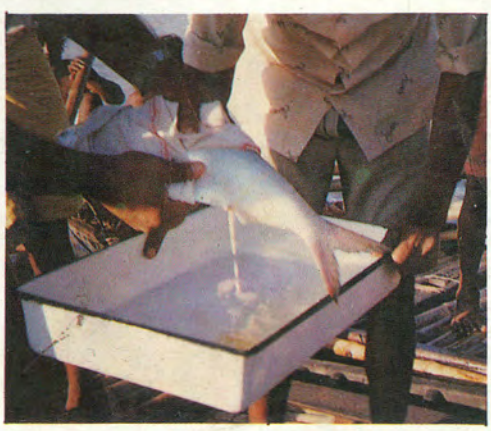

ICAR

ANNUAL REPORT 1989-90

CENTRAL INLAND CAPTURE FISHERIES RESEARCH INSTITUTE BARRACKPORE

ANNUAL REPORT
1989 - 90

CENTRAL INLAND CAPTURE FISHERIES RESEARCH INSTITUTE
(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)
Barrackpore 743 101 West Bengal INDIA

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Published By :
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Printed at :
Documentation Section
CICFRI Barrackpore

ISSN 0970-6267

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BARRACKPORE

BRIEF HISTORY

The Government of India, in a memorandum brought out in 1943, stressed the need for having a separate central department in the best interest of the development of fisheries resources of the country. This memorandum was later endorsed by the Fisheries Sub-Committee of the Central Government Policy Committee on Agriculture, Forestry and Fisheries. Based on this, the Central Inland Fisheries Research Station was formally established on 17 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 a 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). The main objectives were to conduct investigations for a proper appraisal of inland fisheries resources of the country and to evolve suitable methods for their conservation and optimum utilisation. While fulfilling the above objectives, the Institute directed its research efforts towards understanding the ecology and production functions of inland water bodies available in the country like the

river systems, lakes, ponds, tanks, reservoirs and ox-bow lakes. These studies have unravelled the complex trophic structure and functions *vis-a-vis* the environmental variables in different aquatic ecosystems.

The mandate of the Institute was later modified giving added emphasis on capture fisheries resources of the country and the Institute was rechristened as **Central Inland Capture Fisheries Research Institute (CICFRI)** with effect from 1.4.1987. Under the changed set up, the CICFRI is entrusted with the responsibility to conduct research on open water bodies where the fisheries management norms are closely associated with environmental monitoring and conservation.

MANDATE

The CICFRI has a mandate to conduct research for *developing systems for monitoring and improving fish production in natural and man-made inland water resources through stocking, optimum exploitation and conservation.*

ORGANISATION

In order to achieve the above mandate, the research at CICFRI has been organised under three Divisions, corresponding to the major fishery resources of the country. The Riverine Division, with its headquarters at Allahabad, strives to develop systems for effective management of the vast riverine fisheries resources of the country with adequate emphasis on the conservation of riverine environment. The research projects under the Division cover the rivers Ganga, Yamuna, Brahmaputra and Narmada. The Lacustrine Division has its headquarters at Bangalore with centres in Tamil Nadu, Andhra Pradesh, Uttar Pradesh, Madhya Pradesh, Himachal Pradesh and Maharashtra. The investigations being carried out at the Division aim at developing management norms for optimising fish yields from large tanks, lakes, and reservoirs. The Estuarine Division is based at Barrackpore and it covers the entire Hooghly-Matlah estuarine system and the Narmada Estuary. The effluents from a number of industrial units, agricultural wastes, municipal wastes etc. make the Hooghly Estuary one of the most polluted stretches of the Ganga river system which is being investigated by the Division. Hilsa, the most important estuarine fish is being subjected to intensive research. The Institute also conducts investigations on oxbow lakes of West Bengal, Assam and Gandak basin *(mans)*. Other areas covered include cage and pen culture systems in open waters, the ecology and production biology of inland molluscs, engineering aspects of cage and pen structures and investigations on fisheries economics and statistics. The Institute's researches have been organised under 20 research projects and a Central Sector Scheme. The projects are operated from the Headquarters at Barrackpore, 12 Research Centres, 6 Survey Centres and a Krishi Vigyan Kendra covering 11 states of the country. The distribution of research and survey centres and different sections are shown in the organization chart.

IMPORTANT ACHIEVEMENTS

Ganga Action Plan

Some ameliorating effects of the Ganga Action Plan on the riverine environment are clearly visible in some stretches of the river Ganga. A significant improvement in the water quality and primary productivity rate has been observed in Kanpur due to the positive impact of diversion and treatment of the effluents, prior to their release in the river since 1987. Consequently, the fish production potential of the stretch registered an increase from 8-144 kg ha^{-1} yr^{-1} to 111-182 kg ha^{-1} yr^{-1}.

Ecological changes in river Ganga at Kanpur due to regulated discharge of effluent

Parameters	Non Regulated Discharge							
	December 1987				March 1988			
	1	2	3	4	1	2	3	4
1. Water quality								
Dissolved oxygen (mg l^{-1})	7.4	5.0	6.8	2.0	6.0	0.0	0.0	0.0
pH	8.3	8.0	8.0	7.8	8.3	7.4	7.5	7.6
Free CO_2 (mg l^{-1})	0.0	4.0	0.0	10.0	0.0	20.0	36.0	26.0
Total alkalinity (mg l^{-1})	178.0	218	174	280	172	254	344	320
Sp. conductivity (µmhos)	358	438	399	782	391	642	1091	816
Total dissolved solids (mg l^{-1})	176	215.0	195	380	191	316	537	404
2. Carbon production (mg C m^{-2} day^{-1})	423.5	302.0	398.5	22.56	195.4	77.4	13.8	67.6
3. Energy fixed by producers (Cal $m^{-2}day^{-1}$)	4152	2968	3913	222	1918	760	136	663
4. Photosynthetic efficiency (%)	0.355	0.254	0.330	0.019	0.102	0.040	0.007	0.035
5. Fish production potential (kg ha^{-1})	143.9	102.7	135.5	7.7	66.4	26.3	4.7	22.9

(...table contd.)

Table contn....

Parameters	Regulated Discharge December 1988			
	1	2	3	4
1. Water quality				
Dissolved oxygen (mg l^{-1})	10.9	9.7	10.00	9.12
pH	8.3	8.0	8.3	8.3
Free CO_2 (mg l^{-1})	0.0	2.0	0.0	0.0
Total alkalinity (mg l^{-1})	172	186	190	216
Sp. conductivity (µmhos)	391	385	387	356
Total dissolved solids (mg l^{-1})	191	199	148	178
2. Carbon production (mg C m^{-2} day^{-1})	443.2	327.1	540.6	535.2
3. Energy fixed by producers (Cal $m^{-2}day^{-1}$)	4352	3212	5309	5256
4. Photosynthetic efficiency (%)	0.372	0.272	0.454	0.45
5. Fish production potential (kg ha^{-1})	150.7	111.2	183.8	182.0

Zone : 1. Bhagawatghat above confluence
2. Bhagawatghat below confluence
3. Jajmau above confluence
4. Jajmau below confluence

Artificial Fecundation of Hilsa in Narmada Basin

The anadromous hilsa population of Narmada basin is under threat due to the cascade of dams being built under the Narmada Valley Development Programme. The Central Inland Capture Fisheries Research Institute has been probing the means and ways to conserve this important fish and its lucrative fisheries in the Narmada basin. In order to revitalise the upstream hilsa fisheries through artificial recruitment, it is imperative to develop a seed production technology for the Narmada hilsa. Therefore, artificial fecundation of Narmada hilsa and its seed rearing have been attempted during the monsoon month of August with commendable success.

Bharbhut in Gujarat State, 25 km upstream of the Narmada estuary, was selected for hilsa breeding, where more than 400 boats are engaged in hilsa fishing activities. Live brood fishes were collected from the gill nets and dry stripping method was followed to fertilise the eggs. The ova from oozing fishes were stripped into enamel trays followed by sprinkling of milt from the males, with simultaneous

mixing of the germ material with a clean feather. Ten to fifteen minutes after the stripping, settled estuarine water was poured over the fertilized eggs, which were then allowed for water-hardening.

A total of 5 sets of brooders in the size range of 1.0 to1.3 kg were subjected to stripping, yielding a fertilization rate of 58 to 80% and hatching rate of 35 to 45%. After 72 hours of rearing, nearly 7.5 lakh spawn could be obtained, which are being reared in the nursery ponds at Umarwada and Ukai Fish Farms in Gujarat.

Hilsa breeding at Farakka

A portable plastic hatchery fabricated for artificial fecundation of *Tenualosa ilisha* has been put to operation at Farakka with encouraging results. The hatchery consists of a plastic pool (75 cm deep and 90 cm dia) having an outlet and a round markin cloth hapa inside, and a perforated plastic basket (60 cm height and 40 cm dia) lined inside with square mesh (1.2 mm) net with a device for circular/upward water circulation at the bottom. The incubating capacity of a unit of this hatchery is 50,000 fertilised ova.

For incubating the fertilised eggs of hilsa in pond conditions, a special type of hatching hapa has been designed. This includes an outer hapa (183 cm x 122 cm x 91.5 cm) made of markin cloth and an inner hapa (152.5 cm x 91.5 cm x 61 cm) made from netting cloth of two different mesh sizes. The side walls are made of round-meshed (1.4 mm) net while the bottom is made of square-mesh (1.2 mm) netting cloth. The maximum incubating capacity of one set of hatching hapa has been estimated at 70,000 ova.

About 1,50,000 hatchlings were produced from two sets of stripping. Hatching rate was 90-92%. Three days old spawn were stocked at the rate of 5,00,000 nos ha^{-1} in two nursery ponds at Farakka.

Epizootic Ulcerative Syndrome (EUS)

Bacteriological studies made on the Epizootic Ulcerative Syndrome (EUS) during December 1989 has further corroborated the earlier inference that bacteria play a definite role in the propagation of the dreaded disease. The infected fishes collected from the Salt Lake, Hooghly, Barrackpore, Gosaba and Canning regions of West Bengal were subjected to bacteriological investigations at the fish pathology laboratory of the Central Inland Capture Fisheries Research Institute, Barrackpore. Smears taken from the affected fishes were cultured in nutrient agar medium and on examination, the presence of gram positive cocci was indicated, further confirming the role of bacteria in the manifestation of the disease. Investigations

on the causative agents and prophylactic and therapeutic measures to be taken to combat the disease are in progress.

Ulcerative Disease from Estuarine Areas

The Epizootic Ulcerative Syndrome, the dreaded fish killer disease, has been reported for the first time from the estuarine waters. This disease was, so far, restricted to the freshwater systems like ponds, lakes, rivers and beels. The first report on its occurrence in estuarine waters has been received from Kakdwip, where fishes like *Liza tade*, in addition to murrels, carps and catfishes are affected. The Institute has initiated investigations on the diseased fishes collected from the affected areas. The preliminary results, on the basis of pathogens isolated from the lesions of diseased fishes, suggest role of *Micrococcus* in the manifestation of the disease. The pathogen responded positively to treatment with lime, $KMnO_4$ and saline water.

Record Fish Production from Small Reservoir

Enhancement of fish production from reservoirs by employing scientific management norms has been one of the mainstays of the Lacustrine Division of the Central Inland Capture Fisheries Research Institute. It has often been found that interim measures, developed on the basis of a quick first approximation of the productive potential, comes handy to manage the small reservoirs. In Aliyar, a small 646 ha reservoir in the west-flowing drainage of the Western Ghats, an initial target production of 150 kg ha^{-1} had been set and efforts were directed towards achieving this target since 1984. The fish yield which remained around 38 kg ha^{-1} yr^{-1} before scientific management measures were tried, could be increased to 115 kg ha^{-1} yr^{-1} during 1987-88 and 167 kg ha^{-1} during 1988-89. However, the yield touched an all time high of about 200 kg ha^{-1} yr^{-1} during 1989-90 and indications are that there is enough scope for further increase in the fish yield rate.

A rational stocking policy comprising introduction of quick-growing carp species, maintaining optimum stocking density, stipulation of proper stocking and harvesting schedules and a regular monitoring of fish populations are the management measures that led to this remarkable production hike. These management norms were determined on the basis of the biogenic productive potential of the lake and its production biology. All the stocking materials were raised at the reservoir site itself with the active co-operation of the State Government.

COLLABORATION

The Institute collaborated with a number of national and international agencies during 1989-90 for research and training activities.

NATIONAL

The Government of Tamil Nadu has actively collaborated with Central Inland Capture Fisheries Research Institute (CICFRI) in the execution of the project *Ecology and fisheries of the small reservoir in Aliyar basin* at Aliyar Reservoir, Tamil Nadu, by extending the farm and transport facilities.

The Institute collaborated with the Governments of Himachal Pradesh and Arunachal Pradesh in delineating the priority areas in both the capture and culture fisheries of the coldwater regions of the country. Some new projects were identified where ICAR and the respective State Governments could collaborate.

A National Workshop on Epizootic Ulcerative Disease Syndrome was organised by the Ministry of Food and Agricudlture, Govt. of India and the Department of Fisheries, Government of West Bengal in collaboration with the CICFRI on 6th and 7th March, 1990 at Great Eastern Hotel, Calcutta. Altogether 125 participants attended the Workshop representing different State Governments, Research Institutes, Universities, P.G. Institute of Medicine, All India Institute of Hygiene and Public Health and School of Tropical Medicine, Calcutta. A total of 14 technical papers were presented during the three technical sessions. The Workshop adopted an eight point recommendation to tackle the problems arising out of the epizootic. The Workshop urged the research organizations to intensify researches to establish the exact etiology of the disease and to disseminate the existing knowhow on the control measures to the farmers. It was also decided that the tendency to jump into irrational conclusions on the disease and its pathogens may be curbed, in view of the possible adverse impact on the fishermen community. The need for developing quarantine measures during the extra territorial transplantation of fish and maintenance of strict prophylactic measures during fish seed transport was also stressed.

A National Workshop on Reservoir Fisheries was conducted jointly by the Central Inland Capture Fisheries Research Institute and the Indian Branch of Asian Fisheries Society from 3-4 January, 1990. The main objective of the Workshop was to provide a platform to deliberate upon the policies, issues and strategies for optimum exploitation of the reservoirs in the country. The three million hectares of reservoirs form one of the most important inland fishery resources of the country which has the potential to produce 50-300 kg ha^{-1} depending on their size and morpho-edaphic characteristics. A total of 35 research papers were presented during the four technical sessions and the Workshop was attended by over 110 scientists, representatives of central and state departments, administrators, academicians and officials from financing agencies and banks. An 18 point recommendations was adopted by the Workshop for developing the reservoir fisheries in the country.

A training course was conducted by the Institute on **beel fisheries management techniques** for the State Government officers from 11.7.1989 to 20.7.1989. Nineteen State Government officials representing the States of West Bengal, Arunachal Pradesh and Bihar, participated in the training course.

The Institute, in collaboration with All India Institute of Hygiene and Public Health and School of Tropical Medicine, Calcutta launched a joint project for the identification of aetiological agent of Epizootic Ulcerative Disease Syndrome in exotic and indigenous freshwater fishes.

Apart from these, CICFRI is engaged in assisting different state Governments and agencies associated with the fishery developmental activities through its consultancy services.

Consultancy Services Provided by CICFRI

Project on integrated Fisheries Development of North Eastern States

The Central Inland Capture Fisheries Research Institute has been retained as consultants by the Agricultural Finance Corporation (AFC) for preparing a massive fisheries development master plan for the North Eastern States. The project covers all the seven North Eastern States and Union Territories viz., Assam, Meghalaya, Mizoram, Nagaland, Manipur, Tripura and Arunachal Pradesh. The project envisages to develop the vast fisheries resources available in the region such as rivers, ox-bow lakes, natural lakes, reservoirs, upland lakes and mountain streams. Possibilities of developing paddy-cum-fish culture and integrated farming systems are also covered under the project. A team of scientists has completed the field studies and submitted the draft reports which have now been approved. Final reports are under preparation.

Environmental Impact Assessment

The Institute has offered consultancy services to **Consulting Engineering Services India Pvt. Ltd.** to collect base line data on the environmental impact assessment in Kayamkulam, Singrauli and Kakinada Thermal Power Stations. The studies covered physical, chemical and biological parameters with special emphasis on the impact of Thermal Power Station environment. Investigations at Kayamkulam and Singrauli projects have been completed and report is under preparation.

*A **National Workshop on Reservoir Fisheries** was held at Barrackpore from 3-4 January 1990 under the auspices of Central Inland Capture Fisheries Research Institute and the Asian Fisheries Society Indian Branch. The Workshop was inaugurated by **Sri Kiranmoy Nanda, Hon'ble Minister of Fisheries,** Govt. of West Bengal and the Inaugural Session was presided by **Sri M. Muniappa,** Secretary (Fisheries), Govt. of Karnataka.*

The Hon'ble Minister inaugurates the Workshop

(From left)
Sri Gananeela,

Dr. M.J. Bhagat
Ex-Scientist,
CICFRI,

the Hon'ble
Minister

and
Dr.A.G.Jhingran
Director CICFRI

National Workshop on Reservoir Fisheries

Inaugural Session. (*From left*) Sri G. Gananeela, Dr. Arun G. Jhingran, Sri M. Muniappa, Sri Kiranmoy Nanda, Prof. H. P. C. Shetty, Dr. V. D. Singh and Dr. V. K. Unnithan.

The Minister being received by Prof. Shetty and Dr. Jhingran

National Workshop on Reservoir Fisheries

A Technical Session in progress

A section of the audience

Minister visits the Project Site at Fatehpur

Sri Hari Krishna Shastri, Hon'ble Minister of State for Agricultural Research and Education, paid an official visit to Fatehpur on 16-9-89 to inaugurate a Composite Fish Culture Project undertaken by the Institute to disseminate the aquaculture technologies to the rural masses. During the visit, the Minister held discussions with the Scientists of the Institute and local fishermen.

Sri Shastri (Second from left) being briefed on the Project. Also seen in the picture are Dr. B. N. Saigal (left) and Dr. Balbir Singh (right), Scientists of CICFRI

Sri Hari Krishna Shastri, Hon'ble Minister at Fatehpur

The Minister inaugurating the Composite Fish Culture Project by releasing fish seed into the ponds

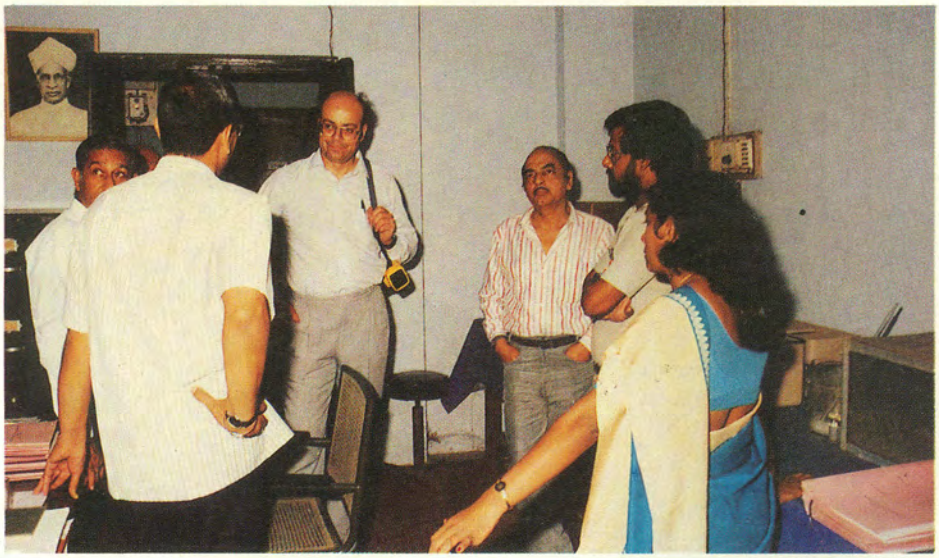
VISITORS

Shri Santosh Mohan Deb, Hon'ble Union Minister of State for Home, Govt. of India,visited the Institute on 17th April 1989. He was accompanied by **Shri Debi Ghosal** and **Ms. Mamata Banerjee**, Members of Parliament.

Dr. Arun G. Jhingran, Director, CICFRI briefing the Hon'ble Minister on the activities of the Institute.

The Minister addressing the scientists and staff of the Institute. Ms. Mamata Banerjee and Shri Debi Ghosal, Members of Parliament (from left) are also seen on the dais.

VISITORS



Dr. R.J. Robert, Fish Pathologist from University of Stirling visited CICFRI on 18th May 1989.

A Vietnamese delegation comprising four senior Government officials visited the Institute. The picture shows the Vietnamese officials presenting a memento to the Director.

VISITORS

Dr. J.G.J. Van Zon, Senior Aquaculturist, FAO/UNDP, the Netherlands visited the Institute on 21st June 1989. Dr. Zon in the CICFRI Library

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Dr. M.A. Kawosa, Director, Ecology and Environment, J & K paid an official visit to the Institute on 6th April 1989. Dr. Kawosa visits a private farm.

Feasibility Study for Reservoir Fisheries

The Institute has taken up the consultancy assignment with the NEC to prepare feasibility studies for fisheries development for Nongmahir and Kyrdamkulai reservoirs at Meghalaya. The preliminary investigations have been initiated and the work is expected to be completed by June 1991.

INTERNATIONAL

Central Inland Capture Fisheries Research Institute has actively collaborated with the Network of Aquaculture Centres in Asia (NACA) in their Regional Research Project entitled "Environmental Monitoring and Ulcerative Syndrome in Fish" was initiated at CICFRI, Barrackpore, India along with 11 other countries. The principal objective of the project is to establish the relationship between the ulcerative disease syndrome in fish and the environment. Under the technical programme, fortnightly diurnal fluctuation of physico-chemical parameters, heavy metal and pesticide analysis, fish population monitoring and haematological study was done in two impoundments in rain-fed and irrigated paddy field areas during the year 1988-89.

FAO-DANIDA Training on Fish Stock Assessment

An FAO-DANIDA Training Programme on ***Fish Stock Assessment*** was arranged at CICFRI, Barrackpore with a view to upgrading the skill of technical personnel engaged in the fish stock assessment. The project was funded by FAO and DANIDA and participants were drawn from various state governments and central agencies of the country. Five fisheries officials from Bangladesh also participated.

MANPOWER DEVELOPMENT

Dr. Arun G. Jhingran, Director, was deputed as a delegate of the four-member Indian team to participate in a **Seminar on Fisheries Research and Management** at Phuket, Thailand during 11-12 September 1989. The seminar covered (i) general research, coordination and management, (ii) evaluation and advices on resources, environment and fisheries with special reference of fish stock assessment. Various theoretical models capable of predicting reliably the effect of fishing on fish stocks and the future catches were discussed in the Seminar. Such models have great relevance in Indian context.

Dr. V.V. Sugunan, Senior Scientist, participated in a Study Tour-cum-Workshop on sanitation and marketing of molluscs in France, from 16-28 October 1989. The avowed objectives of the programme were to upgrade the sanitation of edible molluscs and to promote their domestic and international trade. The workshop was attended by 19 personnel from 12 Asian countries i.e. Bangladesh, China, Hong Kong, India, Indonesia, Korea, Malaysia, Philippines, Sri Lanka, Thailand and Vietnam. The deligation visited the Shell Fish Producing Centres, *viz.* Brest, Nantes, Rochefort, La Trembled, Bordeaux, Arcachon and Sete where the workshop was held.

Shri R.A. Gupta, Senior Scientist, has been deputed to undergo training in Economics Development at the University of Manchester, United Kingdom since October 1989 under Colombo Plan.

Dr. M. Choudhury, Scientist, underwent a short-term training course on *Use of Computers* at IASRI, New Delhi, from 4th to 30th September 1989.

Dr. K.K. Vass, Principal Scientist, was deputed for a two-week training on the *Use of radioisotopes in biological investigations* at BARC, Bombay, from 12th June 1989 to 27th June 1989.

Dr. V.K. Unnithan, Dr. Y.S. Yadava, Shri S. Paul, R.K. Tyagi, Dr. M. Chaudhuri, Shri H. C. Karmakar,Senior Scientists and Ms. Arati Das, and Ms. K. Sucheta Majumder, Technicians, participated in the National Training Course on 'Fish Stock Assessment in Inland Water' organised by FAO/DANIDA/ICAR during 15th January 1990 to 9th February 1990 at CICFRI, Barrackpore. The course was also attended by

Dr. V.R. Desai, Principal Scientist of this Institute underwent training at National Academy of Agricultural Research and Management, Hyderabad, Andhra Pradesh from 21st November 1989 to 2nd December 1989.

HONOURS, AWARDS, ETC

Dr. Ajoy Kr. Ghosh, Senior Scientist has been awarded Fellowships of (i) Zoological Society of India and (ii) Helminthological Society of India

Shri Balbir Singh, Senior Scientist has been awarded Ph.D. degree by Kanpur University for his thesis 'Limnology of pond ecosystem near Allahabad and its bearing on fish production'.

TRANSFER OF TECHNOLOGY

EXTENSION AND NATION-BUILDING ACTIVITIES

The Central Inland Capture Fisheries Research Institute continued its extension activities to help farmers, entrepreneurs, government agencies, financial institutions as well as voluntary organisations through dissemination of fishery management technologies. Highlights of extension activities are as follows :

a) Adoption behaviour of the fish farmers towards composite fish culture :

An investigation has been carried out in 5 districts of West Bengal through a structured schedule to find out the adoption behaviour of fish farmers towards composite fish culture. Out of the 264 respondents, only 61% fish farmers are found to have adopted the technology.

b) Socio-economic status of fishermen engaged in beel fisheries :

An investigation has been carried out in 4 large sized beels of West Bengal *viz.* Padma beel, Mathura beel, Chaltia beel and Katiganga beel to study the socio-economic status of the fishermen engaged in fishing. A total of 321 fishermen were personally interviewed. Their income largely varied between Rs.401 and 500 (42.36 percent). They observed conservation measures by following mesh regulation, making restriction on the catch of brood and juvenile fishes. During the period of stocking in beels they engaged themselves in other jobs when their income declined to the level of Rs.201 to Rs.300 (48.28 percent).

c) Impact of Epizootic Ulcerative Syndrome :

A survey was carried out among fish producers, fish traders and fish consumers in 5 districts of West Bengal to assess the impact of Epizootic Ulcerative Syndrome (EUS).

Fish stocks of 365 farmers were found to be affected with EUS. The pecuniary loss faced by the affected fish farmers has been found to be maximum (58.35 percent) in the range of Rs.1001.00 to Rs.5000.00.

The fish consumption rate has been found to decline by 28.7 percent, 23.3 percent and 20.5 percent in urban, sub-urban and rural sector respectively. No incidence of disease was reported among the persons who consumed or handled the affected fish.

Other extension activities

Advisory services were rendered to 361 individuals on various aspects of inland fisheries. **Trainings** on inland aquaculture was conducted for 325 fish farmers and fishery development officers. **Fish farmers' day, Exhibitions, Film shows, Group discussions, Talks, Pituitary gland supply, Seed supply, Glass jar supply, Lab to land programme** and helping the people of cyclone affected areas etc. were the other major extension activities carried out during the period.

KRISHI VIGYAN KENDRA

The Krishi Vigyan Kendra, Kakdwip was transferred to the administrative control of CICFRI with effect from August 1, 1989. The Kendra has programmes under four disciplines, *viz.*, Crop production, Horticulture, Home Science and Fisheries.

Brackishwater fish farming and paddy cultivation received thrust during the period. Skilled training on need-based, location-specific technologies was imparted to the farming community.

Identification of Problems

The main agricultural problems faced by the farmers of Sunderbans, as identified by the KVK, are :

i) Tidal water inundation of the crop lands;

ii) High rate of precipitation within a short monsoon period coupled with poor drainage, resulting in severe water logging;

iii) Deep submergence of paddy during monsoon season adversely affecting the high yielding varieties;

iv) Use of local low yielding rice varieties under traditional method of cultivation;

v) High water-table with saline groundwater

vi) Non-availability of quality water for irrigation during rabi and summer crops, and

vii) High soil salinity during winter and summer.

EXTENSION

Out of the estimated 71 lakh fishermen in the country, 47 lakh fish in inland waters. Educating the fishermen about the recent developments in inland fisheries is an essential part of the extension activities of CICFRI. *Above:* S/Sri U. Bhowmik and J.G. Chatterjee, Scientists, in discussion with fishermen. *Below :* Estuarine fisherfolk.

A crash training programme was conducted at Nandabhanga (Sunderbans), for the benefit of cyclone-affected fishermen. Free inputs were distributed among 100 affected fish farmers.

Fishermen being trained in extraction of pituitary glands

EXTENSION

The extension and training programmes of the Institute lay special emphasis on the role of women in aquaculture

Women being trained in prawn seed collection, induced breeding and horticulture

Training

A training in Beel Fisheries Management was conducted at Barrackpore from 11.7.1989 to 20.7.1989 for State Fisheries Officials.

Top : Registration of participants .
Left & Bottom : Limnological methods being demonstrated to the trainees.

Additional crops like Chilli, Groundnut, Watermelon, Sunflower, Mustard, Betelvine and Sugarbeat (after the kharif rice) and integrated farming like paddy-cum-fish culture in freshwater and rice-cum-shrimp farming in brackishwater zones are under active consideration of the KVK. In aquaculture, technologies on polyculture of finfish and shellfish, culture of tiger shrimp, culture of mullets, induced breeding of Indian major carps and exotic carp, carp seed raising, and composite fish culture have been transferred to several farmers in the area.

During the period, the Kendra organised five on-campus training courses, details of which are given below:

Discipline	Subject	No. of participants
Horticulture	Improved techniques of chilli cultivation	10
Home Science	(a) Mashroom cultivation and dietary application	10
	(b) Fruit and vegetable preservation	9
Agronomy	Oil seeds production	10
Fisheries	Composite fish culture	20

In addition, 20 off-campus training programme were organised in the field of fisheries (5 courses, 221 participants), agronomy (6 courses, 123 participants), horticulture (5 courses, 229 participants) and home science (4 courses, 137 participants).

Farmers' Days

The Kendra has organised five Farmers' Days in which 635 farmers including women took part in the discussions related to crop production, horticulture, fisheries and home science. The discussions proved to be immensely popular and useful.

Other activities

Over 331 farmers and interested persons have taken the advantage of the technical **advisory services** offered by the Kendra. Radio/TV talks and panel discussions in regional language relating to home science were broadcast/telecast for the benefit of the farming communities.

Demonstration on Oil Seeds Production

Under this programme, thrust was on production of sunflower and mustard under Block Demonstrations. Total land areas 26.67 hectare and 2.67 hectare were brought under demonstration of sunflower and mustard respectively. The average yield from the demonstration plots are *c.* sunflower 11000 kg ha^{-1} and mustard 11500 kg ha^{-1}.

LIBRARY & DOCUMENTATION SERVICE

The CICFRI library added 176 books and 12 reprints of scientific papers to its collection and subscribed 36 foreign and 60 Indian Journals. The library has a total holding of 6313 books, 4124 outside reprints, 749 maps and 2774 miscellaneous publications. Apart from the existing 334 exchange relationships with leading national and international research information centres, 21 new exchange relationships were established during the year.

The Institute continued the free mailing of its publications to various research organizations, universities, entrepreneurs and farmers to keep them abreast with the latest developments in fisheries research. As a part of resource sharing, it lent out 52 publications to other libraries on inter-library loan. The total expenditure incurred by the library during the year was Rs.3,01,474.00.

The section maintains an active unit for photography and reprography services. Photographs, reprints and photocopies were supplied to the scientists of the Institute as well as of other research Institutes and Universities free of cost. The section also maintains a duplicating (cyclostyling) and binding unit to serve the various units of the Institute.

Technical Reports

More than 30 technical reports on the progress of research activities of the Institute were compiled. Research Publications of the Institute scientists were scrutinised before publication in various journals. Technical queries regarding the activities of the Institute from various quarters of the country and abroad were attended to by the section.

Participation of scientists in seminars, symposia, conference etc. was monitored by the section.

Research Project Files

Annual progress reports of all the research projects and the contributors made by individual scientists were recorded in the Primary Project Files and

Scientists' Files. Research progress monitoring through RPF I, II and III; Activity Milestones; and Quarterly, Monthly and Annual reports is one of the major responsibilities of the section.

Publications

The following departmental publications were brought out by CICFRI during the year April 1989 to March 1990.

1 **Annual Report** for the year 1988-89.
2 **Training in Management of Beel (oxbow lake) Fisheries,** Bulletin No.63 : July 11-20, 1989.
3 **Epizootic Ulcerative Syndrome in Fishes** by Arun G. Jhingran & Manas K. Das. Bulletin No.65 .
4 **Limnology and Production Biology of two man-made lakes in Rajasthan (India) with Management Strategies for their fish yield optimization.** Final Report of IDA assisted pilot project on reservoir fisheries management in Rajasthan by Arun G. Jhingran.
5 **Impact of environmental perturbations on the fisheries ecology of river Ganga** by Arun G. Jhingran.
6 **Activity Milestones** 1990-91.
7 **Research Highlights** 1989-90.
8 **Research Project Programme** 1989-90.
9 ***Macher mahamari khata roge*** (in Bengali).
10 **Indian Fisheries Abstracts -**
Vol.23(4), 1984.
Vol.24(1-4), 1985.
Vol.25(2,4), 1986.

CONFERENCES, SYMPOSIA, ETC.

The following important Meetings were organised by the Institute during April 1989 to March 1990.

National Workshop on Reservoir Fisheries on 3rd and 4th January 1990.

FAO/DANIDA/ICAR National Training on Fish Stock Assessment in Inland Waters from 15th January 1990 to 9th February 1990.

National Workshop on Epizootic Ulcerative Syndrome on 6th and 7th March 1990.

Eleventh Meeting of the ICAR Regional Committee II on 15th and 16th December 1989.

Annual Staff Research Council Meeting of the Institute from 18th to 20th April 1989.

Combined Expert Panel Meeting of Ganga Project Directorate on 22nd March 1990.
World Environment Day on 5th June 1989.

Workshop on Larvivorous Fishes of Inland Ecosystems on 27th and 28th September 1989 at the Indian Council of Medical Research, New Delhi, in close liaison with the Malaria Research Centre (MRC), .

Apart from the above, the scientists of the Institute participated in the National Seminar on ***Fish and their environment, Recent advances in the management of fisheries resources in India*** held at Kashmir University on 19.12.1989, ***Indo-Dutch Programme on Aquatic Exotoxicology*** held at NEERI, Nagpur from 6th November 1989 to 1st December 1989, Seminar on ***Man-made environmental problems of North East India,*** organised by N.E. Regional Chapter of Indian Science Congress Association at Guwhati University on 22nd August 1989, Seminar on the ***Teaching of Hindi : National & International perspectives,*** organised by Central Institute of Hindi (Ministry of Human Resource Development, Govt. of India), on 16th October 1989 at Guwhati, National Symposium on ***Environmental management strategies for pathogenesis in parasitic disease,*** held at Allahabad University from 13th to 15th October 1989, Regional Workshop on ***Fish productivity : its status and future challenges in Eastern Region,*** held at Barrackpore on 25th July 1989, ***Fourth National Convention of Indian Helminthologists*** and ***Eighth All India Congress of Zoology at Warangal,*** from 13th to 15th June 1989, ***Seventy-seventh Indian Science Congress Association*** at Cochin from 4th to 9th February 1990, International Conference on ***Heavy metals in Indian environment,*** held at Aligarh University, Aligarh from 8th to 10th January 1990, National Workshop on ***Assessment and control of marine pollution,*** held at Calcutta from 22nd to 24th March 1990, All India Workshop on ***Coastal zone management of West Bengal,*** organised by Sea Explorers' Institute, Calcutta from 14th to 16th December 1989, Workshop on ***Population of exploited fish stock and mathematical modelling,*** held at the Department of Ocean Development, Govt. of India, New Delhi on 28th December 1989, Third National Seminar on ***Agricultural marketing,*** held at Guntur on 4th July 1989, National Symposium on ***Conservation and management of living resources,*** held at University of Agricultural Sciences, Bangalore on 24th October 1989, and National Symposium on ***Animal protection under changing environment,*** held at Gurukula Kangri Vishwavidyalaya, Hardwar on 6th December 1989.

A total of 39 papers were presented by the scientists of the Institute in the above mentioned meetings.

Eleventh Meeting of the ICAR Regional Committee II

Eleventh Meeting of the ICAR Regional Committee No.2 was held at the Central Inland Capture Fisheries Research Institute Barrackpore during 15 - 16 December 1989. The meeting was represented by the Departments of Agriculture, Forestry, Fisheries and Veterinary of the States of Assam and West Bengal, apart from the Agricultural Universities and the ICAR Institutes in the region. More than 80 members including special invitees participated in the high level meeting which eviewed the progress made by the Agricultural Universities and the ICAR Institutes. The meeting identified the areas needing research thrust in the region and formulated action plan for the coming year. A book entitled, *The Impact of Environmental Perturbations on the Fisheries Ecology of River Ganga* by Dr. Arun G. Jhingran was released on the occasion by the Director General, ICAR.

Dr. N. S. Randhawa, DG, Dr. R. M. Acharya, DDG(AS) and Dr. Arun G. Jhingran, Director on the dais (*From right*)

A section of the delegates

Dr. N. S. Randhawa, releasing a book entitled *The Impact of Environmental Perturbations on the Fisheries Ecology of River Ganga* by Dr. Arun G. Jhingran. Prof. P. C. Bora, Vice Chancellor, Assam Agriculture University (*Right*) is also seen in the picture

Dr. P. V. Dehadrai, DDG (Fy) driving home a point

VISITORS

A large number of distinguished personalities including national leaders visited the Institute's Headquarters and its different centres during 1989-90. They include **Shri Hari Krishna Shastri**, Hon'ble Union Minister of State (DARE) ; **Shri Santosh Mohan Dev**, Hon'ble Union Minister of State for Home; **Shri Kironmoy Nanda**, Hon'ble Minister for Fisheries, Govt. of West Bengal, **Shri Debi Ghosal** and **Ms. Mamata Banerjee**, Hon'ble Members of Parliament.

The following is the list of other distinguished visitors from India and abroad who visited the Institute's Headquarters and its different centres during 1989-90.

Acharya, R.M. (Dr.), Deputy Director General (AS), ICAR, New Delhi

Alam, A. (Dr.), Assistant Director General (Engg.), Indian Council of Agricultural Research, New Delhi

Allen Prescott Christine (Ms.), PADATA, IDRC, Canada

Allen Prescott Robert (Mr.), PADATA, IDRC, Canada

Andrews, Michael J. (Dr.), Thames Water International, U.K.

Arora, C.L. (Dr.), ICAR, New Delhi

Bagchi, K.K. (Dr.), Secretary, CMDA, Calcutta

Bhatia, Ashok (Dr.), Scientist, Ministry of Environment & Forests, Govt. of India

Bhusan, Vidya (Mr.), Deputy Director (Finance), ICAR, New Delhi

Boonyarptlin, S. (Dr.), Expert, Epizootic Ulcerative Disease Syndrome, NACA, Bangkok

Bose, A.N. (Dr.), Ex-Vice Chancellor, Jadavpur University, Calcutta

Bose, K.C. (Dr.), Ex-Vice-Chancellor, Ranchi University, Bihar

Bora, P.C. (Dr.), Vice-Chancellor, Assam Agricultural University, Jorhat

Chandra, A.K. (Mr.), Sr. Consultant, Bihar Industrial Technical Consultancy Organisation

Chatterjee, Sheuli (Dr.), Secretary General, Sea Explorers' Institute, Outram Ghat, Calcutta-21

Chen Foo Yan (Dr.), Coordinator, Network of Aquaculture Centres in Asia, UNDP, GPO 618, Bangkok

Das, P. (Dr.), Director, National Bureau of Fish Genetic Resosurces, Allahabad

Datta, Debajyoti (Mr.), Secretary, Sea Explorers' Institute, Outram Ghat, Calcutta

Degnbol, P. (Dr.), DIFMAR, FAO, Rome

Dehadrai, P.V. (Dr.), Deputy Director General (Fisheries), ICAR, New Delhi

Due Hoi, Nguyen (Mr.), Research Institute for Aquaculture No.1, HABAC, Vietnam

Dutta M.K. (Mr.) Section Officer, Finance Dept., Govt. of West Bengal

Dutta, A. (Dr.), Reader, Dept. of Zoology, Guwahati University, Assam

Dutta, N.C. (Dr.), Professor and Head, Department of Zoology, University of Calcutta

Dwivedi, S.N. (Dr.), Additional Secretary, Dept. of Ocean Development, New Delhi

Gananeela, G. (Dr.), Director of Fisheries, Karnataka, Bangalore

George, P. (Lt.), Officer-in-Charge Administration, Engineer Stores Depot, Kakinara

Ghai, S. (Mrs.), Deputy Director of Fisheries, Government of Rajasthan

Gortworst, J.L. (Dr.), The Netherlands

Jae, Hak IM (Mr.), Director, Aquaculture Research Institute, Pyongyang, DPR, Korea

Jain, A.K. (Mr.), IAS, Director of Fisheries, Govt. of West Bengal, Calcutta

Jiswal, Prem (Mr.), Chief Executive Officer, FFDA, Bharoch, Gujarat

Johri, V.K. (Dr.), Director of Fisheries, Govt. of Uttar Pradesh, 7 Faizabad Road, Lucknow

Kang, Han (Mr.), Senior Officer, Aquaculture Research Institute, Pyongyang, DPR, Korea

Kawosa, M.A. (Dr.), Director, Ecology and Environment, Government of Srinagar, Jammu & Kashmir

Kirkeguard, E. (Dr.), DIFMAR, FAO, Rome

Kutty, M.N. (Dr.), NACA Coordinator, Bangkok

Mara, Duncan (Dr.), University of Leeds, U.K.

Mazumder, C.K. (Dr.) Manager (Fishery & Poultry), Nadia District, Central Cooperative Bank

Mishra, R.N. (Mr.), Farm Manager, Nepal

Mohan, K. (Shri), Director, Ganga Project Directorate, New Delhi

Mukhopadhyay, Dilip (Mr.), Member, Sea Explorers' Institute, Outram Ghat, Calcutta-21

Muniyappa, G. (Dr.), Secretary, Animal Husbandry, Fisheries & Forests, Govt. of Karnataka, Bangalore

Pande, M.R. (Shri), Ex-Director of Fisheries, Madhya Pradesh, Bhopal, M.P.

Pandey, K.D. (Dr.), Joint Director, U.P. Fisheries, Lucknow

Pathak, S.C. (Dr.), Manager (T), NABARD, Bombay

Phillips, Mike (Dr.), University of Stirling, Scotland

Pok, Gwang Chong (Mr.), Laboratory Chief, Aquaculture Research Institute, Pyongyang, DPR, Korea

Prasad, Om (Dr.), Reader, Allahabad University, Allahabad

Randhawa, N.S., (Dr.), Director General, ICAR, New Delhi

Ranjitsinh, M.K. (Dr.), Additional Secretary, Ministry of Environment & Forests, Govt. of India

Rao Ramachandra, B. (Prof.), AB 14, Pandara Road, New Delhi-110 003

Rao, Rajeswar B. (Dr.), Chairman, National Fisheries Advisory Board, New Delhi

Robert, R.J. (Prof.), Director, Institute of Aquaculture, University of Stirling, Scotland

Sadaphal, M.N. (Dr.), Asst. Director General, (TC), ICAR, New Delhi

Sarkar, Anil (Prof.), Treasurer, Sea Explorers' Institute, Outram Ghat,Calcutta-21

Shetty, H.P.C., (Prof.), Director of Instruction (Fisheries), University of Agricultural Sciences, College of Fisheries, Mangalore-2

Shin, Y.K. (Mr.), Asian Development Bank

Shrestha, Gopal (Mr.), Assistant Fisheries Development Officer, Nepal

Shukla, J.P. (Mr.), Deputy Director of Fisheries, Government of Rajasthan, Jaipur

Sinha, Mani Ranjan (Dr.), Adviser (Fisheries), North Eastern Council Secretariat, Shillong

Sinha, V.R.P. (Dr.), Director & Vice-Chancellor, CIFE (Deemed University), Bombay

Sparre, P. (Dr.), Marine Resources Service, FAO, Rome

Srivastava, Anand Swaroop (Dr.), Executive Officer, Fish Farmers' Development Agency, Allahabad

Srivastava, C.B.L. (Prof.), Head, Dept. of Zoology, Allahabad University

Srivastava, G.C. (Dr.), Secretary, ICAR, New Delhi

Srivastava, G.S. (Mr.), Joint Director of Fisheries, Govt. of Madhya Pradesh, Raipur, M.P.

Srivastava, U.K. (Dr.), Professor, IIM, Ahmedabad

Srivastava, U.S. (Prof.), Ex-Head of Department of Zoology , Allahabad University, Allahabad

Swarup, Krishna (Dr.), Former Head of Department of Zoology , Gorakhpur University, Gorakhpur

Thu Vu Thi (Mr.), Research Institute for Aquaculture No.1, HABAC, Vietnam

Tonguthai, Kamonporn (Dr.), Parasitologist, NIFI, Bangkok

Tripathi, S.D. (Dr.), Director, Central Institute of Freshwater Aquaculture, Dhauli, Bhubaneswar, Orissa

Tripathi, Shree Ram (Dr.), Asstt. Professor, Gorakhpur University, Gorakhpur

Tripathi, Y.R. (Dr.), Ex-Director of Fisheries, Govt. of Uttar Pradesh, Lucknow

Upadhyaya, S.N. (Mr.), Project Officer, Agricultural Finance Corporation, Guwahati

Zon Van J.G.J. (Dr.), Senior Aquaculturist, FAO/UNDP Project, Netherland

FINANCE

For the year 1989-90

(Rs. in lakhs)

		B.E. 1989-90 (Rs.)	R.E. 1989-90 (Rs.)	Actual Expenditure 1989-90 (Rs.)
Plan	:	70.00	56.00	56.79
Non-Plan	:	174.80	240.00	240.00
Total	**:**	**244.80**	**296.00**	**296.79**

PROGRESS OF RESEARCH

CENTRE-WISE LIST OF ONGOING PROJECTS 1989-90

BARRACKPORE	:	FC/A/4	FC/A/6	FC/A/13
		BF/B/2	BF/B/3	BF/B/8
		BF/A/2	AN/A/7	AN/A/9
		CSS/1		
AGRA	:	FC/B/10		
ALLAHABAD	:	FC/B/7	FC/A/14	
BANGALORE	:	FC/A/7		
BILASPUR	:	FC/A/7		
CALCUTTA	:	BF/B/2		
COIMBATORE	:	FC/A/10		
CANNING	:	BF/B/3		
DIAMOND HARBOUR	:	BF/B/3	BF/A/2	
DIGHA	:	BF/B/3	BF/A/2	
ELURU	:	FC/B/5		
GUWAHATI	:	FC/B/9	FC/A/16	
LALGOLA	:	FC/B/7		
PATNA	:	FC/B/7	FC/A/15	
PUNE	:	FC/A/7		
RAIDIGHI	:	BF/B/3		

RAIPUR	:	FC/A/7
ULUBERIA	:	BF/B/3
VADODARA	:	BF/B/9
KAKDWIP	:	KVK

Research project merged during 1989-90

Nil

Research project completed during 1988-89

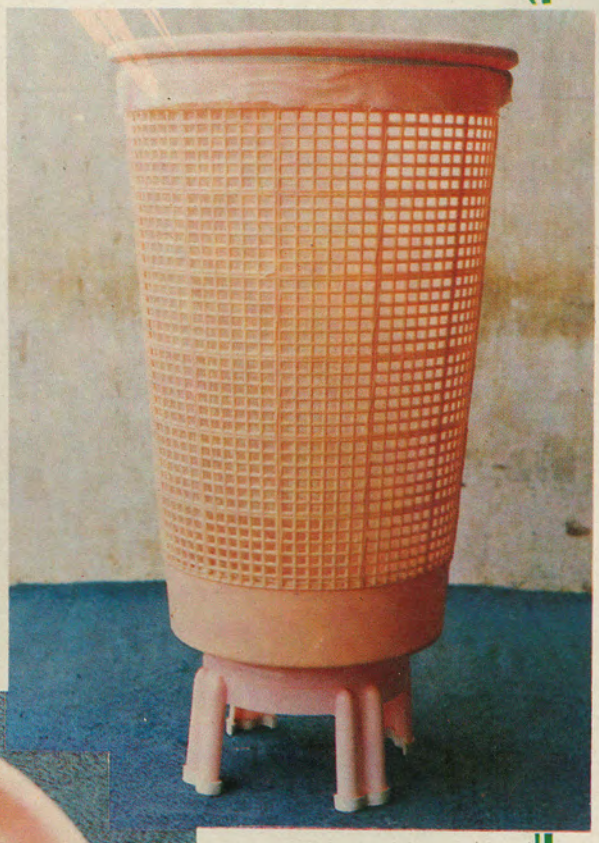
1	FC/A/12	ECOLOGY AND FISHERIES MANAGEMENT OF LARGE PENINSULAR TANK

A haul of Indian shad, *Tenualosa ilisha*

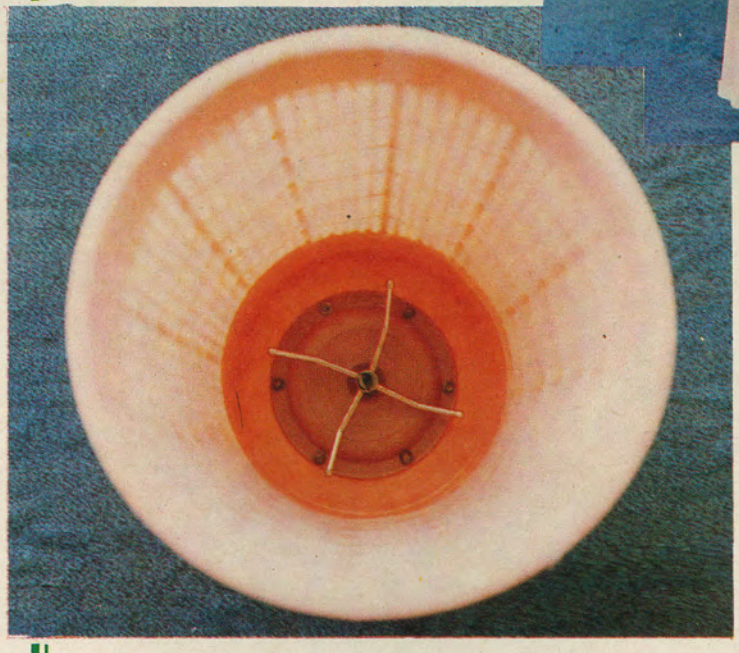
Stripping of hilsa

Improvised field hatchery installed at Bharbhut for hilsa

Closer view of a hatching unit



Closer view of the plastic hatching chamber

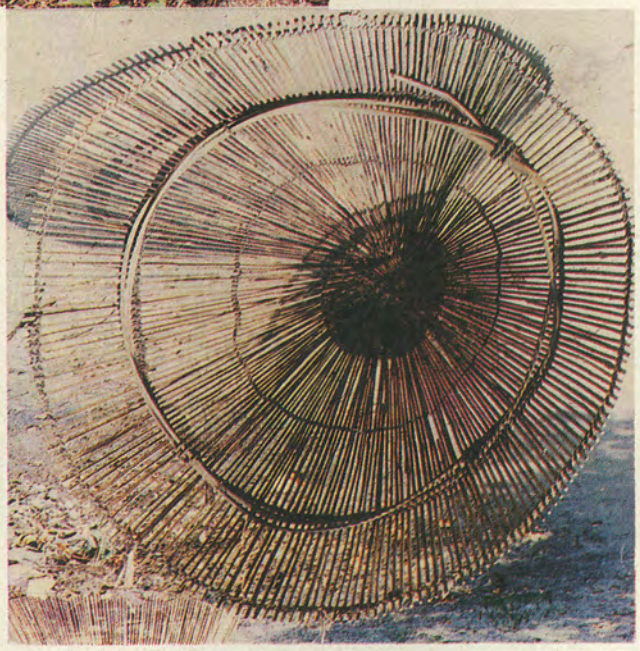


Inside of the bucket-type hatching chamber containing the sprinkler to facilitate aeration and water movement

Anal fins of catla and other carps stocked in Aliyar reservoir were clipped for growth monitoring. Although regeneration takes place, the clipped fishes can be easily recognised as shown below:

Fishing in riverine wetlands

Water samples being collected from a beel



Clearing of aquatic weeds is an essential component of fisheries of wetlands. The picture above shows weed clearance in Kolleru lake. *Below*: A trap used in small reservoirs, beels and Kolleru lake.

Brackishwater impoundments (*bheries*) are extensively stocked with prawns, especially *Penaeus monodon*. *(Top)* Water regulatory system of *bheries* to check the escape of prawns. *(Bottom)* An improvised prawn seed collection gear, used in Sunderbans for collecting *P. monodon* seed.

ONGOING PROJECTS

Project : **FC/B/5**

STUDIES ON THE ECOLOGY AND FISHERIES OF KOLLERU LAKE ECOSYSTEM AND DEVELOPMENT OF SUITABLE MANAGEMENT MEASURES FOR OBTAINING SUSTAINED FISH PRODUCTION

Personnel : Ch. Gopalakrishnayya (upto 27.10.89), R.S. Panwar, K.V. Rao, M. Ramakrishniah, J.B. Rao, T.S. Rama Raju, K.S. Rao, P.S.C. Bose, Ch. G. Rao, S. Kotaiah

Duration : 1987-1991

Location : Eluru , Andhra Pradesh

i) Catch, species and size composition of different species :

A distinct variation in the species composition at different landing centres can be seen from Table 1. The remarkable feature of the fish catch during the year is the decline in air breathing fishes and an appreciable increase in other groups. Live fishes decreased from 1030.7 to 900.0 t while carps increased from 258.7 to 385.3 t. The euryhaline fishes increased from 140.3 to 203.4 t. The total fish production during the year was estimated at 2002.2 t, an increase of 12.82 percent from the previous year.

Akividu centre recorded maximum catches (65.85 percent) followed by Bhimavaram (17.66 percent) and Eluru (16.49 percent), as in previous years . Sharp increase in catches of carps and *W. attu* during the year is attributed to prolonged heavy flood during July to September. Flood has also affected the recruitment of indigenous air breathing fishes causing their decline in catch.

ii) Biotic Communities

Plankton: Production of plankton was observed to be poor almost throughout the year in the western part of Kolleru. The zooplankton was represented by copepods, cladocerans, and rotifers. Phytoplankters consisted of *Euglena, Spirogyra,* and *Oscillatoria.*

Pedayedlagadi : Volumetric analysis revealed two plankton peaks in January 1990 (1.0 ml) due to sudden spurt of *Spirogyra* bloom and in May 1989 (0.1 ml) due to *Oscillatoria* bloom. Numerical estimation of plankters ranged between 4 u l^{-1} (September and October) to 436 u l^{-1} (January 1990).

Table - 1. Fish landings (kg) at different Centres of Kolleru laks : 1989-90

Species	Eluru		Akividu		Bhimavaram		Total	
	Qty.	%	Qty.	%	Qty.	%	Qty.	%
P. monodon	-	-	2433	0.18	6786	1.92	9219	0.46
M. monoceros	7708	2.34	107275	8.14	161541	45.69	276524	13.81
M. malcolmsonii	10903	3.30	36650	2.78	3508	0.99	51061	2.55
M. rosenbergii	373	0.11	15995	1.21	1333	0.38	17701	0.88
Other prawns	920	0.28	7036	0.53	22858	6.47	30814	1.54
S. sgrrata	78	0.02	754	0.06	13242	3.75	14074	0.70
C. catla	22894	6.92	51520	3.91	3106	0.88	77480	3.87
L. rohita	50447	15.28	104768	7.95	7043	1.99	162258	8.10
C. mrigala	16763	5.08	41798	3.17	2584	0.73	61145	3.05
L. calbasu	688	0.21	9167	0.70	465	0.13	10320	0.52
P. sarana	3426	1.04	9063	0.69	78	0.02	12567	0.63
W. attu	39056	11.83	66823	5.07	1149	0.32	107033	5.35
A. oligolepis	28560	8.65	184552	14.00	2534	0.72	215646	10.77
H. fossilis	14466	4.38	371001	28.14	-		385467	19.25
C. batrachus	1242	0.38	90914	6.90	62	0.02	99218	4.61
C. striatus	54399	16.48	88079	6.68	2928	0.83	145406	7.26
C. punctatus	34226	10.37	24069	1.83	3171	0.90	61466	3.07
M. gulio	19527	5.92	67688	5.13	61392	17.36	158607	7.42
A. bicolor	1422	0.43	6434	0.49	825	0.23	8681	0.43
M. cephalus	910	0.28	2951	0.22	13313	3.77	17174	0.86
M. parsia	664	0.20	1416	0.11	15665	4.43	17745	0.89
L. calcarifer	741	0.22	3080	0.23	12533	3.54	16354	0.82
Miscellaneous	20685	6.26	25045	1.92	17445	4.94	63175	3.15
Total	330078		1318516		353561		2000155	

Chinayedlegadi: Plankton density ranged from 6 u l^{-1} (December 1989) to 45 u l^{-1} (August 1989) at this centre.

Polraju drain. Plankton count varied from 8 u l^{-1} (April 1989) to 47 u l^{-1} (October 1989).

Upputeru drain : Volumetric estimation of plankton at Tadinada showed peaks in production during May (0.1 ml) June (0.2 ml) and February (0.1 ml). Marine plankton like *Microcyclops*, medusae, nauplii of *Balanus*, and *Euterus acutiformes* were also rarely encountered in the collections due to the tidal influence in Upputeru. Phytoplankton population was dominated by blue green algae represented by *Spirulina*. Numerical abundance ranged between 2 u l^{-1} (October 1989) to 225 u l^{-1} (May 1989).

Bottom Fauna: ranged between 65 u m^{-2} in June at Pedayedlagadi to 1443 u m^{-2} in July at Polraju drain. Different generea encountered in the Kolleru collections were *Bellamya dissimilis*, *Indoplanorbis exustus* and *Melania striatella tuberculata* among Gastropods *Corbicula*, *Lemnea* and *Parresia corrugata* among bivalves, *Neroids* (polychaete), Oligochaete worms, and *Gammarus* (Amphipod).

Macrovegetation: Weed infestation was higher during the post-monsoon ranging from 10 to 12.5 kg m^{-2}, compared to lower production of 0.3 -1.6 kg m^{-2} during the pre-monsoon in western part of Kolleru. *Eichhornia crassipes* and *Ipomea canuatica* were the dominant macrophytes in Western Kolleru. The other forms of weeds were *Nymphoides*, *Alternanthere sessilis*, *Cyperus platystylis*, *Phrogmatis communis*, *Ottellia*, *Salvinia*, *Vallisneria spiralis*, *Platystylis*, *Corunebosis* and *Hydrilla*.

iii) Physico-chemical features of soil, water and primary productivity

The discharge of untreated sewage wastes and industrial effluents into peripheral regions of the lake showed pollutional effect especially during summer months. Severe pollution was noticed when dissolved oxygen depleted to the level of 0.24 to 0.40 mg l^{-1}. Primary productivity was estimated at nil to 41.66 mg m^{-3} hr^{-1}. At Tadinada, the water did not show any remarkable change in 6 to 12 hourly chemical condition but its productivity was low in most part of the year. However, it was found to be moderate (41.66 mg C m^{-3} hr^{-1}) in the month of April.

pH of the water fluctuated in the range of 7.4 to 8.4 and transparency 31.5 to 66.0 cm. The salinity showed high range of 4.2 ppt to 6.25 ppt during the month of May and June with high ionization capacity of water (11470.0 to 14950.0 micro-mhos cm^{-1}). The salinity was reduced to 0.098 ppt during September due to dilution and during winter it ranged from 0.30 to 0.50 ppt. High content of CO_2 (1.6 to 17.20 mg l^{-1}) was observed during May and Alkalinity (320.0 to 360.0 mg l^{-1}) during November. D.O. was low (0.72 to 4.2 mg l^{-1}) in November. But during September it increased to 5.2 to 7.2 mg l^{-1}. Total Alkalinity, hardness, sp. conductance and primary productivity fluctuated between 155.0 and 360.0 mg l^{-1}; 120.0 and 240.0 mg l^{-1}; 945.0 and 14950.0 micro-mhos cm^{-1} and nil and 41.66 mg C m^{-3} hr^{-1} respectively.

Soil sampling was restricted to western part of lake. The high value of conductance gives an indication of saline nature of soil. Bottom energy in the form of organic detritus was high (274.0 to 577 K cal m^{-3}) in all the centres.

PROJECT FC/B/7

INVESTIGATIONS ON FACTORS RELATING TO DECLINE IN FISHERY OF RIVERS GANGA AND YAMUNA

Personnel : Ravish Chandra, S.K. Wishard, D.N. Singh, R.K. Saxena, M.A. Khan, Balbir Singh, G.N. Srivastava, R.K. Dwivedi, R.K. Tyagi, H.P. Singh, P.K. Katiha, S.K. Mukhopadhyay, V. Pathak, K.P. Srivastava, V.R. Chitranshi, P.N. Jaitly, A.R. Chaudhuri, N.K. Srivastava, D.N. Srivastava, B.D. Saroj, Ram Chandra, J.P. Misra, Bhai Lal, M.P. Singh, Saket Kumar

Duration : 1986-1991

Location : Riverine Division, Allahabad/Patna Research Centre and Lalgola Survey Centre

Sub-Project - A : Population structure, breeding biology and recruitment of *Tenualosa ilisha*

The fishery of hilsa at Allahabad which was maintaining a steady trend of revival from 1984 to 1987 (Av. 1.8 t) dropped to 1.2 t during 1988-89 and the declining trend continued during 1989-90 (0.7 t). This decline in hilsa population is attributed to the severe draught experienced during 1987 in the country as a whole, and the stretches of the Gangetic Valley in particular. Monsoon failure was also observed during 1989.

The estimated market arrival of hilsa at Allahabad during the period under report was 724.40 kg. At Sadiapur, hilsa landings during the peak months *viz.*, September, October and November were 4.75 kg, 369.87 kg and 66.64 kg respectively, as against 200.44 kg, 475.00 kg and 189.19 kg during the same months of 1988. In Daraganj, hilsa catch was estimated at 110.44 kg, 39.00 kg, 54.25 kg and 164.25 kg during October, November, December and January respectively in 1988-89 while in 89-90 the landing figures were 188.01 kg, 13.50 kg, 3.10 kg and nil during October, November, December and January respectively. Patna Centre contributed only 0.03 t of hilsa, in contrast to 0.11 t during 1988-89.

Investigations on natural spawning of hilsa were continued at Madhuka, Lawain (Allahabad), Vindhyachal, Sindhoraghat (Mirzapur), and Ramnagar/Samneyghat (Varanasi). Intensive natural breeding of hilsa, though restricted for two months (September and October), was reported this year in a limited area around Allahabad.

Fry and fingerlings of hilsa were reported in catches at Sadiapur fish assembly centre during January and February, 1990 when 40-150 fingerlings, in the size range of 50-80 mm, were recorded.

Sub-Project - B : Estimation of biological and population parameters of commercially important fish species

The drought of 1987 and the scanty or erratic rains of 1988 affected the fishery as a whole. During the period under report, the fish landings at Sadiapur and Daraganj landing centres at Allahabad and Patna were estimated at 84.92 t, 25.44 t and 39.92 t respectively. The landings at Sadiapur declined by 15.8%, compared to 1988. The decline was more pronounced in case of *L. calbasu* and miscellaneous group of fishes. The species-wise break-up is given in Table 1.

Table - I Fish landings in tonnes

Species	Sadiapur	Daraganj	Patna
C. mrigala	3.82	0.75	0.50
C. catla	1.44	0.01	2.34
L. rohita	3.56	0.33	1.65
L. calbasu	6.88	0.52	0.51
Total Major Carps	15.70	1.61	5.00
M. aor	11.81	1.30	4.16
M. seenghala	11.47	2.72	3.74
W. attu	1.48	0.17	1.22
Total selected Cat Fishes	24.76	4.19	9.12
H. ilisha	0.54	0.37	0.03
Miscellaneous	43.92	19.27	25.77
Total	84.92	25.44	39.92

The MSY for *L. calbasu* (based on the available past data) was estimated at 47.15 t, which is far above the present level. Among catfishes, *M. aor* and *M. seenghala* showed an improvement in their MSY levels which stood at 12.09 t and

12.56 t. Miscellaneous group was the worst affected along with *R. rita* and small fishes. The landing of *R. rita* was half the level of 1988, while that of miscellaneous group declined by 30% this year. Daraganj fish landing centre did not show much change as compared to 1988 (28.01 t), both qualitatively and quantitatively. At Patna, the landings showed a decline of 33.0%, compared to 1986-88. The decline was almost uniform for all of the commercially important species.

The juvenile fishery of major carps was almost negligible at all the centres and was estimated at 23.0 kg at Allahabad and 25.6 kg at Patna.

The mean lengths of commercially important species at Sadiapur were higher and significantly different statistically from 1988, barring *Labeo calbasu* and *Tenualosa ilisha.*

The yield (kg ha^{-1}) for Allahabad and Patna are depicted in Figure 1. The yield rate for both the centres showed a sharp decline as compared to the past.

Sub-Project - C : Studies on the breeding and recruitment of selected commercial and non-commercial fishes

To study the spatio-temporal variations in the availability of spawn/fry/fingerlings of major carps, investigations were conducted on the river Yamuna at Madauka and on the river Ganga at Chhatnag and Patna.

The Yamuna

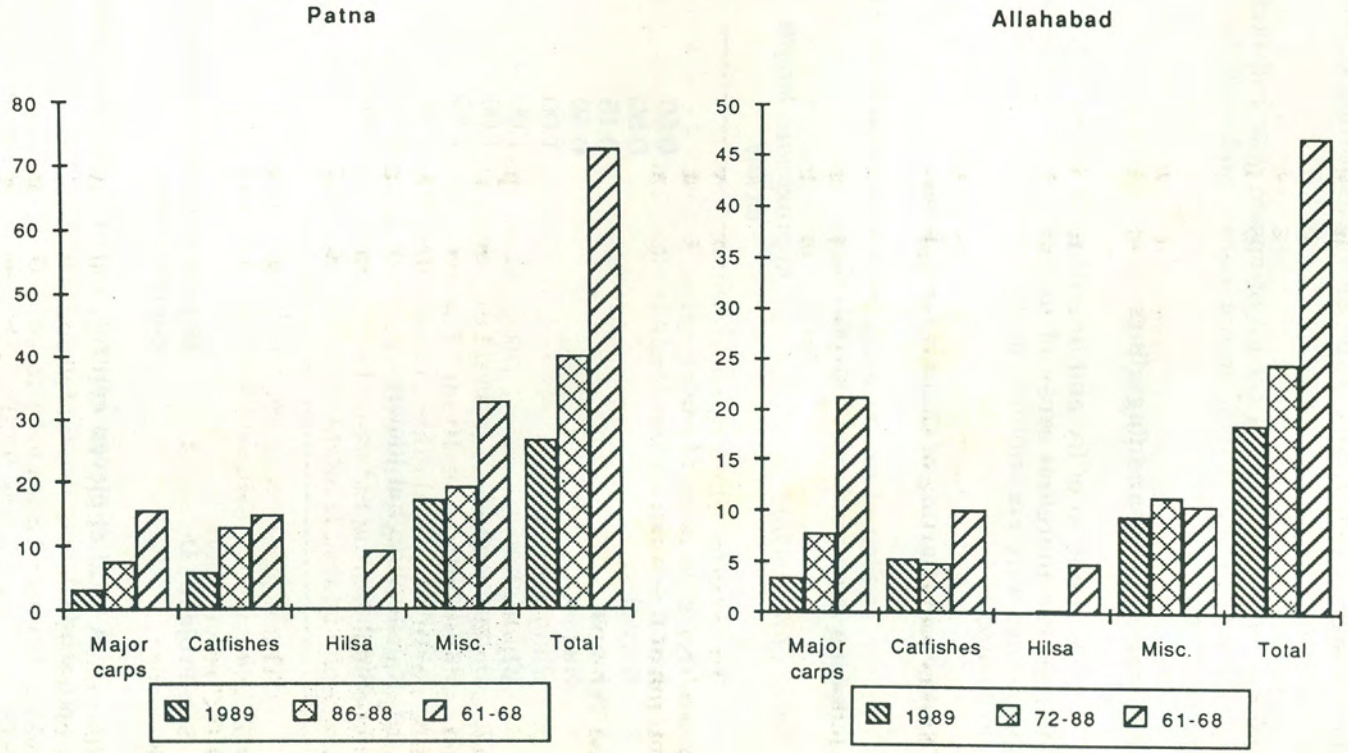
Madauka: A total of 3600 ml of spawn was collected by operating five shooting nets as against 6095 ml in previous year. The maximum catch per net per hour was estimated at 10 ml. The average composition of major carp was 30%, while minor carp and others constituted 70%. Seasonal indices of spawn quality and quantity were estimated to be 710 ml and 49.6% respectively. Nursery and plastic pool rearing indicated the percentage of major carp to be 49.6% constituting *C. mrigala* 24.0%, *L. rohita* 16.0%, *C. catla* 8.3% and *L. calbasu* 1.3% respectively.

The current velocity, turbidity and water temperature during the spawn availability period fluctuated between 0.40 to 1.6 km/h, 500 to 1200 ppm and 28.5 to 31.0°C respectively.

The Ganga

Chhatnag: A total of 520 ml of spawn was available. The maximum catch/net/hour was estimated to be about 2 ml. The seasonal indices of quantity and quality were estimated to be 100 ml and 38.0%. The average percentage of major carp spawn was 22.0%. The desirable spawn in two spurts was estimated at 9.4% and 34.6% respectively. Nursery and plastic pool rearing indicated the

Figure 1. Decline in fish yield (kg ha^{-1}) in Allahabad and Patna



percentage of major carp to be 38% constituting *C. mrigala* (24.5%) and *L. rohita* (13.5%).

Patna: A total of 69 ml of spawn was collected during the whole season comprising major carps, minor carps, and catfishes (38.3%, 45% and 16.7% respectively).

Estimation of fry and fingerlings

Estimation of fry and fingerlings of major carps was done by operating drag nets in the marginal areas of main river as well as in cut-off pools. While no fingerlings were encountered in the main river, they were collected from the cut-off pools *(Kol).*

Survey and charting of shelters/deep pools

A stretch of river Ganga from Allahabad to Fatehpur was surveyed and the following deep pools were identified:

Name of the village	*Approximate length (in km)*	*Depth (in metre)*
1. Kurai	0.50	15
2. Karaghat	0.50	20
3. Ezuva	0.15	10
4. Navasta	0.50	40
5. Champutpur	1.00	18
6. Ujjanighat	1.00	25
7. Badanpurghat	1.00	10
8. Palhanai	1.50	40
9. Kanithi	1.00	40
10. Kalakankarghat (down)	0.50	30
11. Rajghat	0.50	15

Sub-Project - D : Impact of environmental changes on the biotic communities

A total of eleven centres, nine on the river Ganga and two on the Yamuna, were studied.

The River Ganga

During the current year, pollution effects from industrial sources were of a lesser magnitude at Allahabad, compared to 1988-89, as the effluents from the

Naini industrial area were mixed with the city sewage and diverted for irrigation purposes. Water quality parameters like temperature, pH, free carbon dioxide, bicarbonate alkalinity, DO, specific conductivity, total dissolved solids, NO_3 and PO_4 were studied at Kanpur, Allahabad and Varanasi. Discharge of textile and tannery wastes into the river resulted in lowering transparency and pH at Kanpur due to precipitation of colloidal particles as a result of higher concentration of eloctrolytes, as evident from the higher values of specific conductivity and TDS.

Soil quality was monitored at Bhagwatghat and Naini in the context of industrial effluent discharge. While the textile mill wastes resulted in increase of alkalinity, sewage polluted zones at Rajghat (588-817 μ mhos cm^{-1}) and Mehdauri (206-408 μ mhos cm^{-1}) recorded an increased specific conductivity. Organic carbon was low (0.29%) in the freshwater zone, compared to the polluted zone (1.3%). Concentration of zinc, arsenic and chromium in soil ranged from 28.72 to 96.82, 6.1 to 21.21, and 3.82 to 16.86 $\mu g\ g^{-1}$ of soil respectively.

The gross primary productivity declined from 68.7 to 56.25 g C m^{-3} hr^{-1} at Bhagwatghat due to industrial effluents. At Jajmau, on the contrary, the sewage effluents resulted in an increase of gross primary productivity from 50-187.5 mg C m^{-3} day^{-1} to 87.5-287.5 mg C m^{-3} day^{-1}. Changes in primary productivity rates due to the discharge of sewage and city wastes, were discernible in Rajghat and Nagawa.

Concentration of zinc, arsenic, and chromium in water varied from traces to 48.0 $\mu g\ l^{-1}$, 6.74 to 27.08 $\mu g\ l^{-1}$ and 0.84 to 2.96 $\mu g\ l^{-1}$. Bioaccumulation of the heavy metals was detected in tissues of *Mystus seenghala, Bagarius bagarius, Channa* sp. and *Puntius* spp. in the range of traces to 32.84 $\mu g\ g^{-1}$, 0.65 to 4.5 $\mu g\ g^{-1}$ and 0.98-6.84 $\mu g\ g^{-1}$ (zinc, arsenic and chromium respectively). Quarterly monitoring of BOD in the river system indicated that Kanpur recorded the highest (14.72-246.0 mg l^{-1}) values followed by Varanasi (8.2-246.0 mg l^{-1}) and Allahabad (7.38-66.6 mg l^{-1}). Tannery wastes were found responsible for the higher BOD values.

In general, the ameliorating influence of sewage treatment and diversion was clearly visible through lower values of BOD and COD, compared to 1988-89. However, the tannery wastes continued to affect the water quality.

Plankton

Plankton community was regularly monitored at Kanpur, Jajmau, Bhagwatghat, Fatehpur, Mehdaurighat, Mavaiya, Manaiya and Varanasi. Total plankton population was not affected by the tannery, sewage and industrial effluents, though the pollution load was reflected by the presence of indicator species like *Zooglaea remigera* (bacterium) and low species diversity of Chlorophyceae.

There was a drastic reduction in the benthic community from 132 660 units m^{-2} to 440 units m^{-2} due to tannery wastes at Kanpur. Community metabilism in the riverine ecosystem in the middle stretch of Ganga at Allahabad is depicted in Table-2.

Table 2. Rate of energy transformation by producers in different stretches of the Ganga and its tributaries

Stretches	Sampling	Rate of energy transformation (cal m^{-2} day^{-1}) Range of variation	Average
KANPUR			
Bhagwatghat	AOF	2482 - 12,170	8563
	BOF	1763 - 14,913	6905
Jajmau	AOF	1290 - 9,785	6112
	BOF	524 - 9,972	5128
Av. for the whole stretch		-	6678
ALLAHABAD			
Fatehpurghat	-	299 - 13,004	5158
Mehdauri	-	758 - 19,712	9408
Manaiya	-	295 - 8,553	3360
Av. for the whole stretch		-	4838
VARANASI			
Rajghat	AOF	346 - 8,468	3679
	BOF	423 - 1,554	939
Asighat	AOF	606 - 4,235	2384
	BOF	134 - 3,209	1752
Av. for the whole stretch		-	2298
PATNA			
Dighabata		90 - 3,714	1807
Rajapur		35 - 5,024	2093
Fatuha		125 - 3,349	1454
Hajipur		95 - 3,638	1201
Average for the stretch		-	1665

Stretches	Sampling	Rate of energy transformation (cal $m^{-2} day^{-1}$) Range of variation	Average
RIVER YAMUNA			
ALLAHABAD			
Kakerahaghat		509 - 3,422	1746
Sugawan		687 - 3754	2186
Average for the stretch		-	1967
River Punpun		403 - 4,696	1489
River Gandak		33 - 2,143	966

Shannon -Weaver Index (H)

The values of the diversity index with respect to phyto- and zooplankton and macrobenthos pertaining to a stretch of river Ganga from Kanpur to Varanasi are depicted in Table 3.

Benthic fauna was found to be a better indicator of pollution. Jajmau and Tannery wastes outfall zones recorded a benthic species diversity of 0.16, indicating high pollution. Based on phytoplankton, Bhagwatghat at Kanpur was the most polluted zone. At Mehdaurighat in Allahabad, the H was 1.31 suggesting mild pollution. Sewage polluted zones in Varanasi showed H values ranging from 0.43 (Rajghat) to 1.49 (Assisghat) indicating mild to high degree of pollution.

Table - 3 . Shannon-Weaver index (H) at various centres of the river Ganga

Centre	Station	AOF	OF	BOF	FW
		PHYTOPLANKTON			
Kanpur	Bhagwatghat	0.54	0.45	0.22	-
	Jajmau	1.49	1.01	0.54	-
	Tannery	1.99	0.96	2.09	-
Allahabad	Fatehpur (FW)*	-	-	-	1.69
	Mehdauri	1.74	1.31	1.34	-
	Mavaiya	1.82	2.12	1.69	-
	Manaiya (FW)*	-	-	-	1.59
Varanasi	Assisghat	1.49	1.26	1.13	-
	Rajghat	0.45	0.43	0.80	-
		ZOOPLANKTON			
Kanpur	Bhagwatghat	0.98	0.61	1.03	-
	Jajmau	1.33	1.33	0.79	-
	Tannery	1.33	0	0.43	-
Allahabad	Fatehpur (FW)*	-	-	-	1.14
	Mehdauri	0	0.87	0.85	-
	Mavaiya	0.95	1.10	1.00	-
	Manaiya (FW)*	-	-	-	1.22
Varanasi	Assighat	0.38	0	0.69	-
	Rajghat	1.60	1.05	1.39	-
		BENTHOS			
Kanpur	Bhagwatghat	1.64	0.41	0.59	-
	Jajmau	0.16	0.41	0.59	-
	Tannery	0.16	0.54	0.02	-
Allahabad	Fatehpur (FW)*	-	-	-	0.92
	Mehdauri	1.89	0.17	1.86	-
	Mavaiya	1.97	1.36	1.82	-
	Manaiya (FW)*	-	-	-	1.87
Varanasi	Assighat	1.28	0.75	1.21	-
	Rajghat	0.99	1.30	0.81	-

* FW indicates non-polluted water

The River Yamuna

Soil characteristics - River Yamuna

Soil was less alkaline at Kakrahaghat (pH 7.76-7.83) than at Sujawan (pH 3.0-8.5). Specific conductivity and TDS were not so high (201-255 μ mhos cm^{-1} and 101-128 mg l^{-1} respectively) as encountered in river Ganga. Organic carbon was higher at Kakrahaghat (0.51-0.84%) than at Sujawan (0.39-0.42%). Free calcium carbonate, however, was high (9.25%) in June at Kakrahaghat and low (8.0%) in January, contrary to which it was low (5.5%) in June at Sujawan and high (9.25%) in January.

Primary productivity was estimated at the BOF of Kakrahaghat and freshwater zone of Sujawan. Gross and net production varied between 28.12 and 225.0 mg C $m^{-3} hr^{-1}$ and 15.62 and 100.0 mg C $m^{-3} hr^{-1}$ respectively. Respiration varied from 15.0 to 180.0 mg C $m^{-3} hr^{-1}$. The lowest production was recorded in September.

Phytoplankton community was richer (64.86%) both at Sujawan and Kakrahaghat sampling centres, with maximum density (3885 u/l) in June and minimum (36 u/l) in November. Maximum zooplankton density (3652 u/l) was in in May and minimum (8 u/l) in November. Phytoplankton was represented mainly by *Microspora, Pediastrum, Spirogyra and Merismopedia,* while major zooplankters were *Brachionus, Keratella* and *Polyarthra.*

Macrobenthos was studied at Kakrahaghat and Sujawan. At Kakrahaghat, benthic population at the AOF was 13 122 u m^{-2}, compared to 50 430 u m^{-2} at OF and 54940 u m^{-2} at BOF, dominated by molluscs (67.5%), followed by annelids (30.87%), chironomids (1.30%) and dragonfly nymphs (0.32%). Total macrobenthic population at Sujawan was (3 349 u m^{-2}), dominated by molluscs (65.55%), followed by dragonfly nymphs (9.20%), chironomids (2.63%) and annelids (2.62%).

Sub-Project - E : Economics of Riverine Capture Fishery Operations

Higher price spread has been recorded for carps, compared to catfishes, as indicated by higher gross price shares for retailers at 27.23 per cent in case of the former and 14.36 per cent for the latter. The fishermen's share for carps and catfishes were estimated at 65.09 and 76.64 per cent respectively with an overall percentage of 69.91. Wholesalers' share in respect of both the categories did not vary much.

As in the case of the previous years, carps fetched better price than catfishes. *L. rohita* commanded the highest retail and wholesale prices at Rs. 30.95 and Rs. 25.27 respectively. No regular wholesale and retail price trends were observed over the year. The price behaviour across different size groups for current and the previous years indicate comparatively smaller difference in wholesale price for carps in current year and *vice versa* for catfishes. It is due to better prices of small-sized carps and large-sized catfishes.

The regression analysis with riverine fish landings as independent and price as dependent variables showed an insignificant correlation. This is attributed to very low share of the riverine catch in the total fish landings.

PROJECT **FC/B/9**

INVESTIGATIONS ON FACTORS RELATING TO DECLINE IN FISHERY OF THE RIVER BRAHMAPUTRA AND ITS TRIBUTARIES

Personnel : S.P. Singh, D.K. Chowdhury, S.N. Mehrotra, Y.S. Yadava (upto July 1989), M. Choudhury (upto November 1989), A. Sarkar, B.K. Biswas

Duration : October 1985-September 1990

Location : Guwahati

ENVIRONMENTAL IMPACT ASSESSMENT

The Elanga group of beels receives wastes from Hindustan Paper Mill @ 72,000 $m^{-3}\,d^{-1}$. This enormous discharge of effluents affects the water quality of beel by altering its pH (6.4 - 7.6), alkalinity (138-230 mg l^{-1}), conductivity (658-1549 micro mhos cm^{-1}) and total dissolved solids (334-560 mg l^{-1}). Very low values of dissolved oxygen (0-0.64 mg l^{-1}) was accompanied by high concentration of free CO_2(48-52 mg l^{-1}). Carbon fixation in the sector I of the beel remained nil. Table 1 depicts the water quality of river Brahmaputra as assessed at Noonmati (upstream of Guwahati city) and Saraighat (downstream of Guwahati).

Table 1. Physico-chemical features (range) of river Brahmaputra at Noonmati and Saraighat sites

Sl. No.	Parameters	Noonmati	Saraighat
1	Water temperature (°C)	21.5-29.0	20.00-27.50
2	Transparency (cm)	9.0-13.0	11.0-14.0
3	pH	7.6	7.6
4	Free CO_2 (mg l^{-1})	4.0-10.0	4.0-8.0
5	Dissolved oxygen (mg l^{-1})	6.8-11.52	6.4-11.52
6	Total alkalinity (mg l^{-1})	50.0-54.0	52.0-56.0
7	Conductivity (µmhos cm^{-1})	97.0-140.0	102.0-142.0
8	Total dissolved solids (mg l^{-1})	46.0-68.0	48.0-70.0
9	Gross primary productivity (mg C m^{-3} hr^{-1})	16.67-89.59	50.0-83.34
10	Net primary productivity (mg C m^{-3} hr^{-1})	Nil - 83.34	50.0-83.34
11	Respiration (mg C m^{-3} hr^{-1})	Nil - 66.67	Nil - 25.00

FISHERIES

Estimated fish landings at Guwahati (Uzanbazar) and Jorhat fish assemply centres were 246.93 t and 36.40 t respectively as against 52.12 t and 23.89 t during the corresponding period of the previous year. Species-wise details of the landings are given in table 2. The operation of clap net *(shangla jal)* continued except during heavy floods. The main catch in *shangla jal* was hilsa. Other nets found in operation round the year were dip nets *(dheki jal)*. cast nets *(asra jal)*, and scoop nets *(thela jal)*. The catch in these nets comprised miscellaneous fishes and prawns.

Table 2. Species-wise fish landings (t) in Brahmaputra at two centres

	Uzanbazar	*Jorhat*
L.rohita	34.68	0.95
C.catla	28.04	2.17
C.mrigala	0.79	0.23
L.calbasu	4.99	0.00
Major Carps	**68.50**	**3.53**
L.gonius	4.92	0.77
C.reba	27.08	0.33
L.bata	28.60	0.21
Minor Carps	**60.60**	**1.31**
W.attu	22.98	0.75
M.seenghala	2.29	1.84
M.aor	1.35	0.41
Large catfishes	**26.62**	**3.00**
Other catfishes	4.80	5.52
N.chitala	9.68	0.68
N.notopterus	7.90	0.00
Featherbacks	17.58	0.68
H.ilisha	5.47	0.49
Miscellaneous	63.36	22.05
TOTAL	**246.93**	**36.40**

PROJECT FC/B/10

EVALUATION OF FISH COMMUNITY STRUCTURE IN THE CONTEXT OF ENVIRONMENTAL MODIFICATIONS IN RIVER YAMUNA

Personnel : D.N. Mishra, Usha Moza, Krishna Chandra, V. Kolekar, Ramji Tiwari, Sudarshan Bandopadhyay

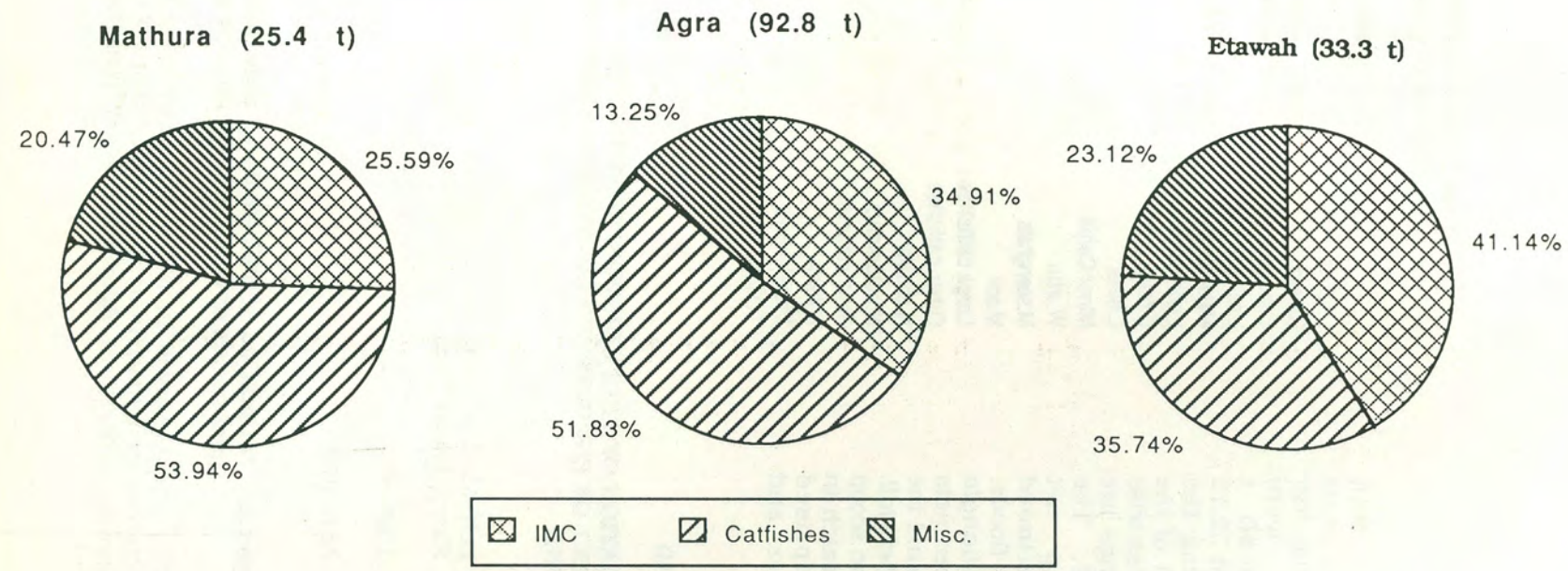
Duration : 1989-90

Location : Agra (U.P.)

Sub-Project A. **Estimation of biological and population parameters of commercially important fish species.**

Intensive fishing was observed in the stretch extending from Keravali to Strechi bridge. The average catch/man/hour was estimated at 690 gms by drag net. The estimated fish landings at Mathura, Agra and Etawah from River Yamuna have been shown in Figure 1.

Figure 1. Estimated fish landings in Mathura, Agra and Etawah



Biology of fishes

Biology of *W. attu* and *L. calbasu* was studied. The length-weight relationship of *L. calbasu* can be described by the equation :

$$\log W = -3.6151 + 2.5415 \log L \ (r = 0.9962).$$

Sub-Project B. Abundance pattern of various biotic communities in relation to environmental changes.

The spatio-temporal variations in the availability of major carps spawn/fry were studied during July/August 1989. Out of the three spurts observed, spawn was noticed in the second spurt. About 12 lakh spawn of minor carps and forage fishes were collected by operating eight sets of shooting nets.

Availability of spawn of common carp, *C. carpio communis* was observed in the Yamuna in Ramghat area near Wazirabad.

Sub-Project C. Abiotic determinants of production functions in the ecosystem.

The detailed survey of Ghaziabad indicated no discharge of industrial or sewage wastes into the River Yamuna at Ghaziabad. However, the wastes were being discharged into the Hindon river.

The hydrobiological studies indicated high rate of pollution at Delhi followed by Agra, Mathura and Etawah. The maximum adverse impact was noticed during summer and winter months, especially at Delhi and Agra when discharge rate of water was very low in these stretches. The BOD value at OF was 405 mg l^{-1} at Delhi, 236.50 mg l^{-1} at Agra, 131.88 mg l^{-1} at Etawah and 26.21 mg l^{-1} at Mathura. The BOD values of freshwater zones were14.05 mg l^{-1} at Delhi, 10.0 mg l^{-1} at Agra,5.42 mg l^{-1} at Mathura and 7.44 mg l^{-1} at Etawa.

Severe impact was recorded at Delhi from outfall of Najafgarh drain to downstream of Okhla sewage treatment plant (13 km). At Agra water works, an estimated 9 km stretch was polluted. Pollution was recorded at Mathura 1 km from above the outfall of dye industry and the oil refinary wastes the impact of which was noticed 50 to 500 m downstream, depending upon season and quantum of river discharge. The Etawah centre showed maximum impact during summer, followed by winter months.

The primary productivity studies at Delhi, Mathura, Agra and Etawah centres veried within a narrow range in unpolluted zones; gross production being 67.50-270.0 (Delhi), 95.18-270 (Agra), 33.75-212.25 (Mathura) and 29.51-180.0 mg C $m^{-3}hr^{-1}$ respectively. The outfall at Agra indicated gross production in the range of 210.28-310.50 and a net production of 47.59-49.56 mg C m^{-3} hr^{-1}. The same at Mathura indicated 33.75-212.25 and 9.05-90.0 mg C m^{-3} hr^{-1}respectively.

Plankton

The average annual plankton density at the unpolluted zone at different sites along the Yamuna was 475 u l^{-1} (Delhi), 2567 u l^{-1} (Mathura), 2100 u l^{-1} (Mathura Oil Refinary), 1460 u l^{-1} (Agra) and 2024 u l^{-1} (Etawah). The total plankton density at polluted areas of river Yamuna was considerably high at Delhi being 850 u l^{-1} in outfall but came down below outfall region, being only 375 u l^{-1}. At Mathura the polluted zone had less population density compared to unpolluted zone. Total plankton density at Agra did not vary much among different zones. At Etawah, the population decreased considerably, being 1800 u l^{-1} (Out Fall), and 1301 u l^{-1} (Below Out Fall). Phytoplankton formed the bulk of planktonic fauna all along the Yamuna constituting 72.64-93.64% in unpolluted zone and 61.46-86.42% in polluted zone.

Macrobenthic Fauna

The average annual macrobenthos density recorded at Agra, Mathura, Etawah and Delhi centres was 9216.9 u m^{-2} 2315 u m^{-2}, 5409 u m^{-2}, and 239 u m^{-2} respectively. The maximum occurrence of organisms was found during December (48939.6 u m^{-2}) at Agra, November (20955 u m^{-2}) at Mathura, January (44978 u m^{-2}) at Etawah and May (952.5 u m^{-2}) at Delhi centres.

The density of benthic organisms in sewage polluted areas of the river Yamuna was very high ranging between 86.6 u m^{-2} and 20086.5 u m^{-2} at Agra, 86.6 u m^{-2} and 3746 u m^{-2} at Mathura and 173 u m^{-2} and 9827 u m^{-2} at Etawah centres, respectively. At Delhi, however, the sewage zone exhibited low availability of organisms.

***Sub-Project D*. Economics of capture fisheries operations**

The prices of different species of fishes from riverine sources and other water resosurces were recorded through well-designed pre-tested schedules. The only market channel observed was the *fishermen-wholesaler-retailer-consumer* chain. Carps fetched higher prices than all other species including catfishes. The price increased across small to large size fishes.

PROJECT FC/A/4

ECO-DYNAMICS AND FISHERY MANAGEMENT OF BEEL ECOSYSTEMS IN WEST BENGAL

Personnel : Arun G. Jhingran, K.K. Vass, V.V. Sugunan, H.C. Joshi, G.K. Vinci, K. Mitra, N.N. Mazumder

Duration : Upto March 1990

Location : Garapota and Mogra Beels in the district of 24 Parganas (N), West Bengal

A. Limno-chemical Studies

pH of both the beels was moderately alkaline. The values for alkalinity, hardness and specific conductivity indicated the water quality conducive to fish growth. The appreciably higher values of chloride suggested regular discharge of sewage into these systems. The beel sediment had alkaline pH. The detection of mercury in Garapota beel (water phase) was very significant. Although the levels were as low as 0.05 ppb, its presence, estimated on the basis of dry wt., in sediment (0.22 $\mu g\ g^{-1}$) , fish (0.37 $\mu g\ g^{-1}$) and plant (3.49 $\mu g\ g^{-1}$) indicated that entire food chain was contaminated.

B. Bio-limnological Studies

Among algal populations, *Ceratium* and *Dynobryon* constituted dominant forms. Both horizontal and vertical variations in population density were noted. The total phytoplankton density ranged from 20 to 112 x 10^2 unit l^{-1} .The vertical density distribution of phytoplankton was correlated with trend in primary production profile, and phytoplankton biomass ranged from 0.5 to 2.0 mg l^{-1} dry weight. The zooplankton population was mostly dominated by rotifers especially *Keratella, Asplanchna* and *Notholeca.* The plankton blooms were usually short-lived. Macrophytic component in the beel was represented by three life forms *viz.* submerged, rooted floating and emergent. The standing crop of macrophytes in terms of dry weight ranged from 80.7 to 242.5 g m^{-2}. Among benthic communities mollusca dominated followed by dipterans and hemipterans.

C. Fish and Fisheries

The predominant fishery of both the beels was Indian major carps, followed by the miscellaneous group. Total fish production for the year in Garapota was estimated at 47548 kg (530 kg ha^{-1}). The yield rate of Indian major carps in this beel was 475.5 kg ha^{-1} . In Mogra, the fish landings comprised 18055 kg of major carps and 3245 kg of miscellaneous fishes at a total yield rate of 300.8 kg ha^{-1}. On an average, the catch per day ranged from 5.74 kg to 391.48 kg with a mean of 130.11 kg in Garapota beel. The daily catch in Mogra ranged from 16.5 kg to 355.5 kg day^{-1} with the mean at 62.9 kg.

In Garapota beel, stocking was done at the rate of 2200 fingerlings ha^{-1} (107.5 kg ha^{-1}) and the stock comprised catla, rohu and mrigal.

D. Organic Production and Energy Transfer

It has been estimated that in Mogra and Garapota beels, annual phytoplankton carbon fixation was 3.29t and 4.81t respectively. The photosynthetic efficiency ranged between 0.075% - 0.868% in Mogra and between 0.069% - 0.659% in Garapota beel. The activity coefficient values are given in Tables 1 & 2. The energy transfer estimates in two beels differ markedly due to different eco-biotic communities. In Garapota beel, total energy-fixation at the primary level was estimated at 155 x 10^5 cal m^{-2} y^{-1} , while fish harvest was only 63600 cal, which gives a corresponding conversion of 0.409%. On the other hand in

Table -1 Activity coefficient in Garapota beel, 1989-90

Month	Phytoplankton biomass mg m^{-2} within 0-4 m Trophogenic layer		Primary Prroduction mg c m^{-2} d^{-1}	% of Biomass renewed by one day phytosynthesis	F/B ratio	Photosynthetic efficiency
	Algal Fresh wt.	Organic Carbon				
March'89	25639	3333.07	2370	71.12	0.092	0.659
April	10335	1353.5	1050	77.6	0.101	0.292
May	6619	860.5	740	86.04	0.111	0.205
June	4670	607.1	980	161.45	0.209	0.272
July	1259	164.7	470	284.84	0.373	0.130
August	9842	1279.5	1580	123.43	0.160	0.439
September	14071	1829.26	1260	68.9	0.089	0.350
October	13281	1726.53	2180	126.30	0.164	0.606
November	18750	2437.50	2490	102.17	0.132	0.069
December	11625	1511.25	980	64.85	0.084	0.272
January'90	1566	203.58	470	231.5	0.300	0.130
February	8900	1157	1260	108.9	0.141	0.350
Mean	10546.4	1372.9	1320	125.6	0.163	0.314

Table -2 Activity coefficient in Mogra beel, 1989-90

Month	Phytoplankton biomass mg m^{-2} within 0-4 m Trophogenic layer		Primary Prroduction mg c m^{-2} d^{-1}	% of Biomass renewed by one day phytosynthesis	F/B ratio	Photosynthetic efficiency
	Algal Fresh wt.	Organic Carbon				
March'89	12840	1669.20	1684	100.9	0.131	0.468
April	3680	478.40	685	143.3	0.186	0.190
May	2465	320.45	470	146.8	0.190	0.130
June	6230	809.90	680	84.0	0.109	0.189
July	2140	278.20	295	105.7	0.137	0.082
August	4670	607.10	1085	178.7	0.232	0.301
September	6350	825.50	860	104.2	0.135	0.239
October	9845	1279.85	1470	114.8	0.149	0.408
November	14840	1929.20	1870	97.97	0.127	0.525
December	4566	593.58	560	94.27	0.122	0.155
January'90	2530	328.90	270	82.0	0.106	0.075
February	3655	475.15	780	164.2	0.213	0.216
Mean	6150.9	799.6	904	118.07	0.153	0.248

Mogra beel total energy fixation was estimated at 273 x 10^5 cal $m^{-2} y^{-1}$ and the fish harvest comes to only 42 000 cal m^{-2} y^{-1}, thus giving a conversion ratio of 0.133%.

E. Pen culture Experiment and Disease Monitoring

A split bamboo pen of 400 m^2 size was erected in Garapota beel and stocked with species combination of *Catla catla, Labeo rohita, Cirrihinus mrigala* and *Cyprinus carpio.* It is anticipated that a fish biomass of 85-120 kg can be obtained from this pen at an estimated production range of 2.2-3.0 t ha^{-1} from the pen enclosure.

Epizootic ulcerative syndrome was recorded from Garapota beel in spring last year. Comparative bacteriological analysis of water revealed that mean density of coliform bacteria was 36 and 13 MPN/100 ml of water from open beel and pen enclosure respectively. Liming @ 200 kg ha^{-1} has been suggested as a prophylactic measure against the EUS.

PROJECT FC/A/6

ECONOMICS OF FISHING - A CASE STUDY OF SELECTED RESERVOIR

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

Duration : Upto March 1991

Location : Barrackpore

Reservoirs under study indicated low productivity and consequent low income. This trend was more discernible in respect of Ukai, Nagarjunasagar and Rihand. With the exception of Bhavanisagar and Govindsagar, all other reservoirs under review were generating low income for the fishermen (ranging from Rs. 1000 to 4000 per annum). The stocking programmes were generally devoid of any rationale behind them, as no visible impact could be seen on productivity or production. Free fishing as practised in several reservoirs of Andhra Pradesh is antithetical to fishery development, since relationship between effort and production is not clearly established.

Chances of creating additional employment in reservoir fisheries are very bleak. Unless average fish yield is stabilized at 50 kg ha^{-1} or above by 2000 AD, poverty among fishermen will continue to persist.

PROJECT FC/A/7

FISHERIES MANAGEMENT OF FRESHWATER RESERVOIRS

Personnel : Y. Rama Rao (From 23 January 1989 to July 1989), Ch. Gopalakrishnayya (From 31 July 1989), A.K. Lal, D.S. Krishna Rao, P.K. Sukumaran, M. Choudhury, M.F. Rahman, P.L.N. Rao, M.D. Pisolkar, B.K. Singh (Upto 4 September 1989), B.L. Pandey (From 18 August 1989), D. Saha (Pune), G.K. Bhatnagar, D.K. Kaushal, V.K. Sharma, Syshil Kumar (Bilaspur), V.R. Desai, Dhirendra Kumar, N.P. Srivastava, K.K. Agarwal (Raipur)

Duration : 1987-1992

Location : Bangalore, Pune, Bilaspur, Raipur

Upto September 1989 - KRS
From September 1989 - Markonahalli Reservoir

Markonahalli Reservoir (From September 1989)

Preliminary investigations were carried out during the period to assess the water quality and biogenic productivity of the reservoir. Markonahalli is a small irrigation reservoir impounded in the year 1939 on the river Shimsha at Markonahalli village of Tumkur District, Karnataka. It is situated at latitude 12° 55' 0" N and longitude 76° 55' 15" E. All the physico-chemical parameters indicated the productive nature of the reservoir. Water temperature ranged from 22 to 26.2°C and the transparency range was from 60 to 94 cm. Water was alkaline in reaction within the pH range of 7.2 to 8.4. Other abiotic and biotic parameters in ranges were as follows :

DO : 6.4 to 7.0 mg l^{-1} ; M.O. alkalinity : 104.0 to 140.0 ppm. specific conductivity :167 to 204 micro mhos; phosphate: in traces to 0.028 mg l^{-1} ; nitrite and nitrate nitrogen : in traces and silicate : from 8.0 to 11.0 ppm.

Standing crop of plankton was estimeted at 0.01 to 0.1 ml l^{-1} (6 to 128 u l^{-1}) and the density of benthic population varied from 20 to 661 u m^{-2}. Primary productivity values indicated erratic trend ranging from 266.03 (November) to 123 (January) mg C m^{-3} hr^{-1}. Community respiration ranged from 21 to 112.5 mg C m^{-3} hr^{-1}. Aquatic macrophytes comprised *Hydrilla vorticilata, Vallisneria appendiculata* and *Potamogeton* spp. Among them, *Vallisneria appendiculata* was dominant with a biomass of 4.4 g m^{-2}.

The fish fauna mainly comprised *Cirrhinus mrigala, L. calbasu, P. sarana, P. dorsalis, C. reba, P. bimaculatus, W. attu, Notopterus notopterus* and *Cyprinus carpio* var *communis*.

Krishnarajasagar (Upto September 1989)

Physico-chemical parameters :

In Krishnarajasagar reservoir, the water temperature and transparency ranged from 24.5 to 27°C and 50-100 cm respectively. The water was alkaline (pH 7.3 to 8.0). The other parameters ranged as follows :

Dissolved oxygen : 6.2 to 9.0 mg l^{-1}; methyl orange alkalinity : 4 to 120 mg l^{-1}; Carbondioxide : 0.4 to 8.0 mg l^{-1}; nitrate - nitrogen : 0.008 to 0.011 mg l^{-1}; and phosphate - phosphorus: 0.014 to 0.054 mg l^{-1}.

Plankton :

The variation in the settling volume of plankton ranged from 0.01 to 0.3 ml l^{-1}. The total counts of plankton varied between 6 to 496 u l^{-1}; the maximum and minimum occurring during October and August 1989. The zonal average counts showed a predominance of phytoplankton, particularly Chlorophyceae (*Spirogyra* sp., *Staurastrum* sp.,) and Bacillariophyceae (*Fragilaria* sp.). In general, the zooplankton density was less. The benthic fauna ranged from 103-633 u $m^{-2}$and the weight from 0.20-107.05 g m^{-2}.

The density of littoral organisms ranged from 1-34 u m^{-2} ; their biomass being 0.01-3.15 g m^{-2}. The forms encountered were insects, molluscs, and fish. The fishes recorded from the reservoir were, *L. calbasu* (460-495 mm/1.500-2.000 kg); *C. reba* (140-270 mm/0.080-0.160 kg); *O. bimeculatus* (160-190 mm/1.100-0.100 kg); *G. giuris* (175-250 mm/0.050-0.140 kg); *O. mossambicus* (176-204 mm/0.070 to 0.120 kg); *M. corsula* (193-207 mm/0.065-0.80 kg); *M. cavasius* (184-290 mm/0.050-0.170 kg) and *N. notopterus* (270 mm/0.140 kg).

Bhatgar Reservoir, Pune

Water level, inflow and outflow :

The average reservoir level for the period under report was found to be 612.61 m. The minimum water level was recorded in the month of June, 1989 (594.13 m), while maximum was recorded in the month of October, 1989 (622.97 m). Annual precipitation was 834.00 mm. About 642.60 mm of rainfall was recorded during the months of July to September, 1989.

Physico-chemical features of water :

		Range	Average
i)	Air temperature (°C)	15.0-26.9	21.6
ii)	Water Temperatrure (°C)	20.5-27.0	24.5
iii)	pH	7.0-7.4	7.17
iv)	D.O. (mg l^{-1})	4.2-8.4	7.1
v)	CO_2 (mg l^{-1})	0.3-6.0	3.03
vi)	Alkalinity (mg l^{-1})	19.0-31.0	22.5
vii)	Conductivity (µ mhos cm^{-1})	46.8-79.2	55.9
viii)	T.D.S. (mg l^{-1})	23.9-40.2	28.2
ix)	Chloride (mg l^{-1})	6.0-10.0	10.0
x)	Silicate (mg l^{-1})	2.5-25.0	10.0

Soil : Red loam with maximum percentage of clay (60.0%) followed by sand (32.5%) and silt (7.5%). Other detrails were as under : pH - 7.2; Organic carbon - 0.38 mg l^{-1}; Available phosphorus - 1.68 mg 100 g^{-1}.

Plankton,bottom biota and periphyton

Quantitative estimation of plankton revealed minimum abundance of 7,317 u m^{-3} during the month of October, 1989 and a maximum of 13,26,073 u m^{-3} during March, 1990; the average for the period being 2,64,874 u m^{-3}. There were two peaks of plankton one in September, 1989 and the other in March, 1990. Phytoplankton dominated over zooplankton during the period under report.

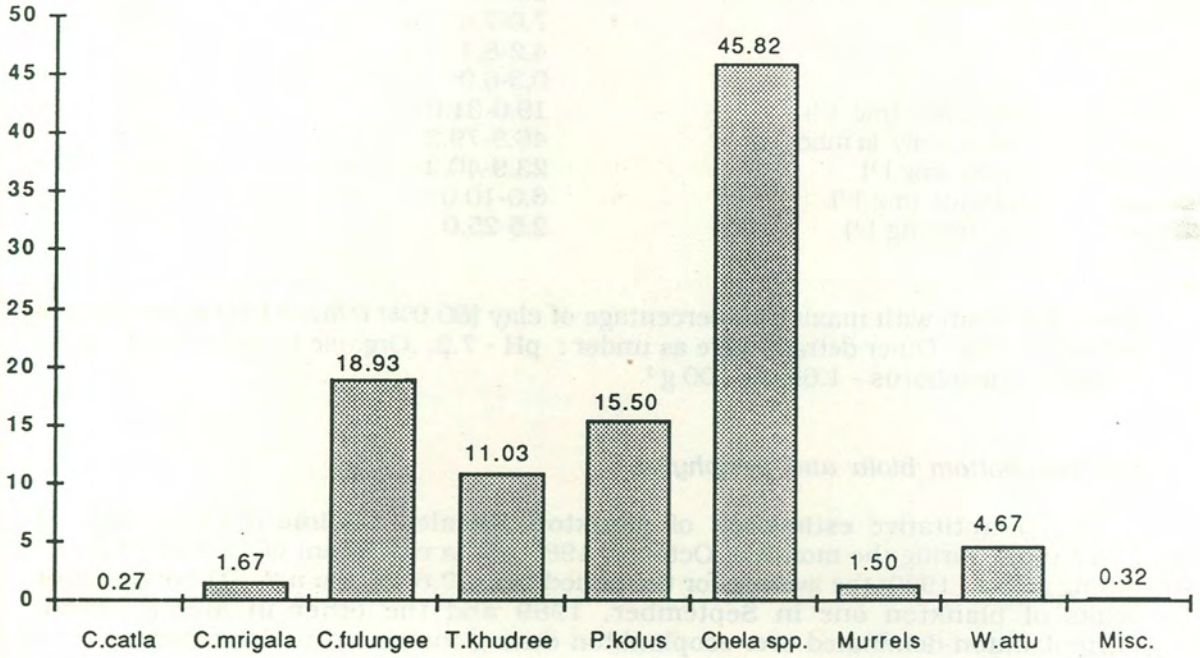
Among benthos, molluscs *viz.*, gastropods (families Planorbidae and Melaniidae) and bivalves (families Corbiculidae and Unionidae) were encountered in the reservoir. Studies of periphyton from submerged substrata in the lentic zone were continued. Average population of periphyton was found to be 3300 u cm^{-2}. The maximum was in the month of November, 1989 (7700 u cm^{-2}). Among Chlorophyceae *Spirogyra* was dominant followed by *Cosmarium* and *Pediastrum*. Periphyton density at the intermediate sector was found to be 4800 u cm^{-2}.

Epixylon samples collected from dead wood were also analysed. The average rate of abundance for the community was 7616 u cm^{-2} .The organisms encountered as per importance were *Synedra*, *Navicula* and *Anabaena*.

Fisheries

A total of 9,287.50 kg of fish were landed from Bhatgar reservoir comprising *Chela* sp. (4254.97 kg), *C. fulungee* (1758.69 kg), *Puntius kolus* (1439.81 kg), *Tor khudree* (1023.95 kg), *Wallago attu* (441.15 kg), *Cirrhinus mrigala* (155.04 kg), *Channa* sp. (140.11 kg), Miscellaneous (47.89 kg), and *Catla catla* (25.87 kg); the percentage composition given in Figure 1. About 364 gill net units with mesh range

Fig. 1 Percentage composition of fish catch from Bhatgar reservoir



of 10 mm to 150 mm were in operation resulting in a catch of 320.423 kg. The catch per unit effort was estimated to be 0.88 kg.

Breeding and recruitment

Shooting net collection from intermediate zone (12 km to the dam site) revealed the presence of juveniles of *C. fulungae*, *R. corsula* and *C. mrigala*. Oozing females and milting males were encountered in meagre numbers from the lentic zone.

Experimental fishing

Experimental fishing with departmentals gill nets resulted in stray catches of *C. mrigala* and *Wallago attu* when operated in the lentic zone.

Fish fauna

Earlier 41 species were identified from the reservoir. The following has been added.

1. *Nemachilichthys ruppelli*
2. *Puntius amphibius*
3. *Labeo sindensis*
4. *Nemachilus evagardi*
5. *Puntius phutunio*

Puntius phutunio and *Rihinomugil corsula* were encountered for the first time from Maharashtra. This may be attributed to the accidental entry of these species through fish seed purchased from Bengal for stocking.

Gobindsagar Reservoir, Bilaspur

Water level, inflow and outflow

The water level of the reservoir during the period April 1989 to March 1990, fluctuated from a minimum of 465.48 m (May) to a maximum of 508.73 m (September). The total inflow during the period was 17,75,072 ha m. This showed decline in the total inflow compared to that of 21,27,441 ha m in the preceding year, 1988-89. The total outflow during the period was 17,94,162 ha m.

Plankton

Plankton population of the reservoir showed that its abundance declined from 1382 units litre^{-1} in April to reach a minimum of 249 u litre^{-1} in July. Plankton population increased from September onwards to attain a winter peak in January (1346 u litre^{-1}) except that spurt of plankton in August (1416 u litre^{-1}). The planktonic biomass was negligible during the months of July-June while maximum of 1.22 ml m^{-3}was recorded in the month of October.

Lunkhar khad had comparatively rich plankton with an average of 923 u l^{-1} with biomass of 1.40 ml m^{-3}. Plankton population in lentic zone was estimated to be 860 u l^{-1} with 1.17 ml m^{-3}. Lotic zone had 892 u l^{-1} with 0.71 ml m^{-3} of plankton population.

Macrobenthos

The average standing crop for whole of the reservoir was estimated at 260 u/0.44 g m^{-2}. This indicated decline in the population of benthos than that of 368 u/1.28 g m^{-2} during 1988-89 and 587 u/13.40 g m^{-2} during 1987-88. It showed a bimodal pattern of distribution similar to that observed in the preceding year. The annual average bethymetric distribution of benthos showed their maximum concentration at 8 m depth in lotic zone dominated by dipteran larvae. In the lentic zone maximum abundance was recorded at 8 m, contributed mainly by dipterans and at 30 m depth, contributed by oligochaetes. In Lunkhar Khad, the maximum abundance of benthic fauna was recorded at 20 m.

Periphyton

Studies of periphytic communities showed that Bacillariophyceae remained the dominant flora both qualitatively and quantitatively (62.2-90.0%) with the maximum abundance in the month of June-July.

Fish yield

The fish landing records showed that a total of 810.6 metric tonnes of fish was landed during the period April 1989 to March 1990. Thus, a gross yield of 891.6 tonnes was estimated at the rate of 78.90 kg ha^{-1} $year^{-1}$ of fish production after considering 10% of the total landings as poaching and spoilage. Thus, the fish production increased by 5.78% compared to the 766.6 tonnes of landings during the period April 1988 to March 1989. The period from 16 June 1989 to 15 August 1989 was observed as closed season for fishing.

Spatial distribution of fish showed that maximum fish were landed at Bhakra Centre (Lentic zone) (Table1).

Stocking

A total of about 30 lakhs of fingerlings were stocked during the year 1989-90 in the Gobindsagar reservoir. This was composed of 25.88 lakhs (86.5%) of common carp and 4.02 lakhs (13.5%) of major carp. Rate of stocking is therefore 273 fingerlings ha^{-1}.

Ravishankarsagar reservoir, Raipur

The average water level of the year under report was 339.4 m against 338.8 m of last year. Like previous two years, the water did not attain FRL (348.70 m) in 1989-90 also.

Table-1 Zonewise fish landings (in kg) from Gobindsagar reservoir during the period April 1989 to March 1990

Zone / Species	Bilaspur	Bhakra	Lathiani	Total	%
C. catla	18345.5	22905.0	11857.6	53108.1	6.55
L. rohita	607.0	1378.0	711.0	2696.0	0.33
C. mrigala	119.5	655.0	1414.5	2189.0	0.27
L. calbasu	78.0	957.0	1045.0	2080.0	0.26
C. carpio	7284.1	34764.2	8820.8	50868.1	6.27
T. putitora	7607.0	15194.5	2693.7	25495.2	3.15
H. molitrix	122748.5	481828.9	53997.9	658554.4	81.24
C. idella	450.0	427.0	136.8	1013.8	0.13
M. seenghala	1139.5	620.5	2009.5	3770.0	0.47
L. dero	484.5	6919.0	3089.0	10492.5	1.29
Misc.	-	13.0	290.5	303.5	0.04
C. reba	-	-	5.0	5.0	neg.
Total	158,863.6	565,661.2	86,071.3	810,596.6	
%	19.60	69.78	10.62		

Water analysis

The water quality was comparatively in the productive range only in the month of May and the overall productivity of the reservoir was found to be low. None of the parameters estimated in the study, showed any significant variation within the three sectors of the reservoir.

Fish Catch Statistics

A total fish catch of 37,889.00 kg was landed from the reservoir this year in 235 fishing days against 17,676.3 kg of last year (163 days). The fish yield increased by 20.0 t over that of previous year, registering a rise of 114%. The per hectare fish production on average productive area of the reservoir (6380 ha) was calculated to be 6.0 kg ha^{-1} against 2.5 kg of previous year. The increase in yield was mainly due to increase in fishing effort by 170% over that of last year. The quantum jump in the fishery of this year was also witnessed from catch per day, which was found to be 161.0 kg against 118.0 kg of 1988-89 and 55.0 kg of 1987-88. The monthly fish catch in relation to fishing effort and catch/net are shown in Table 2 and 3.

The total catch was represented by four groups viz. major carps, other carps, catfish and miscellaneous fish. In the overall catch of this year the miscellaneous fish (41.99%), comprising smaller catfishes, minor carps, murrels, *N. notopterus* and minnows, were the most important followed by major carps (33.49%), catfish (23.72%) and other carps (0.80%) (Table). In view of keen competition of minnows with the major carps in feeding on plankton, this group has to be weeded out from the reservoir. The catfish population, which dominated (51.0%) till last year, was found to have dwindled this year (23.72%).

Biology of fishes

About 249 specimens of different species-wise studied for length-weight relationship.

Length-at-age of major carps is given below :

Length-at-ages (mm)

Species	*C. catla*	*L. rohita*	*C. mrigala*
1+yr	557	407	365
2+yr	700	493	462
3+yr	793	563	548
4+yr	879	-	-
$L\infty$ (mm)	1100	870	1200
Fish length-Scale length formula	Y=0.6065+0.0296X *(r=0.93)*	Y=4.5221+0.315X *(r=0.92)*	Y=0.2741+0.0214X *(r=0.95)*

Table - 2 Monthly fish catch in relation to fishing effort and fish abundance (1989-90) in Ravishankarsagar reservoir

Month	Fish catch (kg)	No. of fishing days	Catch/day (kg)	No. of gill nets operated	Catch/net (kg)	Mesh bar (mm)	Reservoir water level (m)
April'89	3,088.5	30	102.95	5,400	0.57	50-100	337.12
May	3,755.0	28	134.11	2,828	1.33	50-100	336.42
June	2,728.5	26	104.94	2,704	1.00	60-300	336.14
July	10,156.5	22	461.66	30,206	0.34	60-300	336.06
August	2,047.5	8	255.94	5,440	0.38	50-300	341.39
Oct.	3,675.5	16	229.72	5,560	0.66	50-200	342.27
Nov.	4,363.5	28	155.84	5,486	0.80	50-200	339.23
Dec.	3,098.5	27	114.76	5,454	0.57	50-180	340.44
Jan'90	3,238.5	31	104.47	3,791	0.85	50-180	340.94
Feb.	1,737.0	19	91.40	2,027	0.86	50-150	340.93
							340.54
Total	37,889.0	235		68,896	0.54		

Table 3 Monthly fish landidngs (kg) from Ravisankar Sagar reservoir (1989-90)

Month	Total landings (kg)	Major carps		Other carps		Cat fish		Miscellaneous	
		kg	%	kg	%	kg	%	kg	%
April'89	3088.5	400.5	12.96	11.0	0.36	1336.0	43.26	1341.0	43.42
May	3755.0	377.5	10.06	9.0	0.24	819.5	21.82	2549.0	67.88
June	2728.5	611.0	22.40	-	-	658.0	24.10	1459.5	53.50
July	10156.5	6082.6	59.89	179.6	1.77	1657.6	16.32	2236.7	22.02
August	2047.5	867.5	42.37	-	-	449.0	21.93	731.0	35.70
October	3675.5	1232.5	33.53	27.0	0.73	1003.5	27.31	1412.5	38.43
November	4363.5	1430.0	32.77	20.5	0.47	1000.0	22.92	1913.0	43.84
December	3098.5	788.5	25.44	14.5	0.47	977.5	31.55	1318.0	42.54
January'90	3238.5	679.0	20.97	39.0	1.20	653.0	20.17	1867.5	57.66
February	1737.0	220.5	12.70	3.0	0.17	434.5	25.01	1079.0	62.12
March									
Total	37889.0	12689.6	33.49	303.6	0.80	8988.6	23.72	15907.2	41.99

As seen from the above data the growth of the major carps in this reservoir appears to be good. It appears that though the phytoplankton group was not reflected significantly in plankton studies and despite feeding of abundant population of minnows on it, this food niche was available to the major carps in the ecosystems.

Study of Minnows :

The overall fish catch of the reservoir had 42.0% of miscellaneous fish, in which the contribution of minnows was 23.0%. About 27 species were recorded and examined during the period under report. *Gadusia chapra* (58.88%) was the most dominating which was mainly followed by *C. nama* (6.33%), *P. ticto* (5.32%), *O. bacaila* (5.12%), *C. ranga* (4.88%), *A. mola* (4.85%), *O. cotio* (3.30%), *P. sophore* (2.66%) and *C. laubuca* (2.34%). Most of the species, including *G. chapra* were found to compete with major carps with regard to their active feeding on phyto and zooplankton.

Plankton

The monthly average plankton ranged from 812 u l^{-1}(November) to 3455 u l^{-1} (September). As seen from yearly averages by number (1479 u l^{-1} and volume (0.82 ml m^{-1}), the overall plankton of the reservoir appeared to be poor, evidently due to continuous processes of inflowing and outflowing waters. The plankton was mainly constituted by zooplankton (88.0%) with the predominance of Copepoda (50.52%) and Rotifers (22.85). The phytoplankton was represented by Bacillariophyceae (4.46%), Myxophyceae (4.19%) and Chlorophyceae (3.43%).

Benthos

Since there is no stagnancy for longer period, the overall benthic population in a month ranged from 30 u m^{-2} (August) to 805 u m^{-2} (December) registering two peaks in a year *i.e.*, June and December. The biomass was chiefly constituted by dipteran larvae *Chironomus* and *Chaoborus* (41.4%), gastropods (28.5%), oligochaetes (12.8%) and bivalves (11.4%). The overall concentration of benthos was more in lotic sector (600 u m^{-2}), owing to its muddy and soft bed. The benthic population structure of intermediate (343 u m^{-2}) and lentic (363 u m^{-2}) sectors was more or less the same. They were more dense in the depth range of 2 to 6 m.

Macrophytes

The average weight of the plants (g) per square metre water area during peak availability was 2884.00 g. Macrophyte population in the reservoir seemed to be moderate. The plants were mainly represented by submerged forms like *Vallisneria* and *Hydrilla*.

Pre-recruitment study

Observations were made by operating 1-3 spawn collection nets and a drag net (locally known as 'Jholi'), 40 km above the dam site, in the main course of River Mahanadi at village Mahod and also in its marginal areas, nalas and deep pools.

The presence of fry of catla, rohu, mrigal and kalbasu, clearly showed the breeding of major carps in the reservoir. The occurrence of catla and rohu fry much higher up in the reservoir and that of mrigal in lower stretch of the reservoir indicated the extent of longer range of migration of catla and rohu against shorter migration of mrigal. As seen from the gonadal condition of fish on 12-13 July, the breeding appeared to have commenced in the first week of July with complete breeding of *C. mrigala* but partial and no breeding of *C. catla* and *L. rohita.*

Stocking and Reservoir management

A total of 7.24 lakh fish fry were stocked in the reservoir during this year by State Fisheries Corporation; the species composition being *C. mrigala* (41.30%), *L. rohita* (37.0%) and *C. catla* (21.70%). On the basis of average productive area of the reservoir (6380 ha), the stocking rate worked out to be 113 no. ha^{-1}. Stocking details are as follows :

Stocking of fish in Gangrel reservoir

Year	Stocking rate (Nos ha^{-1})	Species Composition (%)		
		C. catla	*L. rohitas*	*C. mrigala*
1986	330	8.56	51.44	40.00
1987	198	55.39	32.96	11.65
1988	230	24.70	49.44	25.86
1989	113	21.70	37.00	41.30

PROJECT **FC/A/10**

ECOLOGY AND FISHERIES MANAGEMENT OF A SMALL RESERVOIR IN ALIYAR BASIN

Personnel : C. Selvaraj, V.K. Murugesan, R.C. Singh

Duration : 1985-1992

Location : Coimbatore

Yield estimation and reservoir management

The reservoir produced a total of 59 200.25 kg during the period of 11 months from April, 1989 to February 1990, as against 54 181.15 kg obtained during 1988-89. The total annual yield for the period ending March, 1990 was around 64 582 kg i.e., at a yield rate of 199.33 kg ha^{-1} yr^{-1}. There was a conspicious improvement in the catch per unit effort which increased from 16.91 kg during 1988-89 to 17.12 kg during the current year. Similarly, the average monthly yield improved from 150.9 kg to 192.2 kg during the year (Table 1).

Thus, a record yield of 199.33 kg ha^{-1} yr^{-1} was achieved during the year, against the target of 150 kg ha^{-1} yr^{-1} fixed under the Mission Project. There is sufficient scope for further enhancement of the yield by making share-fishing units more viable.

Population dynamics and growth of fish

Growth of major carps was monitored through fin-clipping. A total of 2 250 fishes (catla 500, rohu 500, mrigal 650 and common carp 600) were stocked in Aliyar reservoir after clipping the left pelvic-fin during December 1987 to February 1988. Out of them, 12 specimens of catla, 7 of rohu, 56 of mrigal and 2 of common carps were recovered. Catla registered a growth increment of 363.5 - 559.8 mm during a free life of 15 - 22 months. Growth rate of rohu estimated on the basis of clipped fingerlings ranged from 278 - 329 mm for a liberty period of 18 - 27 months. Mrigala grew 306.7 - 406.8 mm during a period of 14 - 25 months. The two specimens of common carp, recovered during the period, registered a growth of 256.9 and 329.0 mm for a free life period of 20-21 months.

The pattern of regeneration of clipped fins varied from individual to individual, ranging from total absence to full regeneration. However, the regenerated fins could be easily recognised by their length, breadth, shape and number of rays even after a liberty period of four years.

Fish seed production

A total of 14.75 lakh spawn was produced at the Aliyar farm which comprised *C. catla* (6.6 lakh), *L. rohita* (6.4 lakh), *C. mrigala* (0.05 lakh) and *C. carpio* (1.7 lakh). More than 6.7 lakh spawn were stocked in 12 nursery ponds (0.01 ha each) for raising fry/fingerlings to be stocked in the reservoir. The remaining spawn was handed over to the Tamil Nadu Fisheries Development Corporation Ltd. The fry raised in the nursery ponds were transferred to rearing ponds (0.1 ha each) and reared upto fingerling stage (>100 mm).

Stocking

A total of 1,00,580 fingerlings were stocked in the reservoir during the period ending February, 1990. Catla constituted the bulk (43.07%), followed by common carp (17.98%), mrigal (16.49%), rohu (15.65%), silver carp (4.88%) and grass carp (1.93%). On an average, the stocking density was estimated at 310 fingerlings ha^{-1}.

Table - 1. Data on fish yield during the period from April 1989 to February 1990 (kg)

Month	*C. catla*	*L. rohita*	*C. mrigala*	*C. carpio*	*H. molitrix*	*L. fimbriatus*	*Channa* spp.	*T. mossambica*	Miscellaneous	Total
April'89	6165.850	268.000	151.500	282.700	87.500	-	-	1.000	-	6956.550
May	5434.300	114.500	102.050	123.150	87.250	2.750	-	-	-	5864.000
June	8316.100	1450.500	1192.500	480.200	267.000	24.500	-	589.000	-	12239.800
July	1252.200	521.500	1137.950	1188.900	160.000	25.250	-	1604.000	326.000	6215.800
August	1151.350	164.350	410.000	455.100	15.000	5.250	-	153.750	33.500	2388.300
September	2184.000	508.000	746.000	1268.950	27.300	3.500	-	86.500	18.500	4842.850
October	1238.950	279.000	616.700	1450.600	23.750	7.000	-	0.500	-	3616.500
November	1739.000	507.000	1103.900	898.500	6.250	2.000	-	-	-	4256.650
December	1999.000	948.250	1097.050	691.300	6.000	-	4.000	160.250	51.000	4956.950
January'90	1051.950	1180.350	1489.700	509.250	44.750	1.000	-	69.500	3.500	4350.000
February	990.500	636.700	1334.750	437.400	13.250	-	5.000	87.750	7.500	3512.850
Total	31523.300	6578.150	9382.200	7786.050	738.050	71.250	9.000	2672.250	440.000	59200.250
% Cont.	53.25	11.11	15.85	13.15	1.25	0.12	0.02	4.51	0.74	

	No. of units operated	Catch/Unit Effort (kg)	Average daily yield (kg)	No. of fishing days
April'89	330	21.08	231.885	30
May	310	18.92	195.467	30
June	330	37.09	407.993	30
July	355	17.51	207.19	30
August	240	9.95	119.42	20
September	250	19.37	210.56	23
October	308	11.74	129.16	28
November	330	12.90	141.890	30
December	359	13.81	159.90	31
January'90	309	14.08	155.36	28
February	336	10.45	125.459	28
Total	3457	17.12	192.21	308

PROJECT FC/A/13

A COMPARATIVE STUDY OF PRE-HARVEST AND POST-HARVEST MANAGEMENT PRACTICES OF SELECTED BEELS OF THE COUNTRY

Personnel : S. Paul, M.J. Bhagat (upto May 1989), Y.S. Yadava, H.K. Sen

Duration : Upto 1991

Location : Barrackpore

The picture in beel fisheries as revealed from the study of 15 beels in Assam is very much akin to large reservoirs where productivity per fisherman is low. The interest in fishing is sustained only as part-time activity. The average yield of 56 kg ha^{-1} has to be increased at least five-fold to give them income level of Rs. 2 000/- per person per annum. The official middleman *i.e.* Assam Fisheries Development Corporation appropriates lion's share of sale proceeds. This is a serious distortion that further brings down the income of fishermen who operate nets in beels.

Low productivity and consequent low incomes make it almost impossible to contemplate sizeable investment in pre-harvest and post-harvest infrastructure comprising fishing craft, gear, quick transport channels, ice plants and other facilities. Therefore, it will be worthwhile to evolve a cluster approach where beels in a contiguous area should be developed so as to bring down average fixed cost per unit of production by making fuller utilization of created facilities.

PROJECT FC/A/14

ECOLOGY AND FISHERIES MANAGEMENT OF A SMALL RESERVOIR IN GANGA BASIN (BAGHLA RESERVOIR)

Personnel : M.A. Khan, D.N. Singh, Balbir Singh, H.P. Singh, R.K. Dwivedi, R.K. Tyagi, Ram Chandra, J.P. Misra.

Duration : 1988-1991

Location : Allahabad

With a view to assessing the habitat variables in the context of productitvity, the water and soil samples were collected from different sectors of the reservoir and examined.

Physico-chemical features of water and soil

Soil quality	
Specific conductivity (μ mhos cm^{-1})	210.0 -337.0
pH	7.55 - 7.72
Organic matter (%)	0.66 -1.95
Calcium carbonate (%)	3.4 -5.2
Water Quality	
Temperature (°C)	23.0-31.2
Transparency (cm)	9.0-204.0
Dissolved Oxygen (mg l^{-1})	2.4-11.2
Free CO_2 (mg l^{-1})	nil-4.0
Carbonate (mg l^{-1})	nil-13.0
Bicarbonate (mg l^{-1})	40.0-82.0
pH	7.15-8.84
Specific conductivity (μ mhos cm^{-1})	76.0-121.0
Total dissolved solids (mg l^{-1})	37.0-60.0
Nitrate (mg l^{-1})	0.26-0.37
Phosphate (mg l^{-1})	0.26-0.38
Silicate (mg l^{-1})	2.9-3.9
GPP (mg C m^{-3} hr^{-1})	70.0 - 334.75 (av.154.19)
NPP (mg C m^{-3} hr^{-1})	40.-300.00 (av. 108.33)
Respiration (mg C m^{-3} hr^{-1})	30.0-90.0 (av.55.41)

Diurnal variation of chemical parameters and plankton

Diurnal variation in respect of some of the important physico-chemical factors was studied at four hourly intervals during summer (June), monsoon (August) and winter (February) seasons. Highest values of water temperature, transparency and dissolved oxygen were observed at 12.00 hrs., and 16.0 hrs. Free carbon dioxide was present only in monsoon and it was absent in summer and winter seasons. Vertical stratificaton of physico-chemical parameters indicated a klinograde distribution of oxygen (10.4 to 6.08 mg l^{-1}), suggesting the productive nature of the reservoir. Distribution of other parameters like pH and alkalinity along the water column also indicated productive nature of the reservoir. In general, two plankton peaks were observed *i.e.*, at 8 hrs. and 16 hrs. Maximum concentration of plankton was observed below 1 m (8705 u l^{-1}) and minimum (300 u l^{-1}) at 5 m. A definite dial cycle was noted in respect of distribution of *Microcystis*, copepodes and cladocerans.

Biotic communities

Plankton: The planktonic population ranged from 736 u l^{-1} in November 1989 to 6002 u l^{-1} in January 1990. Winter and summer pulses of plankton were clearly discernible. The high percentage of *Microcystis* and *Melosira* together with the high value of nutrients indicated eutrophic nature of the lake .

Periphyton : Periphytic community was sampled by scrapping the submerged substrata like stones and tree trunks. Myxophyceae was numerically the most abundant group.

Macrobenthos : The density of macrobenthos ranged from 352 to 4972 to u m^{-2}. Their maximum density was recorded in November and the minimum in September. The benthic macrofauna was represented by molluscs and dragonfly nymphs.

Aquatic vegetation : The aquatic weeds were observed from October, 1989 to March, 1990 in the reservoir. In summer months, the weeds were removed by manual method for the purpose of commercial fishing. During monsoon, it remained confined to deeper portions of the reservoir. The weed consisted mainly of two species viz. *Potamogeton* spp. (85% wet weight) and *Vallisneria americana* (15% wet weight). It ranged from 300 g m^{-2} in March, 1990 to 1450 g m^{-2} in October, 1989 with an average of 900 g m^{-2}. The associated fauna comprised molluscs (70%) and insects (30%). The former was dominated by *Viviparus bengalensis* and *Melanoides tuberculatus* and latter by odonates and Hemiptera. The associated fauna varied from 60 u m^{-2} in March to 110 u m^{-2} in October. Its abundance was directly related to the preponderance of weeds.

Pre-recruitment studies

Major carps were not observed to breed in the reservoir due to untimely rains.

Stocking : The stocking rate for this reservoir was determined on the basis of its potential fish yield (PFY) and average growth rate of the fishes. The PFY of the reservoir was calculated with the help of a trophodynamic model, based on carbon value derived through primary production. From the estimated annual carbon production of 1150 t, a potential fish yield of 11.5 t is obtainable which is equivalent to 184 kg ha^{-1}. However, keeping in view the uneven topography and heavy weed infestation, 60% of the PFY *i.e.*, 65 qt or 105 kg ha^{-1} can be considered as a realistic target. About 90,000 fingerlings in the size range of 30 to 50 mm were stocked in the first week of September 1989; ratio being- mrigal 50%, rohu 40% and catla 10%.

Fish population and growth studies

About 1000 fingerlings in the size range of 80 mm to 120 mm were tagged and fin-clipped. Streamer and anchor (Floy model, FDN, 68) tags were used.

Nine fishes bearing internal tags were recovered during the commercial fishing operations with period of liberty varying from 78 to 383 days. On the basis of recovered fishes, *C. mrigal* registered a growth increment of 0.94 mm/3.9 g day^{-1} for liberty period of 383 days. Catla gained 0.65 mm/2.9 g day^{-1}. Maximum period of liberty was 78-90 days.

Commercial fishing : The current yield rate from Baghla reservoir was estimated at 106 kg ha^{-1}. The species composition by weight was estimated to be : major carps 33.80%, *Mystus* sp. 30.60%, *Puntius* sp. 21.60%, *Notopterus notopterus* 10.90%, *N. armatus* 1.31%, murrels 1.1% and *W. attu* 0.7%.

Productivity studies using radio isotope ^{14}C technique

The average rate of carbon synthesis was 323.0 mg C $m^{-2}day^{-1}$, of which 154.2 was synthesised by nannoplankton and the rest by net plankton. Thus, almost 50% of the carbon synthesised by the producers was contributed by nannoplankton. Based on the energy flow studies, fish production potential of the reservoir has been estimated at 110 kg $ha^{-1}yr^{-1}$.

PROJECT FC/A/15

ECOLOGY AND FISHERIES MANAGEMENT OF MUKTAPUR OXBOW LAKE (*MAN*) IN GANDAK BASIN (NORTH BIHAR)

Personnel : K.P. Srivastava, B.C. Jha, V.R. Chitranshi, P.N. Jaitley, V. Pathak, C. Lakra, M.P. Singh, S.K. Srivastava

Duration : 1988-91

Location : Muzaffarpur, Muktapur

Salient environmental features of the lake

The physico-chemical features of soil and water are presented in Table 1.

Table - 1
physico-chemical characteristics of soil and water

Parameters	Range of variation	Annual average
Soil		
pH	6.8-7.4	7.1
Organic carbon (%)	2.8-9.0	6.5
Available - P (ppm)	40-185	112
Available - N (ppm)	605-985	780
Water		
Dissolved Oxygen (mg l^{-1})	4.6-9.0	5.9
pH	7.5-8.1	7.9
Free carbondioxide (mg l^{-1})	0.0-8.0	4.2
Alkalinity (mg l^{-1})	80.0-104.0	90.5
Sp. Conductivity (µ mhos)	134-183	168.5
Total dissolved solids (mg l^{-1})	65-88	81.5

Primary production

Primary energy fixation in the lake was channeled through both the plankton and macrophyte communities; the contribution by latter being maximum. Studies were made by using radio-isotope ^{14}C technique. The rate of carbon synthesis by phytoplankton ranged from 57.26 to 384.2 mg C m^{-2} day^{-1} (av. 236.3 mg C m^{-2} day^{-1}), out of which 29.06 to 272.3 mg C m^{-2} day^{-1} (av. 145.12 mg C m^{-2} day^{-1}) was contributed by nannoplankton. Rate of energy transformation ranged from 562 to 3773 Cal m^{-2} day^{-1} (av. 2321 Cal m^{-2} day^{-1}), of which 285 to 2674 Cal m^{-2} day^{-1}(av. 1452 Cal m^{-2} day^{-1}) was fixed by nannoplankton and the remaining by net plankton. Thus almost 65% of the energy fixed by phytoplankton through phytosynthesis was contributed by nannoplankton.

The rate of carbon synthesis by macrophytes ranged from 1125 to 4200 mg Cm^{-2} day^{-1} (av. 2751.4 mg C m^{-2} day^{-1}) and thus the primary production was mainly contributed by macrophytes; the contribution by phytoplankton being only 10%. The average rate of energy transformation by macrophytes was @ 27 019 Cal m^{-2} day^{-1}.

Qualitative and quantitative abundance of plankton

Net plankton : The numerical abundance of plankton ranged from 283 units l^{-1} to 24 28 units l^{-1} (av. 1087 units l^{-1}), of which 61.5% was contributed by phytoplankton and 38.5% by zooplankton. There was a distinct plankton pulse in

February. The abundance of plankton in the pen enclosure installed in the beel (174 to 2892 units l^{-1} : av. 1003 units l^{-1}) was almost similar to that in lake, but the percentage of zooplankton was slightly higher (46.7%).

Nannoplankton : Abundance of nannoplankton in Muktapur lake ranged from 8 025 units l^{-1} (August) to 35 105 units l^{-1} (June). The qualitative spectrum of nannoplankton showed the dominance of bacterioplankton which contributed 83.65 to 95.36% to the total nannoplankton biomass.

Periphyton ranged from 1288 units cm^{-2} (July) to 7308 units cm^{-1} (December). Bacillariophyceae contributed maximum (63.37% to 80%). The lake was choked with macrophytes by 60-70% of surface area. The biomass ranged between 7.5 to 18.6 kg m^2 (wt .weight) with an average of 11.9 kg m^{-2}. The numerical abundance of benthic macrofauna in the lake was on an average 5301 nos m^{-2}. The weed inhabiting flora were represented mainly by members of Bacillariophyceae and Chlorophyceae. However, the fauna was represented mainly by the members of gastropods and other insects.

Fish catch statistics

The commercial fishing, which commenced on 19th January 1989 and ended on 18th of July, yielded a total catch of 6309.75 kg of fish (Table 2).

Pen culture in the lake

A pen of 0.08 ha area was constructed and stocked with 800 major carp fingerlings comprising 300 mrigal, 250 catla, and 250 rohu. The initial size and weight of the fingerlings ranged between 60-122 mm or 10-15 g in case of mrigal, 80-165 mm or 15-19 g in case of catla and 90-120 mm or 17-20 g in case of rohu. The pen was harvested in three operations and the total catch was 203.5 kg, which was equivalent to a yield rate of 2.53 tons ha^{-1}. Incidence of Ulcerative Epizootic Syndrome (EUS) was noticed among the fishes.

PROJECT **FC/A/16**

ECOLOGY AND FISHERIES MANAGEMENT OF BEEL IN BRAHMAPUTRA BASIN (ASSAM)

Personnel : S.N. Mehrotra, S.P. Singh, Y.S. Yadava (upto July 1989) M. Choudhury, D.K. Biswas

Duration : 1988-1990

Location : Siligurijan beel, North Guwahati, Dist. Kamrup

Table 2 Commercial fish catch in Muktapur ox-bow lake during the year 1989

Months	No. of days	Total major carps (kg)	Minor carps (kg)	Cat fishes (kg)	Feather backs (kg)	Murrels (kg)	Misc. including shrimps (kg)	Grand total (kg)
Jan.'89	7	77.950	7.600	4.200	8.800	3.300	17.400	119.250
Feb.'89	10	85.650	13.300	3.600	11.000	7.200	27.000	147.750
Mar.'89	25	253.100	86.200	19.400	27.600	19.100	284.500	689.900
Apr.'89	28	464.350	93.700	37.350	32.400	37.200	270.700	935.700
May'89	14	80.450	28.500	7.600	13.400	2.400	107.00	239.350
June'89	27	1171.400	129.500	48.500	42.300	40.300	356.900	1783.900
July'89	14	1156.300	416.500	201.300	91.200	86.100	437.500	2388.900
Total	125	3289.200	775.300	321.950	226.700	195.600	15501.000	6309.750
Percentage in total yield	-	52.1	12.3	5.1	3.6	3.1	23.8	

Cage cuture of carps

Twelve split-bamboo cages were designed , constructed and erected in a 2250 sq. m area of the beel specially cleared for this purpose. The cages were in the size of 2 x 1 x 1 m and covered on all the four sides with bamboo mat. The top portion was provided with a door opening on one side. The bamboo mats were tied with iron wire, nylon twines and corners were strengthened by using old cycle tyres.

Heavy discharge and high water level of river Brahmaputra made the installation of cages extremely difficult till August 1989. The entire beel, unlike the previous year, was heavily choked with floating weeds, mainly water hyacinth. The cages were fixed in the month of September.

The stocking density of fingerlings, their initial length and weight ranges are given below :

Species	Length range in mm (Av.)	Weight range in gm (Av.)	Stocking density M : R
Mrigal (M)	55 - 76 (66)	4 - 10 (6)	30 : 15
			30 : 20
Rohu (R)	47 - 70 (63)	4 - 10 (6)	30 : 25

Rice bran and mustard oil cake were fed in the ratio of 1 : 1 @ 2% body weight to the fishes.

Study of water quality within the cage and beel proper

No appreciable difference in temperature, pH, alkalinity, conductivity and total dissolved solids (except on one occasion) was recorded both inside and outside the cage in the beel (Table 1).

Monitoring of fish health and growth

Treatment with acriflavine & $KMnO_4$ was done as a prophylactic measure. Maximum increment of 44 mm was observed in rohu. In case of mrigal maximum increment was 27 mm for a 6 months culture period. As a result of decomposition of floating weeds, large scale fish mortality was observed.

Table 1 Cage culture experiment at Siligurijan beel (abiotic feature)

Date	Air temp. (°C)	Water temp. (°C)	pH	D.O. (mg l^{-1})	Free CO2 (mg l^{-1})	Total alkalinity (mg l^{-1})	Transparency (cm)	GPP (mgC $m^{-3}hr^{-1}$)	NPP (mgC $m^{-3}hr^{-1}$)	Respiration	Conductivity (micro mhos cm^{-1})	Total dissolved solid (mg l^{-1})
BEEL PROPER												
15.9.89	31.5	31.0	6.6	5.76	56.0	60.0	80.0					
6.10.89	30.0	27.5	6.0	1.44	100.0	30.0	105.0	25.0	0	11.25	98	49
6.11.89	21.5	20.0	6.2	4.16	56.0	30.0	170.0	-	-	-	39	20
19.1.90	22.0	18.0	6.2	7.04	72.0	36.0	87.0	-	-	-	42	20
31.3.90	-	-	7.0	11.28	26.0	48.0	42.0					
INSIDE CAGE												
15.9.89	31.5	31.0	6.6	5.12	48.0	60.0	60.0	-	-	-	108	52
6.10.89	30.0	27.5	6.2	2.88	90.0	32.0	-	12.5	0	135.0	44	24
6.11.89	21.5	20.0	6.2	2.56	52.0	34.0	100.0	-	-	-	41	20
19.1.90	22.0	18.0	6.2	10.72	70.0	38.0	52.0	-	-	-	-	-
31.3.90	-	-	7.0	11.04	24.0	48.0	38.0					

PROJECT **BF/B/2**

STUDIES ON THE FISHERIES POTENTIAL OF ESTUARINE WETLANDS

Personnel : Apurba Ghosh, G.N. Saha, A.C. Nandy, P.K. Chakraborty, K.R. Naskar, R.K. Das, H.C. Joshi, S.C. Thakurta, Amitabha Ghosh, H.C. Karmakar, A. Hajra, N.N. Mazumder, S.K. Chatterjee, L.K. Parbat

Duration : 1986-1990

Location : Barrackpore and Calcutta

BARRACKPORE CENTRE

Ecology of Wetlands

Investigations on the biological, physico-chemical, and microbiological features of freshwater and brackishwater sewage-fed wetlands were continued. Bloom of *Microcystis* was found to be a hazard in the Bantala area during March to May. A new wetland at Kantatala, which has been taken up this year, also showed rich bloom of *Microcystis* . Some of the sections of these wetlands also depicted *Euglina* infestation. The Bantala and Kantatala wetlands had a higher plankton concentration than that of Minakhan.

Among the benthic fauna, odonate nymphs, chironomid larvae, nematodes and *Lamellidens* sp. dominated in the non-saline zone, whereas tenaeid worms were abundant in the saline zone. The flora in the non-saline zone was principally represented by *Spirogyra* sp. and *Lyngbya* sp., while that in the saline zone by *Enteromorpha* sp., *Oscillatoria* sp. and other filamentous algae.

Macrophytes: Seasonal observations were made to identify the aquatic and semi-aquatic flora both in freshwater and saline sewage-fed fisheries of the estuarine wetlands at Bantala and Minakhan areas. Besides these, the sewage-mixed brackishwater wetlands in the Minakhan areas were studied and they were found to be heavily infested with the benthic algal species, *Enteromorpha tuberosa.*

Physico-chemical parameters: The bheries were rich in available nitrogen both in the soil and water phase. The available phosphate phosphorus was also in the higher range. Reserve calcium carbonate was found to be quite sufficient for buffering activities. C : N ratio was low. The details of microbiological studies are given in Table - 1.

Table - 1. Bacterial Count in Sewage-fed wetlands (both freshwater and saline bheries)

	Bantala	Minakhan
Heterotrophic bacteria	$6.5x10^3$ to $1.1x10^2$ ml^{-1}	$4.9x10^3$ to $5.1x10$ ml^{-1}
Phosphate solubilizing bacteria	$2.2x\ 10^3$ $x1.0^2$ ml^{-1}	$2.8x10$ to $8.5x10$ ml^{-1}
Aerobic Nitrogen fixing	$2.1x10^2$ to $3.0x10$ ml^{-1}	$5.5x10^2$ to $4.1x10$ ml^{-1}
Faecal coliform/100 ml	Nil	Nil
IN SOIL		
Heterotrophic bacteria	$6.2x10^7$ to $2.2x10^6$ g^{-1}	$4.4x10^6$ to $1.4x10^6$ g^{-1}
Phosphate Solubilizing bacteria	$4.5x10^7$ to $2.1x10^6$ g^{-1}	$3.8x10^6$ to $1.5x10^5$ g^{-1}
Aerobic nitrogen fixing bacteria	$2.9x10^6$ to $1.1x10^5$ g^{-1}	$2.5x10^6$ to $2.8x10^4$ g^{-1}

While Bantala receives non-saline sewage water, the Minakhan-Malancha receives saline sewage water effluents. Lab-lab enriched with *Spirogyra* formed the fish food in the former and *Enteromorpha* sp. constituted the main fish food in the latter. The nutritive value of *Oreochromis mossambicus* obtained from both the bheries, (Bantala and Minakhan-Malancha) was determined and compared in the light of the differences in their ecological and trophic status.

Biochemical composition of *Oreochromis mossambicus* in the weight range of 5.7 g to 9.3 g (on fresh wt. basis) was : moisture, 72.5%; protein, 14.3%, fat, 1.2%; soluble carbohydrate (N.F.E.) 8.3% and ash, 3.7% in the Bantala region. The composition for Minakhan-Malancha was moisture, 70.3%; protein, 16.0%; fat 1.0%; N.F.E., 9.5% and ash, 3.2%.

Bio-accumulation of the heavy metals was detected in the tissues of *Oreochromis mossambicus*. The levels of concentration are presented in Table-2.

Table-2. Accumulation of heavy metals in *Oreochromis mossambicus* collected from freshwater wetland at Bantala

Metal	Muscle *ug/g wet wt.*	Liver *ug/g wet wt.*
1 Zinc	11.80	33.700
2. Copper	0.31	0.600
3. Chromium	0.82	0.350
4. Cadmium	0.01	0.017
5. Mercury	0.65	2.690

Fish Production

A system of continuous harvesting and replenishing is being followed in the harvesting of fish from the sewage-fed saline and non-saline impoundments. Fishes are first harvested within three months of stocking when they grow to a size of 100 - 150 g and the wetlands are freshly stocked with fingerlings. The stocking density in the freshwater bheries has been found to be in a very high range of 50 000 - 100 000 ha^{-1} or some time even more. *Cyprinus carpio* and *Oreochromis niloticus* form the principal stocking material in freshwater, while *Oreochromis niloticus*, *O. mossambicus*, mullets and *Penaeus monodon* are commonly used in saline wetlands.

CALCUTTA CENTRE

The seasonal ecological studies were continued in selected bheries at Kharibari (low saline), Kulti & Malancha (medium saline) and Golabari (high saline) during the year, besides the observations on diurnal variations in key parameters. The other aspects of studies included recruitment of fish and prawn seed into the bheri and experiments on the effect of low salinity on survival of *P. monodon* post-larvae.

This year, all the saline bheries recorded highest salinity such as 12.5 ppt (Kharibari), 22.7 ppt (Kulti and Malancha) and 36.3 ppt (Golabari). Salinity in the low saline bheri also registered an increase and it rose to a record level of above 10 ppt during the year. D.O. (3.6-12.2 ppm) and total alkalinity (100.0-236.0 mg l^{-1}) were also found much higher than that of last year. Kulti bheri, which is subjected

to sewage pollution, had the lowest concentration of D.O. (3.6 ppm) and highest concentration of CO_2 (8.0 ppm).

Plankton

The net plankton density varied widely among the three saline zones. The volumetric abundance of plankton ranged from trace-3.0 ml, tr - 4.5 ml and 0.1-2.0 ml in 50 litres in low, medium and high saline bheries respectively. In numerical terms, the plankton concentration ranged from 42-336 units l^{-1}, 116-4286 units l^{-1} and 185-1045 units l^{-1} in high, medium and low saline bheries respectively.

Benthos : *Benthic algae :* The composition of benthic algal community varied considerably from month to month and the greatest diversity in their species abundance was observed at Golabari. The concentration of benthic algae was 3-20 ml m^{-2}, 5-90 ml m^{-2} and 20-555 ml m^{-2} in low, medium and high saline bheries respectively. *Benthic macrofauna:* The abundance of benthic macrofauna varied from 107-1110 units m^{-2}, 58-1290 units m^{-2} and 60-3415 units m^{-2} in low, medium and high saline bheries respectively.

Fish and prawn production: Total fish and prawn yield rates recorded for the bheries were 428.5 , 444.8 and 612.6 kg ha^{-1} yr^{-1} at Kharibari (low saline), Malancha (Medium saline) and Golabari (high saline) respectively ; the contribution of *P. monodon* in the yield being 112.0 (26.1%), 256 (57.5%) and 320 (52.2%) kg ha^{-1} yr^{-1}. *L. parsia* was 49.88% in low saline bheri followed by Indian major carps (17.25%) and *O. mossambicus* (6.75%). Fish species in a medium saline bheri comprised *L. tade* (8.31%), *L. parsia* (6.06%), *O. mossambicus* (7.86%), *L. calcarifer* (5.16%) and gobiids (7.56%). In a high saline bheri, the major fish species were *O. mossambicus* (10.74%), followed by *L. calcarifer* (6.19%) and *Mystus* sp. (3.09%).

Effect of salinity on post larvae of *P. monodon* : To study the effect of salinity, 100-125 postlarvae of *P. monodon* were reared for a fortnight in hapas (2 x 1 x 1 m) fixed in bheries . The survival of postlarvae was recorded as 74% at 4.1-3.8 ppt salinity and 89% at 10.0-11.0 ppt in the low saline bheri, while in the high saline one, it was 81% at 17.1-22.0 ppt.

Recruitment of commercial and non-commercial fish and shellfish populations : The most important commercial penaeid prawn, *P. monodon* was encountered in most of the months for high saline centre. *M. brevicornis* and *M. monoceros* were recorded for medium and high saline centres. *P. stylifera* was recorded at all the centres - maximum being in low saline centre. Amongst commercial fish, *Liza parsia* and *Liza tade* were recorded at high saline centre.

PROJECT **BF/B/3**

ECOLOGY AND PRODUCTION BIOLOGY OF HOOGHLY-MATLAH AND KULT I ESTUARINE SYSTEM

Personnel : R.N. Pal, B.B. Ghosh, Babu Lal, A.K. Ghosh, M.K. Mukhopadhyay, H.C, Joshi, R.K. Banerjee, M.K. Das, M.M. Bagchi, R.K. Das, P. Mitra, H.C. Karmakar, S.N. Dutta, R.N. Dey, S.N. Sar, D.K. De, A.R. Paul, A.K. Roy, N.C. Mondal, S.P. Ghosh, A.K. Banerjee, T. P. Ghosh, Pintu Biswas, T. Chatterjee, S.K. Chakraborty, Keya Saha, Subhra Das

Duration : 1983-90

Location : Barrackpore, Canning, Uluberia, Diamond Harbour, Digha and Frazerganj/Namkhana

Ecology of the Hooghly estuaridne system

That the Hooghly estuarine environment is passing through a phase of stabilization is evident from the consistency in physico-chemical characteristics of the estuarine water (Table - 1). The lower most zone (Zone III) of the estuary exhibited maximum salininity (5.361-28.650 ppt) and productivity (0.362-2.429 gC m^{-2} day^{-1}) throughout the year.

Table 1 Physico-chemical characteristicsd of estuarine waters

ZONE	Pre-Farakka	Post-Farakka	
	1960-61	*1975-77*	*1986-88*
Maximum salinity (% o)			
II	12.00	0.379	2.383
III	32.80	29.240	18.604
Plankton density (units l^{-1})			
II	40.77	222.780	129.670
III	60.21	144.790	290.230

Lunar influence on plankton population was pronounced in coastal waters of the Bay of Bengal indicating high rate of abundance of the micro-organisms in full moon phases, followed by the new moon peaks (Fig.1). The plankton density was maximum (average 445 units l^{-1}) during December; the diatoms constituting 65-82% of the total population. While correlating tidal pattern with plankton distribution, higher plankton densities were observed in low tide periods in coastal waters around the Sunderban deltaic region.

Matlah estuary (salinity : 6.715-25.496 ppt) sustained high plankton densities (average 971 x 10^3 m^{-3}) with a sharp peak during March-April (average 7.793 x 10^3 m^{-3}) of the year. Rate of ^{14}C assimilation in the system fluctuated between 0.512 and 1.856 gm C $m^{-3}day^{-1}$.

The pooled data on salinity and plankton populations of the Hooghly estuarine system has shown the impact of freshwater dilution from Farakka Barrage on salinity pattern and plankton population in gradient as well as lower brackishwater zones of the estuary.

Energy dynamics in estuarine and coastal water

^{14}C assimilation values obtained during four quarters of the year for twelve centres of the Hooghly-Matlah and Rupnarayan river systems are presented in Table 2. Productivity curve (Fig. 2) shows the relationship of the rate of ^{14}C assimilation with half -bound carbon, electrical conductivity and total dissolved solids. Although, freshwater zone showed more bicarbonate alkalinity than the coastal zones, the rates of ^{14}C assimilation and energy fixation were much higher in the coastal zones of the estuary. Jamboodwip showed exceptionally high values of ^{14}C assimilation and energy transformation, the values being 2.42 g C $m^{-2}day^{-1}$ and 23.877 Cal m^{-2} day^{-1} respectively.

Gradient zone of the estuary, which is more prone to industrial and sewage effluent, showed low values of ^{14}C assimilation and energy fixation (0.2979 g C $m^{-2}day^{-1}$ and 2919 Cal $m^{-2}day^{-1}$) at Uluberia. Various types of biocides are responsible for low values of energy fixation in the gradient zone of the estuary. Based on ^{14}C assimilation and energy fixation values, potential yield of fish for various centres were found to be in the order - Jamboodwip > Digha > Kalisthan > Canning > Bokkhali > Frazergunj > Diamond Harbour > Kolaghat > Nabadwip > Barrackpore.

Studies on the productivity of bottom dwelling benthic autotrophs indicated that shallow coastal zones with mud flats were more productive than other regions and almost one third of the total energy fixed by autotrophic organisms was due to phytobenthos.

Environmental constrains in the system

The effluents discharged from the Tribeni Tissue at Kuntighat were found to be adversely affecting the microbial populations like heterotrophic bacteria, phosphorus solublising bacteria, aerobic nitrogen fixers and actinomycetes within100 m of the discharge point.

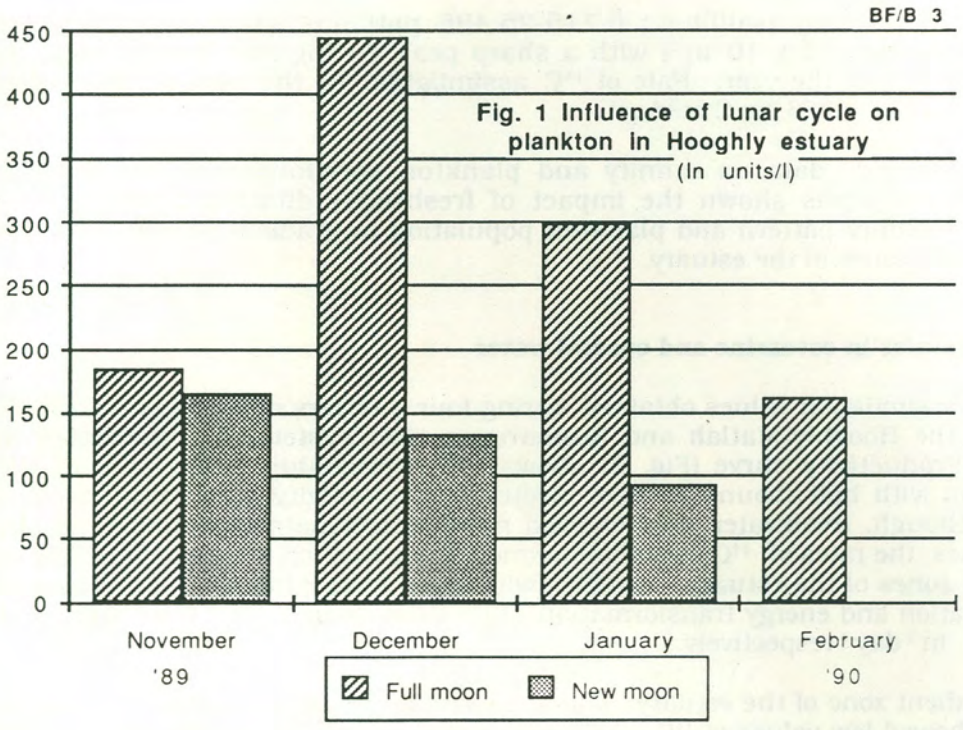
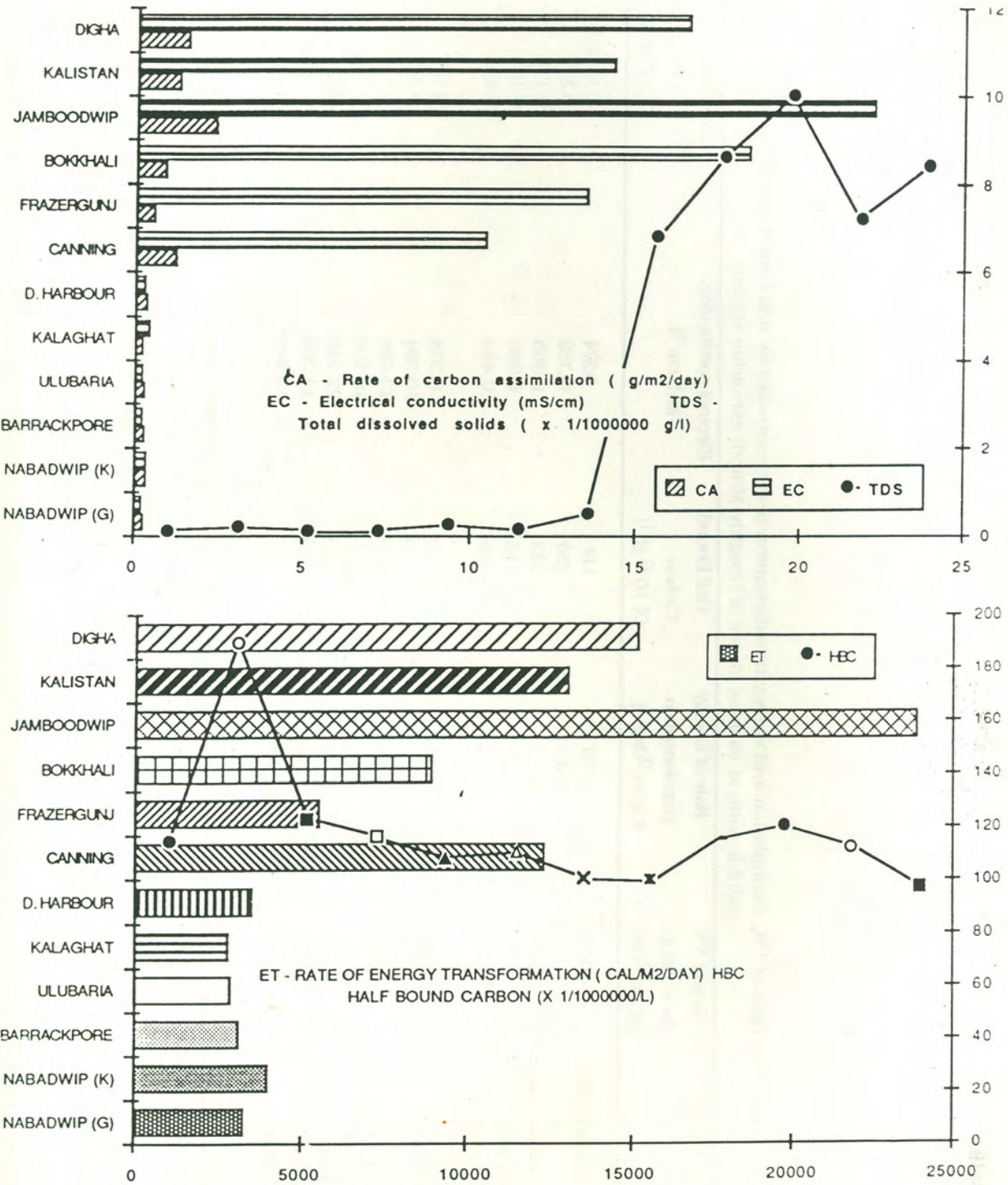


Fig. 1 Influence of lunar cycle on plankton in Hooghly estuary
(In units/l)

Table - 2. Rate of ^{14}C assimilation and energy transformation being controlled by half bound carbondioxide and soluble salts at various places of Hooghly-Matlah estuarine system

STATIONS	Rate of ^{14}C Assimilation ($gC\ m^{-2}day^{-1}$)	Rate of Energy Transformation ($Cal\ m^{-2}day^{-1}$)	Half Bound Carbon ($X\ 10^{-6}\ gl^{-1}$)	Electriol conductivity ($m\ S\ cm^{-1}$)	Total Dissolved Solids ($X\ 10^{-6}\ gl^{-1}$)
Nabadwip (G)	0.341	3350	114	0.274	0.1344
K	0.411	4040	189	0.382	0.201
Barrackpore	0.323	3175	123	0.265	0.118
Uluberia	0.297	2919	116	0.280	0.135
Kolaghat	0.288	2831	108	0.483	0.271
Diamond-Harbour	0.362	3558	110	0.334	0.167
Canning	1.255	12337	100	10.391	0.542
Fraserganj	0.568	5583	99	13.498	6.810
Bokkhali	0.915	8994	115	18.503	8.632
Jamboodwip	2.429	23877	120	22.316	10.000
Kalisthan	1.334	13113	112	14.302	7.234
Digha	1.545	15187	97	16.607	8.420

Figure 2 Productivity and energy transformation in Hooghly Estuary



Metal residues in fish : Monitoring of metal residues in different tissues of the fish *Rita rita* indicated higher accumulation of Zn, Cu, Cr, Cd and Hg in the fish in industrial stretch around Calcutta, as compared to non-industrial zone near Nabadwip. Liver tissues retained maximum metals, when compared to the other organs.

Pesticide residues in sediments and fish tissues : Pesticide residues were detected in sediments collected from the stretch between Kakdwip and Farakka. The values indicated maximum concentration of metabolite of pp' DDT (17.8 $\mu g\ g^{-1}$, pp'DDD) and BHC-y (3.25 $\mu g\ g^{-1}$) at Diamond Harbour beach, while metabolites of DDT (DDE and DDT including DDT) and Aldrin were detected from predominantly agricultural areas like Nabadwip and Farakka.

Experiments were also conducted at Barrackpore and Hajinagar on the fish, *Rita rita*, where high levels of BHC (max. 0.83 $\mu g\ g^{-1}$) and t-DDT (max. 0.546 $\mu g\ g^{-1}$) were detected in muscle and BHC (max. 1.03 $\mu g\ g^{-1}$) and t-DDT (max. 2.63 $\mu g\ g^{-1}$) in liver tissues.

Pollution in the Kulti estuary

Impact of metropolitan wastes on the water quality of the Kulti estuary was studied. At Malancha, the levels of albuminoid ammonia (3.62 mg l^{-1}) and free ammonia (1.15 mg l^{-1}) characterise the extent of pollution prevailing in the estuary. Metals such as zinc and copper were found upto 110 $\mu g/l^{-1}$ and 50 $\mu g/l^{-1}$ respectively. The bottom biota was dominated by polychaetes and gastropods. The fish catch mainly consisted of *Aplochelius*, gobiids and *Acetes* sp.

Annual fish yield and catch spectrum in Hooghly estuary

The lower estuary accounted for about 95% of the total estuarine catch of 33139.6 t with relative SD of 2.52% at the assembly centres and 3.94% in case of winter migratory bagnet fishery. This year, the fish production showed a decline of 21% from the level of 1988-89, with a corresponding decline in yield per hectare from 52.9 kg to 41.4 kg. However, the decline in total catch and yield per hectare was restricted to the current year and compared to 1987-88, the increasing trend continued.

Harpodon nehereus, *Setipinna* spp., *Trichiurus* spp., *Pama pama*, *Tenualosa ilisha*, *Coilia* spp., *Tachysurus jella* and various prawn and shrimp species formed the mainstay of the estuarine fisheries, contributing 22275.5 (67.2%) to the total catch. The species-wise break up of the the dominant fishery in 1988-89 and 1989-90 are presented in Table-3.

Hilsa fishery : Apart from the bag net catches, the hilsa fishery represented by *T. ilisha* has been the major component of the estuarine fishery contributing 1563.4 t to the total catch. However, hilsa landings registered a 9% decline from the previous year, mainly due to low catch during winter season which fell short by 495 t from the corresponding catch of 1988-89.

Table - 3. Contribution of dominant fish species and prawns (in t) to the total estuarine fish catch

Name of species	Contribution to the total catch		% in the total catch		Contribution to total catch*		% of	% of
	Feb.'89-Jan.'90	Feb.'88-Jan.'89	Feb.'89-Jan.'90	Feb.'88-Jan.'89	Feb.'89-Jan.'90	Feb.'88-Jan.'89	Col.6	Col.7
Tenulosa ilisha	1563.4	1720.9	4.7	4.1	1563.4	1720.6	21.0	21.3
Pama pama	3978.2	6641.9	12.0	15.7	374.7	440.1	5.0	5.5
Setipinna spp.	4379.4	6059.6	13.2	14.3	322.9	336.2	4.3	4.2
Trichiurus spp.	3978.6	3792.2	12.0	9.0	189.4	103.8	2.5	1.3
Harpodon nehereus	4735.7	8000.2	14.3	18.9	528.0	462.5	7.1	5.7
Tachydurus jella	432.8	799.3	1.3	1.9	244.0	354.8	3.3	4.4
Stromateus cinereus	160.1	896.9	0.5	2.1	103.4	123.7	1.4	1.5
Polynemus peradiseus	98.2	313.4	0.3	0.7	78.2	66.2	1.0	0.8
Coilia spp.	537.2	1347.5	1.6	3.2	302.6	528.6	4.1	6.6
Ilisha elongata	413.4	501.8	1.2	1.2	101.2	98.7	1.4	1.2
Sciaena biauritus	87.5	362.1	0.3	0.9	60.3	67.3	0.8	0.8
Polynemus indicus	191.3	177.4	0.6	0.4	191.3	177.4	2.6	2.2
Chirocentrus doral	98.1	90.6	0.3	0.2	82.6	90.6	1.1	1.1
Prawns	2670.0	3451.9	8.1	8.2	760.8	1004.7	10.2	12.5
Others	9815.7	8164.9	29.6	19.2	2548.0	2492.4	34.2	30.9
Total	33139.6	42320.6	100.0	100.0	7450.0	8062.6	100.0	100.0

The mean length of male and female hilsa were 37.2 and 30.3 cm with a length range of 23.5 t 51.0 cm and 22.0 to 40.5 cm respectively representing 2nd to 5th year age groups during monsoon period. Quantity of young hilsa captured in bagnets and other small meshed nets in the upper stretch was estimated at 55.2 t.

Month-wise length -frequency and catch data of hilsa from 1987 and 1988 were processed using LFSA and ELEFAN computer packages and the following key parameters were determined :

Asymtotic lendgth $L\infty$	=	55 cm
Growth coefficient K	=	0.5
Natural mortality rate Z	=	1.151.

Winter migratory bagnet fishery : Winter migratory bagnet fishery contributing a catch of 25688.8 t accounted for 77.5% of the total estuarine catch. The average CPUE was 107.4 kg as against 157.47 kg for the previous year. The main components of the bagnet fishery in order of abundance were, *Harpodon nehereus*, *Setipinna* spp., *Trichiurus* spp., *Pama pama* and prawns. These species together accounted for 64.5% of the total winter bagnet catch.

Multiple regression analysis of environmental parameters, primary productivity and CPUE of bagnet indicated significance of dissolved phosphate in water and primary productivity over CPUE. The prediction mode was worked out as:

$$Y = 0.2539 + 5.9309\ X_1 + 0.0379\ X_2$$

Where Y = CPUE of bagnet in kg.
X_1 = Phosphate of water in ppm

X_2 = Net primary productivity in mgC m^{-3} hr^{-1}
MSY = 1435 t yr^{-1}

The b_1 and b_2 of the model were significant. $R^2 = 0.2998$ ($P < 0.05$) indicated that 30% of the variability in CPUE of bagnet is explained by the model.

A correlation could be drawn between the fish catches, primary productivity and plankton abundance for winter migratory fishery at Sunderban regions of the Bay of Bengal coast (Fig. 3).

Biology of commercial estuarine fishes

Examination of fifty four female specimens of *Polynemus paradeseus*, collected from Hooghly estuary and its tributary- the Rupnarayan, indicated that the fecundity of the species gradually increased upto the size range of 201-210 mm and thereafter it declined.

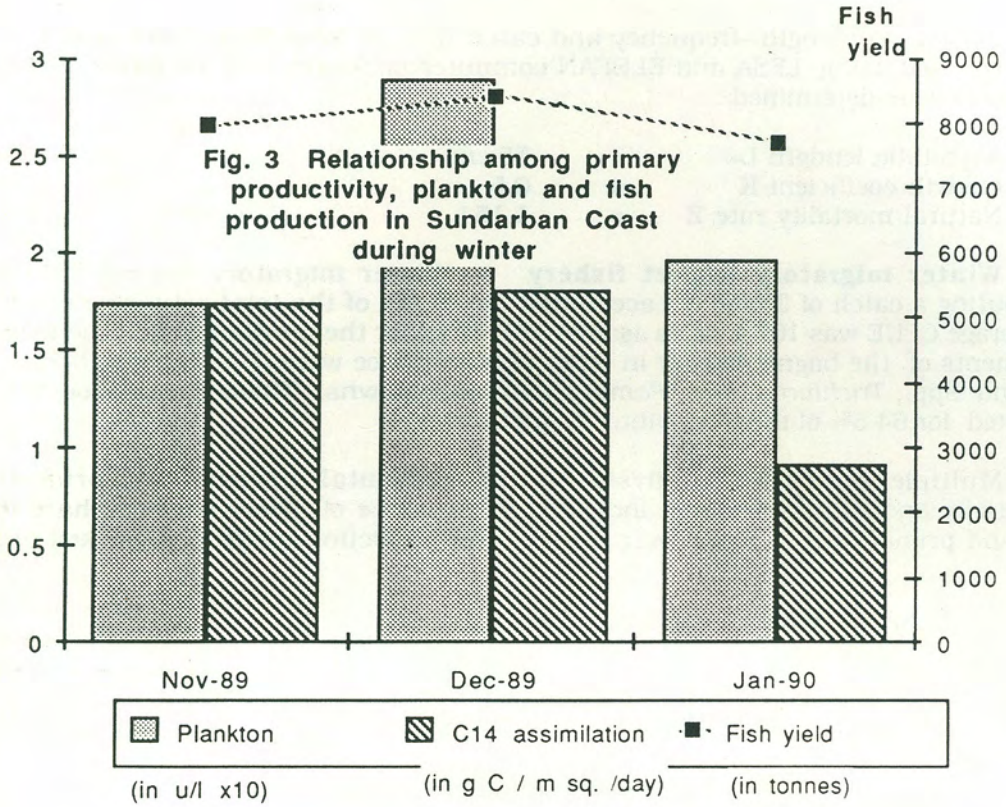


Fig. 3 Relationship among primary productivity, plankton and fish production in Sundarban Coast during winter

Fish pathological studies

Extensive studies were conducted on Epizootic Ulcerative Syndrome (EUS) in fishes of various affected states. The syndrome is predominantly encountered in the genera *Channa, mastocembelus, Clarias, Puntius, Nandus ,Cyprinus, Mugil* and *Rhinomugil* during the post-monsoon season *i.e.* from October to March when a noticeable decrease in temperatrure (4-12 °C) was observed. Environmental monitoring in affected areas showed that the disease was more severe (65% incidence) in waters of low alkalinity (13-30 ppm) and hardness (6-45 ppm). Accumulation of heavy metal in environment and fish tissues was studied in the affected areas. The results showed that values of Zn, and Cu, though significant, were not perceptible enough to create stress in fish. However, BHC, DDT and their metabolites have been detected in water plankton and fish samples collected and this might be responsible for causing stress to fish. *Micrococcus* sp. was predominantly associated with the syndrome and its biochemical tests were done (Table 4). Histopathological studies of ulcers, kidney and liver of affected *Channa* sp. revealed the ulcers as fungal granulomata with necrotic foci and liver vacuolization.

Efficacy of lime in controlling the EUS was studied in an experiment conducted in a 20 m x 20 m pen ,stocked with carps. Application of CaO initially @ 30 kg and then @15 kg per month checked the EUS effectively. Sensitivity test of *Micrococcus* to antibiotics indicated maximum sensitivity to Erythromycin and trimethoprim.

Table -4 Chemical characters of the *Micrococcus* sp.

Character Response		Character Response	
OXIDASE	-	GROWTH ON BHIA AT 30°C	+
CATALASE	+	GROWTH ON SCDA AT 30°C	+
H_2S	-	GROWTH ON CASEIN	+
METHYL RED TEST	+	ENRICHED NUTRIENT A	
VOGES PROSKAUER	+	OXIDATION OF SUGAR :	
LYSINE DECARBOXY LASE	+	RAFFINOSE	+
ARGININE DECARBOXY LASE	_	MANNOSE	+
ORNITHINE DECARBOXY LASE	+	ADENOSITOL	+
INDOLE	-	ARABINOSE	+
GROWTH ON NA AT 30°C	+	SUCROSE	+
GROWTH ON TSA AT 30°C	+	RHAMNOSE	+
GROWTH ON TSI AT 30°C	+	INOSITOL	+
		DULCITOL	-
		SORBINOSE	+
		SALICIN	+

INGREDIENTS OF CASEIN ENRICHED NUTRIENT AGAR

DIPOTASSIUM HYDROGEN PHOSPHATE	...	0.2 g
MAGNESIUM SULPHATE	...	0.2 g
FERROUS SULPHATE	...	Trace
GLUCOSE	...	1.0 g
SODIUM CASSINATE	...	1.0 g
PEPTONE	...	5.0 g
DISTILLED WATER ...		1000 ml

PROJECT **BF/B/8**

ECOLOGICAL STUDIES ON TROPICAL MANGROVE VEGETATION ON WESTERN FRINGE AREA OF THE SUNDERBANS

Personnel : P.K. Chakraborti, Y.S. Yadava, K.R. Naskar, A. Hajra, R.K. Das, Babu Lal, N.N. Mazumder

Duration : 1986-1990

Location : Gosaba-Sajnakhali, Kulti and Bakkhali

The vanishing mangals of the Malancha area have hardly two mangrove tree species (*Avicennia marina* and *Sonneratia cascolaris)* and a few shrubs (*Acantius* sp., *Clerodendrum* sp. and *Crinum* sp.) besides grassess and sedges like *Panicum* sp., *Sporobolus* sp., *Scirpus* sp., *Fimbristylis* sp., *Cyperus* spp. etc., the floral density being very insignificant.

Bakkhali area showed a better floral diversity, compared to Malancha, the species being *Avicennia alba* (30%), *A. marina* (25%), *Ceriops* spp. and *Excoecaria* sp. (about10% each), *Aegialitis* sp. and *Aegiceros* sp. (about 5% each) and *Phoenix* (about 15%), besides the existence of harbaceous flora like *Suaeda* sp., *Phragmites* sp., *Panicum* sp., *Sporobolus* sp., *Cyperus* sp., *Fimbristylis* spp. and *Heliotropium* sp. A patch of 5-6 plants of endangered *Nypa fruiticans* could be detected from the region. Some of the denuded areas have been aforested with *Casurina* sp., *Eucalyptus* sp., and other plants of exotic origin.

In Gosaba, most of the mangrove species have disappeared, barring *Avicennia alba*, *Excoecaria* sp. and *Clerodendrum* sp. to cover 90%, 5% and 5% areas respectively, besides patches of *Portresia* sp. and *Suaeda* sp.

River beds and slopes in the core areas are covered with *Portegesia* sp. (25%) and *Suaeda* sp. (5%). Sixty percent area of the intertidal consolidated soil layers are having even coverage of *Avicennia* spp., *Sonneratia* sp. and *Bruguiera* spp. while *Rhizophora* sp. and *Ceriops* sp. cover 10% area each leaving rest of the area for other plants. The tidal ridge forest of the core area has maximum coverage of *Ceriops* sp. (25%) followed by *Avicennia* sp., and *Sonneratia* sp. (15% each). About sixteen species of periphytic, epiphytic and benthic algae have been recorded from the area.

Microbial studies

Nutrient release in water phase by the bacterial action on mangrove detritus was confirmed both in the field observation and in laboratory trials. Microbial load was maximum at Pakhiralaya (soil : 7.5 $x10^6$ g^{-1}, water : 1.97x 10^2 ml^{-1}) followed by Sudhannyakhali, Bakkhali, Sajinakhali and Gosaba.The least concentration was however at Kaliachar region of Sajinakhali forest (soil 3.2 x 10^6 g^{-1} and water : 1.3x10^2 ml^{-1}).

Plankton

Studies conducted at six stations (Malancha, Gosaba, Durgaduania, Sudhannyakhali, Sajinakhali and Bokkhali) covering sewage influenced, human interfered, denuded mangrove territory and core area (including Guano influenced zone) revealed significant differences in the plankton population. The maximum plankton density (units l^{-1}) was observed in Gosaba (2 041.6-2 733.8 units l^{-1}) and the minimum in the denuded mangrove region-Bokkhali (484.6-505.6 units l^{-1}). In the core region, the density ranged between 1 422.8 and 1 742.5 units l^{-1}. Qualitative composition revealed a homogeneous distribution of dominant planktonic forms. Presence of *Noctiluca* sp., a saline form, in Bokkhali was significant.

Associated fauna

Studies of associated fauna, undertaken at the six centres, revealed maximum concentration (1 068 nos/30 min. effort) of organisms at the Gosaba site, followed by Sudhannyakhali (993 nos./30 min. effort) in the core area. The man-induced shift in the mangrove ecology in Bokkhali region was amply reflected by the poor concentration (39 nos/30 min. effort) of organisms at the site. *Acetes indicus* formed the dominant organism in the associated fauna comprising 41.84% (average) of the total density.

Benthos

The benthic fauna and flora at the sites studied were conspicuous by their high density (7 6245.0 units m^{-2}) in the sewage influenced Malancha region, followed by semi-core area (3 503.5 units m^{-2}). The benthic organisms were at their lowest ebb (60 units m^{-2}) in the denuded mangrove region, Bokkhali.

Quantitative estimation of detritus in the ecosystem revealed maximum concentration (2 93.02 g m^{-2}) in the semi-core area, probably influenced by the concentrated activities of the human settlements on the fringes.

Biochemical aspects

The nutrients present in the mangrove leaves and their detritus are expected to influence the body composition and nutritive value of important brackishwater shrimps and fishes and, therefore, biochemical composition of leaves was determined. Between the leaves of *Avicennia* and *Xylocarous*, the former was found to have higher nutrient make-up with respect to protein and caloric contents (Table -1).

The nutrient status of detritus revealed elevations in the protein and gross energy and decreases in the total carbohydrate content in both the samples, after the formation of detectable detritus from the fallen leaves. The lipid contents, however, remained more or less unchanged, as no appreciable alterations could be detected (Table-2).

Estimation of the body composition of fish and shrimp, caught from the regions, have shown that both the *L. parsia* and *P. indicus* have slightly higher levels of protein and caloric contents in the zone dominated by *Avicennia*, compared to the fish and shrimp inhabiting the zone infested with *Xylocarpus* (Table-3).

Primary productivity

Rate of ^{14}C assimilation showed positive correlation with half-bound carbon, electrical conductivity and total dissolved solids of water bodies and organic carbon, electrical conductance and dissolved solids of land masses. Sajinakhali and Sudhannyakhali areas of the region showed very high values of ^{14}C assimilation and solar energy transformation. Average values of ^{14}C assimilation and energy transformation for these two places were 1.125 g C $m^{-2}day^{-1}$; 11 058 Cal $m^{-2}day^{-1}$ and 1.255 g C $m^{-2}day^{-1}$; 12 336 Cal $m^{-2}day^{-1}$ respectively. Autotrophic organisms in these areas fixed the solar energy with very high rate of photosynthetic efficiency (0.505-0.563%). Probable reasons for such a high rate of efficiency is the higher values of exchangeable cations, high content of organic matter and electrical conductance of soil phase of mangrove ecosystems coupled with high detritus content, electrical conductivity and total dissolved solids of the water bodies. In the Bakkhali and Gosaba

Table - 1. Proximate chemical composition and caloric contents of the leaves of mangroves

Mangrove leaf	Moisture (%)	DRY WEIGHT COMPOSITION (%)					Energy (K Cal.)
		Protein	*Fat*	*N.F.E.*	*Crude fibre*	*Ash*	
Avicennia marina	69.5	18.0	8.3	29.9	22.6	21.2	356.7
Xylocarpus mekongensis	67.2	16.9	7.2	28.0	24.9	23.0	344.0

Table - 2. Proximate chemical composition of detritus of mangroves

Detectable detritus of	DRY WEIGHT COMPOSITION (%)		
	Protein	*Lipid*	*Total carbohydrate (N.F.E. + Crude fibre)*
Avicennia marine leaves	21.9	8.4	40.0
Xylocarpus mekongensis	19.1	7.0	38.9

Table - 3. Whole body composition of shrimp and fish caught from different mangrove zones

Mangrove zones of	FISH/ SHRIMP	DRY WEIGHT COMPOSITION (%)					ENERGY KCal/100 g
		Moisture (%)	Protein	Total carbohydrate (N.F.E. + Crude fibre)	Lipid	Ash	
Avicennia marina Zone	*L. Parsia*	77.7	70.2	8.6	6.9	14.3	378.5
	P. indicus	73.6	68.8	8.4	5.9	16.9	361.9
Xylocarpus mekongensis Zone	*L. Parsia*	76.9	69.4	7.4	7.3	15.9	372.9
	P. indicus	72.9	67.4	7.2	6.3	19.1	355.1

regions, despite the availability of sufficient amount of solar radiation on the water surface and rich nutrients , lower values of ^{14}C assimilation and energy transformation (0.453 g C $m^{-2}day^{-1}$; 5 650 Cal $m^{-2}day^{-1}$ and 0.746 g C $m^{-2}day^{-1}$; 7 333 Cal $m^{-2}day^{-1}$ respectively) were observed. Turbidity of water and disturbances due to fish seed collection might be the causes for the low values.

PROJECT **BF/B/9**

ECOLOGY AND FISHERIES OF NARMADA ESTUARINE SYSTEM WITH SPECIAL REFERENCE TO PROPOSED IMPOUNDMENT OF RIVER NARMADA (SARDAR SAROVAR)

Personnel : D. Nath, S.N. Singh, S.K. Sarkar, R.C. Mandi, K.S. Banerjee, C.K. Vava

Duration : 1988-1993

Location : Vadodara

Hydrological regime

Highest turbidity was recorded during July at all the centres and this varied from 5.0 to 145.0 cm. By and large, estuarine as well as transitional zones were more turbid than the upper stretch. Dissolved oxygen was fairly abundant at all the centres which varied from 5.8 to 9.6 mg l^{-1}. It was relatively low during extreme summer condition, which is attributed to decline in oxygen holding capacity of water and acclerated catabolic processes as a result of increase in temperature. pH of water varied from 7.2 to 8.3, which had more or less similar pattern of variation at all the centres. Total alkalinity which was mostly determined as bicarbonate alkalinity varied from 92.0 to 164.0 mg l^{-1} during the period under report. Free CO_2 ranged between traces and 15.0 mg l^{-1} and was high at lower estuarine zone. Chlorinity was highest at Bharbhut (9 000 mg l^{-1}), followed by Bharuch but there was no significant difference in the chlorinity of the entire region stretching beyond Bharuch. Values of total dissolved solids (TDS) were comparatively higher in the estuarine stretch than in the upper stretch and these varied from 110.5 to 7 050 mg l^{-1}. Specific conductivity, which ranged from 179.7 to 13 351 micro mhos cm^{-1}, also exhibited identical trend. Nitrate and silicate were more or less evenly distributed. Silicate was quite high and ranged from 9.8 to 24.0 mg l^{-1}.

Soil was alkaline at all the centres; pH range being 8.3 to 8.9 during the period under report. Jhanor followed by Poicha had higher organic carbon content and which fluctuated from 0.12 to 1.62%. Poicha recorded highest free $CaCO_3$, followed by Bharuch, Bhadbhut, Jhanor and Sisodara. Soil texture was sandy at Sisodara whereas it was loam to clay-loam or sandy-loam at other centres.

Primary productivity and plankton

Average gross primary production was highest at Bhabhut (145.8 mg C m^{-3} hr^{-1}), which declined as one proceeded towards freshwater stretch. Net production was highest at Bharuch (av. 91.1 mg C m^{-3} hr^{-1}). Bhadbhut recorded the highest plankton density (244 units l^{-1}) during this period, phytoplankton (84.43%) forming the mainstay of the standing crop. Zooplankton comprised Protozoa (5.33%), Copepoda (4.92%) and Rotifera (2.0%). Contribution of Foraminifera (Protozoa) was the most conspicous.At the Bharuch centre, phytoplankton (93.02%) was the most dominant group. Jhanor centre, representing the transitional zone, was the least productive. At this centre too, phytoplankton was abundant(87.69%). At the freshwater centres *viz.*, Sisodra and Poicha, phytoplankton formed 86.93 and 91.53% respectively of the total plankton population.

Benthic macrofauna

Jhanor was the most fertile centre bearing an average benthic population density of of 10 898 units l^{-1}. Oligochaetes and polychaetes (98.18%) constituted the main groups of organisms. Bhadbhut and Bharuch, the two deltaic centres, recorded an average macrobenthic population of 67 and 224 units l^{-1} respectively. Sisodara and Poicha stretches were quite rich in macrobenthos; the density being 2 780 and 1 333 units l^{-1} respectively. Dipterans (64.59 to 82.88%) were the most dominant component. Other groups were Mollusca (7.62 to 12.30%), Ephemeroptera (2.09 to 7.95%), Oligochaeta and Polychaeta (3.42 to 6.00%), Malacostraca (1.47 to 2.03%), Odonata and Trichoptera. Rich faunistic diversity of macrobenthic organisms indicated a stable nature of the ecosystem as a whole.

Identification of effluent discharge points (industrial, agricultural and domestic)

Baijalpur, in the vicinity of Bharuch has been identified as the point of discharge of domestic and industrial effluents. At outfall (OF), high level of total alkalinity (371.6 mg l^{-1}) and turbidity (17.2 cm), low dissolved oxygen (3.8 mg l^{-1}), high chlorinity (662.5 mg l^{-1}) and high level of sp. conductivity (2,333.7 µmhos cm^{-1}) and total dissolved solids (1 159.4 mg l^{-1}) were noticed indicating stressed conditions. This is further substantiated by high organic carbon (1.28%) in the soil, high rate of BOD (31.8 mg l^{-1}) and high gross and net primary productivity of 218.5 and 125.0 mgC $m^{-3}hr^{-1}$ respectively.

Plankton was very rich (1 988 units l^{-1}) at the outfall. Presence of bacteria (*Zoogloea* sp.) in appreciable number (5.08%) and the occurrence of rat tail maggot, *Eristalis* sp. also confirm the stress conditions. The hydrobiological regime at AOF and BOF indicated that effect of effluents diminished at these centres.

Artificial fecundation of *Tenualosa ilisha*

Artificial fecundation of hilsa,*Tenualosa ilisha* was achieved during the monsoon by following the dry stripping method. A total of 7.5 lakh hilsa spawn were produced.

Major fisheries of the system

Major fishery in the deltaic stretch was the hilsa *(Tenualosa)* and *Macrobrachium* sp., whereas *Tor tor* fishery was the major fishery in the upper freshwater hilly regions. Major carps are fished in the upper and middle regions of the Narmada estruary. In the transitional zone, although the major carps contributed significantly to the landings, the most prized fishery in this region was that of the giant freshwater prawn, *Macrobrachium rosenbergii.*

PROJECT **BF/A/2**

FISHERIES AND BIOLOGY OF HOOGHLY HILSA, *TENUALOSA ILISHA*

Personnel : B.N. Saigal, M.K. Mukhopadhyay, A. Mukherjee, D.K. De, Amitabha Ghosh, V.K. Unnithan, H.C. Joshi, P.M. Mitra, A.B. Mukherjee

Duration : 1986-90

Location : Estuarine Division, Barrackpore with sampling centres at Uluberia, Diamond-Harbour, Digha, Frazergunj and Farakka

Artificial propagation

Following the method of dry stripping of live oozing females and milting males in the ratio of 1 : 4-5, 7.5 lakh hilsa spawns were produced at Bhadbhut on Narmada estuarine system. From similar attempts at Farakka, 1.5 lakh hilsa spawn were obtained and reared in freshwater nursery ponds. Details of the breeding experiments are shown in Table - 1.

Table - 1. Details of breeding experiments of hilsa in Narmada and Ganga river systems

Parameters	Narmada river	Ganga river
Breeding season	*July-August*	*September-November*
Breeding site	*Bhadbhut (45 km upstream from the sea face)*	*Farakka (About 500 km upstream from the sea face)*
Brooder caught by	*Gill net*	*Boat seine, clap net and gill net*
Size of the brooders (mm)	*385-410* *340-365*	*340-360* *285-335*
Number of sets bred	*5*	*3*
Water used during stripping	*Estuarine water*	*Pond water*
Percentage of fertilization	*58-80*	*90-95*
Method of incubation	*Hatching hapa* *Glass jar hatchery* *Plastic basket hatchery*	*Hatching hapa* *Plastic basket hatchery*
Water quality during incubation and larval development		
DO (mg l^{-1})	*5.4-6.8*	*5.4-6.5*
Temperature (°C)	*26.0-27.7*	*25.2-28.0*
pH	*6.78-6.80*	*7.7-7.9*
Turbidity (ppt)	*650-700*	*121-245*
Incubation period (hrs)	*17-20*	*18-20*
Percentage of hatching	*35-45*	*85-92*

Nursery rearing

At Umarwada, hilsa spawn were stocked in a 0.1 ha nursery pond @ 800 000 ha^{-1} and at Ukai two nurseries (0.1 ha each) were stocked at the rates of 800 000 ha^{-1} and 3 300 000 ha^{-1} respectively. The spawn recorded a growth of approximately 1.0 mm day^{-1} in Umarwada pond. Ground nut oilcake and rice bran @ 5% of the body weight of the fish were given as supplementary feeding.

At Farakka, two nurseries (0.1 ha each) were prepared and stocked with 7-8 days old hilsa spawn @ 500 000 ha^{-1} . The spawn grew to the size of 32.40 mm/0.3125 g and 70-78/3.278 g after 45 and 100 days of rearing respectively.

Catch estimates

The estimated hilsa landings in the Hooghly estuary during the year were 1 563.4 t, against 1 720.6 of the previous year, showing a decline by 9%.

Morpho-histological studies on the thyroid gland of *Tenualosa ilisha*

The follicles of thyroid gland in *T. ilisha* are clustered instead of scattered around the ventral aorta in the phyaryngeal region between the dorsal branchial cartilages and ventral stenohyoid muscle. Each follicle possesses a central lumen encircled by a single layer of epithelial cells. The lumina of the follicles are filled with a granular eosinophilic colloid material. The follicles are found to be highly vascularised and are frequently aggregated around the blood vessels. AB (2.5) positive mucous cells were noticed in posterior-intestinal epithelium of hilsa. Muscle lipid content was low and moisture content was high in the juveniles (62-65 mm), compared to the adults (above 150 g).

Investigation on fish lock of the Farakka barrage

The water level variations between upstream and downstream faces adjoining the fish lock bays in the Farakka barrage at different months are hereunder -

1989	July	-	1.11m
	August	-	0.57 m
	September	-	0.50 m
	October	-	2.03 m

The flow velocity at the downstream end ranged from 3.85 to 4.8 m sec^{-1} during August-September. The water discharged through the submerged gate orifices reversed after striking the energy dissipators on the lock aprons and creating a turbulent

circulatory motion in the fish lock chambers when the flow hit the dividing walls. This might be one of the reasons coming in the way of hilsa migration through the fish lock.

Fabrication of hatchery

A portable plastic basket hatching-cum-rearing unit has been fabricated for the incubation and hatching of the eggs of *Tenualosa ilisha*. The unit consists of a plastic pool (75 cms height and 90 cms diameter) with provision of a sub-surface outlet at a depth of 4". A round markin hapa of 90 cms height is placed inside the plastic pool and is kept attached to the inner wall of the pool by means of a grid fitted at the inner bottom of the hapa. A tapering plastic basket having perforated wall, 60 cms high with upper and lower diameters of 40 cms and 30 cms respectively, is placed at the centre of the plastic pool.

Each unit has a capacity of one lakh eggs (2 to 3 hrs after stripping). Water-hardened eggs are placed in the basket and a gentle water current is maintained through the revolving sprinkler to keep the eggs afloat. After 18 to 20 hours, the eggs hatch and the hatchlings come out at an average water temperatrure of 28°C.

PROJECT AN/A/7

ECOLOGY AND PRODUCTION BIOLOGY OF EDIBLE INLAND MOLLUSCS

Personnel : G.K. Vinci, V.V. Sugunan, V.K. Unnithan, H.C. Joshi, A. Hajra

Duration : 1984-1990

Location : CICFRI, Barrackpore

Achatina fulica is a herbivore feeding entirely on a vegetable diet. Experiments were conducted to find out a cheaper substitute for the vegetables and to formulate a cheaper feed. Two tests were conducted with *Wolffia*, *Spirodella* and *Hydrilla* as test feed. *Wolffia* was found to be better suited as an ingradient for the snail feed. The results are given below :

Feed	Growth rate (%)	Survival rate (%)	FCR
Wolffia	28.15	80	2.02
Spirodela	24.54	62	2.71
Hydrilla	18.4	28	6.20

The results shows that a formulated feed could be prepared using Wolffia as the base.

To determine the assimilation and conversion rates of two feed materials, feeding trials were conducted with ash gourd *(Benincasa cerifera)* and cauliflower *(Brassica oleracea)* leaf on the snail, *Achatina fulica.* Details are given in Table - 1.

Table - 1. Digestibility coefficients for *Achatina fulica*

Feed	Palatability	Protein	Fat	Fibre
Ash gourd	Very high	79.5	71.4	Inappreciable
Cauliflower leaf	High	74.3	67.3	9.4

The nutritive value and digestibility of dry matter as well as the nutrients suggested that both the feed stuffs could be used for intensive culture of the snail. As the better food conversion efficiency (2.02) and growth rate (28.15%) of *Wolffia* were established, it is proposed to formulate a feed for the snails consisting of *Wolffia*, cauliflower leaves or ash gourd as the major components with other usual ingredients of the ration like vitamin additives and antioxidants etc.

The nutritive value of the snail meat was determined and the details are given in Table - 2.

Table - 2. Nutritive value of *Achatina fulica*

Composition of 100 g meat (wet wt.)

Moisture (%)	Protein (%)	Fat (%)	Soluble carbohydrate (%)	Ash
75.0	12.4	0.9	8.4	3.3

Composition of dry-matter (100 g meat)

Protein	Fat	Soluble carbohydrate	Ash	Energy (K cal/100 g dry meat)
49.6%	3.6%	33.6%	13.4%	363.4

Bioaccumulation of pesticides in the snail flesh was monitored by examining samples from both urban (Monirampore, Ichhapur) and rural (Midnapore) areas. In rural samples, isomers of Aldrin and BHC were either nil or well within the permissible limit. Samples collected from the urban areas were normally free of pesticides barring a case in which Aldrin was present but under permissible limit.

PROJECT AN/A/9

DEVELOPMENT OF SUITABLE DESIGN OF PENS AND CAGES FOR AUGMENTING FISH PRODUCTION IN LAKES AND RESERVOIRS

Personnel : A.B. Mukherjee

Duration : 1986-91

Location : Barrackpore

Survey: Engineering survey was conducted to select a suitable site for pen culture operations in a *man* (oxbow lake) in the Gandak basin. The selected site has a gentle shore gradient varying between 1 : 3 000 and 1 : 3 500. The fine grained sediment had a high initial porosity and considerable change in volume due to drying or

superimposed load. The average density was of the order of 1.5 g cm^{-3}. Since the rainfall was almost evenly distributed and the terrace covered with thick vegetation, the soil loss has not of appreciable magnitude.The rate of soil loss was been estimated at 1.25 tons ha^{-1} for a surface discharge of about 3.67 m^3 sec^{-1}.

Design : The pen enclosure has been designed as a semi-rigid structure covering an area of 1 500 m^2 and a small nursery unit of 120 m^2. It is rectangular in shape with symmetrical round corners to facilitate even fixing of net. Bamboos of different diameters and sizes have been considered as main construction materials for the pen owing to their easy availability, cheapness, less dead weight and reasonable strength to withstand external forces.

Anchorage arrangements for a single cage unit

Analytical design of a suspended anchor for a floating cage (10 m x 6 m x 2.5 m) to offer stability against rocking or heel has been developed. The weight is suspended from the centre of the cage base. The tension in the anchor rope puts an additional downward force on the body, enabling it to displace a larger volume of water. To prevent the net being swept to one corner by current and to keep the net well-spread, a rectangular metal frame is fitted at the base of the cage. The net is firmly tied with the frame and thus the lateral displacement is prevented.

PROJECT **CSS/1**

DEVELOPMENT OF INLAND FISHERIES STATISTICS

Personnel : R.A. Gupta, S. Paul, S.K. Mandal, Arati Das, K. Sucheta Mazumder

Duration : 1985-90

Location : CICFRI, Barrackpore

In the initial phase of the work the studies were conducted in eight states to evolve the sampling designs for estimation of area and catch from different categories of water bodies . In the latter phase, the work was extended to five more states to test the evolved methodologies. The designs suggested for the survey work and the results are presented below :

Sampling design and estimates for ponds and tanks

Stratified cluster sampling was found to be efficient in estimation of area under ponds and tanks. Two types of estimates were worked out using the data collected from different states. The results are presented in Table -1. In most of the cases, the estimates based on area per pond were found to be better than the estimates based on cluster mean. The percentage of sampling error for these estimates ranged from 4% to 35%. The analysis of data collected by complete enumeration in some states showed that about 90 villages had to be selected from each district in order to restrict the error within 25%. From the estimates based on 90 villages in Gujarat, Maharashtra and Tamil Nadu, it was revealed that the percentage of error was less than 25 in all cases. Whereas the estimates based on 60 villages in other states showed that the percentage of error was even upto 35%. Accordingly, 6 clusters of 5 villages each have been recommended for the three strata in a district. Stratified two - stage cluster sampling with cluster of villages as first stage unit and ponds within cluster as second stage unit have been recommended for the estimation of catch from ponds and tanks. Here, the estimates based on production per hectare were found to be better than the estimates based on yield for cluster.

Sampling design for estimation of catch from rivers, stream and estuaries

For these types of water bodies, stratified two stage sampling design was suggested with landing centres or fishing village as the first stage unit and gear/fishing unit as the second stage unit. Collection of data on inventory is in progress in various states.

Sampling design for reservoirs, lakes and beels

Stratified random sampling has been proposed for these resources, making stratification according to the size of the water bodies. The data on these water bodies are being collected by the states.

Table - 1. Estimates of resosurce under *ponds and tanks* in the selected districts of different states

State and District	No of cluster	Cluster estimate		Per pond estimate	
		Total area (ha)	% SE	Total area (ha)	% SE
ANDHRA PRADESH					
Chittor	4	51516	11.94	53981	4.54
Mehaboobnagar	4	35687	7.62	43307	11.11
Warangal	4	18312	14.27	18065	13.43
BIHAR					
Bhagalpur	4	1119	14.47	1078	7.65
Purnea	4	1131	18.70	1031	14.80
Patna	4	392	13.83	431	11.99
GUJARAT					
Panchmahal	6	6903	23.66	5034	25.11
Rajkot	6	4835	14.21	4468	11.61
MAHARASHTRA					
Nagpur	6	3753	17.77	1257	18.90
Sangli	6	4052	21.10	3243	18.52
Nanded	6	5183	15.51	1786	15.37
MADHYA PRADESH					
Sarguya	4	4083	20.83	3498	11.19
TAMIL NADU					
Coimbatore	6	2308	18.46	2788	22.37
Tanjavur	4	11598	15.16	14894	30.17
South Arcot	6	15918	12.77	16008	12.77
UTTAR PRADESH					
Agra	4	1139	20.22	1139	20.22
Allahabad	4	4674	8.08	4674	8.08
Gorakhpore	4	2479	18.84	2579	18.84
Nainital	4	891	34.89	891	34.89

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PERSONNEL

Dr. Arun G. Jhingran, Director, Barrackpore

The following scientists rendered their services to the Institute during the period April 1989 to March 1990.

RIVERINE DIVISION

Allahabad Centre

Dr. Y. Rama Rao, Principal Scientist
Shri Ravish Chandra, -do-
Dr. S.K. Wishard, Senior Scientist
Shri R.K. Saxena, -do-
Shri G.N. Srivasthava, -do-
Dr. D.N. Singh, -do-
Shri Balbir Singh, -do-
Shri R.K. Dwivedi, -do-
Dr. M.A. Khan, -do-
Dr. H.P. Singh, -do-
Shri R.K. Tyagi, -do-
Shri P.K. Katiha, Scientist

Lalgola Centre

Shri A.R. Chaudhdury, Scientist

Guwahati Centre

Shri S.P. Singh, Principal Scientist
Shri S.N. Mehrotra, Senior Scientist
Shri D.K. Choudhury, -do-

Patna Centre

Shri K.P. Srivastava, Senior Scientist
Dr. V.R. Chitransi, -do-
Dr. B.C. Jha, -do-
Dr. V. Pathak, -do-
Dr. P.N. Jaitly, Scientist

Agra Centre

Shri D.N. Mishra, Senior Scientist
Dr. (Ms.) Usha Moza, -do-
Dr. K. Chandra, -do-
Shri Shree Prakash, -do-
Shri V. Kolekar, Scientist

LACUSTRINE DIVISION

Bangalore Centre

Shri Ch. Gopalakrishnayya, Principal Scientist
Dr. D.S. Krishna Rao, Senior Scientist
Dr. A.K. Laal, -do-
Shri P.K. Sukumaran,Senior Scientist
Dr. M. Choudhury, -do-
Shri M. Karthikayan, Scientist
Shri A. Hazra, Scientist

Eluru Centre

Dr. R.S. Panwar, Principal Scientist
Dr. K.V. Rao, Senior Scientist
Dr. M. Ramakrishnaiah, -do-
Dr. J.B. Rao, -do-

Coimbatore Centre

Shri C. Selvaraj, Principal Scientist
Shri V.K. Murugesan, Senior Scientist
Shri R.N. Seth, -do- (Yet to join)

Pune Centre

P.L.N. Rao, Senior Scientist
Dr. M.D. Pisolkar, -do-
Shri B.K Singh, -do-
Shri B.L. Pandey, Scientist

Raipur Centre

Dr. V.R. Desai, Principal Scientist
Dr. D. Kumar, Senior Scientist
Dr. N.P. Srivastava, -do-

Bilaspur Centre

Shri G.K. Bhatnagar, Principal Scientist
Shri K.L. Shah, Senior Scientist (upto 17.10.1989)
Dr. D.K. Kaushal, Senior Scientist
Dr. V.K. Sharma, -do-

ESTUARINE DIVISION

Barrackpore Centre

Dr. B.N. Saigal, Principal Scientist (Head)
Shri R.N. Pal, Principal Scientist
Shri B.B. Ghosh, -do- (upto 31 July 1989)
Dr. A.K. Ghosh, Senior Scientist
Dr. M.K. Mukhopadhyay, Senior Scientist
Dr. H.C. Joshi, -do-
Shri M.M. Bagchi, -do-
Dr. R.K. Das, -do-
Shri P.M. Mitra, -do-
Dr. M.K. Das, -do-
Dr. D.K. De, -do-
Shri H.C. Karmakar, -do-
Shri A. Mukherjee, -do-
Dr. Babulal, -do-

Vadodara Centre

Shri D.N. Nath, Senior Scientist
Dr. S.N. Singh, -do-
Shri S.K. Sarkar, Scientist
Shri G.C. Laha, -do- (yet to join)

Calcutta Centre

Shri G.N. Saha, Principal Scientist
Shri A.C. Nandy, Senior Scientist
Dr. R.K. Banerjee, -do-
Shri S.C. Thakurta, -do-

Canning Centre

Shri S.N. Dutta, Senior Scientist

BRACKISHWATER IMPOUNDMENT SECTION, Barrackpore

Shri Apurba Ghosh, Principal Scientist
Dr. Y.S. Yadava, Senior Scientist
Dr. Amitabha Ghosh, -do-
Shri P.K. Chakraborty, -do-
Dr. K.R. Naskar, -do-

OTHER CENTRES/SECTIONS AT BARRACKPORE

Inland Molluscs Section

Dr. V.V. Sugunan, Senior Scientist
Ms. G.K. Vinci, -do-
Dr. V.K. Unnithan, -do-

Beel Fisheries Section

Dr.K. K. Vass, Principal Scientist
Dr.(Ms.) Krishna Mitra, Senior Scientist

Extension Section

Shri U. Bhowmick, Senior Scientist
Shri P.K. Pandit, -do-

Engineering Section

Shri A. B. Mukherjee, Principal Scientist

Economics Section

Shri S. Paul, Senior Scientist

Central Sector Scheme for Inland Fisheries Statistics

Shri R.A. Gupta, Senior Scientist
Shri S.K. Mondal, Senior Scientist

Krishi Vigyan Kendra, Kakdwip

Shri J.G. Chatterjee, Senior Scientist

Scientists on Deputation/Lien

Dr. Kuldip Kumar, Senior Scientist, State Fisheries Dept., Himachal Pradesh

Dr. G.N. Chattopadhyay, Senior Scientist, Visva-Bharati, Santiniketan

Shri S.K. Saha, Senior Scientist, Planning Commission, Govt. of India, New Delhi

The following members of staff (Technical/Auxiliary) rendered their services during the year.

Sr.R.A.

Shri S. N. Sar

T-7

Dr. A.K. Chattopadhaya

T-6

Shri J. Ghosh
Shri S.K. Sadhukhan
Ms. Mira Sen

T-5

Shri Ramchandra
Shri A.K. Roy
Shri Md. F. Rahaman
Shri P.S.C. Bose
Shri R.N. De
Shri R.C. Singh
Shri A.R. Mazumder
Ms. Anjali De
Shri P.K. Ghosh
Shri S.K. Das
Shri N.K. Srivastava,
Shri K.S. Rao
Shri T.S. Rama Raju
Shri R.C. Satapati
Shri K.K. Agarwal
Shri R.C. Mandy
Shri Sanjoy Bhowmick
Md. T.K. Syed Shakul Hameed

T-4

Shri A.R. Paul
Shri K.S. Banerjee
Shri D.N. Srivastava
Shri B.D. Saroj
Shri Alok Sarkar
Shri N.N. Mazumdar
Shri S.P. Ghosh
Shri N.C. Mondal

Shri H.K. Sen
Shri P. Dasgupta
Shri Sukumar Saha
Ms. Dipti Manna
Shri C.N. Mukherjee
Ms. Satnam Kaur
Shri Ladu Ram Mahabhar

T-II-3

Shri J.P. Mishra
Shri H. Chaklader
Shri Amiya Kr. Banerjee
Shri Fatik Manna
Shri Ramji Tiwari
Shri Camil Lakra
Shri M.P. Singh
Shri S.K. Srivastava
Shri D.K. Biswas
Shri T. Chatterjee
Shri Pintu Biswas
Shri B.K. Biswas
Shri H.C. Banik
Ms. Keya Saha
Ms. Arati Das
Ms. K. Sucheta Majumder
Shri B.B. Das
Shri Swapan Kr. Chatterjee
Shri Sushil Kumar

T-I-3

Shri D. Sanfui
Shri A.K. Banerjee
Shri Donald Singh
Shri M.M. Das
Shri S.N. Sadhukhan
Shri Swapan Chatterjee
Shri K.P. Singh
Shri R.K. Halder

T-2

Shri D. Chatterjee
Ms. Rina Basak
Shri B.N. Das
Shri P. Rajani
Shri Bhai Lal
Shri A. Mitra
Shri C.K. Vava

T-I

Shri Prahlad Singh
Shri L.K. Parbat
Shri D. Saha
Shri S. Bandopadhyay
Shri C.G. Rao
Shri S. Kotaiah
Shri Atanu Das
Shri H.L. Biswas
Shri S.N. Chakki
Shri A.K. Barui
Shri K.K. Das
Shri H.K. Routh
Ms. Shuvra Das
Shri S.K. Chakraborty
Shri N.K. Saha
Shri Rajesh Kumar Sah
Shri Sakshi Gopal Biswas
Shri S.G. Biswas

Auxiliary

Shri P.R. Rao, Hindi Translator
Shri Swapan Kr. Das, Time Keeper
Shri G.N. Burman, Mike Operator
Shri S.K. Biswas, Carpenter
Shri S.K. Dev, Plumber
Shri K.L. Chakraborty, Sr. Gestetner Operator
Shri J.L. Bose, Sr. Gestetner Operator
Shri S.C. Bhowmick, Sr. Gestetner Operator
Shri Mool Chand Raikwar, Sr. Gestetner Operator
Shri M.C. Raikwar, Sr. Gestetnar Operator
Shri D. Bergyoary, Driver
Shri K. Ganesan, Driver
Shri K.L. Das, Driver
Shri Kanchan Datta, Driver
Shri U.K. Chatterjee, Driver
Shri R.L. Balmiki, Driver
Shri S. Bahadur, Driver
Shri Badal Lal Singh, Driver
Shri V.G. Dhindore, Driver
Shri N.C. Bidwas, Driver
Shri K.R. Deb, Driver

Shri Kishan Deo, Driver
Shri Ranjit Singh, Driver
Shri M.C. Paul, Driver
Shri Virendra Kumar, Driver
Shri Ram Prasad, Driver
Shri Sunder Singh, Driver
Shri Arun Kumar Mondal, Driver
Shri Subhendu Mondal, Boat Driver
Shri R.M. Roy
Shri T.P. Ghosh
Shri C.R. Das
Shri A.K. Majumder
Shri Saradindu Chakraborty
Shri A.K. Goswami

The following members of staff (Administrative) rendered their services during the year.

Senior Administrative Officer

Shri L.M. Nandy (upto 31.12.1989)

Accounts Officer

Shri J.R. Verma

Administrative Officer

(Vacant)

Assistant Administrative Officer

Shri A.K. Sengupta

P.A. to Director

Shri G. Lahiri

Senior Stenographer

Shri R.C. Srivastava

Superintendent

Shri B.C. Dutta
Shri M.R. Roy
Shri N.K. Sarkar
Shri N.H. Baidya

Assistant

Shri B.C. Bhattacharjee
Shri M.M. Neogi
Shri D.C. Bose
Shri I.N. Kodandaraman
Ms. Bani Roy
Ms. Namita Choudhury
Shri S. Dasgupta
Shri T.P. Das
Ms. S. Majumder
Shri D.K. Banerjee
Shri S.K. Pramanick
Shri S.P. Sastry
Shri Mahesh Prasad
Shri C.C. Das
Shri R.C.P. Singh

Stenographer

Shri U.K. Ghosh
Shri T.K. Roy
Shri S. Bhattacharjee

Senior Clerk

Shri T.K. Sreedharan
Shri L.P. Mishra
Shri Baij Nath
Shri S.K. Kar
Shri N.K. Mitra
Shri J.C. Patra
Shri Keshab Prasad
Shri H.K. Nath
Shri J.N. Banerjee
Shri S.K. Sarkar
Shri D.N. Baidya
Shri S.R. Halder
Shri H.L. Sarkar
Shri B.B. Mukherjee
Shri B.C. Mazumdar
Shri S. Bhowmick
Shri M.K. Das
Shri D.K. De Sarkar
Shri R.R. Mukherjee
Shri M. Kachhap
Shri A.B. Biswas

Shri Samir Kr. Roy
Shri S.B. Roy
Shri H.B. Sutar
Shri T.K. Mazumder
Shri Ranjit Kr. Ghosh
Shri Kalu Singh
Shri S.S. Sinha

Junior Stenographer

Ms. G. Vinoda Lakshmi
Ms. Jolly Saha

Junior Clerk

Ms. Sikha Mazumder
Ms. N. Banerjee
Ms. G. Mazumder
Ms. M. Banerjee
Ms. Anita Mazumder
Ms. Bulbul Mallick
Ms. A. Neogi
Ms. A. Chakraborty
Ms. Jayasree Pal
Ms. Swapna Talapatra
Ms. Sefali Biswas
Ms. Shyamali Mitra
Ms. Arati Panigrahi
Shri S.P. Mondal
Shri K. Majhi
Shri Paras Ram
Shri S.K. Maranappan
Shri Kunja Behari
Shri Chotte Lal
Shri Ambika Lal
Shri P.K. Dutta
Shri P. Lahiri
Shri B.K. Das
Shri S.K. Bose
Shri N.R. Kundu
Shri J. Roy
Shri Biswanasth Sah
Shri S.K. Tikadar
Shri U. Bhattacharjee
Shri P.K. Ghosh
Md. Quasim
Shri Surendrea Kumar
Shri C.K. Pandey
Shri C.K.N. Sahi
Shri K.S. Rao
Shri M.L. Biswas
Shri Debesh Chowdhury
Shri Brahmapal Balmiki
Shri S. Karmakar
Shri Sukumar Sarkar
Shri A.K. Dey
Shri M.K. Joardar
Shri S.K. Ghosh
Shri A. D. Sinde

The followisng members of staff of supporting grade rendered their services during the period.

Supporting Grade IV

Shri R.L. Raikwar
Shri J.M. Kujur
Shri H.B. Lama
Shri Antiram Das
Shri H.K. Das
Shri J.N. Biswas
Shri T.K. Biswas
Shri Sunil Kr. Das
Shri M.S. Burman
Shri Mewa Lal
Shri H.K. Pramanick
Shri Nar Bahadur
Shri Sitaram Balmiki
Shri A.M. Patra
Shri B. Prakash

Supporting Grade III

Shri S.C. Balmiki
Shri P. Sayalu
Shri S.P. Yadav
Shri B.N. Mondal
Shri R.N. Tar
Shri Laluram Balmiki
Shri B.B. Das
Shri Balaram Bhanja
Shri S.N. Burman
Shri G.C. Mondal
Shri D.D. Poudel
Shri Jungli
Shri Jugal Kishore

Shri S.K. Boral
Shri Tek Bahadur
Shri H.S. Burman
Shri S.S. Burman
Shri Munshi Ram Balmiki
Shri L. Samulu
Shri Bhim Bahadur
Shri K.L. Balmiki
Shri N.L. Das
Shri H.K. Burman
Shri Ram Sunder
Shri J. Khalko

Supporting Grade II

Shri Munnilal Mallah
Shri Maha Singh
Shri Dukhharan Sahani
Shri Laxmi Ram
Shri Suraj Bahadur
Shri B.N. Mondal
Shri Rajendra Ram
Shri A. Sahani
Shri C.P. Singh
Shri K.D. Raju
Shri P. Seshanna
Shri P.C. Bez
Shri D.C. Das
Shri B.C. Das
Shri B. Hazarika
Shri P.C. Kachari
Shri A.L. Yadav
Shri Parameswar
Shri S. Mahendra
Shri M.L. Saha
Shri J. Mukhia
Shri A.K. Biswas
Shri Khemchand Balmiki
Shri L.K. Halder
Shri A.C. Ghosh
Shri J.N. Mallah
Shri Gulab Shaw
Shri Subrahmani
Shri M. Mahadeva
Shri K. Ningigowda
Shri S.T. Gavate
Shri S. Mahendran
Shri V. Mariappan
Shri A, Ramaswamy
Shri M.V. Krishnan
Shri K. Kaliannan
Shri Ram Prasad
Shri Karam Raj
Shri Satyendra Burman
Shri Lalta Prasad
Shri Sita
Shri Rajdhari Mallah
Shri Sukchand Biswas
Shri Bideshi Lal
Shri B. Pugalendhi
Shri Om Prakash
Shri M.P. Bind
Shri A. Gangaiah
Shri K. Bahadur
Shri A. Biswas
Shri R. Palaneswami
Shri C.P. Singh
Shri K.K. Dhir
Shri A. Murugesan

Supporting Grade I

Shri Lakshmi Ram
Md. Yusuf Dar
Shri Suresh Kumar
Shri Umesh Chowdhury
Shri Kuldeep Singh
Ms. Bimla Devi
Shri Kawalpati Ram
Shri Mahadev Panika
Shri N. Rajak
Shri Sureshs Rajak
Shri R.U. Muchi
Shri A. Kistaiah
Shri U. Satyanarayana
Shri S. Jaan
Shri P. Atchaiah
Shri S. Kalita
Shri N. Deka
Shri Khagen Ch. Das
Shri Bhabalu Boro
Shri Jai Ram Prasad
Ms. Godhuli Mondal
Ms. Mina Rani Bahadur
Ms. Mina Biswas
Ms. B. Balmiki
Shri K.C. Malakar
Shri H.P. Bhanja
Shri T. Ghosh

Shri Sankar Bose
Shri Muktipada Das
Shri Kharban Kumar
Shri Man Bahadur
Shri S.L. Bairagi
Shri Bhaskar Sardar
Shri Pasupati Ghosh
Shri Jagdish Balmiki
Shri S. Banerjee
Shri Sibu Lal Das
Shri S.C. Sadhukhan
Shri Dipak Chakraborty
Shri Biswanath Bose
Shri Ananta Kr. Bhanja
Shri Rabi Kr. Sardar
Shri Lal Bahadur
Shri Dilip Kr. Das
Ms. B. Sakuntala
Shri Mohan Lal Sarkar
Ms. Hemlata Halder
Shri Balkishen Balmiki
Shri S.N. Nan
Shri Mahendra Balmiki
Shri Ullas Naik
Ms. Rupali Chatterjee
Shri Ashok Kr. Dey
Shri Ganesh Ch. Paramanick
Shri Iswarram Balmiki
Ms. Anjali Dutta
Shri Bharat Kr. Halder
Shri Anil Ch. Das
Shri S. Guin
Shri P. Singh
Shri D. Singh
Shri Atiullah
Shri Sitla Prasad
Ms. Kamal Devi
Shri M. Anjanappa
Shri B.N. Krishnappa
Shri S.S. Bondre
Shri G.J. Roundale
Shri M.S. Bhoi

Shri T.H. Ghume
Shri K. Subbaiya
Shri R. Nagraj
Shri S. Govindarajan
Shri K. Subramahnaiyan
Shri Gopal Chand
Ms. Kalosasi Mondal
Shri G. Lal
Shri Sree Nath
Shri A.C. Biswas
Shri R.D. Chaudhury
Sk. Monsur Ali
Shri S.K. Chakraborty
Shri Gunadhar Dhibar
Shri Prasidh Sahani
Shri Amar Nath Prasad
Shri Umashankar Ram
Shri P.C. Paramanick
Shri Prakash Ch. Paramanick
Shri N.K. Das
Shri Joydev Patra
Shri A. Bhattacharjee
Shri K. Kumar
Ms. Dharamaya
Shri M. Mutta
Shri Basudev Gharami
Shri T.K. Gayen
Shri B.P. Samanta
Shri B.P. Mishra
Shri R.P. Halder
Shri N.T. Dolui
Shri Gour Gharami
Shri M.C. Gharanu
Shri C. Muniappa
Shri T.K. Halder
Shri Ganesh Chandra Burman
Shri Ranjit Kumar Roy
Shri M.C. Das
Shri P.N. Rao
Shri Sitaram Nisad
Shri M. Pannappa

PROMOTIONS

The following members of staff were promoted on recommendation of the Assessment Committee/Departmental Promotion Committee during the period.

Name	Designation	Promoted to	With effect from
Shri K.K. Agarwal	T-4	T-5	1.1.1989
Shri P.S.C. Bose	T-4	T-5	1.1.1989
Shri Swapan Kr. Chatterjee	T-I-3	T-II-3	3.11.1989
Shri R.K. Calder	T-2	T-I-3	1.1.1989
Shri C.R. Das	T-2	T-I-3	1.7.1988
Shri A.K. Majumder	T-2	T-I-3	1.7.1988
Shri Bholanath Das	T-1	T-2	1.7.1988
Shri N.H. Baidya	Asst.	Supnt.	27.10.1989
Shri S.K. Pramanick	Sr. Clerk	Asst.	27.10.1989
Shri A.M. Patra	SSG-III	SSG-IV	5.4.1989
Shri Nar Bahadur	SSG-III	SSG-IV	4.4.1989
Shri B. Prakash	SSG-III	SSG-IV	1.8.1989
Shri Sitaram Balmiki	SSG-III	SSG-IV	27.10.1989
Shri Ram Sunder	SSG-II	SSG-III	5.4.1989
Shri J. Khalko	SSG-II	SSG-III	1.8.1989
Shri Bhim Bahadur	SSG-II	SSG-III	4.4.1989
Shri N.L. Das	SSG-II	SSG-III	27.10.1989
Shri H.K. Burman	SSG-II	SSG-III	27.10.1989
Shri Karna Bahadur	SSG-I	SSG-II	4.4.1989
Shri S. Mahendra	SSG-I	SSG-II	4.4.1989
Shri K. Dhir	SSG-I	SSG-II	5.4.1989
Shri C.P. Singh	SSG-I	SSG-II	27.10.1989
Shri J. Mukhia	SSG-I	SSG-II	27.10.1989
Shri M.L. Saha	SSG-I	SSG-II	27.10.1989

The following members were granted merit increments as below on the recommendation of the Assessment Committee.

Name	Designation	Merit increments	With effect from
Shri R.N. De	T-5	One	1.1.1989
Shri R.C. Singh	T-5	One	1.1.1989
Shri K.S. Rao	T-5	One	1.1.1989
Shri Ranjit Singh	T-I-3	Three	1.1.1989
Shri Kishan Deo	T-I-3	One	1.1.1989
Shri S.C. Bhowmick	T-I-3	Three	1.7.1988
Shri M.M. Das	T-I-3	Three	1.7.1988
Shri R.M. Roy	T-I-3	One	1.1.1989
Shri Swapan Chatterjee	T-I-3	One	1.1.1989
Shri S. Bhattacherjee	T-I-3	Two	1.1.1989

Retirement during the period

Name	Designation	Date of Retirement
Shri D.D. Halder	Principal Scientist	30 April 1989
Shri B.B. Ghosh	Principal Scientist	31 July 1989
Shri K.L. Shah	Senior Scientist	17 October 1989
Shri S.N. Sar	Sr. Res. Assistant	31 March 1990
Shri L.M. Nandy	Sr Adm. Officer	31 December 1989
Shri H.B. Lama	SSG-IV	31 March 1989
Shri Lalu Ram	SSG-III	31 January 1990

Appointments

Following appointments were made during the period

Name	Designation	Place of posting	Date of appointment
Shri C. Muniappa	SSG-I	Bangalore	19.3.1990
Shri Tarun Kanti Halder	SSG-I	Vadodara	3.3.1990
Shri G.C. Burman	SSG-I	Vadodara	28.2.1990
Shri Ranjit Kr. Roy	SSG-I	Vadodara	28.2.1990
Shri R.C. Mande	T-5	Vadodara	13.12.1989
Shri A.K. Barui	T-1	Barrackpore	1.1.1990
Shri Sanjoy Bhowmick	T-5	Allahabad	30.11.1989
Shri Virendra Kumar	Driver	Agra	19.12.1989
Shri Ram Prasad	Driver	Vadodara	15.12.1989
Shri Sunder Singh	Driver	Raipur	11.12.1989
Md. T.K.Syed Shukul Hameed	T-5	Bangalore	30.11.1989
Shri Mool Chand Raikwar	Sr. Get. Oprtr.	Allahabad	5.10.1989
Shri Subhendu Mondal	Boat Driver	Eluru	25.10.1989
Shri C.K. Vava	T-2	Vadodara	30.9.1989
Shri Rajesh Kr. Sah	T-1	Bangalore	18.9.1989
Ms. Jolly Saha	Jr. Stenographer	Barrackpore	22.9.1989
Shri Sushil Kumar	T-II-3	Bilaspur	17.8.1989
Shri Arun Kumar Mondal	Driver	Patna	6.7.1989
Shri Arjun Digambar Shinde	Junior Clerk	Pune	3.6.1989
Shri H.K. Routh	T-I	Barrackpore	4.4.1989
Shri K.K. Das	T-I	Barrackpore	4.4.1989
Shri Sakshi Gopal Biswas	T-I	Barrackpore	9.4.1989
Shri P. Dasgupta	T-4	Barrackpore	4.4.1989
Shri M. Sennappa	SSG-1	Bangalore	30.9.1989
Shri Ladu Ram Mahabhar	T-4	Allahabad	4.10.1989

Transfers

The following transfers were made during the period April 1989 to March 1990.

Name	Designation	From	To
Institutional			
Dr. Y. Rama Rao	Pr. Scientist	Bangalore	Allahabad
Shri Ch. Gopalakrishnayya	Pr. Scientist	Eluru	Bangalore
Dr. Y.S. Yadava	Senior Scientist	Guwahati	Barrackpore
Shri J.G. Chatterjee	Sr. Scientist	Barrackpore	KVK, Kakdwip
Dr. M. Choudhury	Scientist	Guwahati	Bangalore
Shri B.L. Pandey	Scientist	Bhagalpur	Pune
Shri P.S.C. Bose	T-5	Eluru	Bangalore
Shri R.C. Singh	T-5	Aliyarnagar	Guwahati
Shri Alok Sarkar	T-4	Bhagalpur	Guwahati
Shri K.P. Singh	T-I-3	Bhagalpur	Canning
Shri S. Kotiah	T-1	Eluru	Bangalore
Shri K.B. Soni	Junior Clerk	Allahabad	Vadodara
Shri S. Kumar	Junior Clerk	Bhagalpur	Allahabad
Shri C.K. Pandey	Junior Clerk	Bhagalpur	Canning
Shri S.P. Yadav	SSG-III	Bhagalpur	Agra
Shri Biswanath Mondal	SSG-III	Bhagalpur	Canning
Shri Parameswar	SSG-II	Bhagalpur	Allahabad
Shri Jairam Prasad	SSG-I	Bhagalpur	Allahabad
Shri J. Mukhia	SSG-I	Bhagalpur	Allahabad
Inter-Institutional			
Shri M. Karthikeyan	Scientist	CMFRI, Cochin	Bangalore
Shri Shree Prakash	Sr. Scientist	CIFA, Dhauli	Agra
Shri R.N. Seth	Sr. Scientist	CIFA, Dhauli	Coimbatore
Shri D.K. Choudhury	Sr.Scientist	CIFE, Lucknow	Guwahati

वार्षिक रिपोर्ट 1989-90

केन्द्रीय अंतर्स्थलीय प्रग्रहण मात्स्यकी अनुसंधान संस्थान
(भा.कृ.अनु.प.) : बैरकपुर : पश्चिम बंगाल

संक्षिप्त इतिहास

भारत सरकार ने सन् 1943 में अपने एक ज्ञापन में देश के मात्स्यकी स्त्रोतों के विकास हेतु एक केन्द्रीय विभाग की स्थापना पर विशेष बल दिया था । तत्पश्चात् कृषि वानिकी तथा मात्स्यकी से संबधित केन्द्रीय सरकार नीति-समिति की मात्स्यकी उप-समिति ने इस विषय का पृष्ठांकन किया था । इसके आधार पर 17 मार्च सन् 1947 में भारत सरकार के खाद्य तथा कृषि मंत्रालय के अधीन कलकत्ता में केन्द्रीय अंतर्स्थलीय मात्स्यकी अनुसंधान केन्द्र की स्थापना औपचारिक रूप में हुई। एक अन्तरिम योजना के रूप में प्रवर्तित यह अब अंतर्स्थलीय मात्स्यकी क्षेत्र में एक प्रमुख अनुसंधान संस्थान बन गया । यह केन्द्र सन् 1959 में एक अनुसंधान संस्थान का रुप ग्रहण कर बैरकपुर स्थित अपने निजी भवन में स्थानान्तरित हो गया । सन् 1967 से यह संस्थान भारतीय कृषि अनुसंधान परिषद (आई.सी.ए.आर.) के प्रशासनिक प्रबंध में है । इस संस्थान का मुख्य उद्देश्य देश के मात्स्यकी स्त्रोतों के उचित मूल्यांकन हेतु अन्वेषण करना तथा इनके संरक्षण और समुचित उपयोग के लिए उपयुक्त पद्धतियों को विकसित करना है । उक्त उद्देश्य की पूर्ति के दौरान इस संस्थान ने अपने अनुसंधानात्मक प्रयासों

द्वारा विभिन्न प्रकार के जल-स्त्रोतों जैसेः नदी, सरोवर,तालाब, जलाशय और चापझील के पर्यावरण तथा उत्पादन-क्रियाशीलताओं को सुलझाने का प्रयास किया है । इन अध्ययनों द्वारा भिन्न-भिन्न प्रकार के वातावरण में जलीय पारिस्थितिक तंत्र की जटिल पोषी संरचना तथा प्रकार्यो को सुलझाया गया है । संस्थान के अधिदेश में किंचित परिवर्तन कर देश के प्रग्रहण मात्स्यकी स्त्रोतों पर विशेष ध्यान दिया गया तथा 1.4.87 से संस्थान का नामकरण केन्द्रीय अंतर्स्थलीय प्रग्रहण मात्स्यकी अनुसंधान संस्थान किया गया । पुनर्प्रतिष्ठित के. अ. प्र. मा. अनु.स. को उन उन्मुक्त जल क्षेत्रों में अनुसंधान कार्य करने का दायित्व सौपा गया है जहाँ मात्स्यकी प्रबंध प्रणाली पर्यावरणीय अनुमापन तथा संरक्षण से संबद्ध है ।

अधिदेश

प्राकृतिक एवं मनुष्य द्वारा निर्मित अंतर्स्थलीय जल-स्त्रोतों में संग्रहण, उचित समुपयोजन एवं संरक्षण द्वारा मछली उत्पादन में वृद्धि के लिए अनुसंधान करने हेतु इस संस्थान की स्थापना की गई है ।

संगठन

उक्त उद्देश्यों की प्राप्ति हेतु संस्थान के अनुसंधान कार्य को देश के मुख्य मात्स्यकी स्त्रोतों के अनुरुप तीन प्रभागों के अंतर्गत रखा गया है । नदीय प्रभाग अपने इलाहाबाद स्थित मुख्यालय से देश के नदीय मात्स्यकी स्त्रोतों की सम-प्रबंध पद्धतियों को विकसित करने के लिए, नदीय-पर्यावरण के संरक्षण में आवश्यक ध्यान देते हुए कार्य कर रहा है । गंगा, यमुना, ब्रह्मपुत्र और नर्मदा नदियाँ इस प्रभाग की मुख्य अनुसंधान पारियोजना के अंतर्गत आती हैं । सरोवरीय प्रभाग का मुख्यालय बंगलोर में तथा इसके केन्द्र तमिलनाडु, आन्ध्र प्रदेश, उत्तर प्रदेश, मध्य प्रदेश, हिमाचल प्रदेश और महाराष्ट्र में स्थित हैं। इसके अन्वेषणों का लक्ष्य बड़े तालाबो, सरोवरों और जलाशयों में मत्स्य उत्पादन बढ़ाने हेतु प्रबंध पद्धतियों को विकसित करना है । बैरकपुर स्थित ज्वारनदमुखी प्रभाग पूरे हुगली-मातलाह ज्वारनदमुखी तंत्र और नर्मदा ज्वारनदमुखी क्षेत्र में विभिन्न अनुसंधान योजनाओं का संचालन कर रहा है । औद्योगिक केन्द्रों के बहिस्त्राव तथा कृषीय और नगरीय अपरद्द पदार्थो के प्रवाह के कारण हुगली ज्वारनदमुखी क्षेत्र को गंगा नदीय तंत्र के अत्यधिक प्रदूषित क्षेत्रों में एक माना जा रहा है । इस प्रदूषित

क्षेत्र में इस प्रभाग ने उल्लेखनीय कार्य किया है । ज्वारनदमुखी मछलियों में महत्त्वपूर्ण मछली हिल्सा पर गहन अनुसंधान कार्य चल रहा है । यह संस्थान पश्चिम बंगाल और असाम की बीलों और गन्डक बेसिन की चापझीलों पर भी अनुसंधानात्मक कार्य कर रहा है । इनके अतिरिक्त विवृत जल क्षेत्रों में केज तथा पेन कलचर, अंतर्स्थलीय घोंघों की पारिस्थितिकी एवं उत्पादन प्रक्रिया, हाड्रॉलिक संरचनाओं से मत्स्य पारगमन के अभियात्रिक पहलुओं तथा मात्स्यकी के आर्थिक और साख्यिक विषयों पर भी अनुसंधान कार्य हो रहा है । इस संस्थान के अनुसंधान कार्य को 20 अनुसंधान परियोजनाओं तथा एक केन्द्रीय सेक्टर योजना में विभाजित किया गया है ।

मुख्य उपलब्धियाँ

गंगा परिशुद्धीकरण योजना

गंगा परिशुद्धीकरण योजना (गंगा एक्शन प्लान) का सुधारात्मक प्रभाव गंगा नदी के कुछ भागों के नदीय पर्यावरण में स्पष्ट दृष्टिगोचर है । सन् 1988 से कानपुर में पानी की गुणक्त्ता एवं प्राथमिक उत्पादकता में उल्लेखनीय सुधार हुआ है । नदी में प्रवाहित करने से पूर्व निःस्त्राव पदार्थों के उपचार एवं अपवर्तन के अनुकूल प्रभाव से यह सुधार संभव हुआ है । परिणामतः नदी के इन भागों में मत्स्य-उत्पादन क्षमता 8-144 कि.ग्रा. प्रति हेक्टर से बढ़कर 111-182 कि.ग्रा. प्रति हेक्टर प्रति वर्ष हो गई ।

कानपुर के पास गंगा नदी में औद्योगिक बहिःस्त्राव के नियंत्रित निस्सरण से पारिस्थितिक परिवर्तन

प्राचल (पैरा मीटर) — अनियंत्रित निस्सरण

		दिसम्बर 1987				मार्च 1988			
		1	2	3	4	1	2	3	4
1.	जलीय गुणक्ता								
	घुली आक्सीजन (मि.ग्रा. प्रति ली.)	7.4	5.0	6.8	2.0	6.0	0.0	0.0	0.0
	पी. एच.	8.3	8.0	8.0	7.8	8.3	7.4	7.5	7.6
	उन्मुक्त कार्बन डाइऑक्साइड (मि.ग्रा. प्रति ली.)	0.0	4.0	0.0	10.0	0.0	20.0	36.0	26.0
	कुल क्षारीयता (मि. ग्रा. प्रति ली.)	178.0	218	174	280	172	254	344	320
	विशिष्ट परिचालकता (माइक्रो म्होज़)	358	438	399	782	391	642	1091	816
	कुल घुले ठोस पदार्थ (मि.ग्रा. प्रति ली.)	176	215.0	195	380	191	316	537	404
2.	कार्बन उत्पादन (मि. ग्रा. कार्बन/वर्ग मी./दिन	423.5	302.0	398.5	22.56	195.4	77.4	13.8	67.6
3.	उत्पादकों द्वारा ऊर्जा संश्लेषण (कैलोरी वर्ग मी./दिन)	4152	2968	3913	222	1918	760	136	663
4.	प्रकाश संश्लेषण (प्रतिशत)	0.355	0.254	0.330	0.019	0.102	0.040	0.007	0.0
5.	मत्स्य उत्पादन क्षमता (कि. ग्रा. प्रति हेक्टर)	143.9	102.7	135.5	7.7	66.4	26.3	4.7	22.9

(कृपया अगले पृष्ठ पर देखें)

नियत्रित निस्सरण
दिसम्बर 1988

		1	2	3	4
1.	**जलीय गुणवत्ता**				
	घुली आक्सीजन (मि. ग्रा. प्रति ली.)	10.9	9.7	10.0	9.12
	पी. एच.	8.3	8.0	8.3	8.3
	उन्मुक्त कार्बन डाइऑक्साइड (मि.ग्रा. प्रति ली.)	0.0	2.0	0.0	0.0
	कुल क्षारीयता (मि. ग्रा. प्रति ली.)	172	186	190	216
	विशिष्ट परिचालकता (माइक्रो म्होज़)	391	385	387	356
	कुल घुले ठोस पदार्थ (मि.ग्रा. प्रति ली.)	191	199	148	178
2.	कार्बन उत्पादन (मि. ग्रा. कार्बन वर्ग मी. दिन)	443.2	327.1	540.6	535.2
3.	उत्पादकों द्वारा ऊर्जा संश्लेषण (कैलोरी वर्ग मी. दिन)	4352	3212	5309	5256
4.	प्रकाश संश्लेषण प्रतिशत	0.372	0.272	0.454	0.45
5.	मत्स्य उत्पादन क्षमता (कि. ग्रा. प्रति हेक्टर)	150.7	111.2	183.8	182.0

क्षेत्रः
1. भगवतघाट ऊपरी मिलन क्षेत्र
2. भगवतघाट निचली मिलन क्षेत्र
3. जाजमऊ ऊपरी मिलन क्षेत्र
4. जाजमऊ निचली मिलन क्षेत्र

नर्मदा बेसिन में हिल्सा मछलियों का कृत्रिम प्रजनन

नर्मदा घाटी विकास कार्यक्रम के अंतर्गत बनने वाले बाँधों के कारण नर्मदा बेसिन में महत्त्वपूर्ण हिल्सा मछलियों की संख्या चिन्ताजनक है । केन्द्रीय अंतर्स्थलीय प्रग्रहण मात्स्यकी अनुसंधान संस्थान नर्मदा बेसिन में इन महत्त्वपूर्ण मछलियों के संरक्षण तथा इनके लाभकर मात्स्यकी क्षेत्र के परिरक्षण हेतु प्रयास कर रहा है । नर्मदा के ऊपरी क्षेत्रों में हिल्सा मात्स्यकी की कृत्रिम आपूर्ति हेतु नर्मदा हिल्सा के बीज उत्पादन तकनीक का विकास करना अनिवार्य है । अतः मानसून के अगस्त माह में नर्मदा हिल्सा का कृत्रिम प्रजनन तथा बीजों के पालन-पोषण का सफल प्रयास किया गया ।

गुजरात राज्य के भड़भूत क्षेत्र को, जो नर्मदा ज्वारनदमुख के ऊपरी भाग से 25 कि. मी. की दूरी पर स्थित है, हिल्सा प्रजनन हेतु चुना गया है । इस क्षेत्र में 400 से भी अधिक नावें हिल्सा मछलियों को पकड़ने के कार्य में लगी हुई हैं । प्रजनकों को गिल नेट की सहायता से निकाल कर ड्राई स्ट्रिपिंग पद्धति द्वारा अंडो का निषेचन कराया गया । एक एनैमल ट्रे में मछलियों से अंडाणुओं को स्ट्रिपिंग कर उन पर नर-मछलियों के शुक्र का छिड़काव किया गया तथा एक साफ पिच्छ की सहायता से मिलाया गया । स्ट्रिपिंग के 10-15 मिनट बाद निषेचित अंडों पर स्थिर ज्वारनदमुखी जल डाल कर जल-दृढ़ीकरण हेतु रखा गया ।

कुल 5 जोड़े प्रजनकों को (1.0 से 1.3 किलो वजन वाले) स्ट्रिपिंग किया गया जिनसे 58 से 80% निषेचन तथा 35 से 45% अंडजोत्पत्ति दर प्राप्त हुई । 72 घन्टों के संवर्धन के बाद 7.5 लाख जीरों की प्राप्ति हुई जिनका गुजरात के उमरवाड़ा तथा उकाई मत्स्य प्रक्षेत्र (फ़िश फ़ार्म) में पालन-पोषण किया जा रहा है ।

स्फुटनशाला (हैचरी) में हिल्सा प्रजनन

टेन्यूलोसा इलिशा के कृत्रिम निषेचन हेतु तैयार किये गये सुवाह्य प्लास्टिक हैचरी के प्रारूप का फ़रक्का में सफल प्रयोग किया गया । इस हैचरी में एक प्लास्टिक पूल (75 से. मी. गहराई तथा 90 से.मी. व्यासवाली) होती है जिसके भीतरी भाग में मारकीन कपड़े का हापा लगा रहता है और इस प्लास्टिक पूल में एक निकास द्वार भी होता है । इसके अलावा एक छिद्रोंवाली प्लास्टिक की बाल्टी (60 से.मी. ऊँची एवं 40 से.मी. व्यासवाली) होती है जिसकी भीतरी भाग में चौकोर छिद्रोवाली कपड़े की जाली लगी रहती है । बाल्टी की सतह पर पानी को ऊपर की ओर या वृत्ताकार रुप में परिचालन करने वाला यंत्र लगा रहता है । इस हैचरी की एक यूनिट की ऊष्मायन क्षमता 50,000 नषेचित अंडाणु है । तालाब की पारिस्थितिकी में हिल्सा मछली के निषेचित अंडों को ऊष्मायित करने हेतु एक विशेष प्रकार का हापा तैयार

किया गया है । इसका बाहरी हापा (183 से.मी. x 122 से.मी. x 91.5 से.मी.) मारकीन कपड़े का तथा भीतरी भाग (152.5 से.मी. x 91.5 से.मी. x 61 से.मी.) दो भिन्न प्रकार के जालीदार कपड़ों का बना होता है । इसके चारो ओर प्रयोग किया गया कपड़ा गोल छिद्रों (1.4 मि.मी.) का तथा निचली सतह के लिए प्रयोग किया गया कपड़ा चौकोर छिद्रों (1.2 मि.मी.) वाला होता है । एक सेट स्फुटन हापा की अधिकतम ऊष्मायन क्षमता 70,000 अंडाणु है ।

दो सेट मछलियों की स्ट्रिपिंग द्वारा करीब 1,50,000 डिंभको का उत्पादन किया गया । अंडजोत्पत्ति दर 90 से 92% रही । तीन दिन आयु वाले इन जीरों को 5,00,000 प्रति हेक्टर की दर से फ़रक्का के दो संवर्धन तालाबों में संग्रहण किया गया ।

मछलियों में व्रणकारी रोग संलक्षण

दिसम्बर 1989 में व्रणकारी रोग संलक्षण पर किये गये अध्ययनों से इस भयानक रोग के फैलाव में जीवाणुओं की भूमिका के पूर्व अनुमान की पुष्टि हुई । पश्चिम बंगाल के साल्ट लेक, हुगली,बैरकपुर, गोसाबा और कैनिंग क्षेत्रों से संग्रहित रोगग्रस्त मछलियों का जीवाणु परीक्षण केन्द्रीय अंतर्स्थलीय प्रग्रहण मात्स्यकी अनुसंधान संस्थान, बैरकपुर की मत्स्य रोग विज्ञान प्रयोगशाला में किया गया । रोगग्रस्त मछलियों के आलेपन को पोषक एगार में रखकर परीक्षण करने पर ***ग्राम पोज़िटिव जीवाणु*** की उपस्थिति पायी गयी, जिससे इस रोग के फैलाव में जीवाणुओं की भूमिका की पुष्टि होती है । इस रोग के कारक तत्वों तथा रोग के समाधान के लिए आवश्यक रोग-निरोधी एवं उपचारात्मक उपायों हेतु अनुसंधान कार्य जारी है ।

ज्वारनदमुखी क्षेत्रों में व्रणकारी रोग

इस भयानक रोग का संकेत ज्वारनदमुखी जल क्षेत्रो में पहली बार मिला है । अब तक यह रोग अलवणीय जल क्षेत्र जैसे तालाब, झील, नदी तथा बीलों तक ही सीमित था । इस रोग की सूचना सर्वप्रथम काकद्वीप से प्राप्त हुई जहाँ मरेल, कार्प और शिंगटी मछलियों के अतिरिक्त ***लिज़ा टडे*** मछलियाँ भी प्रभावित हुई हैं । संस्थान ने प्रभावित क्षेत्रों से संग्रहित रोगग्रस्त मछलियों का परीक्षण प्रारम्भ किया है । रोगग्रस्त मछलियों के विक्षत भागों से निकाले गये रोगाणुओं के आधार पर प्राथमिक परिणाम के रुप में यह पाया गया कि इस रोग के फैलाव में ***माइक्रोकोकस*** की भूमिका होती है । इन रोगाणुओं पर चूना, पोटाश तथा लवणीय जल का उपचार करने से लाभकारी परिणाम निकले हैं ।

छोटे जलाशय से उल्लेखनीय मत्स्य उत्पादन

वैज्ञानिक प्रबंध द्वारा जलाशय के मत्स्य उत्पादन में वृद्धि करना केन्द्रीय अंतर्स्थलीय प्रग्रहण मात्स्यकी अनुसंधान संस्थान के सरोवरीय प्रभाग के मुख्य दायित्वों में से एक है । यह प्रायः देखा गया कि उत्पादन क्षमता के आधार पर किये गये अंतरिम सुझाव छोटे जलाशयों के प्रबंध में सुविधाजनक होते हैं । अलियार जलाशय (646 हेक्टर) में प्राथमिक तौर पर 150 कि.ग्रा. प्रति हेक्टर का लक्ष्य निर्धारित कर सन् 1984 से इस लक्ष्य प्राप्ति हेतु कार्य किया जा रहा है । वैज्ञानिक प्रबंध से पूर्व जो मत्स्य उत्पादन 38 कि. ग्रा. प्रति हेक्टर था उसमें वर्ष 1987-88 के दौरान 115 कि. ग्रा. प्रति हेक्टर तथा वर्ष 1988-89 में 168 कि.ग्रा. प्रति हेक्टर तक वृद्धि करने में सफलता मिली है । वर्ष 1989-90 के दौरान अब तक के अधिकतम मत्स्य उत्पादन 200 कि.ग्रा. प्रति हेक्टर प्रति वर्ष की उपलब्धि हुई तथा यह संकेत भी प्राप्त हुआ है कि इस उत्पादन दर में अभी और वृद्धि संभव है ।

युक्तिपूर्ण संग्रहण पद्धति जिसमें तीव्र वृद्धि वाली कार्प प्रजातियों का संचयन, अनुकूलतम संचयन सघनता, उचित संचयन अनुबंध करना, योजनाबद्ध रुप से मत्स्य संग्रहण तथा मछलियों की संख्या का नियमित रुप से अनुमापन करना आदि वैज्ञानिक प्रबंध प्रणाली हैं जिनकी सहायता से मत्स्य उत्पादन की इस प्रकार की उल्लेखनीय वृद्धि प्राप्त की गयी । इस प्रबंध प्रणाली का निर्धारण जलाशय की जीव उत्पादन क्षमता तथा जैविक उत्पादन के आधार पर किया गया । संचयन के लिए आवश्यक मत्स्य बीजों का उत्पादन जलाशय के निकट ही राज्य सरकार के सहयोग से प्राप्त किया गया ।

सहयोग

इस संस्थान ने वर्ष 1989-90 के दौरान अनेक राष्ट्रीय तथा अंतर्राष्ट्रीय सहयोगिक अनुसंधान कार्य और प्रशिक्षण कार्यक्रम में भाग लिया ।

राष्ट्रीय

'*अलियार बेसिन के छोटे जलाशयों की मात्स्यकी तथा पारिस्थितिकी*' परियोजना के कार्य में केन्द्रीय अंतर्स्थलीय प्रग्रहण मात्स्यकी अनुसंधान संस्थान को तमिलनाडु सरकार ने प्रक्षेत्र (फ़ार्म) तथा वाहन सुविधाएँ उपलब्ध कराकर अपना सक्रिय सहयोग प्रदान किया ।

इस संस्थान ने हिमाचल प्रदेश सरकार तथा अरुणाचल प्रदेश सरकार को प्रग्रहण मात्स्यकी एवं मत्स्य-पालन हेतु प्राथमिकता प्राप्त जल क्षेत्रों का रेखांकन करने में सहयोग दिया । कुछ नई परियोजनाओं का भी प्रस्ताव किया गया जहाँ भारतीय कृषि अनुसंधान परिषद एवं तत्संबंधी राज्य सरकार आपसी सहयोग कर सकें ।

खाद्य एवं कृषि मंत्रालय, भारत सरकार और मात्स्यकी विभाग, पश्चिम बंगाल सरकार ने केन्द्रीय अंतर्स्थलीय प्रग्रहण मात्स्यकी अनुसंधान संस्थान के सहयोग से व्रणकारी रोग संलक्षण विषय पर दिनांक 6-7 मार्च 1990 को कलकत्ता के ग्रेट ईस्टर्न होटल में एक राष्ट्रीय कार्यशाला का आयोजन किया । इस राष्ट्रीय कार्यशाला में विभिन्न राज्य सरकारों, अनुसंधान संस्थानों, विश्वविद्यालयों तथा पी.जी. इस्टिट्यूट ऑफ मेडिसिन, ऑल इंडिया इस्टिट्यूट ऑफ हाईजीन एवं पब्लिक हेल्थ कलकत्ता के कुल 125 प्रतिनिधियों ने भाग लिया । कार्यशाला के तीन तकनीकी सत्रों में कुल 14 तकनीकी लेख प्रस्तुत किए गएं । कार्यशाला ने इस जन्तुमारी रोग के समाधान हेतु 8 सूत्री सुझावों का अनुमोदन किया । कार्यशाला ने अनुसंधान संस्थानों से रोग के कारक तत्वों की जानकारी हेतु अपने अनुसंधान कार्यों में तीव्रता लाने तथा मत्स्य-पालकों को अभी तक उपलब्ध उपचारात्मक सुझावों से अवगत कराने का अनुरोध किया । यह भी निर्णय लिया गया कि रोग के संबंध में असंगतिपूर्ण निष्कर्ष करने की प्रवृत्ति का नियंत्रण करें । मत्स्यपालक समूह पर पड़नेवाले प्रतिकूल प्रभाव की दृष्टि से मछलियों के क्षेत्रीय स्थानान्तरण के दौरान संगरोध के निरोधोपचार करना आवश्यक है । मत्स्य बीजों के परिवहन के दौरान रोगनिरोधी युक्तियों पर भी बल दिया गया ।

केन्द्रीय अंतर्स्थलीय प्रग्रहण मात्स्यकी अनुसंधान संस्थान के सहयोग से एशियन फिशरीज़ सोसाईटी की भारतीय शाखा ने जलाशय मात्स्यकी विषय पर दिनांक 3-4 जनवरी, 1990 को एक राष्ट्रीय कार्यशाला का आयोजन किया । इस कार्यशाला का मुख्य उद्देश्य देश के जलाशयों के उचित समुपयोजन हेतु नीतियों, समस्याओं तथा उनके समाधानों को सामूहिक रूप से संकल्पित करना था । देश के जलाशयों का 30 लाख हेक्टर क्षेत्र अंतर्स्थलीय मात्स्यकी का एक महत्त्वपूर्ण स्त्रोत है । इन जलाशयों में आकृति मूलक मृदीय गुणों के अनुरुप 50-300 कि.ग्रा. प्रति हे. की उत्पादन क्षमता आकलित की गई है । कार्यशाला के चार तकनीकी सत्रों में कुल 35 अनुसंधानात्मक लेख प्रस्तुत किए गए तथा इसमें कुल 110 वैज्ञानिकों, केन्द्र तथा राज्य सरकारों के प्रतिनिधियों, प्रशासकों, तथा विभिन्न वित्तीय संस्थानों एवं बैंकों के अधिकारियों ने भाग लिया । देश के जलाशय मात्स्यकी के विकास हेतु 18 सुझावों का अनुमोदन किया गया ।

संस्थान ने राज्य सरकार के अधिकारियों के लिए बील मात्स्यकी प्रबंध पद्धतियों पर दिनांक 11.7.89 से 20.7.89 तक की अवधि में एक प्रशिक्षण कार्यक्रम का आयोजन किया । इस प्रशिक्षण कार्यक्रम में पश्चिम बंगाल, बिहार, अरूणाचल प्रदेश सरकारों के कुल 19 अधिकारियों ने भाग लिया ।

संस्थान द्वारा आल इन्डिया इस्टिट्यूट ऑफ हाइजीन एवं पब्लिक हेल्थ तथा स्कूल ऑफ ट्रोपिकल मेडिसिन, कलकत्ता के सहयोग से अलवणीय जल क्षेत्रों के (विदेशी तथा देशी प्रजातियों की) मछलियों में व्रणकारी रोग संलक्षणों के कारक तत्वों के अन्वेषण हेतु एक संयुक्त परियोजना प्रारम्भ की गई ।

इनके अतिरिक्त केन्द्रीय अंतर्स्थलीय प्रग्रहण मात्स्यकी अनुसंधान संस्थान ने विभिन्न राज्य सरकारों तथा मात्स्यकी विकास में संलग्न अभिकरणों को अपनी परामर्शक सेवाओं द्वारा सहयोग दिया ।

केन्द्रीय अंतर्स्थलीय प्रग्रहण मात्स्यकी अनुसंधान संस्थान द्वारा उपलब्ध की गई परामर्शक सेवाएं

उत्तर पूर्वी राज्यों की एकीकृत मात्स्यकी विकास परियोजना

केन्द्रीय अंतर्स्थलीय प्रग्रहण मात्स्यकी अनुसंधान संस्थान को कृषि वित्त निगम ने उत्तर-पूर्वी राज्यों के लिए एक व्यापक मत्स्य योजना बनाने हेतु परामर्शक के रुप में नियुक्त किया । इस परियोजना में सातों उतर-पूर्वी राज्य तथा केन्द्र शासित प्रदेश जैसेः- असम, मेघालय, मीजोरम, नागालैंड, त्रिपुरा और अरुणाचल प्रदेश सम्मिलित हैं । यह परियोजना इन क्षेत्रों में उपलब्ध विस्तृत मात्स्यकी स्त्रोतों जैसेः- नदी, चापझील, प्राकृतिक झील, जलाशय, उपरिभूमि झील, पर्वतधारा आदि के विकास हेतु है । एकीकृत उत्पादन पद्धति के अंतर्गत धान व मत्स्य पालन की सम्भावनाओं पर भी विचार किया गया । संस्थान के वैज्ञानिकों के एक दल ने परियोजना से संबंधित क्षेत्रीय अध्ययन करने के उपरान्त एक रिपोर्ट तैयार की है जिसका अनुमोदन भी हो चुका है

पर्यावरणीय प्रभाव के मूल्यांकन हेतु अध्ययन

संस्थान ने कन्सल्टिंग इंजीनियरिंग सर्विसेज़ इण्डिया प्राइवेट लिमिटेड को कायमकुलम, सिंगरौली तथा काकिनाडा तापीय विद्युत स्टेशन क्षेत्र में पर्यावरणीय प्रभाव के मूल्यांकन करने में अपनी परामर्शक सेवाएं उपलब्ध कराईं । इस अध्ययन में भौतिक, रासायनिक एवं जैविक गुणों के अतिरिक्त तापीय विद्युत केन्द्र के पर्यावरणीय प्रभाव पर भी विशेष ध्यान दिया गया । कायमकुलम तथा सिंगरौली परियोजनाओं से संबंधित अध्ययन पूरा हो चुका है तथा इसकी रिपोर्ट तैयार की जा रही है ।

जलाशय मात्स्यकी की सम्भाव्यता का अध्ययन

संस्थान ने मेघालय के मात्स्यकी विकास की सम्भाव्यता के अध्ययन हेतु उत्तर-पूर्वी परिषद के साथ कार्य आरम्भ किया और जून 1991 तक अध्ययन समाप्त होने की आशा है ।

अंतर्राष्ट्रीय

केन्द्रीय अंतर्स्थलीय प्रग्रहण मात्स्यकी अनुसंधान संस्थान ने नेटवर्क ऑफ एक्वाकल्चर सेन्टर्स इन एशिया (नाका) को उनकी क्षेत्रीय अनुसंधान परियोजना 'पर्यावरण नियंत्रण और मछलियों में व्रणकारी संलक्षण' में सक्रिय सहयोग दिया । इस परियोजना में अन्य 11 देशों के साथ भारत स्थित केन्द्रीय अंतर्स्थलीय प्रग्रहण मात्स्यकी अनुसंधान संस्थान, बैरकपुर भी शामिल है । परियोजना का मुख्य उद्देश्य मछलियों के व्रणकारी रोग संलक्षण तथा पर्यावरण में संबंध स्थापित करना है । तकनीकी कार्यक्रम के अंतर्गत वर्ष 1988-89 के दौरान हर पखवाड़े में वर्षा और सिंचाई पर आधारित धान के खेतोंवाले क्षेत्र की दो कृत्रिम झीलों में भौतिक-रासायनिक प्राचलों तथा भारी धातुओं एवं कीटनाशकों का विश्लेषण, मत्स्य जीवसंख्या का नियंत्रण तथा रुधिर विज्ञान सम्बन्धी अध्ययन किया गया ।

मत्स्य सम्पदा मूल्यांकन पर खाद्य एवं कृषि संगठन-डैनिडा प्रशिक्षण

केन्द्रीय अंतर्स्थलीय प्रग्रहण मात्स्यकी अनुसंधान संस्थान, बैरकपुर में मत्स्य सम्पदा मूल्यांकन पर खाद्य एवं कृषि संगठन-डैनिडा प्रशिक्षण कार्यक्रम, मात्स्यकी क्षेत्र में कार्यरत तकनीकी कर्मचारियों की कार्यक्षमता को बढ़ाने हेतु आयोजित किया गया । इस योजना से संबंधित व्यय खाद्य एवं कृषि संगठन और डैनिडा द्वारा वहन किया गया तथा प्रशिक्षण में विभिन्न राज्य सरकारों और केन्द्रीय अभिकरणों के प्रतिनिधियों को सम्मिलित किया गया । इनके अतिरिक्त बंगलादेश के तीन मत्स्य अधिकारियों ने भी इस प्रशिक्षण में भाग लिया ।

प्रौद्योगिकी हस्तांतरण

विस्तार एवं रचनात्मक कार्य

केन्द्रीय अंतर्स्थलीय प्रग्रहण मात्स्यकी अनुसंधान संस्थान विगत वर्षों की तरह इस वर्ष भी मत्स्य पालकों,उपक्रमियों, सरकारी अभिकरणों, वित्तीय संस्थाओं तथा स्वायत्त संगठनों को अपनी मात्स्यकी प्रबन्ध तकनीक उपलब्ध कराकर विस्तार कार्य में अग्रसर रहा है । विस्तार कार्य की मुख्य उपलब्धियाँ निम्नलिखित हैं ।

क) मिश्रित मत्स्य-पालन के प्रति मत्स्य-पालकों की उत्सुकता

मिश्रित मत्स्य-पालन के प्रति मत्स्य-पालकों की अंगीकार्यता जानने के लिए पश्चिम बंगाल के 5 जिलों का अध्ययन किया गया । सम्पर्क किए गए 264 मत्स्य-पालकों में से लगभग 61 प्रतिशत मत्स्य-पालकों ने इस तकनीक का अनुसरण किया ।

ख) बील मात्स्यकी में कार्यरत मछुआरों की सामाजिक एवं आर्थिक स्थिति

पश्चिम बंगाल स्थित 4 बड़े बीलों जैसे- पद्मा बील, मथुरा बील, छालतिया बील और कातिगंगा बील का अध्ययन इन बीलों से मत्स्य संग्रहण कार्य से जुड़े हुए मछुआरों की सामाजिक व आर्थिक स्थिति जानने के लिए किया गया । इस अध्ययन के अंतर्गत कुल 321 मछुआरों से साक्षात्कार किया गया । इनकी आय रु. 401-500 रुपए तक होती है । इन्होंने सही जाल का प्रयोग करना तथा छोटे एवं प्रजनक मछलियों का संग्रह न करना आदि परिरक्षण उपायों पर भी ध्यान दिए । बीलों में मत्स्य संचयन के दौरान जब उनकी आय घटकर 200-300 रुपए हो जाती है तो वे अन्य प्रकार के रोजगारों में जुट जाते हैं ।

ग) व्रणकारी रोग संलक्षणों का प्रभाव

व्रणकारी रोग संलक्षणों के प्रभाव के मूल्यांकन हेतु पश्चिम बंगाल के 5 जिलों के मत्स्य-उत्पादकों, मत्स्य व्यवसायियों तथा मत्स्य उपभोक्ताओ से सम्पर्क किया गया ।

365 मत्स्यपालकों की मत्स्य सम्पदा व्रणकारी रोग से ग्रस्त पाई गई । प्रभावित मत्स्य पालकों को 1001 रुपए से 5000 रुपए तक की आर्थिक क्षति हुई । मत्स्य उपभोग की दर शहरी, उप शहरी एवं ग्रामीण क्षेत्रों में क्रमशः 28.7, 23.3 और 20.5 प्रतिशत घट गई । प्रभावित मछलियों के उपभोक्ता एवं इस व्यवसाय में कार्यरत लोगों के बीमार होने की कोई सूचना नहीं मिली ।

अन्य विस्तार गतिविधियाँ

361 व्यक्तियों को अंतर्स्थलीय मात्स्यकी के विभिन्न पहलुओं पर जानकारी दी गई। 325 मत्स्यपालकों एवं मत्स्य विकास अधिकारियों को अंतर्स्थलीय जलीय कृषि का प्रशिक्षण दिया गया। इस वर्ष के दौरान मत्स्यपालक दिवस प्रदर्शनियाँ, फिल्म प्रदर्शनियाँ, सामूहिक चर्चाएं, वार्ताएं, पियूष ग्रन्थियों की आपूर्ति, बीजों की आपूर्ति,ग्लास जारों की आपूर्ति, प्रयोगशाला से भूमि की ओर कार्यक्रम, तूफान बाधितों की सहायता आदि मुख्य गतिविधियाँ रहीं ।

कृषि विज्ञान केन्द्रः-

कृषि विज्ञान केन्द्र, काकद्वीप का प्रशासनिक प्रबंध 1 अगस्त 1989 से केन्द्रीय अंतर्स्थलीय प्रग्रहण मात्स्यकी अनुसंधान संस्थान के अधीन हो गया । इस केन्द्र के अधीन चार विशेष क्षेत्रों में जैसेः- फ़सलों का उत्पादन, बागबानी, गृह विज्ञान और मात्स्यकी कार्यक्रम चल रहे हैं ।

इस अवधि के दौरान लवणीय जल में मत्स्य पालन तथा धान उत्पादन को विशेष महत्व मिला है । आवश्यकतापूर्ण स्थानों में कृषक समुदायों को विशेष तकनीकी पद्धतियों का कुशलतापूर्ण प्रशिक्षण दिया गया ।

समस्याएं

कृषि विज्ञान केन्द्र ने सुन्दरवन के कृषकों के समक्ष प्रस्तुत निम्नलिखित मुख्य कृषीय समस्याओं से परिचय प्राप्त किया :-

1. शस्यभूमि में ज्वारीय जल का आप्लावन
2. मानसून के दौरान उच्च दर का अवक्षेपन साथ ही जल निकास की असुविधा परिणामतः तीव्र जलाक्रान्ति
3. मानसून के दौरान धान का फसल अत्याधिक जलमग्न रहने के कारण अधिक उपज देनेवाली किस्मों पर दुष्प्रभाव
4. उत्पादन की पारम्परिक पद्धति के कारण कम उपज देनेवाले धान की किस्मों का प्रयोग करना
5. लवणीय भौमजल युक्त जलस्तर प्रसार
6. रबी तथा ग्रीष्मकालीन फसलों के दौरान सिंचाई के लिए गुणयुक्त जल उपलब्ध न होना
7. ग्रीष्म तथा शीतकाल में मृदा की उच्च क्षारीयता

प्रशिक्षण तथा प्रौद्योगिकी हस्तांतरण

कृषि विज्ञान केन्द्र के अधीन मिर्च, मूँगफली, तरबूज़,सूर्यमुखी, सरसों, सुपारी और चुकन्दर (खरीफ़ फसल के बाद) तथा अलवणीय जल में एकीकृत धान व मत्स्यपालन और धान व झींगा पालन विषयों पर विशेष ध्यान दिया जा रहा है । जलीय कृषि के अंतर्गत अनेक कृषकों को पक्षमीन और झींगा पालन, बड़े झींगों का पालन, मलेट पालन, विदेशी तथा भारतीय मेज़र कार्प मछलियों का प्रेरित प्रजनन, कार्प बीज उत्पादन और मिश्रित मत्स्य-पालन विषयों से संबंधित तकनीकी पद्धतियों से अवगत कराया गया ।

इस अवधि के दौरान केन्द्र ने 15 प्रशिक्षण पाठ्यक्रमों का आयोजन किया जिनका विवरण निम्नलिखित है:-

क्षेत्र	विषय	सम्मिलित कृषकों की संख्या
बागवानी	मिर्च के उत्पादन की उन्नत तकनीकें	10
गृह-विज्ञान	छत्रक उत्पादन एवं आहार के रुप में इसका उपयोग	10
सस्य विज्ञान	तिलहन उत्पादन	10
मात्स्यकी	मिश्रित मत्स्यपालन	20

इनके अतिरिक्त कृषि विज्ञान केन्द्र परिसर से बाहर 20 प्रशिक्षण कार्यक्रम मात्स्यकी (5 कार्यक्रम, कुल 221 मत्स्यपालक), सस्य विज्ञान (6 पाठ्यक्रम 123 कृषक), बागबानी (5 पाठ्यक्रम 229 प्रतिनिधि) और गृह विज्ञान (5 पाठ्यक्रम 137 किसान) क्षेत्र में आयोजित किया गया ।

किसान दिवस

केन्द्र ने 5 किसान दिवसों का आयोजन किया जिनमे स्त्रियों सहित कुल 635 किसानों ने फ़सल उत्पादन, बागबानी, मात्स्यकी तथा गृह विज्ञान सम्बन्धी विषयों की गोष्ठियों में भाग लिया । ये गोष्ठियाँ बहुत ही उपयोगी एवं चर्चित साबित हुई ।

अन्य क्रियाकलाप

केन्द्र द्वारा प्रस्तुत की गई सलाहकार सेवाओं का लाभ करीब 331 कृषक एवं रुचि रखने वाले व्यक्तियों ने उठाया । कृषक समुदायों के हित के लिए रेडियो एवं दूरदर्शन के माध्यम से गृह विज्ञान से संबंधित विषयों पर वार्ता एवं चर्चाओं का प्रसारण किया गया ।

तिलहन उत्पादन का प्रदर्शन

इस कार्यक्रम के अंतर्गत आयोजित निदर्शनियों में सूर्यमूखी एवं सरसों का उत्पादन विशेष आकर्षण रहा । सूर्यमूखी एवं सरसों के उत्पादन का निदर्शन क्रमशः 26.67 हे. क्षेत्र तथा 2.67 हे. में किया गया । इन निदर्शनात्मक फसलों का औसत उत्पादन क्रमशः 1,100 कि. ग्रा. प्रति हे. तथा 11500 कि.ग्रा. प्रति हे. रहा ।

पुस्तकालय एवं प्रलेखन सेवा

केन्द्रीय अंतर्स्थलीय प्रग्रहण मात्स्यकी अनुसंधान संस्थान के पुस्तकालय ने इस वर्ष 176 पुस्तकों एवं 12 पुनर्मुद्रित वैज्ञानिक लेखों का संकलन किया तथा 36 विदेशी एवं 60 भारतीय वैज्ञानिक पत्रिकाओं की प्राप्ति हेतु सम्पर्क बनाया । पुस्तकालय में 6313 पुस्तकें, 4124 पुनर्मुद्रित वैज्ञानिक लेख, 749 मानचित्र तथा 2774 विविध प्रकाशनों का संग्रहण है । पुस्तकालय ने वर्तमान 334 से अधिक प्रमुख राष्ट्रीय तथा अंतर्राष्ट्रीय अनुसंधान सूचना केन्द्रों के साथ पुस्तक विनिमय संबंधों के अतिरिक्त इस वर्ष के दौरान 21 नए सम्बंध स्थापित किया ।

यह पुस्तकालय अनेक अनुसंधान संगठनों, विश्वविद्यालयों, उपक्रमियों और मत्स्यपालकों को संस्थान के निजी प्रकाशन निःशुल्क भेजता रहा है ताकि वे मात्स्यकी क्षेत्र में हुई अनुसंधान की जानकारी पा सकें । 52 पुस्तकें अन्तर पुस्तकालय-ऋण के रुप में अन्य पुस्तकालयों को भी भेजी गई। इस वर्ष के दौरान पुस्तकालय के लिए खर्च की गई राशि रु. 3,01,474.00 थी ।

इस अनुभाग में फोटोग्राफी तथा रेप्रोग्राफ़ीं सेवाओं के लिए एक सक्रिय एकक बना है । संस्थान के वैज्ञानिकों के अतिरिक्त विभिन्न अनुसंधान संस्थानों और विश्वविद्यालयों को फोटोग्राफ्स पुनर्मुद्रित लेख तथा फोटोकापियाँ निःशुल्क दी गई । इस अनुभाग ने एक साइक्लोस्टाइलिंग और जिल्दसाज़ एकक को भी संस्थान के विभिन्न अनुभाग के सेवार्थ कायम रखा ।

तकनीकी रिपोर्ट

संस्थान की अनुसंधानात्मक प्रगति से संबधित 30 से भी अधिक तकनीकी रिपोर्टो का संकलन किया गया । संस्थान के वैज्ञानिकों के अनुसंधानात्मक लेखों को विभिन्न वैज्ञानिक पत्रिकाओं में प्रकाशित करने से पूर्व उनका संवीक्षण किया गया । समस्याओं और प्रश्नों का जवाब भी अनुभाग के वैज्ञानिकों द्वारा प्रस्तुत किया गया । इस अनुभाग ने संस्थान के वैज्ञानिकों द्वारा सेमिनार,संगोष्ठी,सम्मेलन आदि में भाग लेने से संबधित कार्यो का भी पर्यवेक्षण किया ।

अनुसंधान परियोजनाओं की वार्षिक प्रगति रिपोर्टो तथा संस्थान के वैज्ञानिकों के योगदान से सम्बन्धित सूचनाओं को प्राथमिक परियोजना फ़ाइल तथा वैज्ञानिकों की निजी फाइलों में संग्रहित किया गया । आर.पी.एफ. (रिसर्च प्रोजेक्ट फाइल), अनुसंधानात्मक सक्रियता के लक्ष्य (एक्टिविटी माइलस्टोन्) तथा मासिक, तिमाही एवं वार्षिक रिपोर्टो के माध्यम से अनुसंधान प्रगति की देख-रेख, इस अनुभाग का एक महत्वपूर्ण दायित्व है ।

प्रकाशन

निम्नलिखित विभागीय प्रकाशनों को वर्ष अप्रैल 1989 से मार्च 1990 के दौरान प्रकाशित किया गया ।

1. वार्षिक रिपोर्ट 1988-89

2. बुलेटिन संख्या 63
   बील मात्स्यकी प्रबन्ध का प्रशिक्षण, 11-20 जुलाई, 1989

3. बुलेटिन संख्या 65
   मछलियों में व्रणकारी संलक्षण- अरुण झिंगरन एवं मानस कुमार दास

4. राजस्थान में जलाशय मात्स्यकी प्रबन्ध परियोजना की अन्तिम रिपोर्ट - अरुण झिंगरन

5. गंगा नदी की मात्स्यकी पारिस्थितिकी पर पर्यावरणीय अव्यवस्था का प्रभाव- अरुण झिंगरन

6. अनुसंधानात्मक सक्रियता का लक्ष्य 1990-91

7. अनुसंधानात्मक उपलब्धियाँ, 1989-90

8. अनुसंधानात्मक परियोजनाएँ 1989-90

9. माछेर महामारी खता रोग (बंगला भाषा में)

10. इंडियन फ़िशरीज एब्स्ट्रैक्ट-
खण्ड 23(4) 1984
खण्ड 24(1-4) 1985
खण्ड 25(2,4) 1986

APPENDIX -I

Ministry /Department/Office of the Central Inland Capture Fisheries Research Institute (I.C.A.R.), Barrackpore, West Bengal. Statement showing the total number of I.C.A.R. servants and the number of Scheduled Castes and Scheduled Tribes among them as on 31st March ,1990.

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)							
Permanent -							
(i) Other than lowest rung of Cl.I							
(ii) Lowest rung of Cl.I total							
Temporary -							
(i) Other than lowest rung of Cl.I							
(ii) Lowest rung of Cl. I							
Gr. B(Cl. II)	Permanent	32	8	25%	-	-	
	Temporary	1	-	-	-	-	
Gr.C (Cl.III)	Permanent	135	31	22.96%	3	2.26%	
	Temporary	30	3	10%	1	3.12%	
Gr.D (Cl. IV) Excluding sweepers	Permanent	148	50	33.78%	6	4.05%	
	Temporary	39	10	25.64%	2	5.12%	
Gr. D (Cl. IV) sweepers	Permanent	11	8	72.72%	-	-	
	Temporary	1	1	100%	-	-	

APPENDIX - II

CENTRAL INLAND CAPTURE FISHERIES RESEARCH INSTITUTE (I.C.A.R.) : BARRACKPORE : WEST BENGAL

Address List of Research/Survey Centres

Headquarters	**Telegram/Telephone**
Central Inland Capture Fisheries Research Institute Barrackpore-743 101 West Bengal	**FISHSEARCH** BARRACKPORE-743 101/ 56-1190 56-1191 56-033

Research/Survey Centres

1	**Allahabad Research Centre** Central Inland Capture Fisheries Research Institute 24, Pannalal Road Allahabad-211002, Uttar Pradesh	**FISHSEARCH** ALLAHABAD-2/ 52245
2	**Bangalore Research Centre** Central Inland Capture Fisheries Research Institute No.22 (Old No.1031-C & D), 80 ft, Road, 1st Main, IV Block, Rajainagar, Bangalore - 560 010	**FISHSEARCH** BANGALORE-560010/ 626910
3	**Bilaspur Research Centre** Central Inland Capture Fisheries Research Institute, Roara Sector, Bilaspur - 174 001, Himachal Pradesh	
4	**Calcutta Research Centre** Central Inland Capture Fisheries Research Institute M.S.O. Building (2nd Floor, 'C' Block) DF Block, Salt Lake, Calcutta - 700 064	

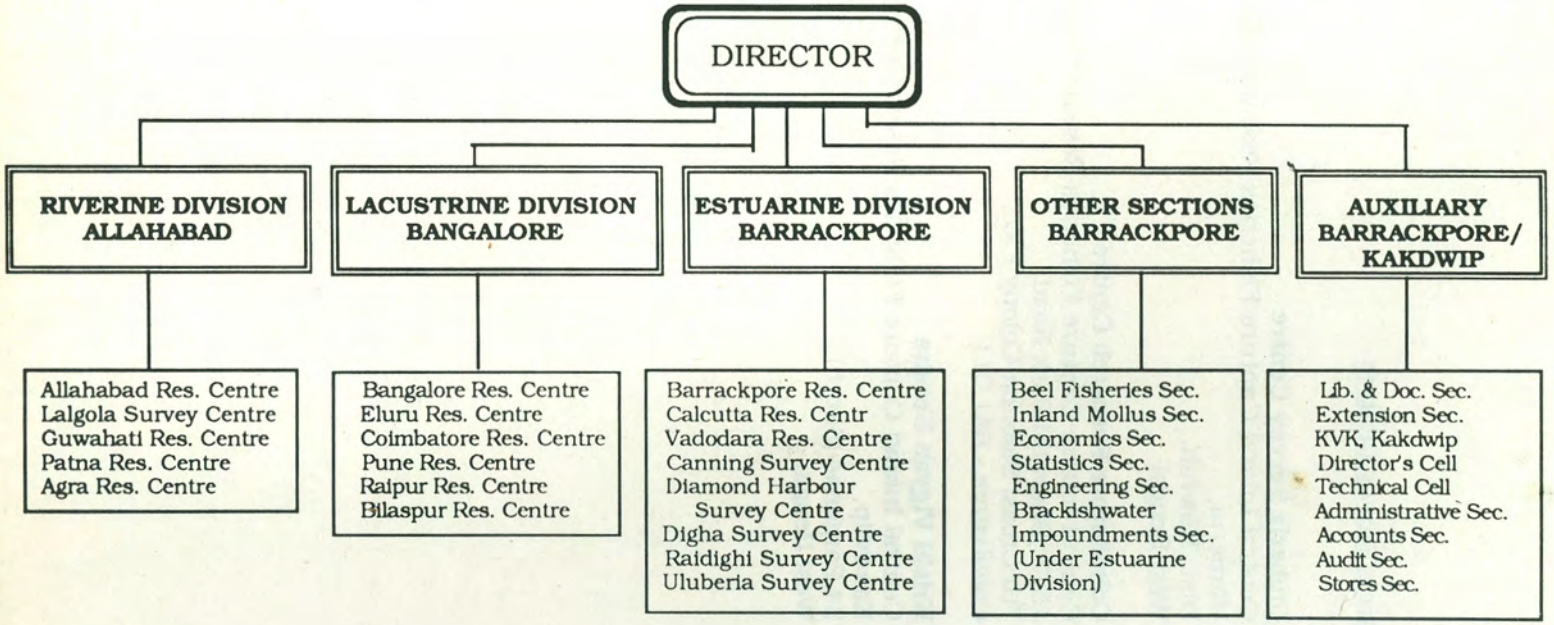
Research/Survey Centres	Telegram/Telephone
5 Canning Survey Centre Central Inland Capture Fisheries Research Institute M.S.O. Building, (2nd Floor 'C' Block), DF Block, Salt Lake, Calcutta-700 064	
6 Diamond Harbour Survey Centre Central Inland Capture Fisheries Research Institute House of Bidhu Bhushan Bhuiya, New Madhavpur, P.O. Diamond Harbour, 24 Parganas (South), West Bengal	
7 Digha Survey Centre Central Inland Capture Fisheries Research Institute Digha, Midnapur Dist., West Bengal	
8 Kolleru Lake Research Centre Central Inland Capture Fisheries Research Institute 24-B/10-53 Panugantivari House & Street, P.O. RAMACHANDRARAO PET, ELURU - 534 002, West Godavari District, Andhra Pradesh	**FISHSEARCH** ELURU - 534 002/ 2520
9 Vadodara Research Centre Central Inland Capture Fisheries Research Institute Gaikwad Building (Opposite Bhimnath Mahadev Temple), Sayajiganj, Vadodara - 390 005	
10 Guwahati Research Centre Central Inland Capture Fisheries Research Institute Natun Sarania, Guwahati - 781 003, Assam	31717

IV

Research/Survey Centres	Telegram/Telephone
11 Agra Research Centre Central Inland Capture Fisheries Research Institute Bhagawatisadan, First Floor, 47, Heerabagh Colony, Dayal Bagh Road, Agra-282 005	
12 Lalgola Survey Centre Central Inland Capture Fisheries Research Institute Lalgola-742 148, Dist. Murshidabad, West Bengal	
13 Patna Research Centre Central Inland Fisheries Research Institute,m 1st Floor, Shambey House, Kankarbagh, Patna - 800 020, Bihar	
14 Pune Research Centre, Central Inland Capture Fisheries Research Institute Flat No.6, Indraprasta House Society, Godital-Hadapsar P.O., Pune - 411 028 Maharastra	672401
15 Raidighi Survey Centre, Central Inland Capture Fisheries Research Institute, Raidighi, 24 Parganas (South), West Bengal	
16 Raipur Research Centre Central Inland Capture Fisheries Research Institute 326, 'Ashirwad', Shankar Nagar, Near Bottle House, Raipur - 492 007, Madhya Pradesh	

CENTRAL INLAND CAPTURE FISHERIES RESEARCH INSTITUTE
BARRACKPORE - 743 101, WEST BENGAL

ORGANIZATION CHART, 1989-90



Research/Survey Centres **Telegram/Telephone**

17 **Uluberia Survey Centre**
Central Inland Capture Fisheries Research Institute
Uluberia,
Dist. Howrah,
West Bengal

18 **Coimbatore Research Centre**
Central Inland Capture Fisheries Research Institute
15/3, Bharathi Park Road,
7th Cross, Saibaba Colony P.O.,
Coimbatore - 641 011

19 **Krishi Vigyan Kendra**
Central Inland Capture Fisheries Research Institute
Kakdwip,
24 Parganas (South),
West Bengal