Bengal.	
11. **Paddy-cum-fish Culture Unit,** Central Inland Fisheries Research Institute, CRRI Campus, Cuttack, Orissa.	
12. **Diamond Harbour Survey Centre,** Central Inland Fisheries Research Institute, New Madhavpur, P.O. Diamond Harbour, 24-Parganas, West Bengal.	
13. **Digha Survey Centre,** Central Inland Fisheries Research Institute, Digha, Midnapur Dist., West Bengal.	
14. **Eluru Research Centre,** Central Inland Fisheries Research Institute, Sastry Bhavan, D.M.C. Home Street, Kandukuruvarithota, Patehbad, Eluru-2, West Godavari Dist., Andhra Pradesh.	
15. **Freshwater Aquaculture Research & Training Centre,** Central Inland Fisheries Research Institute, P.O. Kausalyagang, (Via) Bhubaneswar-751 002, Orissa.	Aquaculture Bhubaneswar 53084
16. **Gauhati Research Centre,** Central Inland Fisheries Research Institute, Natun Sarania, Gauhati-781 003, Assam.	23831

Research/Survey Centre	Telephone/Telegram
17. **Kakdwip Research Centre,** Central Inland Fisheries Research Institute, Kakdwip-743 347, 24-Parganas, West Bengal.	Fishsearch Kakdwip 72
18. **Kakinada Research Centre,** Central Inland Fisheries Research Institute, 16-23-1, Sambamurthi Nagar, Kakinada-533 001, A.P.	
19. **Kalyani Research Centre,** Central Inland Fisheries Research Institute, B/11/226, Central Avenue, East Kalyani, Nadia, West Bengal.	
20. **Karnal Research Centre,** Central Inland Fisheries Research Institute, Govt. Fish Seed Farm, P.O. Saidapur (CSSIR), Karnal-132 001, Haryana	3382
21. **Krishnagar Operational Research Centre,** Central Inland Fisheries Research Institute, Anjana Fish Farm, Shaktinagar, Krishnanagar-741 102, Dist. Nadia, West Bengal.	
22. **Krishi Vigyan Kendra,** Central Inland Fisheries Research Institute, P.O. Kakdwip-743 347, Dist. 24-Parganas, West Bengal.	
23. **Krishi Vigyan Kendra/TTC (Matsya),** Central Inland Fisheries Research Institute, P.O. Kausalyagang, (Via) Bhubaneswar-751 002, Orissa.	
24. **Lalgola Survey Centre,** Central Inland Fisheries Research Institute, Lalgola, Dist. Murshidabad, West Bengal, Pin-741 148.	
25. **Madras Research Centre,** Central Inland Fisheries Research Institute, 1, Karaneeswarar Koil Street, (Near All India Radio), Mylapore, Madras 600 004.	Ulnadmeen Madras
26. **Muzaffarpur Research Centre,** Central Inland Fisheries Research Institute, House No. 113, Ward No. 27, Damnchak, Muzaffarpur-842 001, Bihar.	

Research/Survey Centre	Telephone/Telegram
27. **Patna Research Centre,** Central Inland Fisheries Research Institute, Mithapur Fish Farm, Patna-800 001, Bihar	26285
28. **Pollachi Research Centre,** Central Inland Fisheries Research Institute, 10, Chakrapani Iyer Street, Venkatesa Colony, Pollachi-642 001, Tamil Nadu.	
29. **Pulicat Survey Centre,** Central Inland Fisheries Research Institute, Pulicat, Chingelpet Dist., Tamil Nadu.	
30. **Pune Research Centre,** Central Inland Fisheries Research Institute, C/O. Asstt. Director of Fisheries, Sadasiv Sadan, 873, Bhandarkar Institute Road, Daccan-Gymkhana, Pune-411 004, Maharashtra.	
31. **Puri Research Centre,** Central Inland Fisheries Research Institute No. 12, M.I.G. Quarters, Water Works Road, Puri-752 002, Orissa.	
32. **Rahara Research Centre,** Central Inland Fisheries Research Institute, 8, Station Road, Khardah, Dist. 24-Parganas, West Bengal, Pin-743 186.	
33. **Raidighi Survey Centre,** Central Inland Fisheries Research Institute, Raidighi, 24-Parganas, West Bengal.	
34. **Rihand Research Centre,** Central Inland Fisheries Research Institute, C/O. Asstt. Director of Fisheries, Rihand, P.O. Turra, Dist. Mirzapur, Uttar Pradesh-231 221.	
35. **Srinagar Research Centre,** Central Inland Fisheries Research Institute, Harwan, Srinagar-191 123, Kashmir.	Fishsearch Srinagar
36. **Uluberia Survey Centre,** Central Inland Fisheries Research Institute, Uluberia, Dist. Howrah, West Bengal.	

APPENDIX III

ORGANISATION CHART, 1985

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
BARRACKPORE-743 101, WEST BENGAL