CENTRAL INLAND FISHERIES RESEARCH INSTI
BARRACKP

Annual Repo

1984

Credits

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Cover : An inside view of CIFRI'S shrimp hatchery at Ennore, Madras.

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ANNUAL REPORT 1984

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
BARRACKPORE

Brief History

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

Mandate

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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

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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. In addition, the Institute has 4 All India Co-ordinated Research Projects, *viz.*, Composite Fish Culture and Fish Seed Production, Air breathing Fish Culture in Swamps, Reservoir Fisheries, and Brackishwater Fish Farming. These Co-ordinated Research Projects are basically meant for testing various technologies developed by the Institute in diverse ecoclimatic conditions.

The Institute has 20 outstation centres and survey centres under 3 Divisions and 11 Institute-based centres under the 4 All India Coordinated Research Projects spread all over the country. In addition, Institute has Extension Section at Barrackpore, KVK on barackishwater fish farming at Kakdwip and KVK/TTC on freshwater aquaculture at Dhauli, Kausalyagang, and one Operational Research Project at Krishnagar. The Rahara Centre contcentrates on sewage-fed fish culture and the Kalyani Centre on frog breeding and culture. Library and Documentation Section, Extension Section,Administrative, Accounts, Audit, Stores and other sections also function at Head-quarters.

IMPORTANT ACHIEVEMENTS (1984)

A MAJOR BREAKTHROUGH IN SEED PRODUCTION OF TIGER SHRIMP *P. MONODON*

CIFRI has achieved a major breakthrough in breeding and seed production of tiger shrimp, *P. monodon*. Breeding and larval rearing of this brackishwater prawn has been successfully carried out at Ennore, Madras in a hatchery model designed and installed by the Institute. Over 50,000 prawn larvae were reared upto post larvae stage PL-12 and handed over to the State Fisheries Department for stocking in culture ponds.

Top : *Penaeus monodon* post larvae produced at the tiger shrimp hatchery of CIFRI at Ennore, Madras. Below : An inside view of the prawn hatchery.

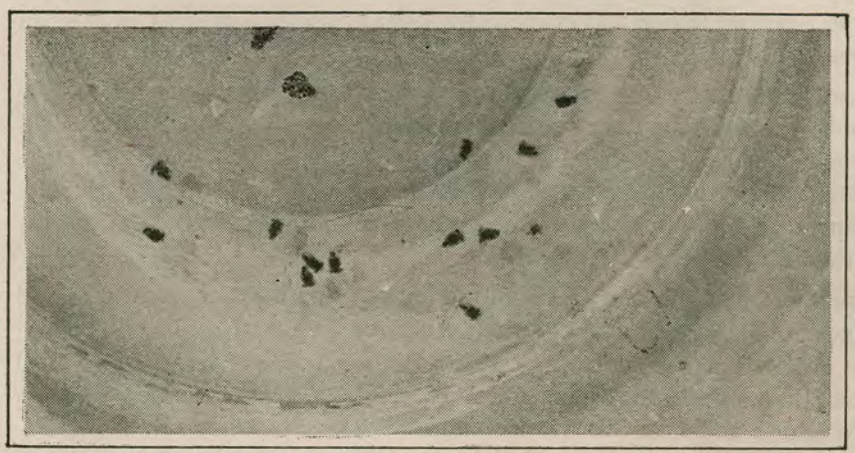
The hatchery model developed by the Institute comprises *in situ* filteration system, aeration system and a series of well aerated synthetic hatchery chambers of different size and descriptions. Artificial and live larval feeds like egg custard, rotifer, *Tetraselmis* sp., *Brachionus* spp., and *Mytilus* tissue suspension were used for different stages of prawn larvae. Proper water quality monitoring, handling and appropriate larval feed had ensured high survival at nauplius, protozoea and mysis stages. Post-larvae were reared up to PL-12 stage with high survival in hatchery pools.

The sump of the hatchery for collecting filtered sea water, with the filter box exposed.

CIFRI's achievement in this crucial area of shrimp seed production paves the way for viable seed production technology for *P. monodon* and hopefully a new orientation to brackishwater aquaculture in this country.

BREEDING AND LARVAL REARING OF ESTUARINE EDIBLE CRAB *PORTUNUS PELAGICUS*

Investigation on breeding and larval rearing of edible crab *Portunus pelagicus* at the Madras Research Centre gave encouraging results. Berried specimen collected from the sea was reared in the aerated saline water (salinity 33.4 ppt) in the improvised hatchery. The eggs hatched out into zoea in a week. Larval rearing was done in plastic pools in filtered aerated water employing different feeds like the Chlorophyta, *Tetraselmis* sp., diatom, *Brachionus plicatilis*, egg custard and the green mussel (*Perna viridis*) suspension at different stages. Out of 36,000 zoea, over 1,000 moulted into megalopae in 15 days. In another four days, the megalopae moulted into first post larval instar, a stage suitable for stocking in crab culture operations.



Larvae of *Portunus pelagicus* (left) and young crabs (*P. Pelagicus*) raised at Ennore hatchery (below).

The successful breeding and larval rearing of this economic variety of crab is a very significant step in the direction of seed production and culture technology of edible crab in the country.

OFFSEASON BREEDING OF INDIAN AND EXOTIC CARPS

Year-round carp seed production became a possibility when CIFRI achieved a major technical breakthrough in breeding Indian and exotic carps during offseason months in different geoclimatic regions of the country.

Indian major carps and exotic Chinese carps were bred at Rahara Centre in March-April 1984. Earlier, under the All India Coordinated Research Project on Composite Fish Culture, mrigal was bred in November-December, 1983 at Tamil Nadu Centre taking advantage of the north east monsoon. Major carps were also bred at the Jaunpur Centre (U.P.), as early as May under high temperature (38°C). The Karnal Centre (Haryana) also bred them in May under controlled temperature.

By water temperature manipulation, gonadal maturation of silver carp was advanced and early breeding was achieved in March itself at Rahara Research Centre of CIFRI. In breeding trials, water column in ponds was regulated in February-March and brooders were exposed to 29 to 31°C for at least 6 hours during day time, and thick plankton concentration comprising largely of *Spirulina*, *Oscillatoria* and *Chlorella* was maintained. This environmental manipulations resulted in attaining gonadal maturation in 2nd week of March. Induced breeding was successful in March at ambient temperature of 25-26°C and hatchlings produced in an indoor experimental glass jar hatchery equipped with 'khas khas' and desert coolers to keep temperature down in summer months. Gonadal maturation of Chinese carps was also advanced through environmental manipulation and hybrid hatchlings of *C. mrigala* × *H. molitrix* were produced during last week of March. Success was also achieved in breeding *C. mrigala* and *L. rohita* during April at Rahara and hatchlings were produced.

Breaking the season barrier in breeding by environmental manipulation is a big step forward in the development of techinques for round the year breeding paving the way for easier availability of carp seed.

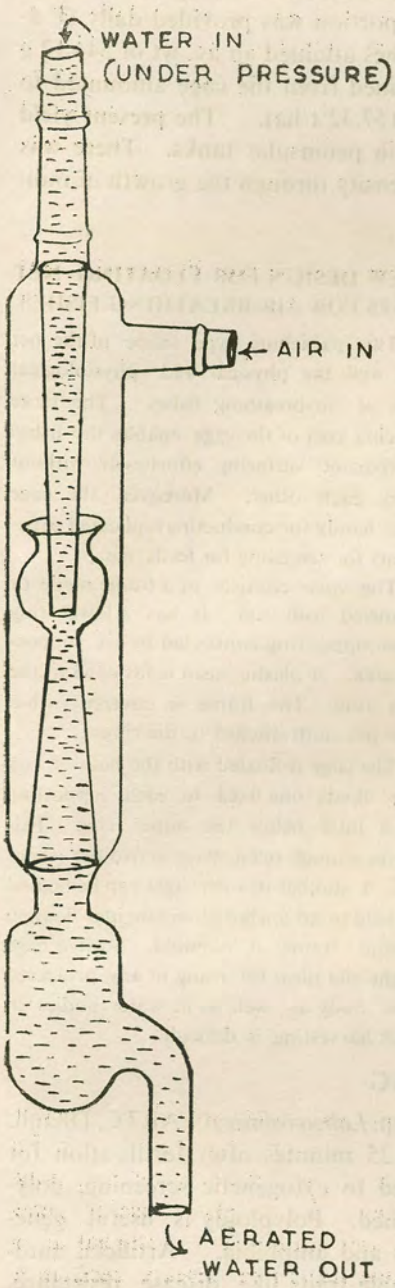
RESOUNDING SUCCESS IN HILSA SEED PRODUCTION

The Institute has made further headway in the refinement of technique of artificial fecundation of hilsa and raising its seed. The migratory variety of the Indian shad, *Hilsa ilisha* was once again successfully subjected to artificial breeding, and the seed thus obtained are being reared at the Institute's farm. The artificial fecundation was done at the Baniagram—Nimtita stretch of the Ganga River System near Farakka in West Bengal in the latter half of October, 1984.

Live male and female hilsa in 'running condition' were collected from the River Ganga from gill net catches. Wet stripping was resorted to. In four attempts, the rate of fertilisation ranged from 30 to 50%. Incubation of the developing embryo was done in the field laboratory under semi-controlled conditions. The ambient water temperature ranged from 22-29°C. DO

6.5-8.2 ppm and the pH, 7.6-7.8. Hatching took place in 16-20 hours after fertilization and altogether 0.265 million hatchlings were obtained from these attempts.

A NEW INEXPENSIVE AERATION DEVICE FOR FISH AND SHRIMP HATCHERIES



With a view to augmenting dissolved oxygen in fish and shrimp hatcheries, a new inexpensive method has been developed at CIFRI. The apparatus used is a simple 'aspirator' commonly used in chemical laboratories for creating vacuum. The aspirator is connected to a circulatory water passing through a tube flowing under gravity from a height, thus creating a pressure. The same could also be connected to water pipes. With the flow of water, vacuum is created in the side tube of the aspirator. Air is sucked in and gets mixed with the flowing water under pressure, thus aerating it.

Laboratory experiments showed that at an average water temperature of 30°C, dissolved oxygen could be raised from an initial level of 7.8 ppm to 8.6 ppm within a short period.

Outdoor experiments at the mouth of water pipes at a water temperature of 34°C showed that by simply connecting the aspirator, dissolved oxygen could be elevated from 5.8 ppm to 7.0 ppm even during mid-day when the dissolution of oxygen is minimum.

Using continuous flow in a circular tank at CIFRI with approximately 1,000 litres of water, dissolved oxygen was raised from 5.6 to 8.0 ppm at a water temperature of 28°C when the water was allowed to flow at the rate of 2.30 litre per minute through the aspirator for 2 hours.

Above trials indicated that a single aspirator may prove its worth very efficiently when about 1,000 litres of water is used in bioassay experiments, breeding experiments or a hatchery management with continuous flow system or recirculatory water systems. For large water areas the same process may be applied with more number of aspirators.

RECORD YIELD FROM CAGE CULTURE OF CATLA

A high rate of production to the tune of 16.64 kg/sq. m (166.43 t/ha) in eight months was obtained in a culture experiment involving catla from a 10.56 m^2 cage installed at Sankey tank, Bangalore. The cage was stocked at a higher stocking density (450 no./cage). Artificial feed comprising rice bran and groundnut oil cake in equal proportion was provided daily @ 5-10% of the stocked fishes. In 243 days of rearing period the fishes attained an av. wt of 544.12 g from the initial wt of 19.64 g. The total biomass of fish obtained from the cage amounted to 175.75 kg. The net production was equivalent to 15.73 kg/m^2 (157.32 t/ha). The present yield is the highest rate obtained so far from cage culture of carps in peninsular tanks. There was a significant increase in production rate under higher stocking density through the growth of individual fish was rather low.

A NEW DESIGN FOR FLOATING NET CAGES FOR AIR-BREATHING FISHES

This parachute type shape of the net suits well the physical and physiological needs of air-breathing fishes. The large surfacing area of the cage enables the fishes for frequent surfacing effortlessly without hitting each other. Moreover, the cage comes handy for conducting replicated experiments for screening for feeds, etc.

The cage consists of a frame made of galvanised iron rod. It has a lower ring and an upper ring connected by six supporting rods. A plastic basin is fastened to the lower ring. The frame is covered with a nylon net cloth stitched to the rings.

The cage is floated with the help of six rexin floats one fixed to each supporting rod a little below the upper ring. This ensnres enough open space above the water level. A number of such cages can be floated and held in an anchored rectangular floating bamboo frame, if required. Such a cage is light and ideal for using in any protected water body as well as in water bodies in which harvesting is difficult.

FURTHER SUCCESS IN FISH GENETIC ENGINEERING

Polyploidy was successfully induced in Indian major carp, *Labeo rohita* at FARTC, Dhauli. Fertilised eggs of rohu were subjected to colchicine treatment, 25 minutes after fertilisation for inducing polyploidy. Later, when treated fish were subjected to cytogenetic screening, polyploid-diploid mosaics were observed in 6 out of 8 fishes screened. Polyploidy is useful genetic engineering tool of immense potential in culture of fishes and amphibia. Artificial autopolyploids open the road for stock development with favourable traits like disease resistance, faster growth rate, bigger size, etc.

MASS CULTURE OF DUCKWEED *WOLFFIA* FOR USE AS A CHEAP CARP FEED

Success has been achieved in mass culture of aquatic duckweed *Wolffia arrhiza*, which is a nutritious fish food, in sewage-fed circular pond at Rahara Centre of CIFRI. Duckweed contains 32%protein and when tried on Indian and exotic carps resulted in phenomenal growth of the fishes both in fingerlings rearing phase as well as in growing marketable fish. In 100% treated sewage effluent medium a weed harvest of 55 t/ha was obtained in 150 days. In 66% and 50% media the rates of harvest were 38 t and 28 t respectively for the same duration. In a yard experiment conducted at Rahara Centre of CIFRI, carp fingerlings were raised exclusively on *Wolffia* fed at the rate of 10 times their initial body weight for the first 63 days and equal to their body weight during the remaining period. In the 143 days experiment, grass carp, silver carp, common carp, *P. javanicus*, rohu and mrigal recorded growth of 579, 342, 285, 189, 430 and 308 g respectively and a total production of 4,058 kg/ha was obtained. *Wolffia* is equally useful as a feed for fingerlings rearing.

BLEACHING POWDER, AN EFFECTIVE SUBSTITUTE FOR MAHUA OIL CAKE

Based on the experiments conducted by CIFRI at FARTC, Dhauli, bleaching powder, calcium hypochlorite, emerged as an excellent fish toxicant and a potential substitute for the scarce mahua oil cake. In a series of laboratory and field trials the bleaching powder when applied @ 25-30 ppm effectively killed various undesirable fishes in carp pond including *Channa striatus*, *C. gachua*, *Glossogobius giuris*, *Heteropneustes fossilis*, *Mystus cavasius*, *M. bleekeri*, *Ompok bimaculatus*, *Wallago attu*, *Anabas testudineus*, *Etroplus suratensis*, *Nandus nandus*, *P. sarana*, *Oxygaster bacaila*, *Amblypharyngodon mola*, *Ambassis ranga*, *A. nama*, *Puntius ticto*, *etc.*

Bleaching powder is also a good pond disinfectant. Moreover, it retains toxicity only for a shorter period. Plankton and benthos start appearing in the pond from 8th day of the treatment. Application of bleaching powder as fish toxicant is more economical than that of mahua oil cake, and the former is readily available throughout the country. Performance of cultured fishes in bleaching powder treated ones is under study.

NEW ORIENTATION TO BRACKISHWATER AQUACULTURE IN LOWER SUNDERBANS

A cropping sequence system based on paddy, shrimp and fish suitable for large-scale adoption in low lying tidal wetlands in lower Sunderbans has been successfully developed experimentally by the Institute. Normally these coastal tidal lands are used to raise one rice crop during Kharif season. CIFRI has now demonstrated that the paddy plots lying fallow in summer can be utilised for brackishwater aquaculture followed by freshwater fishes and prawns during Kharif season along with paddy. In April, the rice plots were filled with tidal water from the nearby river using a sluice gate. Tiger shrimp, *P. monodon* and mullet, *L. parsia* stocked during early summer in the plot yielded 0.65 t/ha in the month of June. By August the salinity came down considerably due to monsoon and one month old seedlings of CSR-1, Assam (S) and SR-26-B variety of paddy were transplanted. During Kharif season freshwater fishes like *Labeo rohita*, *C.catla*, *C.mrigala*, *H. molitrix* and the prawn *M. rosenbergii* were stocked at the rate of 23,500/ha along with paddy. Paddy harvested in late November gave a yield of 3.1 t/ha and fish and prawn yielded 0.51 t/ha in 83 days of rearing.

This cropping sequence of paddy, fish and shrimps ensures optimum utilisation of tidal wetlands for year-round productive uses where earlier only a single crop of paddy was raised and ensures a higher income for small and marginal farmers. The experiments conducted so far on the system have not shown any degradation of soil on account of summer intake of saline water.

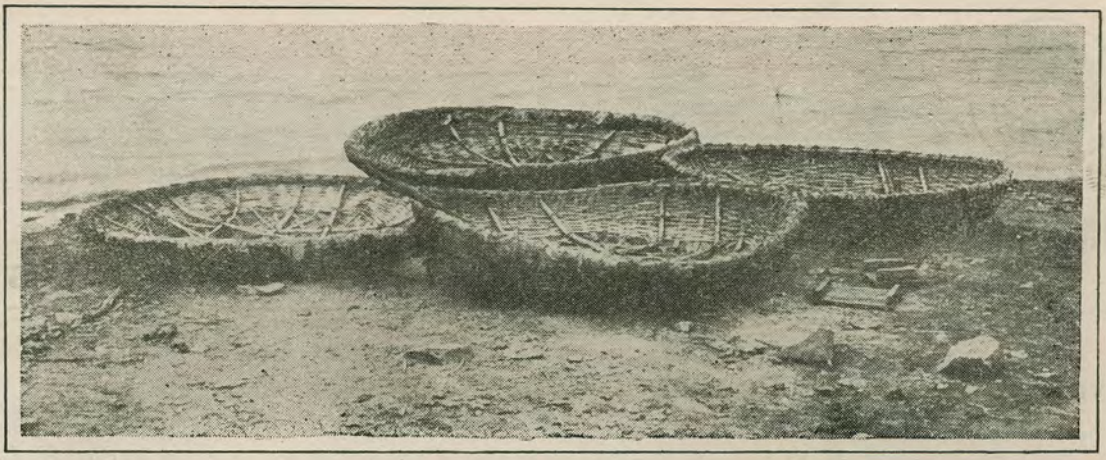
Harvest of the summer crop (tiger prawn and mullets) being done in one of the coastal saline paddy plots in Sunderbans.

ADVERSE EFFECT OF INDUSTRIAL POLLUTION ON FISHERIES IN RIVER TUNGABHADRA

A recent study by CIFRI has revealed a high degree of aquatic pollution in River Thungabhadra due to the effluent discharge from two rayon manufacturing plants, the Harihar Poly Fibre (HPF) and Gwalior Rayon Manufacturing Co. Ltd., (GRASIM) at Kumarapatnam, Dharwar District, Karnataka. The effluents discharged into the river amounts to 33,000 m^3/day from HPF and 490 m^3/hour from GRASIM. The effluents adversely affected the plankton, benthos and fish population at the outfall as well as downstream stretches.

The studies also revealed bio-accumulation of zinc to the tune of 82-100 μg/g dry weight in the tissues of the commercial fish *Puntius kolus* collected from the outfall region. Concentration of chromium was also detected at the rate of 0.12-0.13 μg/g. There was a sharp decline of plankton population in the downstream of HPF effluent discharge point.

A NEW LOW-COST CORACLE FOR FISHERMEN



The low cost coracles fabricated at Bangalore Centre.

A low-cost coracle suitable for fishing in peninsular tanks and small reservoirs has been fabricated. In this new coracle, buffalo hide used in conventional ones is substituted by high density polypropylene (HDPP) or high density polyethylene (HDPE) woven sack material (16×16 counts in runing length). A thin coating of melted bitumen is applied on the outer side of the material HDPP/HDPE) to make the coracle walerproof. The fabrication cost of such a coracle works out to be only one fifth of the traditional ones. As regards to durability both types have same economic life. Taking on to the HDPE/HDPP woven sack coracle, financial burden on the fishermen is substantially reduced in possessing and maintaining a craft. This coracle has already become popular with the fishermen in Karnataka and parts of Tamil Nadu and is fast replacing the conventional one in these States.

A NEW MEASURING BOARD FOR AIR-BREATHING FISHES

A new measuring board for easy measuring of the length of air-breathing fishe has been designed at Bangalore Centre. This measuring board consists of a piece of split half of a hollow bamboo, a head piece, a scale mounted on a wooden plank and a supporting base.

A piece of high density polyethylene (HDPE) pipe of desired diameter, cut length-wise into two can also be used instead of the split bamboo.

Measuring the length of live air-breathing fishes, espectally the murrels with cylindrical body and catfishes with dorso-ventrally flat head and sharp pectoral spines is difficult using conventional flat measuring board. The present measuring board offsets these problems. Live catfishes will fit exactly in the curvature, thus preventing the fish from struggling and slipping out. The device also reduces the time considerably, *i.e.* up to a level of 50, 53 and 43% in casse of murrel, magur and singhi respectively over the time needed by the conventional measuring board.

IMPORTANT EVENTS

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VIITH WORKSHOP ON AIR BREATHING FISH CULTURE

The Seventh Workshop on Air-breathing Fish Culture was inaugurated by Dr. S. Z. Qasim, Secretary to the Dept. of Ocean Development, Government of India on 10th July, 1984 at Veterinary College, Patna. Progress of research and achievements made at various centres of the Project were presented and discussed in the Workshop.

The discussions mainly centred around seed resources, breeding the fishes under laboratory and field conditions and the seed raising. The Bihar Centre achieved large scale breeding of magur in nature under simulated conditions. The Bangalore Centre reported mass scale breeding of magur under controlled conditions besides the high rate of yield in murrel and magur culture in ponds and the growth of magur and singhi fed on formulated feeds. Palair Centre (A.P.) achieved cent percent survival in *Channa striatus* seed raising even at a density of 13 lakhs/ha. The Barrackpore Centre highlighted on nutritive requirements of *Clarias batrachus*, specially the protein sparing action on dietary carbohydrate.

Dr. Qasim was optimistic of narrowing the gap between the theoretical possibility of production and the rate of production obtained under practical conditions by putting together the intellectual, physical, biological and engineering inputs. Dr. P. V. Dehadrai, Fisheries Development Commissioner, Government of India acclaimed the world-wide recognition of air-breathing fishes in nutrition. He called for wider popularisation of the culture technologies. Dr. V. G. Jhingran, Ex-Director, CIFRI spoke on the importance of seed, feed and breed, the three vital aspects in fish culture.

Dr. A. V. Natarajan, Director of CIFRI expressed his optimism that with the improved physical facilities available at research centres of the Project, it would be possible to achieve a higher rate of production. He demanded innovative techniques in seed production and culture of air-breathing fishes. Dr. M. Y. Kamal the Project Coordinator noted that with the limited

facilities available, the progress at various centres was satisfying. After two days discussion, on 11th July, the Workshop concluded with the finalization of the future work programme for each centre.

Dr. S. Z. Qasim, Secretary, Dept. of Ocean Development, Govt. of India delivers the inaugural address of the workshop

VIITH WORKSHOP ON COMPOSITE FISH CULTURE

The Workshop was held at Institute of Engineering and Rural Technology, Allahabad during 5-6 May, 1984. Dr. R. M. Acharya, Dy. Director General (Animal Sciences) of ICAR inaugurated the Workshop. Dr. Acharya appreciated that the demonstration of high production rates at all the centres of the Project over the years paved the way for the Country to embark upon major development programmes in composite fish culture.

The Workshop spanned in to four technical sessions, of which the first two were devoted to discussions on progress of work at various project centres. In the next session, Project Coordinator Shri S. D. Tripathi presented his report on the project. Finalization of the technical

programme for 1984-85 was done in the fourth and final session of the Workshop. Dr. A. V. Natarajan chairing the final session identified a dozen crucial parameters that govern the production process in carp culture ponds.

Shri S. D. Tripathi, Project Coordinator presents his report in the workshop.

The important achievements of the project during the period were highlighted in the Workshop. The Jaunpur Centre experimented a low input technology resulting in production of 3.0-3.5 t of fish/ha /yr applying either fertilizers alone or adopting grass carp as a major component in culture system. The operation cost of production worked out only to be Rs. 1.13-1.42/ kg fish. The Pune Centre repeated its higher production rate reporting a yield of 8.2-10.0 t/ha/ yr. Tuticorin Centre achieved a breakthrough in carp breeding by breeding mrigal in the off-season month of December, 1983.

EIGHTH WORKSHOP ON RESERVOIR FISHERIES

The eighth Workshop on AICRP on Ecology and Fisheries of Freshwater Reservoirs was held at Veterinary College, Patna during 11-12 July, 1984. Shri B. V. Govind, Project Co-ordinator highlighted the ecosystem approach in reservoir fisheries investigations carried out for over a decade. This approach already had yielded rich dividends in certain reservoirs. The Workshop utilized the information gathered so far under the project in order to identify the areas which needed further investigation. Specific management approach needed to implement in all the reservoirs investigated under the project was outlined.

The discussions in the Workshop mainly pertained to the studies on breeding and recruitment, appropriate crafts and gears, experimental fishing, and the policy on stocking and harvesting. It was decided that all the centres would take up in addition to routine investigations, the following programme during 1984-85 :—

—Analysis of unutilized data ;
—Experimental fishing with multimeshed gears ;
—Year-wise analysis of age-groups with reference to the gears used ; and
—Drag-netting of all possible inshore areas for studying possible recruitment.

The report from Ranchi Centre is presented in the workshop.

WORLD ENVIRONMENT DAY AT CIFRI

CIFRI's concern over the deterioration of our environment was once again echoed when the Institute observed World Environment Day on 5th June at its Headquarters at Barrackpore. Speaking on the occasion, Dr. A. V. Natarajan, Director of CIFRI drew attention of the gathered people to the multifarious activities of man that adversely affected the delicate fabric of nature. He said, though organisations, Governments, and departments throughout the world were keen on reversing the process of environmental deterioration, the success of the movement rested on the attitude of the masses. On the occasion, the staff and scientists of CIFRI once again took pledge to spread the message of the Day far and wide.

Dr. A. V. Natarajan, Director addresses CIFRI staff on the occasion of World Environment Day.

Members of ICAR Evaluation Committee on LLP witness a netting demonstratron in a pond adopted under Lab to Land Programme.

IIIRD PHASE OF LAB TO LAND PROGRAMME INITIATED

The IIIrd phase of the ICAR sponsored Lab to Land Programme was initiated in the Institute in June, 1984. This phase covers a total of 600 farm families belonging to the groups of landless, small and marginal families. The programme is implemented through six centres of the Institure.

Earlier under the second phase, three hundred families were exposed to modern aquacultural procedures through this transfer of technology programme. On an average, the farmers could raise their production rate 4 to 8 times more than the yield obtained under traditional practices.

IVTH ADVISORY COMMITTEE MEETING OF NACA AT FARTC, DHAULI

The Fourth Advisory Committee meeting of NACA (Network of Aquaculture Centres in Asia) was held at Bhubaneswar during 3-5 December, 1984. The meeting held in Hotel Konark was inaugurated by Dr. O. P. Gautam, Director General of ICAR. Dr. R. K. Nayak, I.A.S., Secretary for Fisheries, Government of Orissa presided over the function. About thirty delegates representing eight participating Governments in Asia, FAO, UNDP, SEAFDEC (South East Asian Fisheries Development Centre) and University of Philippines attended the meeting.

In his inaugural address Dr. O. P. Gautam stressed the importance of aquaculture research and training in Asia in general and India in particular. He pointed out the role of the four research Institutes in advancing the cause of aquaculture research and development in this Country.

Talking on the occasion, Mr. David M. Thorup, Leader of UNDP Evaluaton Team for NACA Project, said that the team was highly impressed by the progress achieved at FARTC of CIFRI in the brief span of time. He informed the meeting that UNDP is favourably considering the proposal to continue the Project and to continue the funding support at least over the next two years.

The meeting reviewed the programmes and progress of work of NACA and provided fresh guidance and assistance in fulfilling its objective of expanding aquaculture development in Asia and Pacific.

CIFRI HOSTS FOURTH ICAR EAST ZONE SPORTS MEET

The Fourth ICAR East Zone Sports Meet was conducted at CIFRI during 17-24 September, 1984. Over 250 athletes from six Institutes participated in the competition which included ten track events and six team events. Lively competitive thrill and enthusiasm prevailed in the campus during those days. For the athletes and officials gathered at CIFRI, this was also an opportunity to strengthen further the interinstitutional brotherhood, good will and co-operation among the ICAR Institutes.

Dr. T. V. R. Pillay, Programme Leader, Aquaculture Development and Coordination talks to the delegates of NACA Meeting.

Dr. N. K. Chakraborty, Director, JARI speaks at inaugural session of fourth ICAR East Zone Sports Meet.

Shri J. C. Sengupta (IAS Retd.) Vice Chancellor, Bidhan Chandra Krishi Vidyalaya inaugurated the meet. The trophies, shields and medals were distributed by Dr. N. K. Chakraborty, Director, Jute Agricultural Research Institute, West Bengal. Dr. A. V. Natarajan, Director of CIFRI and Chairman, Zonal Sports Committee declared the meet closed.

At the end of the meet, CRRI, Cuttack stood first with 30 points. This Institute was followed by CIFRI, NEH Complex JTRL and ILRI in that order in overall winning position.

As Dr. Natarajan put it, was a privilage for CIFRI to host this meet and to provide a forum to promote understanding, goodwill and cooperation among the participating Institutes.

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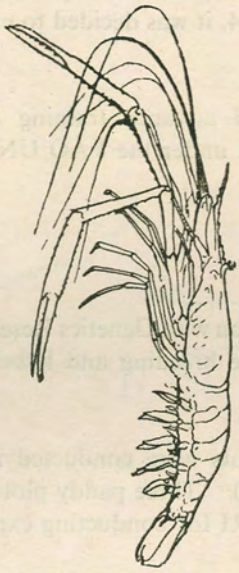

Collaboration

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INTERNATIONAL

- Freshwater Aquaculture Research and Training Centre (FARTC) of CIFRI at Dhauli continued its activities as a joint venture by ICAR and FAO/UNDP. In the fourth Advisory Committee Meeting of NACA (Net work of Aquaculture Centres in Asia) held at Bhubaneswar during 3-5 December, 1984, it was decided to extend the FAO/UNDP aided projects at FARTC for another two years.

  About six scientists received advance training in various aspects of carp culture in leading laboratories of the world under the FAO/UNDP Fellowship programme.

NATIONAL

- 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 (W. Bengal). Three paddy plots of 0.01 ha belonging to the Institute were kept at the disposal of CIFRI for conducting experiments.

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

- 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.

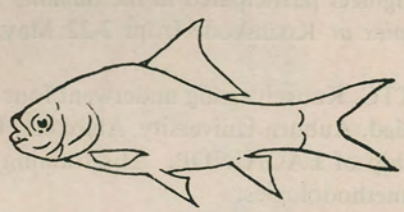
- Similar collaboration was extended by U. P. Fisheries Department to CIFRI in the project Breeding and culture of the masheer, *Tor putitora* at Bhimtal.

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

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

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

□



- Shri M. Ranadhir, Senior scientist at FARTC was deputed to College of Marine Studies, University of Delware, U.S.A. on a Fellowship programme of FAO/UNDP to conduct higher studies in *fisheries economics*. The Fellowship continued from 9th October, 1984 to 8th January, 1985.

- Shri Dilip Kumar, S-2, at FARTC underwent a six months training programme in *Viral and bacterial diseases of fish* in Yugoslavia under the FAO/UNDP Fellowship Programme during 22-11-83 to 21-05-84.

- Shri B. K. Misra, S-2 at FARTC was trained in *Fish health monotoring* under the FAO/UNDP Fellowship Programme in Yugoslavia from December 83 to June 84.

- Shri D. Narayana Swamy, S-1, completed a four months training programme in the field of *fish nutrition* under FAO/UNDP project at the University of Auburn, Alabama, USA from 8-1-84—7-5-84.

- Dr. A. K. Mondal, Senior Scientist at Kalyani Centre worked on hybridization and genetic engineering of frogs for a period of four months at Rice University, USA.

- Shri J. P. Verma, T-6, at KVK, Kausalyaganga underwent a two weeks training programme on *Plant propagation and nursery management* at IIHR, Bangalore.

- Shri S. K. Sadhukhan, Training Associate (Horticulture) at KVK, Kakdwip was deputed to TTC, IIHR, Bangalore for a period of 20 days to aquaint himself with *Recent developments* in *horticultural science*.

- Shri Kuldeep Kumar, T-5, at KVK/TTC, Kausalyaganga was trained in *Instrumentation* at FARTC, Dhauli during April-May, 1984.

- Ms. Mira Sen, Training Associate at KVK, Kakdwip and Ms. Lekha Sanfui,T-4, at KVK, Kaulasyaganga were trained at TTC of NDRI, Karnal from 2-4-84 to 19-4-84 on *Aspects of clean milk and utilization of surplus milk and milk products.*

- They also attended the *Summer Institure on Recent research in child development*, at Lady Irwin College, University of Delhi from 8-6-84 to 26-6-84.

- Ms. Sanfui was also trained in *Rural bakery* under UNICEF Nutrition Education Programme at Extension Education Institute, Anand, Gujarat during second half of November, 1984.

- Shri D. Nath, B. K. Saha, B. L. Pandey, B. C. Jha, R. K. Chakraborty, S. Srinivasagam, and S. K. Saha completed the one month *Orientation Course in Agricultural Research Management* at NAARM, Hyderabad.

Honours and awards

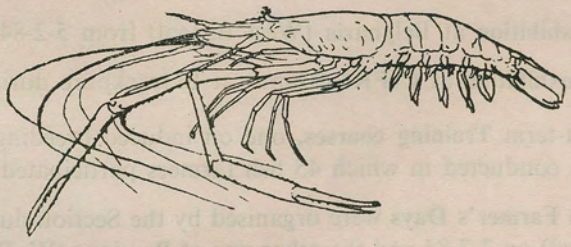
8

The following scientists of the Institute were awarded the degree of Doctor of Philosophy during the year.

Name	Centre	University	Topic of Research
Shri R. D. Prasadam	Madras	Agra University	Studies on grey mullets (Mugilidae) of Pulicat Lake.
Shri N. Sarangi	TTC, Dhauli	University of Calcutta	Ecology of macrobenthos in some sewage and brackishwater impoundments of W. Bengal, India
Shri A. Ghosh	Barrackpore	Burdwan University	Histophysiology of the digestive organs and their relationship with the food and feeding habits in *Notopterus* spp.
Shri P. Das	Barrackpore	Burdwan University	Studies on management and limnobiology in relation to fish production in some freshwater ponds.
Shri B. N. Saigal	Barrackpore	University of Calcutta	Biology and fishery of *Mystus* (*Osteobagrus*) *aor* (Ham.) and *M.* (*Osteobagrus*) *seenghala* (Sykes).

Name	Centre	University	Topic of Research
Shri Shyam Sunder	Srinagar	University of Kashmir	Biology of the indigenous carp *Schizothorax curvifrons* Hackel from stretch of River Jhelum with certain hydrobiological parameters.
Shri M. K. Mukhopadhyay	Barrackpore	University of Kalyani	Effect of heavy metals on fish and fishfood organisms.
Shri Maniranjan Sinha	Kalyani	University of Calcutta	Biology and fishery of the canine catfish eel *Plotossus canius* Hamilton.

Smt. Munawar Sultana, Scientist at Madras Centre was awarded Senior Research Fellowship of ICAR for her Ph. D. Studies.



TRANSFER OF TECHNOLOGY

9

EXTENSION AND NATION BUILDING ACTIVITIES

The technological advancements made by the Institute in aquaculture are efficiently disseminated to the farmers by the extension wing of the Institute and by the centres. Quite a number of new entrepreneurs were identified during the year in addition to those who are already in contact. Short-term training courses, exhibitions, fish farmers' days, audiovisual presentations, extension lectures, farm visits, personal discussions, etc. form the major extension programmes of the Institute.

BARRACKPORE CENTRE

The main extension wing of the Institute, centred at Barrackpore conducted several programmes during the year.

Following were some of the major **Exhibitions** in which the Extension Section participated during the year.

- **Bharat mela** organised at the Territorial Army Ground at Calcutta during 27-12-83 to 11-1-84 ;
- **Science exhibition** at Belgharia (West Bengal) from 5-2-84 to 9-2-84 ; and
- **Fisheries exhibition** at CIFRI campus at Barrackpore during 10-11 March, 1984.

- Two short-term **Training courses,** one on induced breeding and another on composite fish culture were conducted in which 45 fish farmers participated.

- Two **Fish Farmer's Days** were organised by the Section during the year. One was at Jangalpara (W. Bengal) on 7-7-84 and the other was at Bandpur (W. Bengal) on 25-11-84. A total of 250 fish farmers attended the programme to sort out their technical problems in aquaculture.

- The Section conducted two **Demonstrations** during the year on composite fish culture in farmers' ponds at Nababpur and Krishnarampur in West Bengal under Chanditala Block.

Harvest is in progress in one of the demonstration ponds in Chanditala block.

- The following **Group discussions** with fish farmers were arranged during the year by the extension scientists.
  - On *Breeding of carp and hatchery management* at Alipore village on 19-7-84 which was attended by 22 fish farmers ;
  - On *Composite fish culture* at Nilgunj on 19-9-84 and
  - On *Use of organic manure and supplementary feeding in fish culture* at Charuhat (Nilgunj) on 26-9-84.
- The scientists of Extension section delivered a total of 22 **Extension lectures** at various occasions in 1984. The topics covered various aspects of aquaculture practices and fisheries extension. Fish farmers, trainee officials of state Governments and private organisations, students, extension officers, members of voluntary organisations, bank officials, etc. constituted the audience.
- The Section continued to provide **Advisory services** to farmers, financial organisations voluntary agencies, cooperatives, etc. through farm visits, personal discussions, letters and phone calls. It is estimated that over two hundred personnel were directly benefitted by this service. In addition, the technologies of fish culture and the activities and achievements of the Institute were explained to over seven hundred visitors to the Institute in 1984.
- The section also arranged for nation-wide press coverage of CIFRI's achievements in developing technologies in aquaculture and its potential and possible impact on inland fish production of the country.

LAB TO LAND PROGRAMME

- The Extension Section also coordinated the Lab to Land Programme under progress at various centres of the Institute, which covered our six hundred farm families. In addition the section directly had one hundred farm families adopted under its LLP. The details of LLP of the the section are given in the chapter on Lab to Land Programme.

EXTENSION ACTIVITIES OF CENTRES

Kalyani Centre : Some progressive fish farmers of Kalyani (West Bengal) were trained in induced breeding, frog hatchery and nursery managment and rearing of frogs to marketable size.

Rahara Centre : Specialised lectures on fish culture was delivered by P. R. Sen, Scientist under the training programme of West Bengal at KVK, Nimpith.

Demonstrations were given to different extension workers and fish farmers on sewage-fed fish culture and paddy-cum fish culture. Technical advices were given to local fish farmers on various aspects of fish culture.

Kakdwip Centre : A number of students from various colleges and universities, AFPRO trainees from Nimpith, KVK and fisheries extension officers from Govt. of West Bengal were briefed on various technologies of brackishwater aquaculture.

Allahabad Centre : Trainees from CIFE at Bombay, Hyderabad, Barrackpore and Agra centres, and students of Fisheries College, Mangalore were briefed on various aspects of riverine and lacustrine fisheries management.

Puri Centre : Six officials from Laos and 40 trainees from CIFE, Bombay were given demonstrations of shrimp hatchery management practices.

Ranchi Centre : Periodical domonstrations on composite fish culture were organised for the benefit of local fish farmers and post graduate students of Ranchi University.

Pune Centre : Training in composite fish culture was imparted to the candidates sponsored by the College of Agricultural Banking, Pune, two private fish farmers of the locality, and some rural fish farmers sponsored by the Dept. of Fisheries, Government of Karnataka.

KVK/TTC, Dhauli : Under the extension programme of the centre, seed production of Indian major carps and common carp were undertaken. Resultant to the demonstration programmes, 7.5 lakhs spawn of major carps and 1.5 lakh spawn of common carp were produced.

Under the Prime minister's new 20 point programme, the KVK has taken up the task of popularising the technology of composite fish culture in rural areas so as to enable the farmers to reap better harvest of fish from village ponds and thereby earn more income. During the period under report, 4 villages, namely, Kairi, Gangeswarpur, Balakati (Deputisahi) and Matiapada (Pradhansahi) were adopted under this programme involving a total of 105 farmers. In all, 20 training programmes each of one day duration were organised on various aspects of composite fish culture technology.

KVK, Kakdwip : Transfer of technology during the year to farmers through extension activities of the Kendra covered a wide range of agricultural practices such as dry land agriculture, cultivation of pulses and oilseeds, and composite fish culture. The following offcampus training programmes were conducted during the year :

Subject	*No. of Courses*	*Course duration*	*No. of trainees attended*
Fish culture	10	2 days	82
Crop production	10	1-2 days	103
Horticulture	8	-do-	83
Home Science	4	2 days	84

Netting in one of the farmer's ponds adopted under the extension programme of KVK, Kakdwip.

KRISHI VIGYAN KENDRA, DHAULI

While the major emphasis in activities here have been on training and extension in the field of freshwater aquaculture, this KVK is actually envisaged to develop into a composite training centre including other disciplines as well.

The trainees of KVK include farmers, farm women, unemployed village youth, school drop-outs and village level extension functionaries. For their selection, the KVK principally relies upon the data on village and farm family survey.

A fresh programme of survey was initiated in which 3 community development blocks of district Puri, namely, Balianta, Balipatha and Bhubaneswar Relevant information and basic data for various Gram Panchayats have been collected and villages were identified having potential for aquacultural development. The programme of farm family survey is in progress. The survey forms the fundamental basis for identification of training needs, selection of courses and course structuring.

Courses offered

Accordingly, various need-based courses have been developed for imparting training in the field of freshwater aquaculture. These include fish culture, fish breeding, fish seed raising, fish culture-cum-horticulture, paddy-cum-fish culture, duck-cum-fish culture and net fabrication.

Under the Home Science discipline, the courses which are offered with a view to facilitate development of entrepreneurship faculty in the womenfolk of this region as well as to improve upon their general standard of living include tailoring, knitting, handicraft, childcare, mothercraft, improved methods of cooking, fruit preservation, nutrition education, health care and hygiene, sanitation, purification of drinking water, etc.

Training activities

Training activities	*Fisheries*		*Home Science*	
	No. of courses organised	*No. of farmers trained*	*No. of courses organised*	*No. of womenfolk trained*
On-campus	13	190	7	89
Off-campus	13	257	9	142

Unicef nutrition education programme

The KVK, Kausalyaganga is one of the 25 KVKs in the country which has been selected for participation in the Nutrition Education Project being funded by UNICEF (EFNAG Programme).

The work under the project was initiated in August, 1984. A total of 6 training courses each of 3-day duration have already been organised on various aspects of nutrition education involving 118 farm women. The aspects covered under the programme include basic information on food and nutrition, improved methods of cooking, importance of breast feeding, supplementary diets for infants and toddlers, feeding for pre-school and school-going children and nutritional do's and don'ts for pregnant women and nursing mothers.

A scheme on nutrition gardening has been launched with a view to make the selected farm families aware of the fact that how a little piece of land in the backyard of their houses can enable them to have lots of fresh vegetables and fruits to make their diet wholesome and more nutritious. So, far, a total of over 120 farm families in 7 villages have been motivated to develop such nutrition gardens and supplied with planting materials of various fruit trees and vegetables. A model nutrition garden has been developed at the KVK campus to impart practical training on various aspects of gardening as well as to make use of it as a nursery for growing seedlings of various vegetable crops to be supplied to the gardening enthusiasts.

The programmes of honey bee culture and fish culture in backyard ponds have also been initiated under this project.

EXTENSION AND LAB TO LAND PROGRAMME : Separately mentioned under the the respective chapters.

TRAINERS TRAINING CENTRE, DHAULI

Training activities

The training programmes offered at the centre are of two types (a) Short-term courses of 21 days to 2 months and (b) Long-term courses of 3 to 6 months duration. Both are in the field of freshwater fish culture and fish seed production. All the above courses are inter-disciplinary in approach, utilizing the technical expertise available in the Institute as well as outside.

During the period under report, 29 fishery extension staff deputed by the Department of Fisheries, Government of Orissa, one lecturer from Berhampur College, Ganjam and one person sponsored by the Chilka Lake Development Corporation for a period of 3 months and 7 technicians from Bihar Fish Seed Corporation, Patna for a period of 2 months were trained in composite fish culture and fish seed production technologies. The training was also imparted on integration of fish culture with poultry, duck-raising and horticulture. The training courses imparted at this TTC includes on-campus programmes carried out on the Centre's farm as well as off-campus training which provides the trainees with the opportunity to have a thorough background of the technology through lectures, practical and field demonstrations.

At present, 19 persons sponsored by the Deptt. of Fisheries, Government of Orissa are undergoing training for a period of 3 months commenced from 1st December, 1984 in composite fish culture and fish seed production. The earlier training programmes of the year were the following :

Sponsoring organization	*No. of persons trained*	*Duration of training*	*Aspects covered under the course*
Deptt. of Fisheries, Government of Orissa.	29	3 months (1-3-84—31-5-84)	Composite fish culture and fish seed production & integrated fish farming.
Berhampur College, Ganjam ; Maritime Chilka Lake Development Corporation.	2	3 months (1-7-84—30-9-84)	Composite fish culture, fish seed production & integrated fish farming.
Bihar Fish Seed Corporation, Patna.	7	2 months (1-8-84—30-9-84)	-do-
Deptt. of Fisheries, Government of Orissa.	19	3 months (1-12-83—28-2-84)	-do-

COURSES OFFERED

The following courses on fish culture, fish seed production and integrated fish farming were offered to the trainees of TTC during the period under report.

(A) **General**

1. Introduction of fish culture.
2. Principles and system of fish culture.
3. Biology of Indian and exotic major carps.

(B) **Fish culture**

1. Physico-chemical conditions of pond water and soil.
2. Chemical analysis of water and soil of ponds.
3. Pond productivity and its management.
4. Role of plankton in fish culture.
5. Plankton analysis.
6. Pond preparation (nursery, rearing & stocking and management).
7. Aquatic weeds, their control and utilization.
8. Liming of ponds.
9. Eradication of predatory fishes.

10. Eradication of aquatic insects.
11. Fertilization of pond (both organic and inorganic).
12. Stocking and management of ponds (Nursery, rearing and stocking).
13. Composite fish culture.
14. Intensive fish culture.
15. Fish nutrition and supplementary feeding.
16. Fish pathology
17. Harvesting of fishes
18. Economics of composite fish culture.
19. Constraints and hazards of fish culture
20. Role of statistics in fish culture.
21. Air breathing fish culture.
22. Paddy-cum-fish culture.
23. Brackishwater fish culture.
24. Prawn culture
25. Fish diseases and their control.

(C) **Fish seed production**

1. Care of brood stock.
2. Identification of male and female breeders.
3. Role of pituitary gland in fish breeding.
4. Factors responsible for breeding.
5. Breeding of common carp
6. Induced breeding of cultivable carps (Indian and exotic major carps).
7. Bundh breeding.
8. Hathcery management.
9. Stocking and management of nursery and rearing ponds and their management.

(D) **Fisheries extension**

1. Role of extension in training,
2. Integrated fish farming with special reference to horticulture.
3. Banana plantation on embankment of fish culture ponds.
4. Varities of banana suitable for plantation.
5. Poultry farming.
6. Techniques of chick-hatching and rearing and control of diseases.
7. Pig-cum-fish culture.
8. Duck-cum-fish culture.

FISH SEED PRODUCTION

Induced breeding and fish seed production programme were undertaken by the trainees under the guidance of TTC staff. A total of 8.0 lakh spawn of rohu and mrigal was produced at the centre.

EXTENSION AND LAB TO LAND PROGRAMME

(Reported under Chapters on Lab to Land Programme).

KRISHI VIGYAN KENDRA, KAKDWIP

Thei Krishi Vigyan Kendra of CIFRI at Kakdwip imparts need-based skill training to the farming community thereby helping them to strengthen their farming programme on scientific lines. During 1984. the Kendra conducted several courses of short-term duration in addition to the constant technological support given to the farming community of the area. Following are the details of the course programmes conducted in 1984.

ONCAMPUS TRAINING

Fisheries : The subjects covered included composite fish culture, paddy-cum-fish culture, seed collection from brackishwaters, polyculture of finfish & shellfish, culture-of tiger shrimp and gear technology. 12 courses were conducted during the year, participated by 108 farmers.

Agronomy : Five courses covering cultivation of paddy and sunflowers ; reclamation and management of saline soils, and plant protection were conducted in 1984. 48 farmers were benefited.

Horticulture : Eight courses were conducted imparting know-how in cultivation of chilli, water melon, vegetables, cucurbits, fruit plants, coconut, sapota and core crops. A total of 87 farmers attended the courses.

Homescience : Courses were conducted in childcare diet planning and balanced diet, home crafts, wool knitting, tailoring and embroidery, deficiency diseases, and first aid. Seventy six farm women were trained through nine courses.

OFF CAMPUS TRAINING

Several training courses were conducted under this programme as shown below :—

Sl. No.	*Sujbect*	*No. of courses*	*Duration (days)*	*No. of farmers trained*
1.	Fisheries	33	2-4	555
2.	Agronomy	13	2-6	136
3.	Horticulture	6	1	285
4.	Homescience	4	2-3	81

VILLAGE SURVEY : Approaches for village and farm family survey were made with a simpel schedule meant for interview to get an overall idea of the villages with respect to their socio-economic conditions and to identify the village institutions, leaders, school teachers and progressive farmers who could be associated with and utilized to formulate as well as to conduct the need based training programmes. During the period under report four (4) villages and 350 farm families were surveyed.

PUBLICATIONS : The following hand-outs were published during 1984 by this KVK for distribution among the interested farmers and farm women.

1. Cultivation of sugerbeet (*Sugerbeet chas*) .....
2. Cultivation of mustard (*Sarisher chas*)
3. Cultivation of pointed gourd (*Patal chas*)
4. Pest management in betelvine (*Paner roag 'O' poka daman*)
5. Cultivation of sunflower (*Suryamukhir chas*)
6. Fertilizer schedule based on soil test (*Mati parikher vittite saar proyag*)
7. Food preservation (*Khadya sanrakhan*)
8. Health and hygiene (*Swastha 'O' swasthaniti*)
9. Tailoring and embroidery (*Dorjibidhi 'O' suchisilpa*)
10. Balanced diet (*Susama khadya*)

LAB TO LAND PROGRAMME AND 20-POINTS PROGRAMME

(Reported under chapters on Extension and Lab to land Programme)

Lab to Land Programme

The second phase of the Lab to Land Programme was concluded in May, 1984. The Institute had taken up 300 families in this phase covered by 7 centres. With the technological support of CIFRI, these farmers not only had a richer harvest, but also got acquainted themselves with scientific lines in aquaculture.

The third phase of this technology transfer programme was initiated in June, 1984. A total of 600 families at six centres in West Bengal and in Orissa are covered under this phase. The details are given in the table.

Table : Salient features of farm families adopted under IIIrd phase of Lab to Land Programme of CIFRI.

1.	**Total number of adopted farm families**	600
2.	**Breakup—Holdingwise**	
	No. of landless families	83
	No. of marginal families	437
	No. of small families	80
3.	**Breakup – Castewise**	
	No. of S. C. families	242
	No. of S. T. families	3
	No. of B. C. families	19
	No. of O. C. families	336
4.	**Water area covered**	
	Brackishwater area	10.170 ha
	Freshwater area	179.616 ha

LAB TO LAND PROGRAMME AT CENTRES

AT BARRACKPORE CENTRE

The Extension Section coordinated the Lab to Land Programme at various centres of the Institute. The Section has adopted one hundred families under its LLP fold, from Chanditala and Nilgunj areas of West Bengal. The farmers are exposed to induced breeding, seed raising, carp culture, magur culture, integrated farming, horticulture, etc. The fish production in farmers' ponds under IInd phase concluded in May 84 ranged from 2200 to 4784 kg carp/ha/yr and 1675 to 2200 kg magur/ha/6 months.

Seed production : About 7.75 lakhs spawn of Indian major carps and Chinese carps and 3.2 lakh spawn and 80,000 fry of common carp were produced in farmers' pond under Lab to Land demonstration programme.

Seed raising in paddy fields : Field trials in farmers' paddy plots resulted in production of healthy fry (18-25 mm) in 18 days with a survival of 33-37%. Healthy fingerlings were raised in 42 days (40-70 mm) from paddy plots with 40% survival, . Supplementary feeding was adopted in none of these cases.

AT RAHARA CENTRE

Fifteen families adopted under Lab to Land programme were trained to adopt improved culture techniques in paddy-cum-fish culture under both freshwater and brackishwater ecosystems.

AT KAKDWIP CENTRE

The Kakdwip centre has adopted 10 farmers practising brackishwater aquaculture under the Lab to Land Programme. These farmers have taken up monoculture of *Penaeus monodon* in their ponds.

AT TTC, DHAULI

Lab to Land programme for the third phase has been undertaken during the period under report. One hundred farm families in twenty villages have been adopted under this programme covering about 11.32 ha water area. A bench mark survey of the farm families has been completed. The different caste and categories of the adopted farm families are tabulated below :

	% of the total farm families	*Categories of the farm families*	*% of the total farm families*
General caste	54	Landless farmers	43.0
Scheduled caste	44	Marginal farmers	47.0
Scheduled tribe	2	Small farmers	3.0
		Big farmers	7.0

The technologies being transferred under this programme are fish seed production, composite fish culture and integrated fish farming.

Fry rearing programme was successfully carried out at seven villages. In two villages, the farmers could be motivated for increasing the numbers of nurseries and the work has been taken up for excavation of nine nurseries, each having a water area of about 0.02 ha. Brood stock management of common carp was also carried out under the programme.

In two farmers' ponds, the programme of duck-cum-fish culture has been initiated. One-day old ducklings have been supplied to the farmers and the growth and survival of the ducklings are statisfactory.

In two villages, where the programme of composite fish culture has been undertaken, the ponds have been cleared, prepared and stocked. The work is picking up well.

The pond embankments at some of the centres are being utilised for growing various horticultural crpos.

AT KVK/DHAULI

The IInd Phase of the Lab to Land Programme continued till 31st May, 1984. Under the programme, 25 farm families were adopted in 2 villages for the transfer of need-based aquacultural technologies. On March 22, 1984, the ICAR Evaluation Committee visited the LLP centres of this KVK to take a stock of the situation. A status paper on the Lab to Land Programme was prepared and submitted to the Committee.

Work under the III Phase of the Lab to Land Programme has commenced from 1st June, 1984. Of the 200 farm families allocated to KVK/TTC the KVK has been given to handle 100 farm families. The bench-mark survey has been done. In all, 17 centres have been selected for the transfer of various need-based aquacultural technologies, covering a water are of 13.12 ha. The categories and types of the adopted farm families are as follows :—

Landless	18%	Scheduled Caste	37%
Marginal	68%	Scheduled Tribe	nil
Small	14%	Other backward class	12%
Others	nil	General caste	51%

AT KVK, KAKDWIP

The second phase of Lab to Land Programme at this centre covering 25 farm families came to an end in May, 84. Dissemination of various technologies in fish culture brought about a radical change of yield structure both in fish culture and field crops. This increase in yield is reflected in the following table :

Crop	*Av. yield before adoption (kg/ha/yr)*	*Av. yield after adoption (kg/ha/yr)*
Paddy (Boro)	2,500	4,500
Chilli	750	2,150
Potato	3,000	10,000
Watermelon	25,000	52,500
Carp culture	400	3,000
Brackishwater fish & prawn	150	800

During the 111rd phase 200 farm families are adopted for the transfer of technologies. Most of them belong to weaker section of the society.

Library and Documentation Service

10

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 also frequent to this library. The library maintains an active relationship with leading national and international agricultural research information centres.

During the year 14 new exchange relationships were established which would further strengthen the information flow to this library. By the beginning of the year CIFRI had already established a relationship with about 240 foreign and Indian research establishments to receive their journals either on an exchange basis or in gratis. This is over and above the 53 foreign and 65 Indian journals subscribed during the year.

In 1984, 87 books, 48 reprints, 53 miscellaneous publications and over 1,400 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 5466, reprints 3965 ; miscellaneous publications 2289. The library preserves an attractive collection of pamphlets, maps, bulletins, brochures, and acore of grey literature. An amount of Rs, 1,13,438.81 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) unit to serve the various units of the Institure.

Technical reports: About 150 technical and nontechnical queries from India and abroad were attended to by the staff of the Section. In addition, 38 reports on progress of research were compiled and sent to ICAR. 46 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 1984 with over a few hundreds of notifications issued during the year. Interest profiles of about 200 research personnel of CIFRI were updated and the incoming documents were scanned to identify prospective users and issued notifications.

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"**. Eight issues were released during the year.

Current contents lists : Covering the relevent titles of research papers in various journals this is an internal information service of the Section. Six issues of the bimonthly **CIFRI Newsletter** were released by the Section in 1984, intending to serve a larger 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. **Indian Fisheries Abstracts, 19** (1-4), 1980
   20 (1-2), 1981
   21 (1-2), 1982

2. **CIFRI Newsletter, 6** (3-6), 1983,
   7 (1-4), 1984.

3. **Souvenir Released on the Occassion of Fourth Advisory Committee Meeting of NACA (FAO/UNDP Project)**, 3-6 Dec., 1984, Bhubaneswar, Orissa.

4. **Report 7th Workshop, All India Co-ordinated Research Project on composite Fish Culture and Fish Seed Production,** 5-6 May, 1984 (*Mimeo*).

5. **Report 7th Workshop, All India Co-ordinated Research Project on Air-breathing Fish Culture,** 10-11 July, 1984. (*Mimeo*).

6. **Report 8th Workshop, All India Co-ordinated Research Project on the Ecology and Fisheries of Freshwater Reservoirs,** 11-12 July, 1984. (*Mimeo*).

7. **CIFRI Publications**, 1977-1984 (*Mimeo*).

8. **Survey Report No. 7.** A report of the Survey of North Bihar in relation to effects of Gandak and Kosi River Valley Projects on the fisheries of the area. By H.P.C. Shetty & J. C. Malhotra.

9. **CIFRI's Research Project Programmes, 1984.**

10. **Some considerations on introduction of *Tilapia* into Indian waters.** (*Mimeo*)—by A. G. Jhingran.

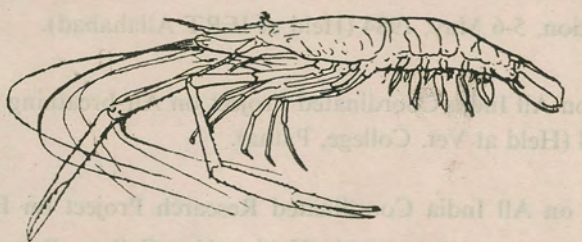
CIFRI Technilogies Reprinted

11. Frog seed production.

12. Fish-cum-duck culture and Fish-cum-pig culture.

13. Paddy-cum-fish culture.

14. Carp seed raising.



Conferences, Symposia, Etc.

11

The following are the important meetings organised/hosted by the Institute during 1984.

* VIth Meeting of ICAR Regional Committee No. II, 10-11 March, 1984.

* Annual Staff Research Council Meeting of CIFRI, 17-18 April, 1984.

* VIIth Workshop on All India Coordinated Research Project on Composite Fish Culture and Fish Seed Production, 5-6 May, 1984 (Held at IERT Allahabad).

* VIIth Workshop on All India Coordinated Project on Air-breathing Fish Culture, 10-11 July, 1984 (Held at Vet. College, Patna).

* VIIIth Workshop on All India Coordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs, 11-12 July, 1984. (Held at Vet. College, Patna).

* Fourth Advisory Committee Meeting of NACA (Network of Aquaculture Centres in Asia), Bhubaneswar, 3-5 December, 1984.

The scientists of the Institute participated in various conferences/symposia/seminars and meetings held during 1984 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.*
Data Analysis Workshop on the Life Sciences (16 January-4 February, 1984)	Indian Statistical Institute, Calcutta.	—	A. K. Roy & Y. S. Yadava.
National Symposium on Applied Biotechnology of Medicinal, Aromatic Timber Yielding plants (12-13 January, 1984).	Calcutta University.	—	K. R. Naskar.
International Conference on Biology of Benthic Marine Organisms-Techniques & Methods as Applied to the Indian Ocean (20-24 January, 1984).	Dept. of Zoology, Marathwada University, Aurangabad.	The brackishwater fish culture technology of India and its role in coastal zone management.	T. Rajyalakshmi.
Workshop on Food From the Sea to Feed a Billion by 2000 A.D. (28-29 January 1984).	Institute for Coastal & Offshore Research, Andhra University, Waltair.	Inland fisheries research of India.	T. Rajyalakshmi.
VIth Programme on Financing Fishery (30 Jan.-3 Feb., 1984)	College of Agricultural Banking, Reserve Bank of India, Pune.	(i) Inland Fishery Resources culture-capture fisheries. (ii) Water resources and their distribution requirement of fish seed. (iii) Techno-economic appraisal of paddy-cum-fish culture/coastal aquaculture.	B. N. Saigal. Apurba Ghosh.

Conferences/Symposia	*Organised by*	*Papers presented*	*Authors/Participants.*
Seminar on Aquaculture (11-12 February, 1984).	Dept. of Fisheries, Govt. of Orissa, Cuttack.	* Principles of composite fish culture.	V.R. P. Sinha.
		* Prospects and potential of freshwater aquaculture in India	S. D. Tripathi.
		Application of genetics in freshwater fish culture.	H. A. Khan.
		* Induced breeding of craps and hatchery management.	K. K. Sukumaran.
		* Control of aquatic weeds in fish ponds.	S. Patnaik.
		* Recent advances in aquaculture practices in Thailand.	N. K. Thakur.
		* Carp hybrids and their importance in aquaculture.	R. K. Jena.
		* Role of information-communication system in aquaculture technology propagation.	B. R. Datta & B. B. Satpathy.
		* Aquaculture : A potential contribute to rural development.	B. B. Satpathy & B. R. Datta.
		* Some common fish diseases and their control in aquaculture.	R. K. Dey.

Conferences/Symposia	*Organised by*	*Papers presented*	*Authors/Participants.*
		* Pond fertilization for optimum fish production.	S. L. Kar.
		* Scope and prospects of brackishwater culture including seed production in Orissa in 1980.	T. Rajyalakshmi.
Seminar on Rural Development (10-11 March, 1984).	Orissa University of Agric. Technology, Bhubaneswar.	—	N. K. Thakur & Radhesham
National Workshop on Changing Perspectives in Extension (February 13-16, 1984).	National Institute of Rural Development, Rajendranagar, Hyderabad.	* Aquaculture research communication.	P. Das, U. Bhaumik & P. K. Pandit.
15th Annual Meeting of the World Mariculture Society (18-21 March, 1984).	World Mariculture Society, Vancouver B. C., Canada.	* A note on growth and production of *Lates calcarifer* (Bloch) in brackishwater in India.	T. Rajyalakshmi & D. M. Reddy.
National Workshop on Fish Seed Production (March 24-25, 1984).	Dept. of Fisheries, Govt. of W. B. Calcutta.	—	P. R. Sen.
Seminar on Freshwater Fisheries and Rural Development (6-7 April, 1984).	Directorate of Fisheries, Govt. of Orissa, Rourkela.	* Technology transfer in freshwater fish culture for rural Development.	S. D. Tripathi.
		* Introduction of *Macrobrachium* group of prawns in rural aquaculture schemes in northern Orissa.	T. Rajyalakshmi.

Conferences/Symposia	*Organised by*	*Papers presented*	*Authors/Participants.*
		* Fisheries in irrigation projects (minor, medium & major) problems potential development and management.	B. V. Govind.
		* Air-breathing fish culture system.	M. Y. Kamal.
		* Effects of inbreeding in culturable fishes.	H. A. Khan
		* Composite fish culture-Is it a successful technology ?	M. A. V. Lakshmanan.
		* On the locational & constructional aspects of freshwater fish ponds.	C. D. Sahoo.
		* On the pelletization of fish feed.	S. N. Mohanty *et al.*
		* Entire family approach in a aquaculture training in rural sector.	Radheshyam *et al.*
		* Rearing of fry in a tribal village of Orissa.	A. N. Mohanty & S. N. Mohanty.
National Seminar on "A historical analysis of the development of science & technology in India and its impact on the Society" (April, 1984).	Centre for Advanced Studies in History & Culture, Bhubaneswar.	Evolution of integrated farming systems for natural resource utilisation particularly for rural upliftment.	V. R. P. Singh & H. A. Khan.

Conferences/Symposia	*Organised by*	*Papers presented*	*Authors/Participants.*
International Symposium on Early life History of the Fishes and 8th Larval Fish Conference (May 7-9, 1984).	Vancouver Public Aquarium Association, Vancouver, B.C. Canada.	Dispersal and recruitment of fry and juveniles of *Chanos chanos* Forskal in Kakinada Bay area (India).	T. Rajyalakshmi.
Summer Institute on "Water Management Practice for Humid Tropics", (May 2-22, 1984).	Kozhikode	—	A. B. Mukherjee.
Seminar on Guidelines for Science and Technology Policy, (June 4-6, 1984.)	National Productivity Council & Regional Research Laboratory, Jorhat.	Potentialities & problems of beel fisheries development in Assam	Y. S. Yadava.
Summer Institute on "Energy Management in Agriculture & Rural Sector - Sources & Technologies", (June 5-28, 1984).	Central Institute of Agricultural Engineering, Bhopal.	—	A. Sneghupta.
Summer Institute on Recent Research in Child Development Implications for Curriculum Change (June 8-28, 1984).	New Delhi.	—	Miss Mira Sen & Miss Lekha Sanfui
Training Course in Use of Computer (June, 1984)	Indian Agricultural Statistics Research Institute, New Delhi.	—	R. A. Gupta.
Environmental Awareness Workshop (June 20-30, 1984).	Bidhan Chandra Krishi Viswa Vidyalaya, Kalyani.	Water pollution and its impact on aquatic life with special reference to the Hooghly stretch of the Ganga river system.	B. B. Ghosh & M. M. Bagchi, M. K. Mukhopadyhay & H. C. Joshi.

Conferences/Symposia	*Organized by*	*Papers presented*	*Authors/Participants*
National Seminar on Integrated Information System for Socio-Economic Development (June 27-28, 1984).	Indian National Science Academy, New Delhi.	—	V. K. Unnithan.
8th Course on Financing Fisheries (July 3-5, 1984).	College of Agricultural Banking, (R. B. I.), Pune.	* Conducted Sessions on : Inland Fishery resources & seed requirements.	B. N. Saigal.
		* Techno-economic appraisal of carp culture murrel and catfish.	(,,)
		* Techno-economic appraisal of fish-cum paddy culture and other integrated systems.	S. Paul
		* Techno-economic appraisal of coastal aquaculture.	(,,)
Ist. International Conference on the Culture of Penaeid Prawns/Shrimps (Dec. 1984).	SEAFDEC Aqua-Ilo-Ilo City, Philippines.	* On the strategy of development of a hatchery technology for prawns perticularly *P. monodon* in Central Inland Fisheries Research Institute, India.	A. V. Natarajan.
		* Notes on the biology of *P. monodon* in the capture fisheries off Orissa Coast India in the context of occurrence of natural brood stock.	T. Rajyalakshmi *et al.*

Conferences/Symposia	*Organised by*	*Papers presented*	*Authors/Participants*
		* An experimental pen-culture study on *P. monodon* in Chilka Lagoon, India and notes on the strategy for brackishwater culture development in lagoons.	P. Ravichandran *at al.*
		* Meeting the natural needs of prawns in gonadal maturation and hatchery, particularly *P. monodon*.	S. M. Pillai *et al.*
		* Growth of *P. monodon* in rainfed poly culture pond at Sunderbans, West Bengal, India.	S. M. Pillai *et al.*
Training Course in Investment Planning & Project Evaluation, National, Sectoral & Regional Perspectives (July30-August 8, 1984).	Institute of Economic Growth, University of Delhi Delhi.	—	S. Paul.
"Pre-implementation Workshop of the AICRP on Pesticide Residues" (August 16-17, 1984).	Indian Agricultural Research Institute, New Delhi.	—	H. C. Joshi.
International Conference on Rainfed Low Land Rice (October, 15-20, 1984).	Konark Hotel, Bhubaneswar.	—	V. R. P. Sinha.
Conservation and Management of Fish Resources (October 27-30, 1984)	Dept. of Biosciences, University of Jammu, Jammu,	* Changing ecology of riverine resources of North-Western Himalaya and its effect on commercial and sport fisheries.	K. L. Sehgal.

Conferences/Symposia	*Organised by*	*Papers presented*	*Authors/Participants*
		* Natural endowment of magur, *C. batrachus* seed in the tribal belt of Chhotanagpur division of Bihar State.	D. Kumar *et al.*
		* Snow trout - possibilities of its culture and problems in Kashmir.	K. K. Vass *et al.*
		* An approach towards successful trout farming in Kashmir.	Shyam Sunder *et al.*
Seminar on LKBU ltramicortome (September, 5, 1984).	Bose Research Institute, Calcutta.	—	R. N. Pal, R. K. Dey & Dilip Kumar
International Symposium on Biological Monitoring of the State of the Environment, India (October 11-13, 1984).	Indian National Science Academy, New Delhi.	Preliminary observations on bottom biota community for monitoring pollution due to community sewage waste in Kol of R. Ganga and the main river Ganga.	A. K. Laal, *et. al*
Vth All India Seminar on Ichthylogy (October 13-17, 1984).	Dept. of Zoology, Govt. P. G. College, Mhow.	Toxicity of three chemical toxicants of freshwater fish *C. carpio Communis*.	D. N. Singh, *et al.*
		Observations of possible methods of averting hazards of loss of viable eggs in breeding hapas in rural ponds having common carps.	Radheshyam.

Conferences/Symposia	*Organised by*	*Papers presented*	*Authors/Participants*
Review of the Year Competition 1984 - Organised by the Information Service, International Centre for Living Aquatic Resources Mamagement.	Makati, Metro Manila, Philippines.	Chemistry of brackishwater fish pond soils with special conference to India.	G. N. Chattopadhyay.
Management of Agricultural rural Development Programmes (November 5-8, 1984).	College of Agriculture, Nagpur.	Agriculture communication for rural development.	U. Bhaumik, P. K. Pandit & P. Das.
National Seminar on Pollution Control and Environmental Management. (November , 1984).	NEERI, Nagpur.	* Pesticide residue monitoring in the Bhagirathi Hooghly stretch of the Ganga river system.	H. C. Joshi.
		* Status of zinc pollution in the Hooghly estuary & the related acute and chronic toxicity to fish and fish food organisms.	B. B. Ghosh *et al.*
17th Annual Convention of the Indian Society of Agricultural Chemists. (November, 27-28, 1984).	Indian Society of Agricultural Chemists, Allahabad.	—	K. Chandra.
Seminar on Soil Resources and Productivity Management - Organised by Indian Society of Soil Science Division & Soil Science & Agricultural Chemistry (November 5-8, 1984).	Indian Agricultural Research Institute, New Delhi.	—	G. N. Saha.
		A study on paddy cum brackishwater aquaculture in coastal saline soil.	G. N. Chattopadhyay, *et al.*
Workshop on "Problems of Transfer of Technology in Aquaculture" (November 21-23, 1984)	National Institute of Rural Development, Hyderabad.	* Overview of CIFRI's contribution to research, training and transfer of technology in fresh and brackishwater aquaculture & management of natural fisheries.	A. V. Natarajan

Conferences/Symposia	*Organised by*	*Papers presented*	*Authors/Participants*
		* Transfer of aquaculture technology by Central Inland Fisheries Research Institute.	P. Das, U. Bhaumik & P. K. Pandit.
38th Annual Conference of the the Society of Agricultural Statistics (November 24-26, 1984).	Calcutta	* Seed estimation and aboundance of commercially important prawn *P. monodon* and *M. rosenbergii* in West Bangal.	G. C. Laha P. B. Das & H. C. Kramakar.
		* Studies on the utilization of sewage (a non monetary input) to increase fish production.	A. K. Roy & Apurba Ghosh.
National Seminar on Organic Waste Utilization and Vermicomposting (December 5-8, 1984).	School of Life Sciences, Sambalpur University, Orissa	Environmental impact assessment (EIA) on organic waste stabilization zone of R. Ganga and its utilization spectrum.	A. K. Laal, *et. al*
National Symposium on Assessment of Environmental Pollution due to Industrialization and Urbanization (December 20-22, 1984).	Dept. of Zoology, Marathwada University, Aurangabad, Maharashtra.	Possible pollution problems from wastes of thermal power plants a case study of Rihand reservoir, Dist. Mirzapur (U.P.)	K. Chandra, *et al.*
National Solar Energy Convention, 1984 (Dec 21-23, 1984)	Solar Energy Society of India, Bhopal.	—	Attended by A. K. Laal.

VISITORS

12

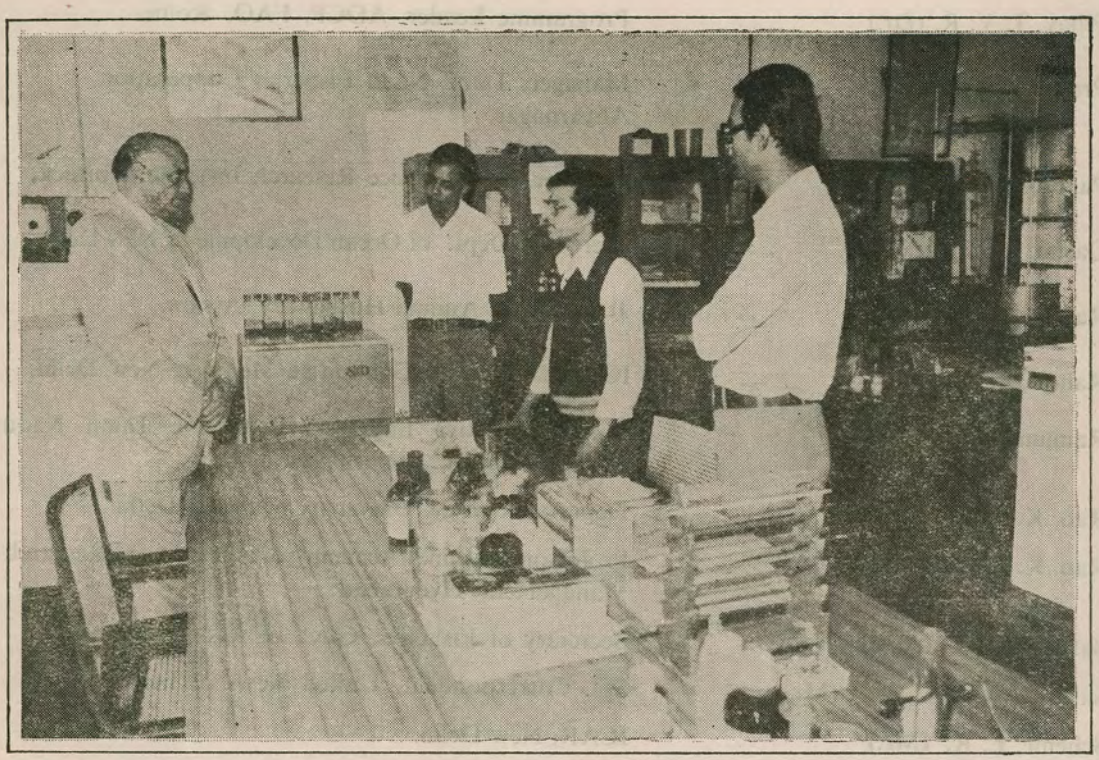
The following is a list of distinguished personalities and scientists from different parts of the country and abroad who visited the Institute and its regional centres. They were taken round the research laboratories, experimental and demonstration centres to apprise them of the achievements of the Institute.

Acharya, R. M. (Dr.)	..	Deputy Director General, ICAR, New Delhi.
Ahmed, R. (Dr.)	..	Deputy Director (Poultry), Assam.
Ali, Yusuf (Dr.)	..	Bangabasi College, Calcutta.
Barua, Bhaskar (Mr.)	..	A. P. C., Government of Assam, Gauhati,
Bouathy (Mr.)	..	Agriculture of Provincial Municipal, Viantiane LAOS.
Bora, P. C. (Dr.)	..	Vice-Chancellor, Assam Agriculture University, Jorhat.
Bose, P. K. (Dr.)	..	Visiting Professor, Cryogenic Engineering Centre, IIT, Kharagpur.
Basu, T. (Dr.) (Mrs.)	..	Ram Mohan College, Calcutta.
Chommany (Mr.)	..	Agriculture of Provincial Municipal, Vientiane, LAOS.
Chaudhury, B. N. (Dr.)	..	ICAR Evaluation Committee Member, New Delhi.
Chen, F. Y. (Mr.)	..	NACA Coordinator, Bangkok.
Choudhury, P. C. (Dr.)	..	FAO, Rome, Italy.
Chowdhury, A. (Dr.)	..	Prof. of Zoology & Head, Marine Science Dept., Calcutta University, Calcutta.
Chandrasekhar, K. (Mr.)	..	Director of Fisheries, Kerala.
Datta, Amal (Mr.)	..	M.P., West Bengal.

Devendran, K. (Dr.)	..	University of Cochin, Cochin.
Dubey, G. P. (Dr.)	..	Fishery Consultant, Govt. of M. P., Bhopal.
Dwivedi, S. N. (Dr.)	..	Director, CIFE, Bombay.
Eyres, J. P. (Dr.)	..	Asst. Education Advisor (Science), Council Divn., British High Commission, Calcutta.
Ghose, Arabinda (Mr.)	..	Spl. Correspondent, Hindustan Times, New Delhi.
Guinerd, F. (Miss)	..	French Scientist.
Gautam, O. P. (Dr.)	..	Director General, ICAR New Delhi.
Gupta, P. D. (Dr.)	..	Dy. Director, Zoological Survey of India, Jabalpur.
Hall, Jillian (Miss)	..	University College of Wales, ABGYRSMOYTH, U.K.
Hazarika, Lakhi Prasad (Mr.)	..	Honourable Minister for Agriculture & Fisheries, Government of Assam, Assam.
Hussain, Md. Delowas (Mr.)	..	Agricultural Extension Officer, Divisional Agric. Office, Goalpura.
Idyll, C. P. (Mr.)		Bethedda MD,U.S.A.
Jennings, Martin (Mr.)	..	University College of Wales, ABGRYSMOYTH, U. K.
Jeswani, L. M. (Dr.)	..	ICAR Evaluation Committee Member, New Delhi.
James, P. S. B. R. (Dr.)	..	Asst. Director General (F), ICAR, New Delhi.
Jhingran, V. G. (Dr.)	..	Ex-Director of CIFRI, Dehradun.
Khan, Md. Golam Azam (Mr.)	..	Asst. Director of Fisheries, Rajshahi, Bangladesh.
Kumar, Kamala (Dr.) (Mrs.)	..	Principal Scientific officer, Dept. of Science & Technology, Government of India, New Delhi.
Karan, Hari Har (Mr.)	..	Minister of State for Forest, Fisheries & Animal Husbandry, Government of Orissa, Bhubaneswar.
Kindo, L., IAS (Mr.)	..	Director of Fisheries, Orissa.
Laisanivong, Amarathithada	..	Agriculture of Provincial, Savannakhet, RDPLA.

Lavarde, Patric (Mr.)	..	French Scientist
Lenka, K. (Mr.)	..	Managing Director, OMCAD, Bhubaneswar, Orissa.
Mukherjee, A. (Mr.)	..	Bar-at-Law, IAS Probatoriet, Govt. of West Bengal.
Menon, A. G. K. (Dr.)	..	Ex-Joint Director, Zoological Survey of India, Madras.
Nayak, R. K. (Dr.)	..	Secretary to the Govt. of Orissa, Bhubaneswar.
Nayak, R. K. (Mr.)	..	Spl. Correspondent, P.T.I., New Delhi.
Palit, A. K. (Mr.)	..	Chief Secretary to the Govt. of Assam, Gauhati.
Patel, N. H. (Dr.)	..	ICAR Evaluation Committee Member, New Delhi.
Pilloquet, J. M. (Mr.)	..	French Scientist
Pillay, T. V. R. (Dr.)	..	Programme Leader, ADCP, FAO, Rome.
Prabhakaran, A. (Mr.)	..	Manager, Tamil Nadu Fisheries Cooperation, Aliyarnagar.
Pande, H. K. (Dr.)	..	Director, Central Rice Research Institute, Cuttack.
Qasim, S. Z. (Dr.)	..	Secretary, Dept. of Ocean Development, New Delhi.
Rahaman, S. (Dr.)	..	Jt. Director, Animal Husbandry, Assam.
Raheja, S. K. (Dr.)	..	ICAR Evaluation Committee Member, New Delhi.
Ramamoorthy, V. (Mr.)	..	Asstt. Executive Engineer (Fisheries), Tamil Nadu Fisheries Corpn., Aliyarnagar.
Rao, K. V. Subba (Dr.)	..	Dept. of Zoology, University of Delhi, Delhi.
Rao, K. V. Subba (Dr.)	..	Professor, National Academy of Agricultural Research Management, Hyderabad.
Samaddar, C. R. (Mr.)	..	Secretary of Fisheries, Govt. of Assam, Gauhati.
Satyanarayanan, T. V. (Mr.)	..	Spl. Correspondent, United News of India (UNI).
Scheme, E. R. (Mr.)	..	ICAR, New Delhi.
Singh, C. S. (Dr.)	..	G. B. Pant University of Agriculture, Pantnagar, U. P.
Singh, Sujan (Mr.)	..	Ambassador designate to Maldives.

Sisana, B. (Mr.)	..	Agriculture of Provincial Municipal, Vientiane, LAOS.
Singkeo, (Mr.)	..	Agric of Provincial Municipal, Vientiane, LAOS.
Sood, S. N. (Mr.)	..	Spl. Correspondent, Times of India.
Soud, (Mr.)	..	Agriculture fo Provincial Municipal, Vientiane, LAOS.
Saxena, B. B. (Dr.)	..	Professor, CIFE, Bombay.
Sharma, T. (Dr.)	..	Prof. & Head, Zologoy Dept., BHU, Varanasi.
Singh, V. D. (Dr.)	..	Dy. Commissioner, Ministry of Agriculture, Krishi Bhavan, New Delhi.
Thongsouk (Mr.)	..	Agriculture Province Savan nekhet, RDPLA.
Thorup, David M.	..	Leader of UNDP Evaluation Team.
Ukil, S. C. (Mr.)	..	Bar-at-Law, IAS Probatoriet, Govt. of West Bengal.
Yadav, J. S. P. (Dr.)	..	Chairman, ASRB, New Delhi.
Yadav, R. S. (Dr.)	..	S. R. O. (Engg.), Aquaculture Engineering Dept., IIT, Kharagpur.



Dr. J. S. P. Yadav, Chairman, A. S. R. B, in a discussion with the CIFRI Scientists in the biochemistry laboratory.

Finance

The provision of funds for the financial year 1984-85 was as under—

Non-plan	:	Rs.	1,86,05,000/-
Plan	:	Rs.	68,00,000/-
Total			2,54,05,000/-

Against the above provision, the expenditure from 1.4.84 to 31.12.84 was as follows :

Non-plan	:	Rs.	1,35,81,568/-
Plan	:	Rs.	5,67,273/-
Total			1,41,48,841/-

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

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

Period : 1983-88.

Location : FARTC, Dhauli.

Investigations on seasonal variation of various physico-chemical parameters *viz.* depth, temperature, pH, total alkalinity, dissolved gases and major nutrients both in water and sediment were continued. The variation in dissolved nutrients (nitrogen and phosphorus) in water remained more or less uniform while in the sediment available phosphate declined from monsoon to post-monsoon period. Available nitrogen and organic carbon content did not show any definite trend.

The oligocarbophilic bacteria have been studied to know the fluctuations in the bacterial counts in the pond water and sediment in different periods of the year. The oligocarbophilic bacterial counts on the sodium-cascinate agar plate gives an indication of the total bacteria in the colony-forming phase, hence is usually known as the total count. The studies carried out in 1984 indicate that the fluctuation in the bacterial population is very much pronounced. The lowest count in the case of planktonic bacteria was in July, whereas the highest was in October. The number increased from 470 ml to 219,000/ml. In the case of sediment also the lowest and highest values were obtained in the same months, the increase being from 1.1 million to 29 million/g wet weight of sediment.

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

Personnel : G. N. Chattopadhyay, A. C. Nandy, N. M. Chakraborti & B. Ghosh.

Duration : 1983-1986.

Location : Rahara Research Centre.

During the period under report, regular application of primarily treated sewage was not done in the pond under study due to heavy monsoon precipitation. This, associated with dilution of pond water, resulted in low BOD_5 values of water, ranging from 4.8 to 6.8 ppm only. D. O. and pH values varied between 4.4 and 12.6 ppm and 7.8 and 8.0 respectively. Amount of water-soluble phosphorus varied from trace to 0.1 ppm. Higher concentrations of nutrient elements were observed after application of sewage effluents and the values started declining thereafter.

Poor nutrient status of the pond was reflected in plankton, bottom biota and periphyton population of the pond. The plankton analysis of the pond revealed that the total sedimentation of plankton varied from trace to those of zooplankton. The representatives of phytoplankters were *Melosira* sp., *Diatomella* sp., *Pinnularia* sp., and *Navicula* sp. among Bacillariophyceae ; *Nostoc* sp., *Oscillatoria* sp. and *Merismopedia* sp. among Myxophyceae ; and *Coelastrum* sp., *Scenedesmus* sp. and *Cladophora* sp. among Chlorophyceae. The dominant zooplankters were *Cyclops* sp. *Diaptomus* sp. and their nauplii stages among copepods, *Moina* sp., *Daphnia* sp. *Simocephalus* sp. among caldocerans and *Brachionus* sp. and *Keratella* sp. among rotifers.

The studies on bottom biota upto a depth of 5 cm at the pond bottom revealed presence of oligochaete worms, culicoides larvae and larvae of hemipteran insects. In general, presence of chironomid larvae at the pond bottom was very limited.

The periphyton community observed during this period were *Epistylis* sp., *Stigeochlonium* sp., *Vorticella* sp., *Pinnularia* sp., and *Amphora* sp. besides a number of ciliates.

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

Personnel : B. N. Singh, K. Kumar and D. N. Swamy.

Period : 1981-87.

Location : FARTC, Dhauli.

Two feeds were formulated to evaluate their nutritional value and growth efficiency. The best feed were formulated to evaluate the nutritive value of the aquatic weed *Salvinia*. The dried and powdered *Salvinia* weed was used to replace a portion of groundnut oil cake and rice bran of conventional carp feed. The feeds were fortified with vitamins and minerals. The crude protein content of the test diet was 23% and that of conventional feed 22.5% The above mentioned diets were pelletized and their feed efficiency will be tested on rohu fingerlings.

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.

Period : 1983-86.

Location : FARTC, Dhauli.

The study on *in vitro* maturation of oocyte of rohu has been intiated with the use of different exogenous hormones like HCG, Desoxycorticosterone and the carp pituitary homogenate under different culture media such as Wolf & Quimby medium and MEM (minimum essential media). HCG was found to give better result in terms of oocyte maturation than LHRH and Desoxycorticosterone in MEM media.

The work on the histology of pineal organ of rohu and mrigal is in progress. In both the species the stalk is long and thin and expands with a saccular end vessicle into the cerebral hemisphere. The ventral surface of the cranial roof has a depression into which the end vessicle is accomodated. The dorsal sac is well developed and thrown into several folds which surround the base of the pineal stalk upto one third of its height.

PROJECT FA/B/5 : CYTOLOGICAL, MORPHOLOGICAL AND BIOLOGICAL INVESTIGATIONS ON CARP HYBRIDS.

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

Period : 1983-86.

Location : FARTC, Dhauli.

About 2,000 fingerlings of rohu-catla hybrid were raised from 4,000 fry. The rearing continues.

Analyses of the flesh of the hybrid showed on an average 81.4% moisture, 54.5% protein and 10.8% fat.

A total of three experiments were attempted on hybridization between grass carp and silver carp. In the first experiment, development of embryo in both hybridised and control eggs was normal till the yolk-plug stage. Most of the eggs turned opaque at this stage. A few embryos appeared to develop further but the characteristic twitching movement was not normal. A few hybrid hatchlings obtained in this experiment, were abnormal and died after hatching.

In the second experiment, 25 hatchlings were obtained from a total of 75,000 eggs. Out of the 25 hatchlings only 5 survived and those are being reared in a pond along with silver carp of karyological studies. In the cotrol, a total of 60,000 spawn was obtained from about 3,75,000 eggs.

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.)

Period : 1980-85.

Location : Kalyani.

In several feeding trials conducted during 1984 and earlier years, tadpoles of *R. tigrina* fed with silkworm pupae powder, in addition to natural food, showed extraordinary growth and precocious metamorphosis. Even early frogs so raised were bigger in size than their normal ones. In indoor culture, early frogs fed with second and third instar silkworm larvae showed excellent growth and cent percent survival. An outstanding achievement made in frog culture research during 1984 is that in four months these frogs could be made to grow to marketable size of over 59 g on feeding with 3rd to 5th instar larvae, adult moth, trash fish and tadpoles.

PROJECT FA/B/7 : CERTAIN PHYSIOLOGICAL ASPECTS OF REPRODUCTION IN CARPS WITH SPECIAL REFERENCE TO ISOLATION OF FISH GONADOTROPIN.

Personnel : (CIFRI) P.K. Mukhopadhyay, Amitabha Ghosh & V. K. Unnithan; (Viswabharati University) Samir Bhattacharya and A. K. Roy.

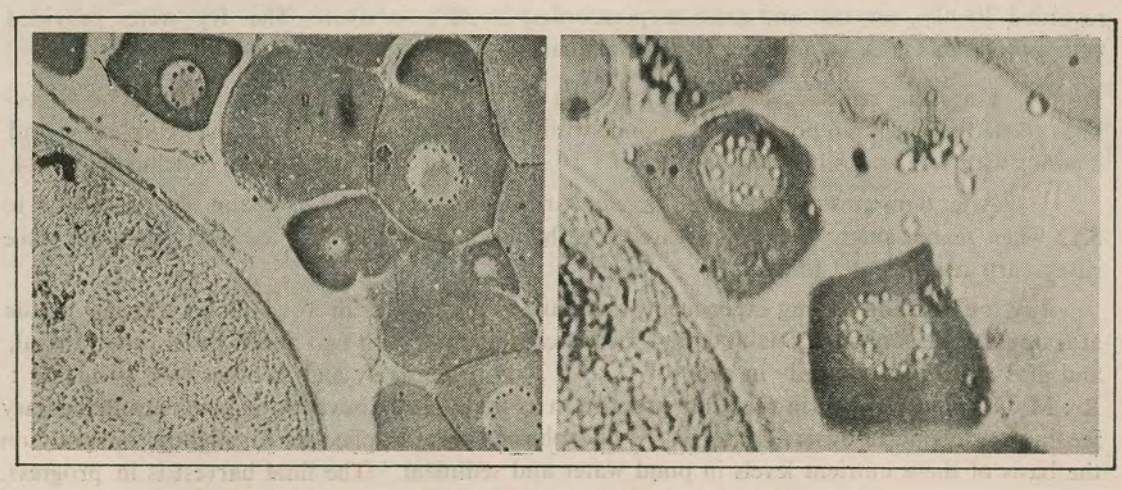
Duration : 1984-86.

Location : CIFRI, Barrackpore, Viswabharati University (Santiniketan).

Biochemical changes : Studies were initiated to investigate certain aspects of physiology of reporduction in common carp, *Cyprinus carpio*. Investigation relating to the variations in the level of total cholesterol, lipid, protein and ascorbic acid in liver and gonads were undertaken in maturing and mature fishes.

Ovarian lipid showed an increasing trend (1.29-2.26%) with increase in maturity of the fish. Cholesterol also showed an elevated pattern (0.29-3.55 mg/g tissue) in ovary with the approach of spawning phase. The level of ascorbic acid showed a decrease in liver tissue (201.90 to 156.19 μg/g) of the fish with progressive maturity.

Histological studies of gonads : Histological observations on the ovary showed three distinct stages of oocytes - vacuolated, yolky and resting - in July. Some oocytes with signs of vacuolation around the periphery of the cytoplasm were also observed. August samples also showed oocytes with yolk granules dispersed throughout the cytoplasm. A few vacuolated oocytes were also observed at this stage.



T. S. of the ovary of *C. carpio* at maturing and mature stages.

PROJECT FA/A/1 : BREEDING OF MAJOR INDIAN AND EXOTIC CARPS AND REARING OF THEIR FRY / 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 : 1981-84

Location : FARTC, Dhauli.

Brood rearing : 2-3 years old brood fishes of the Indian major carps and exotic carps were stocked @ 950-1500 kg/ha singly and in combination. The fishes were provided with formulated feed at 30% protein level in experimental ponds and in control ponds with conventional feed (GOC + Rice bran) @ 3% body weight of the stocked fishes and the grass carps were fed with suitable aquatic vegetation @ 20-25% body weight, daily.

It was observed that the fishes fed with formulated feed had registered better gonadal development compared to the fishes fed with conventional feed. In the case of *Labeo rohita* success in induced breeding was 76% with the fishes fed with formulated feed against 52% in control. In case of silver carp and catla the same was observed 100% and 60% respectively.

However, the number of sets tried in catla was limited. The grass carp and mrigal had also showed a similar trend, but the number of sets tried were very few. A total of 4.4 million spawn were produced consisting of catla, rohu, mrigal, grass carp and silver carp and some hybrids. 766 Vet + Progesterone was tried on stray sets of rohu and silver carp which gave possitive results.

Biochemical studies on the brood fishes at different stages of maturity, with formulated feed and conventional feed are in progress.

Fry rearing : Rohu spawn reared @ 2.25 to 6.25 m/ha recorded survival range of 41% to 65%, catla spawn reared @ 2.5 m to 4 m/ha recorded survival of 46.6 to 62.2% ; mrigal spawn reared @ 2.25 to 3 m/ha recorded 51 to 55% survival, silver carp spawn reared @ 1.25 to 3.5 m/ha recorded 30-40% survival and grass carp recorded 25-30% survival. The fry were provided with powdered G. O. C. and rice polish in equal proportion as supplementary feed.

Fingerling rearing : An experiment on the rearing of rohu and silver carp fry to fingerlings started in 1983 in 6 ponds, i. e. 2 ponds with rohu alone, 2 ponds with silver carp alone and 2 ponds with rohu and silver carp in ratio of 1 : 1 at stocking density of 1 m/ha concluded in 1984.

After 6 months rearing percentage of survival of rohu was 98 to 99 ; in silver carp 51.9 to 52.2 when reared singly and when reared together rohu recorded 90.1 to 96.6% survival while silver carp recorded 69 to 86.2%.

Fry to fingerling rearing experiment was initiated in this year in four 0.1 ha rearing ponds at a stocking density of 1.25 lakh with 4 species combination. In two ponds catla, rohu, mrigal, and grass carp was stocked in ratio of 3 : 3 : 3 : 1 respectively and in other two ponds Sc : R : M : Gc were stocked in the same proportion as mentioned above. Alongwith supplementary feeding, inorganic fertilisers (nitrogen + phosphorus) were applied at fortnightly intervals on the basis of these nutrient levels in pond water and sediment. The final harvest is in progress.

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

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

Duration : 1982-84.

Location : Allahabad.

BREEDING AND CULTURE OF MYSTUS SPP.

Culture of *M. Seenghala* in ponds : The hatchlings produced in April-June, 1982 attained a size of 400-500 mm in ponds by March, 1983. The initial parent stock are also reared along with offsprings in the same pond. The forage fishes mainly *Amblypharyngodon mola*, *P. ticto*, *P. sophore*, *Oxygaster bacaila*, etc. breed prolifically round the year in the pond and serve as food for the growing *seenghala* stock. No supplementary feed was provided. The manuring of cowdung @ 50 kg/month was done, which maintained production of food for the fry of fishes.

Breeding of *Mystus seenghala* : Breeding of *M. seenghala* in the pond at Yusufpur occurred third time successfully during May-August, 1984. Formation of breeding pits commenced on 22-4-84. The eggs were encountered on 28-4-84 in one of the pits and hatchlings (size range 8-12 mm) on 3-5-84. A total of 17 breeding pits (size 30-50 cm dia) were seen in the pond with eggs/hatchlings. The second spurt of breeding was also observed in June, 1984 with the formation of new breeding pits. Certain breeding pits, which had earlier been abandoned, were reused during second spurt of breeding.

It was observed that breeding of the two-year old stock of *M. seenghala*, produced and reared in the pond after the 1st breeding of the parent stock in 1982 and subsequently reared in the same pond, bred for the first time during May 1984 and continued till August 1984. The hatchlings (300-400 nos/pit) ranged between 6 and 15 mm in the newly formed pits.

Breeding in pond continued beyond June till August, 1984 unlike in the previous years, probably due to late rains.

Assessment of seed resources : Assessment of seed resources of *Mystus seenghala* and *M. aor* was done in rivers Ganga and Yamuna at Allahabad and Gomti at Lucknow. Breeding pits located in river Ganga were seen having *M. seenghala* hatchlings (size 10-20 mm). *M. aor* hatchlings were not encountered.

Culture of *M. aor* in pond : To initiate culture of *M. aor* in pond, collection of fry/fingerlings of *M. aor* (Av. size 110 mm) was done in rivers Ganga and Yamuna by spawn net/cast net during August-October 1983. They were stocked in a pond at Khaninar near Allahabad. The forage fishes, mainly *A. mola*, *P. ticto* and *P. sophore*, were stocked earlier to serve as food for growing *M. aor* . During a period of 5 months rearing fingerlings (110 mm) attained an average length of 225 mm (size range 220-250 mm).

SEED COLLECTION AND CULTURE OF EUTROPILICHTHYS VACHA AND CLUPISOMA GARUA

To assess the feasibility of breeding and availability of seed of *E. vacha* and *C. garua* in the middle stretch of Ganga river system, areas in and around Allahabad and Buxar were surveyed during May, 1984 to July, 1984. 300 fingerlings of the above two species were collected at Buxar with the help of scoop net and transported to Allahabad under oxygen packing in the end of July and mid-August 1984. Out of this stock, 225 fingerlings were kept in cement tank and 75 were reared in plastic pools, but due to stress of journey and change in environment 50% fingerlings died on next day. However, feeding trials were done with the remaining fishes. It was observed that both the species accepted chopped weed fishes, insects, molluscs and supplementary feed comprising rice bran (50%), GOC (10%), powedered fish (20%), crushed maize (14%), molasses (5%), minerals (0.8%), vitamins (0.2%) and dolfin oil (in traces).

Efforts were also made to breed the two species by using pituitary gland extract, but the fishes did not respond. The fingerlings reared in plastic pools survived for 29 days and in cement tank for two months.

500 fingerlings (av. 87.5 mm/3.5 g) of *E. vacha* and *C. garua* collected from river Yamuna at Allahabad on 31-8-84 and 1-9-84, were directly released in a pond of 0.15 ha near Sulemsarai, Allahabad. The pond was manured once with raw cowdung @ 5000 kg/ha. Supplementary feeding was regularly done with feed mentioned above.

After 85 days of rearing the fishes grew to 120 mm and 12.5 g. Thus a growth of 32.5 mm in av. length and 9 g in average weight was obtained. Experiment is in progress.

The physico chemical parameters of the pond-water were as follows :

Water temperature (av.)—			25°C.
pH	8.2-8.4	D. O.	6.8-7.2
Free CO2—	Nil.	Alkalinity	125-150 mg/l.
Chlorides—	7-8.8 mg/l.	Sp. conductance—	494-514 micromhos/cm.
Nitrate—	0.001 mg/l.	Phosphate—	0.01 mg/l.

PROJECT FA/A/3 : BREEDING AND CULTURE OF *TOR PUTITORA* AT BHIMTAL, U. P.

Personnel : C. B. Joshi (CIFRI) and K. C. Malkani (State Fisheries , U. P.)

Duration : 1982-85.

Location : Bhimtal, U.P.

A steep decline of catches of Mahseer *Tor putitora* was observed in Bhimtal lake during monsoon months. The landings declined from 411.7 kg in 1982 to 218.2 kg in 1983 and further declined to 169.7 kg in 1984 during monsoon season. Breeding programme was severely affected in 84 due to insufficient landings of quality brooders.

Seven females (500-850g) were subjected to stripping in 84 and a total of about 25,000 eggs were collected (5110 eggs/kg body wt.). Percentage of fertilization was 50-100%. The rate of survival of hatchlings was nill to 100% with an average of 32.4% (39.3% from eggs to hatchlings and 82.5% from hatchlings to fry stages). The hatching process completed between 72 and 144 hours at a temperature range of 22-26°C. The hatchlings were reared in plastic pools and floating nylon cages.

In 30 days rearing of young mahseer fry in plastic pools, (14-15 mm in length and 00.15 mg mean weight) it has been observed that the fry fed with hens egg yolk @ 25-50% body weight twice daily attained the size ranging 20-22 mm in total length and 42 mg average weight, where as the fry fed with encapsulated feed @ 25-50% body weight twice daily attained the size ranging 18-21 mm in total length and 40 mg mean weight.

The growth rate was found to be higher in lake environment. In 30 days they grew to 19-24 mm/102.5 mm from an initial size of 15-17 mm (15.5 mg) with artificial feed no. 1 and 107.5 mg (21-25 mm) with artificial feed no. 2. On conventional feed (Mustard oil cake + rice bran 1 : 1 ratio) they attained an average size of 12-24 mm (82.0 mg) only.

In the nursery pond at Bhimtal, the fry (9-11 mm ; 0.0005 g) grew to 40-70 mm size weighing an average 110.0 g after 180 days of rearing. The survival rate was 36.7%.

During the breeding season in 1984, the water temperature ranged from 21.0 to 27.0°C in Bhimtal lake, 21.0 to 26.0°C in the hatching trays and 22.0 to 27.0°C in the plastic pools. The concentration of the dissolved oxygen was found to be in the range of 9.0 to 9.2 ppm in Bhimtal lake (floating synthetic netting cages) and 7.6 to 9.0 ppm in plastic pool during the rearing operations, whereas free carbon dioxide ranged from nil to 1.8 ppm and nil to 2.4 ppm in Bhimtal lake and plastic pools respectively. The pH of the lake water and the water in the plastic pools was 8.1 to 8.2 and 8.0 to 8.2 respectively.

Besides from Bhimtal lake the efforts for procuring the mature fishes for breeding trials were extended to Naukuchiatal and Sattal lakes in Kumaon hills and Sheer Khad and Alikhad streams in Himachal Pradesh. But failed to get the desired specimens. Moreover the fishes earlier stocked in Kangrand Deoli fish farm (H.P.) had also not been found suitable for taking up any breeding programme during the breeding season of 1984.

PROJECT FA/A/4 : SEED PRODUCTION AND CULTURE OF SCHIZOTHORACID FISHES IN KASHMIR

Personnel : K. K. Vass, Shyamsundar, H. B. Singh, Usha Moza &, R. K. Langer.

Duration : 1983-1985.

Location : Srinagar.

Experimental production and procurement of seed : Only a limited number of brooders could be procured which were kept under control in simulated conditions. In all eight sets of

brooders could be bred, out of which six were of *Schizothorax nigar* and two *Schizothorax esocinus*. Both the species were bred by stripping method. In case of *Schizothorax niger* the brooders ranged in weight between 220-650 g (females) and 80-I50 g (males). About 2 lakh fertilized eggs were produced and reared upto initial fry stage, the survival being 40-60% under different treatments. In case of *Schizothorax esocinus* the females weighed 300-740 g and the males 100-250 g. About 10,000 fertilized eggs were produced which were successfully reared upto early fry in a running water system with 30-40% survival.

Induced breeding experiments with pituitary extract injections were also tried in lake conditions but the fishes did not respond.

Natural seed resources assessment of *Schizothorax niger* was also undertaken in Pushpow nallah adjoining Dal lake during May-July. During samplings, two groups of spawn were collected, one ranging between 10-35 mm and the other between 10-50 mm in length. The stream appears to have good potential for seed for just 1½ months. Mixed spawn assessment were also carried out on Madhumati stream from where spawn of *Schizothoram esocinus*, *S. micropogon S. curvifrons* and *S. planifrons* were collected. The two size groups encountered were 15-30 mm and 20-45 mm in length. Middle stretch of the stream recorded a good density of spawn as compared to the lower stretch near the lake mouth.

Experimental feeding on artificial diet : Laboratory feeding experiments were tried on fry with four artificial diets containing mixture of plant and animal protein. But in all the cases the fry did not respond to artificial diets.

Fish seed transport : Transportation trials with the fry of *Schizothorax niger* (20-40 mm) were conducted. In plastic bags, the fry at two different densities @ 50 fry/l and 100 fry/l were introduced with stream water. Experiments were run in replicates. The transportation experiments were made restricted to 4 hours, 8 hours, 16 hours and 24 hours in case of tin boxes containing plastic bags with 50 fry/l whereas 4 hours, 24 hours and 48 hours in case of tin boxes containing plastic bags with 100 fry/l. The water quality observed during transportation are depicted in the table. The results are averages of various experiments in different periods.

Table : Water quality and mortality rates observed during the transport of fry of *S. niger*.

Parameters	*Initial values*	*Values after time intervals*			
		4 hours	8 hours	16 hours	24 hours
Stocking density 50 No./1					
Water temperature (°C)	10.15	24.0	28.0	24.0	25.0
pH	7.3-7.4	7.2	7.2	7.2	7.2
Dissolved oxygen (ppm)	11.0-12.4	8.2-8.8	7.0-7.4	6.4-6.6	3.2-3.4
Free carbon dioxide (ppm)	2.4-4.6	4.0-4.6	5.0-6.2	5.0-6.8	20-22
Mortality rate (%)		6-16	2-8	2-8	90-98

Stocking density 100 Nos. / 1

		4 *hours*	24 *hours*	48 *hours*
Water temperature (°C)	10-15	25	24	24
pH	7.3-7.4	7.2	7.2	7.2
Dissolved oxygen (ppm)	11.0-12.4	8.3-8.6	7.0-7.2	0.2
Free carbon dioxide (ppm)	2.4-2.6	3.0-3.8	5.2-5.6	30-34
Mortality rate (%)		nil	6-8	96-98

Segregation of spawn : For this the developmental studies of *Schizothorax niger* were undertaken. It was observed that fertilized eggs take about 7-8 days for hatching out at a temperature range of 10-16°C. The hatchlings are 7 mm long, pale yellow in colour with a bulbous yolk sac. The yolk sac is absorbed in about 10 days. Hatchlings takes 15-20 days to become complete fry at 15-20°C water temperature. The fry measures 20 mm in total length, head is 5 mm in length, depth of body being 6-7 mm. The eyes are lateral, mouth being subterminal, and fry is pale yellow in colour with black and small melanophores scattered all over the body. Certain features have been assessed to identify the bigger fry.

PROJECT FA/A/5 INTENSIVE CULTURE OF CARP AND CATFISH IN RECIRCULATORY FILTERING SYSTEM (RFS) PONDS.

Personnel : K. L. Sehgal, Kuldip Kumar, R. K. Das, and S. K. Majumdar.

Duration : 1981-85.

Location : Barrackpore.

In 1984 two trials of rearing spawn of *L. rohita* at stocking density of 30.0 million/ha were carried out. In one experiment using the same diet the percentage of survival after 10 days of stocking was 59%. In the second experiment the RFS pond was given 15 cm thick soil base and was manured with cowdung at the rate of 20,000 kg/ha about 12 days before stocking the spawn at 30.0 million/ha stocking density. The plankton concentration in the pond on 6th day of manuring consists mainly *Brachionus* of (88 units/1), followed by Diaptomus (22 units/1), *Moina* (12 units/1), *Cyclops* (4 units/1) and *nauplii* (14 units/1). Since larger zooplankters are considered unfavourable with the newly emerged spawn the pond was treated with Smithion at a dose of 0.25 ppm 4 days before stocking the spawn. On fourth day of Smithion treatment the density of diaptomids gradually decreased from 22 to 6 units/1 with a corresponding increase in density of *Brachionus* from 88 to 198 units/1. Plankton concentration on the day of stocking of spawn was *Diaptomus* 6 units/1, *Brachionus* 198 units/1 and nauplii 6 units/1. The pond was also given oil-emulsion treatment before stocking the spawn. On the second day of spawn stocking there was a sudden spurt in population of *Diaptomus* and steep fall in density of *Brachionus*. The spawn for the first four days of stocking was maintained on whole-egg encapsulated diet given every two

hour at 15% body weight. From 5th to 12th day the fry was maintained on mash formulation I commencing with 10% body weight gradually reduced to 8% body weight. The experiment was, however, vitiated by the access of *Glossogobius giuris* in the pond resulting in heavy predation of the young fry.

The utilization of RFS ponds as rearing unit for raising fingerlings of Indian and exotic carps has proved that the system is well conceived to raise several crops of fingerlings. At uniform stocking density of 5.0 lakhs of advanced fry of *Catla catla*, *L. rohita*, *C. mirgala*, *C. carpio*, *C. idella* and *H. molitrix* the average survival rate achieved is 81.0, 97.0, 94.0, 72.0, 96.0 and 98.0% respectively in 35-39 days of rearing. The advanced fry were fed on agglomerates every 4 hour in six feeding baskets at 5.0-8.0% body weight. The feed efficiency over conversion ratio for different species are 19.8%/1 : 5.2 in *C. catla*, 54.9%/1 : 2.8 in *L. rohita* 61.8%/1 : 2.0 in *C. mrigala*, 68.4%/1 : 2.0 in *C. carpio*, 81.2%/1 : 1.7 in *C. idella* and 69.8%/ 1 : 1.9 in *H. molitrix*. The average size of different species attained are *C. catla* 93.2 mm ; *L. rohita* 108 mm ; *C. mrigala* 112.3 mm, *C. carpio* 97.5 mm ; *C. idella* 115.2 mm and *H. molitrix* 118.5 mm from initial lengths of 32.0, 36.0, 39.0, 34.0, 33.2 and 30.2 mm respectively.

Along with the experimental work relating to fish production technology random sampling of the extent of natural plankton available in culture units during 1983-84 has shown that Chlorophyceae, Rotifers and Cladocera constitute the bulk. The range of concentration of plankton remained between 840-9360 units/litre. The standing crop of plankton is due to pulses of Chlorococcales and Cladocerans. The dominant genera encountered are *Pediastrum*, *Chlorella*, *Scenedesmus* among green algae, *Brachionus*, *Asplanchna* and *Keratella* among rotifiers and *Daphnia*, *Ceriodaphnia* and *Moina* among cladocerans.

During 1984, diurnal fluctuations of dissolved oxygen in RFS ponds have been studied. In all the units the maximum concentration of dissolved oxygen was at 02.00 PM (8.8-14.8 ppm) and minimum at 05.00 AM (3.6-7.6 ppm) in summer season. During winter season the maximum level of D.O. was 11.00 AM (8.6-11.2 ppm) and minimum at 03.00 AM (6.3-8.8 ppm). This shows that water quality in the RFS never fall below the required level of dissolved oxygen.

The other aspects undertaken during 1983-84 include extent of utilization of artificial feed and natural feed available in culture units. The analysis of gut contents of fry and fingerlings of *L. rohita* of 28.0-90.0 mm in length and 0.4-7.2 g in weight has shown that artificial feed constitute 37.6% followed by green algae 30.3%, diatoms 11.4% protozoans 8.1% and rotifers 3.3%. The important forms encountered are *Ulothrix*, *Spirogyra*, *Closterium*, *Pediastrum*, *Scenedesmus*, *Chlorococcus*, *Tetraspora* and *Cosmarium* among Chlorophyceae, *Fragilaria*, *Synedra* and *Navicula* among Bacillariophyceae, *Diflugia* and *Arcella* among Protozoa and *Brachionus*, *Keratella* and *Polyarthra* among Rotifiera. This shows that natural feed quality play an important role in survival and growth of fry, fingerlings, etc. in RFS ponds.

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

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

Period : 1983-88

Location : FARTC, Dhauli.

Ponds under different management practices *viz.*, (i) feed + fertilizer with aeration, (ii) feed + fertilizer, (iii) organic + inorganic fertilizer, (iv) organic manure and (v) manual input, were stocked with fingerlings of 6 species of carps @ 3000/ha density in proportion of C : R : M : Sc : Gc : Cc : 0.5 : 3.5 : 1.5 : 3.0 : 0.5 : 1. After a rearing period of 10 months best performance was recorded with feed + fertilizer compared to others.

Ponds of 0.1 ha in size with an average water depth of 1.5 m - 2.0 m having alkaline reaction (pH 8.1 - 8.7) high total alkalinity (88-120 ppm), low in dissolved nitrogen (0.02-0.07 ppm) and phosphorus (tr. - 0.04 ppm) were treated with bleaching powder @ 37.0 ppm and mahua oil cake @ 250 ppm separately.

Within 5 minutes of application of bleaching powder, *Colisa fasciatus*, *Notopterus notopterus*, *Labeo rohita*, *Puntius sophore*, *P. ticto*, *Glossogobius giuris*, *Labeo calbasu*, *Cirrhina mrigala*, *C. reba*, *Nandus nandus*, *Amblypharyngodon mola*, *Cyprinus carpio*, *Ambassis nama* and *Esomus dandrica* were killed while in mahua oil cake treatment it took 15 minutes to 2 hours depending on the species.

Chemical parameters of soil and water in these ponds indicated an increase of available phosphorus in soil and dissolved phosphate in water to some extent with the bleaching powder treatment while an increase in dissolved inorganic nitrogen and a fall in available nitrogen in soil was observed in ponds treated with mahua oil cake.

The effect of bleaching powder on the bacterial, plankton and benthic populations is being studied.

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

Personnel : S. K. Mukhopadhyay, S. K. Saha, A. K. Datta, A. K. Roy, N. M. Chakrabarti, B. K. Saha and B. Ghosh.

Duration : 1983-88

Location : Rahara, West Bengal.

With a view to examining the effect to stocking density of growth, yield and survival pattern, carp fingerlings were stocked in nine sewage ponds at stocking densities 5000, 7000 and 10,000/ha keeping three replicates for each density. The species ratio was kept constant for all the experimental units which is *C. catla*, 1.5 : *L. rohita* 1.5 : *C. mrigala* 1.5 : *H. molitrix* 2.5 : *C. idella* 0.5 : *C. carpio* 1.5. In addition to fishes each pond was stocked with juveniles of *M. rosenbergii* @ 1500/ha. Prior to stocking all the ponds were fertilised with primary treated sewage at a ratio of sewage : water (1.5 : 1). The ponds were subsequently treated with lime @ 200 kg/ha for stabilization of the ecosystem. Periodical intake of primary treated sewage @ 4000 gallons per ha per week was also envisaged for these ponds for maintenance of the high values of the nutrient elements in the pond water. Partial harvesting was done from some ponds during May to November 1984. Complete harvesting could not be done due to sudden rise of water level in ponds. Assessment of yield has been made based on sampling upto November, 1984. The ranges of estimated yield were 1595-2309, 2086-4420 and 2116-2954 kg/ha/yr for densities 5000, 7000 and 10,000/ha respectively.

PROJECT FA/A/11 : ECOLOGY OF 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 and M. J. Bhagat.

Duration : 1983-86

Location : Barrackpore.

A total of 720 fingerlings were stocked in a 0.07 ha pond after 24 days of retting. The stocking ratio was catla 5 : rohu 2.5 : mirgal 1 : silver carp 2 : *Puntius javanicus* 0.5. The growth rate recorded after 3 months of rearing was as follows.

Species	Total length (mm)	Av. weight (g)
H. molitrix	240-245	162
C. catla	185-225	90
L. rohita	105-115	50
P. javanicus	235-245	240
C. mrigala	90-100	40

Fishes being studied for their growth performance in the jute-retted pond at Khardah.

No feed or fertilizer was applied during this period of culture.

The results of hydrological studies and the microbiological studies carried out in jute-retted ponds are given in the following table :

(a) *Physico-chemical properties :*

(Water sample collected at 6 AM)	Before retting	During retting	After retting
pH	7.1	6.80	7.5
D. O. (ppm)	2.64	0.80	4.26
CO2 (ppm)	20.00	46.00	10.00
HCO3 (ppm)	180.00	310.00	280.00
CO3 (ppm)	nil	nil	nil
NH_4^+ - N (ppm)	0.15	6.20	1.25
NO3 - N (ppm)	0.06	2.25	1.00
PO_4 - P (ppm)	0.50	1.04	0.30

(b) *Bacterial counts :*

Heterotrophic bacteria	2.2×10^2/ml of water.	1.26×10^4/ml of water.	2.8×10^2/ml of water.
	5.1×10^5/g of bottom soil.	4.4×10^6/g of bottom soil.	1.0×10^5/g of bottom soil.
Phosphate solubilizing bacteria.	3.0×10^2/ml of water.	4.0×10^2/ml of water.	5.5×10/ml of water.
	2.45×10^6/g of bottom soil.	3.5×10^6/g of bottom soil.	1.2×10^5/g of bottom soil.
Nitrogen fixing bacteria	1.04×10^6/ml of water.	3.1×10^6/g of soil	1.0×10^5/g of soil.
	3.0×10/ml of water	2.6×10^2/ml of water.	2.0/ml of water.
Denitrifying bacteria	2.5×10/ml of water.	2.0×10^3/ml of water	1.0×10^2/ml of water.
	1.2×10^5/g of soil	1.0×10^6/g of soil	1.0×10^4/g of soil

The rearing of fish is in progress.

PROJECT FA/A12 PADDY-CUM-FISH CULTURE.

Personnel : A. K. Datta, S. K. Mukhopadhyay, K. K. Bhanot (upto July 1984), S. K. Saha, P. K. Chakraborty (for expt. of 1983-84 only), K. R. Naskar, A. K. Roy, N. M. Bhattacharya and B. B. Das.

Duration : 1983-85.

Location : Rahara, West Bengal.

Sewage-fed paddy-cum-fish culture :

Old trials : (i) Experiment on the culture of *Macrobrachium rosenbergii* (freshwater giant prawn) in one pond measuring 0.4 ha was initiated at the end of September, 1983. Initially, the pond was fertilised with primary treated sewage effiuent at a ratio of 1 : 3 (sewage : freshwater) immediately followed by lime treatment @ 200 kg/ha for stabilisation. After three week of fertilization, the pond was stocked with *M. rosenbergii* at a density of 15,000 juveniles/ha, average weight being 4.18 g. Indian and exotic carp fingerlings were also introduced in the pond @ 2,250 nos./ha. Initially, supplementary feed, a mixture of rice polish and mustard oil cake (1 : 1) was provided @2% of the body weight of fish and prawn mainly aiming to reduce the cannibalism among prawn. Harvesting operation could not be done completely in time due to unprecedented rainfall during the year. However, a production of 1.7 t fish and 0.9 t prawn totalling 2.6 t/ha/yr has been estimated on the basis of sampling.

Biotic characteristics of the pond revealed that phytoplanktonic bloom appeared after initial intake of treated sewage water into the pond, comprising algae belonging to class Myxophyceae and Chlorophyceae. The range of plankton sedimentation varied from 0.5 to 4.0 ml in 50 litres of pond water. Among different phytoplankters species of *Lyngbya*, *Spirulina* & *Closterium* were observed to dominate over other groups, while rotifers mainly *Brachionus* and nauplii of copepods were dominated among zooplankters.

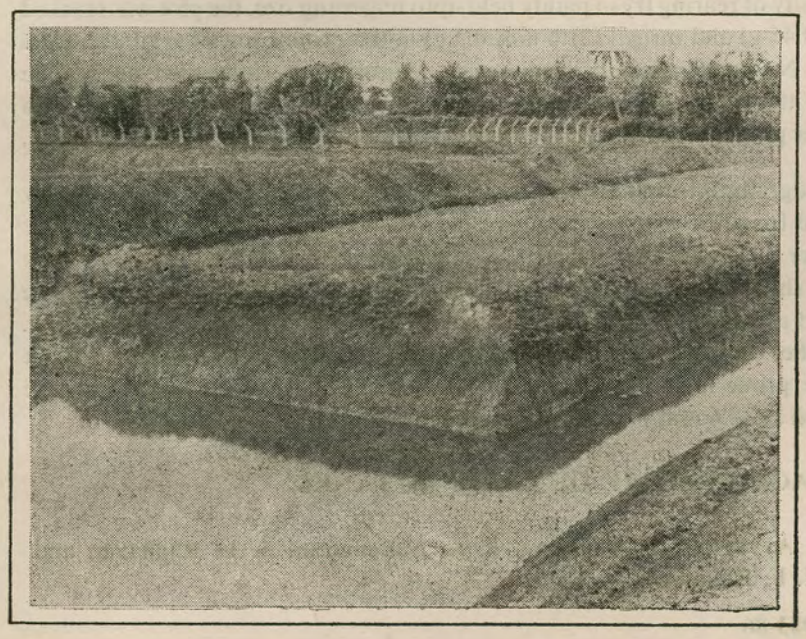
Among abiotic factors, DO level of the pond water ranged from 0.9 to 12.6 ppm, pH 7.6 to 8.2, alkalinity 80 to 135 ppm, dissolved inorganic nitrogen 0.15 to 0.95 ppm and phosphate 0.09 to 2.1 ppm.

(ii) In another plot (0.38 ha) having two ponds (0.07 ha each) on either side was stocked during September-November, 1983 with carp fingerlings at a density of 4,000 nos./ha and the species composition was *Labeo rohita* (25%), *L. bata* (15%), *L. calbasu* (23%) and *Puntius javanicus* (37%), besides *Liza tade* @ 130 nos./ha. In addition to this, *Macrobrachium rosenbergii* was also stocked @ 2,000 juveniles/ha in September, 1983. Initial size of the species was recorded as 78.9 mm/4.5 g for *L. rohita*, 107.6 mm/10.3 g for *L. bata*, 54.3 mm/2.5 g for *L. calbasu*, 87.4 mm/8.8 g for *P. javanicus*, 58.3 mm/3.0 g for *L. tade* and 78.4 mm/4.2 g for *M. rosenbergii*. Final harvesting could not be possible due to heavy showers. As such, culture operation was extended and continued in 1984.

Periodic sampling was done to assess the growth of stocked fishes. Within 14 months, *L. rohita* attained an average weight of 374.2 g, *L. bata* 68.3 g, *L. calbasu* 145.0 g, *P. javanicus* 318.3 g, *L. tade* 75.0 g and *M. rosenbergii* 100.10 g.

During rabi season of 1984, Ratna paddy was cultivated in this plot with treated sewage mixed pond water. NPK fertiliser was used once for regaining nutrient status of this plot. The yield of paddy was 6081 kg/ha/125 days.

The dyke area of the plot was also utilised by planting banana and coconut. About 5,000 banana were harvested during the period of 14 months.



A view of the sewage-fed paddy-cum-fish culture plot showing perimeter canal at Rahara farm of CIFRI.

The plankton sedimentation of this plot varied from 0.6 to 5.0 ml/50 litres of water. Species of *Spirogyra*, *Euglena*, *Lyngbya*, *Nostoc*, *Closterium* & *Ankistrodesmus* were dominant phytoplankters while *Cyclops*, *Diaptomus*, nauplii and rotifers were the dominant forms amongst the zooplankters. Among bottom macrofauna molluscs (family - Viviparidae and Lymnadae) were the prime forms followed by different types of insect larvae.

During the period under report, the DO level of the system varied between 4.0 and 7.4 ppm while pH ranged from 7.2 to 8.6, total alkalinity 86 to 180 ppm. Values of dissolved nitrogen and phosphate varied from traces to 0.5 ppm and traces to 1.8 ppm respectively.

New trials : (i) During the period under report, one paddy plot (perimeter canal system) measuring 0.18 ha has been renovated and undertaken for culturing *Macrobrachium rosenbergii* mainly alongwith few carps.

M. rosenbergii at a sex ratio of 1.00 ♂ : 2.18 ♀ has been stocked in December, 1984 at a density of 18,000 nos./ha with an average size 92.8 mm/7.5 g for male and 76.5 mm/4.25 g for female. In addition to this, the plot has been stocked with *Puntius javanicus* (132.2 mm/29.1 g) @ 500 nos/ha to utilise the excess periphyton and filamentous algae. Other carp species are being stocked.

(ii) During the period, one new plot, was converted into a paddy field (unilateral system), measuring 0.03 ha of which, the effective paddy grown area has been measured as 0.027 ha and the remaining portion is covered by a 1.5 m deep ditch.

A local variety of paddy (Pantaras) was planted in this plot in the month of September, 1984. To assess the possibility of rearing fry in paddy field upto fingerling size, the plot was stocked with fry of rohu (20.4 mm/0.45 g) and mrigal (21.6 mm/0.5 g) in the proportion of 1 : 1 at a total density of 50,000 nos/ha. No supplementary feeding nor manuring was provided during the course of experiment. But the plot was treated with sewage water @ 5000 gallons/ha prior to stocking of fish. In the later phase of experiment the plot was fed with sewage mixed pond water.

Harvesting of the agri-aqua products was done in December, 1984. A total quantity of 25 kg paddy was obtained from the plot indicating a production of 833.3 kg/ha alongwith hay of 1.7 t/ha. A total number 183 rohu and 94 mrigal fingerlings were harvested from this plot after 3 months rearing showing a production (in number) of 6.1 and 3.12 thousand/ha. The resulted fingerlings indicated a survivability of 24.4 and 12.5% for rohu and mrigal respectively. Chances of escapement of fishes through hole made by field rat and crab at the base of the adjacent boundary wall probably the prime factor for low survivability. The growth attained by the two species has been recorded as 82.6 mm/5.1 g for rohu and 112.0 mm/10.1 g for mrigal.

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

Personnel : S. Ayyappan, S. Sivakami, P. K. Sukumaran, S. L. Raghavan and M. F. Rahman

Period : 1983-86.

Location : Sankey Tank, Bangalore.

Cage culture experiments :

The experiment on rearing of catla fry to fingerlings at a stocking density of 6.628 lakhs/ha (700 nos. in the cage of 10.56 sq. m) was completed after a period of 90 days. The fish (av. 79.30 mm/5.45 g) in the test and control cages had grown to 103.75 mm/19.64 g and 88.85 mm/8.09 g respectively. Fish were fed with rice bran and groundnut oil cake in an equal proportions @ 20% of the body weight. The survival rate in the test and control cages were 70.57% and 33.57% respectively.

Further, table size rearing of catla fingerlings was intiated at density of 4.64 lakhs/ha (490 nos. in the cage) in the two cages, with and without artificial feed. In the control cage the stocking density was 2.23 lakhs/ha (235 nos./cage). The experiment was concluded after a period of 8 months. The fish had grown to 320.36 mm/544.12 g in the experimental cage and 297-43 mm/380.57 g in the control cage respectively. The yield in the experimental cage was 175.75 kg and that in control cage was 23.25 kg. An escapement of 88 fish in the test cage and 25 fish in the control cage reduced the percentage of recovery to 65.92% and 25.96% resepectively. But for

this loss which is not mortality, the survival rates in the two cages are 83.87% and 36.59% respectively. The gross production in the test production was 157.32 tonnes/ha for 8 months and net production was 157.32 gonnes/ha for 8 months.

Rearing of common carp from fry to fingerlings stage at two different stocking density was conducted. The stocking density was 2,500 nos/cage (23.67 lakhs/ha) with an initial average length/weight of 34.90 mm/0.39 g. The experiment was concluded after 290 days of culture and the survival rate was 64.04%. Those stocked @ 3,000 nos/cage (28.4 lakhs/ha) with an initial average length/weight of 37.27 mm/0.50 g were reared for a period of 194 days with a survival rate of 64.87%. Artificial feed comprising of rice bran and groundnut oil cake (1 : 1) was given at the rate of 10-20% of body weight in both cages.

Rearing of common carp from fingerlings to table size @ 528 nos/cage (5 lakhs/ha) is in progress. The initial average length 181.24 mm/89.14 g in the experimental and 143.36 mm/44.11 g in the control cage had grown to length/weight 197 mm/119.20 g and 157 mm/47.34 g respectively in a culture period of 42 days.

Biochemical studies on carps cultured in cages :

Cage culture experiments to rear advanced fry of silver carps to table size with different combination of feed was completed after a culture period of 9 months. The experiment was started on 21-12-83 with advanced fry of silver carps at a stocking density of 2.8 lakhs/ha (180 nos/cage of 6.25 sq. m. area). They were stocked in 3 cages designated as experimental I (E-1), experimental II (E-2) and control. Artificial feed comprising of silkworm pupae (40%), fish meal (40%) and maida (20%) was given in the E-1 cages, while the feed given in E-2 cages was composed of silkworm pupae (25%), wheat bran (50%) and maida (25%). The feed was given at 10% of the body wieght daily.

The fish with an initial average length/weight of 62.83 mm/3.0 g had grown to 297 mm/264.51 g in the E-1 cage, 225 mm/115.55 g in the E-2 cage and to 281.89 mm/227.50 g in the control cage in a culture period of 9 months.

The parameters analysed and their ranges in the test fish and control fish were as follows :—

Parameters	Test fish		Control fish	
Moisture	73.69	89.85%	82.36	89.85%
Protein	12.37	21.77%	12.37	17.10%
Fat	2.12	3.88%		
Glycogen	0.08	0.15%	0.02	0.15%

No distinct differences were observed between the test and control fishes, with regard to histological characters.

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 : 1983-86.

Location : Kolleru lake.

Survey was conducted during the 1st half of the year to study the existing conditions of fish culture and management of trench type 'ponds in Kolleru lake area. The study indicated that 230 units impounded many tanks in different contours of the lake with a total waterspread area of about 2,500 hectares. The ponds varied in size from 2 to 16 ha in waterspread area. The study also revealed that scientific methods of fish culture and pond management are largely absent resulting in poor yields, not exceeding in an average production of 500 kg/ha/year.

PROJECT FA/A/15 : FISH FEED FORMULATION AND NUTRITIONAL BIOENERGETICS OF ASIATIC CARPS.

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

Period : 1983-87

Location : FARTC, Dhauli.

Feed formulation : Blood meal, aquatic weed (*Salvinia* sp.) powder and sugar wastes were incorporated in the conventional feed mixture of groundnut oil cake and rice bran and was fortified with vitamins, minerals and trace elements. Two test diets were prepared with a protein level of 28-29%. One comprised blood meal, rice bran and groundnut oil cake (1 : 3 : 6) and the other groundnut oil cake, *Salvinia* and sugar wastes (8 : 1 : 1). These diets were tested in the laboratory against the conventional feed mixture on the fry of *Labeo rohita*. In a 60 day experiment with three replicates under each diet, it was observed that the growth performance was the best (0.8 g average live weight gain) with the feed comprising blood meal (Diet A). The live weight gain with the feed comprising the aquatic weed powder and sugar wastes (Diet B) was 0.45 g as against 0.44 g with the conventional feed. The growth was found to be significantly high with Diet A at 1% level.

Testing of commercial diets : A locally available commercial diet consisting of groundnut oil cake, rice polish, fish meal, vitamins and minerals with 7% moisture, 30% protein and 12.9% fat was tested against groundnut oil cake and rice bran mixture (5.45% moisture, 18% protein and 7.35% fat) and dehydrated aquatic weed, *Salvinia* (5.9% moisture, 16.73% protein and 4.2% fat). The best growth (0.78 g average increase in body weight) and the highest rate of survival (96.67%) was observed with the commercial diet in a 50 day experimental run in the laboratory on rohu fry. *Salvinia* diet resulted in the loss of wieght and the lowest survival (3.3%).

Protein and fat composition of body muscle and alimentary canal : Studies on the protein and fat content of the muscle and alimentary canal of silver carp, grass carp and rohu, maintained on the pelletised feed (30% protein level) comprising rice bran and groundnut oil cake and fortified with vitamins and minerals were made and compared with those maintained on the conventional diet (18.0% protein). The results were as follows :

	Muscle		*Alimentary canal*	
Species	*Protein* (%)	*Fat* (%)	*Protein* (%)	*Fat* (%)
	Pelleted feed (30% protein)			
Brood silver carp	72.72	17.00	22.40	65.00
Rohu	62.56	19.64	32.01	45.90
	Non-pelleted conventional feed (18% protein)			
Grass carp	59.63	26.09	17.74	8.70
Silver carp	56.36	13.27	16.35	8.35

Preparation of feed composition table : About 50 feed ingredients, received from the various centres of the All India Coordinated Research Project on Composite Fish Culture and Fish Seed Production, as well as available locally have been analysed for their proximate composition and a table prepared to enable feed formulation.

Fasting catabolism : Studies on fasting catabolism with rohu at an ambient temperature of 27.2-27.0°C indicated a weight loss of 6.38-30.43% at the end of a 60 days starvation period. A higher percentage of weight loss was registered in juveniles than in adults.

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

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

Period : 1983-88.

Location : FARTC, Dhauli.

Various substances such as full cream milk powder (containing 26-38% fat), urea, sodium chloride, sodium sulphate + tannic acid and human urine + tannic acid were used for the first time for degumming of fertilized eggs of common carp. The milk gave the best result in removing the adhesiveness of eggs, rate of fertilization, percentage of hatching and egg swelling.

Of the several chemicals tried for marking common carp and rohu, M-Procian Blue was found to be the best. Adult fishes of both species have been found to retain the mark for more than one year. In case of the fingerlings of common carp which were injected with the above dye and reared in nursery ponds, the mark was retained for more than 2 months.

Experiments are being conducted in four ponds on the response to the selection and heritability for body weight in two separate lines of common carp. Fingerlings obtained from the progeny of Parents I (Line I) and Parents II (Line II) grown under identical conditions were chosen in two groups i. e. select and non-select. First of all two random samples of fingerlings were taken from each line. From the first sample, largest fignerlings numbering 140 were selected for each line. The average initial weight of the selected fingerlings was 12.0 g from line I and 13.8 g from line II. From the second sample, 140 fingerlings were randomly taken from each line. The average initial weight for these fingerlings 9.3 g and 6.7 g respectively from the first and second line. Different markings were used to identify 4 groups of fingerlings in both lines. The total stocking density of fingerlings was @ 7000/ha. Experiments are still in progress. However, the monthly sampling from each pond showed that a trend could be observed wherein the select progeny showed better growth than the randomly chosen progeny.

The hybrids produced were stocked in nursery ponds along with common carp fry produced from the same mother in the last week of October, 1984. The hybrid growth performance will be studied in due course of time.

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

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

Period : 1983-85.

Location : FARTC, Dhauli.

Gynogenesis : Experiments were conducted for artificially inducing gynogenesis in *Cirrhinus mrigala* and have been successful for the first time. As in the case of *Labeo rohita* and *Catla catla*, restoration of diploidy in the activated eggs was possible by cold shocking (12°C ; 10 min) or heat shocking (39°C ; 1 min). *Cyprinus carpio* milt irradiated by ultravoilet light was used for activating mrigal eggs. Some of the gynogenetic mrigal are being reared in the laboratory while about 200 have been released into a pond.

Polyploidy : Fertilized rohu eggs were exposed to cytochalasin B concentrations of 10 μg/ml and 5 g/ml during their development till the 4 celled stage, and the 8 celled stage. The higher concentration did not yield viable offspring. Treatment with 5 μg/ml concentration (8 celled stage) yielded over 300 hatchlings. They are being reared in a pond for cytological screening.

Chromosome studies of suspected rohu polyploids produced in earlier experiments have shown that polyploid-diploid mosaics could be induced in *Labeo rohita*, when fertilized eggs

were exposed to colchicine (0.01%). The treatment started 25 min. after fertilization and lasted till morula stage. Polyploid-diploid mosaics were observed in six out of eight fish screened.

PROJECT FA/A/18 : ICHTHYOPATHOLOGY AND FISH HEALTH PROTECTION.

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

Period : 1983-88

Location : FARTC, Dhauli.

Routine diagnosis and examination of samples from LLP ponds were conducted and remedial measures suggested. Most common and serious diseases were investigated in detail such as cases of large-scale mortality of catla fingerlings due to gill myxoboliasis and mass mortality of Indian major carp fingerlings due to parasitic infection of uncorfirmed identity. In the latter case infected specimens showed minute blisters throughout the body, haemorrhages and abnormal swimming behaviour ultimately resulting in mass mortality within in a fortnight. Large number of parasitic spores were detected inside each blister. Infected carps were treated inside the laboratory to evaluate the efficicay of various drugs.

Environmental gill disease was detected initially in catla fingerlings related to increased carbon dioxide (40 ppm) and ammonia (0.2 ppm) levels and decreased dissolved oxygen level (0.72-4.08 ppm). The condition caused gill hyperplasia in other major carp species also, e.g. common carp, silver carp, rohu and mrigal. However, the most susciptible species was found to be common carp. This observation was made on the basis of *in situ* field experiment by inducing similar pathological condition in healthy carp species kept in nylon hapas in the pond.

Balanced pelleted feed and medicated feed with antibiotics and antiprotozoal drugs could not reduce the disease level. Several drugs and improvement in water quality are being tried in the lab to cure the diseased specimens.

Quite a large number of additional bacterial strains were isolated during the period from diseased fish specimens. The most common among them are the strains of *Aeromonas hydrophila* isolated from different organs of catla, rohu and silver carp. Bacterial strains were differentiated on the basis of gram staining, O/F, Catalase, motility, VP, H_2S indol, citrate, malonate, ONPG, urease, gelatinase, NO_3-NO_2, glucose, glycreol, mannose, mannitol, galactose, fructose, maltose, erabinose tests, etc. EPC cell lines brought from Yugoslavia are sub-cultivated. Primary cell culture is being used to test the viral pathogens, if any.

Histopathological studies in some vital organs of the Indian major carp, *Catla catla* (150-200 mm) infected by *Myxobolus* spp. revealed the presence of *Myxobolus* spp. cysts of varying sizes in the gills and the kidneys. Larger cysts were at the distal while the developing smaller ones at the proximal end of the gill filaments. The infection restricted, through damages, the respiratory surface in the gills and excretory tubules in the kidneys. Histopthological observations on the *Microsporidia* infected rohu revealed that the parasites were found in the tubular epithelial cells causing extensive damage, degeneration and necrosis of the kidney tubules.

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

Sub Project I : *Intensive culture of Spirulina sp., and Brachionus sp. in the laboratory and field.*

Sub Project II : *Duckweed culture with sewage waters.*

Personnel : *Sub project-I* : A. C. Nandy, N. M. Chakraborty, A. C. Banerjee and B. Ghosh.

: *Sub project-II* K. R. Naskar, A. C. Banerjee and B. B. Das.

Duration : Sub project-I : 1983-1988.
Sub project-II : 1983-1984.

Location : Rahara Research Centre.

Culture of algae and rotifers : Mass culture of *spirulina platensis* and *spirulina fusiformis* and *Chlorella virginica* has been successfully achieved in the laboratory and yard by utilising N P K fertilisers fortified with sodium bicarbonate at a dosage of 5.15 g/litre and Scenedin mix at 300 ppm respectively.

The biomass yield was 7-8 g/m2/day. The pH range between 8.5 and 10.5 during culture period was conducive and inhibited the growth of any algal species other than the cultured *Spirulina* spp.

The culture is agitated either manually or by aerators so as to keep the species in suspension. The algae was harvested by cloth filtration method. Harvesting was done when the culture attained 0.8-1.0, 0.0 (optical density) at 560 nm in a period of fifteen days.

Mass culture of the green alga, *Chlorella virginica* (10-15 million cells/ml) was achieved in the fibreglass culture tanks with Scenedin mix at 300 ppm. The alga was harvested using pH adjustment technique, and was sundried.

The ovigerous females of the rotifer, *Brachionus* sp. was isolated and reared in the laboratory and a production of 15000 no./litre was obtained in the laboratory from 50 no/litre by feeding brewers yeast at 0.01 ml/litre on alternate day.

Culture of duckweed : *Wolffia arrhiza* was cultured in 100,66 and 50 per cent sewage effluent. The respective average production of *W. arrhiza* from these three treatments was 100.5, 74.5 and 51.5 tonne/ha/annum.

A gradual fall in nitrogen and phosphate values was noted indicating the utilization of these nutrients by *W. arrhiza*. The average value of nitrogen (NO3), phosphate (PO4) chloride and total alkalinity ranged between 0.05-0.10 mg/l., 0.10-0.40 mg/l., 50-130 mg/l., and 150-308 mg/l. respectively.

In a yard experiment a cemented cistern of an area 180 m² was filled with 18,000 l of freshwater and stocked with carp fingerlings at the rate of 11,000 fingerlings/ha. Total 200 numbers of fishes were released in the cistern (Gc, 50 : Sc, 50 : Cc, 50 : R, 20 : Jp, 10). In 143 days the growth of grass carp, silver carp, common carp, rohu, mrigal and java punti were 579.0 g. 342.0 g, 285.0 g, 430.0 g, 308.0 g and 189.0 g respectively.

Harvesting of duckweed from a circular cement cistern fertilized with sewage.

These fishes were fed only with *W. arrhiza*, which was daily provided at the average rate of 10 times of their initial body weight for the first 63 days and the rest 80 days it was supplied at the rate (average) equivalent to their body weight. Besides this, no other feed or fertilizer was supplied to them. Total production obtained in 143 days from the cistern worked out to be 4,058 kg/ha.

The algal association of the cultural cisterns contained species of *Microcystis*, *Anabaena*, *Closteriopsis*, *Coelastrum*, *Nostoc*, *Pinnularia*, *Euglena* and *Chlorella* and the common zooplankters were *Brachionus*, *Cyclops*, *Filinia*, *Keratella*, crustacean eggs, mysis and nauplii of copepods. Among the macrofauna, water snail (*Planorbidae*) and *Tubifex* were recorded in all the cisterns.

W. arrhiza detritus in the form of fish excreta enriched the water bodies very effectively and resulted in rapid growth of phytoplankters like species *Nostoc*, *Anabaena*, *Anabaenopsis*, *Spirulina*, *Euglena*, *Pediastrum*, *Peridinium*, *Chlorella*, *Navicula*, *Microcystis*, *Nitzschia*, *Chlamydomonas*, *Eudorina*, *Pinnularia*, *Pandorina*, *Volvox*, *Cosmarium*, and *Scenedesmus*. In course of time the species of *Brachionus*, *Cyclops*, *Filinia* and *Keratella* appeared in cistern water.

In the next phase of experiment with 70 carps comprising Gc, 10 ; Cc, 10 ; R, 20 ; M, 20 ; and Jp 10 were released in two cisterns. These fishes were also fed with *W. arrhiza* at the rate of their initial body weight. The chemical parameters of these cisterns were also studied from time to time.

PROJECT FA/A/20 : STUDIES ON AQUATIC WEED CONTROL.

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

Period : 1983-86.

Location : FARTC, Dhauli.

An overview report on the problem of a very large water hyacinth infestation in Harke Lake of Punjab was prepared analysing the possible causes and impact of the infestation and suitable management measures to be adopted were suggested.

An increase of about 8.9 kg in biomass (fresh weight) in 130 days (68 g/day/sq. m) of water hyacinth was observed in two rearing ponds in which the weed was introduced. *Hydrilla* showed an increase of less than 1 kg during the same period (7 g/day/sq. m.).

Observations on natural field infestations of floating weeds (water hyacinth and *Salvinia*), submerged weeds (*Hydrilla*) and weed free waters taken at monthly intervals to study oxygen production in the morning, midday and evening for three days revealed that the submerged weeds contributed nearly about 40 to 80 kg of oxygen per ha meter per day on average while floating weeds (*Salvinia*) contributed only 25 to 60 kg/ha meter and water hyacinth, 28 to 44 kg/ha meter. In weed free waters 37 to 84 kg oxygen/ha meter production was recorded.

Analysis of dried, processed aquatic weeds showed that the fresh weight : dry weight relationship varied between 8 and 17 in a number of weeds and the crude protein content varied between 15 and 20% which indicated that the utilization of aqutic weeds for fish feed formulations will have to be carefully considered for economical utilization.

In preliminary laboratory study, the space-biomass relationship varied from less than 1 cc to 1.5 cc per g (fresh weight) in some of the submerged weeds (*Vallisneria*, *Hydrilla*, *Najas* and *Nechamandra*) which shows that the volume of a wteter body is reduced cconsiderably by the weeds and the management of weeds can be based on this relationship.

In laboratory experiment dimethyl urea (diuron) formulation was found effective against *Hydrilla* at 1 ppm and above by continuous exposure for 4-6 weeks while short-term exposures upto 72 hrs. could not affect the weeds. The duration of exposure may be important for drainable ponds.

A laboratory prepared formulation of chelated copper was found more effective at 2.0 ppm on *Nechamandra*, *Vallisneria* and *Najas* than 0.5 and 1.0 ppm copper.

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

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

Period : 1982-85.

Location : FARTC, Dhauli.

Field trials were conducted in June and December. The treatments differed according to volume, temperature and the pH of the water. In June the volume of water in two ponds which were treated was 150m³, pH 7.1 and 7.2 and water temperature 30 and 31°C. This required on average of 10 kg ammonia giving only 30-35 ppm total ammonia and 0.33 and 0.66 ppm unionized ammonia. However as the pH rose to 8.4 and above after treatment the percentage of unionized ammonia became higher (5 ppm and above) and toxic to fishes, species of *Glossogobius*, *Gadusia*, *Puntius* and *Barbus* were in distress even in 10 mts. after treatment and killed within a few hours. However bioassay with *Cyprinus* fry showed that the toxicity disappeared after one week when the total ammonia concentration was above 20 ppm and the pH was 7.6 and 8.4 and water temperature was 32°C.

The experiment was repeated in December with the application of 2-5 kg ammonia in the above two ponds and also in three more ponds of the same size when the water volume was only 75 to 90 m³, water temperature about 27°C and pH 8.1-8.6. The unionized ammonia at the above pH and temperature range from 8 to 18 percent and therefore the minimum 5 ppm unionized ammonia could be present even though the total ammonia was less than 10 ppm as the pH increased to about 9.6 Fishes mostly *Amblypharyngodon*, *Puntius*, *Glossogobius* and a few silver carp as well as major carps mrigal and catla, surfaced in distress within 15-20 min. after treatment. Small prawns (*P. lamarrie*) and crabs were also affected. No live fish or other organisms were observed one day after treatment, and a large dead *Glossogobius* was bound floating on the second day.

Acute toxicity for 10 days to rohu fry was recorded in the laboratory when the fry were exposed to pond water from treated ponds, and some fish were living in pond water from 13th day of application while toxicity was noted after 25 to 27 days.

The two trials showed that the treatments of ammonia varied considerably in the two seasons due to changes in water qualities and volume. Eventhough total ammonia concentration was only 6-8 ppm after treatment in December the percentage of unionized ammonia was as high as 75 percent due to increase in pH above 9.6. However, since the water volume is quite less in December considerable loss of ammonia was noticed. An increase in value in the water from about 0.01 before treatment to about 1 to 5 ppm and high percentage of NH4-N (193-325 ppm) in soil after treatment were also recorded, indicating the high fertilizer value of ammonia application. The time lag for attaining maximum concentration of ammonia nitrogen in water and exchangeable with NH4-N in soil varied from pond to pond but attained more or less uniform level in all the ponds after one month.

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

Personnel : M. Subrahmanyam.

Duration : 1979-1984.

Location : Kakinada.

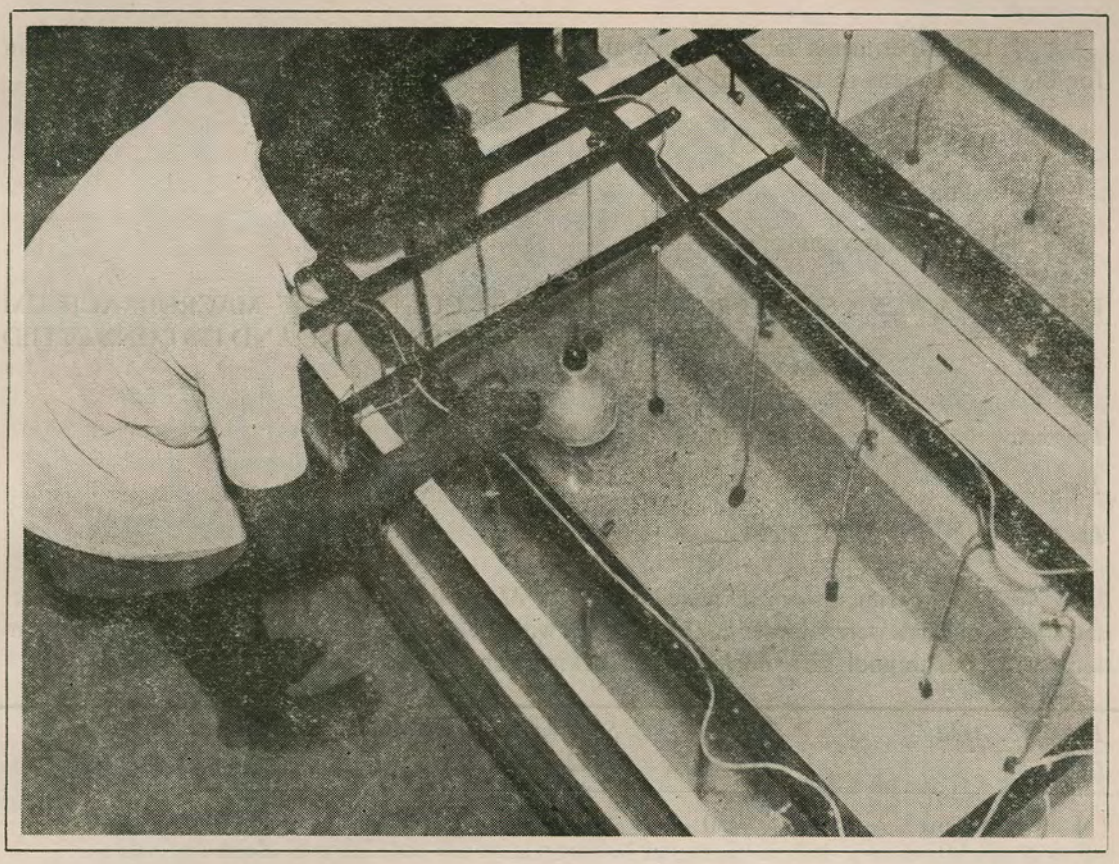
Brood stock production : Seed stocked in a private farmer's pond in November 1983 did not produce any gravid females as the pond dried up due to lack of freshwater supply from

the irrigation canal from the Godavari river. Seed stocked in the 24 plastic pools in the laboratory, however, survived well but the production of gravid females was delayed due to draught conditions. Gravid females were available in the plastic pool from August 1984. The number of gravid females required for synchronous hatching could be produced from this pool, but for mass production of seed, a plastic pool of larger dimension would be useful.

Larval rearing experiments of Macrobrachium spp. and Larval feed culture in plastic pools kept in yard at Kakinada centre.

Demonstration of prawn culture : Seed produced in the laboratory were sold to private farmers at Rs. 50/1000 seed. A sum of Rs. 1615/- was realised through sale of seed. A small freshwater pond in the Dairy Farm at Kakinada was stocked with the laboratory produced prawn seed for demonstration of prawn culture to local farmers and the production of brood stock for mass production of seed for distribution.

Economics of seed production : Economics of seed production were calculated from a 3.5 capacity F. R. P. tank (effective volume 2.5). Larvae hatched from 15 gravid females were stocked and 19,776 seed were produced. The cost of production of 1000 seed was calculated at Rs. 39.80 based on operating cost . The principal operating costs for the production of 1000 seed were : (a) Labour (at Rs. 12/8 hours), Rs. 33.15 ; (b) Power (water pump, light and aeration; at Rs. 0.50/unit) Rs. 2.70 and (c) feeds (Rs. 1.00/day) Rs. 3.95 . Further reduction in operating costs would be possible through increased stocking (conversely, production of more gravid females).



Seed production trials in FRP tanks at Kakinada centre of CIFRI.

PROJECT FA/A/23 : SEED PRODUCTION OF THE FRESHWATER PRAWN MACROBRACHIUM MALCOLMSONII.

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

Duration : 1982-1985.

Location : Kakinada.

Berried prawns of *Macrobrachium malcolmsonii* were procured from nature and maintained in a freshwater plastic pool till they hatched. The zoea released were slowly acclimatized to 14.5% brackishwater and kept in plastic pools. The water was aerated continuously. Cut pieces of tubificid worms and plankton were given as feed for the zoeae. The larvae could be successfully reared exclusively on *Tubifex* worms as diet. Newly mixed sea water gave better results than 4 to 15 days aged recycled water.

The experiments indicated that the following environmental variables were optimum for the development of the larval stages.

Water temperature (°C)	26.0—30.0
Salinity (ppt)	14.0—18.0
Dissolved oxygen (ppm)	4.0—6.5

PROJECT FA/A/25 : SEED PROSPECTING AND CULTURE OF MACROBRACHIUM MALCOLMSONII NEAR KOLLERU LAKE AND ITS CONNECTED WATERS.

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

Duration : 1974-1985.

Location : Kolleru Lake.

The experiments on the mixed culture of *Macrobrachium malcolmsonii* with some selected species of carps were initiated in three ponds with a waterspread area of 840, 940 and 990 sq. m located at Badampudi Fish Farm. The stocking densities of fishes were as follows :

Pond No. Area	*Catla* (8.3 g)	*Silver carp* (12.2 *g*)	*Rohu* (6.9 g)	*Grass carp* (7.4 *g*)	*Total*
I (840 sq. m)	50	75	201	50	376
II (940 sq. m)	60	90	186	60	396
III (990 sq. m)	50	75	169	50	344

The initial average size of the above fingerlings stocked in these ponds are as shown in the brackets.

The juveniles of *M. malcolmsonii*, (21.5 mm/0.08 g) collected from the anicuts on Godavari river at Vizzeswaram on 12.1.84 were stocked at a density of 5000 no./ha, after usual conditioning.

Supplementary feed comprising of groundnut oil cake and rice bran in equal ratio by weight was provided daily at the rate of 2% of body weight for fish and 5% for prawn. The grass carp was fed with adequate quantities of *Hydrilla*. The weight of the feed for the fish and prawn was progressively recorded every month depending on the growth per month.

The ponds were treated with cattle dung at the rate of 10 t/ha/year and lime 500 kg/ha/year in 10 monthly doses. Growth of species is shown as below.

Species	*Pond I* (*g*)	*Pond II* (*g*)	*Pond III* (*g*)
June 1984 :			
M. malcolmsonii	10.6	6.8	7.2
Silver carp	958.3	531.2	687.5
Catla	330.0	238.0	325.0
Rohu	325.0	121.0	250.0
Grass carp	950.0	531.2	630.0
September 1984			
Silver carp	1,083	938	875
Catla	350	250	462
Rohu	232	250	321
Grass carp	—	1,125	—
M. malcolmsonii	7.8	14.4	20
October 1984			
Silver carp	1,270	1,000	1,000
Rohu	317	250	306
Catla	400	333	429
Grass carp	2,000	1,250	—
M. malcolmsonii	8.3	9.04	—

The water level in the ponds during the summer season of 1984 was very low, less than one foot due to severe drought condition. It could not be replenished even from the adjacent irrigation canal due to its dry condition.

PROJECT FA/A/26 : BREEDING AND CULTURE OF MACROBRACHIUM BIRMANICUM CHOPRAI.

Personnel : Shree Prakash, S. K. Wishard, G. N. Srivastava, R. K. Saxena and K. Chandra.

Duration : 1983-1987.

Location : Allahabad.

Breeding : 16 males and 44 females of *Macrobrachium birmanicum choprai*, collected from the river Ganga near Buxar, were transported to Allahabad under oxygen packing with 100% survival. They were released in RFS during July-August. Breeding, embryonic development and hatching occurred successfully twice in most of the females ; first during the second

week of August and second in the first week of October. The larvae appeared in the surface sampling of RFS water for 17 days after the first hatching and for 20 days after the second hatching. Due to fall in temperature in winter, netting operation was suspended. Further sampling shall be done in late February.

Culture : Twelve experiments were conducted for larval culture, both in freshwater as well as in 5% seawater medium. The larvae were fed with supplementary feed comprising mixed plankton, copepod larvae, live rotifers, caridean larvae, prawn paste, plankton paste, minced tubificid worms, Ostacalcium and greenwater. The larvae did not survive beyond 15 days in most of the cases but when fed on copepod larvae, live rotifers, prawn paste and plankton paste, larvae survived for 31 days and in an isolated case even for 45 days when fed on caridean larvae alone. During this period the post-mysis stage was attained. The physico-chemical conditions of the culture media were found to range as follows : Water temperature 25-27°C, pH 8.0-8.2, DO 6.45-6.80 mg/l, free CO_2 4.0-5.0 mg/l, alkalinity 150-230 mg/l, chlorides 1.80-2.0 mg/l and sp. conductance 519-589 micromhos /cm. Temperature of 26°C ($\pm$1°C) has been found to be the most suitable for culturing these larvae.

Feeding experiments on the young ones, obtained from two berried females, were initiated in 21 glass jars after giving a bath in 1 ppm acriflavin solution. Ostocalcium (Glaxo), a suspension of calcium and vitamins B12, in different doses and dried plankton were tried but the survival never exceeded 14 days. In control also no larvae survived beyond 14th day. The water temperature ranged between 30-31°C during these experiments.

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.

Period : 1983-85.

Location : Kalyani.

The expansion of the present frog hatchery complex located at Kalyani Centre had been done. During 1984, 252 sets of *Rana tigrina* and *R. crassa* were bred and 3.6 million hatchlings were produced in the hatchery, out of which 3.0 million tadpoles were released in the nature. In a field rearing experiment conducted in hapas, 4 day old tadpoles of *R. tigrina* stocked at 10.0 million per hectare and regularly fed with silkworm pupae powder registered a survival rate of 62% to early frogs. The same experiment done in a pre-prepared field nursery pond gave a retrieval of 23.2% early frogs. This poor retrieval is due to the pond not being fenced. In all these experiments, the tadpoles showed excellent growth and precocious metamorphosis and the early frogs raised were bigger in size than the normal ones, due to feeding with silkworm pupae powder.

An outstanding achievement in growing early frogs of *R. tigrina* to their marketable size (50-87 g) in a span of four months in the laboratory has been made during 1984. Breeding and culture of larvae of *Bombya mori* was successfully done.

In induced hybridization, faster post-metamorphic growth over *Rana crassa* was observed in the hybrid resulting from cross between *R. tigrina* X *R. crassa*. A gradation in the size of hatchlings was observed, depending upon the species involved in the cross. (The entire technology of seed and early frog production on commercial basis as evolved by the Research centre had been passed on to the ICAR, the Ministry of Food and Agriculture and the Department of Environment and MPEDA (Ministry of Commerce), Government of India, for wider adoption).

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

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

Period : 1980-86.

Location : FARTC, Dhauli.

Carp culture data have been analysed and the following model has been evolved for total fish.

$$\begin{aligned} Y\ FISH = & -176013 + 83.2494\ MAH - 0.0119558\ MAH^2 \\ & + 64.1404\ COW - 0.00515717\ COW^2 \\ & + 1502.58\ CHE + 233.644\ FEED \\ & + 14421.4\ WEE - 22.9051\ WEE^2 \\ & * + 175.561\ TONU \end{aligned}$$

where,

Y FISH	=	Total fish in g
MAH	=	Mahua oil cake in kg
COW	=	Cowdung in kg
CHE	=	Chemical fertilizer in kg
FEED	=	Feed in kg
WEE	=	Weed in tonnes
TONU	=	Total number

The above model explained 84% of variation in output (R^2=0.8408) and the overall regression equation is significant. ($F_{9,146}$ = 85.6462).

Following are the production elasticities.

*MAH	=	0.035
*COW	=	0.152
*CHE	=	0.181
*FEED	=	0.433
*WEE	=	0.174
NUMBER	=	0.256

The production function exhibited increasing returns to scale. Feed is the most powerful explanatory variable with highest output elasticity. As the marginal physical product of feed is greater than price ratio, increasing use of feed will improve farm profitability.

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

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

Duration : 1983-87.

Location : KVK/TTC, Kausalyagang.

Village survey : A fresh programme of village and farm family survey was initiated again in 1983 in which 3 community development blocks, namely, Balianta, Balipatna and Bhubaneswar are being covered. Relevant information and basic data for various Gram Panchayats have been collected and villages identified having potential for aquacultural development.

BALIANTA BLOCK : It covers a geographical area of 37,505 acres with a population of 81,279. The SC and ST communities constitute 24.92% and 1.33% of the total population respectively. There are 10 Gram Panchayats under this Block covering a total of 104 villages, of which 31 have been identified having potential for aquacultural development. The number of G. P. tanks/ponds under this Block aggregates to 245, covering a water area of approximately 325 acres. The total water area of the 31 villages is 615.33 acre of which only 398.99 acre is under actual cultivation, the level of utilization being 64.84%. The average fish yield from these cultivated water areas accounts for 1700 kg/ha/year.

BALLIPATNA BLOCK : It covers a geographical area of 54.2 square miles with a population of 79,232. The SC and ST communities constitute 25.16% and 0.03% of the total population respectively. There are 11 Gram Panchayats under this Block covering a total of 86 villages of which only 13 have been identified having adequate potential for aquacultural development. The number of G. P. tanks/ponds aggregates to 68 covering a water area of over 115 acres. The total water area of the 13 identified villages is 135.41 acre of which 86.03 acre is the cultivable water area and 72.15 acre is under actual cultivation, the level of resource utilization being 83.87% of the available cultivable water. The average fish yield from these cultivated water areas accounts for 1703 kg/ha/year.

BHUBANESWAR BLOCK : It covers a geographical area of 146.31 square miles with a population of 86,243. The SC and ST communities constitute 16.55% and 8.56% of the total population respectively. There are 15 Gram Panchayats under this Block covering a total of 117 villages, of which 58 have been identified having potential for aquacultural development. The total number of G. P. tanks/ponds under this Block aggregates to 111, covering a water area of over 100 acres.

The programme of farm family survey is in progress.

Low cost fish culture and fish seed production : Successful induced breeding of rohu, mrigal and common carp was done during August, 1984 in farmers' ponds. The brood stock of the above mentioned fishes were reared in farmers' ponds. A total of 10.5 lakh spawn of rohu, mrigal and common carp was produced. The seeds so produced were reared in 3 nursery ponds and the resultant fry were stocked in farmers' ponds and the rest was sold out.

Culture of rohu and common carp stocked in a 0.75 ha pond at Village Nakhaurpatna during 1983 was carried out without supplementary feeding. During August 1984, 300 kg of rohu of average weight 500 g was harvested and sold out by the farmers @ Rs. 15-16 per kg. Still, about 1000 fish are estimated to be present in the pond. A total of 97 kg of rohu, mrigal and common carp was also harvested and used as brood fish during the last fish breeding season.

PROJECT FA/A/30 : CULTURE OF *PANGASIUS PUNGASIUS*

Personnel : N. K. Thakur.

Duration : 1984-86.

Location : FARTC, Dhauli.

Survey was conducted in Cuttack and Puri districts to find out the prospects of availability of *P. pangasius*. Sixty five specimens (0.25-2.5 kg) were procured and stocked in ponds. While carrying out laboratory experiments, it was established that *P. pangasius* is able to survive low dissolved oxygen content of the ambient environment through aerial respiration for which its swim-bladder is secondarily adapted to function as an accessory respiratory organ.

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

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

Duration : 1984-86.

Location : FARTC, Dhauli.

Four nursery ponds each of 0.02 ha area were stocked with *Puntius ticto* and *Puntius sophore* at the rate of 40,000/ha during the end of the year. Two ponds were treated with both organic and inorganic fertilizers and the other two either inorganic fertilizers and with supplementary feed or oil cake and rice bran, keeping total nitrogen and phosphorus applied uniform in all the ponds.

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

Personnel : S. K. Mukhopadhyay, S. K. Datta, S. K. Saha, A. K. Roy and N. M. Chakraborti.

Duration : 1984 - 1984.

Location : Rahara.

The project was been initiated in 1984 in the month of March. Three sets of *H. molitrix* could be induced through hypophysation producing 40,000 to 60,000 developing eggs. The rate of fertilisation was recorded as 67-75%. A total number of 380 hatchlings could be obtained.

Hybrid between grass carp male and silver carp female was also tried in the month of March in two sets. Fertilisation was recorded as 80%.

Again in the month of April 4 sets of *C. mrigala* could also be bred through hypophysation producing 40,000 developing eggs-resulting in 10,500 spawn.

During February-March 2.5 lakh of common carp spawn were produced. The spawn when stocked @ 6 million/ha and reared in sewage-fed nurseries (sewage water 1 : freshwater 5) for 15 days, a total number of 1.02 lakh of fry were produced.

In mid June, from 10 sets of *L. rohita* 4.817 lakh of spawn were produced.

Induced breeding experiment on *L. rohita* with injection of partially purified fish pituitary gonadotropin, synthetic LH RH and synthetic LH RH + fish gonadotropin was undertaken in collaboration with Dr. S. Bhattacharjee and his colleagues, Department of Zoology, Visva Bharti University. In case of gonadotropin both female and males could be stripped and fertilization occured.

PROJECT FA/A/33 : BREEDING AND CULTURE OF PENINSULAR CARPS AND NONPREDACEOUS CATFISHES IN COMBINATION WITH GANGETIC AND EXOTIC CARPS.

Personnel : P. K. Sukumaran, S. Sivakami, S. Ayyappan, S. L. Ragahvan and M. F. Rahman.

Duration : 1984-86.

Location : Bangalore.

During September, 1984 a survey was made in Shimoga division to study the availability of *Puntius pulchellus* fingerlings in river Tunga. Intensive surveys were made in Tunga river, below the Bhadra Dam site and N. R. Pura. Oozing males of *P. pulchellus* were obtained from a pond in the Bhadra Project Fish Farm. However, no female fish was caught. Due to the heavy rains in the Maland region and resultant flood in September 1984 fingerlings collection could not be made. Study was made during January-June, 1984 to chart the microbial activity in fishing ponds at Hebbal.

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

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

Period : 1984-88.

Location : Cuttack.

Brood fish maintenance in cement cisterns : Brood stocks of magur, *Clarias batrachus*, singhi, *Heteropneustes fossilis*, koi, *Anabas testudineus*, and spotted murrel, *Channa punctatus*

collected locally, during January to May, 1984 were maintained in cement cisterns wherein the fishes were fed daily at 7% of body weight with a 5 : 4 : 1 mixture (by weight) of groundnut oil cake, rice bran and dried / fresh trash fish. All the four species attained maturity in the cisterns.

Natural breeding in cement cisterns : During the months of May and June, 84 koi bred in four cisterns (3.1 × 2.4 × 0.9 m each). A total of 1,442 cisterns-bred advance koi fry were obtained.

Spotted murrel also bred naturally in two separate cisterns during the month of July, 1984. A total of 1,200 cisterns-bred murrel fingerlings were obtained.

Large-scale natural breeding in paddy fields : Experiments on large-scale natural breeding of magur met with success in a specially prepared paddy plot. The spawners bred profusely and the spawning continued till 3rd week of September, 1984.

Natural breeding trials with singhi brooders in a specially prepared paddy plot also met with success. Small fry of singhi were observed in plenty by middle of August, 1984.

Induced breeding through hypophysation in cement cisterns : Experiments on the hypophysation of singhi were conducted using carp pituitary extract (8-10 mg/100 g body weight of the recipient). The experiment yielded a total of 3,257 cisterns-reared advance fry.

Seed rearing in paddy plots : Scientific utilisation of paddy plots for seed rearing of common air-breathing fishes of interest is under a field trial with CR 1018 variety of paddy at CRRI Farm, Cuttack. The culture of fish in fields, which remain wet even after the paddy is harvested. is continuing.

Seed supply : The excess stockable materials, a total of 1,150 advance fry consisting of singhi, magur, koi and spotted murrel, produced at this centre were handed over to Freshwater Aquaculture Research and Training Centre, Dhauli for conducting experiments.

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

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

Duration 1984-86.

Location : Allahabad.

The project has been initiated in October, 1984 when the middle stretch of the River Ganga was surveyed for selection of a site for the experimental work. Catches of *Hilsa ilisha* examined at Sirsa and Buxar, comprised male specimen only, measuring 25.0-30.0 cm. The availability of females being very poor attempt on artificial fecundation could not be made both at Buxar and Sirsa. The catches in the later part of November consisted either immature or spent specimens only.

250 ml spawn (mixed) collected from River Ganga at Buxar are being reared at Pandepur Fish Farm. The first sampling after 30 days did not show any hilsa young. Rearing continues for further sampling.

Hydrological parameters of the River Ganga at the centre where the spawn was collected, and the nursery are as under :

Parameters	*River Ganga*	*Nursery*
Water temperature	25°C	24°C
Transparency	36 cm	80 cm
pH	8.0	7.8
Alkalinity	180 ppm	120 ppm
Chloride	40 ppm	20 ppm
Calcium	32.6 ppm	21.4 ppm

PROJECT FC/B/1 : FISHERY LIMNOLOGY OF COLDWATER WULAR LAKE..

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

Duration : 1983-86.

Location : Wular Lake, Kashmir.

FISH LANDINGS : At Nasu landing site of lake, the average catch was estimated as 1.2 kg/man/hour., in which exotic carp *C. carpio* formed 70% and local Schizothoracid only 30%. Among exotic carp two varieties recorded were, scale carp having a weight range of 100-500 g and mirror carp 150-320 g while Schizothoracid was represented by *Schizothorax curvifrons* (100-200 mm/50-60 g) respectively. At Kanibathi landing site the average estimated catch was 1.8 kg/man/hr., in which *Cyprinus carpio* was 66% by weight and Schizothoracid only 33%. Among Schizothoracid the species composition in catches were *Schizothoriachthys esocinus* (22%—200-375 mm/100-370 g), *Schizothorax curvifrons* (8%), while remaining (3%) was contributed by *Schizothorax niger*. Other fish landing site was Laharwalpore, recording almost similar landing pattern. In terms of biomass about 200-300 kg of fish was landed daily at sector-I from different landing sites.

The experimental fishing, with cast nets was done at Laharwalpora, Kanibathi and Beniyar stations of sector-I. The study indicated that during spring the catch at Baniyar was dominated by Schizothoracid while at other two stations *Cyprinus carpio* dominated. Overall catch effort ranged between 0.750—1.5 kg/man/hr. In summer and autumn the ranges were from 1-1.5 kg and 1.5-2.0 kg, respectively. During these seasons the average catch composition was 70-90% exotic carp and 10-30% endemic carp.

At sector-II Wutlab, main forms recorded were *Cyprinus carpio specularis*, *Cyprinus carpio communis*, *S. esocinus*, *S. longipinnis*, *S. curvifrons* and *S. micropogon*. The length range of exotic carps was 140-390 mm in summer and 150-340 mm in autumn, while in case of Schizothoracid the range was between 140-430 mm in summer and 150-460 mm in autumn. In terms of biomass about 150-270 kg of fish was landed daily from this site during this period but the catches would increase five folds in winter months, when more catch effort is put by the fisherman. The experimental fishing at this sector revealed the catch per unit effort to range from 800-1,000 g/man/hr.

The fishing in the lake during summer and autumn is mainly done by long-lines and the baits used are fish (*Crossocheilus latius*, *Puntius conchonius* and nymphs of odonata). In winter with appreciable fall in water level cast net is usually used as fishing gear.

Seed-resources/breeding behaviour : In Madhumati stream, feeding the Wular lake, different Schizothoracid species were observed to exhibit spawning migration in April from the main lake and breeding was observed during May-June on gravelly and sandy bottom. The seed collected was of *Schizothorax esocinus*, *S. curvifrons*, *S. micropogon* with a density of 50-500 fry/m^2 in the size range of 15-30 mm. In the middle stretch, 25-100 fry/m^2 (20-45 mm) were collected during July to September. However, the density of spawn near lake mouth ranged between 15-25 fry/m^2 (15-30 mm) and 5-10 fry/m^2 (20-45 mm) during the above period.

Phytoplankton : In the sector-I, the density ranged between 6,160—71,776 units/l at Beniyar station ; between 9,544—44,244 units/l at Laharwalpora and at Kanibathi station the range was 1,500—8,500 units/l indicating a declining trend at all the stations. The major contribution was of Bacillariophyceae. The column profile recorded more phytoplankton density in surface water at Baniyar station while it was othersiwe at Laharwalpora. The dominant forms recorded were *Navicula*, *Amphora*, *Fragillaria*, *Triploceros* and *Oscillatoria*.

At sector-II, the phytoplankton ranged from 2112-54736 units/l at station—A ; 4200-38544 units-l at station—B and at station—C. Main forms recorded were *Navicula*, *Fragillaria* and *Oscillatoria*.

Zooplankton : The population comprised at sector-I Protozoa, Rotifera, Cladocera and Copepoda as the main groups. Among Protozoa *Penardia* and *Centropyxis* were common. Rotifera forms recorded were *Brachionus*, *Monostyla* and *Trichocera*. Among Cladocera mostly *Chydorus*, *Bosmina* and *Daphnia* were recorded, while *Cyclops* and *Diaptomus* were main Copepoda forms. The population density at different stations during the period ranged from 26-53 units/l (surface) 24-120 units/l (bottom) at Baniyar station ; 15-95 units/l (surface) and 30-67 units/l (bottom) at Laharwalpora station ; while the range was 16-104 units/l (surface) and 6-110 units/l (bottom) at Kanibathi station. The protozoa and Rotifers were main dominant groups in total zooplankton population with percentage ranging between 22-66. Only once during summer Cladocera population was 35%.

In sector-II higher population density of zooplankton was recorded. At sector—A zooplankton ranged between 70-300 units/l (surface) and 22-200 units/l (bottom) ; at station—B

70-225 units/l (surface) and 46-140 units/l (bottom); while of station—C the density 25-525 units/l (surface) and 25-600 units/l (bottom). The dominant groups at this sector were again Rotifera and Protozoa.

Benthos : The benthic macrofauna from three stations of sector-I revealed that the dominant forms were Mollusca, Diptera and Oligochaeta. At Baniyar station the population density ranged between 133—1555 individuals/m^{-2} (having wet biomass range of 344-545 g/m^2, with Mollusca contributing maximum towards biomass. At Laharwalpora station the density ranged between 135-622 individuals/m^{-2} (biomass of 2.6-6.2 g/m^{-2}). At this site, maximum population (18-88%) was recorded of diptera and oligochaetes. While of Kanibathi station a density 178-488 individuals/m^{-2} biomass 2-411 g/m^{-2}). At this site benthic life was mainly dominated by oligochaetes (28-75%), followed by Diptera (25-30%) and Mollusca (nil-14%). The main forms recorded during the period from this sector-I was *Chaetogaster*, *Aelosoma*, *Nais* (Oligochaeta,), *Tendipex*, *Culicoides* and *Pentineura* (Diptera) and bivalves (Mollusca).

At sector-II, benthic fauna was studied from five stations, both pelagic and littoral. The total number of animals/m^{-2} at various sites ranged from 66-1143 at site 1 ; 111-954 at site 2; 177-1352 at site 3 ; 221-1331 at site 4 ; and 111-1343 at site 5, While respective wet biomass from sites 1 to 5 ranged between 0.6-10 g/m^2 ; 0.99-9.6 g/m^2 ; 1.6-12 g/m^2 ; 2.2-221 g/m^2 and 1.0-350 g/m^2. The organisms at sites 1, 2, 3, 4 and 5 comprised mainly of oligochaetes in the range 22-87% ; 51- 100% ; 10-84% ; 10-66% and 32-100% respectively. Percentage of dipteran larvae ranges were 12-77% ; 35-100% ; 18-89% ; 23-89% and 14-59% from sites 1-5. Molluscan shells were recorded only at sites 4 and 5 contributing 9-20% at the former site and 3-14% at the latter site.

Physico-chemical characters and primary productivity : The physico-chemical characteristics and primary productivity of the lake during the year were recorded as follows :—

Parameters	*Values*	
	Sector-I	*Sector-II*
Water temperature (°C)		
Surface)		12.0—28.5
)	8.0— 28.0	
Bottom)		10.0—26.8
Transparency (cm)	15.0— 60.0	1.5—5.0
Depth (cm)	75.0—350.0	—
pH	7.2— 8.2	7.2—8.1
Dissolved oxygen (ppm)		
Surface	3.3— 12.7	5.3—8.4
Bottom	3.5— 12.4	4.5—7.4

Free CO_2 (ppm)	nil— 8.8	1.2—8.0
Total alkalinity (ppm)	56.0—180.0	88.0—228.0
Silicates (ppm)	0.015— 0.048	0.01—0.04
Chloride (ppm)	3.0— 14.0	3.0—12.0
Calcium (ppm)	32.0— 96.0	7.6—35.0
Magnesium (ppm)	1.8— 24.3	0.08—8.6
Dissolved org. matter (ppm)	18.0— 76.0	30.0—63.0
Sp. conductivity (μmhos/25°C)	106.0— 253.0	112.0—400.0
Productivity (mg C^{-3}/h^{-1})		
Surface	9.4—122.0	8.0—247.0
1 m depth	12.5— 18.0	10.0—168.0
2 m. depth	14.0— 62.5	9.4— 78.0

PROJECT FC/B/2 : COMPARATIVE STUDY OF FISHERIES AND ECOLOGY OF R. GANGA AND KOL AT BHAGALPUR.

Personnel : A. K. Laal, B. L. Pandey, S. K. Sarkar and A. Sarkar.

Duration : 1979-85.

Location : Bhagalpur.

Limnology : Studies on hydrobiological parameters of water, primary production and their diurnal changes during winter, summer and post-monsoon periods were made at Hanumanghat on R. Ganga and at Adampurghat on Kol of R. Ganga. In addition, the above studies were also conducted at Maniksarkarghat confluence (O.F.) and Maniksarkarghat main sewage (B.O.F.) to assess the pollutional effect of the sewage in the water of the 'Kol' where these sites are located.

Studies revealed that the water of R. Ganga showed oligotrophic conditions all along. But the values of free CO_2 in August (4.4 ppm), silicate in July (23.0 ppm), dissolved organic matter in August (10.3 ppm), and maximum values of gross and net productions, (179.06 and 117.81 mg C/m^3/hr) respectively in December, showed that they were above the oligotrophic limits of the aquatic ecosystem. The condition of water of the B.O.F. zone in the 'Kol' was mainly eutrophic in nature. Maximum values revealed were : free CO_2 (6.9 ppm in Aug.), SiO_2 (27.0 ppm in June), dissolved organic matter (10.3 ppm in Oct.) and gross and net primary production (204.69 and 144.69 mg C/m^3/hr respectively in April.). But the condition of water of the O. F. zone showed superiority over eutrophicity in nature, as revealed by the higher values of free CO_2 (9.68 ppm in Feb.), SiO_2 (50.0 ppm in Aug.), dissolved organic matter (18.04 ppm in April) and gross and net primary production (810.0 and 775.63 mg C/m^3/hr) respectively in March.

Ubiquitous presence of Potamoplankton, (*Gonatozygon*) and Tychoplankton during the first advent of flood indicated oligotrophic condition but its density to the tune of 3,205 u/l (Feb.) indicated eutrophic status. Zooplankton population ranged from 9 u/l (June) to 498 u/l a (July) and comprised of species of *Keratella*, *Annuraeopsis Brachionus calyciflorus*, *Bosmina*, *Sida*, *Diaphanosoma* and *Cyclops* common amongst rotifers, cladocera and copepods respectively. In June some rhizopods (*Arcella* and *Difflugia*) were also present. Presence of these last two species only in June indicate polluted nature of R. Ganga which might have come from allochthonous source in flood.

Heavy density and frequency of occurrence of some algal members viz. *Euglena acus*, *Oscillatoria* sp. and *Pinnularia gibba* at B. F. G. zone indicated superiority over trophocity of the R. Ganga. Zooplankton population ranged from 10 u/l (June) to 400 u/l (Apr.). Rotifers were dominant over cladocerans and copepods. Rotifers were *Brachionus*, *Filinia longispina*, *Anuraeopsis*, *Keratella tropica* and *Cephalodella*. Similar to Hanumanaghat *Difflugia* sp. and *Arcella* sp. amongst the protozoa were noticed here in June.

In the O. F. zone higher phytoplankton density (76,000 u/l) comprising *E. acus*, *Navicula radiosa* and *Chlorella vulgaris* further supported the findings stated above. Species of *Oscillatoria*, *Synura*, *Fragilaria*, *Melosira* and *E. acus* were present in the main sewage. Zooplankton population ranged from 20 u/l (Jan.) to 71,000 u/l (Apr.). In April zooplankton population was also high (10,000 u/l) with rotifers dominating, comprising of *Brachionus rubens*, *B. calyciforus*, *B. quadridentatus* and *Moina brachiata*. Such heavy plankton population was attributable to sewage discharge in this zone.

O. F. and B. O. F. zones of the ox-bow lake were influenced by the sewage waste. O. F. zone was more polluted and rich in nutrients, showing superiority over eutrophicity. B. O. F. zone was lesser polluted (eutrophics) in comparison to the former. The site, Hanumanaghat, in R. Ganga is nearly 4 km away from this confluence zone and hence, did not show any effect of sewage waste due to dilution, attributed to more depth and water current as evidenced by hydrobiological parameters.

This year at the proposed site for pen culture experiment, water depth is more (Av. depth 4 m) and there is feeble current, only carp culture experiment has been taken up as *Clarius* culture will face the problem of retrieval. A pen has been constructed and fish has been procured and stocked.

FISH AND FISHERIES

In river Ganga *Wallago attu* was dominant over other fisheries. Miscellaneous trash fishes such as *Gadusia chapra*, *Setipina phasa*, *Aspidoparia morar* and *Pseudeutropius atherinoides* were brought in local market in plenty. They were mostly caught by small mesh nylon net. *Hilsa* catch was very poor. Only in April and May, juveniles of *Hilsa* were found in local market while in the other months they showed sporadic trend in one or two numbers.

Many of the Gangetic fishes have a specialized ecological niche and they have zonal preferences e. g. *Pangasius pangasius* and *Bagarius bagarius* were encountered in maximum number

between Pirpainti and Sahibganj belt. *Pangasius pangasius* has affinity for molluscs and *Bagarius bagarius* for insetcs and dacayed flesh. *Rhinomugil corsula* was found in plenty in the vicinity of putrescible organic matter discharge.

Some riverine fauna like *Platanista gangetica* (dolfin)'and *Dasyatis sephen* (sting ray) deserve attention for their conservation. Dolfin is being caught for extracting oil, which is utilized for fishing *Clupisoma garua* and *Eutropichthys vacha* which run to that site where dolfin oil is sprinkled. Sting ray locally known as Sakuchi is preferred by the tribals at Sahebganj and poor people around this area.

As in previous years, this year also in 'Kols' carps juveniles were encircled and caught in plenty. Due to lack of awareness for proper scientific nursing method and place, these juveniles were sold at very cheap price for consumption in local market.

'Kols' are encircled by bamboo reeds and strips (locally known as Bari or Jangha) in the month of October when flood recedes and fishes are caught from mid November to last week of December. Worth mentioning 'Kols' where carps juveniles were caught in plenty were Champa nala, Ghogha nala, Ekchari, Trimuhan and Udhua nala.

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

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

Duration : 1982-86.

Location : Kolleru lake (A.P.)

The total fish yield from the three centres on the Kolleru Lake during the period from December, 1983 to November 1984 was estimated to be 2339.1 tonnes. Out of this, Akivedu centre contributed 1168.8 t (49.97%), Eluru centre 888.9 t (38.0%) and Bhimavaram centre 281.4 t (12.03%)

Table : Month wise fish landings at three centres of Kolleru Lake.

Month	*Akivedu*	*Eluru*	*Bhimavaram*
December, 1983	121.0	143.9	48.2
January, 1984	100.9	63.9	22.2
February, 1984	64.9	60.6	19.3
March, 1984	81.7	90.0	10.9
April, 1984	172.4	89.4	9.7
May, 1984	179.0	117.9	1.6
June, 1984	214.2	122.8	5.8
July, 1984	64.3	68.9	14.2
August, 1984	62.7	42.8	14.3

September, 1984	23.3	16.7	27.5
October, 1984	26.8	32.8	35.8
November ,1984	57.7	39.1	73.0

Perches contributed 731.03 t (31.25%) to the grand total followed by catfishes 611.65 t (26.15%), murrels 371.42 t (15.87%), prawns 296.43 t (12.69%) and carps 237.75 t (10.16%).

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

Personnel : A. G. Jhingran, G. N. Mukherjee, Ravish Chandra, S. P. Singh, R. A. Gupta, K. P. Srivastava, R. K. Saxena, S. K. Wishard, G. N. Srivastava, R. S. Panwar, M. Peer Mohamed, D. N. Singh, R. K. Tyagi, B. Singh, R. K. Dwivedi, M. A. Khan, S. N. Mehrotra, R. N. Seth, K. Chandra, A. R. Chowdhury, N. K. Srivastava, Ram Chandar, D. N. Srivastava, B. D. Saroj, Ramji Tiwari, J. P. Mishra, Bhailal, A. K. Laal, B. L. Pandey, S. K. Sarkar and A. Sarkar.

Duration : 1984-1988.

Location : Allahabad, Bhagalpur, Buxar and Lalgola.

ALLAHABAD

Fish catch statistics : Fish yield during the period under report was estimated at 149.04t at Allahabad, showing an overall increase by 24% over the same period in the preceeding year. The contribution of major carps, catfishes, hilsa and miscellaneous fishes was 38%, 15%, 1% and 45% respectively. The species-wise fish yield and their percentage contribution during the year was as follows :

Species	*Total landing (t)*	*Percentage*	*Av. length (mm)*
C. mrigala	5.57	3.73	562
C. catla	4.73	3.17	721
L. rohita	2.99	2.01	595
L. calbasu	43.58	29.24	416
M. aor	9.34	6.27	564
M. seenghala	9.02	6.05	582
W. attu	4.55	3.05	753
Hilsa	1.73	1.16	412
Misc. fishes	67.53	45.32	—
TOTAL	149.04		

BHAGALPUR AND LALGOLA

During the period under report, total estimated fish production from the centres viz., Bhagalpur and Lalgola were 100.86 t and 62.88 t respectively. The production decreased by 2.39% at Bhagalpur and increased by 31.52% at Lalgola, when compared with the preceeding year.

At Bhagalpur, in species-wise fish yield, the miscellaneous varieties were dominant, contributing 34.50% to the total production followed by *W. attu* (28.12%), *M. aor* (8.79%), *M. seenghala* (5.71%), *N. chitala* (4.35%), small prawns (4.30%), *L. rohita* (3.65%), *C. catla* (2.53%), *C. garua* (2.15%), *C. mrigala* (2.02%), *R. rita* (1.97%), *Channa* spp. (0.94%), *H. ilisha* and *E. vacha* (0.79% each), *B. bagarius* (0.72%), *L. calbasu* (0.70%), *P. pangasius* (0.40%), *S. silondia* (0.30%) and large prawn (0.22%).

H. ilisha was dominant in the species-wise fish yield at Lalgola, contributing 46.16% to the total production followed by miscellaneous (21.84%), *C. garua* (4.43%), *M. aor* and large prawns (4.21% each), *B. bagarius* (3.82%), *M. seenghala* (2.94%), *R. rita* (2.71%), small prawns (2.41%), *L. rohita* (1.64%), *C. catla* (1.53%), *E. vacha* (1.15%), *W. attu* (0.70%), *P. pangasius* (0.65%), *C. mrigala* (0.64%), *S. silondia* (0.54%), *N. chitala* (0.41%) and *L. calbasu* (0.01%).

Observations on spawning of hilsa : Observations on the spawning of hilsa were made at Madhauka (R. Yamuna) and Sirsa, Manda and Buxar (R. Ganga). While at Buxar the hilsa spawn was available during September and October, around Allahabad they were available during October only.

It is interesting to note that while in September the breeding was scanty, intensive breeding was observed in first week of October, especially at Buxar. The details are as under :

	Spawn quantity (ml)	
Centre	*September*	*October*
Madhauka	—	11
Sirsa	—	5
Manda	—	11
Buxar	18	10863

1733.72 kg of hilsa was estimated to have landed at Sadiapur landing centre. As revealed by the following table, bulk of the catch was landed during September-November, being maximum in October, 1984. The month-wise landing is given below :

Month	*Catch (kg)*	*Month*	*Catch (kg)*
January-March	nil	August	—
April	2.0	September	41.75
May	19.20	October	1351.91
June	—	November	316.18
July	2.68		
		Total :	1,733.72 kg

As compared to 1982 and 1983, the landing was more in 1984. However, examination of the landing data from 1972 onwards revealed that the landings during 1984 were heavy for the 4th time, the three others being 1972 (12.2 t), 1973 (3.0 t) and 1979 (1.8 t). The breeding during 1984 indicated that the hilsa stock is slowly building up.

CARP SEED COLLECTION AND SEGREGATION

Spawn abundance : Investigations were conducted in a stretch of R. Yamuna near Allahabad at Madhauka, for a period of 51 days. Due to failure of monsoons the season remained almost dry and the river did not experience any major flood. However, during August and September, three floods were recorded with peaks at 2.38, 7.19 and 5.69 m respectively. The vascillation phase with a lower peak of 1.73 m was observed on 2nd of August 1984.

Three spawn spurts were observed one in each flood and their durations were 22 hours, 16 hours and 38 hours respectively. The first, second and third spurts yielded 465 ml (74.4%), 75 ml (12.0%) and 85 ml (13.6%) of spawn taking the season's total yield to 625 ml (c 3.12 lakh hatchlings).

The average percentages of major carps was estimated as 23.0 and 28.6 at 2.38 m and 5.7 m water levels but the quality had considerably improved (42.5%) when the second flood had touched a peak of 7.19 m. This confirms the earlier observations that bulk spawn, both quantitatively as well as qualitatively, is available only when the river crosses over 5.0 to 8.0 m above the summer level.

Turbidity around 360 ppm and current velocity at 0.8-1.0 km/hr of R. Yamuna showed positive relationship with the spawn availability. Other hydrological and meteorological factors did not appear to have any effect on the quantitative and qualitative abundance of spawn.

Spawn rearing : About 375 ml spawn (c. 1.87 lakh hatchlings) were reared in the Jail nursery pond at Naini. The growth in size and weight in respect of *C. mrigala*, *C. catla*, *L. rohita* and *L. calbasu* were observed to be 140-170 mm/10-15 g ; 211-240 mm/100-225 g ;

155-217 mm/15-40 g and 147-165 mm/15-25 g respectively, after a period of about 3 months. The reared fry and fingerlings were handed over for work under different research projects of the Division.

Segregation experiments : One set of experiment for segregation of quality fish seed from the wild riverine collection was set up using metallic sieves of different mesh sizes. About 5 ml of spawn was released in the inner-most sieve (1/20″). When the movement of the hatchlings had practically stopped from one chamber to the other, the hatchlings retained in difierent chambers were preserved. The percentages of spawn retained in 1/20″, 1/24″, 1/28″ and 1/30″ meshed chambers were 84.2, 50.6, 20.5 and 8.7 respectively, whereas, the hatchlings retained and escaped through 1/36″ meshed size were totally of minor carps and mostly below the length of 5 mm.

Spawn quality : Microscopic analysis of spawn samples revelaed that the percentages of major carps, minor carps and others were 31.4, 59.7 and 8.9 respectively and on rearing, the percentage of major carps was observed to be 50.9, mrigal, catla, rohu and calbasu constituting 36.8, 3.5, 8.8 and 1.8% respectively. Minor carps mostly *L. bata* followed by *C. reba*, *O. bacaila* and *Puntius* sp. constituted 45.6% whereas, shrimps formed 3.5% of 'others' group. The seasonal indices of quantity and quality were estimated at 107 ml and 50.9% respectively.

IMPACT OF POLLUTION

Physiological aspects : The standard metabolic rate of *C. carpio* and *T. mossambica* increased when tested under sublethal mercury and aldrin. Histopathological studies revealed that the kindey of major carp fingerlings exposed to sublethal BHC, was more severely damaged compared to liver and intestine. *C. catla* was found to be more susceptible to pesticide hazards than the other major carps on account of lesser number of RBC in its blood.

Bioassay studies : Bioassays were conducted with chemical toxicants viz., aldrin, MEMC, mercuric chloride and copper sulphate using test organisms, *C. carpio* and *O. mossambicus*. The toxicity of these toxicants with respect to the fishes were found in the order of aldrin, mercuric chloride, MEMC and copper sulphate. For bioaccumulation upto lethal concentration of mercury (0.5 mg/l), the test fish, *O. mossambicus* (av. wt 3.5 g) was exposed for two hours. It was found that mercury content in gills, liver, intestine and muscles were 50, 37, 16 and 7 ppb respectively. The results revealed that there was maximum amount of mercury accumulation in gills, followed by liver, intestine and muscles. For bioaccumulation upto lethal concentration of pesticide BHC (0.05 mg/l), the test fish *O. mossambicus* was exposed for an hour. BHC-Y content in vital organs of the test fish was determined. The results indicated that there was maximum amount of BHC-Y in liver (0.909 μg), followed by intestine (0.429 μg), gills (0.184 μg) and muscles (0.054 μg).

Biochemical studies : Depression was observed in case of acid phosphatase activity in the liver of *T. mossambicus* when treated with sub-lethal concentration of BHC.

Impact of chemical wastes : The composite effluent from IFFCO complex, Allahabad, manufacturing urea and ammonium sulphate was characterised by high free ammonia (16.6 mg/l), alkalinity (460 mg/l), conductance (1000.56 micromhos/cm) and fairly alkaline pH (8.2). Heavy metal namely, chromium (0.2 mg/l) was present in water samples of IFFCO nalla and Bairagiya nalla.

The free ammonia content, though gradually decreased in its quantity after treatment, was noticed above ISI limit in the composite effluent being discharged into river Ganga at Dumdum. The quality of soil showed 50 ppb of Arsenic. The impact of toxic wastes was noticed upto 1000 m from the outfall region of river Ganga where plaknton and benthic population were sparsely distributed.

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

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

Duration : 1983-1987.

Location : Rihand (U.P.).

Chemical pollution : The industrial wastes released into Rihand reservoir by Kanoria Chemicals, manufacturing caustic soda, bleaching powder and BHC were characterised by acidic to alkaline pH (6.4 to 9.2) and high chlorine content (186.8 mg/l) and chlorides (1030 mg/l), besides nil dissolved oxygen. The acute toxicity of combined effiuent having chlorine and mercury was reflected in the total absence of planktonic and benthic communities at the outfall region during all the seasons. The spread of pollutional effect was recorded upto 500 m from the outfall.

Fishes as well as sediments were estimated for mercury residues. While in soil the mercury content was recorded to be 50 to 60 ppb, in *Notopterus notopterus* (av. wt 145.0 g) the same was recorded upto 30 ppb and 12.5 ppb in the gonad and liver respectively. The water samples of affected zone recorded less than 0.002 ppm of mercury.

Impact of thermal wastes : Heated effluents (46 to 52°C) released from thermal power plant, Renusagar Power Co. resulted in total absence of bottom fauna upto 1000 m. Heavy ash deposition was also recorded in the affected zone. The NTPC Centre did not show any servere adverse impact on Rihand reservoir.

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

Personnel : S. Sivakami, S. Ayyappan, P. K. Sukumaran, S. L. Raghavan and M. F. Rahman.

Duration : 1983-86.

Location : Bangalore.

The **physico-chemical features** recorded at Yalahanka and Bandematta tanks were as follows :—

Parameters	*Yalahanka*	*Bandematta*
Atmospheric temperature (0°C)	20-36	21-28
Water temperature (0°C)	22-29	20-28
Dissolved oxygen (ppm)	3.17-9.2	2.28-9.2
pH	6.0-7.95	7.0-8.9
Free carbon-di-oxide (ppm)	nil-12.0	nil-24.86
Carbonate lakalinity (ppm)	nil-20.0	nil-26.0
Bicarbonate lakalinity (ppm)	20.2-250.0	56.0-376.0
Sp. conductivity (μ mhos/cm)	51.24-536.8	65.88-397.77
Nitrate-nitrogen (ppm)	Tr-0.25	Tr-0.20
Phosphate-phospherus (ppm)	Tr-0.51	Tr-0.325
Silicates (ppm)	Tr	Tr
Primary production :		
Gross primary production (mg C/m^3 /hr)	20.84-468.75	36.46-375.0
Net primary production ,,	39.6-281.75	54.68-500.0
Respiration production ,,	11.80-310.0	300.0-375.0

Plankton : The plankton values in Yalahanka tank were : settling valume-1-14 ml/m3 ; wet weight-0.1-0.29 g/m^3 ; dry weight-0.1-0.6 g/m3 ; and total counts-86000-2927000/m3. The ranges of plankton in Bandematta tank were : volume-1-3 ml/m^3 ; wet weight 0.1-0.4 g/m^3 ; dry weight-0.13-0.60 g/m^3 ; and total counts-155000-1247000/m^3. The former tank was mainly comprised of *Microcystis* sp., *Ulothix* sp., *Spirogyra* sp., *Pediastrum* sp., *Closterium* sp. and among zooplankton *Brachionus* sp., *Keratella* sp., *Lecane* sp., *Filinia* sp., *Diaphanosma* sp., *Moina* sp., *Daphnia* sp., *Bosmina* sp., *Diaptomus* sp., and its nauplii. In the latter tank the phytoplankton comprising of *Microcystis* sp., *Ulothrix* sp., and *Pachycladon* sp., and among zooplankton *Brachinous* sp., *Keratella* spp., *Filinia* spp., *Diaptomus* and its nauplii. In Yalahanka tank, zooplankton dominated.

Littoral fauna : The density of littoral fauna in the Yalahanka tank the organisms ranged from 1-104 u/m^2 by numbers and from 0.006-4.150 g/m^2 by weight. The organisms recorded were : insects, Dragonfly, Damsel fly nymphs, *Ranatra elongata*, aquatic spider : *molluscs*, *Lymnea* spp., *Gyraulus* spp., *Pleurocerca* spp., fish : *Puntius ticto*, *P. stigma*, *G. affinis*, *Nemacheilus* spp., and prawn : *Macrobrachuim* spp.,

In Bandematta tank the density of organisms ranged from 1-3 u/m^2 by number and from 0.022-0.146 g/m^2 by weight respectively. The organisms recorded were fishes (*A. mola*, *Gaira* spp., *Chela* spp., *Nemacheilus* spp.,) and prawn (*Macrobrachium* spp.).

Sediments : In both the tanks size and texture of soil varied from silt to sandy. The range of chemical parameters in the two tanks were as follows :

Parameters	*Yalahanka tank*	*Bandamatta tank*
pH	6.0-8.2	6.0-8.2
Specific conductivity	19.52-229.36	36.6-175.68
Available nitrogen (mg/100 g)	4.70-17.15	6.30-17.86
Available phosphorus (mg P_2O_5/100 g)	0.53-4.53	0.93-7.99
Organic carbon (%)	0.27-2.50	0.89-2.50
Free calcium carbonate (%)	0.50-3.08	0.50-4.40

ECOLOGICAL STUDIES AT SANKEY AND HEBBAL TANKS

Microbial studies : Monthly hydrobiological collections alongwith microbial analysis of water and sediment samples of Sankey tank, Bangalore, were carried out. Diurnal studies on water quality and plankton were conducted during February 1984. Two earthen ponds in Hebbal were selected for studies, with one being manured with cowdung at 10,000 kg/ha/yr at monthly interval and the other kept as a control. The studies were initiated in March, 1984.

The physico-chemical conditions : The physico-chemical conditions in Sankey tank and Hebbal ponds were as follows :

Parameters	*Sankey tank*	*Hebbal tank*
Water		
Atmospheric temperature (O°C)	20.0-26.0	23.0-33.5
Water temperature O°C	21.5-25.5	22.0-33.0

Parameters	*Sankey tank*	*Hebbal tank*
Dissolved oxygen (ppm)	2.14-8.01	5.63-6.40
pH	8.0-8.5	8.0-8.5
Free carbon dioxide (ppm)	0-8.0	3.20-24.0
Carbonate alkalinity (ppm)	0-16.0	Nil
Hardness (ppm)	40.0-84.0	44.0-140.0
Bicarbonate alkalinity (ppm)	68.0-120.0	60.0-132.0
Sp. conductivity (μmpos / cm)	164.28-424.56	577.2-1952.0
Nitrate-nitrogen (ppm)	Tr-0.002	Tr-0.002
Phosphate-phosphorus (ppm)	Tr-0.0126	Tr
Silicate (ppm)	Tr-0.20	Tr
Iron (ppm)	Tr-0.55	0.03-10.04
Dissolved organic matter (ppm)	6.0-13.6	2.4-10.0
Sediment		
pH	7.0-8.0	6.5-8.5
Sp. conductivity (μmhos/cm)	512.40-1854.40	107.36-246.44
Available nitrogen (mg/100 g)	18.82-47.88	2.80-16.80
Available phosphorus (mg $P^2 O^5$ /100 g)	3.46-12.79	Tr-7.46
Organic carbon (%)	3.00-6.25	0.90-1.11
Free calcium carbonate	0.67-6.00	0.67-5.53

The ranges of primary production values in the two water depth levels in Sankey tank were as follows :

	Surface	*Bottom*
Gross production (mgC/m^3 /h)	21.87-208.32	upto 152.37
Net production ,,	21.87-120.31	upto 152.37
Respiration ,,	10.63-192.50	upto 192.50

Plankton : The plankton values in Sankey tank were : settling volume - 5-10 ml/m^3 ; wet weight - 0.5-1.95 g/m^3 ; dry weight 0.07-0.2 g/m^3 ; and total counts - 562000-1542000/m^3. Zooplankton dominated in the counts of plankton. The counts in Hebbal ponds varied between 138000 and 250000 per m^3, with zooplankton dominance.

Benthic and littoral fauna : The bottom fauna ranged upto 89/m^2 by number and 0.2 g/m^2 by weight (chironomids). The littoral faunal varied from 11 to 108 / m^2 by number and 0.09-4.04 g/m^2 by weight (insects, molluscs, fish fry and prawn).

Decomposition studies : The ranges of decomposition ratio (%) of organic substrates were as follows :

	Sankey tank	*Hebbal pond*
Silk (Protein base)	0-20	—
Filter paper (cellulose base)	0-71	0-35
Eichhornia	0-86	0-70

The volume of gas produced at the tank bottom in Sankey tank ranged from 5620 ml/m^2 . to 15130 ml/ m^2 . during the period.

Microbial analysis : The ranges of bacterial counts in the water and sediment samples of Sankey tank and fish pond at Hebbal were also studied during the period under report.

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, D. N. Singh, M. A. Khan, R. K. Saxena, R. A. Gupta and Ramchandra.

Duration : 1983-87

Location : Allahabad.

A. BACHHRA RESERVOIR

The physico-chemical characteristics of the water and soil of the reservoir during the year were as follows :

Parameters	*Values*	*Remarks*
Water		
Temperature (0°C)	21-32	—
pH	7.6-8.4	—
Transparency (cm)	33-143	—
Dissolved oxygen (ppm)	4.2-7.0	—

Perameters	*V a l u e s*	*Remarks*
Alkalinity (ppm)	96-160	—
Calciums ions (ppm)	18.0-23.1	—
Free CO_2 (ppm)	1.8-4.0	(observed during monsoon months only).
Nitrates (ppm)	0.10-0.15	
Phosphates (ppm)	0.08-0·13	
Silicates (ppm)	6.8-10.6	
Sp. conductivity (m. mhos/cm)	184-300	
Soil		
Sand	67-70%	org. carbon 0.9-1.0%
Clay	10-12%	sp. conductivity 750-810- m. mhos/cm.
Silt	20-21%	
$CaCO_3$	2-22%	

Productivity : The productive capacity of the reservoir, as determined by primary productivity (light and dark bottle method) was of a high order. Gross production varied between 50.0 to 112.5 and net productivity from 37.5 to 100.0 mg C/m^3/hr, whereas, the respiration ranged from 12.5 to 25.0 mg C/m^3/hr.

Plankton : Plankton population in Bachhra reservoir ranged from 197 (February) to 4533 u/l (November). Two pulses of plankton population were observed, the larger one in November and a comparatively smaller one in the month of June. The former pulse was due to the putrification of allocthonus detritus brought in by flood water into the reservoir and the latter due to the favourable water temperature.

Phytoplankton normally dominated over the zooplankton their ratio being 2.2 : 1. But during the month of October the zooplankters had an edge over the phytoplankters. Myxophyceae, Chlorophyceae and Bacillariophyceae, constituted 35.1, 19.3 and 11.3% respectively in the total plankton population while copepods (19.7%) followed by rotifers (8.3%) were the chief components of the zooplankton group.

Periphyton : The periphytic population ranged from 31 to 13.500 u/cm^2 in the lotic zone and 55 to 4200 u/cm^2 in the lentic zone. The maximum values in both the zones were obtained during the month of September.

Bacillariophyceae group (48.0%), represented by species of *Navicula*, *Pinnularia* and *Synedra*, dominated over other groups *viz.* Myxophyceae (29.0%) and Chlorophyceae (23%). The Myxophyceae group was mainly represented by *Oscillatoria* sp., *Phormidium* sp., and the the Chlorophyceae by *Cladophora* sp., and *Oedogonium* sp., A succession in different groups of of algae was observed. Generally a rich periphyton population was encountered in post-monsoon and summer months while it was poor in winter.

Bottom Biota : The macrobenthic fauna of Bachhra reservoir ranged between 456 to 17164/m^2 being maximum in February and minimum in August. The benthos were dominated by insect larvae (67.3%) followed by annelids (27.4%) and molluscs (5.3%). The insect larvae contributed two peaks in the months of February and July, the dominant forms being *Chironomus*, *Chaoborus* and *Phylopotamus*. The annelids were represented by *Aulodrilus pluriseta* and *Branchiura sowerbyi* whereas, the molluscan group comprised *Pisidium parreysis*, *Indonia* sp., and *Lamellidens*. Gastropods, represented by *Melanoides*, *Viviparus* sp., *Gyraulus* sp., *Lymnea* sp., and *Indoplanorbis* sp. No significant vriation between the zones was observed.

Bathymetric distribution of the benthic population was studied upto a depth of 6m. The benthos were constituted by *Chironomid* larvae which were available at all depths. Chironomid fauna was rich (456 u/m^2) between the depth range of 3.0 to 4.0 m but poor at 6.0 m level. The *Chaoborus* sp. were present only upto a depth of 3.0 m. The Oligochaetes were maximum (380 u/m^2) even at 5.0 m depth. The mulluscs, though encountered in lesser numbers in the samples, appeared to be quite rich as was evident by the fact that a large number of them were seen in the abondoned breeding pits of *Mystus* sp. in the shallower areas of the reservoir.

Stocking and tagging : 15,235 major carp fingerlings were stocked in the reservoir. 822 specimens (5.4%) comprising 317 C. *mrigala* (104-340 mm/10-360 g), 288 *C. catla* (120-261 mm/ 25-250 g), 269 *L. rohita* (143-420 mm/20-900 g) and 8 *L. calbasu* (141-290 mm/15-290 g) were tagged by anchor tags.

Experimental fishing : 21.435 kg of fish comprising 12.765 kg (59.6%) of major carps, 3.655 kg (17.0%) of minor carps, 3.520 kg (16.4%) of catfishes and 1.495 kg (7.0%) of featherbacks was captured with the help of multi-meshed nylon gill nets. Amongst the major carps eight specimens of *C. mrigala*, 6.820 kg (31.8%) dominated over other species *viz.* 2 specimens of *C. catla*, 3.510 kg (16.4%), 5 specimens of *L. calbasu*, 1.889 kg (8.80%) and 2 specimens of *L. rohita* 0.550 kg (2.6%). In the catfish group one specimen each of *W. attu*, 0.770 kg (3.6%) and *S. silondia*, 2.750 kg (12.8%) were caught in the nets. The minor carp group was represented by 4 specimens of P. sarana, (1.430 kg ; 6.7%) and two spcimens each of *L. bata*, (0.930 ; 4.3%) and *L. dyocheilus*, (1.430 kg ; 6.7%). The feather-back group was represented by 7 specimens of *N. notopterus* (1.495 kg ; 7.0%).

Most of these fishes were caught in smaller meshed gill nets of 0.45 cm bar. The size and weight ranges of major carp specimens, captured in the gill nets clearly denote that these catches were from the fingerling stock released in the reservoir in 1982-84. This is further confirmed

by recovery of one *C. catla* specimen, which was, stocked at the size and weight of 211 mm and 135 g, on 15th of February 1984 and captured on 31.8.84, attaining a size of 366 m and 260 g thus gaining an increase of 95 mm and 130 g in 197 days. The growth rate in size and weight was estimated respectively at approx. 0.5 mm and 0.7 g/day.

Drag net operations in a disconnected water area of the reservoir in May, 1984 showed presence of *M. seenghala* fingerlings, along with the trash fishes, indicating its breeding in the reservoir. A few breeding pits were also located in the shallower zones.

Induced breeding : Two pairs of *C. mrigala* and one pair of *L. rohita* were bred through hypophysation on 18th of August. About 2-5 lakh of spawn of the latter was obtained and released in a nursery pond at village Sirhir.

Pre and post-recruitment studies : Pre-recuitment studies were conducted in the reservoir, by operating shooting nets and dragging hapas near the probable breeding grounds of major carps. But no eggs/hatchling/fry were encountered. No escapement of major carp fingerling was noticed through the irrigation channel.

McPHERSON LAKE

McPherson Lake water revealed a fairly alkaline character, pH and alkalinity values ranging between 7.8-8.4 and 170-310 ppm respectively. Inorganic nutrients *Viz.*, nitrates and phosphates were observed to be at moderate level, ranging between 0.14 to 0.22 and 0.20 to 0.28 ppm respectively. Dissolved oxygen fluctuated between 4.0 to 5.8 ppm and chlorides from 20 to 30 ppm. Primary productivity was of a moderate order. The gross and net productivity ranged between 68.0 to 96.0 mg $C/m^3/hr$ and 40 to 58 mg C/m^3 /hr respectively. Macrobenthic fauna ranging 428 to 836 u/m^2 was dominated by mulluscs.

Aquatic weeds like *Hydrilla, Potamogeton., Azolla* and *Vallisneria*, were abundantly encocountered in the lake. The studies on the lake have been completed in the month of September, 1984.

PROJECT FC/A/3 : ECOLOGY AND FISHERY OF DHIR BELL IN ASSAM.

Personnel : Y. S. Yadava and M. Choudhury.
Duration : 1983-88.
Location : Dhir beel , Assam.

Catch statistics : The production in the beel remained more or less constant during March to August. From September onwards, production stepped up and attained peak during November-December. Production in the beel ranged from 8 kg/ha/month (June 1984) to 66 kg/ha/month (November 1894). The average monthly production was 32 kg/ha, whereas, the annual production worked out to be 377 kg/ha/yr.

112 tons of fishes were estimated to have been caught from Dhir beel as compared to 79.8 m tons during the previous year, thereby showing 41.5% increase in the total catch. The monthly distribution of the species in the catch is presented below :—

Table : Species wise distribution of the catch (wt. in kg) during December 1983 to November 1984.

Species / *months*	*Dec.* 83	*Jan.* 84	*Feb.* 84	*March* 84	*April* 84	*May* 84	*June* 84	*July* 84	*Aug.* 84	*Sept.* 84	*Oct.* 84	*Nov.* 84	*Total*	%
L. rohita	4398	2736	3933	1004	251	191	306	624	382	548	317	2253	16943	15.00
L. calbasu	53	214	93	18	—	1	4	32	14	342	118	98	988	0.88
L. gonius	—	—	38	—	—	3	—	—	—	—	—	—	41	0.04
L. bata	—	8	129	77	6	1	—	112	53	11	—	1	398	0.35
C. catla	1538	516	744	13	—	31	—	7	2	347	192	674	4064	3.60
C. mrigala	56	151	471	117	9	4	9	14	11	34	11	60	947	0.84
C. reba	—	—	—	98	136	94	60	—	—	32	4	—	424	0.38
W. attu	611	436	581	216	371	340	123	368	503	793	763	416	5521	4.89
M. seenghala	262	253	239	320	107	58	18	77	4	12	3	365	1718	1.52
M. oar	—	—	—	—	—	—	—	—	22	8	170	38	238	0.21
E. vacha	—	—	—	—	—	—	—	—	—	23	9	4	36	0.03
S. phasa	—	—	—	—	—	—	—	—	—	269	326	5	600	0.53
R. rita	—	—	—	—	—	—	—	19	4	—	—	—	23	0.02
H. ilisha	—	—	—	—	—	—	—	4	2	22	17	—	46	0.04
G. chapra	10395	1527	1022	175	90	66	23	145	206	1156	6676	17273	38757	34.33
N. notopterus	110	435	150	18	6	19	16	14	35	55	113	16	987	0.87
N. chitala	923	2506	1278	—	—	—	—	1	2	53	38	2	4803	4.25
Grass carp	—	—	—	—	—	—	—	—	12	15	65	89	181	0.16
Silver carp	—	—	—	—	—	—	—	—	—	162	63	51	276	0.24
Common carp	—	—	—	—	—	—	—	—	2	125	1	—	128	0.11
Miscellaneous	1867	1631	1497	1172	2172	3603	2254	1889	1523	1577	1639	958	21782	19.30
Live fishes	1344	736	736	992	1059	1281	1204	1630	1589	1240	1472	701	13984	12.38
Total	21557	11149	10911	4220	4208	5693	4017	4936	4366	6827	11997	23004	112885	

It is interesting to note that the exotic carps have been recorded in the catch from August onwards, the reason may be due to unusual high flood in the valley flushing exotic carps cultured in the ponds of surrounding area to the beel.

Hydrological observations : Air and water temperature during the period ranged from 14.0 to 30.6°C and 18.6 to 31.0°C respectively. Transparency varied from 22.6 to 117.0 cm and depth from 90.0 to 536.0 cm.

Primary productivity : Gross and net primary production ranged from nil to 263.75 $mgC/m^3/hr$ and nil to 239.375 $mgC/m^3/hr$ respectively. Respiration ranged from nil to 150 $mgC/m^3/hr$.

Diurnal variation : Diurnal variation in the physico-chemical properties of the beel water was studied on three occasions, i.e. during January, June and October, 1984.

Soil analysis : Monthly soil samples were collected for detailed chemical analysis.

Macrobenthos : The average occurrence of macrobenthos was 3468 nos/m^2 . It comprised mainly of Gastropoda 1.796, Diptera 856, Pelecypoda 573, Oligochaeta 503, and Acari 65 nos^{-m2} . Other groups present were Odonata 6 and fishes (9) and miscellaneous contributed 47^{-m2} . Gastropoda dominated throughout the year except in January, April and September and contributed 51.8% to the total benthic fauna. Macrobenthic biomass (dry wt.) varied from nil to 188.67 gm m^2 in the beel.

Organic detritus : Organic detritus (dry wt.) in the beel ranged from 47.16 to 566.03 g m^2 in sector I, 56.6 to 2258.49 g m^2 in sector II and 150.94 to 1698.4 g m^2 in sector III. The organic detritus in sector III contained five sand and stone particles.

Macrovegatation : The average macrovegatation density in the three sectors of the beel ranged from nil to 2.106 kg^{-m2} in wet weight and nil to 0.126 kg^{-m2} in dry weight.

Soil and water micro-organisms : Studies pertaining to soil and water micro-organisms conducted during January, June and October 1984, indicate that both bacterial nitrogen fixing and detitrification potential are quite high.

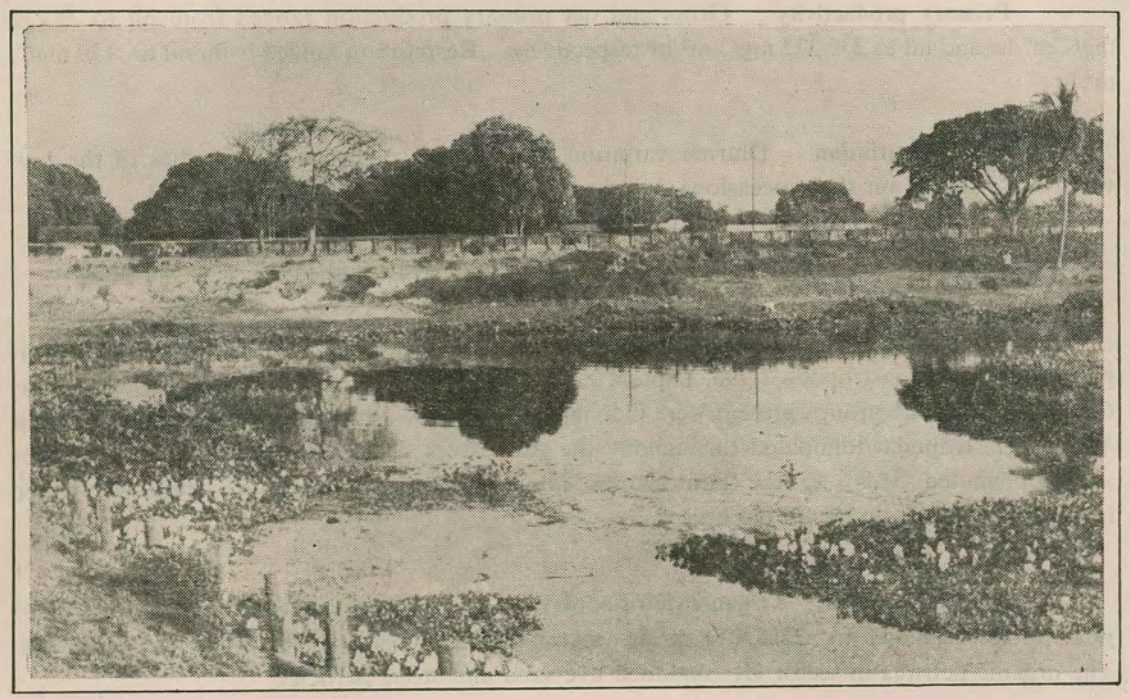
The details of microbial population in this beel is given under project AN/B/7.

PROJECT FC/A/4 : ECOLOGY AND FISHERIES MANAGEMENT IN BEELS IN WEST BENGAL.

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

Duration : 1980-85.

Location : Barrackpore.



A view of the weed-infested Media beel in West Bengal. The beel is being studied by CIFRI for the management of its ecology and fisheries.

Due to severe drought, studies on the Kulia beel were shifted to Media beel of about 120 ha. The beel was chocked (40-60%) with aquatic macrophytes, like *Eichhornia crassipes*, *Azolla*, *Ceratophylum demersum*, *Hydrilla verticilata* and *Naja*. Plankton density was of low order (45-5, 531 n/l. av. 625 n/l), main forms being *Ceratium hirudinella*, *Coscinodiscus* and *Pediastrum* spp.

Physico-chemical parameters along with gross and net production (table) showed that beel was quite productive.

Physico-chemical factors of Media beel

	Range	*Av. value*
Dissolved oxygen (ppm)	6.6-8.8	7.8
Carbon dioxide (ppm)	0.7-11.6	5.2
Total alkalinity (ppm)	82-93	88
Nitrate (ppm)	0.12-1.8	0.7
Phosphate (ppm)	0.03-0.3	0.16
Organic carbon (ppm)	7.2-8.3	7.7
pH	7.2-8.3	7.8
Gross production (mgC/m^2 /d)	480.3-870.0	680.5
Net production (mgC/m^2 /d)	305.8-735.0	520.5

A pen (0.02 ha) of split bamboo was installed in the beel and stocked with 160 (@ 8,000 n/ha) fingerlings of mrigal, rohu and catla in the ratio of 6 : 5 : 5. In 3 months time the average weight gained was as follows :—

	Initial wt.	*Final wt.*	*Wt. gained*
C. catla	125 g	340 g	215 g
C. mrigala	43 g	224 g	181 g
L. rohita	60 g	238 g	178 g

Gut contents analysis indicated that due to less depth of the beel almost all the fishes took to bottom feeding as indicated by the presence of organic detritus as the major food item in the gut, varying from 70-90%.

PROJECT FC/A/5 : ECOLOGY AND FISHERY DEVELOPMENT IN 'MANS' IN GANDAK BASIN.

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

Duration : 1983-86.

Location : Muzaffarpur.

A pen (25×25 m) of old bamboo chips was erected during the third week of December. The pen was stocked with 1,500 fingerlings of Indian major carps as follows in the last week of December : catla-115, av. 71.35 g), rohu-990 (av. 21.60 g), mrigal-310 (av. 30 g), and calbasu-85 (av. 20 g).

Ecological investigations : Ecological studies in the ox-bow lake are being done since September. The average values of various physico-chemical parameters of soil and water recorded as follows :—

Parameters	*Man (Lake)*	*Manika man Pen*	*Kanti man (Lake)*
Water			
Air Temperature (°C)	29.40	29.40	23
Water Temperature (°C)	26.40	27.00	22
Depth (m)	3.09	2.40	2.9
Transparency (cm)	236.6	180.00	241
Dissolved oxygen (ppm)	15.15	5.82	3.6
Carbondioxide (ppm)	1.40	4.12	10.0
Total alkalinity (ppm)	84.88	84.80	160
pH	8.98	8.08	7.5
EH (Mv)	+161.04	+166.00	+174
P_2O_5	Tr	Tr	0.09
Primary productivity (mgC)	40.0	186.69	31.2
Chlorophyll (μ mg/l)	0.08	0.23	0.07
Soil			
pH	8.0	7.9	8.0
EH (Mv)	-120	-140	-145
Organic carbon (%)	0.50	0.50	2.1

Comparative study of the average values of DO, CO_2 and pH indicates that the lake and pen waters showed distinctly separate chemical qualities. Significant difference was noticed in the rate of carbon fixation in the lake (40 mgC/m^3/h) and pen (186.60 mgC/m^3/h). Chlorophyll concentration was also better in pen (0.23 μmg/l) as compared to that of the lake (0.08 μmg/l). Stage of supersaturation (DO 20 ppm) was observed in the lake due to heavy infestation of aquatic weeds.

Macrovegetation : The Manika and Kanti *Mans* are heavily infested with marginal, floating and submerged weeds. Among the submerged weeds, *Hydrilla* and *Naja* species were found dominant.

Species	*Percentage frequency*	*Density expressed in kg/m²*	*Abundance*	*Biomass*
Manika man				
1. *Hydrilla*	77.7	53.8	62.29	3.53 (dry. wt.)
2. *Naja*	44.4	37.2	83.75	0.12 (dry. wt.)
Kanti man				
1. *Hydrilla*	55.5	39.4	71.0	
2. *Naja*	33.3	30.4	91.3	

Plankton collections were made from inside and outside the pen of Manika man and the average monthly plankton was 1343 u/l and 5450 u/l inside and outside the pen respectively. The zooplankters dominated over the phytoplankters, being maximum in July, 1984 and minimum density in March, 1984 in pen and man.

The common genera observed were nauplius *Cyclops*, *Diaptomus*, *Daphnia*, *Brachionus*, *Keratella*, *Filina*, *Polyarthra*, *Triartnra* among the zooplankters and *Closterium*, *Cosmarium*, *Coelosphaerium*, *Microcystis*, *Tabellaria* and *Fragilaria* among phytoplankters.

The bottom biota population was maximum in July (5,474 n/m²) and minimum in March (2,581 n/m²) in the pen while in the man the maximum was noticed in May (506 n/m²). The common organisms recorded were *Chironomus*, *Viviparus*, *Tubifex* and oligochaete worms.

The average occurrence of plankton of Kanti man (ox-bow lake) was 6,450 n/l, phytoplankton dominating over the zooplankton. The common genera observed were nauplius, *Arcekkam*, *Cyclops*, *Brachionus*, *Oscillatoria Spirogyra*, *Phormidium*, *Navicula*, etc.

Bottom biota of Kanti man was 220 n/m² , the common organisms recorded were *Chironomus* and annelid larvae.

Fish catch statistics : During the period 2,733.25 kg of fish was landed from Manika man. In the total fish production, miscellaneous species dominated (1,248.50 kg) followed by shrimps 448.50 kg, murrels (427.50 kg) major carps (401.00 kg) and *Notopterus* and *H. fossilis* (207.75 kg) . The fish production/ha was estimated as 27.33 kg.

Fish landing from Kanti man was also collected. The man is 4-5 km long and there is no fixed landing place. The fish landing was very poor, and was dominated by the *H. fossilis* and *Channa* spp. A total of 291.30 kg of fish landing was recorded for Kanti man in October, 1984 and the species encountered were rohu, catla, *H. fossilis*, *Channa* spp. and *Wallago attu*.

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

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

Duration : 1983-85.

Location : Barrackpore.

Economic data in respect of reservoirs like Ukai, Nagarjunasagar and Aliyar were collected and processed. The findings are as follows :—

Ukai Reservoir (Gujarat) :

During 1975-76 to 1982-83, 306 boats with 3,400 fishing units (50m hung length each) operated in the Ukai reservoir (36,523 ha). Total costs including both fixed and variable approximated to Rs. 5,46,000 as against gross sale proceeds of Rs. 22,62,000 by sale of 174 tonnes of fish @ Rs. 13000/ton. The fish business income of Rs. 17,16,000 accrued to 1836 fishermen engaged in fishing for 260 days during the period under review, thereby giving Rs. 935 per fisherman per annum.

Nagarjunasagar (A. P.) :

Nagarjunasagar reservoir with an area of 24,429 ha is a catfish dominated reservoir. Available data reveal that the number of fishermen engaged in 300 days of fishing are about 520 coracles with a leather bottom and bamboo frame are operating to net out an annual average crop of 170 tonnes.

Annual capital costs and variable costs work out to be around 4,24,666 as against fish business of income 4,25,334. The income per fisherman per year adds up to Rs. 818/-

Aliyar Reservoir (Tamil Nadu) :

It is a small reservoir with an area of 324 ha and annual average crop of 17 tonnes. The total cost (F + V) works out to around Rs. 52,950 as against fish business income of Rs. 32,050 thereby giving per head income of Rs. 2,289 for 14 fishermen engaged. The significant cost component is a royalty of 50% basis.

A factor causing distortion in their income is the penal rate of royalty on 50% catch sharing basis. If like Vallabhsagar (Ukai) Reservoir royalty is levied @ Re. 1/- per kg per head income of fishermen is likely to be little less than double, say around Rs. 4,144/- per annum.

PROJECT BF/B/1 : ECOLOGY AND PRODUCTIVITY MANAGEMENT OF BRACKISH-WATER PONDS.

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

Duration : 1983-87.

Location : Kakdwip.

Culture experiments of *P. monodon* were made at three farms Rangafale, Kakdwip and Ganeshnagar. Salinity at these farms ranged between 0.3-18.25 ppt (Rangafale), 1.5 to 25.0 ppt (Kakdwip) and 16.5-32.00 ppt (Ganeshnagar) and water temperature ranged from 22.2 to 30.0°C at 8 A.M. at all the three farms. Growth of *P. monodon* was faster at Rangafale (43 g/135 days) than at Ganeshnagar (31.5 g/135 days) or at Kakdwip (60 g/210 days). Growth and yield of *P. monodon* at low range of salinity (15.25 ppt) was found to be better than at higher salinity Kakdwip 25.0 ppt, and Ganeshnagar 32.0 ppt).

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

Personnel : G. N. Saha, S. C. Thakurta, G. C. Laha, A. C. Nandi, H. C. Karmakar, K. R. Naskar, V. Pathak, P. B. Das, S. K. Chatterjee, R. N. Dey and N. D. Sarkar.

Duration : 1982-86.

Location : 24 Parganas, West Bengal.

Inventory : Inventory of bheries was carried out in Barasat (low saline), Haroa and Hashnabad(Medium saline) and Mathurapur, Kakdwip and Namkhana (high saline) areas of 24 Parganas, West Bengal. Total area surveyed was 10,353 ha comprising 300 bheries. Average annual per hactare production of fish and prawn (*P. monodon*) estimated based on information were 336.81 kg and 39.58 kg (low saline) 657.83 kg and 192.87 kg (medium saline) and 710.80 kg and 42.25 kg in high saline bheries respectively. The contribution of *P. monodon* to total production was 11.75%, 29.32% and 5.94% respectively in the above saline zones. Both casual and regular labourers are engaged in this trade. Main gears like *berjali*, *bitti* and cast nets are used in harvesting fish and prawn. Fertilizers and feeds are not used in regular practices. Banks provide loans to bheri owners.

Ecology : Ecological studies were made in selected bheries in Kharibari (low saline), Haroa and Kulti (medium saline) and Golabari (high saline). Important physico-chemical parameter of bheri waters like temperature, turbidity, pH, alkalinity, salinity, phosphate, nitrate, calcium and magnesium showed wide variations in the respective bheries. Annual average values of parameters in between saline zones, no remarkable variations were noticed in water temperature (27.7-29.3°C), turbidity (8.7-11.1 cm) and pH (7.1-7.2), while striking variations were observed in salinity (3.6-15.8 ppt), total alkalinity (116-142.9 ppm), calcium C65-186.0 ppm), magnesium

(153-843.0 ppm), phosphate (0.12-0.18 ppm) and nitrate nitrogen (0.11-0.20 ppm). Maximum values of salinity (15.8 ppt), calcium (186.0 ppm), magnesium (843.0 ppm) and phosphate 0.18 ppm) were recorded in high saline bheri at Golabari. Primary production was also recorded maximum in high saline bheries (385 $mgC/m^3/hr$) compared to low (115 $mgC/m^3/hr$) and medium saline bheries (96 $mgC/m^3/hr$).

Total plankton ranged from 94-2548 n/l (high saline), 90-1542 n/l (medium saline) and 108-2770 n/l (low saline) bheries. Phytoplankton was dominated by species of *Spirogyra* and *Melosira* and zooplankton by *Diaptomus* and *Cyclops*. Benthic biota was mainly represented by molluscs which were maximum in medium saline bheri (3105 n/m^2).

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

Personnel : B. N. Saigal (from June, 1984), Apurba Ghosh (up to June, 1984), P. M. Mitra, H. C. Karmakar, D. K. De, S. B. Saha, M. M. Bagchi, A. chowdhury, S. N. Sar, H. S. Majumder, A. R. Paul, A. K. Roy, N.C. Mondal, R. N. De, N. D. Sarkar, N. P. Saha, A. K. Banerjee, G. C. Laha, P. B. Das and B. B. Das.

Duration : 1983-84.

Sample survey for estimation of catch and effort : Estimated total landings amounting to 7,949.8 t during the period November 83-October 84 were recorded from Hooghly-Matlah Estuarine System as against 5,734.9 t in the corresponding period of November 82-October 83 with an increase of 2,214.9 t (38.6%). Heavy fish landing at Digha (2,219 t) during November and December 83 mainly accounted for the increase. Fish landing at Digha during the months comprised 445 t of *Hilsa ilisha* the rest were miscellaneous fishes.

Zonewise and monthwise catch structure : A catch of 6,299.2 t (79% of the total fish landings) was recorded from lower estuary, while 8% and 7% of the total catch came from the upper estuary (zone I) and Rupnarayan tributary (zone IV) respectively. Winter months particularly November and December 83 accounted for maximum catch (3,062.9 t, 38% of total landings). March, April, May and June 84 together contributed only 980.1 t (12.3%).

Species composition : *Hilsa ilisha* dominated in the catches from the entire estuarine zone accounting for 1,977.2 t (25% of the total fish landings) against 1,295.8 t during the corresponding period of the preceding year and registered an increase of 681.5 t. Of the hilsa landings, 1007.8 t was contributed during the winter months (November 83 to February 1984) and 672.7 t were recorded during monsoon period (July to September 1984). A striking feature of the monsoon fishery was that hilsa catch was dominated by large sized fishes in the length range of 34.5 to 59.3 cm with a mean length of 48.5 cm, specially during July and August. Most of the fishes in the above size range were in advanced stages of maturity.

Table : Contribution of major fish species and prawns to the total estuarine fish catch during November 83 to October 1984.

Name of the species	*Contributed to total catch (t)*	*% in the total catch*
Hilsa ilisha	1,977.2	25.3
Stromateus cinereus	337.0	4.2
Tachysurus jella	291.3	3.7
Harpodon nehereus	288.8	3.6
Pama pama	278.4	3.5
Setipinna phasa	211.5	2.7
Polynemus paradiseus	44.0	0.53
Prawns	559.3	7.0

Polynemus paradiseus accounting 44 t in the total catch was mainly caught in the middle estuary and Roopnarayan tributary 33.7 t during April and May. Freshwater fishes mainly the Indian major carps forming about a tonne were also caught by different gears in the upper zone.

Effort and CPUE pattern of different hilsa gears and bagnet : In the upper estuary the effort by drift-gill nets during 1984 monsoon was almost of the same order as in 1983, while CPUE was about 20% higher in 1984 as compared to 83. The effort by purse net in 1984 monsoon was two time higher compared to 1983 but CPUE was more or less of the same order. The effort and CPUE for drift gill nets in mid-estuary during 1984 monsoon was much higher in comparison to that of 1983. The effort was three times higher and CPUE was two times higher in 1984 than that of 1983. The effort by drift gill nets in Rupnarayan was about 42% lesser when compared to 83 but CPUE was three times higher. Zonewise total hilsa catch, effort, CPUE by different hilsa gears in 81-82, 82-83 and 83-84 are presented in the table.

Total bagnet effort in the upper estuary in 1984 was 26% higher than that of the last year, but CPUE was almost of the same order, while in mid-estuary the total effort was almost similar in 1983 and 1984 but CPUE was two times higher in 1984 compared to 1983. Total bagnet effort in Rupnarayan tributary was 28% less in 1984, compared to 1983 but the CPUE was almost of the same order.

Table : Zonewise total hilsa catch, effort, CPUE by different hilsa gear in 81-82, 82-83 and 83-84.

Zone	*Gear*	*Catch (kg)*			*Effort (net tides)*			*CPUE (kg)*		
		81-82 (Nov.-Oct.)	82-83 (Nov-Oct.)	83-84 (Nov-Oct.)	81-82 (Nov-) Oct.)	82-83 (Nov-Oct.)	83-84 (Nov-Oct.)	81-82 (Nov-Oct.)	82-83 (Nov-Oct.)	83-84 (Nov-Oct.)
I.	Purse	88575	75771	29785	232095	258815	127321	0.38	0.29	0.23
	Drift	235169	274045	153179	383050	583740	507703	0.61	0.47	0.30
	Set-gill	93860	159002	39319	35190	34483	38949	2.67	4.61	1.01
II.	Bag	974	12446	39339	—	—	—	—	—	—
	Drift	356791	59831	318471	99386	58847	190527	3.59	1.02	1.67
III.	Bag	—	2255	6841	—	—	—	—	—	—
	Drift	5779752	586331	1085337	—	—	—	—	—	—
IV	Drift	330115	120048	286893	134854	89567	160322	2.45	1.34	1.79
	Bag	—	6093	18038	—	—	—	—	—	—
	Total	6885235	1295822	1977202	884575	1025452	1024822			

Catch of hilsa at Farakka was 358.7 t comprising 73.8% of the total catch during November 83- October 84 as against 236.1 t in the corresponding period last year. Large sized hilsa in the length range of 33.6 to 53.0 cm with a mean length of 43.6 cm dominated the hilsa fisheries at Farakka during monsoon.

After a lapse of several years winter migratory bagnet fishery was intiated this year in the month of November. Preliminary analysis of the inventory survey showd that 169 fishing camps were set up and 747 bagnets of different mesh sizes, 347 boats out of which 73 were mechanised

were in operation at different places in lower estuary. 3729 fishermen were reported to be engaged in winter fishing which is as follows :

Table : Centrewise fishing camps, bagnets, boats, men engaged in winter migratory bagnet fishery in lower estuary.

Centre	*Fishing camps*	*Bagnet*	*Boat*	*Men engaged in fishing*
Frasergunj	18	68	37	246
Bakkhali	19	110	59	599
Upper Jamboo	21	137	62	741
Lower Jamboo	28	189	86	1366
Sagar Island	83	243	103	777
Total	169	747	347	3729

Biological investigation on *Hilsa ilisha*

Based on the samples in length range of 19 to 115 cm, collected from the freshwater zone of the Hooghly estuary, a stretch of 110 km extending from Barrackpore to Dhatrigram, growth rate of juvenile hilsa was studied during the period from November 1983 to June 1984. The percentage frequency distribution of the lengths of juvenile hilsa in different months showed that the growth increment in the first month after spawning was 33 mm and in the subsequent months between 10 mm to 20 mm. The average monthly growth rate at the end of 2nd, 3rd, 4th and 5th month old age groups appeared to be 24.9, 20.7, 18.5 and 17.1 mm, respectively.

The length frequency data showed that June to October more larger size groups (320-520 mm) were recorded than in other months. From January to May smaller size groups (195-341 mm) were observed.

Studies of the gut content analysis revealed that copeopd to be the principal food item of hilsa fry (20-50 mm) and fingerlings (51-115 mm) followed by rotifer, diatom and cladocerans.

Ecological investigations

Freshwater zone in the Hooghly estuary was found to be extending up to Uluberia where salinity ranged between 0.016-0.049 ppt and thereafter gradual increase in salinity was reflected at Nurpur where the salinity ranged as 0.021 to 0.967 ppt and further rise in salinity at Kakdwip was to a maximum of 16.268 ppt. Higher salinity ranged between 9.729 to 33.392 and 4.187 to 24.102 ppt were observed at Digha and Canning respectively. No marked deviation in salinity pattern

was indicated compared to the previous year. The values of hardness, salinity and specific conductivity were found to be higher at Kakdwip, Digha and Canning in comparison to other centres. The pH ranged from 7.9-8.5, DO from 5.0-10.0 ppm turbidity from 85-966, total alkalinity from 56-160 ppm, salinity from 0.016-33.392 ppt, sp. conductivity from 167—37752 micromhos/cm, hardness from 37-5130 ppm, nitrate from Tr-0.15 ppm, phosphate from Tr-0.16 ppm and silicate from Tr-23 ppm in the Hooghly—Matlah—Rupnarayan estuarine ecosystem.

The primary productivity in the upper stretch of the Hooghly estuary (Farakka-Nabadwip) ranged from GP (15.6 - 75.0 mg $C/m^3/hr$) and NP (6.25 - 31.2 mg $C/m^3/hr$) ; in the lower stretch of the Hooghly estuary (Nurpur - Kakdwip) ranged from GP (31.2 - 83.4 mg $C/m^3/hr$) and NP (15.6 - 62.5 mg $C/m^3/hr$), both the values being higher in comparison to the mid stretch at Nawabgunj (GP : 10.9 - 37.5 mg $C/m^3/hr$ and NP : 3.9 - 15.6 mg $C/m^3/hr$) being in the industrial belt. At Port Canning (Matlah estuary) max. GP : 48.5mg $C/m^3/hr$ and max. NP : 39.1 mg C/m^3 /hr were recorded.

Analysis of soil samples from the Hooghly, Matlah and Rupnarayan estuarine system indicated the following values of different parameters.

Parameters	*Hooghly*	*Matlah*	*Rupnarayan*
pH	7.0-7.3	7.0-7.2	7.1-7.2
Organic carbon (%)	0.019-0.451	0.294-0.641	0.057-0.27
Total Nitrogen (%)	0.017-0.134	0.047-0.073	0.017-0.031
C/N ratio	1.51-8.84	5.44-9.48	2.0-8.7

The lowest value of organic carbon (0.019%) was observed at Farakka and the highest (0.641%) was observed at Canning.

PROJECT BF/B/4 : SEED ABUNDANCE AND RECRUITMENT OF BRACKISHWATER FISHES AND PRAWNS IN HOOGHLY-MATLAH ESTUARINE SYSTEM.

Personnel : K. K. Bhanot (upto May), D. K. De, H. S. Majumder and R. N. De.

Duration : 1984-85.

Location : Hooghly-Matlah Estuary (Barrackpore).

Exploitation of natural resources of the brackishwater fish and prawn seed was done in the lower stretch of the Hooghly estuarine complex. Sufficient tidal fluctuations were marked at all the places throughout the year. Standard shooting nets were used for the collection of seed.

The collections were made in two successive days of each fortnight during spring high and low tides. The improtant culturable prawn and fish species observed in the samples were post larvae and juveniles of *Penaues monodon*, *P. indicus*, *Metapenaeus brevicornis*, *M. monoceros*, *Liza parsia*, *L. tade*, *Eleutheronema tetradactylum* and *Rhinomugil corsula*.

Penaeus monodon (8-17 mm) were available from March to June with maximum abundance during May. *P. indicus* (21-50 mm) were available from June to November with peak abundance in October. *M. brevicornis* (15-59 mm) were available almost throughout the year with peak abundance during July and October. *M. parsia* were available from May to July and *L. tade* were obtained from July to September.

The maximum numbers collected per net per hour were : 262 of *P. monodon* in May, 38 of *P. indicus* in October , 122 and 195 of *M. brevicornis* in July and October. 272 of *L. tade* in July, 90 of *L. parsia* in May, 24 of *E. tetradactylum* in October, and 24 of *M. corsula* in July. Higher quantity of seed was collected during high tides.

Analysis of parameters such as water temperature and salinity showed that *P. monodon* was available during the period of high salinity (21.0-23.0 ppt) and temperature (29.4-33.1°C), while *P. indicus*, *M. brevicornis* and *M. monoceros* were available over a wide range of salinity (3.9-23.0 ppt) and temperature.

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

Personnel : K. M. Das and Amitabha Ghosh.

Duration : 1983-85.

Location : Barrackpore.

Investigations on the physiology of digestion of adult *L. parsia* under natural conditions have been completed. The RIG has been observed to be 2.2. The stomach though have glandular structures has been found to be mainly triturating in function. Acid digestion absent. AB (2.5) and PAS positive mucous cells have been found to be present throughout the intestinal mucosa. Lipase activity was recorded in the intestine, intestinal caeca and liver with highest activity in the intestine (226/ug of alpha napthol liberated per mg protein/hr).

Studies on the alimentary canal of another brackishwater fish *Lates calcarifer* have been initiated. This fish has well developed stomach with acid phase of digestion. The RLG is 0.6. Hepatopancreas present. Protease activity has been detected in the stomach, intestine and hepatopancreas with maximum activity in the latter organ. Amylase activity has been recorded throughout the length of the alimentary canal with maximum activity in the anterior intestine. AB (2.5) and PAS positive mucous cells have been found to be present in the intestinal caeca and interior intestine. The pH of the empty stomach has been found to range between 6.0 and 6.5. The work is in progress.

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

Personnel : B. B. Ghosh, M. K. Mukhopadhyay, H. C. Joshi, M. M. Bagchi, A. Hazra, U. Bhowmick and P. K. Pandit.

Duration : 1983-86.

Location : Barrackpore.

Water and effluent quality monitoring : Samples of water, effluent, plankton and fish from different centres in the industrial belt between Kuntighat and Batanagar (zone-II) and non-industrial belt between Nabadwip and Kamargachi (zone-I) in the upper stretch and between Nurpur and Kakdwip (zone-III) in the lower stretch of the Hooghly estuary were collected for studying water and effluent quality and other biological parameters.

The physico-chemical parameters studied with respect to water quality were as under :

Water temperature	—	23.8-32.5°C.
pH	—	4.0-8.4.
DO	—	3.0-9.8 mg/l.
BOD (at room temp.)	—	1.1-26.9 mg/l.
Salinity		0.016-15.268 ppt.
Hardness (as $CaCO_3$)	—	44-4000 mg/l.
Sp. conductivity	—	171-21769 μmhos/cm.

Pollutional characteristics of effluent collected from rayon industries at Kuntighat showed a low pH (2-4) and absence of alkalinity and dissolved oxygen. On an average basis lesser value of DO (6.4 mg/l) and slightly higher value of BOD_5 (6.7 mg/l) were observed in the industrial belt (zone-II) whereas, these parameters in the non-industrial belt (zone-I and II) were : DO-7.6 mg/l (av) BOD_5-5.9 mg/l(Av). However, lowest value of DO (3 mg/l) and pH (4.0) and higher value of BOD_5 (26.9 mg/l) were recorded in the industrial belt.

There appears to be no distinct change in the pollutional characteristics as evidenced by the above parameters in the industrial belt (zone-II) when compared with previous year's observations.

Biological parameters : Primary productivity in terms of gross organic production (GP : 10.9-62.5 mg C/m^3/hr) and net organic production (NP : 10.4-41.7 mg C/m^3/hr) was less in industrial belt (zone-II) was compared to zone I and III in the non-industrial belt (GP : 20.8-83.4 and NP ; 10.4-62.5 mg C/m^3/hr.)

In the Hooghly estuary plankton density varied between 11-278 u/l in the industrial belt (zone-II) whereas, in the non-industrial belt it ranged between 29-426 u/l. Availability of zooplankton was less in zone II as compared to zone I and III. Amongst phytoplankters, the dominated species were *Spyrogyra*, *Zygnema*, *Spirulina*, *Nostoc*, *Lyngbya*, *Anabaena*, *Synedra*, *Navicula*, *Nitzchia*, *Amphora*, *Coscinodiscus*, etc. *Coscinodiscus* sp was available from Shalimar (zone-II) downwards and was in abundance at Kakdwip (zone III).

In the industrial zone, plankton density around the outfall area of chemical complex at Rishra was lowest. (10-18 u/l). followed by the Mulajore power station are (10-50 u/l) at Shyamnagar.

Low condition factor (CF 0.924-1.213) and haematoglogical values (RBC-1.10-1.45 $\times$ 10^6 no/m^3 $\times$ Hb-4.8-8.2%) in case of *Rita rita* collected from the industrial stretch (zone-II) indicated adverse environmental condition in this zone as compared to the corresponding values (CF-1.016-1.434, RBC-1.34-3.6 $\times$ 10^6 nos/m^3, Hb-7.0-10.25%) for the above species examined from the non-industrial zone (zone-I).

Static acute toxicity tests were performed on fish *Tilapia mossambica* (in fresh and saline conditions) using cadmium, zinc and copper salts, whereas, such tests on plankton (*Daphnia* sp.) and benthos (chironomid larvae) were performed using only cadmium salts under freshwater condition. Rise in temperature and lowering in salinity increased cadmium toxicity (as cadmium chloride) to *Tilapia mossambica* as evident from 96 hr LC_{50} values (246.5 and 250.6 mg/l) at 7.2 and 12.6 ppt salinity level under 19.5-21.0°C temperature and 242.3 and 254 mg/l (96 hrs LC_{50}) at respective salinity under 26.5-29.5°C temperature. In combination, zinc and chromium did not show any synergestic effect on *Tilapia mossambica* but addition of copper increased the combined toxicity (3.6 mg/l) of these metals by five to ten times of their individual toxicities (96 hrs LC_{50}) values : Cu-34.75 mg/l, Zn-19.05 mg/l, Cr-38.08 mg/l).

Daphnia sp, was found to be more sensitive to cadmium (96 hrs LC_{50}-0.509 mg/l) as compared to chironomus larvae (96 hrs LC_{50} - 255.2 mg/l) under freshwater condition at 20-21.0°C temperature and 210 mg/l hardness as $CaCO_3$.

Under long term exposure (128 days) in 2 ppm and 4 ppm of Cr (as CrO_3) the survival rate of *Tilaphia mossambica* was recorded as 72% and 56% respectively against 84% in control. In haematological studies, a gradual fall in Hb content and RBC count was observed with the increase in chromium concentration.

Bioaccumulation of heavy metals : Data collected over the years 1978-84 and analysed have indicated that average level of zinc (Zn) in the whole body was in the order—mollusc (83.0

ppm), juvelnile *H. ilisha* (36.6 ppm) *small* sized scaly fish (*E. macrodon, B. ticto, O. ruloicondus, A. bata, S. phasa, C. faciatus, G. giuris* ; 33.9 ppm), catfishes (*R. rita, C. garua, M. manoda, P. pangasius S. silondia* ; 31.6 ppm) and crab (24.0 ppm). In different organs average highest zinc accumulation (82.05 ppm) was observed in the ovaries of cat fish, *R. rita* compared to 26.6 ppm in scaly fish (*P. pama, R. corsula, P. sophore, P. paradesius*). In nature *Hilsa ilisha* zinc content ranged between 6.4-69.8 ppm in flesh, liver and kindey maximum in kdiney) compared to traces to 68.1 ppm in the juveniles of the above species (82 to 132 mm length range). The situation was almost reverse in case of small catfish (*R. rita, C. garua, M.manoda, P.pangasius, & S. silondia*) where zinc content ranged from trace to 215.1 ppm while in the adults it ranged btetween trace and 60 ppm only. Bioaccumulation factor of zinc in whole body of various organisms ranged between 1,200 and 4,150, maximum being in mollusc, while the organs like kidney and gonad showed much higher values (max 14,754 and 3,340 respectively).

Pesticide toxicity and monitoring : Short term (24 hrs) toxicity bioassay experiments were conducted on *Daphnia carrinata* using organochlorine (DDT and BHC), organophosphorus (methyl parathion) and carbamate (carbaryl) insecticides. The toxicity was in the order-methyl parathion DDT carbaryl BHC as was evident from respective LC_{50} (24 hrs.) values (1.44, 4.79, 17.78 and 33.88 ppb, respectively) under 20.5-21.5°C temperature and 200-210 mg/l hardness as $CaCO_3$.

Studies on the long-term (3 months) effect of low levels of DDT (2.6 and 5.2 ppb) exposure on growth, condition factor, maturity and enzymic activity (acid phosphatase) of *Tilapia mossambica* were undertaken. Fishes exposed to 5.2 ppb DDT showed significant reduction in growth in length as compared to the fishes kept under normal conditions (16.6% against 21.2%), condition factor (1.22 against 1.34) and maturity (G. S. I. being 1.63 against 4.27 for female) of *Tilapia*. Biochemical examination of the test fish indicated no change in the acid phosphatase activity at 2.6 ppb DDT, while the enzymatic activity was markedly reduced at 5.2 ppb DDT. Bioaccumulation of DDT was maximum in liver followed by visceral fat and muscles.

While studying the long term effect of sub-lethal concentrations of DDT (0.25, 0.5 and 1.0 ppb) on plankton population a gradual decline in zooplankton population was observed at 1.0 ppb DDT with the increase of exposure period upto 2 months. Cladocerans were the most affected group at this level of DDT.

DDT residues (197 ppb) were detected in one specimen out of four specimens of *Rita rita* collected from the Hooghly estuary around Hazinagar. Twenty two sediment samples also showed DDT residues out of 78 sample collected from the estuary.

Compatability of application of pesticides in paddy-cum-fish culture :

Experiments were conducted to study the compatibility of raising of major carp fingerlings with pesticides application in paddy fields. Pesticide (phosphamidon) application for the control of insect pests was done twice before the introduction of carp fry (*C.catla, L.rohita* and *C.mrigala*)

in the paddy fields and once during the rearing period. One of the four paddy plots was kept as control in which pesticide was not used. Paddy fields were mostly flooded with rainwater but some times water was supplemented from the adjacent pond which marked the fluctuations in physio-chechemical parameters as is distinct from the weekly observations. Weekly plankton population studies indicated decline in filamentous algae in the plots treated with phosphamidon. Diatoms were the dominant speices in all the paddy plots showing negligible effect of phosphamidon. Condition factor for the fishes *L. rohita C. catla* and *C. mrigala* in treated plots was found to be slightly better (0.9718, 1.0113 and 0.9012) than in control plot (0.9265, 0.9623 and 0.8689). No significant difference in the haematological conditions of the fishes was observed in control and treated plots. Phosphamidon degraded fast in water and soil and no residues were encountered after 21 days. Phosphamidon residues was not detected in fingerling examined after the close of the experiment. Bioassay experiments conducted under the laboratory conditions showed LC_{50} (24 hrs.) and LC_{50} (96 hrs.) of phosphamidon for *L. rohita* as 495 and 270 mg/l and for *C. catla* as 430 and 284 mg/l, respectively.

These experiments have shown that carp fry (*C. catla, L. rohita* and *C. mrigala*) can be reared in the paddy fields alongwith the applications of phosphamidon for the control of insect pests. Phosphamidon is a systemic insecticide, degrades fast under water-logged conditions and is rapidly removed from the systems. Its toxicity to these fishes is quite low. Result of biological studies do not indicate symptoms of residual toxicity of fish.

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 and P. M. A. Kadir.

Duration : 1984-87.

Location : Madras.

Water, sediment and biological samples collected from Pulicat, Ennore, Adyar and Kalpakkam estuaries were analysed using atomic absorption spectrophotometer (AAS) for assessing the metal pollution status. Cadmium, Copper, Nickel, Zinc, Lead, Chromium, Manganese and Mercury were estimated. The concentration factors (enrichment factor) for prominant metal ions observed in issues of the oyster *Crassostrea madrasensis* collected from Ennore along with water samples were as follows :

Metal ion	*Range of CF value*	*Av CF value*
Zn	2.5×10^{4} - 2.8×104	2.6×104
Cu	1.6×10^{4} - 1.8×104	1.7×104
Cr	1.2×10^{4} - 1.8×104	1.4 - 104
Mn	2.5×10^{3} - 3.1×103	2.9×103

Breeding of hilsa was successfully done in Baniagram-Nimtita stretch of Hooghly in October. Out of 23 sets, breeding took place in four sets only with fertilization ranging from 30-50%. Developing eggs were incubated under laboratory conditions (water temperature 22-29°C, DO 6.5-8.2 ppm and pH 7.6-7.8) and 0.265 million hatchlings were obtained. Hatching time varied from 16-20 hours depending upon water temperature.

Hatchlings (49,000) were transported @ 1,000 n/l to Rahara Research Centre from Farakka in open containers without oxygenetion. Water used was from the river, settled for 12-16 hours. The mortality was 5-10% only.

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

Personnel : T. Rajyalakshmi, G. V. Kowtal (upto 29-10-1984) P. Ravichandran, S. M. Pillai and A. N. Mohanty.

Duration : 1980-1984

Location : Puri.

Survey was conducted along Orissa coast to assess the potential of fisheries of five brackish-water species, *Mugil cephalus*, *Liza macrolepis*, *Lates calcarifer*, *Chanos chanos* and *Sparus*. The details are as below :—

	Seasons of availability/Maturity stage			
Places/surveyed	*Chilka Mouth*	*Ramachandi Lagoon*	*Balithota (Mahanandi)*	*Balugaon (Chilka)*
Mugil cephalus	Oct.-Dec. (III)	Oct.-Dec. Spent	—	—
Liza macrolepis	Dec.-Jan (IV)	Dec (III)	—	—
Lates calcarifer	Apr.-May (II & III)	Apr.-May (II & III)	Mar.-June (II & III)	Mar.-June (II & III)
Sparus datnia	Dec.-Feb. IV (oozing)			
Chanos chanos	Brood fish not found in any of inshore/offshore catches.			

Sparus datnia (female 453 mm/1.7 kg and males of 316 mm/0.6 kg and 367 mm/0.9 kg) were successfully bred at Chilka mouth. Out of 2 lakhs fertilized eggs, 40,000 hatchlings were ob-obtained. The hatchling occured after 12 hours of fertilization. The hatchlings survived for 7 days. The ambient salinity at the time of fertilization was 38 ppt and temperature 20°C.

Liza macrolepis was also successfully bred at Chilka mouth camp during December 84. The oozing female of 530 mm/1.4 kg and males of 355-370 mm/500-525 g were stripped. About 50% hatching was observed. The larvae died after the second day. The salinity at the time of stripping was 32 ppt and temperature 26°C.

The second set of *L. macrolepis* (female 430 mm/900 g and Males 350-370 mm/500-600 g) yielded 2 lakh fertilized eggs. The hatching took place within 24 hours at 36 ppt and 25°C temperature. Hatching rate was about 70% but the larvae died after third day.

PROJECT BF/A/4 : BREEDING AND SEED PRODUCTION OF BRACKISHWATER FIN FISHES.

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

Duration : 1979-84.

Location : Madras.

Feamles (165-285 mm) and males (135-190 mm) of *L. macrolepis* were kept separately in velon hapas (50 m^2) for breeding experiment. They were fed on a mixture of rice bran, groundnut oil cake and cotton seed oil cake (1 : 1 : 1) @ 10% body weight daily in three instalments.

Five females (240-255 mm) were given pituitary extract injection every week @ 2 mg/kg body weight. The entire stock was lost during the cyclone in November.

Six females (116-235 mm/50-100 g) of *Liza macrolepis* were given pituitary extract and HCG injection singly and in combination. Males (170-195 mm/40-70 g 4 to 6 numbers per female) were given the injection synchronising with the second injection of females. One female and six males were stripped. Fertilized eggs died two hours after stripping without further development.

PROJECT BF/A/5 : BREEDING AND CULTURE OF PENAEID PRAWNS IN POND AND BHERIES.

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

Duration : 1983-88.

Location : Kakdwip.

Culture of prawns : Monoculture of *P. monodon* was initiated in 17 small ponds. The post larvae were stocked @ 30,000-50,000 n/ha. Ponds stocked in Feb-March were harvested in June-July and production achieved ranged from 275 kg/ha in 120 days to 250-318 kg/ha in 150 days with survival ranging from 30 to 57.3%. The ponds stocked @ 40,000 n/ha gave better survival rate and production. It was observed that better growth was obtained when culture period was 60 days irrespective of stocking density.

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

Personnel : T. Rajyalakshmi, G. V. Kowtal (upto 29-10-84) P. Ravichandran, S. M. Pillai and A. N. Monahty.

Duration : 1982-87.

Location : Puri.

Intensive survey of offshore areas along Puri-Paradeep coastline was carried out for locating fishing grounds of mature prawns. Details as follows :—

	Offshore			Chilka Lake		
Species	**Pentakotta**	**Paradeep Astharang**	**Ram-chandi**	**Alupatna**	**Satapada**	**Keslsab**
P. monodon	Oct.-Dec.	Oct.-Feb.	Oct.-Dec.	May-Jul.	May-Jul.	August
P. indicus	Nov.-Dec.	Nov.-Dec.	—	Adults not available		
P. merguiensis	Oct.-Dec.	Oct.-Feb.	Oct.-Dec.	—	—	—
M. affinis	Oct.-Dec.	Oct.-Dec.	Oct.-Dec.	—	—	—
P. semisulcatus	—	—	—	Only juveniles are available.		
P. japonicus	—	Jan.-Feb.	Oct.-Dec.	Only juveniles at mouth area.		

A smallscale hatchery was designed and constructed with adequate facilities for prawn larval rearing. The system included a shell-gravel-sand filter bed housed in a 6′ height cement tank, sea water reservoir, pools, air compressors with air lines made of GI pipes/PVC pipes, maturation and larval rearing tanks with air-lift pumps and algal culture tanks. Recycling of used water was done by ageing and filtering in biological filters. This system was resorted to since the hatchery is located away from sea shore and was found successful.

A small scale hatchery was constructed with adequate facilities for prawn larval rearing The system comprises maturations and rearing tanks and algal culture tanks with aeration, filtration and recycling facilities.

Induced maturation experiments of immature *P. monodon* from Chilka lake and rematuration of spent off-shore spawners through eyestalk ablation were carried out. The details of the experiments are given below :—

Source	Technique Uni/bilateral	No. of animals		Size g.		Mortality (%)	Maturity (%)
		M	*F*	*M* (*mm/g*)	*F*		
Chilka	Unilateral	9	19	155-179 / 35-54	160-198 / 35-78	7.20	Nil
	Bilateral 40 days after Uni lateral	6		—Do—			80
Offshore	Unilateral	6	13	207-220 / 80-130	210-280 / 90-180	15	Nil
	Bilateral 21 days after	-do-		——do——		25	40

The above results show that successful induced maturation and rematuration can be a achieved through bilateral eyestalk ablation. Successful maturation with viable spawning was achieved for the first time in Chilka lake prawns. High percentage of survival obtained for the ablated prawns indicates that the system of rearing was efficient. Feeding with fresh molluscan meat with regular recycling of water with continuous aeration aided in the maturation process. Higher percentage of maturation upto 80% was achieved when the temperature was above 25°C.

Live gravid spawners of *Penaeus monodon*, *P. merguiensis*, *P. japonicus*, *M. affinis* and *M. monoceros* from offshore catches were transported to the hatchery for spawning and larval rearing. Induced matured *P. monodon* was also used for larval rearing. The details of the spawnings obtained are detailed below :—

Sl. No.	*Species*	*Season*	*No. of spawners*	*Size range mm/g*	*Av. fecundity in lakhs*	*% hatching*	*No. of Nauplii in lakhs*
1.	*M. affinis*	Jan-Feb.	5	121-181/20-57	2.14	25	2.76
2.	*M. monoceros*	-do-	1	122/20	0.6	30	0.18
3.	*P. monodon*	-do-	3	250-275/155-160	7.35 2.35	80 40	5.88 1.88
4.	*P. merguiensis*	April	1	160/35	1.5	60	0.9
5.	*P. monodon*	Oct-Nov.	4	200-296/80-250	3.5	38.5	5.40

Successful spawning and hatching was obtained in about 80% of the prawn transported from offshores. A total of 17 lakhs larvae were produced during the reporting period. The hatching rate ranged between 25-80%. In most of the larval rearing runs carried out during Jan-Feb 1984 the temperature was very low (19° to 24°) and the moulting of each sub-stage was very much delayed and the larvae were found to inactive resulting in high mortality. One set of *M. affinis* larvae were removed reared upto Mysis 1 stage, while in all the other sets the larval rearing was terminated in Z_1, when the larvae failed to moult into Z_6. During Oct-Nov 1984, one set of *P. monodon* larvae were successfully reared upto P_5 stage. In this case also low temperature (10 to 26°C) has reduced the survival very much and 2500 P_5 healthy postlarvae were produced. The feeding schedule followed during the successful rearing is given below :

Feed/larval stages	N_1 — N_6	Z_1 — Z_3	M_1 — M_3	P_1 — P_5
Yeast		0.3 g/ton		
Vitamin Mix		Micro quantities		
Diatoms		30×10^5 cells		
Suspension (mysids)		150 micron		200 micron
Artemia nauplii				50n/larvae

Facility for ready exchange of sea water is a major constraint in the hatchery operation although recycling of used water has also been a useful development. The technology so far developed has shown that the large scale seed production is feasible under a permanent hatchery set up adjacent to coast.

Physico-chemical properties of sea water in maturation tanks and larval rearing tanks were as follows :—

Sl. No.	*Parameters*	*Jan-March*	*April-June*	*July-Sept.*	*Oct-Dec.*
1.	Water temperature (°C)	20-29	24-31	28-31.5	22-30
2.	pH	8.0-8.4	8.0-8.4	7.9-8.4	8.3-8.4
3.	Salinity (ppt)	32-36	30-38	26-36.5	30-40
4.	D.O (ppm)	2.6-7.2	2.2-7.0	2.0-7.6	3.2-6.9

The larval rearing is generally restricted during Oct-Mar. when the offshore prawns are available during which period the temperature goes as below as 20°C. Attempts are being made to synchronise the larval rearing with the high temperature regime through induced maturation of immature prawns collected from Chilka.

Algal culture : Various nutrient media were tried for algal culture. Generally algal bloom developes after 6-7 days of fertilization. Best result was obtained with the media consisting

of Potassium nitrate-100 ppm, Sodium monobasic phosphate-10 ppm, Ferric chloride-30 ppm, Sodium silicate-1 ppm, EDTA-1 ppm and groundnut cake-10 ppm, Organic fertilizers resulted in good bloom but were found infested with ciliates and as such could not be used for larvae.

Artemia culture : Continuous culture of *Artemia salina* was maintained in the hatchery, at a salinity of 110-150 ppt. The cysts were continuously collected and the freshly hatched nauplii fed to the larvae from Mysis stage onwards.

Tubifex culture : Attempts were being made to culture the tubificids, by designing a running water system over a channel of clayey mud fertilized with pig dung. A good population of tubificids are being maintained.

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

Personnel : K. Raman, C. P. Rangaswamy, S. Srinivasagam, Munawar sultana, K. O. Joseph and S. Krishnan.

Duration : 1982-85.

Location : Madras.

Unilaterally eye-ablated crabs, *Scylla serrata* and *Portunus pelagicus* reared in tide-flushed ponds at Pulicat showed no sign of maturity. However they recorded better growth rates than the unablated ones kept in hapas fixed in the lake. *S. serrata* showed monthly growth increment of 10.5 mm/14.66 g and *P. pelagicus*, 13.62 mm/21.06 g with survival percentages of 50 and 46 respectively in the ablated ones as against corresponding rates of 6.33 mm/12.0 g and 10.86 mm/13.33 g with 75% and 70% survival in the unablated (controls.).

In the last quarter, an ovigerous *Portunus pelagicus* (150 × 60 mm/150 g) collected from marine catch off Ennore was maintained in a plastic pool with filtered and well aerated brackish-water (Sal 33.4%) at the Ennore hatchery. The eggs hatched out after an incubation period of 6-7 days. After a rearing period of 15 days the megalopa stages were obtained after passing through the 2nd and 3rd zoeal stages. After 5 days the megalopae moulted into the first post-larval instar and after a lapse of 10 more days they moulted into the 2nd post-larval instar.

Species of *Tetraselmis* and *Brachionus* cultured in the hatchery were used as feed in addition to egg custard for the early zoeal stages. The 3rd zoeal stages were fee on egg custard and green mussel tissue suspension. The megalopae and the post larval instars were provided with slightly larger particles of mussel meat and trash fish. Feeding was given 4 times a day and the water in the rearing container was changed (50-80%) daily.

In *Scylla serrata* the eggs hatched out in plastic pools and zoea stages could be reared upto 2nd stages only.

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

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

Duration : 1982-85.

Location : Madras.

Two rectangular pens of 0.06 ha fixed in the lake during the previous quarter were stocked with *L. macrolepis* (48.66 mm / 1.2 g), *M. cephalus* (69.1 mm/4.73 g) and *P. monodon* (56.67 mm/ 2.67 g) at the combined stocking rate of 40,000 n/ha. Supplementary feed of groundnut oil cake + rice bran (1 : 1) was given in one, while in other no supplementary feeding was made (control).

At the end of 7 months, *L. mcacrolepis* showed an increment of 66.3 mm/16.6 g and *M. cephalus* 184.6 mm / 152.0 g with the supplementary feed of G.O.C. + rice bran (1 : 1). An estimated production of 37.01 kg/0.06 ha of mullets and 11.90 kg/0.06 ha of other fishes, and crabs was obtained. This worked out to 616.83 kg/ha/7 months of mullets and 198.33/ha/7 months of others species which amounted to a total production of 915.17 kg/ha/7 months.

In the second pen, *L. macrolepis* showed an increment of 78.7 mm/16.2 g and *M. cephalus* 180.9 mm/155.3 g for the same period without supplementary feed. An estimated production of 36.39 kg/0.06 ha of mullets and 6.46 kg/0.06 ha of other fishes and crabs was obtained. This worked out to 606.50 kg/ha/7 months of mullets and 107.67 kg/ha/7 months of other species which amounted to a total production of 714.17 kg/ha/7 months.

Chanos (49.4 mm/0.6 g), mullets (*M. cephalus* 183.3 mm/70 g and *L. macrolepis* - 109.8 mm/25.0 g) and prawns *P. indicus* (54.0 mm/0.7 g) were stocked in a velon pen (300 m2) in the ratio of 1 : 3 : 6 @ 50,000/ha. They were being reared on natural food only.

Fingerlings of *Lates calcarifer* (142 mm/30 g) stocked in two velon cages in September, 1983 registered growth increments of 164.1 mm/338.8 g and 207.7 mm/496 g with survival of 50 and 55% at the end of about 14 months.

PROJECT BF/A/10 : FISH DISEASES IN BRACKISHWATER AND SEWAGE ECO-SYSTEMS.

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

Duration : 1980-85.

Location : Barrackpore.

Parasites : Sixty brackishwater fishes, collected from lower Sunderbans, were examined during the last quarter of the year. *Trichodina*, a protozoan parasite, was found to infect both *Liza parsia* and *Lates calcarifer*. The infection was heavier in *L. parsia* fry and fingerling, compared to fry and fingerlings of *L. calcarifer*. *L. parsia* also suffered from *Ergasilus* infection. An acanthocephalan worm, *Echinorhynchus*, was recorded from the alimentary canal of *Mystus gulio*. Histopathological manifestations of these diseases are being studied.

A catla specimen collected from sewage-fed pond showing ulcer disease caused by bacteria.

Eleutheronema tetradactylum, *Setipinna phasa*, *S. taty* and *Therapon jarbua* remained free from external and internal parasites.

Bacterial diseases : Fry and fingerlings of Indian major carps, collected from a sewage fed pond in Barasat, suffered from bacterial diseases *viz.*, fin-rot and dropsy. *Puntius javanicus* yearlings, cultured therein, showed the symptoms of neoplasia, i. e. ovarian and/or epithelian tumours. Persistent high alkalinity (pH 8.6) of water, *Euglina* and *Microcystis* bloom, heavy accumulation of muck at the pond bottom and high stocking density of the fish were the stress-factors for the disease manifestation.

A *Pseudomonas* like strain was isolated from the water of the same pond. The strain was cultured on *Pseudomonas* isolation agar (Hi-media) plate (diameter 7.5 cm) for 48 hours at 20°C. The bacteria were used to make a suspension in distilled water (1 ml.). Eight *Heteropneustes fossilis* fishlets (Av 5 g) were injected each with 0.1 ml of the suspension whereas, other 2 specimens (used as control) were injected with 0.1 ml of 1% saline. All the specimens showed

the symptom of swelling near the site of injection. Swellings of the controlled specimens disappeared within 48 hours. But 50% of the injected specimens died. Rest of the injected specimens showed the symptoms of ulcer and putrefaction at the tip of the barbels after one week of injection. These specimens were treated with sulphadiazine ; dose being 100 mg/kg of fish/day. The treatment was continued for seven days when the ulcers healed up though extra pigmentation was noticed at the site of ulceration. Barbels started regenerating.

Load of aerobic bacteria in 9 ponds of Rahara fish farm were measured monthly during the period under report. The details are given under the project AN/B/7.

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

Personnel : S. Paul and H. K. Sen.

Duration : 1983-85.

Location : Barrackpore.

Data was collected with regard to input mix and yield rates. On the basis of available information, it is gathered that brackishwater fish farming in filteration farms, paddy-cum-fish culture, monoculture and poly culture, by and large are profitable mainly due to ruling prices at high levels.

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.

An experiment was conducted with 14 varieties of paddy in the high saline brackishwater paddy plots with the objectives of production of double crops of paddy and fish simultaneously from the same field and effective use of pesticides in paddy cum prawn culture along with varietal trial of paddy in saline soils (Table).

Sl. No.	*Name of varieties*	*Grain yield (Q/ha)*	*Duration in days*	*Salinity tolerance level (mm hos/cm)*
1.	C. SR-1	29.00	130	2.5-8.0
2.	C. SR-2	30.67	128	2.5-8.0
3.	C. SR-3	30.00	130	2.5-8.0
4.	C. SR-4	32.00	115	2.5-8.0

Sl. No.	*Variety*	*Yield (Q/ha)*	*Duration (days)*	*Salinity tolerance level (m mhos/cm)*
5.	SR-26B	18.33	138	2.5-8.0
6.	Talmukur	23.67	140	2.5-8.0
7.	Khaersal	15.33	135	2.5-8.0
8.	Ajirmal	21.10	140	2.5-8.0
9.	Dudherswar	11.00	128	1.0-3.5
10.	CM 691-1	20.00	130	2.5-8.0
11.	Tilakkachhari	21.00	135	2.5-8.0
12.	Tangra	20.00	132	2.5-8.0
13.	Durgabhog	19.00	125	1.0-3.5
14.	CM-506	19.67	130	1.0-3.5

Six plant protection chemicals were used for pest control and no fish toxicity had been observed so far physical toxicity is concerned. But the biochemical study is required for the purpose of future work. (Table).

Pesticides applied	*Dosage*	*Effect of study on*	*Day after application*	*3 days application*	*7 days application*	*At harvest*
Dimecron-100 (Phosphomidon)	0.5 ml/litre water	Mortality	Nil	Nil	Nil	Nil
		Malformation	Nil	Nil	Nil	Nil
Hinosan 50 EC (Organophosphorus)	1.0 ml/litre water	Mortality	Nil	Nil	Nil	Nil
		Malformation	Nil	Nil	Nil	Nil
Streptocyclene (Streptomycin sulphate) (Tetracyclene Hydrochloride)	0.1 gm/L.W.	Mortality	Nil	Nil	Nil	Nil
		Malformation	Nil	Nil	Nil	Nil
Gamaxene 10% dust (BHC)	25 kg/ha	Mortality	Nil	Nil	Nil	Nil
		Malformation	Nil	Nil	Nil	Nil
Hexidole 50 WP (BHC)	2.5 g/litre water	Mortality	Nil	Nil	Nil	Nil
		Malformation	Nil	Nil	Nil	Nil
Furadon-3G (Carbofuran)	12.5 kg/ha	Mortality	Nil	Nil	Nil	Nil
		Malformation	Nil	Nil	Nil	Nil

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 and P. M. A. Kadir.

Duration : 1982-85.

Location : Madras.

One gravid *P. monodon* female weighing 125 g shed the eggs in a plastic pool and the fertilisation was 90%. The nauplii that hatched out were estimated at 3 lakhs and were distributed in six plastic pools @ 50/l of filtered well-aerated estuarine water. The larval feed consisted of egg custard suspension and *Tetraselmis* sp at the protozoeal stage egg custard and *Brachionus plicatilis* at the mysis stage and tissue suspension of green mussel (*Perna viridis*) in the postlarval stage. Feeding was done 5-6 times a day. The water in the rearing containers was changed at the rate of 50% every day at the protozoeal stage and 80% at mysis and post-larval stages.

The survival rate from egg to PL-1 was 48%, but it was reduced to 19% at PL-13. 54,000 post larvae (PL-13) were handed over to the State Fisheries Department and about 4,000 were reared in a plastic pool (10′ dia) in the open yard. On the 30th day after post larval appearance the survival was 70% but on the 43rd day heavy mortality occurred after a heavy rain and small number which survived (700) were released in the Santhome ponds.

Using the same management methods and same larval feeds another cycle of larval rearing of *P. indicus* was accomplished producing 20,000 post larvae upto PL-15 stage. The eggs released by two gravid females and partial spawning by another showed 80% fertilisation and hatched out into an estimated 1,35,000 nauplii. They were reared at an average density of 45/1. The efficiency of two larval feeds was tested in this cycle. Tissue suspension of *Perna viridis* gave a better survival upto mysis stage (27.6%) than egg custard (14.0%).

The post-larval production rates in *P. monodon* and *P. indicus* worked out to be 10,000 and 8,000 per tonne of water.

Water qualities during the larval rearing varied as follows :—

Parameters	*P. monodon*	*P. indicus*
Temp (°C)	25.6-30.0	25.0-28.0
Salintiy (ppt)	31.0-34.5	24.5-28.0
D.O. (ppm)	3.2-7.6	4.0-6.5
NH_3N (ppm)	nil-tr.	nil-tr.
Free CO_2	nil	nil

Largescale cultures of *Tetraselmis* sp and *Brachionus plicatilis* were produced using various organic and inorganic nutrients for enriching the medium. Densities of 5,000 to 3,47,000 n/ml of *Tetraselmis* and 50-160 n/ml of *Brachionus* could be obtained.

Samples of *P. indicus* and *Metapenaeus monoceros* taken from commercial catches were analysed for the study of their reproductive biology. Mature females of *P. indicus* showed two major peaks in March and June and a minor one in August. Gonado-somatic index also showed a similar trend. In *M. monoceros* the breeding season was indicated by the presence of late maturing females and spent ones in May-June.

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

Personnel : Apurba Ghosh and Ansuman Hajra.
Duration : 1983-85.
Location : Barrackpore.

Studies on post larval stages of *P. monodon* revealed that dietary energy influences prawn growth. At the optimum protein requirement (*C.* 46%), both the percent growth and specific growth increased as the dietary energy level was raised from 361.7 to 398.3 K Cal/100 g. Slaughter-house offal as one of the ingredients along with mysid shrimp meal showed promising results. Feed efficiency of 1.22 could be achieved with this and the survival was 88-94%. Dietary lipid was seen to exert a protein sparing action. Pelletized feeds remained stable in water for more than 3 hours. Dry matter weight loss was less than 15% in freshwater and 10% in brackishwater.

PROJECT BF/A/16 : GENETIC ENGINEERING BY CHROMOSOME MANIPULATION AND PRODUCTION OF INDUCED GYNOGENETIC AND POLY-PLOIDINDIVIDUALS IN PEARL SPOT.

Personnel : P. Das, M. L. Bhowmik and P. K. Ghosh.
Duration : 1984-89.
Location : Kakdwip.

Efforts were made to develop dependable controlled breeding for obtaining viable eggs and spermatozoa.

PROJECT BF/A/15 : CULTURE OF *LATES CALCARIFER* IN SEWAGE-FED POND USING *O. MOSSAMBICUS* AS FORAGE FISH.

Personnel : Apurba Ghosh, G. N. Chattopadhyay, P. K. Chakraborti, Amitabha Ghosh (from September, 1984) and A. K. Roy.
Duration : 1983-86.
Location : Barrackpore.

In a sewage-fed pond (0.17 ha) forage fish *O. mossambicus* was stocked @ 20,000/ha, three months prior to stocking *L. calcarifer* @ 400/ha. After 7 months experiment the growth of *L. calcarifer* was 109 mm/116 g.

The gut content analysis revealed that bhetki subsisted on fish fry of *Chanos*, *Chanda*, *M. lamarrei* and coleopteran insects. Only few *Tilapia* fry were encountered.

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. Bhowmik, S. K. Mandal and P. K. Ghosh.

Duration : 1984-89.

Location : Kakdwip.

Fry (1.0 g) of known percentage were procured and stocked in Kakdwip farm. Uniform husbandary conditions were maintained and fish grew to an average weight of 21.0 g in 9 months.

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

PROJECT BF/A/18 : PADDY-CUM-BRACKISHWATER FISH CULTURE.

Personnel : G. N. Chattopadhyay, Apurba Ghosh, P. K. Chakraborty and R. N. De (from CIFRI) A. K. Bandopadhyay, C. R. Biswas and S. C. Mandal (from CSSRI)

Duration : 1982-87.

Location : Canning (CSSRI campus)

Brackishwater plots (0.15 ha), treated with rice bran @ 1,000 kg/ha to encourage growth of 'Lab lab' were stocked @ 42,000/ha with *P. monodon* and *L. parsia* (1 : 1). Due to heavy precipitation there was mortality in prawn but overall production of 0.41 t/ha could be achieved. Due to heavy precipitation there was decline in the soil salinity from 2.7 to 2 mmhos/cm. Paddy seedlings of SR-26 B were transplanted synchronously with freshwater aquaculture of rohu, catla and mrigal with total stocking density of 13,000 / ha. After 3 months the paddy yield was 3.2 t/ha and fish 0.3 t/ha.

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

Personnel : V. Pathak.

Duration : 1980-85

Location : Barrackpore.

Energy transformation through primary production :

Studies were made in two beels, Dhir beel (Assam) and Media beel (W.B.). The rate of energy transformation through primary production (phytoplankton) ranged from 7,484 to 9.887 cal/m^2 /day with an average value of 8,340 cal/m^2 /day in Dhir beel and 4,717 cal/m^2 /day in Media. This shows that in Dhir beel phytoplankton transformation is only 0.45% of available light while in Media beel the efficiency is still lower (0.24%). The energy transformation rate by macrophytes was high in both the beels, being of the order of 15,692 to 71,120 cal/m^2 /day (average 43,409 cal / m^2 / day or 2.3% of light) in Dhir beel and 65,136 cal/m^2 /day or 3.3% in Media. Thus the autotrophic energy input in both the beels was mainly by macrophytes.

Energy budget at producer level from chlorophyll studies :

Chlorophyll studies also reflected low plankton concentration in both beels, chlorophyll content ranged from 5.8 to 11.5 mg/m^3 (Av 7.94 mg/m^3) in Dhir beel band 4.1 mg/m^3 in Media beel. From the phytoplankton carbon and energy in both the beels comes to be 397 mg c/m^3 or 4465 cal/m^3 and 205 mgc/m^3 or 2357 cal/m^3 respectively.

Energy value of macrophytes :

Macrophyte biomass ranged from 155 to 351.76 g/m^2 in Dhir beel (Av 302.4 g/m^2) while that in Media beel it was 400.8 g/m^2 . Thus the average value of macrophytes energy in two beels comes to be 120 g K cal/m^2 and 1595 K cal/m^2 respectively.

Studies on detritus and bottom energy :

Studies have shown that the organic detritus at the bottom was of high order in both the beels. Organic detritus estimated from unit area of the beel bottom amounted to 47.5 to 285.0 (av 167.0 g/m^2, dry wt.) in Dhir beel and 368.2 g/m^2 in Media beel. From this the energy available at the bottom of the beels comes to be 16.5×104 cal/m^2 in Dhir beel and 38.0×104 cal/m^2 in Media. Thus beels are very rich in energy resource at the bottom in the form of organic detritus (16.5×10^4 to 380.0×10^4 K cal/ha.).

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

Personnel : A. Sengupta, A. K. Roy and D. Sanfui.

Duration : 1983 - 1985.

Location : Kakdwip Research Centre.

Regular observations on tidal height, current velocity, percentage of silt suspended in water and the rate of sedimentation of the silt in the farm were continued. The results, so far obtained, were analysed statistically and a mathematical relationship was established between the suspended silt load both at surface and bottom of the Muriganga river and the tidal time. It has

been found that the surface silt load, bottom silt load, current velocity, and tidal heights from the zero bench mark of the tidal guage fluctuate from 50 to 1168 mg/l, 416 to 1844 mg/l, 0 to 90 cm/sec. and 0 to 205 cm. The mathematical relationship between tidal time (x) and the bottom and surface silt load (y) has been found to be following equation :—

$$Y \text{ (bottom)} = 2.548294 - 0.023202 \times + 0.000068 \times 2$$
$$Y \text{ (surface)} = 2.77531 - 0.021344 \times + 0.00006 \times 2$$

The above equation expalins 85% and 87% of the tidal variation in silt load distribution respectively.

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

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

Duration.. : 1984-86.

Location : Barrackpore.

The spawn, obtained through controlled breeding, were stocked in glass aquaria in the laboratory. The spawn were fed exclusively on supplementary feed fortified with methyl testosterone at different doses i. e. 20, 30, 40, 50, and 60 mg/kg feed in separate aquaria with replicates and control. Testosterone added feed was given for first forty days only and afterwards the feed was without testosterone.

Histological studies after 4 months of rearing indicated that about 50% of genotypic females could be converted to phenotypic males.

The chromosomal studies revealed 22 pairs of diploid chromosomes. The karyotypic studies of the chromosomes showed the first pair as the 'marker'.

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

Personnel : Krishna Mitra and Kuldip Kumar.

Duration : 1983-86.

Location : Barrackpore.

Predatory efficiency of Diplonychus annulatum :

The study showed that 1st 2nd instar nymphs consume on an average 9.8 hatchlings of 1-3 days old (5-7 mm length) in 24 hours. The average time taken to predate upon one hatchling is a bout 16.6 minutes. These younger nymphs are unable to attack even slightly bigger hatchlings of 4-6 days old (9-11 mm). On the other hand 3rd instar to adult insects unlike the younger ones attack only the bigger hatchlings of 10-15 days old (15-25 mm length) and consume on an average

4 hatchlings in 24 hours. Still bigger hatchlings which are more than 25 mm in length are not attacked by this insect. Besides carp hatchlings these insects also attack tilapia hatchlings of similar size, dragon-fly nymphs (small size), *Anisops* and gastropods. It is thus evident that the stage and size of the insects and the hatchlings attacked are directly proportional but the damage caused by the younger instars are much more severe in comparison to older ones.

Predatory efficiency of Ranatra filiformes :

It seems, that 1st and 3rd instar nymphs are unable to attack the spawn and young hatchlings. The 4th and 5th instar nymphs each consumes on an average 4 hatchlings of 2-4 days old (6-9 mm) in 3 hours, while an adult consumes 8 such hatchlings of 2-4 days old in 6 hours. The predating capacity of the latter instar nymphs and adults was almost the same. The total process of predation usually takes 15-20 mts and after every feed they are found to take rest for a period of 20 minutes to 2 hours.

Predating efficiency of *Anisops* sp. :

The adult insects consume on an average 24.66 hatchlings of 2-4 days old in 24 hours. In the begining it takes 25-40 minutes (Average 32 minutes) to consume one hatchling but afterwards the insects are seemed to leave the damaged hatchlings within a few minutes time. It appears that when the insects are content they indulge in killing the hatchlings without consuming it fully. Further studies are in progress.

PROJECT AN/B/7 : A STUDY 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, Khardah, Gauhati.

Studies on microbiology of nitrogen fixation, nitrification, denitrification and phosphate solubilization in ponds with recirculatory filtering system (Barrackpore), jute retted pond in sewage-fed pond (Khardah) and Dhir beel (Assam) were intitiated. In RFS ponds, the sump sediment has shown much higher concentration of micro-organisms than that of the pond thereby showing rapid decomposition of metabolites and bottom sediments during recirculation through the sump. The values observed in above cases are given below.

1. **Recirculatory filtering system of ponds :**

In ponds with RFS, high bacterial count was noted in the sump than in pond water favouring the passage of water through the sump for faster removal of some of the pollutants of the pond water.

2. **Jute retted waters :**

The results are reported under project FA/A/11.

3. **Sewage-fed ponds :**

In sewage-fed ponds showed high counts immediately after each addition ofse wage effluent. This high count is important for the stabilization of the pond ecology. The counts obtained were as follows :—

Average heterotrophic bacteria	1.5×10^5 to $1.4 \times 10/^7$g of soil
Nitrogen fixing bacteria	5.0×10^4 to 2.0×10^6/g of soil
Organophosphate solubilizing bacteria	2.3×10^5 to 1.0×10^6/g of soil
Inorganic phosphate solubilizing bacteria	1.8×10^4 to $3.0 \times 1p^6$/g of soil
Denitrifying bacteria	1.2×10^2/ml of water 1.0×10^4/g of soil

Average phosphate consumption (microbial) was noted to be 0.001 ppm per hour.

Cellulose decomposition for a period of 15 days :

Pond No.	Soil-waterinterface				watersurface
F2	93.2%	23.0%	10.2%	8.9%	6.5%
SF2	46.3%	41.3%	41.3%	29.0%	14.0%
S2	16.1%	9.1%	trace	trace	trace

Average Protein decomposition noted in course of 15 days :

Pond No.	Soil water interphase				surface water
F2	6.1%	10.2%	15.0%	14.3%	15.0%
SF2	24.0%	24.2%	25.0%	—	26.1%
S2	20.4%	25.8%	20.6%	21.0%	21.8%

4. **Dhir beel, Assam :**

The Dhir beel, the number of bacteria and microbial activity increased during flood season due to increased availability of nutrients. The counts are given in the following table.

Table : Soil & water micro-organisms of Dhir beel, Assam.

Medium	*Inoculum*	*Av. no. of bacterial population*
Casein agar	Water	3×10^2 /ml
	Sediment	1.7×10^5 /g
Aerobic nitrogen fixing bacteria	Water	2.0×10/ml
	Sediment	4.0×10^5/g
Denitrifying bacteria	Water	1.0×10^2 /ml
	Sediment	1.0×10^6/g
Phosphate solubilising bacteria	Sediment	9.0×10^4/g

Table : Sectorwise microbal populati on in Dhir beel, Assam.

1. Average PO_4-P consumption rate by the microbial community is 0.0009 ppm/hour.

Sector-I (Distant)

(a)	Bacterial count (Caseinate medium)	=	1.5×10^6/g of soil
(b)	Inorganic phosphate solubilizing bacteria	=	2.0×10^5/g of soil
(c)	Organic phosphate	=	1.1×10^7/g of soil
(d)	Aerobic nitrogen fixing bacteria	=	2.0×10^5/g of soil
(e)	Organic phosphate solubilizing bacteria in water	=	1.0×10^2/ml of water

Sector-II (Middle)

(a)	Bacterial count	=	2.0×10^7/g of soil 1.0×10^2/ml of water
(b)	Inorganic phosphate solubilizing bacterial population.	=	7.0×10^6/g of soil 1.1×10/ml of water
(c)	Organic phosphate solubilizing bacteria	= =	1.0×10^3/ml of water 1.0×10^7/g of soil
(d)	Response to denitrifying bacteria	=	Nil

Sector-III (Mouth)

(a)	Bacterial count	=	4.0×10^2 /ml of water 5.0×10^6/g of soil
(b)	Inorganic phosphate solubilizing bacteria	=	2.0×10/ml of water 2.5×10^7/g soil
(c)	Organic phosphate solubilizing bacteria	=	1.0×10/ml of water 1.0×10^5/g of soil
(d)	Denitrifying bacteria	=	1.0×10/ml of water 1.0×10^5/g of soil
(e)	Nitrifying bacteria (Stage-I)	=	1.0×10 /ml of water 1.0×10^6/g of soil

PROJECT AN/B/8 : DEVELOPMENT OF AN ECONOMIC 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 overburat jhama bricks used as filtering material in the revised design showed moderate effectiveness of the model biological filter. The rate of filtration was found to be very fast. The waste water drawn from recirculatory pond after passing through the model filter was free from suspended solids and richer in dissolved oxygen when the discharging water was allowed to fall over the projecting flash boards. Nutrients such as nitrogen and phosphate were slightly richer in filtered water. The filter was moderately useful in reducing the concentration of toxic gases. Removal of nutrients by microbial degradation has been satisfactory in the bio-filter as the bacterial load in the bio-filter has been found about 25 to 50 times more than in the pond water.

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

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

Duration : 1983 - 1985.

Location : Rahara.

With a view to increasing DO level in sewage-fed ponds and stabilising the ambient water for prawns and fish culture, three engineering designs for aeration of farm ponds by exploiting the sources of wind energy with the aid of vertical and horizontal axis windmills was prepared. Three horizontal axis windmills (Apoly PU 500) were from the Institute of Engineering Research and Training, Allahabad and installed at Rahara Research Centre farm. 15″×15″ brick massonary pillars (4 nos.) with a brik, massonary tank of 4′×4′×7′ dimensions and having the wall thickness of 10″ were constructed at the three points of the farm for installing the Apoly PU 500 windmills. The floor of the tank is kept at a level of 7′ below the ground level and it is connected with the pipes to take water from the ponds. The water from the pond will be col.elected inside the brick massonary chamber and it will be lifted up by the wind-driven reciprocating pump and will again be thrown back to the pond through the delivery pipe.

PROJECT AN/B/10 : : ROTIFERS AS BIOLOGICAL INDICATORS AF POLLUTION IN GANGA RIVER SYSTEM AND ITS TRIBUTARIES.

Personnel : B. L. Pandey, A. K. Laal, Balbir Singh, Shree Prakash and A. Sarkar.

Duration : 1984-87.

Location : Bhagalpur.

Analysis of the biotic communities and abiotic parameters of some water bodies receiving wastes from industries of leather, silk and cigarette situated at the bank of River Ganga at and around Bhagalpur were made. Leather industry waste caused heavy pollution followed by silk and cigarette industries.

Amongst Phytoplankton, Myxophyceae (*Spirulina princeps* (10,000 u/l) and Oscillatoria tenuis (50 u/l) was present in water body receiving leather industries wastes. *Euglena acus* (240 u/l) *Mastogloia*, (200 u/l), *Merismopedia* (96 u/l), *Nitzschia* (48 u/l) were present in water body receiving silk industry waste at Bhagalpur and *Navicula-radiosa* (320 u/l), *Pinnularia gibba* (32 u/l), *Chlorella vulgaris* (128 u/l), *Scendesmus opoliensis* (48 u/l), *S. cuminatus* (64 u/l) and *Eudorina* sp. (160 u/l) were present in water body receiving cigarette industry (India Tobacco Factory) wastes at Monghyr, Bihar.

Amongst Zooplankton *Brachionus havanaenis* (800 u/l), *B. angularis* (400 u/l), *Polyarthra* sp. (100 u/l) and *Keratella tropica* (400 u/l) were present in water body receiving wastes from leather industry at Bhagalpur. *Polyarthra* sp. (320 u/l), *Horaella* sp. (32 u/l), *Lecane luna* (64 u/l), *Naupleus larvae* (48 u/l) were present in water body receiving wastes from cigarette industry (Indian Tobacco Company) at Monghyr.

Considering the presence and dominance of the microbes in these water bodies receiving wastes from three different industries and impact of pollution in comparison to other water bodies earlier studied, the microbes may be categorised as follows :—

Microbes	*Algae*	*Rotifers*
Polysaprobity	*Spirulina princeps, Oscillatoria tenuis*	*Brachionus havanaensis*
B-mesosaprobity	*Euglena acus*	*Polyarthra* sp.
L-meso saprobity	*Navicula radiosa,* *Pinnularia gibba* *Scenedesmus acuminatus,* *S. opolienis*	*Filinia longispina* *F. opoliensis* *Conochilus* sp. *Horaella* sp.

Abiotic parameters which indicate the impact of pollution of water bodies viz. chloride, SiO2, D.O.M., and specific conductivity were in following orders :

Chloride (6675.98, 44.17, 59.61 ppm) ; SiO_2 (40.00, 2.00, 20.00 ppm) ; D.O.M. (96.32, 76.05, 9.91 ppm) and specific conductivity (18015.00, 1681.50, 451.00 micros cm^{-1}) in water bodies receiving waters from leather, silk and cigarette industries respectively.

High values of chloride, D.O.M., silicate and specific conductivity in water bodies receiving from leather industry indicate that this industry waste causes heavy pollution.

PROJECT AN/A/2 : DISSEMINATION OF INFORMATION IN INLAND FISHERIES.

Personnel : B. N. Saigal, V. V. Sugunan, G. K. Vinci, V. K. Unnithan, M. J. Bhagat, Anjali De and Sukla Das (Barrackpore) ; M. Rout, K. K. Ghosh, M. Randhir and C. R. Das (Dhauli).

Duration : 1983-85.

Location : Barrackpore and Dhauli.

Aquaculture information viz. indentification, geographic and climatic data, culture systems, production, feeds , diseases and economic data were collected from the experiments carried out at Cuttack research centre, IDRC Centres at Orissa and West Bengal and from Workshop reports on composite fish culture. About 150 input sheets have been filled in an kept ready for storing in the computer to form a data bank.

PROJECT AN/A/3 : USE OF DIFFERENT TOXICANTS IN FISH CULTURE OPERATIONS.

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

Duration : 1982-84.

Location : Barrackpore.

Toxicity of saponin (90%) extracted from *Madhuka butyracea* was evaluated on *Heteropneustus fossilis* and *Clarias batrachus*. The results obtained so far revealed that saponin (90%) extracted from *M. butyracea* at dose of 37.5 mg/l and 100 mg/l were sufficient in killing *H. fossilis* (152-188 mm/21.8-39.9 g) within 3 hours 35 minutes and 50 minutes respectively, whereas a dose of 30 mg/l and 45 mg/l was required for killing of *Clarias btatrachus* (150-180 mm/20.0-37.0 g) in 3 hours 15 minutes and 1 hour 55 minutes respectively. All the experiments were conducted in 11 l cylinderical glass jars filled with 10 l of tap water at water temperature between 31.0°C and 32.0°C. The toxicity of saponin persisted for about 48 hours.

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

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

Period : 1983-87.

Location : Kalyani.

During 1984 a survey of frog and toad species occurring in paddy fields in Kalyani during monsoon months was undertaken and the food habits of adults and their tadpoles through gut content analysis and culture, were studied. Altogether six species of *Rana* two species of *Bufo*, three species of microhylids, and one species of *Rhacophorus* were collected and preserved. Gut content analysis found to contain following food items :

Species	*Food items*
R. tigrina	Mostly frogs and toads, earthworm, slugs, and land insects and crabs, in addition to centipedes, millipedes, large insects, small snakes, carp minnows, etc.
R. cyanophlyctis	Fry and carp minnows, tadpoles, molluscs, land and aquatic insects, small toads and frogs, earthworm, millepedes, centipedes, etc.
R. crassa	Small toads and frogs, earthworm and slugs and some land insects mostly dipterans.
R. limnocharis	Land insects mostly grasshoppers, earthworms, small toads, etc.
R. breviceps *R. erythrea*	Ants, land insects, spiders, earthworms, etc.
Buffo melanosticus *B. stomaticus*	Ants, land insects including caterpillers & grasshoppers, earthworms, etc.

R. maculatus	Ants, grasshoppers, dipterans, flies, earthworm, etc.
Uperodon sp.	
Kaloula sp.	Ants, termites, small beetles, earthworm, etc.
Microhyla sp.	

Analysis of gut contents of tadpoles of *R. tigrina*, *R. crassa*, *R. cyanophlyctis*, *R. limnocharis* *R. breviceps* and *R. erythrea* and their culture in the laboratory reveal that they are carnivorous and feed upon detritus and zooplankters. Tadploes of the former three species are highly carnivorous and have tremendous rate of cannibalism. Tadpoles of *Bufo* species feed upon soft aquatic vegetation, and phytoplankters in addition to zooplankters at their pre-metamorphic stage. Tadpoles of *Rhacophorus* feed upon phytoplankters, soft aquatic vegetation in addition to some zooplankters. The microhylid species feed upon detritus and zooplankters, besides soft algae.

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

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

Duration : 1984-85.

Location : Barrackpore.

Production of viable cysts of *Artemia salina* on a pilot scale was taken up at Digha. Ten ponds (450 m^2 each) with a depth of 25-40 cm was filled with sea water.

During 1984, pilot scale production of viable cysts of *Artemia salina* were undertaken at Digha. Ten ponds each of 450 sq. feet area having water depth range of 25-40 cm. Each saltern initially was filled with sea water drawn from the adjoining creek. Before 8-10 days of inoculation with cysts of *A. salina* each saltern was manured with cow-dung @ 40 kg. At temperature range of 29-32°C and salinity 32-33 ppt each saltern was inoculated with laboratory produced cysts for hatching. After 32-37 hours of inoculation the hatching of cysts into nauplii commenced and was completed in 68-72 hours. The percentage of hatching ranged 50-80%. The shrimp was maintained on 'milk' of rice bran extracted by soaking one kg of rice bran in one litre of water over night and straining and squeezing out through a coarse cloth. Since water gets heated in the salterns, palm leaves were spread along its permimeters to provide shade to the a nimals. After 24-27 days of rearing and salinity increased to 75-80 ppt. *A salina* started producing cysts at 35.0-37.0°C. The cysts were found floating in the direction of prevailing wind which were collected in polythene sheet spread along the perimeter of saltern to prevent them getting mixed with mud. Yield would have been still higher but due to incesaant rains for 5 days (6-10 June) six salterns were washed away and the experiment had to be abandoned. After water received from the area fresh experiments were initiated in four salterns and 190 g of dry cysts obtained during the remaining season of 20 days.

PROJECT AN/A/6 DEVELOPMENT OF SUITABLE EXTENDERS AND CRYOPROTECTANTS FOR STORAGE OF FISH SPERMATOZOA USING CRYOGENIC TECHNIQUES.

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

Duration : 1983-85.

Location : Barrackpore

Various extenders and cryoprotectants for cryopreservation of fish speramatozoa were screened. Four types of extenders and two cryoprotectants *viz.* dimethyl sulfoxide and glycerine were put to trial for cryopreserving the sperms of *Hypophthamichtlyhs molitrix*, *Labeo rohita* and *Cirrhina mrigala*. Semen diluent ratio in all the experiments was kept as 1 : 4 while the extender : cryoprotectant ratio was kept as 9 : 1. The equilibration time ranged from 2-30 minutes.

In case of silver carp, maximum motility score was recorded with the diluent containing urea-egg yolk citrate and dimethyl sulfoxide. The motility rate of 11 days stored sperm was 40%. The fertility tests conducted on 50 ml ova with 2 days preserved sperms gave 20% fertilisation rate.

Among the four extenders (Viz. Mixture M^a, Urea-egg yolk citrate, Mixture M^b and Alserver's solution) tried on *L. rohita* semen, the first two proved quite effective while the remaining two gave the minimum motility percentage. The maximum post-thawing motility was 40% and 20% after preservation period of 21 days. Though extender M^a gave higher motility percentage the indicence of coagulation of semen were also higher with this extender. Attributing cogulation to the use of dimethyl sulfoxide, in one of the experiment glycerine was used instead of DMSO but the sperms met the same fate soon after their mixing with diluent.

In case of *Cirrhina mrigala*, three sets of experiments were conducted involving two extenders viz. M^a and Urea-egg yolk cirtate. The respective motility rate with these extenders was 20 and 5% in apreservation period of 9 days.

To sum up, in all the ten sets of experiments conducted during this year the diluent comprising urea-egg yolk citrate and DMSO in the ratio of 4 : 1 has given the best results. Success in the cryopreservation of silver carp sperm is being reported for the first time. The motility percentage with the extender M^a was also encouraging but for the higher incidence of coagulation into a jelly mass.

PROJECT AN/A/7 : CULTURE OF COMMERCIALLY IMPORTANT INLAND MOLLUSCS.

Personnel : G. K. Vinci, V. K. Unnithan, V. V. Sugunan & B. N. Saigal.

Duration : 1984-87.

Location : Barrackpore.

Culture of Achatina fulica : About 35 hatchlings (5 mm/67 mg) of the giant African snail *Achatina fulica* were collected from nature and reared in an improvised glass terrarium (60 × 40 cm). They were fed on kitchen refuse and vegetable wastes from market @ 5% of the body weight every day. Calcium requirements were met with by feeding crushed egg shells once in a week. The growth rate observed was as follows :—

Period of rearing (Days)	Av. total length attained (mm)	Av. total wt. attained (g)
30	23.0	2.45
60	40.1	9.69
90	48.3	18.27
120	59.0	24.40

No mortality was observed during the period of rearing.

PROJECT AN/A/8 : CONTROL OF STEM BORER IN PADDY WITH HIGH YIELDING VARIETY USING MAGUR AS BIOAGENT.

Personnel : P. K. Pandit, U. Bhowmik, and Krishna Mitra.

Duration : 1984-85.

Location : Kalyanbati (Chanditala, Dist. Hooghly, W. Bengal).

The work was initiated in a farmer's field in the kharif season when the attack of the major stem borer, *Tryporyza certulus* Wlk. was negligible. However, the attack of beetle, *Dicladispa armigera* Olive and a few *Chilo suppressalis* Wlks., a minor stem borer was recorded in the month of August and September, 1984. In the month of November-December, 'Ratna' paddy was planted and the fishes were released in 4 plots.

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, M. Sinha, J. B. Rao, M. Kaliamurthy, K. L. Shah, B. C. Tyagi, P. K. Arvindakshan, P. L. N. Rao, D. N. Mishra, A. Mukherjee, D. P. Chakraborty, B. K. Singh, P. N. Jaitly and P. K. Saha.

Duration : 1971-1985 March.

Location : Badampudi, Gauhati, Ranchi, Karnal, Pune, Pollachi, Jaunpur and Kalyani.

Badampudi : The 11th set of experiments, in four 0.12 ha ponds at a stocking density of 5,000 fingerlings/ha in a combination of (i) catla 15, rohu 20, mrigal 15, silver carp 25, grass carp 10 and common carp 15 in two ponds and (ii) catla 30, rohu 30, mrigal 15, common carp 15 and calbasu 10% in the other two ponds, were concluded in June after 7 months' rearing. Freshwater prawn *M. malcolmsonii* was uniformly stocked in all the four ponds at 5,000 juveniles/ha in March, 1984. Fish production obtained from the first combination without calbasu ranged from 2007 to 2,114 kg/ha while the production from the ponds with calbasu ranged from 1,231-1,645 kg/ha. The production of prawns from all the ponds were very poor and ranged from nil to 37 kg. The maximum growth of different fish species recorded during the period was catla 353 g, rohu 346 g, mrigal 617 g, silver carp 656 g, grass carp 945 g, common carp 1275 g and calbasu 222g. The cost/kg of fish production ranged from Rs. 2.83 to Rs. 4.79.

Gauhati : The seventh set of experiments comprising a 3 species Indian major carp combination (catla 32, rohu 34, mrigal 34) gave a production of 1108 kg/ha/10 months while the 6 species combination (catla 7, rohu 22, mrigal 16, silver carp 22, grass carp 11 and common carp 22) resulted in a slightly higher production of 1763 kg/ha/10 months. The poor rates of production are a direct result of improper species mix and non-availability of inputs in time.

A total of 96.92 lakhs spawn comprising 55.67 lakhs mrigal, 40.30 lakhs rohu, 0.94 lakhs catla and 0.01 lakhs silver carp was produced.

Ranchi : The seventh set of experiments on composite fish culture was concluded on 26 May 1984 after 20 months' rearing. The ponds were stocked at 5,000 fingerlings/ha with a 6 species combination of silver carp 25, grass carp 10, common carp 20, catla 10, rohu 15 and mrigal 20. The growth was very poor and hence the production ranged from 2004-2248 kg/ha. The highest weight was attained by silver carp (709 g), catla ranged from 220-308 g, rohu from 333-419 g, mrigal from 469-636 g, common carp 570-596 g and grass carp from 466-660 g. The paucity of aquatic weeds affected the growth of grass carp adversely while low water levels were equally responsible for the poor growth of all the species.

Karnal : The experiment on uniformity trial was initiated in August '84 in four 0.08-0.1 ha ponds. The best growth is registered in the pond provided with feed and fertilizer, grass carp having attained over 1 kg in weight followed by common carp 762 g, catla 520 g, and silver carp 435 g. The treatment with feed only is showing the next best results.

A total of 34.88 lakhs spawn comprising 22.31 lakhs mrigal, 7.75 lakhs rohu, 4.30 lakhs common carp, 0.45 lakh silver carp and 0.05 lakh catla was produced. In addition to supplying the spawn, the Centre also supplied 8.7 lakhs fry/fingerlings to the Fisheries Department and others.

A notable achievement of the Centre was the successful breeding of silver carp and rohu during the last week of May with provision of tubewell water. 'Khas' screens were provided

around the shade covering the cement cisterns and a cooler installed which maintained a temperature of 26.5°C inside the enclosure as against 32°C in the nursery pond and 34.5°C in the brood stock pond. Though about 42% silver carp and 52.8% mrigal eggs were fertilized the hatching rate was very poor and only 30,000 mrigal and 2,500 silver carp spawn was obtained.

Observations on the growth of silver carp during winter months indicated that despite regular feeding they lost their weight when the temperature fell below 18°C. It was also observed that the loss was greater in fishes of larger size than the smaller ones.

A pelletized feed based on a formula recommended by the Punajb Government was given a trial and found to be poorer than the conventional rice polish-deoiled cake mixture. The pelleted feed comprised 55% rice polish 10% wheat bran, 20% deoiled groundnut oil cake, 5% fish meal, 1% calcium, 2% sodium chloride, 0.3 g/kg cobalt chloride. 7% molasses and 100 tablets of yeast/kg of feed.

Pune : The 13th set of experiments initiated in January 1984 was concluded in July after six months' rearing. The stocking density in experiment was reduced to 5,000 fingerlings instead of the usual 10,000 fingerlings/ha. The species proportion was catla 10, rohu 5, mrigal 10, common carp 25, silver carp 30 and grass carp 20. The production obtained under this experiment varied from 3312 kg to 3735 kg/ha. Silver carp had attained a weight of 900-1000 g followed by grass carp 353-578 g and common carp 515-537 g. The cost of production ranged from Rs. 3.18-Rs. 3.23 / kg.

A total of 7.86 lakhs spawn comprising 3.23 lakhs mrigal, 2.84 lakhs silver carp, 0.68 lakhs rohu, 0.61 lakhs catla and 0.50 lakhs grass carp was produced.

Bhavanisagar The centre was shifted to Pollachi.

Jaunpur No work could be done.

Kalyani Owing to severe drought, no work could be done. The centre was closed in September, 1984.

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, M. K. Rehman, H. L. Srivastava, H. B. Dave and S. K. Sahoo.

Duration : 1976-1985 March.

Location : Dhauli, Kausalyagang, Lingda, Durg and Tuticorin.

The Seventh Workshop of the All India Coordinated Research Project on Composite Fish Culture and Fish Seed Production was organised at Allahabad on 5-6 May 1984. The workshop recommended that a uniformity trials should be taken up at all the Centres simultaneously. The stocking density recommeneded for the trial was 5000 fingerlings/ha in the proportion of catla 10, rohu 20, mrigal 15, silver carp 25, grass carp 10 and common carp 20. While one of the ponds was to be taken as control the three different treatments viz. use of fertilizers alone, use of feed alone and use of both feed and fertilizers together, were suggested to be undertaken in one pond each.

Consequently, the ongoing experiments were wound up at whatever stage they were and uniformity trials were initiated as per Workshop recommendations.

Gujarat Centre (Lingda)

An experiment on the monoculture of rohu undertaken in a 0.5 ha pond at 2,000 fingerlings/ ha resulted in a production 1800 kg/ha in 10 months rearing. The presence of some large-sized rohu indicated that the old stock was not completely removed.

The Centre produced the largest quantity of spawn this year since its inception, the total production being 87 lakhs comprising 58.5 lakhs rohu, 28 lakhs mrigal and 0.5 lakh catla.

Experiments on uniformity trial are in progress in four ponds.

Madhya Pradesh Centre (Durg)

On account of the non-availability of facilities from the Madhya Pradesh Fish Seed Development Corporation, which is controlling the farm, no work could be taken up at the centre. The Centre was therefore, closed in September 1984.

Orissa Centre (Kausalyagang)

The experiment with a 5 species combination comprising (i) catla 2, rohu 3, mrigal 1.5, silver carp 2 and common carp 1.5 and (ii) catla 1, rohu 3, mrigal 2, silver carp 2 and common carp 2 in two 0.22 ha ponds was concluded after 4.26 months and production of 1518 kg and 1545 kg/ha obtained.

A total of 34 lakhs spawn comprising 27.5 lakhs rohu, 4 lakhs common carp, 1.5 lakh catla and 1 lakh mrigal was produced. The experiment on uniformity trial is in progress.

Tamil Nadu Centre (Tuticorin)

Experiments on composite fish culture in two ponds at 6,000 fingerlings/ha in the proportion of silver carp 2, catla 2, rohu 2, mrigal 2, common carp 1 and milkfish 1 resulted in a production of 3246 to 3814 kg/ha in 261 days rearing.

Two laksh spawn of ctala and 3 lakhs spawn of mrigal was produced.

The experiment on uniformity trial is in progress.

PROJECT CFCSP-10 : OPERATIONAL RESEARCH PROJECT ONCOMPOSITE FISH CULTURE AND INTEGRATED FISH-LIVESTOCK FARMING.

Personnel : B. K. Sharma, M. K. Das, N. K. Das, D. P. Chakraborty, Y. S. Yadava (CIFRI) and R. U. Islam (Assam State Fisheries).

Period : 1977-86 (Krishnagar) ; 1984 (Gauhati).

Location : Krishnagar (West Bengal) and Gauhati (Assam).

KRISHNAGAR CENTRE

Twenty one trials were undertaken during the year under report for establishing the viability of composite fish culture in large water bodies with manuring alone and integration of ducks, pigs and poultry with fish culture in farmers' ponds.

Aiming at demonstrating high fish production with low operational inputs leading to low cost of production, only abundantly available organic manure (cattle dung) and rock phosphate were used in large water bodies. In farmers' ponds, either pig dung or duck droppings or poultry litter was used for carp production under the integrated systems thereby cutting down the cost of production of fish.

FISH-CUM-PIG FARMING

Three demostrations in farmers' ponds ranging from 0.1 to 0.5 ha were taken up for integrated fish-cum-pig farming with 5 carp species at stocking density ranging from 6000-18000/ha. The pig dung was recycled in the pond for which 40-56 pigs/ha were adequate. No other manuring or supplementary feed was used. While 2 ponds yet to be harvested, a production @ 7600 kg/ha/yr has been obtained from the third pond (0.5 ha) with cost of production @ Rs. 3/- per kg against the conventional cost of Rs. 7/- per kg. This is in addition to some revenue from the sale of pig meat.

FISH-CUM-POULTRY FARMING

One demonstration in a 0.1 ha pond was taken up for fish-cum-poultry farming where the poultry litter was recycled in the pond @ 18500 kg/ha/yr, applied in split up daily doses. This dispensed with additional manuring and supplementary feeding in the culture ponds where 5 carp species were stocked at a density of 6000 fingerlings/ha. Fish production @ 4000 kg/ha/yr has been obtained with cost of production @ Rs. 3/- per kg against Rs. 7/- per kg under conventional system. In addition, eggs and bird meat were also obtained.

The high fish production with low cost motivated many farmers of the locality to adopt the technology.

FISH-CUM-DUCK FARMING

Fourteen demonstrations on fish-cum-duck culture in farmers' ponds in West Bengal and Assam in water areas ranging from 0.1 to 0.3 ha were taken up. 4-6 carp species combinations at stocking density of 6000 fingerlings/ha were taken up while 200-380 ducks were provided per hectare pond area. No supplementary feeding or manuring was necessary in the culture as the duck droppings acted as a substitute to fish feed and pond fertilizer. Fish productions ranging from 800-1150 kg/kg/6 months with an average of 950 kg/ha/6 months, were demonstrated in addition to duck eggs with laying rate of 30-40% and duck meat @ 2.5 kg/bird/yr. The cost of fish production was worked out to Rs. 4/- per kg against Rs. 7/- per kg in conventional systems.

Harvest from a farmer's small back yard pond under duck-cum-fish culture.

COMPOSITE FISH CULTURE IN LARGE WATER BODIES

In large water bodies of about 2.0 ha each, 3-6 species combinations of carp culture were taken up with manuring alone, deleting the supplementary feeding component altogether. The harvesting of fish is presently in progress and a production rate of 2000 kg/ha/yr is expected with cost of production @ Rs. 5/- per kg against Rs. 7/- per kg with manuring and feeding.

GAUHATI CENTRE

FISH-CUM-DUCK FARMING

The experiment and demonstration of fish-cum-duck farming was conducted in a 0.12 ha pond in Ulubari fish farm (Gauhati) from January 1984 to January 1985 and the details are discussed below :

Pond preparation : The pond was completely dewatered during December 1983 and the trash fishes were removed. It was left to dry for a week and lime was applied @ 800 kg/ha prior to filling. The duck house (15′ × 8′) was constructed on one corner of the pond embankment.

Stocking : The pond was stocked with 6 species combination of Indian and exotic carps on 4-1-84 at a stocking density of 5713 fingerlings/ha.

Feeding the fish : No supplementary feed was provided to the fish.

Sample netting : Sample netting was done once a month to see the growth and general condition of the fish.

Manuring : No organic or inorganic fertilizers were added to the pond. The ducks were given a free range over the pond surface during the day time, where they automatically recycled their droppings. Night droppings collected from the duck house were also added to the pond every morning.

Duck husbandry : 50 Nos of local variety of ducks (M 30 : F 20) were brought from Siphajhar (Distt. Darrang) to be raised alongwith fish during January and February 1984. The ducks were allowed to range freely on the pond surface during the day time and were sheltered in the duck house at night.

Ducks kept in the open were able to find natural food from the pond but it was not sufficient for their proper growth. This natural food was therefore supplemented with artificial feed. Duck feed @ 160 g per duck per day was given. Rice husk was kept in the corners of the duck house for egg laying. As the ducks lay only at night and the eggs were collected every morning after the ducks were released in the pond.

Hydrological condition of the pond : The improtant observations are : An increment from 6.4 to 6.8 was observed in soil pH, while water always remained in the alkaline range and exhibited less fluctuation. Pond alkalinity remained fairly high except in July when it came down to 58 mg/l, the average being 86.3 ppm. Phytoplankton dominated over zooplankton in most of the months and the average plankton count was 2227 u/l.

Harvesting : The partial harvesting of the pond was done periodically and fishes attaining marketable size were sold. The final harvesting was done during February 1985. The details of stocking and harvesting of fish and ducks are given in the following tables :

Table : Details of stocking and harvesting of fish under duck-cum-fish culture at Ulubari Fish Farm, Gauhati.

Stocking date : 4-1-1984. **Stocking density** : 5713/ha. **Pond area** : 0.2 ha

Species	*Catla*	*Rohu*	*Mrigal*	*Silver carp*	*Grass carp*	*Common carp*	*Common carp fingerlings*	*Total*
Number stocked	20	160	160	240	80	25	—	685
Species ratio	3	23	23	35	12	4	—	—
Initial av. length (mm)	324.2	83.0	64.1	146.0	93.5	244.1	—	—
Initial av. wt. (g)	476.5	5.7	2.7	35.5	9.9	252.0	—	—
Numbers harvested	16	160	150	199	77	25	1853 *	627
Final av. length (mm)	444.5	295.0	369.7	437.8	293.7	313.2	126.0	—
Final av. wt. (g)	1256.0	289.0	527.0	857.5	282.0	435.5	40.0	—
Total wt. (kg)	20.70	40.250	69.770	139.510	13.160	9.180	74.0 *	367.02
Survival %	80.0	100.0	94.0	83.0	96.0	100.0	—	—
Contribution %	5.64	10.97	19.0	38.0	3.71	2.5	20.16	—

Production = 367.02 kg. Production/ha = 3060.97 kg/ha/yr.

* Not included in total ** Included in total.

Table : Details of ducks' growth and egg laying

No. of Ducks	*Initial av. wt (g)*	*Period of growth*	*Mortality*	*No. of harvested*	*Final av. wt. (kg.)*	*Total wt. (kg.)*	*No. of eggs laid*
50	—	12 months	14	36	1.415	51.0	453

Results : A production of 3061 kg/ha/12 months was achieved from the pond. Silver carp (38%) contributed maximum followed by common carp fingerlings (20.16%) and Mrigal (19%). A net profit of Rs. 1103 was obtained from the experiment. The detailsof operational cost and returns are given in the table.

Table : Operational cost and returns

Duck raising :		
Cost of duck house	=	Rs. 2640.00
Cost of Ducks	=	Rs. 1100.00
Cost of feed	=	Rs. 3448.60
		Rs. 7188.60
Returns :		
Sale of fish (367 kg × 20 / kg)	=	Rs. 7340.00
Sale of eggs	=	Rs. 340.00
Sale of ducks (51 kg × 12/kg)	=	Rs. 612.00
		Rs. 8292.00
Profit :		Rs. 1103.40

PROJECT CFCSP/28 : STATISTICAL EVALUATION OF FACTOR EFFECTS ON GROWTH AND SURVIVAL OF FISHES UNDER COMPOSITE FISH CULTURE.

Personnel : K. K. Ghosh, V. R. P. Sinha and S. D. Tripathi.

Duration : 1984-85

Location : Dhauli

The Project aims at utilising the available data on composite fish culture recorded at various centres of All India Coordinated Research Project to test hypothesis built on probable causal relationships and identify the quantitative contribution of different factors in explaining growth and survival.

Multivariate data analytical approach through computerized data analysis is envisaged. By developing suitable software for the in-house computer HP 3000, data analysis is proposed.

The project is of importance to quantify the relative role of input variables under different ecological suituations encountered in different parts of India, in affecting growth, survival, etc. and is considered to be of value in developing a mathematical model of pond fish production process. The progress so far has been to examine and tabulate the data of some centres. Some models are under examination for normalising the data set. Software development awaits the installation of the Computer.

The progress during the first year has been slower than anticipated due to delays in getting the data and non-installation of the cumputer.

PROJECT CP/ABF/1 : ALL INDIA COORDINATED RESEARCH PROJECT ON AIR-BREATHING FISH CULTURE (CIFRI-based Centres).

Personnel : M. Y. Kamal, S. K. Munnet, Dhirendra Kumar, V. K. Murugesan, S. P. Ayyar and P. Kumaraiah.

Duration : 1971-89.

Location : Barrackpore, Patna, Gauhati and Bangalore.

Barrackpore : Development of compunded feed for air-breathing fishes was formulated. Two feeds, comprising of cowdung, active sludge, fish meal and dried sluaghter house offal were tried. The control feed was only cowdung. Ten number of fish (*A. testudineus*) were taken for each feeding group. The results are given below :

Diet	*Av initial biomass (g)*	*Av final biomass (g)*	*Av biomass gain (g)*	*Growth (%)*	*Survival (%)*	*Total dry feed wt. per fish (g)*	*Feed conversion efficiency*
Feed A	8.251	10.008	1.757	221.3	80	6.500	3.70 : 1
Feed B	8.251	10.479	2.228	27.0	90	7.129	3.20 : 1
Feed C	8.251	9.414	1.163	14.1	90	4.493	3.95 : 1

Patna : Culture of magur was done in two ponds 0.03 and 0.04 ha and stocked @ 44,820 and 24,216 fingerling/ha with mean weight of 9.5 and 12.9 g. Food comprising of deoiled groundnut cake, trash fish and deoiled rice bran in the ratio of 6 : 1 : 13 was distributed in two ponds at the rate of 1.3 to 2.0 kg/day as per their consumption. The production from pond I was 28.95 kg of magur and 1.36 kg of miscellaenous and 25.500 kg of magur alone from pond II.

Gauhati : Monoculture of singhi was done in a 0.05 ha pond with stocked @ 40,000/ha (200 nos. ; 16.5 g wt.). The pond was manured with cowdung @ 2000 kg/ha and limed @ 100 kg/ha. The stock was fed with rice bran and fish meal in equal ratio @ 5-10% body weight of the stock. After 8 months of raring period the fishes, attained an average weight of 34.5 g. As a result of partial harvest of 90 singhi weighing 3.2 kg were handed over to the Dept. of Fisheries, Govt. of Assam.

An experiment on mono-culture of magur has been in progress in a 0.02 ha pond. The fishes were stocked in stages @ 30,000/ha as per availability. The pond was manured with cowdung @ 5,000 kg/ha and lime @ 250 kg/ha. The fishes are fed with rice bran and fish meal (1 : 1) and have grown from average weight of 5.53 g at the time of stocking to average weight of 31.25 g after 8 months of rearing period.

An experiment on mixed culture of magur, singhi and koi has been in progress in a 0.02 ha pond with combined density @ 45,000/ha in the ratio of 1 : 1.5 : 2 with an average weight of 7.6, 8.08 and 15.62 g respectively. The fishes are fed on rice bran and fish meal (1 : 1) 5-10% of the body weight. The pond has been manured with cowdung @ 5000 kg/ha and limed @ 250 kg/ha. The pond is provided with a bamboo mat fencing to prevent migration of koi from the pond. After 8 months of rearing period magur, singhi and koi have grown to 50, 36.5and 25 g respectively.

Bangalore : Though the maturity condition of the breeders was not very satisfactory, probably due to scarcity of monsoon rains, altogether 13 sets of *C. batrachus* 5 sets of *Heteropneustes fossilis* and 3 sets of *C. striatus* from the brood stock maintained in ponds at Hessaraghatta / Kodigehalli fish farm were hypophysed of which 2 sets of *C. batrachus* 4 sets of *H. fossilis* and 2 sets of *C. straitus* responded. The pituitary injection doses and breeding results are given in Table.

An earthen pond (0.06 ha) was stocked @ 900 fingerling of C. marulius (120 mm/3.3 g) and fed with tadpoles and trash fish. After about 6 months 375 fishes in the size 198 mm/75 g were recovered.

Table : Datan o induced breeding experiments at the Bangalore Centre.

Date	*Species*	*Weight of breeders (g)*			*Dose of injection (mg) pituitary 100 g breeder*				*Ovolation (No. of eggs)*	*Fertilization (%)*	*No. of hatchling obtained*
		female	*male*	*1 male 2*	1st. female	1st. male	2nd. female	2nd. 1 male 2			
19-6-84	*C. bratrachus*	100	80	85	2	3	2	2	nil	—	—
	,,	80	120	100	2	3	2	2	nil	—	—
	,,	120	100	80	2	3	2	2	nil	—	—
	H. fossilis	40	30	40	2	3	2	2	nil	—	—
2-7-84	*C. batrachus*	145	60	80	2	4	2	2	475	74.9	Eggs got spilled
	,,	65	45	85	2	4	2	2	nil	—	—
	,,	125	85	80	2	4	2	2	nil	—	—
30-7-84	*C. batrachus*	60	60	45	3	6	3	3	nil	—	—
	,,	80	40	100	3	9	3	3	nil	—	—
	,,	40	40	60	3	12	3	6	nil	—	—
	H. fossilis	40	35	40	3	6	3	3	1600	80.0	1200
	,,	100	80	60	3	9	3	5	4300	95.00	3890
	,,	60	45	40	3	12	3	6	1800	84.00	1400
16-8-84	*C. batrachus*	85	100	—	4	8	4	—	nil	—	—
	,,	100	110	—	4	18	4	—	nil	—	—
	,,	80	100	—	8	16	8	—	nil	—	—
	,,	120	110	—	8	16	8	—	few eggs	negligible	nil
	H. fossilis	25	20	—	4	8	4	—	,,	,,	,,
17-9-84	*C. striatus*	260	270	—	4	—	2	—	Two broods of different sizes were observed in the breeding pond on 28-9-84		
	,,	210	170	—	4	—	2	2			
	,,	375	215	—	4	—	—	2			

PROJECT CP/ABF/18 : STUDIES ON THE DEVELOPMENT OF COMPOUNDED FEED FOR AIR-BREATHING FISH, *ANABAS TESTUDINEUS* AND *CLARIUS BATRACHUS*.

Personnel : M. Y. Kamal and Ansuman Hajra.

Duration : 1980-86

Location : Barrakcpore.

Feed formulation programme for *Anabas testudineus* was taken up first. Keeping in view the nutritional requirement of the species, two compounded feeds were developed from available ingredients viz. cowdung, active sludge, fish meal and dried slaughter house offal. The control feed used was cowdung alone. Bioassay of the developed feeds was conducted in cisterns. Ten number of fishes were taken for each feeding group in duplicate, in cement cisterns having approximately 250 litres of water. The feed was offered once a day @ 5% of total biomass. Average water temperature remained around 27°C during the period of bioassay which was continued for 21 days.

Under such feeding schedule and pattern of formulation, best results were obtained with feed compounded from slaughter house offal, active sludge and cowdung in 1 : 1 : 1 ratio. *Anabas testudineus* of average weight 8.251 g achieved 27% growth in 21 days. The feed compounded from fishmeal, active sludge and cowdung (1 : 1 : 1) registered 21.3% gain during the same period. The cowdung control group showed only 14.2% gain.

All the cases showed excellent survival rates ranging between 80-90%. A feed efficiency of 3.2 : 1 was recorded with slaughter-house offal based diet. The other feed showed feed efficiency of 3.7 : 1.

PROJECT CP/R-1 : ALL INDIA COORDINATED RESEARCH PROJECT ON ECOLOGY AND FISHERIES OF FRESHWATER RESERVOIRS.

Personnel : B. V. Govind, Ch. Gopalakrishnayya, Y. Rama Rao, G. K. Bhatnagar, V. R. Desai, C. Selvaraj, K. Gopinathan, H. P. Singh, M. Ramakrishnaiah, B. P. Gupta, A. Mathew, B. C. Jha, S. N. Singh, D. K. Kaushal, M. D. Pisolkar, K. O. Joseph, N. P. Srivasthava, V. K. Shama, V. Kolekar, A. K. Ekka, K. K. Agarwal, K. S. Banerjee (All at CIFRI Centres), M. A. Varghese, K. A. Pota, M. G. Shaw, K. R. Khan (All at centrally sponsored centres).

Duration : 1971 - 1985 March

Location : Nagarjunasagar (A.P.), Bilaspur (H.P.), Pollachi (Tamil Nadu), Rihand (U.P.), Ranchi (Bihar), Ukai (Gujarat), Kangsabati (W. Bengal).

RIHAND (U. P.)

Reservoir water level which declined from January (258.56 m) to May (254.11 m), indicated rising trend from June (254.26 m) to attain peak in September (265.46 m) and then again declined from October (265.19 m) to December (262.05 m). Total inflow of water during this year was 8.1301 m.a.ft. The influx of water was abrupt in June (2.9037 m.a.ft.) which helped the upward migration and breeding of *C. catla* in the very first week of July.

The entire course of 224 days of fishing yielded a total catch of 56,847.80 kg. Of this only 5035.5 kg. was of drag net, operated from February to April only and the rest from gill nets, used throughout. The monthly total catch ranged from 3311.3 kg. (May) to 18,595.1 kg. (June). During the quarter January-March, with the fishing effort of 23 to 25 units of gill nets/day, catch/net was estimated to range from 0.220 kg. (January) to 0.357 kg (March). But during April-June, keeping the effort as low as 15 to 22 units/day, an increase in catch/net was observed being, 0.542 kg. (April) and more strikingly 1.266 kg. (June). This sudden increase in the catch was mainly due to the catch of mature *Catla* from lotic waters during their spawning migration in June.

In the overall catch, *C. catla* (77.37%) was the most dominating species but its importance went down as compared to earlier years with the improvement in the fishery of predatory fishes such as *S. silondia* (8.41%), *N. chitala* (4.43%), *W. attu* (4.09%), *Mystus* spp. (2.4%) and *B. bagarius* (1.72%). *C. mrigala* (0.93%), which was next to *C. catla* earlier, also sank down.

In this year the experimental fishing could be done in February, March, May and June. The entire course of 348 hours conducted only in intermediate sector, using 488 multi-meshed gill nets (20-150 mm bar), yielded a total fish catch of 199.73 kg. Monthly analysis of the data has shown that the stock density of the fish remained same throughout but consistent dominance of *C. mrigala* in February, March and May was replaced by *S. silondia* in June. While the carps made up 58.22%, the catfish accounted for 41.14% in the catch. Among carps, *C. mrigala* (39.53%) was the most predominant followed by *L. calbasu* (11.77%), *L. rohita* (3.18%) and *C. bata* (3.00%). In catfishes, *S. silondia* (26.26%) was the most important followed by *M. seenghala* (8.71%), *M. aor* (4.43%), *E. vacha* (0.83%) and *C. garua* (0.68%). The nets of smaller meshes (20-45 mm bar) contributed more fish by number (catfishes) but the nets of bigger meshes (55-90 mm bar) collected greater bulk of fish (carps) by weight.

(Length-weight relationship of *C. mrigala* was worked out as log W=-4.7398+2.9143 log L (r=0.99).

Length-at-ages of this species was also determined for the ages 1 to 5 years as 210,384,514, 602 and 695 mm respectively. Using the length-weight relationship, the weights-at-ages of this fish were also estimated for the above ages as 179,697,1515,2524 and 3607 g respectively. Growth of this species was found poor as compared to that reported from rivers Ganga and Jamuna.

Length-weight relationship of *L. calbasu* was determined as log W=-5.8656+3.3574 log L (r=0.99).

GETALSUD RESERVOIR (BIHAR)

Total outflow from January to August was 22,585.24 ha m. Total rainfall during the calender year was 1752.58 mm.

Physico-chemical features of surface water have been studied from April to July 1984.

Depth-wise studies showed the presence of thermocline in April and May.

Chemical stratification in respect of dissolved oxygen and specific conductivity was also recorded.

Primary production studies revealed better carbon production in lotic sector of the reservoir.

Plankton and benthos were studied from April to July. Volumetric plankton abundance was heighest in lotic sector and varied from 0.534 to 0.494 ml/m^3 in three sectors of the reservoir. Total standing crop of plankton varied from 2,54,127/m^3 (lotic sector) to 2,77,473/m^3 (intermediate sector). This plankton abundance was dominated by phytoplankton (65.87% to 74.53%). Phytoplankton was mostly contributed by Myxophyceae (56.97% to 63.88%) whereas Copepoda (12.90 to 15.74%) was the dominant zooplanktonic group.

Bathymetric distribution of macrobenthos revealed that 4 & 6 m depths in lotic sector and 10 m depth in lentic sector maintained considerably high benthic population numerically. A total of 41,857 kg of fish landed at Rukka landing centre. *Puntius sarana* (24.42%) followed by *Cirrhina mrigala* (21.52%). A total of 2,80,000 fry/fingerlings of Indian major carps were stocked during the period under report.

Studies on reproduction and recruitment : Drag net catches revealed the presence of a few specimen of *Labeo calbasu* (TL 74 mm and weight 5.5 g caught on 16.10.84), reflecting the natural recruitment of this fish.

A few specimen of *Labeo calbasu* and *L. rohita* were observed with regard to their food. In *L. calbasu* detritus (87.50%) followed by Bacillariophyceae (11.35%) were the major items whereas in *L. rohita* too, detritus (60.00%) and Bacillariophyceae (37.08%) were the dominant food items but diatoms also were prefered.

GOVINDASAGAR (H. P.)

The water level of the reservoir fluctuated by 39.97 m from a minimum of 454.12 m. (May) to a maximum of 493.91 m. (August). The total inflow for the period January to August was 1304264.43 ha m. and outflow was 1266864.08 ha m. The annual ranges of water temp., pH, D.O., free CO2, total alkalinity, calcium, magnesium nitrate, phosphate, silicate and specific

conductivity for the whole reservoir fluctuated between 9.5-31.0°C, 7.4-8.4, 1.76-13.28 ppm, nil-16.0 ppm 1.8-3.5 ppm and 116.2-277.7 mmhos/cm respectively. Thermal stratification was very much pronounced in summer and of less magnitude in autumn. Strong oxycline, characteristic feature of productive waters was observed in summer in Gobindsagar.

A total of 485 tonnes of fish was landed during the year indicating and increase of 22% over the yield of 1983. The remarkable features of the yield during the year was the dominance of silver carp, *H. molitrix*, which accounted 174 tonnes (35.9%), of the total catch. Other important species in the catch were *L. dero* (25.94%), *C. carpio* (19.46%), *C. catla* (9.60%), *C. reba* (2.94%), *T. putitora* (2.36%) and *L. rohita* (1.88%).

NAGARJUNASAGAR RESERVOIR (A. P.)

Plankton : The standing crop of plankton in lentic sector (ml/m3) gradually reduced from a peak in January (0.558) to minimum in April (0.1697) However, it exhibited another peak in May (0.56 ml), which declined by July (0.3). Phytoplankton was prevalent during the first quarter and zooplankton took over in the second quarter. Mild bloom of *Fragilaria* occured during January to March, while *Microcystis* which was scarce during this period established during May to July. *Ceratium* and *Pediastrum* occurred during February and June respectively.

Summer peak of zooplankton occurred during May and June and was contributed by copepods (*Cyclops*, *Diaptomus* and their larvae) and rotifers (*Keratella*, *Brachionus* and *Filinia*). *Cladocerans* were significant during June. It is interesting to note the occurrence of freshwater medusa for the first time in the reservoir during February and March.

Experimental fishing : Of the five mesh bars operated 70 mm was most efficacious catching 20,933 kg of fish followed by 80 mm while 100 mm did not catch any fish.

Fish yield and species composition : The fish yield during the year was estimated on the basis of 4 months sampling of entire reservoir and one centre throughout the period. The estimated catch amounted to 167.0 t. As in previous years *P. pangasius* dominated the catches (29.99%). This is followed by *L. rohita* (15.97%), *S. childrenii* (14.15%), *M. aor* (9.17%), *C. catla* (6.98%) and others.

The carps on the whole contributed about 35% which is an improvement from the previous years.

New species of fish from the reservoir : A species of *Mystus* which was hitherto referred to as *M. punctatus* has been found to be of a new species and is named *Mystus krishnensis*. It forms a minor fishery and formed 2.54% of the catches.

Dragnet collection : Dragnet collection brought in only uneconomic and weed fishes.

ALIYAR RESERVOIR (TAMIL NADU)

Physical and chemical characteristics of soil

The soil was found to be slightly acidic in reaction (pH 6.40-6.46), low in available P (P_2O_5 2.78-2.96 mg/100 g soil) and medium in available N (25.8-32.7 mg/100 g soil) and organic carbon (0.70-0.87%). The C/N ratio was between 14.0 and 15.6

Physico-chemical features of water

The reservoir is poor in respect of nutrients like nitrate and phosphate. But silica content is fairly high. Phosphate, nitrate and silicate fluctuated between trace and 0.220 ppm, 0.040 and 0.20 ppm and 10.0 and 20.0 ppm respectively.

Primary productivity

The average gross production ranged from 0.278 to 0.572 g C/m^2 /day while the average net production from nil to 0.206 g C/m^2 /day during the period under report.

Plankton

Three spurts in the abundance of plankton was noticed during the year indicating primary, secondary and tertiary peaks. The primary peak with a magnitude of 8.2 ml/m^2 was noticed during December, coinciding with the winter. A secondary peak with an abundance of 7.75 ml/m^3 was observed during April corresponding to the summer. A tertiary peak of less magnitude was noticed during August.

Bottom biota

The botton macrofauna of the lentic sector was composed purely of oligochaetes and larvae of *Chrionomus* and *Chaoborus*. In the intermediate sector also the constitutents of the fauna were same. In the lotic sector, where sampling was done upto 4 m depth, the abundance of fauna was relatively poor and did not show much quantitative variation among various stations. The composition of the fauna was same as that of the other two sectors. Quantitatively, there were no differences in the composition of fauna among the three sectors.

Fish fauna

The following species of fishes were identified and included under the list of fish fauna of the reservoir.

1. *Puntius denisonii*, 2. *Puntius chola*, *Mastacembelus guntheri*, 4. *Mastacembelus armatus*, 5. *Discognathus jerdoni*, 6. *Amblypharyngodon melittinus*.

Yield estimation : A total of 2,442 fishing units were operated during the year, giving an average catch/unit effort of 4.29 kg. *C. mrigala* dominated the catch, though there was a fall in its contribution to the total landings. However, there was an improvement in the contribution of *C. catla*. The level of contribution by *C. carpio* remained almost the same.

VALLABHASAGAR (GUJARAT)

Routine investigations were continued. Natural recruitment of major carps and hilsa were indicated by the presence of their juveniles.

Experimental fishing was continued.

The bottom biota recorded were Gastropods, Bivalves, and oligochaetes.

PROJECT CP/BFF-1 : ALL INDIA COORDINATED RESEARCH PROJECT ON BRACKISHWATER FISH FARMING.

Personnel (CIFRI) : Apurba Ghosh, K. M. Das, Amitabha Ghosh, A. Hajra, M. L. Bhowmick, R. K. Chakraborty, S. K. Mondal, N. K. Das (upto June, 84), G. N. Chattopadhyay, P. K. Chakraborty and R. N. De.

Duration : 1971-1985 March.

Location : Barrackpore, Kakdwip and Canning (Institute-based Centres) ; Keshpur, Vytilla, Goa, Kakinada and Madras (Centrally sponsored Centres).

BARRACKPORE

Studies on the morpho-histology and physiology of the digestive tract of *Liza parsia* were continued. AB (2.5) and PAS positive mucous cells were found to be present throughout the intestinal mucosa. The gizzard though have glandular structures were found to be triturating in function. Lipase activity was recorded in the intestine, intestinal caeca and liver with highest activity in the intestine. Studies on the digestive system of another brackishwater fish *Lates calcarifer* have been initiated.

Studies on post-larval stages of *P. monodon* reveal that dietary energy influences prawn growth. At the optimum protein requirement (46%), both the percent growth and specific growth rate increased as the dietary energy level was raised from 361.7 to 398.3 K cal/100 g. Slaughter house offal as one of the ingredients along with mysid shrimp meal showed promising results. Feed efficiency of 1.22 could be achieved with this and the survival was 88-94%. Dietary lipid was shown to exert a protein-sparing action. Pelletized feeds remained stable in water for more than 3 hours. Dry matter weight loss was less than 15% in freshwater and 10% in brackishwater.

CANNING (CSSRI FARM)

Brackishwater plots (0.15 ha), treated with rice bran @ 1,000 kg/ha to encourage growth of 'lablab' were stocked @ 42,000/ha with *P. monodon* and *L. parsia* (1 : 1). Due to heavy precipitation there was mortality in prawn but overall production of 0.41 t/ha could be achieved. Due to heavy precipitation there was decline in the soil salinity from 2.7 to 2 mmhos/cm. Paddy seedlings of SR-26 B were transplanted and cultivated synchronously with rohu, catla and mrigal at a stocking density of 13,000 /ha. After 3 months, the paddy yield was 3.2 to/ha and fish 0.3 t/ha. Biotic and abiotic ecosystems of the plots were also studied.

KAKDWIP

A survival of 51.1% could be obtained by rearing *P. monodon* post-larvae @ 1,00,000/ha. In monoculture experiments of *P. monodon* gave production ranging from 275 to 350.6 kg/ha/ 120-150 days when stocked @ 40,000-50,000 /ha. The survival in these experiments ranged between 30 and 57%.

KESHPUR

About 15,329 *P. monodon* post-larvae and 5550 juvelines were collected from Rushikulya estuary. Survival of *P. monodon* in nurseries was 64.25%.

Three trials on 5½ months' culture of *P. monodon* were taken up at a density of 15,000/ha by stocking juveniles (40-78 mm). The yield rates were 320.0 and 310.9 kg/ha in the experimental culture and 151.7 kg/ha in the control without feed. In another three traisls on *P. monodon* culture of 7-9 months, the yield rate fell to 50.4-159.9 kg/ha due to poaching while in 2 more trials of about 2 months' duration, the production came down to 43.6-160.2 kg/ha due to leach attack. In a culture of about 2 months with half grown young prawns of 118-142 mm size, the production was 204.3 kg/ha in a pond while mass mortality occurred in another pond due to softness disease. The experimental culture of *P. monodon* with mullets could not be continued for lack of facilities.

KAKINADA

P. monodon seed were collected from Vakalapudi, Chollangi, Suryaraopet and around the feeder canal of the farm by operating hand net. Seed were available round the year and 1,45,000 prawn and 25,000 chanos seed could be collected for experimental culture. In nursery rearing of *P. monodon* with supplementary feed, 92% survival could be achieved. Survival of *C. chanos* was 80-95% in cement cisterns. Monoculture of *P. monodon* at a stocking density of 15,000/ha was taken up in two ponds, one with fertilization and the other without fertilization. Supplementary feeding was done in both the cases. The yield rates were 140 and 300 kg/ha/3 months in ponds with and without fertilization respectively, as the fertilization resulted in excess bloom of algae. In another four trials where *C. chanos* @ 1000/ha were added additionally to control algae the yield rates were 190 and 350 kg/ha/4 months in ponds with manures and 100 and 85 kg/ha/4 months in ponds without manure.

MADRAS

Maximum prawn seed abundance was in September when 82,125 *P. indicus* seed were collected. *C. chanos* seed were available in October and 8,000 seed of the species were collected during the year of the Santhome farm.

Feeding hatchery grown *P. monodon* larvae with boiled and minced tilapia @ 100% of the body weight and rearing them in hapas, survivals between 30 and 32% could be obtained in in 3 experiments.

By stocking *P. indicus* @ 70,000/ha with *C. chanos* (500 nos.) in a 1.14 ha pond the actual yield recorded was 871.7 kg (771.2 kg *P. indicus*, 93.7 kg *C. chanos* and incidental 6.8 kg *P. monodon*) i. e., 765 /kg/ha/110 days. Two ponds were stocked with *P. indicus* and *C. chanos* @ 50,000 and 1000/ha each. The production in one pond was 360 kg/ha/5 months. Culture is in progress in the other. Similarly two more ponds were stocked with *P. indicus* and *C. chanos* @10,000 and 1000/ha each. The production in one was 212 kg/ha/50 days while the other is still under culture.

VYTILLA (COCHIN)

At Puduvypeen and Cochin bar-mouth, peak period for prawn was April when 85,260 seeds were collected. *P. monodon* seed was found to be negligible. Mullet seeds were available from April to August near Cochin bar-mouth. 52% survival was obtained by rearing *P. indicus* post larvae @ 1 lakh/ha. A production of 318.2 kg/ha/3 months could be obtained by stocking prawns @ 20,000/ha and *C. chanos* @ 400/ha with 72.5% survival of prawn.

Production of 1000 kg/ha/6 months could be obtained under monoculture by stocking *C. chanos* @ 2000/ha. In two multispecies trials with *C. chanos*, *M. cephalus* and *L. parsia* stocked @ 4000/ha having species ratio of 3 : 3 : 2, the production rates were 1691 and 1713 kg/ha/yr. with and without supplementary feeding respectively.

ELA DAUJI (GOA)

About 12,000 seed of *C. chanos* were procured from Baga and Campal during April-June. Nursery rearing were foregone and the stockable materials were directly collected from the nature for experimental culture. In three monoculture trials of *P. monodon* @ 20,000/ha, the production rates were 116, 154 and 190 kg/ha in 6, 5 and 4 months' rearing respectively. The production in such a culture operation of *P. monodon* @ 20,000/ha with *C. chanos* @ 150/ha the yield (121 kg/ha/6½ months) did not improve due to improper control of algae. The replicate of this trial failed due to breach of bundh.

In monoculture of *P. indicus* @ 25,000/ha where *C. chanos* were additionaly stocked the productions were 312 and 210 kg/ha, but where no fish was added the yield was 171 kg/ha. Harvestes of 1629 and 700 kg/ha/yr could be obtained by culture of *C. chanos*, *M. dussumieri* and *E. suratensis* together @ 4000, 10,000 and 6000 in one case 6000, 6000 and 2000 in the other. In the latter case, the DO depleted and caused mortality of some of the fishes.

RESEARCH PROJECTS COMPLETED DURING 1983

The following research projects were completed during the year 1983 :

FA/A/6 : Breeding of major carps through canal breeding techniques.

FA/A/8 : Oyster-cum-fish culture.

AN/A/1 : Training needs of fish farmers.

CP/ABF/19 : Paddy-cum-air-breathing fish culture.

RESEARCH PROJECTS MERGED DURING 1984

The following research projects were merged with project FC/B/7 during 1984 :

FA/A/7 : Collection, segregation and prospecting of riverine carp spawn.

FC/B/3 : Impact of Farrakka barrage on the riverine ecosystem and breeding of fishes with particular reference to *Hilsa ilisha*.

FC/B/4 : Riverine fish catch statistics from middle and lower stretches of Ganga River System.

FC/B/6 : Impact of water pollution on freshwater environment and physiology of the fishes.

CENTRE-WISE LIST OF ONGOING PROJECTS

DIVISION/CENTRE	CODE NO.	
FRESHWATER AQUACULTURE DIVISION		
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	AN/A/2
	CP/CFCSP-1.1	CP/CFCSP-28
	CP/CFCSP-1.2	
KVK/TTC, KAUSALYAGANG	FA/A/29	
CUTTACK	FA/A/34	
RIVERINE AND LACUSTRINE DIVISION		
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	CP/ABF/1
BHAGALPUR	FC/B/2	FC/B/7
	AN/B/10	
BUXAR	FC/B/7	

GAUHATI	FC/A/3	CP/CFCSP-10
	CP/CFCSP-1.1	CP/ABF-1
KAKINADA	F/A/22	FA/A/23
LALGOLA	FC/B/7	
MUZAFFARPUR	FC/A/5	
SRINAGAR	FA/A/4	FC/B/1
TADEPALLIGUDEM	FA/A/14	
	FA/A/25	FC/B/5

ESTUARINE FISHERIES AND BRACKISHWATER AQUACULTURE

BARRACKPORE	BF/B/3	BF/A/10
	BF/B/4	BF/A/11
	BF/B/5	BF/A/14
	BF/B/6	BF/A/15
	BF/B/8	BF/A/16
	BF/A/2	BF/A/17
		CP/BFF/1
CALCUTTA	BF/B/2	
KAKDWIP	BF/B/1	BF/A/12
	BF/A/1	BA/A/16
	BF/A/5	AN/B/4
MADRAS	BF/A/7	BF/B/7
	BF/A/4	BF/A/9
		BF/A/13
PURI	BF/A/3	BF/A/6
DIGHA, ULUBERIA, REIDIGHI AND PORT CANNING	BF/B/3	

PROJECTS AT OTHER CENTRES

BARRACKPORE (Other than estuarine projects)	FA/B/7	AN/B/8
	FA/A/5	AN/A/2
	FA/A/11	AN/A/3
	FC/A/4	AN/A/5
	FC/A/6	AN/A/6
	AN/B/1	AN/A/7
	AN/B/5	AN/A/8
	AN/B/6	CP/ABF-1
	AN/B/7	CP/ABF-18
		CP/BFF/1
KALYANI	FA/B/6	CP/CFCSP-1.1
	FA/A/27	CP/CSCSP-10
	AN/A/4	
KRISHNAGAR	CFCSP-10	
RAHARA	FA/B/2	FA/A/32
	FA/A/10	BA/A/2
	FA/A/12	BF/A/18
	FA/A/19	AN/B/9
BADAMPUDI BHAVANISAGAR KARNAL PUNE JAUNPUR	CP/CFCSP-1.1	
BILASPUR	FA/A/3	CP/R-1
RIHAND POLLACHI NAGARJUNASAGAR	CP/R-1	
RANCHI	CP/R-1	CP/CFCSP-1.1
PATNA	CP/ABF-1	

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Personnel

16

The following scientists rendered their services to the Institute during 1984.

Name	*Designation*	*Centre/Section*
DR. A. V. NATARAJAN	DIRECTOR	BARRACKPORE
FRESHWATER AQUACULTURE DIVISION		
1. Dr. V. R. P. Sinha	S-3 (Per Gr.), Head, FARTC & National Project Director, FAO/ UNDP Project.	FARTC, Dhauli
2. Shri M. Ranadhir	S-3	,,
3. Shri N. G. S. Rao	,,	,,
4. Shri K. K. Sukumaran	,,	,,
5. Dr. T. Ramaprabhu	,,	,,
6. Shri H. A. Khan	S-2	,,
7. Shri S. Patnaik	,,	,,
8. Dr. C. R. Das	,,	,,
9. Shri K. K. Bhanot	,,	,,
10. Smt. K. K. Bhanot	,,	,,
11. Shri D. K. Chatterjee	,,	,,
12. Shri G. V. Kowtal	,,	,,
13. Shri G. R. M. Rao	,,	,,
14. Shri M. Rout	,,	,,

Name	*Designation*	*Centre/Section*
15. Dr. K. J. Ram	S-2	FARTC DHAULI
16. Dr. B. N. Singh	,,	,,
17. Shri R. K. Jana	,,	,,
18. Shri K. K. Ghosh	,,	,,
19. Shri Dilip Kumar	,,	,,
20. Shri S. D. Gupta	,,	,,
21. Shri R. K. Dey	S-1	,,
22. Shri R. C. Das	,,	,,
23. Shri D. Narayanaswami	,,	,,
24. Shri B. K. Mishra	,,	,,
25. Dr. George John	,,	,,
26. Shri A. K. Sahoo	,,	,,
27. Dr. S. N. Mohanty	,,	,,
28. Shri C. S. Purushothaman	,,	,,
29. Shri S. Jena	,,	,,
30. Shri P. V. G. K. Reddy	,,	,,
31. Shri S. Ayyappan	,,	,,
32. Shri P. K. Saha	,,	,,
33. Shri S. N. Dutta	,,	Paddy-cum-fish culture unit, Cuttack
RIVERINE AND LACUSTRINE DIVISION		
34. Dr. A. G. Jhingran	S-3 Head, R & L Division	ALLAHABAD
35. Dr. G. N. Mukherjee	S-2	,,
36. Shri Ravish Chandra	,,	,,
37. Dr. R. S. Panwar	,,	,,
38. Shri S. P. Singh	,,	,,
39. Dr. M. Peer Mohamed	,,	,,
40. Shri R. K. Saxena	,,	,,
41. Shri K. P. Srivasthava	,,	,,
42. Shri R. A. Gupta	,,	,,
43. Shri G. N. Srivasthava	S-1	,,
44. Shri Balbir Singh	,,	,,
45. Shri S. N. Mehrotra	,,	,,
46. Shri R. N. Seth	,,	,,

Name	*Designation*	*Centre/section*
47. Shri R. K. Tyagi	S-1	ALLAHABAD
48. Shri M. A. Khan	,,	,,
49. Shri S. K. Wishard	,,	,,
50. Shri Sreeprakash	,,	,,
51. Shri D. Kapoor	,,	,,
52. Shri R. K. Dwivedi	,,	,,
53. Dr. K. Chandra	,,	,,
54. Shri D. R. Kanaujia	,,	BUXAR
55. Dr. A. K. Laal	S-2	BHAGALPUR
56. Shri B. L. Pandey	S-1	,,
57. Shri S. K. Sarkar	,,	,,
58. Dr. S. P. Rai	S-2	MUZAFFARPUR
59. Shri V. R. Chitranshi	S-1	,,
60. Dr. (Smt.) S. Sivakami (upto 16-10-84)	S-2	BANGALORE
61. Shri P. K. Sukumaran	S-1	,,
63. Dr. M. Subrahmanyam	S-2	KAKINADA
64. Dr. K. J. Rao	S-1	,,
65. Shri D. N. Singh	S-2	GAUHATI
66. Shri R. K. Singh	S-1	,,
67. Shri M. Chaudhuri	,,	,,
68. Dr. K. K. Vass	S-2	SRINAGAR
69. Dr. Shyamsunder	,,	,,
70. Dr. H. S. Raina	,,	,,
71. Dr. (Smt.) Usha Moza	S-1	,,
72. Dr. C. B. Joshi	S-2	BHIMTAL
73. Mr. A. R. Choudhury	S-1	LALGOLA

ESTUARINE DIVISION AND BRACKISHWATER AQUACULTURE

Name	*Designation*	*Centre/Section*
74. Dr. B. N. Saigal	S-3, Head, Est. Div.	BARRACKPORE
75. Shri R. N. Pal	S-3	,,
76. Shri B. B. Ghosh	S-2	,,
77. Shri S. B. Saha	,,	,,
78. Dr. H. C. Joshi	,,	,,
79. Mr. A. K. Ghosh	,,	,,
80. Dr. M. K. Mukhopadhyay	,,	,,
81. Shri D. Nath	,,	,,
82. Shri M. M. Bagchi	S-1	,,
83. Shri P. Mitra	,,	,,
84. Shri D. K. De	,,	,,
85. Shri H. S. Mazumdar	,,	,,
86. Shri M. K. Das	,,	,,
87. Shri H. C. Karmakar	,,	,,
88. Shri J. P. Pal	S	,,
89. Shri G. N. Saha	S-2	CALCUTTA
90. Shri S. C. Takurta	S-1	,,
91. Shri S. C. Banerjee	,,	,,
92. Shri G. C. Laha	,,	,,
93. Shri A. C. Banerjee	,,	,,
94. Shri A. Choudhury	,,	,,
95. Dr. M. L. Bhowmick	S-2	KAKDWIP
96. Shri S. R. Das	,,	,,
97. Shri Hardial Singh	,,	,,
98. Shri R. K. Chakraborty	S-1	,,
99. Shri S. K. Mondal	,,	,,
100. Shri P. K. Ghosh	,,	,,
101. Dr. T. Rajyalakshmi	S-3	PURI
102. Mr. P. Ravichandran	S-2	,,
103. Dr. S. M. Pillai	S-1	,,
104. Shri K. Raman	S-3	MADRAS

Name	*Designation*	*Centre/section*
105. Shri K. V. Ramakrishna	S-2	,,
106. Shri A. V. P. Rao	,,	,,
107. Shri K. N. Krishnamurthy	,,	,,
108. Dr. R. D. Prasadam	,,	,,
109. Dr. L. H. Rao	,,	,,
110. Shri M. A. V. Lakshmanan	Sr. Fishery Scientist	,,
111. Dr. S. Radhakrishnan	S-1	,,
112. Shri C. P. Rangaswamy	,,	,,
113. Shri S. Srinivasagam	,,	,,
114. Shri B. P. Gupta	,,	,,
115. Smt. M. Sultana	,,	,,
116. Shri K. O. Joseph	,,	,,
117. Shri S. N. Sar	S	DIGHA

CENTRES/SECTIONS/PROJECTS DIRECTLY UNDER DIRECTOR'S OFFICE

118. Dr. P. Das	S-3	Extension Section, BARRACKPORE
119. Shri U. Bhowmick	S-2	,,
120. Shri P. K. Pandit	S-1	,,
121. Shri B. K. Banerjee	,,	,,
122. Shri D. D. Halder	S-3	Library & Doc, BARRACKPORE
123. Shri V. V. Sugunan	S-2	,,
124. Smt. G. K. Vinci	S-1	,,
125. Dr. V. K. Unnithan	,,	,,
126. Dr. M. J. Bhagat	,,	,,
127. Dr. K. L. Sehgal	S-3	Technical Cell, BARRACKPORE
128. Shri Kuldip Kumar	S-2	,,
129. Shri S. K. Mazumdar	S-1	,,

Name	*Designation*	*Centre/Section*
130. Dr. (Smt.) Krishna Mitra	S-1	Technical Cell, BARRACKPORE
131. Shri S. Paul	S-2	Economics Section, BARRACKPORE
132. Shri R. K. Das	S-2	Microbiology Lab, BARRACKPORE
133. Dr. Babulal	S-1	Radio Isotope Lab, BARRACKPORE
134. Dr. V. Pathak	S-1	,,
135. Shri A. B. Mukherjee	S-2	Engg. Sec., BARRACKPORE
136. Shri P. R. Sen	S-3	RAHARA
137. Dr. S. K. Mukhopadhyay	S-2	,,
138. Dr. R. K. Banerjee	,,	,,
139. Dr. G. N. Chattopadhyay	,,	,,
140. Shri A. K. Dutta	,,	,,
141. Shri S. K. Saha	,,	,,
142. Shri P. K. Chakraborti	S-2 (Posted at Canning)	,,
143. Shri A. C. Nandy	S-1	,,
144. Shri A. K. Roy	,,	,,
145. Shri K. R. Naskar	,,	,,
146. Shri N. M. Chakraborti	,,	,,
147. Shri A. Sengupta	,,	,,
148. Shri B. K. Sharma	S-2	ORP, KRISHNAGAR
149. Shri N. K. Das	S-1	,,
150. Dr. A. K. Mondal	S-3	KALYANI
151. Dr. N. K. Thakur	S-2	KVK/TTC, DHAULI
152. Dr. S. K. Sarkar	,,	,,
153. Shri S. L. Kar	S-1	,,
154. Dr. J. G. Chatterjee	S-2	KVK, KAKDWIP

ALL INDIA COORDINATED RESEARCH PROJECTS

(i) Ecology and Fisheries of Freshwater Reservoirs

Name	*Designation*	*Centre/Section*
155. Shri B. V. Govind	S-3 and Project Co-ordinator	NAGARJUNASAGAR
156. Shri Ch. Gopalakrishnayya	S-2	,,
157. Dr. M. Ramakrishnaiah	,,	,,
158. Shri G. K. Bhatnagar	S-2	RANCHI
159. Dr. S. N. Singh	S-1	,,
160. Dr. Y. Rama Rao	S-3	BILASPUR
161. Shri B. C. Jha	S-1	,,
162. Shri D. K. Kaushal	,,	,,
163. Shri M. D. Pisolkar	,,	,,
164. Shri V. K. Sharma	,,	,,
165. Dr. V. R. Desai	S-2	RIHAND
166. Dr. V. Kolekar	S-1	,,
167. Dr. N. P. Srivasthava	,,	,,
168. Shri C. Selvaraj	S-2	POLLACHI
169. Dr. Mathew Abraham	,,	,,
170. Dr. M. Kaliamurthy	,,	,,
171. Shri P. K. Aravindakshan	,,	,,
172. Shri K. Gopinathan	S-1	,,

(ii) Brackishwater Fish Farming

173. Shri Apurba Ghosh	S-3 and Project Coordinator	BARRACKPORE
174. Dr. K. M. Das	S-2	,,
175. Dr. Amitabha Ghosh	S-1	,,
176. Shri A. Hajra	,,	,,

(iii) **Composite Fish culture and Fish Seed Production**

Name	*Designation*	*Centre/Section*
177. Shri S. D. Tripathi	S-3 (Per Gr.) and Project Corodinator	FARTC, Dhauli
178. Dr. K. G. Rao	S-1	,,
179. Dr. M. Sinha	S-2	KALYANI
180. Shri D. P. Chakraborty	,,	,,
181. Shri D. N. Mishta	S-1	JAUNPUR
182. Shri P. N. Jaitly	,,	,,
183. Shri P. L. N. Rao	S-2	PUNE
184. Shri B. K. Singh	S-1	,,
185. Shri K. L. Shah	S-2	KARNAL
186. Shri B. C. Tyagi	,,	,,
187. Shri R. M. Rao	S-2	BADAMPUDI
188. Shri J. B. Rao	S-1	,,
189. Shri A. Mukherjee	S-1	RANCHI
(iv) Air-breathing fish culture		
190. Dr. M. Y. Kamal	S-3 and Project Coordinator	BARRACKPORE
191. Dr. P. K. Mukhopadhyay	S-2	,,
192. Shri V. K. Murugesan	,,	PATNA
193. Shri Dhirendra Kumar	,,	,,
194. Dr. S. P. Ayyar	S-2	BANGALORE
195. Shri P. Kumaraiah	,,	,,
196. Shri S. K. Munnet	S-1	GAUHATI
197. Shri K. M. Rao	S-2 (on deputation to ICAR)	
198. Shri D. V. Pahwa	S-1 (,,)	
199. Shri C. Saha	S-1 (on study leave)	

B. The following members of **staff (Technical)** rendered their services during the year :

Name	*Grade*	*Designation*
Shri N. K. Tripathi	T-7	Liaison Officer.
Shri N. C. Basu	,,	Sr. Training Asst.
Shri J. P. Verma	T-6	,,
Shri B. B. Satpathy	,,	,,
Shri A. K. Chattopadhyay	,,	,,
Shri P. N. Bhattacharjee	T-5	Overseer
Shri B. R. Dutta	,,	Demonstrator
Shri Kuldeep Kumar	,,	,,
Shri Radheshyam	,,	,,
Shri J. Ghosh	,,	Senior Artist
Smt. Anjali De	,,	Asst. Librarian
Shri S. K. Das	,,	Artist
Shri S. L. Raghvan	,,	Technical Asst.
Shri C. Sahoo	,,	Estimator
Shri R. C. Singh	,,	Technical Asst.
Shri T. S. R. Raju	,,	,,
Shri B. K. Saha	,,	,,
Shri G. Pathak	,,	,,
Shri M. D. Mantri	,,	Draftsman
Shri P. K. Ghosh	,,	Photographic Asst.
Dr. N. Sarangi	T-4	Demonstrator
Shri A. R. Mazumder	,,	Artist Photographer
Smt. Sukla Das	,,	Sr. Library Asst.
Shri P. B. Das	,,	Technical Asst.
Shri K. S. Rao	,,	,,
Shri R. N. De	,,	,,
Shri D. R. Rao	,,	,,
Shri N. K. Srivasthava	,,	,,
Smt. Lekha Sanfui	,,	Training Associate
Smt. Mira Sen	,,	,,
Shri S. K. Sadhukhan	,,	,,
Shri P. M. Abdul Kadir	T-II-3	Technical Asst.
Shri M. F. Rahman	,,	,,

Name	*Grade*	*Designation*
Shri K. S. Banerjee	T-II-3	Technical Asst.
Shri S. P. Ghosh	,,	,,
Shri N. C. Mondal	,,	,,
Shri Aloke Sarkar	,,	,,
Shri H. K. Sen	,,	,,
Shri P. S. C. Bose	,,	,,
Shri Bhaskar Ghosh	,,	,,
Shri N. D. Sarkar	,,	,,
Shri K. K. Agarwal	,,	,,
Shri N. N. Sarkar	,,	,,
Shri A. K. Ekka	,,	,,
Shri N. N. Mazumdar	,,	,,
Shri A. R. Paul	,,	,,
Shri B. D. Saroj	,,	,,
Shri G. P. Bhattacharjee	,,	,,
Shri Ram Chandra	,,	,,
Shri A. K. Roy	,,	,,
Shri D. N. Srivastava	,,	,,
Shri D. P. Verma	T-I-3	Technical Asst.
Shri G. C. Sahoo	,,	,,
Shri A. N. Mohanty	,,	,,
Shri P. Dasgupta	,,	Artist
Shri B. N. Sudhukan	,,	Electrician
Shri R. C. Satpathy	,,	Mechanic
Shri Donald Singh	T-I-3	Mechanic
Shri N. Guin	,,	Electrician
Shri S. C. Bhowmick	,,	Sr. Gestetner Operator
Shri M. M. Das	,,	Sr. Binder
Shri Ranjit Singh	,,	Driver
Shri B. B. Seth	,,	,,
Shri K. L. Das	,,	,,
Shri N. C. Roy	,,	Pumpman
Shri N. P. Saha	,,	Sample Sorter
Shri S. Krishnan	T-2	Technical Asst.
Shri R. K. Langer	,,	,,

Name	*Grade*	*Designation*
Shri D. Sanfui	T-2	Technical Asst.
Shri S. C. Mondal	,,	,,
Shri B. B. Roy	,,	,,
Shri A. N. Mohanty	,,	,,
Shri Ramji Tiwari	,,	,,
Shri B. B. Das	,,	
Shri Sukumar Saha	,,	,,
Shri K. P. Singh	,,	,,
Shri Camil Lakra	,,	,,
Shri J. P. Mishra	,,	,,
Shri M. P. Singh	,,	,,
Shri S. K. Chatterjee	,,	,,
Shri K. C. Pani	,,	,,
Shri Surja Bhadur	T-2	Driver
Shri N. C. Biswas	,,	,,
Shri U. K. Chatterjee	,,	,,
Shri K. R. Deb	,,	,,
Shri K. K. Dutta	,,	,,
Shri Badal Lal Singh	,,	,,
Shri R. S. Neogi	,,	,,
Shri J. C. Saha	,,	,,
Shri R. N. Singh	,,	,,
Shri A. K. Mazumdar	,,	,,
Shri M. G. Subramani	,,	,,
Shri T. P. Ghosh	,,	,,
Shri S. C. Das	,,	,,
Shri T. M. Roy	,,	,,
Shri D. Tarai	,,	,,
Shri R. L. Balmiki	,,	,,
Shri Kishen Deo	,,	,,
Shri Harihar Das	,,	,,
Shri P. Lal	,,	,,
Shri B. B. Roy	,,	,,
Shri B. Kahali	,,	,,
Shri C. R. Das	,,	Pump Man

Name	*Grade*	*Designation*
Shri R. K. Haldar	T-2	Dark Room Asstt.
Shri R. D. Saha	,,	Sample Sorter
Shri Bahilal	,,	Field Asstt.
Shri S. K. Deb	T-1	Driver
Shri K. Ganeshan	,,	Driver
Shri M. C. Pal	,,	,,
Shri D. Borgoyary	,,	,,
Shri Ch. S. Rao	,,	,,
Shri C. K. Nath	,,	,,
Shri B. K. Bahura	,,	,,
Shri R. Tarai	,,	,,
Shri U. N. Jally	,,	Mike Operator
Shri M. C. Pal	,,	Laboratory and Field Asstt.
Shri Aloke Kumar Jain	,,	,,
Shri A. K. Banerjee	,,	Sample Sorter
Shri S. C. Moitra	,,	,,
Shri S. K. Gupta	,,	,,
Shri K. P. Saha	,,	,,
Shri S. K. Biswas	,,	Carpenter

C The following members of **Staff (Administrative)** 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. Bajani
Shri P. C. Kanungo

Superintendent

Shri A. K. Das
Shri A. K. Sengupta
Shri M. R. Roy
Shri S. C. Saha
Shri B. C. Dutta

Assistant

Bhattacharjee, B. C.
Bose, S. K.
Das, T. P.
Dasgupta, S.
Mazumder, Sahdhya
Roy, Bani
Baidya, N. H.
Das, C. C.
Choudhury, Namita
Halim, Abdul
Roy, S. C.
Sarkar, A. C.
Sarkar, N. K.
Shastry, S. P.
Zaidi, F. A.
Mahesh Prasad
Awedh, Saha
Neogi, M. M.
Banerjee, D. K.
Bose D. C.

Senior Stenographer

Lahiri, G.

Stenographer

Banerjee, A. K.
Chakladar, J.
Chakraborty, G. M.
Ghosh, U. K.
Sinha, R. C. P.
Srivastava, R. C.

Junior Stenographer

Bhattacherjee, S.
Chatterjee, T.
Jena, P.
Prasad, P.
Roy, T. K.
Saha, A. K.
Sahu, D. C.

Senior Clerk

Baidya, D. N.
Banerjee, J. N.
Bhowmick, S.
Das, Moloy Kr.
Dey Sarkar, D. K.
Ghosh, B. K.
Halder, S. R.
Kar, S. K.
Kodandarman, I. N.
Majumdar, Biplab

Senior Clerk

Majumdar, T. K.
Mishra, L. P.
Mitra, N. K.
Mukherjee, B. B.
Sutur, H. B.
Mukherjee, R. R.
Nath, H. K.
Patra, J. C.
Pramanick, S. K.
Pramanick, S. N.
Prasad, Keshav
Rai, Jagdish
Sarkar, H. L.
Sarkar, S. K.
Singh, Kallu
Singh, R. C. P.
Sinha, S. S.
Sreedharan, T. K.
Subrahmanian, M.

Junior Clerk

Balmiki, B. P.
Banerjee, Narayani
Banerjee, Mrinalini
Behari, A. C.
Behari, Kunj
Behari, R. C
Behari, Purnachandra
Chakraborty, Amita
Biswas, Manjulal
Biswas, P. K.
Bose, Samir Kumar
Chatterjee, Dipankar
Chowdhury, Debesh
Das, G. B.
Dutta, P. K.
Ghosh, Smar Kumar
Ghosh, R. K.
Kachhap, M.
Kundu, N. R.
Kumar Surendra
Lal Ambika
Lahiri, P.
Mandal, Bulbul
Mahato, R. N.
Rao, K. S.
Rao, G. S.
Ratna, R. L.
Ray, P. K.
Chhotey Lal
Das, B. K.
Das, Jayashree
Ghosh, P. K.
Bhagirathi, S.
Biswas, A.B.
Behari, R. C.
Manju, K.
Mondal, S. P.
Majumdar, Anita
Mondal, A. B.
Maranappan, S. K.
Murthy, P. B. V. S.
Mazumder, Sikha
Neogi, Anjali
Mupid, B. S.
Nath, Kalipada
Naik, N. C.
Nath, Baij
Panda, R. K.
Rao, G. S.
Roy, J.
Roy, Samir Kumar
Srivastava, A. K.
Shan Biswanath
Sadaverte, N.
Tikadar, S. K.

Supporting Grade-IV

Behera, B. N.
Bhuyan, U.
Biswas, D. N.
Biswas, J. N.
Bose, J. L.
Burman, G. N.
Chakraborty, K. L.
Dalai, B.
Das, C.
Das, P. N. V.
Das, K. P.
Dey, S. K.
Dosad, R. B.
Gangaram
Jally, H.
Jana, K. C.
Mewalal
Naik, K.
Prasad, K.
Ramdeo
Sahoo, D.
Samal, B.
Samood Mahij, B.
Samood Majhi, B.
Singh, D.

Supporting Grade-III

Adhikari, A.
Apparao, B.
Bahadur, Nar
Bahadur, Durga
Barik, N.
Barik, Dijia
Barik, S.
Balmiki, Sitaram
Burman, M. S.
Burman, S. N.
Behera, K. C.
Behara, Alekha
Behera, Trailokya
Behera, N.
Bhoi, D.
Bhuloka, D.
Bhuyan, N.
Biswas, T. K.
Kotaiah, S.
Lal, Madan
Patnaik, S. R.
Prakash, B.
Das, Antiram
Das, K. K.
Bose, N. R.
Chakraborty, S. K.
Das, S. K.
Das, Mosa
Das, H. K.
Balmiki, S. C.
Baldevsing, D. N.
Bakshiram
Behera, K. B.
Mishra, P.
Mondal, A. K.
Munda, Budhram
Mohanty, N. N.
Naik, B.
Naik, D.
Panda, Lakshmidhar
Pandey, C. K.
Patra, A. M.
Paramanik .H. K.
Gopal, K.
Iruthiraj, M.
Jally, Khetrabasi
Jana, Natabar

Supporting Grade-III

Jally, Aghur
Raha, R. N.
Raikwar, Ramlal
Routh, H. K.
Rao, Ch. Ganeswar
Singh, C.
Kujur, J. M.
Lajuram
Shyamlal, B. R.
Singh, Meher
Shyamal, H. K.
Saho, D.
Saha, N. K.
Sethi, P. C.
Varghese, P. V.

Supporting Grade-II

Appanna, K.
Bahadur, Bhim
Bahadur, Surja
Bahadur, Tek
Bahadur, R.
Balmiki, Khem Chand
Bahadur, Sitaram
Boral, S. K.
Bhoi, Shyama
Barik, D.
Bhanja, B.
Burman, S. N.
Behera, Khalia
Burman, Niranjan Kr.
Burman, Sudhangshu
Behera, M.
Behera, K. B.
Bhoi, R. C.
Bhania, D.
Burman, S. K.
Behera, Keshab
Balaraman, M.
Burman, H. S.
Burman, Sudhangshu
Balmiki, Kattore
Bhava, C. K.
Lal, Bideshi
Maity, S. S.
Balmiki, Krishanlal
Biswas, Jagdish
Biswas, S. C.
Biswas, Hiralal
Bose, Jiralal
Biswas, Manindranath
Biswas, Ashoke Kr.
Burman, M. K.
Biswas, A. K.
Bhuyan, Dhirendra
Behera, Rajkishore
Bhaskar Bhoi
Chakraborty, Sarabandu
Chaki, S. N.
Das, P. C.
Das, B. S.
Das, Sitaram
Das, Janhtu Ranjan
Das, Giridhari
Das, Nikunjalal
Das, Dhaneswar
Das, Ranjan
Das, Kabir
Dhanuk, Shyamlal
Dehuri, Basudeb
Jangli
Jena, N. C.
Jadav, S. P.
Jally, L.
Jana, Bibhuti Kr.

Supporting Grade-II

Kishore, Jugal
Kaliannan, K.
Krishnan, M. V.
Hazarika, B.
Sayalu, P.
Somulu, L.
Swain, Raghunath
Sahoo, Lakshmidhar
Sakuntala, B.
Mondal, Gokul Chandra
Mondal, S. Balchandra
Manna, L. C.
Mondal, Biswanath
Maniekyam, P.
Mondal, Niranja Kr.
Malleh, Jai Nandnan
Mondal, Biswanath
Narendra, G. C.
Narasappa, B.
Parbat, L.K.
Pradhan, B.
Panda, Jagdish
Parida, Sridar
Parida Fakir
Das, Gunadhar
Tair, R. N.
Parameshwar
Ramalingam, M.
Ram, Japhu
Ram, Munshi
Raju, Kolludharma
Raju, A. Eswar
Singh, S. S.
Sahu, D. N.
Sahoo, D. N.
Singh, Ramdeo
Sahoo, G.
Singh, C. P.
Srinivasan, V. K.
Sundar, Ram
Saha, P. C.
Singh, P.
Shaw, Gulab
Sahoo, K. M.
Yadav, A. L.

Supporting Grade-I

Anjanappa, M.
Ali, Mansur
Arumugam, P.
Dhan, Maya
Dutta, Anjali Rani
Debroy, R. L.
Ali, S. K. Munsur
Bain, G. C.
Behera, Chhakei
Bahadur, Karna
Bahadur, Indra
Bahadur, Asta
Bahadur, Mina Rani
Bose Sankar
Bairagi, Suklal
Bijali, Amalya
Bhattacherjee, Ashutosh
Behera, Debahari
Biswas, Sukchand
Biswas, A.
Bez. P. C.
Choudhury, Panchulal
Bind, M. P.
Bahadur, Lal
Bahadur, Man
Bhoi, M. S.
Bhoi, R. K.
Burman, Shatendra

Supporting Grade-I

Bendra, S. S.
Balmiki, Jagadish
Behera, Dhanu
Buhiya, N.
Boro, Bhabalu
Betal, Sasidhar
Barik, Basanta Kr.
Behera, Mukunda Charan
Bhoi, Bijaya
Balmiki, Iswar Ram
Krishnapada, B. N.
Joseph, K.
Khatua, Jadumani
Kumar, Kharban
Karuppanna, P.
Kemparas, P.
Dhir, K. K.
Dhibar, Gunadhar
Das, Mukti
Das, B. C.
Dukram
Das, B. C.
Das, Rash Bihari
Das, Nayaram
Das, Sudhakar
Das, Parusuram
Ghosh, A. C.
Ghosh, Pusupati
Gowda, Malige
Ghume, T. H.
Choudhsi, Umesh
Chatterjee, Rupali
Gangayya, A.
Govata, S. T.
Gharami, Phani
Govindalal
Halder, L. K.
Halder, Sital Chandra
Halder, Hemlata
Halder, Satyendra Nath
Jally Burman
Jena, Gourhari
Jena, Panchanan
Jena, N.
Jelly, Kedar Chandra
Joseph, K.
Karmakar, Sarbananda
Kachari, P. C.
Pugalendhi, B.
Paik, B. C.
Prasad, Laita
Palaniswamy, R.
Pramanik, G. C.
Prasad, Ram
Kemparas, A.
Khan, Rahmat
Lakshmi, Ram
Mondal, Bholanath
Mani, N.
Mondal, Kalashashi
Mahadeva, M.
Mondal, Godhli
Mallah, Munilal
Muchi, R. U.
Mollick, G. C.
Mani, K.
Mukhia, J.
Mallah, Rajdhari
Murugesen, A.
Mariappan, V.
Mahalick, Antaryami
Mondal, Kalipada
Mohd., Yusuf Dar
Mondal, Sachindra
Naik, G. C.
Naik, Krishna Ch.
Ningegowada, K.
Naik, Sudarsan

Supporting Grade-I

Nayak, P. K.
Nayak, Sripati
Omprakash
Subramani
Samal, Krishna Chandra
Seshanna
Sahni, Aghanu
Subramaniam, K.
Singh, C. P.
Samanta, Pr. Sekhar
Singh, Kuldeep
Swain, Ramesh Chandra
Shree, Nath
Yasish, R.
Paria, J.
Parida, Satyananda
Paramanik, P. C.
Prasad, Shitala
Parida, Y.
Parida, Golekha
Palai, Duryodhan
Parida, Judhistir
Patnaik, B.
Rao, G. Santa
Ram, Rajendra
Rajendran, R.
Ramaswamy, A.
Roy, Pradupta Kishore
Raj, Karam
Ram, Paras
Runadala, G. J.
Rao, Medisethi Chandra
Ram, Kawal Pati
Rao, P. Nageswar
Saha, Mohan Lal
Saha, Manoranjan
Sethi, P. K.
Samanta, Narayan Ch.
Sita
Maha, Singh
Saha, P .C.
Subbaiyan, K.
Sahni, Aghanu
Satyanarayana
Subramani, M.
Swain, Jatadhari
Swain, Pitamber
Samal, Chaitanya Charan
Swain, Ranjan
Mahendran, S.

PROMOTIONS

The following personnel were promoted to the higher grades as shown below during 1984 :

Name	*Designation/ Grade*	*Promoted to*	*w.e.f.*	*No. of advance increment*	*w.e.f.*
1. Dr. K. L. Sehgal	,,	,,	,,	—	—
2. Dr. B. N. Saigal	S-2	S-3	1-7-82	—	—
3. Dr. T. Ramaprabhu	,,	,,	,,	—	—
4. Dr. Y. Rama Rao	,,	,,	,,	—	—
5. Shri R. N. Pal	,,	,,	,,	—	—

	Name	*Designation/ Grade*	*Promoted to*	*w.e.f.*	*No. of advance increment*	*w.e.f.*
6.	Shri M. Ranadhir	,,	,,	,,	—	—
7.	Shri P. R. Sen	,,	,,	,,	—	—
8.	Shri N. G. S. Rao	,,	,,	,,	—	—
9.	Shri B. V. Govind	,,	,,	1-1-83	Two	1-7-82
10.	Shri K. P. Srivastava	S-1	S-2	1-7-81	—	—
11.	Smt. K. K. Bhanot	,,	,,	1-7-82	—	—
12.	Shri V. V. Sugunan	,,	,,	,,	—	—
13.	Shri R. K. Saxena	,,	,,	,,	—	—
14.	Dr. Shyamsunder	,,	,,	,,	—	—
15.	Dr. Harbhajan Singh	,,	,,	,,	—	—
16.	Dr. L. H. Rao	,,	,,	,,	—	—
17.	Shri P. Kumaraiah	,,	,,	,,	—	—
18.	Shri K. V. Rao	,,	,,	,,	—	—
19.	Shri P. L. N. Rao	,,	,,	,,	—	—
20.	Shri M. Ramakrishnaiah	,,	,,	,,	—	—
21.	Dr. V. K. Murugesan	,,	,,	,,	—	—
22.	Shri A. K. Datta	,,	,,	,,	—	—
23.	Dr. S. P. Rai	,,	,,	,,	—	—
24.	Dr. R. K. Banerjee	,,	,,	,,	—	—
25.	Dr. M. K. Mukhopadhyay	,,	,,	,,	—	—
26.	Shri D. N. Singh	,,	,,	,,	—	—
27.	Shri Kuldip Kumar	,,	,,	,,	—	—
28.	Shri U. Bhoumik	,,	,,	,,	—	—
29.	Dr. K. M. Das	,,	,,	,,	—	—
30.	Dr. A. K. Laal	,,	,,	,,	—	—
31.	Dr. S. Sivakami	,,	,,	,,	—	—
32.	Shri Hardial Singh	,,	,,	,,	—	—
33.	Shri Y. S. Yadava	,,	,,	,,	—	—
34.	Dr. K. J. Ram	,,	,,	,,	—	—
35.	Shri C. B. Joshi	,,	,,	,,	—	—
36.	Dr. S. Radhakrishnan	,,	,,	,	—	—
37.	Shri P. Ravichandran	,,	,,	,,	—	—
38.	Shri S. R. Das	,,	,,	,,	—	—
39.	Shri S. R. Ghosh	,,	,,	,,	—	—
40.	Shri D. Nath	,,	,,	,,	—	—

	Name	Designatton Gradd	Promoted to	w.e.f.	No. of advance increment	w.e.f.
41.	Dr. H. C. Joshi	S-1	S-2	1-1-83	Three	1-7-82
42.	Shri R. A. Gupta	,,	,,	,,	Two	,,
43.	Shri S. K. Saha	,,	,,	,,	,,	,,
44.	Shri S. D. Gupta	,,	,,	,,	Three	,,
45.	Shri D. P. Chakraborty	,,	,,	,,	Two	,,
46.	Shri Dilip Kumar	,,	,,	,,	Three	,,
47.	Dr. Mathew Abraham	,,	,,	,,	,,	,,
48.	Dr. M. Kaliamurthy	,,	,,	,,	,,	,,
49.	Shri Dhirendra Kumar	,,	,,	,,	,,	,,
50.	Shri P. K. Chakraborty	,,	,,	,,	—	—
51.	Shri B. C. Tyagi	,,	,,	1-7-83	Three	,,
52.	Shri P. K. Aravindakshan	,,	,,	,,	Two	,,
53.	Shri S. Paul	,,	,,	,,	—	—
54.	Shri P. N. Jaitly	S	S-1	1-7-81	—	—
55.	Shri M. D. Mantri	T-4	T-5	1-7-84	—	—
56.	Shri C. D. Sahoo	,,	,,	,,	—	—
57.	Shri P. K. Ghosh	,,	,,	,,	—	—
58.	Shri S. K. Sas	,,	,,	,,	—	—
59.	Shri N. C. Guin	T-2	T-1-3	,,	—	—
60.	Shri N. P. Saha	,,	,,	,,	—	—
61.	Shri S. R. Gupta	,,	,,	,,	—	—
62.	Shri K. L. Das	,,	,,	,,	—	—
63.	Shri N. C. Roy	,,	,,	,,	—	—
64.	Shri B. Kahali	T-1	T-2	1-1-84	—	—
65.	Shri R. D. Saha	,,	,,	,,	—	—
66.	Shri S. K. Deb	,,	,,	,,	—	—
67.	Shri B. B. Roy	,,	,,	,,	—	—
68.	Shri Bhailal	,,	,,	,,	—	—

The following scientists were given advance increments as shown below :—

Name	*Designation*	*No. of increments*	
		w.e.f. 1-7-82	*w.e.f.* 1-1-83
Shri K. K. Sukumaran	S-2	Three	—
Dr. S. P. Ayyar	,,	Two	Three
Shri G. N. Saha	,,	Two	—
Shri S. Patnaik	,,	Two	—
Dr. G. N. Mukherjee	,,	One	Two
Shri H. A. Khan	,,	One	Two
Dr. M. Subrahmanyam	,,	One	Two
Shri Ch. Gopalakrishnayya	,,	One	Two
Shri G. K. Bhatnagar	,,	—	Two
Dr. M. Y. Kamal	,,	—	Two
Shri Ravish Chandra	,,	One	—
Shri D. V. Pahwa	,,	One	—
Shri K. K. Ghosh	,,	One	—
Dr. K. V. Ramakrishna	,,	—	One
Dr. R. S. Panwar	,,	—	One
Shri S. N. Mehrotra	S-1	Three	—
Shri R. K. Chakraborty	,,	Three	—
Shri M. M. Bagchi	,,	Three	—
Shri Balbir Singh	,,	Three	—
Smt. G. K. Vinci	,,	Two	Three
Shri P. M. Mitra	,,	Two	Three
Shri K. Gopinathan	,,	Two	—
Shri S. C. Thakurta	,,	Two	—
Shri M. K. Das	,,	Two	—
Shri J. B. Rao	,,	Two	—
Shri B. K. Mishra	,,	Two	—
Shri R. C. Das	,,	Two	—
Shri S. N. Mohanty	,,	Two	—
Shri D. N. Mishra	,,	Two	—
Dr. S. M. Pillai	,,	Two	—
Shri B. Roy	,,	Two	—
Shri C. P. Rangaswamy	,,	Two	—

Name	*Designation*	*No. of increments*	
		w.e.f. 1-7-82	*w.e.f.* 1-1-83
Shri K. J. Rao	S-1	Two	—
Dr. M. A. Khan	,,	Two	—
Dr. B. P. Gupta	,,	One	Two
Shri S. Srinivasagam	,,	One	Two
Shri B. C. Jha	,,	One	—
Shri A. K. Sahu	,,	One	—
Shri V. R. Chitranshi	,,	One	—
Shri G. N. Srivastava	,,	One	—
Smt. Munawar Sultana	,,	One	Two (1-7-83)

TRANSFERS

The undermentioned transfers were effected during the year :

Name	*Designation*	*From*	*To*
Shri D. D. Halder	S-3	Kakdwip	Barrackpore
Shri P. R. Sen	S-3	Barrackpore	Rahara
Shri G. V. Kowtal	S-2	Puri	Dhauli
Shri K. K. Bhanot	S-2	Barrackpore	Dhauli
Smt. K. K. Bhanot	S-2	Bararckpore	Dhauli
Dr. L. H. Rao	S-2	Kakinada	Madras
Shri C. Selvaraj	S-2	KVK/TTC Dhauli	Pollachi
Dr. G. R. M. Rao	S-2	Madras	Dhauli
Dr. K. J. Ram	S-2	Kakinada	Dhauli
Shri V. K. Murugesan	S-2	Bangalore	Patna
Shri D. N. Singh	S-2	Allahabad	Gauhati
Shri M. Kaliyamurthy	S-2	Bhavanisagar	Pollachi
Shri K. Gopinathan	S-1	Madras	Pollachi
Dr. B. N. Singh	S-2	KVK/TTC Dhauli	FARTC, Dhauli
Shri P. K. Aravindakshan	S-2	Bhavanisagar	Pollachi
Dr. K. J. Rao	S-1	Tadepalligudem	Kakinada
Shri N. C. Basu	T-7	Kakdwip	Barrackpore (1983)

Nome	*Designation*	*From*	*To*
Shri N. K. Das	S-1	Kakdwip	Krishnanagar
Shri M. K. Das	S-1	Krishnanagar	Barrackpore
Shri D. R. Kanuajia	S-1	Muzaffarpur	Buxar
Dr. Sreeprakahs	S-1	Buxar	Allahabad
Shri P. K. Saha	S-1	Rahara	Dhauli
Shri S. Ayyappan	S-1	Bangalore	Dhauli
Dr. B. P. Gupta	S-1	Ranchi	Madras
Shri D. Kapoor	S-1	Muzaffarpur	Allahabad
Shri B. D. Saroj	T-1-3	Allahabad	Buxar
Shri G. Pathak	T-5	Barrackpore	Rahara
Shri R. C. P. Sinha	Stenographer	Barrackpore	Allahabad
Shri K. P. Nath	Stenographer	Barrackpore	Kakdwip
Shri G. M. Chakraborty	Stenographer	Barrackpore	Kalyani
Shri G. B. Das	Sr. Clerk	Kakdwip	Kalyani
Shri T. K. Sridharan	Sr. Clerk	Bhavanisagar	Pollachi
Shri B. Balmiki	Jr. Clerk	Dhauli	Kakdwip
Shri G. S. Rao	Jr. Clerk	Muzaffarpur	Badampudi
Shri Mahasingh	Gr. I	Karnal	Allahabad
Shri Lakhmi Ram	Gr. I	Karnal	Muzaffarpur
Shri Chattar Singh	Gr. II	Muzaffarpur	Karnal
Shri B. Pugalendi	Lasker	Bhavanisagar	Pollachi
Shri S. S. Burman	Fisherman	Bakkhali	Lalgola
Shri V. Mariappan	Fisherman	Bhavanisagar	Pollachi
Shri A. Murugesan	,,	,,	,,
Shri S. K. Venkatachalam	,,	,,	,,
Shri A. Ramaswamy	,,	,,	,,
Shri S. Mahendran	Watchman	Bhavanisagar	Pollachi
Shri R. Palaniswamy	,,	,,	,,
Dr. S. Sivakami	S-2	CIFRI	CMFRI, Cochin.
Shri M. P. Singh Kohli	S-2	CIFRI	CARI, Port Blair

APPOINTMENTS

The following new appointments were made during 1984.

Name	*Designation/Grade*	*Place of posting*	*w. e. f.*
Shri P. K. Ray	Jr. Clerk	Puri	12-6-84
Shri R. Bahadur	Watchman	Rahara	6-8-84
Shri Ranjan Das	Fisherman	,,	,,
Shri Rabin Das	Watchman	,,	,,
Shri N. Adhikari	,,	,,	20-12-84
Smt. B. Sakuntala	Messenger	,,	6-8-84

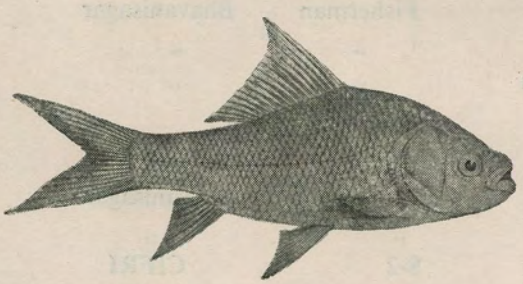
RETIREMENT

Shri R. D. Chakraborty, S-3 took voluntary retirement from the Council's service w. e. f. 27-7-84.

RESIGNATIONS

The resignations tendered by the following staff of CIFRI were accepted during the year.

Name	*Designation*	*Name*	*Designation*
Dr. P. U. Varghese	S-1	Shri S. K. Ghosh	Jr. Clerk
Shri R. K. Langer	T-1-3	Miss Anjali K. Bhagali	Jr. Clerk
Shri Amar Kumar Das	Training Asst.	Shri R. N. Mahato	Jr. Clerk



APPENDIX II

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE (ICAR) : BARRACKPORE : WEST BENGAL

Address List of Research/Survey Centres

(*As in December* 1984)

Research/Survey Centre	*Telegram/ Telephone*
1. **Central Inland Fisheries Research Institute,** Barrackpore-743 101, West Bengal.	Fishearch 53-161
2. (a) **Allahabad Research Centre,** Central Inland Fisheries Research Institute, 24, Pannalal Road, Allahabad-211 002, U.P.	Fishesearch Allahabad-2 52-245
(b) **National Bureau of Fish Genetic Resources (ICAR),** B-209, Mehdauri Colony, Taliyargang, Allahabad-211 002 (U.P,)	Fishbureau Allahabad-2
3. **Badampudi Centre of AICRP on Composite Fish Culture,** Central Inland Fisheries Research Institute, Badampudi Fish Farm, P.O. Badampudi, Tadepalligudem Taluq, West Godavari Dist,, A.P. Pin-534 412	
4. **Bakkhali Research Centre,** Central Inland Fisheries Research Institute, Bakkhali, 24 Parganas Dist., West Bengal,	
5. **Bangalore Research Centre,** Central Inland Fisheries Research Institute. No. 51, 8th Cross Road, 7th Main, Malleswaram, Bangalore-560003 (Karnataka).	Fishearch Bangalore-3 36 6610
6. **Bagalpur Research Centre,** Central Inland Fisheries Research Institute, Khanjarpur, Beatson Road, Bhagalpure-812 001 (Bihar).	1385
7. **Bhavanisagar Centre of All India Co-ordinated Project on Composite Fish Culture, (CIFRI)** P.O. Bhavanisagar, (Via) Erode, Pin-638 451, Tamil Nadu. (Closed on 3-11-84)	
8. **Bilaspur Centre of AICRP on Reservoir Fisheries,** (CIFRI), Roara Sector, Bilaspur-174 001 (Himachal Pradesh).	
9. **Buxar Research Centre,** Central Inland Fisheries Research Inst., 1/644, Sidhanathghat, Buxar-802 101, Bihar.	

APPENDIX—I

Ministry/Department/Office of 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, 1985.

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		61	5	8%	—	—	
	Total							
	Temporary							
(i)	Other than lowest rung of Cl.I			—	—	—	—	
(ii)	Lowest rung of Cl.I		35	3	9%	—	—	
Gr.B (Cl.II)		Permanent	20	2	10%	1	5%	
		Temporary	5	4	125%	1	20%	
Gr.C (Cl.III)		Permanent	200	36	18%	4	2%	
		Temporary	72	13	18.6%	7	10%	
Gr.D (Cl IV)		Permanent	299	50	15%	10	3%	
excluding sweepers		Temporary	123	46	39%	3	3%	
Gr.D (Cl.IV)		Permanent	16	13	81%	—	—	
Sweepers		Temporary	2	1	50%	1	50%	

10. **Calcutta Research Centre,**
Central Inland Fisheries Res. Inst.
39, Rabindra Sarani,
(3rd Floor), Calcutta-700 073,
West Bengal.

11. **Paddy-cum-fish Culture Unit**
Central Inland Fisheries
Research Institute,
CRRI Campus, Cuttack,
Orissa.

12. **Digha Survey Centre,**
Central Inland Fisheries Research
Institute,
Digha, Midnapur Dist.
West Bengal.

13. **Freshwater Aquaculture Reserch and Training Centre,** Aquaculture Bhubaneswar 53084
Central Inland Fisheries
Research Institute, Dhauli,
P.O. Kauslayagang,
(Via) Bhubaneswar-751 002
Orissa.

14. **Gauhati Research Centre,** 23831
Central Inland Fisheries
Research Institute,
Natun Sarania, Gauhati-781 003,
Assam.

15. **Jaunpur Research Centre of AICRP on Composite Fish Culture,** CIFRI
House No. 334, Husainabad,
Near Collectorate,
Jaunpur-222 002,
Uttar Pradesh.

16. **Kakdwip Research Centre,** Fishsearch Kakdwip 72
Central Inland Fisheries
Research Institute
Kakdwip-743 347, 24 Parganas,
West Bengal.

17. **Kakinada Research Centre,**
Central Inland Fisheries
Research Institute,
16-23-1, Sambamurthi Nagar,
Kakinada-533 001, (A.P.)

18. **Kalyani Research Centre,**
Central Inland Fisheries
Research Institute,
B/11/226, Central Avenue,
East Kalyani, Nadia (W.B.).

19. **Karnal Centre of AICRP on Composite Fish Culture**, CIFRI, 3382
Govt. Fish Seed Farm,
P.O. Saidapura (CSSRI),
Karnal-132 001, Haryana.

20. **Krishnagar Operational Research Centre,**
Central Inland Fisheries
Research Institute,
Anjana Fish Farm, Shaktinagar,
Krishnagar-741 102,
Dist. Nadia, West Bengal

21. **Krishi Vigyan Kendra,**
Central Inland Fisheries
Research Institute,
P.O. Kakdwip-743 347
Dist. 24 Parganas, West Bengal.

22. **Krishi Vigyan Kendra TTC (Matsya),**
Central Inland Fisheries
Research Institute,
P.O. Kausalyagang,
(Via) Bhubaneswar-751 002
Orissa.

23. **Lalgola Survey Centre,**
Central Inland Fisheries
Research Institute,
Lalgola, Dist. Murshidabad,
West Bengal, Pin-741 148.

24. **Madras Research Centre,** Ulnadmeen
Central Inland Fisheries
Research Institute, Madras
1, Karaneeswarar Koil Street,
(Near All India Radio)
Mylapore, Madras-600 004.

25. **Muzaffarpur Research Centre,**
Central Inland Fisheries
Research Institute,
House No. 113, Ward No. 27,
Damnchak, Muzaffarpur-842 001,
Bihar.

26. **Nagarjunasagar Centre of** 2617
AICRP on Reservoir
Fisheries (CIFRI)
P.O. Vijayapuri South,
Nagarjunasagar Dam,
Andhra Pradesh, Pin-522 439.

27. **Patna Centre of AICRP on** 26285
Air-breathing Fish Culture,
(CIFRI),
Mithapur Fish Farm,
Patna-800 001, Bihar.

28. **Pollachi Centre of AICRP on**
Reservoir Fisheries, (CIFRI)
10, Chakrapani Iyer Street,
Venketeswara Colony,
Pollachi-642 001 (Tamil Nadu).

29. **Port Canning Survey Centre,**
Central Inland Fisheries
Research Institute,
Port Canning, 24 Parganas,
West Bengal.

30. **Pulicat Survey Centre,**
Central Inland Fisheries
Research Institute,
Pulicat, Chingelpet Dist.,
Tamil Nadu.

31. **Pune Centre of AICRP on**
Composite Fish Culture, CIFRI,
C/o. Asst. Director of Fisheries
Sadasiv Sadan,
873, Bhandarkar Institute Road,
Daccan-Gymkhana,
Pune-411 004,
Maharashtra.

32. **Puri Research Centre**,
Central Inland Fisheries
Research Institute,
No. 12, MIG Quarters,
Water Works Road,
Puri-752 002 (Orissa).

33. **Ranchi Centre of AICRP on**
Composite Fish Culture and
Reservoir Fisheries,
CIFRI,
Doranda Fish Farm,
P.O. Hinnoo,
Ranchi-834 002 (Bihar).

34. **Rahara Research Centre**,
Central Inland Fisheries
Research Institute,
8, Station Road, Khardah,
Dist. 24 Parganas, W. Benal,
Pin-743 186.

35. **Raidighi Survey Centre**,
Central Inland Fisheries
Research Institute,
Raidighi, 24 Parganas (W.B.)

36. **Rihand Centre of AICRP on Reservoir Fisheries.** CIFRI,
C/o. Asst. Director of Fisheries,
Rihand, P.O. Turra,
Dist. Mirzapur,
Uttar Pradesh. Pin-231 221.

37. **Srinagar Research Centre,** Fishsearch Srinagar
Central Inland Fisheries Research Institute,
Harwan, Srinagar-191 123,
Kashmir.

38. **Tadepalligudem Research Centre,**
Central Inland Fisheries Research Institute,
4-11-3, Subaraopeta, Tadepalligudem,
West Godavari Dist., Andhra Pradesh.
Pin-534 107.

39. **Uluberia Survey Centre,**
Central Inland Fisheries Research Institute,
Uluberia, Dist. Howrah,
West Bengal.