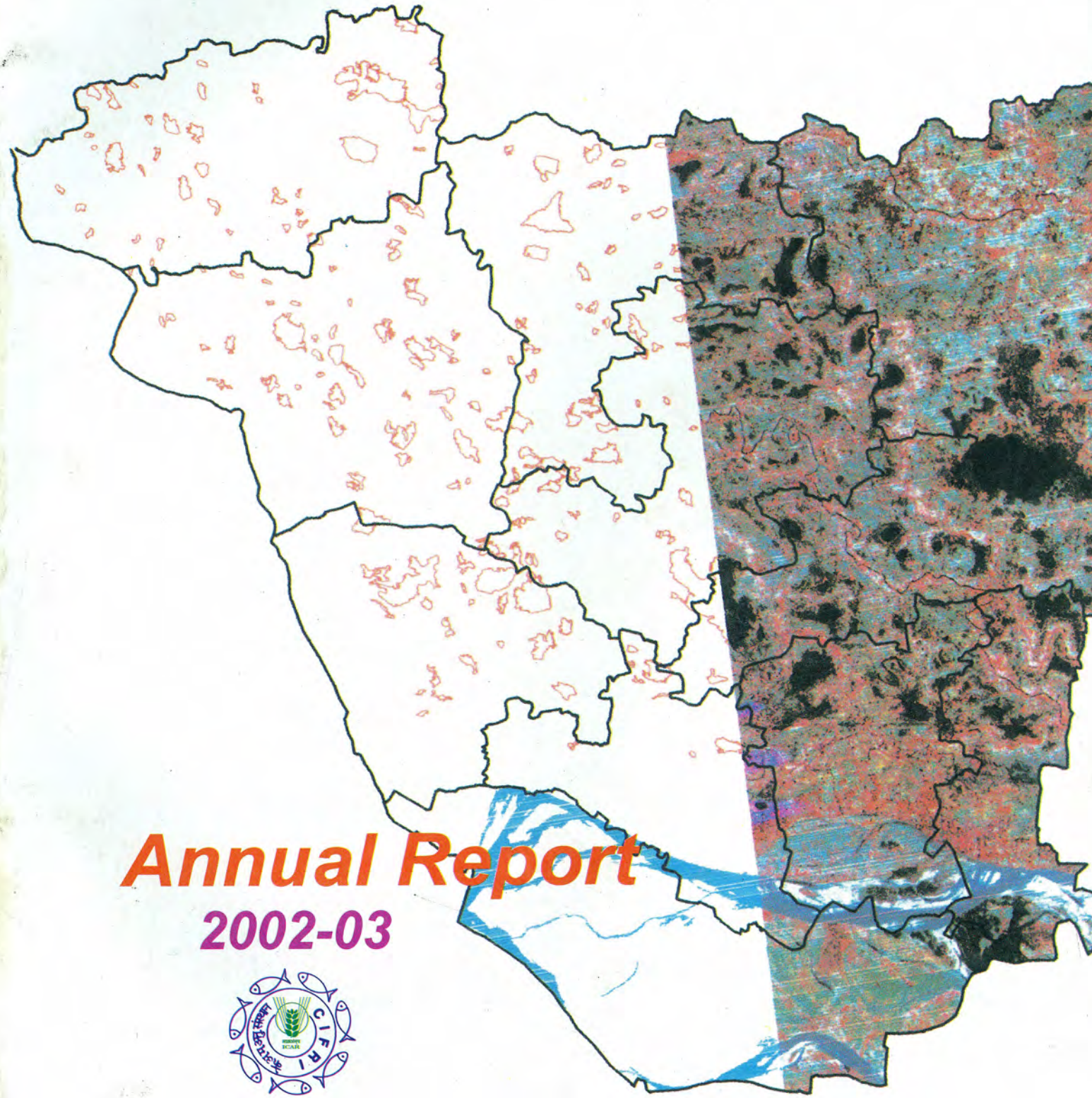
Cifri

Central Inland Fisheries Research Institute



Annual Report

2002-03

वार्षिक प्रतिवेदन
ANNUAL REPORT
2002-2003

केन्द्रीय अंतर्स्थलीय मात्स्यकी अनुसंधान संस्थान
(भारतीय कृषि अनुसधान परिषद्)
बैरकपुर, कोलकाता - 700 120, पश्चिम बंगाल

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)
BARRACKPORE, KOLKATA - 700 120, WEST BENGAL, INDIA

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☞ The activities and achievements reflected in this Annual Report covers the period April 2002 to March 2003 only.

☞ This report includes unprocessed or semi-processed data which would form the basis of scientific papers in due course. The material contained in the report, therefore, may not be made use of without the permission of this Institute, except for quoting it as a scientific reference.

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CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
(Indian Council of Agricultural Research)
BARRACKPORE, KOLKATA-700120, WEST BENGAL

1 PREFACE

The Annual Report of Central Inland Fisheries Research Institute (CIFRI) for the year 2002-2003 contains comprehensive information on the achievements of the various research projects and other activities undertaken by the Institute.

Major emphasis of the Institute during the period has been on i) assessing the production potential and fisheries resources of reservoirs, floodplain wetlands and rivers *viz.* Ganga, Beas and Krishna, ii) assessment of the ecology and fisheries of the Hooghly, Narmada and other estuaries along with the associated wetlands, iii) monitoring the environmental and fishery status of river Ganga and Yamuna, iv) genetic study of hilsa population, v) monitoring of aquatic pollutants and standardization of various parameters for monitoring fish and prawn health and controlling disease outbreak and vi) assessment of inland fisheries resources.

Consultancy assignments were taken up regularly by the Institute for resource generation. Resources were also generated by organizing training programmes on various specialized topics. External funds were mobilized through ad-hoc schemes supported by ICAR and other agencies.

The Institute further strengthened its research activities through linkages with other national/international organizations. The technologies developed by the Institute were effectively transferred.

Director

2 EXECUTIVE SUMMARY/SALIENT ACHIEVEMENTS

1 Mapping of water bodies in 4 Districts of Bihar was done through digital image processing technique by using satellite data (IRS-ID)

2 Pen culture of fishes and prawns in beels recorded a production of 620 kg/ha of *M. rosenbergii* in 150 days and 327 kg of IMC in 177 days. Cage culture of *Clarius batrachus* showed a production of 8.8 kg/8m^3 of cage area in 120 days. The optimum stocking density for carps under cage culture was 16 nos/sq.m.

3 Ecology, fishery status and production potential of 3 reservoirs in Rajasthan, 2 reservoirs in Tamil Nadu, 1 reservoir each in Madhya Pradesh, Andhra Pradesh and Karnataka were investigated. Recommendations for their management were also formulated.

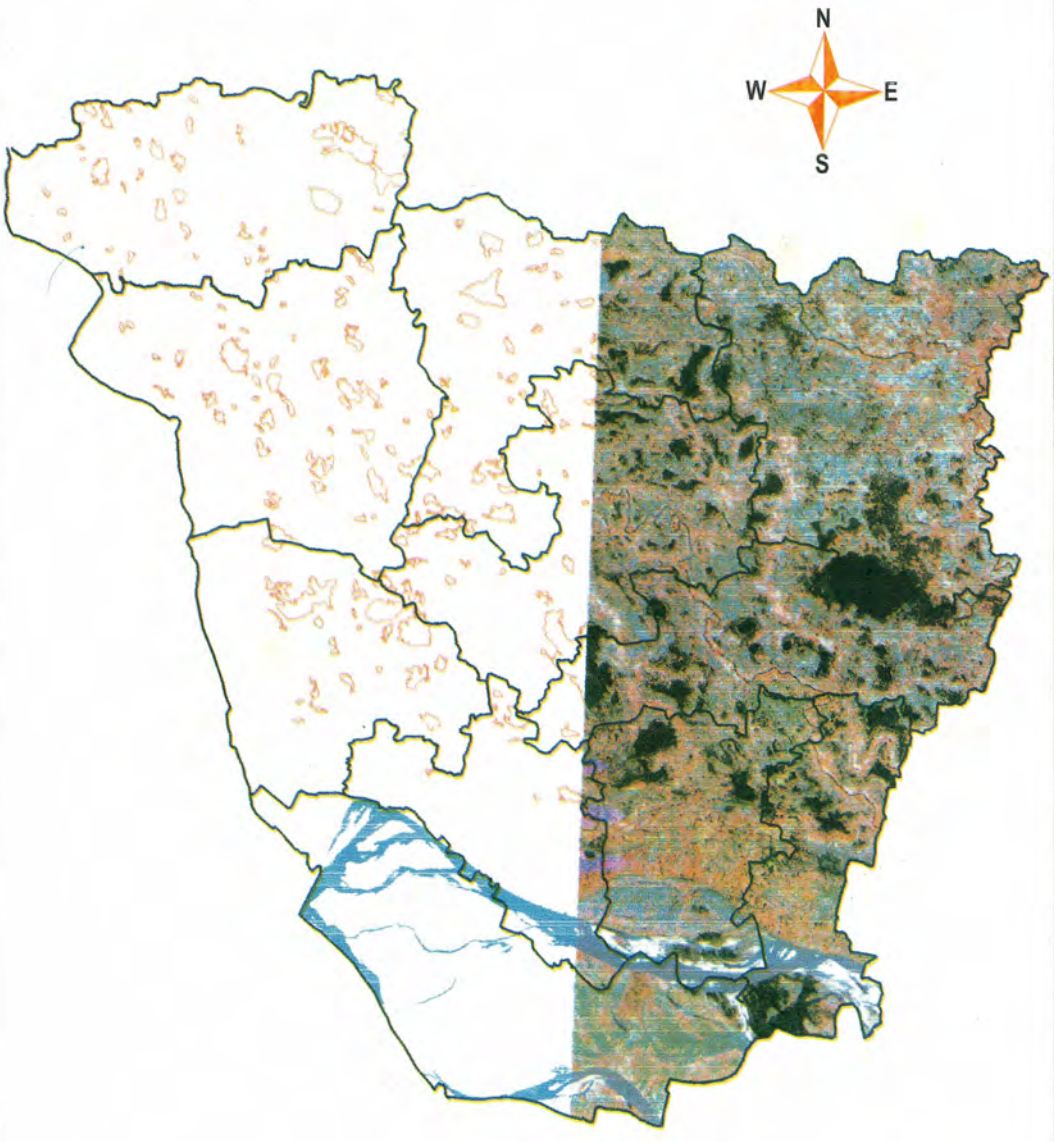
4 A multimetric index of fish assemblages integrity was developed for fish species in river Hooghly and the effects of municipal and industrial effluents and physical conditions on those indices were evaluated. Based on the modification of the IBI, only 3 of the 6 sites of 100 km of the river selected or 50% of the sampled sites supported fish assemblage in acceptable condition and it is concluded that the biological integrity of the fish assemblages in the river at these stretches are not being maintained.

5 Ecology and fisheries of Hooghly and Mandovi-Zurai estuarine systems and production potential of estuarine wetlands wete evaluated. Ecolgical study revealed high production potential of Hooghly estuarine system reflecting total fish yield of 62554.7 t. Hilsa continued to be major component of estuarine fishery contributing 10.4% of total yield from Hooghly estuary.

6 Ecology, production relationship and habitat degradation of rivers Ganga, Krishna, Beas, Yamuna were evaluated.

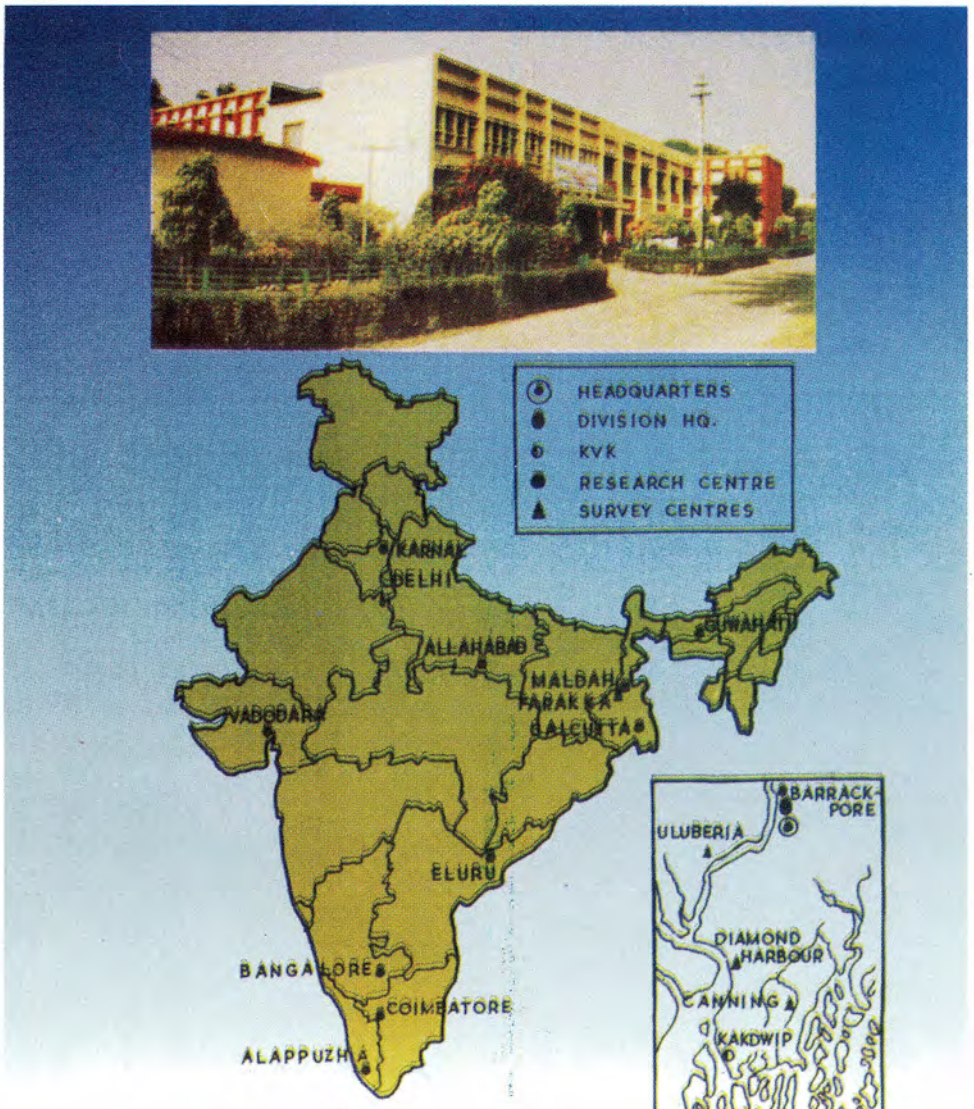
7 Data base on fish catch was developed from data collected at various centres of river Ganga, Yamuna and Narmada.

8 A novel and effective method of partial removal of aquatic macrophyte from beels was developed and successfully implemented in beels of Assam. It is based on the principle of preventing photosynthetic process by physical means.

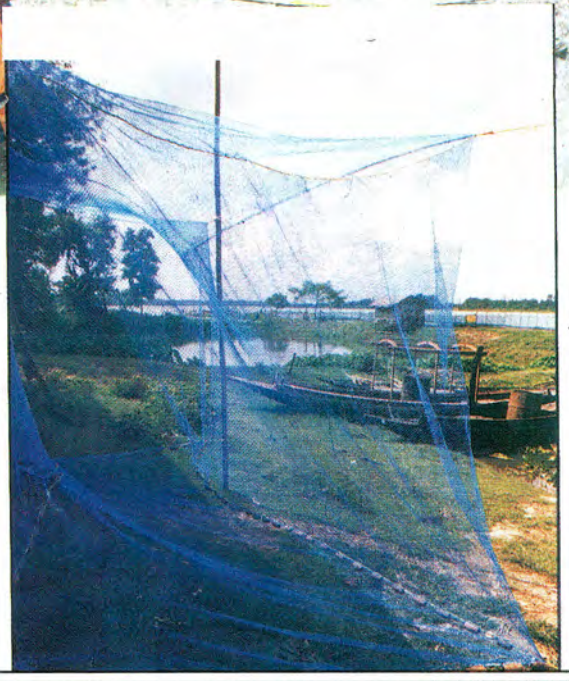


Mapping of water bodies of District Vaishali, Bihar
using Stellite IRS D Image

DIVISIONS, RESEARCH CENTRES & SURVEY CENTRES
of Central Inland Fisheries Research Institute



Pen culture for raising fingerlings in a reservoir



Assorted catch from Hooghly Estuary

3 INTRODUCTION

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 17th 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 and has completed 54 years of its service to the nation on March 17, 2001. By the year 1959, the Station acquired its status as Central Inland Fisheries Research Institute (CIFRI) and moved to its own building at Barrackpore, West Bengal. Since 1967, the Institute is under the administrative fold of Indian Council of Agricultural Research (ICAR).

The main objectives of the Institute 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 utilization. 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 floodplain wetlands. These studies have unravelled the complex trophic structure and functions *vis-a-vis* the environmental variables in different aquatic ecosystems. During the early 1970s, the Institute expanded its activities by initiating various All India Coordinated Research Projects; such as composite fish culture and fish seed production, airbreathing fish culture, ecology and fisheries management of freshwater reservoirs and brackishwater fish farming.

The Institute has the distinction of evolving and popularising technologies on fish seed prospecting from rivers; fish seed transportation; induced breeding and nursery management of carps; bundh breeding of Chinese carps; composite fish culture; aquatic weed control; air-breathing fish culture; integrated fish farming; sewage fed fish culture; fisheries management of small reservoirs; brackishwater fish farming and farming of edible snails. The country has witnessed a phenomenal increase in production of inland fish (0.22 million t in 1950-51 to 2.8 million t in 1999-2000) which can be mainly attributed to the above technologies.

At the beginning of Seventh Five Year Plan, three Institutes (Central Institute of Freshwater Aquaculture, Central Institute of Brackishwater Aquaculture and National Research Centre on Coldwater Fisheries) were carved out from this Institute and the parent Institute was rechristened as Central Inland Capture Fisheries Research Institute (CIFRI) with effect from 1st April 1987. Under the changed set up, CIFRI 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 CIFRI is presently mandated to :

1 study fish population dynamics of exploitable inland water bodies exceeding 10 ha in water area;

2 evolve management systems for optimising fish production from such water bodies;

3 investigate causes, effects and remedies of their degradation/pollution and provide research support for mitigation and for conservation of such resources;

4 study the impact of river valley projects on the fisheries of the basins concerned and evolve strategies for their management;

5 act as national data centre on inland fisheries; and

6 conduct training and provide extension/consultancy services.

Organizational set-up (chart)

In tune with the above mandate, the research activities of CIFRI have been organized under seven divisions, corresponding to the major fishery resources and other research needs of the country related to fisheries development.

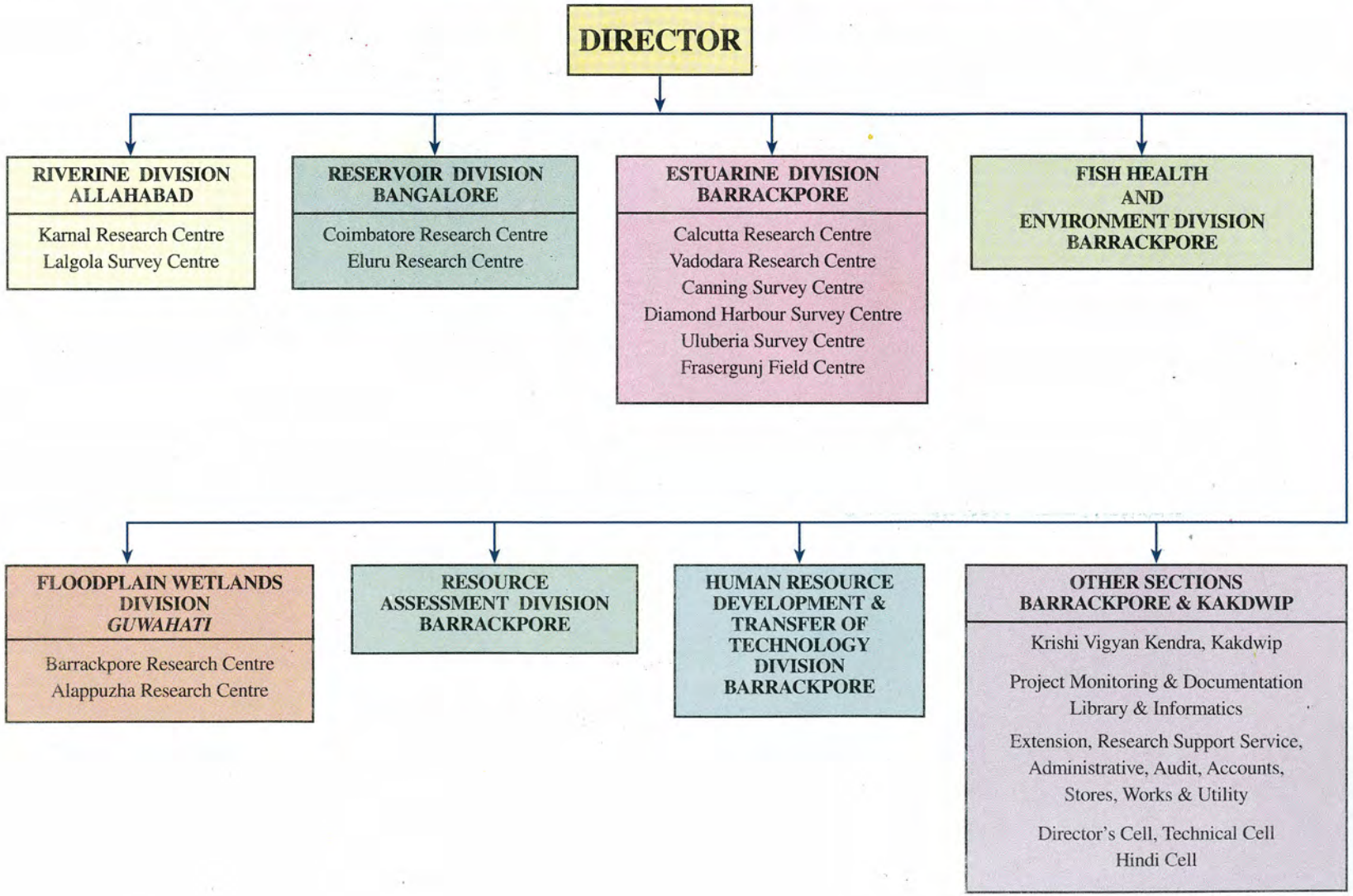
The ***Riverine Division,*** with its headquarters at Allahabad, strives to develop systems for effective management of the vast riverine fisheries resources of the country with adequate emphasis on the conservation of riverine environment. The research projects under the Division cover the river Ganga and their important tributaries.

The ***Reservoir Division*** is based at Bangalore with centres in Tamil Nadu and, Andhra Pradesh. The investigations being carried out at the Division are aimed at developing management norms for optimising fish yield from large, medium and small reservoirs of the country.

The Barrackpore-based ***Estuarine Division***, presently works on the Hooghly- Matlah and Narmada Estuarine systems. Biotic and abiotic features of estuarine tributaries and mangroves of Sunderban region are also being studied. Research on biology and migratory behaviour of hilsa being conducted, aims at development of measures for the recovery of its fishery in the depleted stretches of the river Ganga. It is also undertaking study on genetic characteristics of hilsa from different stretches to know its population structure.

Fish Health and Environment Division, stationed at Barrackpore, is mandated to monitor the man-made changes in the riverine, reservoir estuarine and wetland ecosystems and to evolve suitable amelioration measures. The studies under the Division include collection of basic information on habitat variables, assessment of its impact on biodiversity and fishery through known indicators, fish and prawn stress and disease diagnosis and control. Development of mitigating action plan for ecosystem restoration is also the responsibility of this Division.

ORGANIZATIONAL SET-UP OF CIFRI



The ***Floodplain Wetlands Division*** has its headquarters at Guwahati. The ecodynamics of wetlands spread over the floodplains of Ganga-Brahmaputra basins are being studied in order to evolve management norms for their sustainable development. The wetlands associated with the floodplains of Ganga and Brahmaputra rivers are not only unique in their rich biodiversity, but also constitute an important fishery resource in the states of Bihar, West Bengal and Assam. The Division carries out research on the ecosystem processes and fish productivity from this resource with special attention on protection of biodiversity and development of environment-friendly technologies.

The ***Resource Assessment Division*** is located at Barrackpore and conducts research aimed at creating a database on the fish stocks and fishery resources. The Division is geared up to develop various population models that can lead to scientific exploitation of inland fisheries resources. Mapping the various inland aquatic resources of the country by GIS is also the responsibility of the division.

The **Human Resource Development and Transfer of Technology Division** is located at Barrackpore and has aimed at manpower training and education of fisheries personnel for producing qualified persons to perform assigned tasks in an efficient and effective manner.

The Transfer of Technology wing undertakes on regular basis the dissemination of various technologies of inland fisheries to the fish farmers, fishermen, entrepreneurs, extension functionaries through training, demonstration, advisory service, fish farmers' day, camp discussion, film show, exhibition, etc.

The Institute's research activities are organised under 19 research projects which are operated from the Headquarters at Barrackpore, 12 Research centres, 6 Survey Centres and a Krishi Vigyan Kendra covering 10 states of the country. The distribution of research and survey centres and different sections are shown in the organization chart.

Library services

CIFRI library provides its services to the scientists of the Headquarters and Centres as well as to the research scholars, teachers, students and officials from other organizations. The library added 308 books 87 miscellaneous publications and 650 loose issues of journals to its collection and subscribed 20 foreign and 66 Indian journals during the year. The current total holding of the library comprises 9296 books 4277 reprints 1252 maps and 4137 miscellaneous publications.

The library maintained free mailing of the Institute's 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 extended inter-library loan to other libraries. Rs. 2910357.00 was spent during the year 2002-2003 for procuring library books, journals and other reading materials. Library also brought out Indian Fisheries Abstracts Vol.35(2-4), 2001 & Vol.36(1), 2002 and Current Contents for the period January–December, 2002.

Project Monitoring and Documentation Section

The section monitored the progress of Research Projects of the Institute and organized Staff Research Council Meeting. It also assisted the Director in policy formulation and technical guidelines on plan preparations, apart from publishing reports, write-ups, bulletins, project programmes, and newsletters. The section processed the research papers submitted by the scientists for their publications in different journals and for presentation in symposia/workshops/summer school, etc. Participation of scientists in seminars, symposia, conferences, *etc.* was also monitored by the section. The section maintains an active DTP, photocopy, lamination, duplicating (cyclostyling), and binding units to cater to the needs of the Institute.

Research Project Files

Annual progress reports of all the research projects and the contribution made by individual scientists are being maintained and monitored through the Primary Project Files and Scientists' Files. Monitoring of research progress through RPF I, II and III. Activity Milestones and Monthly, Quarterly and Annual Reports are some of the major responsibilities of the section.

Technical Reports/queries

More than 20 Technical reports highlighting the progress of research under various projects were compiled and sent to the Council, Ministry of Agriculture and other agencies. Technical queries regarding the activities of the Institute from various quarters of the country and abroad were attended to by the section.

Personal Information System (PIS)

During the reported period, biodata of 75 scientists of the Institute have been updated in the PIS based database which is being maintained at the Institute and ICAR.

Publications

The following departmental publications were brought by CIFRI during the year.

Annual Report

1 Annual Report 2001-2002

Newsletter

1 The Inland Fisheries News (Vol.7, No.1, January 2002 to June 2002)
2 The Inland Fisheries News (Vol.7, No.2, July 2002 to December 2002)
3 The Inland Fisheries News (Special Commemorative Issue, April 2002)

Bulletin

1 Bull. No. 107 : Ecology and fisheries investigation in Vembanad lake.

2 Bull. No. 108 : Ecology-based fisheries management in some reservoirs of Eastern Rajasthan.

3 Bull. No. 109 : Fisheries of Hooghly Matlah estuarine systems – further appraisal (1994-95 to 1999-2000).

4 Bull No. 110 : Machliyon ki bimariyan – pehchan ebom upchar (In Hindi).

5 Bull. No. 111 : Management of Estuarine wetlands.

6 Bull. No. 112: Pen culture in floodplain lakes.

7 Bull. No. 113 : Culture – based fisheries for inland fisheries development.

8 Bull. No. 114 : Bibliography on estuarine fisheries of India 1948-2000.

9 Bull.No. 115 : Methods of assessment of aquatic ecosystem for fish health care.

Miscellaneous Publication

1 Training on Inland Fisheries Development for the Fish Farmers of Meghalaya (January 20 – 30, 2003) Barapani. Conducted by CIFRI, ICAR Research Complex of the NEH and CIFA.

2 Workshop on Fishery Management in Lentic Water Systems : stocking of reservoir with fish seed, (February 19-20,2003).

3 Training Programme Development of Reservoir Fisheries in India, CIFRI, Barrackpore, March 12-16, 2003. (under NATP Project).

4 Hand book on pen culture of fish and prawn by *V. V. Sugunan, P. K. Saha & N. K. Barik.*

Book

1 Ornamental fishes of West Bengal

Current Contents

Jan. – Dec., 2002.

Indian Fisheries Abstracts

Vol. 35(2-4),2001 & 36(1), 2002.

Financial statement (Rs. In lakhs) For the year 2002-2003			
	B.E.	**R.E.**	**Actual expenditure**
Plan	250.00	190.00	189.98
NE Component	150.00	100.00	99.71
Non-Plan	785.00	777.75	769.69
TOTAL	**1185.00**	**1067.75**	**1059.38**

Staff Position

Statement showing the total number of employees in the CIFRI, Barrackpore pertaining to the employees under Scheduled Castes and Scheduled Tribes categories (Period from 1.4.2002 to 31.3.2003)

Sl. No.	Class of Posts	Total No. of posts sanctioned	Total No. of employees in position	Total No. of Sch. Caste among them	S.C. in % of total employees	Total No. of Sch.Tribe among them	S.T. in % of total emplo-yees	Remarks
1	**SCIENTIFIC POSTS**							
	Experimental Scientist							
	Scientist	76	59	6	10.16	**1**	**1.69**	
	Sr.Scientist/Scientist (Sel.Grade)/ Scientist (Sr.Scale)	16	7	-	-	-	-	
	Principal Scientist	8	1	-	12.50	-	-	
	RMP Scientist	1	-	-	-	-	-	
	TOTAL	**101**	**67**	**6**	-	**1**	-	
2	**TECHNICAL POSTS**							
	Category – I	55	53	11	20.75	3	5.66	This includes 6 posts under KVK
	Category – II	50	49	10	20.40	4	8.16	
	Category – III	5	5	1	20	-	-	
	TOTAL	**110**	**107**	**22**		**7**		

3	**ADMINISTRATIVE POSTS**							
	Sr.A.O.s/A.Os/Accounts Officer, etc.	2	2	-	-	-	-	This includes 1 (one) L.D.C. under N.F.
	A.A.Os/A.F.& A.O.	6	4	2	50%	-	14.28%	
	Assistant Director (O.L.)	1	1	-	-	-	-	
	Assistants	21	18	2	11.11%	1	5.55%	
	P.S., P.A.	4	4	1	25%	-	-	
	Jr. Steno., Sr. Clerk/U.D.Cs	42	42	12	28.87%	-	-	
	L.D.Cs/Hindi/Time Keeper	13	12	1	8.33%	1	8.33%	
	TOTAL	**89**	**83**	**18**		**2**		
4	**SUPPORTING STAFF**							
	Grade - I	80	79	28	35.44%	6	7.59%	This includes 7 (seven) post of SSG under KVK
	Grade - II	58	58	18	31.03%	4	6.89%	
	Grade - III	35	34	11	32.35%	2	5.88%	
	Grade - IV	18	13	7	53.84%	3	23.07%	
	TOTAL	**191**	**184**	**64**		**15**		

4 RESEARCH ACHIEVEMENTS

PROJECT : RI/A/1

ECOLOGY AND PRODUCTION RELATIONSHIPS IN PENINSULAR RIVER SYSTEMS

Sub-Project : **Investigations on ecology, bio-diversity and production functions in river Krishna**

Personnel : *Scientific :*
D.N. Singh, D.S. Krishna Rao, M. Karthikeyan, A.K. Das, R.K. Manna

Duration : April 2001-March 2003

Location : Bangalore

In conjunction with the post-monsoon survey, the studies on the ecology and fisheries of river Krishna continued with pre-monsoon (May-June, 2002) and monsoon (September2002) surveys on the ecology and fisheries.

River Krishna

The river course was divided into two stretches - upper stretch (Maharashtra and Karnataka) and lower stretch (Andhra Pradesh). From first and second stretch 14 and 9 centres were chosen for sampling respectively. At each centre, sampling was done for various limnological parameters and primary productivity. Data on fish and fisheries and socio-economic status of fishers were collected.

Sediment and water quality

Soil reaction was moderately alkaline in the range of 7.30 to 7.94 and 6.97 to 7.88 in pre-monsoon and monsoon respectively. Specific conductance (mS/cm) registered low to moderate values in the entire river course with higher values in pre-monsoon (0.20 to 0.71) and monsoon (0.12 to 2.11). Organic carbon content (%) was fairly rich in pre-monsoon (0.22 to 2.19) and monsoon (0.23 to 5.85). Downstream always showed higher values of C/N ratios (5.60 to 80.00) due to more organic load in this stretch. Available-N (mg/100g) ranged from 10.89-76.66 and 16.12-80.50 in pre-monsoon and monsoon respectively. Available-P (mg/100g) was fairly rich in river Krishna and ranged from 0.64 to 20.56 in monsoon followed by post-monsoon range of 0.78 to 6.84 and pre-monsoon range of 0.56 to 3.96 in the entire river stretch.

Water transparency remained at low values in monsoon specially in the downstream (0.35-0.80 m). In post-monsoon, the lowest Secchi depth was recorded at Wadapalli (0.20 m) due to loading of organic and inorganic substances through polluted Musi river as against pre-monsoon values (0.60-2.20 m). Sp. conductance (µS/cm) was on an increasing trend from the origin and the extreme lowest estuarine centre showed higher values of sp. conductance (1270, 1440 & 16820 µS/cm in post-, pre- and monsoon period respectively).

Presence of carbonate was to the tune of 4-36 mg/l in the entire river stretch in this study. Total hardness (TH) (mg/l) ranged between 100 & 344 in post-monsoon, 64 & 288 in pre-monsoon and 72 & 460 in monsoon (barring Penumudi, 2000 TH mg/l in monsoon) in the entire river course. Magnesium content also was moderately rich and ranged from 3.84 to 56.26 mg/l in the entire river course during the study period. Penumudi recorded the highest Ca and Mg content (625.25 mg/l & 106.62 mg/l respectively) in monsoon.

River Krishna is locally polluted through its tributaries as indicated by the higher chloride content in water of such tributaries. Chloride content (mg/l) was higher in tributaries like Wenna (36.92, 28.40 & 34.08), Yerala (107.92, 108.24 & 98.25), Varna (56.80, 31.24 & 79.52), Pancha Ganga (59.64, 42.60 & 51.12), Dudh Ganga (59.64, 19.88 & 53.96), Ghataprabha (142.00, 134.56 & 79.52), Malaprabha (255.60, 28.40 & 105.08), Bhima (127.80, 120.36 & 110.28), Tungabhadra (198.80, 156.20 & 184.60) and Musi (60.24, 79.52 & 66.74) during post-monsoon, pre-monsoon and monsoon periods respectively.

The fluctuation of nitrate-N (µg/l) was to the tune of 3 to 1095, 5 to 654 and 9 to 345 in the post, pre and monsoon period respectively in the entire river stretch. Phosphate-P (µg/l) was evenly distributed and ranged from 31-252, 4-127 & 20-192 in post-, pre- and monsoon periods respectively. Overall, the Krishna system showed higher values of dissolved nutrients in water unlike other Indian rivers.

Primary productivity

The gross primary production (GPP, $mgC/m^3/h$) increased progressively as the distance from the origin increased. The overall range of gross production in post-, pre- and monsoon seasons were 37.50 to 253.13, 46.90 to 281.25 and 28.13 to 121.88 respectively.

Net production (NPP, $mgC/m^3/h$) also, in most centres, followed the same trend as observed for GPP and attained the value of around 50% GPP in most occasions irrespective of seasons. Community respiration (CR, $mgC/m^3/h$) varied widely amongst the centres and ranged from 18.75-46.87, 9.38-67.16 & 7.50-37.50 in post-, pre- and monsoon periods respectively. The average daily integral gross and net productions ($mgC/m^3/d$) were 777.17, 743.19 & 717.41 and 570.80, 520.76 & 539.36 in post-, pre- and monsoon months respectively in the entire river stretch. P:R ratio (GPP:CR), an indicator of organic pollution registered moderate amplitude of variation (1.8-3.5, 1.8-3.3 & 2.0-4.5) in upstream and higher values (2.0-13.5, 1.3-13.0 & 2.0-5.4) in downstream during post-, pre- and monsoon months respectively.

Biotic communities

Plankton : Phytoplankton population dominated during pre-monsoon and monsoon periods accounting for 88.37% and 89.80% respectively. Among phytoplankton Myxophyceae remained in abundance throughout the study (46.72% pre-monsoon and 51.50% monsoon). Zooplankton

population was constituted by crustaceans and rotifers. Main forms encountered were *Microcystis aeruginosa, Pediastrum tetras, P. duplex, Synedra ulna, Hormidium sp. Cyclops* and *Brachionus*. Monsoon period depicted more plankton (6314) as compared to post-monsoon (5522).

Benthos : Benthic community remained dominated by molluscs to the tune of 89.80% and 93.50% during pre-monsoon and monsoon seasons respectively. Main forms encountered were *Corbicula peninsularis, Bellanomaya bengalensis, Thiare tuberculata, T. granifera* and *T. lineata*

Macrophytes : Upper stretch was mainly devoid of aquatic vegetation in the main river course, however where water stagnation occurred aquatic weeds were recorded especially in the marginal areas. Macro-phytes encountered were *Potamogeton crispus, Potamogeton indicus, Hydrilla verticillata, Vallisneria spiralis, Ceratophyllum demersum* and *Ipomoea aquatica* in order of their abundance.

Periphyton : Among periphytic population Bacillariophyceae dominated during both the seasons recording 68.06% in pre-monsoon and 95.59% in monsoon season. Main forms recorded were *Merismopedia* sp., *Synedra ulna, Synedra rumbens, Navicula cuspidate, N. exigua,* and *Gomphonema montanum*.

Fisheries

Pre-monsoon season is most important for freshwater prawn fishery. The fishery (*M. rosenbergii*) extends from Penumudi up to Satrasala. Major carps form a fishery all along the length of the river up to Amudhurlanka and includes all the four species catla, rohu, mrigal and calbasu. The major reservoirs Srisailam, Nagarjunasagar and the barrage Prakasam are very important for major carps in particular catla and rohu. Several endemic species like *Labeo gonius, L. boga, L. boggut, L. fimbriatus, Cirrhinus reba* and *Puntius kolus* form a fishery in the river stretches between Satrasala and Prakasam barrage and this length of the river has several deep pools (Satrasala, Taduvayee) which can be considered for developing them as sanctuaries for conservation of these species. *E. suratensis* form a fishery down stream of Nagarjunasagar in all the seasons. Hilsa (*T. ilisha*) was recorded only at Penumudi.

Crafts and gears : The main crafts used are coracles and plank-built boats. The most important gears used are gillnets, castnets and dragnets. Others include traps and hook and line. Dynamiting is rampant in all the stretches of the river. Triangular framed nets are used in the estuarine stretch to collect juveniles of prawns for stocking purpose.

Socio-economic status of Fishers

The average age of fishermen (head of family) was 39.8 years while the average family size was 4.64. The sex ratio (Male : Female) was 1 : 0.82. Majority of the fishermen (72.7 %) had their own fishing crafts. Gillnet was the dominant gear among the fishermen (63.6 %) followed by drag net (*Napavala*) 45.6 % and cast net 36.4%. During the peak fishing season (March–May), fishermen get about 10-15 kg of fish per coracle and during October-December, the fish landings are about 2-5 kg per coracle. July-September is the lean period for fishing when the landings are less than 2 kg per coracle.

Pollution status of river Krishna

A number of molasses and sugar factories are located mostly on the catchment of tributaries as well as main Krishna river in the upper stretch. The factory effluents find their way into the rivers

through first monsoon flood. Heavy fish mortality is a regular phenomenon in Krishna upstream from Wai up to Jamakhandi especially during onset of monsoons every year. Biological oxygen demand (BOD) level (mg/l) was higher in pre-monsoon (0.40–3.30) followed by post-monsoon (0.20-1.60) and monsoon (0.40-1.50) in the entire river stretch. Brahamanal, Haripur, Jamakhandi, Musi, Taduvouy and Amaravathy were showing sign of local pollution with increased order of anthropogenic activities during the course of study.

Heavy metals in sediments : Chromium and cadmium were encountered in low concentration in sediments (mg/kg) of Krishna and its tributaries. Cadmium concentration fluctuated to the tune of 4.01 to 6.54 and 0.10 to 8.46 during post- and pre-monsoon months respectively. Zn and Cu ranged from 40.25 to 292.30 and 58.02 to 222.78 and 37.98 to 188.68 and 31.39 to 184.19 mg/kg in post- and pre-monsoon seasons respectively.

Heavy metals in fishes : Among toxic heavy metals (g/kg), cadmium ranged from 1.48 to 3.06 and 0.80 to 1.40 in tissues and 1.33 to 17.42 and 1.0 to 5.6 in gills during post- and pre-monsoon months respectively. Exceptionally higher concentrations (g/kg) of Zn, Cu and Pb were noticed in gills of *Mastacembelus armatus,* in post-monsoon at T. palayam, to the extent of 4463.28, 517.26 and 182.14 respectively.

PROJECT : RI/A/2

BREEDING BIOLOGY AND FISHERY OF SILVER CARP, *HYPOPHTHALMICHTHYS MOLITRIX* (VAL.) IN SUTLEJ RIVER

Personnel : *Scientific :*

V.V. Sugunan, D.K. Kaushal, V.K. Sharma
Technical :
C. Lakra, Sushil Kumar, Kuldeep Singh

Duration : April 2002-March 2003

Location : Karnal

Spatio-temporal variation in the distribution of silver carp

During the period April 2002-February 2003, the total catch of the reservoir accounted to 1113 t and chiefly consisted of *H. molitrix* (85.0%), *C. carpio* (6.3%), *C. catla* (4.4%) and gid (1.5%). Species contributing less than 1% were *T. putitora* (0.7%), *M. seenghala* (0.7%), *L. rohita* (0.6%), *C. idella* (0.5%). The seasonal variations in the landings of *H. molitrix* was evident by its lowest catch (27.5 t) in January and highest catch (249 t) in May out of an annual catch of 946 t.

Breeding biology of silver carp

Relative condition factor (kn) : The mean condition factor for female ranged from 0.9128 in August, 2002 to 1.1115 in January, 2003. In case of male the mean condition factor varied between 0.8929 in May, 2002 to 1.1293 in March,2003. Both male and female had condition factor below 1 during the months of May to November.

Maturation : Like Indian major carps maturation in silver carp is monsoon oriented. The maturity stages are :

Stage I : The gonads in both sexes appear as thin thread like structures, whitish in colour below the swim bladder. Sex at this stage is not differentiated.

Stage II : Majority of females have well defined ovaries with well marked oocytes in follicles . The weight of ovary starts increasing in this stage. Gonadal recrudescene takes place in both the sexes. This stage of developing gonads is noticed in January and February.

Stage III : The ovary increases in size, dense net work of blood vessels are seen in ovarian follicles. Oocytes increase in size and visible. Ovaries are grayish in colour. This stage occurs in the month of March.

Stage IV : In May, the ovaries and testes are fully mature. Male pass out milt on slight pressure. Ovarian maturity and testicular follicle maturity is at its peak .

Stage V : Ovaries increases in size and weight, become broader and attain yellowish colour. Ovary wall is transparent. Oocyte are round well defined and visible from out side as fully mature. This is noticed in late April. The testes are follicular creamy coloured and lobulated, while ovaries are smooth, follicle being broader, fully developed.

Stage VI : Ovaries occupy whole of abdominal cavity and ready to breed with natural trigger.

Thereafter gonadal regression takes place. The texture of ovaries changes and partial emptiness is noticed. The testes loose flaccid texture. This is noticed in October. During October/November the gonads are fully regressed and absorption of oocytes takes place.

Sex ratio : Generally there was no significant difference in expected sex of 1:1 (F:M) except in April (1:2.5), August (1:2.5) and March (1:0.57) The overall sex ratio , however, was 1:1.16 and oscillated around the normal value of 1:1.

Spawning season : Spawning of the fish in Gobindsagar could not be observed as there was a total failure of North-West monsoon. The matured females were recorded till October. Thereafter, regression and absorption of ova took place. The spawning marks on the scales were observed in May and August. The mature fish were in size group of 695-860 mm and were of 3+ age group.

Gonado somatic index ranged between 2.162-19.28 in case for female silver carp. Its peak was during the months of August through May.

Fecundity : Ripe specimens of silver carp ranging 695 to 860 mm total length and of 3+ age group weighing 3650 to 7600 g were examined in August and September since fish samples in June-July were not available. The gonads weight varied from 200 to 825 g. The total fecundity ranged from 1,19,167 to 6,68,115 eggs per female with an average of 3,01,396 eggs. The relative

fecundity varied from 29.065 to 123.72 (mean 63.556) eggs per g of total weight of fish. The number of eggs per g ovary weight ranged between 487 and 810 (mean 653).

The fecundity (6,68,115) of fish weighing 5400 g and measuring 815 mm indicated maximum number of ova accounting 124 per g body weight and the number per g ovary weight being 810. The specimen of 860 mm in length and 7600 g weight had 58 ova per g body weight and 517 ova per g ovary weight. Gonado-somatic index (%) in ripe fish varied from 5.26 to 19.28. The diameter of the ripe eggs before spawning varied between 1.00-1.84 mm. The percentage frequency of ova diameter revealed dominance of nature ova ranging 1.2 to 1.84 mm in the month of May and August indicating that one spawning season can be considered for this fish.

Collection of data on mesh selectivity of gill net : Gill nets of mesh size 40-59 mm were found effective for fishing of silver carp ranging between 370-770 mm while nets of mesh bar 60-79 mm commonly used were useful for fishing silver carp of the size 380-890 mm. Nets of larger mesh bar (80-99 mm) were effective for fishing silver carp in size range of 620-905 mm. Gill-nets of mesh bar 50-49 mm were in use during August to December months.

Location of spawning ground : The silver carp do not normally breed in stagnant water. The lacustrine influence is required for full gonadal development and natural spawning. Spawn collection work was conducted in June-July in Lunkhar khad and Seer khad. In Lunkhar khad, eggs in size of 2.4 to 5.5 mm @ 74 eggs/ml and in the size of 3.06-5.0 mm @ 70 eggs/ml were recorded on 4th and 5th July respectively indicating poor availability of spawn. Similarly, in Seer khad spawn was collected at the rate of 68 eggs/ml (2.5-3.5 mm) on 20th July and 75 eggs/ml (2.3-3.3 mm) on 25th July. Developing eggs were collected with a maximum rate of 2000 ml/hr in Lunkhar khad and 8000 ml/hr in Seer khad. Due to unusual delay in South-West monsoon the breeding of silver carp was not noticed and occurrence of ripe specimens in landings during August-September reflected either poor breeding or failure in breeding of silver carp during monsoon.

PROJECT : RI/B/2

ASSESSMENT OF ECOLOGY, BIODIVERSITY AND PRODUCTION POTENTIAL OF INDUS RIVER SYSTEM

Sub-project : Evaluation of ecology and fish community structure of river Beas.

Personnel	:	*Scientific :* D.N. Mishra, UshaMoza *Technical :* C. Lakra, Sushil Kumar, Kuldeep Singh
Duration	:	April 2002-March 2005
Location	:	Karnal

The survey of river Beas over an approximate stretch of 165 km from Talwara to Kapurthala was conducted to study the ecology, biodiversity and production potential.

Characterisation of effluent load : Two main effluent carriers into river Beas *viz.* Chakwal Nalla and Kalibein were evaluated. The soil as well as water within both were alkaline in nature, pH being 7.73 and 7.50 at Chakwal and 7.70 – 7.58 at Kalibein. Water within Chakwal was very hard, T. hardness 455.6 mg/l and had high mineral content of 138.25 mg/l of calcium and 26. 24 mg/l of magnesium. High conductance of 938 µmhos/cm, high value of B.O.D., 33.38 mg/l and C.O.D. 458.0 mg/l and low value of DO , 3.4 mg/l suggested that the effluent within this Nalla was harmful for fish.

Fish community structure : F.C.S. was evaluated at 6 landing centers namely Talwara, Pathankot, Mukerian, Amritsar, Sultanpur and Harike.
Fishing activity : Fishing activity in Beas takes place from post-monsoon to pre-monsoon. Fishing is legally banned during monsoons.

Fish biomass : Total fish biomass of river Beas was 14.76 t/m for the year 2002-03. It being almost equal at all stations barring minor disparity. The biomass was slightly high, 2.81 t/m at Pathankot and minimum 2.16 t/m at Sultanpur. The calculated biomass per km estimates to be 0.0894 t/m.

Fish catch composition : In River Beas the minor carps constituted mostly of *Labeo dero, L. dyocheilus, L. bata, L. gonius* and *C. reba* were dominant forming 28.52% of the total population. Common carp represented by both species formed (22.09%) of the population. Its presence throughout the river depict its establishment within the system. Indian major carps and large catfishes represented 19.45 and 11.38% of the total population respectively. Mahseer, *T. putitora,* constituted 0.95% of total population within the river. Miscellaneous fishes represented by murrels *(B. bagarius)* and eel in upper stretch (Talwara-Pathankot) and by *Rita rita, Notopterus* sp. in the lower stretch (Sultanpur-Harike) contributed 17.61% of the total population.

The dominant species of various centers were *Cyprinus carpio* 73.59% and *L. dero* 8.65% at Talwara, *C. mrigala* 14.03%, *M. seenghala* 13.71% and *B. bagarius* 12.72% at Mukerian, *L. dyocheilus* 36.65%, *L. dero* 29.18% and *L. bata* 12.81% at Pathankot; *C. carpio* 23.07%, *C. mrigala* 11.15% and *C. reba* 10.27% at Amritsar; *C. mrigala* 18.98% and *C. carpio* 12.96% at Sultanpur; *R. rita* 23.07%, *C. carpio* 20% and *L. calbasu* 13.46% at Harike.

Length- frequency distribution : Length-frequency data of commercial fishery showed that catch of *C. mrigala* (47.4%) and *L. calbasu* (69.4%) were in III group (length range 501-660 mm); *C. carpio* (50%), *Tor* sp. (66.7%) were in II group (length range 306-500 mm) and *C. catla* (44.4%), *L. rohita* were (53.0%) in IV group (length range 661-762 mm).

Ecological characteristics

Soil Quality : Soil texture of Beas bed is sandy upstream between Talwara to AOF Mukerian containing 75.7-79.5% sand and is sandy loam downstream having 59-58.9% sand.

River sediment is alkaline, pH ranging between 7.6 to 8.12. Organic carbon was low (90.25%) to moderate (0.61%). Soil was generally deficient in available phosphorus (1.47-3.4 mg/100g) and nitrogen (5.88-10.5 mg./100g), thereby making it less productive.

Water Quality : River water is alkaline having low amplitude of variation (pH 7.81 to 8.11). Low alkalinity value of 48.5 to 62.5 mg/l make it less productive however availability of major nutrients like calcium 25.25-33.75 mg/l and magnesium 11.85-20.1 mg/l may help in enhancing its productivity.

DO ranged between 8.0 to 9.0 mg/l. BOD (18.0-15.6 mg/l) and COD (74.5-64.5 mg/l) at effluent loaded sites (OF-BOF Mukerian) depict the Talwara stretch polluted due to Chakwal Nalla.

Primary productivity : Gross primary production ranged between 175.78 to 218.75 mgC/m^2/hr, with the highest at BOF Mukerian followed by Talwara and was lowest at Beas bridge site.

Biotic communities

Plankton : Standing crop of plankton within Beas was maximum at non effluent points 117 u/l (Mukerian) 204 u/l (Beas bridge) and 334 u/l (Beas Harike) barring Talwara having only 71 u/l of the population. Standing crop of plankton at tail end of Sutlej and confluence in Harike was 217 u/l and 229 u/l respectively depicting wetland having more influence of Sutlej than Beas.The composition mainly comprise of Bacillariophyceae (89-67%) at non induction sites. Thereafter the composition changes under the influence of effluents.

Dominant forms present within river Beas were *Diatoma, Frustulia* at Talwara while in the rest of the stretch it was *Navicula, Synedra, Diatoma* and *Nitzschia* (Bacillariophyceae), *Spirogyra, Cladophora, Characium* (Chlorophyceae), *Microcystis, Spirulina, Phormedium* and *Polycystis* (Myxophyceae). *Brachionus sp., Filinia sp.* (Rotifers), *Cyclops* and *Diaptomus* (Copepoda), *Daphnia* (Cladocera) and *Euglena* (Protozoa).

Periphyton : Periphyton population ranged between100 to 480 u/cm^2.

Dominance of Bacillariophyceae at non effluent sites Talwara (89%), AOF Mukerian (81%) depict the stretch as fresh. Presence of 63-41% of myxophyceae between OF-BOF Mukerian depict it as polluted zone. The rest of Beas is between the two conditions.

Presence of 56% bacillariophyceae, 41% myxophyceae in Kalibein depict its eutrophic nature.

Macrobenthos : Total density ranged between 93-1315 u/m^2. The density showed large fluctuation. It being high 957 u/m^2 at Talwara and 1315 u/m^2 at Beas.

Percentage composition of benthic population exhibit site specific variation.Talwara at the foot hills of mountains with clean water exhibit maximum diversity of population having Caddis flies (5.0%), Ephemeroptera (5.91%), Hemiptera (3.59%), Coleoptera (5.36%) and Odonate nymphs (5.36%) although mollusca, 78.34% are dominant.

Presence of chironomids, 15.13-38.42%; cladocerans, 15.16-11.46% and tubificids, 18.8-26.79% at tail end of Beas and Sutlej within Harike show the site having organic effluents. Benthic

density of 275 u/m^2 at Kalibein contributed mainly by Coleopterans (2.56%) and mollusca (97.42%) show this tributary organically rich but not polluted.

Macrophyte : Submerged weeds were present only at Talwara and Harike and the rest of Beas had marginal emergent weeds.

The population composition showed maximum diversity at Talwara wherein *Chara* and *Azolla* was exclusively present during winter; *Hydrilla* in pre-monsoon; *Vallisneria* and *Potomogeton* from pre to post-monsoon seasons.

Heavy presence of *Eichhornia* sp. within Harike depict the site to be eutrophic.

Macrophyte associated fauna : Macrophyte associated fauna within main river ranged between 4-70 u/kg/m^2.

The composition reveal presence of stone fly, May fly and Caddis worm nymphs at Talwara in addition to mollusks indicating it as fresh water zone. Presence of insects mainly Bugs and Beetles along OF-BOF Mukerian during monsoon to winter only indicate dilution of pollution in this stretch during the period due to high flow of water. Heavy presence of beetles namely *Dyticid, Psephnrus* and *Hydrocanthus* sp. at this site indicate their resistance to industrial load mainly that of paper and pulp mills.

PROJECT : RI/B/3

EVALUATION OF HABITAT DEGRADATION IN THE CONTEXT OF FISHERIES ECOLOGY IN RIVER GANGA

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Duration **:** April 2001-March 2006

Location **:** Allahabad/Karnal

River Ganga

Physical features

Physical features of R. Ganga between Deoprayag and Farakka has shown that current velocity ranged from 0.58 to 4.69 km/hr[1] being maximum in Deoprayag and minimum in Farakka. The velocity showed a continuous decline from upper stretch to lower stretch. Silt load was minimum in Farakka (82.7 g/m^3) and maximum at Kanpur (515.0 g/m^3). In general, the load was maximum in the middle stretch between Kannauj and Patna.

Sediment quality

Sediment samples were dominated by sand (77.0 to 100%) with silt and clay percentage being slightly higher in the down stretches (10 to 16% and 5.5 to 14%, respectively). It was alkaline in reaction throughout the stretch with pH ranging from 7.7 to 8.0 and conductance 151.0 to 515 µmhos (the high values were observed at Kanpur). Free calcium carbonate ranged from 1.25 to 7.5%. Organic carbon was poor throughout the stretch (0.021 to 0.405%) but both the available nutrients (nitrogen-20.2 to 34.8 mg/100g) and phosphate (0.96 to 5.4 mg/100 g) were moderate to high.

Water quality

Water temperature ranged from 16.5 to 28.8 °C being lower in the upper stretches. The overall range of transparency was 26.8 to 73.7 cm. Dissolved oxygen was fairly high in the entire stretch (5.65 to 10.2 mg/l) being maximum in Rishikesh and minimum in Kanpur. Water was always alkaline in reaction with pH ranging from 7.95 to 8.35. The water quality parameters alkalinity, conductance, dissolved solids, calcium, magnesium and hardness were within the range of 52.0 to 143.6 mg/l, 146.3 to 407.6 µmhos,73.0 to 203.0 mg/l, 16.3 to 30.93 mg/l, 4.18 to 18.4 mg/l and 58.6 to 154.1 mg/l, respectively. All the above parameters were minimum at Deoprayag and maximum at Varanasi. The common features in the entire stretch was poor nutrients (nitrate 0.029 to 0.213 mg/l and phosphate 0.012 to 0.142 mg/l) and rich dissolved organic matter (1.03 to 2.01 mg/l). Chloride ranged from 9.12 to 24.43 mg/l and silicate 3.0 to 6.45 mg/l being comparatively lower in the upper stretches. Transparency between Varanasi and Farakka ranged between 26.0 and 73.7 cm being highest at Varanasi. Dissolved oxygen was moderate in all the above stretch (5.59-7.33 mg/l), indicating lowest value at Bhagalpur.

Primary production

Gross and net productions in the entire stretch ranged from 200.2 to 929.6 $mgC/m^2/day$ and 123.4 to 554.0 mg/Cm2/day, respectively. Production rates were minimum in Deoprayag and showed a gradual increase reaching maximum at Kanpur. The energy fixation rate by producers ranged from 1966 to 9129 $Cal/m^2/day$ (Gross) and 1212 to 6395 $Cal/m^2/day$ (Net). The rate of energy fixation followed the same pattern as that of carbon synthesis with increasing trend from Deoprayag to Kanpur.

Biotic Communities

Plankton

Plankton population ranged between 10 u/l (Deoprayag) and 70 u/l (Rishikesh) and 510-3470 u/l in the po[illegible]mon region. Site-wise variations in plankton population, species and percentage contribution of zooplankton in total plankton communities showed gradual increase with cascades of river flow. Plankton comprised mostly members of Bacillariophyhceae *viz. Navicula* sp., *Synedra* sp., *Asterionella* sp., *Nitzschia* sp., *Cymbella* sp., *Amphora* sp., *Fragilaria* sp., *Gyrosigma* sp. and *Gomphonema* sp; followed by members of Chlorophhyceae *viz. Spirogyra* sp., *Scenedesmus* sp., *Pediastrum* sp., *Hormidium* sp., *Tribonema* sp. and *Mougeotia* sp., and Myxophyceae comprising mostly *Microcystis* and *Oscilatoria* sp.. Amongst zooplankton, rotifers were dominant though members of cladocera and copepods were conspicuous.

Periphyton

The periphytic assemblages recorded at different centers revealed that the Kanpur recorded the highest density of flora (1395 u/cm^2) and Deoprayag recorded the lowest density (240 u/cm^2). The density of flora had the maximum peak in February at all the centers. The composition of different groups in the entire stretch revealed that the Diatoms were the maximum followed by blue-green and green algae. The dominant algal genera were *Navicula, Cymbella, Synedra, Diatoma, Oscillatoria, Phorimidum, Scenedesmus, Ankistrodesmus, Spirogyra* and *Mougeotia.*

The qualitative and quantitative abundance of periphyton studied at seven centers of lower stretch of river Ganga revealed maximum abundance at Farrakka (903 u/cm^2), Hanumanghat (483 u/cm^2), Gaighat (374 u/cm^2) and Digha (281 u/cm^2), portraying a direct correlation with enhancement of water level and lowering of current. The lowest abundance was recorded in monsoon (118 u/cm^2) which enhanced to 1057 u/cm^2 in winter and 592 u/cm^2 in summer. The Diatoms ranging from 40.74% to 95.23% have contributed to total periphyton. The dominating forms encountered were: *Navicula, Synedra, Gomphonema, Melosira, Tribonema, Cymbella, Phormidium* and *Oscillatoria.*

Benthos

A considerable increase in benthic population in the entire stretch of river Ganga has been recorded in comparison to preceding year. However, the benthic population was moderate at upper stretch of river Ganga from Deoprayag to Kanpur which ranged from 286 n/m^2 (Deoprayag) to 1122 n/m^2 (Kanpur) but there has been increase in benthic population from preceding year (44-528 n/m^2). In lower stretch of river Ganga a considerable increase in benthic population has been recorded ranging from 792-2520 n/m^2 against preceding year's range of 88-1452 n/m^2. During preceding year the benthic population of 4488 n/m^2 was maximum at Varanasi, which during 2002-2003 was lower (2244 n/m^2).

Group-wise predominance in upper stretch was of Dipteran larvae (Chironomus) ranging from 21.06-92.3% followed by Mollusca (21.82-45.95%), Annelida (nil-47.36%) and Odonata (nil-9.52%). While in lower stretch from Varanasi and downwards the predominant group was Mollusca (21.82-95.92%), followed by Annelida (nil- 24.39%), Dipteran larvae (nil-15.79%) and Odonata (nil-12.35%). However, in lower stretch exceptionally at Allahabad Dipteran larvae

abundance was 74.54% (Manaiya) to 77.78% (Fatehpurghat) was predominant group followed by Mollusca (19.82-22.22%) and Odonata (nil- 3.64%).

Amongst major groups of benthos Mollusca was represented by gastropoda and pelecypoda. The forms representing gastropoda were : *Bellamya bengalensis, Malania plotia scabra, M. striatella tuberculata, Gyrulus, Lymnaea accuminata, Lamelledens marginalis, L.corrianus* and *L.pisciuda.* Annelida was represented by Oligochaetes having single species *Tubifex tubifex.* Insecta indicated predominance of dipterans larvae (Chironomus) followed by Odonata represented by dragonfly nymph and mayfly nymph.

Fish biology

Biological aspects of major carps namely *Labeo rohita* and *Cirrihinus mrigala* were carried out during the period. Fishes were in the length and weight range of 285-580, 490-550 mm and 0.840-1.5 and 1.5-2.75 kg, respectively. The examination of the gut showed that the organic detritus, mud and sand, diatoms, green algae and macro aquatic vegetation were the preferred food items in varying quantity. Condition of the stomach was mostly empty, 1/4th and ½ with food items. The examination of the gonads revealed that the fishes were in the 4th and 5th stage of maturity.

Electrophoretic profile of muscle/serum proteins of fish

Rita rita was used as the test fish and compared with *Aoricthys aor, Aoricthys seenghala, Clarias batrachus* and *Clarias gariepinus.* The serum protein profile of the fish species were recorded.

Proteins extracted from three different organs viz. gill, foot and mantle of molluscs, *Lamellidens marginalis* and *Lamellidens corianus* collected from three different stretches of the river Ganga viz. Kanpur, Allahabad and Varanasi were also analyzed by SDS-PAGE. Subtle difference were observed in the protein profile in the respective organs of the molluscs collected from different stretches. These observations have to be confirmed by analysis of the proteins by two-dimensional polyacrylamide gel electrophoresis (2-D PAGE) AND western blot analysis of the samples.

Estimation of fish catch

Fish landings at Sadiapur (Allahabad) were estimated at 68.37t (IMC-6.4%, Catfishes-13.1%, Hilsa-0.1%, Exotic carps-17.8%, Others-62.7%). Fish landings registered a marginal decline of 1.8% as compared to the preceding year. Among major carps all the species excepting *C. mrigala* showed a declining trend and major carps showed a decline of 40%. Among large catfishes all the species declined (19.2%). This year hilsa landings were an all time low (37 kg). This may be due to the severe drought situation in the catchment area. Others group showed an increase of 9.9%. This increase may be attributed to heavy catches of exotic species, mainly *C. carpio* (12.15t).

At Daraganj (Allahabad), mainly fed by river Ganga, landings were estimated at 24.97t (MC-5.2%, Catfishes-11.1%, Exotic species-2.9%, Others-80.8%).

At Kanpur two centres Parade ground and Apsara were covered. At Parade the landings were estimated at 101.50t (MC-18.9%, Catfishes-42.2%, Exotic species-9.3%, Others-29.6%). At

Apsara the landings were estimated at 42.83t (MC-7.1%, Catfishes-44.9%, Exotic species-5.8%, Others-42.1%).

At Lalgola centre below Farakka barrage landings were estimated at 115.81t (MC-12.6%, Catfishes-15.2%, Hilsa-14.5%, Others-57.7%). As compared to preceding year fishery did not reflect any appreciable change. However, hilsa fishery showed a decline of 11.8%.

Quantitative and qualitative variations in availability of spawn

Spawn collection investigation was carried out in river Ganga at Varanasi. Analysis of spawn revealed that the percentage of desirable spawn was 31.96 and undesirable spawn was 68.04. The index of spawn quantity was 760 ml and qualitative index of spawn was *C.mrigala* (14.15%), *L.rohita* (8.84%), *L.calbasu* (7.07%) and *C.catla* (4.42%); minor carps (17.72%) and others (47.80%).

At Kanpur, spawn availability was poor (348 ml). On rearing, it was found to consist of *L. calbasu* and *C. mrigala.*

PROJECT : ES/B/1

INVESTIGATIONS ON THE FISHERIES OF HOOGHLY ESTUARINE SYSTEM AND ITS WETLANDS

Sub-projects : **1 Investigations on the fisheries of Hooghly estuarine system**

2 Ecological changes in the estuarine wetland impoundments and its effect on production potential

Personnel : *Scientific :*
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Duration : May 1998-March 2003

Location : Barrackpore and Calcutta

Sub-project : 1 Investigations on the fisheries of Hooghly Estuarine System

Fish catch of Hooghly estuarine system and Digha

- Catch of 40339.8 t and 22214.9 t of fish and prawn were estimated from the Hooghly estuary and Digha centre respectively. The combined estimated catch (62554.7 t) showed a decrease by 6.5% from the catch of corresponding period of previous year.

- Total catch of Winter migratory bag net fishery in lower estuary amounted to 27165.8 t with an average CPUE of 44.0 kg showing a decrease of both catch (by 3.4%) and CPUE (by 7.4%) in comparison to last winter.

- An estimated catch of 6497.5 t of Hilsa was netted out from the Hooghly estuary and Digha centre. The combined Hilsa catch showed a sharp decrease by 43.7% from that of the last year. Without taking into account winter migratory bagnet fishery, Hilsa continued to be the major component of estuarine fishery contributing 18.4% of the total yield from Hooghly estuary.

- Average CPUE of Hilsa gear during monsoon in a centre at lower zone was 216.7 kg.

- Wanton destruction of Hilsa juvenile decreased by 35.8% from that of the previous year.

Water and Sediment qualities

Qualitywise the Hooghly estuarine water reflected consistency showing no great alteration in values over the previous years and thus indicating the sign of stabilization in estuarine environment after the upwelling created through Farakka discharges. However, Haldi and Icchamoti remained oligohaline, while Saptamukhi, Thakuran, Matla and Bidya were in hyperhaline range of salinity fluctuation. Water transparency in hyperhaline estuaries were generally higher compared to the oligohaline ones. Dissolved oxygen fluctuated within narrow

but moderately productive (5.3-7.1 mg/l) range. Alkaline pH (7.8-8.1), low concentration of free CO_2 (4.5-8.2 mg/l), high levels of calcium (156.3-499 mg/l), magnesium (274.3-776 mg/l), sodium (1124-2254 mg/l) and sulphate (10.6-247 mg/l) can be attributed to the sustained productivity for all the estuaries. Important nutrients such as nitrate (0.13-0.3 mg/l), phosphate (0.06-0.16 mg/l) and hardness (1650-4475 mg/l) contents also indicated rich nutrient status of the distributaries. However, silicate content (2.1-5.5 mg/l) was slightly low presumably due to its utlization by diatoms.

Soil

The soil reaction was slightly alkaline (8.8-9.15) and conducive for aquatic life. Sp.conductivity ranged between 1.5 and 5.4 millimhos/cm indicating moderate to slightly higher soil salinity. Moderate contents of organic carbon (0.79-1.17%), available nitrogen (14.3-16.8 mg/100 gm), total nitrogen (0.08-0.10 %) and available phosphorus(2.5-5.0 mg/100gm) and rich calcium carbonate (13.0-15.5%) content indicated that nutrient release was very fast in this system presumably due to favourable environmental and physico-chemical factors such as temperature, water flow, tides, water reaction etc. Reduced nutrient load in soil is beneficial, since chance of

formation of toxic and growth inhibitory sustances (nitrite, NH_3, CH_4 etc.) was almost negligible. The silty clay loam texture and C : N ratio (10.0-13.0) were also conducive for survival and growth of fishes and prawns.

Primary production

Primary production was estimated in situ both by oxygen method and by C_{14} technique. Maximum gross primary production ($mgC/M^3/hr$) was recorded at Thakuran (Av. 86.5), followed by Haldi (Av. 85.4) presumably due to their higher salinity and transparency. Maximum net primary production ($mgC/M^3/hr$) was recorded at Thakuran (Av. 64.6) followed by Haldi (Av. 52.10), Saptamukhi (Av. 51.0) and Matla (44.8), while slightly lower production was recorded at other estuaries.

Heavy Metal contents

In water, average chromium content ranged between 0.024 and 0.056 mg/l, Zinc 0.022 and 0.045 mg/l, Manganese 0.016 and 0.041 mg/l, and iron 0.13 and 0.22 mg/l. Thus the levels of heavy metals in water in these estuaries were generally low and within permissible range. However, Cr content occasionally showed slightly higher values in Saptamukhi, Thakuran and Matla.

Heavy metal contents in soils of the distributaries showed that the heavy metal contents were significantly high in bottom sediments in all the estuaries. Iron contents were very high, followed by manganese and zinc, while Cr content was comparatively low. The heavy metals in soils were mostly in insoluble bound state and very low quantities were liberated in water phase by water soil exchange.

Biotic communities

Plankton

Plankton study was conducted at six sampling centres covering freshwater to estuarine zones as well as mangrove areas. The abundance and fluctuation of plankton population indicated an erratic trend. However, the size of plankton community was the highest at Bhagwatpur (296 u/l) followed by freshwater a stretch Nabadwip (292 u/l), Jharkhali (250 u/l), Harwood point(242 u/l), Dhamakhali (183 u/l), Hasnabad (180 u/l) and Haldia (136 u/l). Among the seasons relatively better abundance was recorded during summer months.

Benthos

The abundance of benthic population indicated much larger community size during winter (7442 No/m^2) followed by post-monsoon (4280 No/m^2), monsoon (3223 No/m^2) and summer (2439 No/m^2). The community size of benthic population indicated the greater dominance of Gastropods to the tune of 2178-6754 No/m^2. The other dominant group was bivalves (261-688 No/m^2). Among the sampling sites Haldia harboured the highest number of average population followed by Bhagwatpur and Harwood point. The average abundance of bivalves was either dominant or relatively better at Bakkahali (335 No/m^2) followed by Jharkhali (60 No/m^2).

Estuarine fin and shell fish seed prospecting

The availability of prawn seed varied between 2,986 and 6178 Nos./man day, where as fish seed varied between 209 and 493 Nos./man day. Out of collected prawn seeds, availability of *Penaeus monodon* seed ranged between 23 and 547 nos. The general practice of destruction of fish/prawn/seed after assorting *P.monodon* has been checked to some extent through mass awareness campaigns of the Institute.

Sub-Project : 2 Ecological changes in the estuarine wetland impoundments and its effect on production potential

Jhagrashisha (Sewage-fed , Freshwater)

The mean DO of the wet land was 11.47 mg/l and the total alkalinity had a mean value of 178.36 mg/l. Nitrate nitrogen ranged between 0.01 and 9.24 mg/l with a mean value of 3.42 mg/l. The NH4-N ranged between 0.04 and 5.88 mg/l the mean value being 2.41 mg/l. Free CO^2 ranged from tr. to 69.72 mg/l. The pH of water was found to be congenial (mean : 7.7) . The pH of soil was found to be alkaline. The available N and P were 25.55 and 16.0 (mg/100 g). The Organic carbon was 1.4% .

The plankton concentration in the freshwater sewage -fed wetland (mean 570 u/l) was higher than the other two types of saline wetlands. The mean SDI for plankton was 2.7226.

The macro-zoobenthic fauna was constituted principally of gastropods (mean 905 nos.per sq.m), followed by insect larvae and annelids.

Machhibhanga (Low-saline)

The DO of the wetlands ranged between 3.65 and 14.59 mg/l (Av7.70 mg/l).The salinity of water ranged from 0.39 ppt to 7.45 ppt. (2.17 ppt). Total alkalinity ranged from 116.0 -272.0 mg/l (mean 167.75). NO^3-N and PO^4-P were 0.01-2.06 and 0.08-0.80 mg/l respectively.The mean pH of soil was 7.6. Available N, P and organic carbon were found to be less than those of the freshwater zone.

There was an overall dominance of zooplankton in these bheries .The mean plankton concentration was 262 u/l with zooplankton contributing 63.84% and phytoplankton 36.16 %.

The macrozoobenthos was principally constituted of gastropods (43.24%) and bivalves constituted only 0.05%.

Sarberia (High saline)

The DO of water ranged between 5.38 and 15.36 mg/l (Av.8.78 mg/l). The salinity of water ranged from 4.37 ppt to 20.8 ppt. (Av.9.77 ppt). Total alkalinity had a mean value of 124.0 ppm. The mean values of NO^3-N and PO^4-P were 0.67 mg/l and 0.17 mg/l respectively. NH^4 - N had a mean value of 1.29 mg/l and free CO_2 ranged from Tr - 39.8 mg/l . The mean PP was found to be 179.71 $mgC/m^3/hr$. Water pH ranged between 7.6 and 8.8.

The pH of soil ranged from 7.2 to 8.4. Available N and P were 15.59 and 11mg/100gm respectively. Organic Carbon was 1.15 - 2.49%.

Unlike other two types of wet-lands the plankton population was dominated by phytoplankters. The contribution of phytoplankton to the total plankton was 71.59%.

The macrozoobenthos demonstrated some erratic values indicating the dominance of different groups in different wetlands. The mean concentration of benthic macro fauna was 5165 nos/sq m, tanaids contributing 59% and gastropods (15.91 %).

Assessment of Production

Total annual production from the two selected wetlands at low saline zone were estimated as 505.662 kg/ha/yr.(*Penaeous monodon*: 170.435 kg/ha) and 591.988 kg/ha/yr. (*P.monodon:* 235.849 kg/ha). The average production of these two wetlands was 538.244kg/ha/yr. (*P.monodon* : 195.124 kg/ha) .While estimated total annual productions from the two selected wetlands at high saline zone were found to be 394.474 kg/ha/yr. (*P.monodon*:116.994 kg/ha) and 427.127 kg/ha/yr. (*P.monodon* : 146.723 kg/ha) and the average production was 404.762 kg/ha/yr.(*P.monodon* :126.361kg/ha). Thus the average total production and average *P.monodon* production at low saline zone were 33% and 54.4% higher than that of high saline zone. The freshwater zone was found to be most productive and the estimated production of a selected wetland was found as 4409.090 kg/ha/yr. Indian major carps were the prime contributors (about 70%) in the freshwater sewage-fed wetland studied.The percentage composition of *Penaeus monodon* in total production varied from 33.5- 40.0 % to 29.5 - 34.4 % in low and high saline zones respectively.

Cost and returns

On an average the per ha cost of production was Rs.50000/- and the gross returns were Rs.149000/- leaving a net margin of 198%, i.e. BC ratio was 2.98.

PROJECT : ES/B/2

ECO-STATUS OF SELECTED WEST COAST ESTUARIES OF INDIA

Sub-Projects : (a) **Confirmation of the endemic population of *Tenualosa ilisha* in Ukai reservoir, Dist. Surat, Gujarat**

(b) **Eco-status of Mandovi-Zuari estuarine complex and other estuaries of west coast.**

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Duration : Apri11998-March 2003

Location : Vadodara (Gujarat)

Sub Project **Confirmation of the endemic population of *Tenualosa ilisha* in Ukai reservoir, Dist. Surat, Gujarat**

The scanning of fish landings revealed the occurrence of young ones of *T. ilisha* varying from 45.0 to 70.0 mm in length and 0.73 to 3.20 g in weight. The specimens encountered during the months of November 2002 and January 2003 fluctuated in length from 182.0 to 285.0 mm and 57.26 to 202.80 g in weight at Selud landing centre on the periphery of the reservoir. The coves and bays in proximity to Selud and Narayanpur villages are being accessed as nursery grounds. The reservoir does not have connection with any marine environment. This further substantiated the last year's inference that an endemic population of this fish species thrived in Ukai reservoir, a fresh water lacustrine system.

Sub-Project **Eco-status of Mandovi-Zuari estuarine complex and other estuaries of west coast**

Water Quality

Tapti estuarine system

Water temperature varied from 22.5 to 31.^{0}C. The transparency regime indicated zonal demarcation as the estuarine sites were least transparent (15.33 to 22.33 cm) as compared to fresh water expanse (74.0 to 93.66 cm). The pH varied from 7.35 to 8.60 for the system as a whole

The dissolved Oxygen content (5.45 to 8.30 mg/l) was favorable at fresh water extent but significantly low D.O level (0.8 mg/l) was occasionally recorded at Chowpati site, representing the estuarine expanse

The total alkalinity levels (95.66 to 139.33 mg/l) were congenial at fresh water expanse. The T.D.S and conductance exhibited higher values in the estuarine expanse (Conductance; 10.77 to 28.26 mS/cm; T.D.S; 6.11 to 13.83 ppt).

Phosphate content (9 0.062 to 0.122 mg/l), nitrate (0.87 to 1.30 mg/l) and silicate (4.46 to 9.70 mg/l) indicated productive status.

Sediment Quality

The soil reaction was alkaline and the pH varied from 7.30 to 8.12.The conductance was high at the estuarine spread (5.08 to 7.09 mS/cm). Organic carbon and total nitrogen were high at fresh water sites. The C:N ratio varied from 2.83 to 1060 for the system as a whole. The free calcium carbonate was comparatively more available at estuarine sites. The available phosphate ranged from (1.13 to 1.67 mg/100 g). Sand content ranged from (71.16 to 88.83%).

Biotic communities

Plankton : The average net-plankton abundance of Tapti estuarine system varied from 113 to 7469 nos./l. Phytoplankton(61.64 to 99.03%) was the major group except at Chowpati. Bacillariophyceae was dominant followed by Myxophyceae and Chlorophyceae. The zoo-plankton assemblage comprised of Protozoa at estuarine expanse while copepods and rotifers were dominant at fresh water extent.

Benthos : The average macro-benthos abundance of Tapti estuarine system fluctuated from 98 (Hazira) to 2239 nos./m^2.(Jahangirpur). Mollusca (61.33 to 89.93%) and Annelida (51.70 to 92.64%) were predominant at Jahangirpur and Bodhan and Chowpati to Unkhud respectively.

Organic production

The estuarine sites (88.54 to 102.43 mgC/m^3) experienced low gross production rate as compared to fresh water expanse (109.38 to 168.40 mgC/m^3). The net energy retained by the producers for utilization by other consumers varied from 42.27 to 58.97%.

Damanganga Estuarine System

Biotic Communities

Plankton : The average planktonic abundance of Damanganga Estuarine System as a single entity varied from 113 to 564 nos./l. Phytoplankton (76.11 to 95.39%) was the mainstay of this abundance. Bacillariophyceae (52.22 to 84.91 %) excelled as the mainsay of this abundance. The zoo-plankton assemblage was shared by Protozoa and Copepoda.

Spatio-temporal variations of macro-benthos

The average macro-benthic crop of Damanganga Estuarine System as a whole fluctuated from 64 to 1283 nos./m^2. Mollusca (40.91 to 95.33%) and Annelida (9.38 to 95.28%) were important macro-faunal elements.

PROJECT : ES/B/3

STUDIES ON HILSA FISHERIES IN THE STRETCH BETWEEN FARAKKA AND SAGAR ISLAND

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Duration : April, 2000-March, 2003

Location : Malda

Fish landing at the Farakka region

Feeder Canal Fish Landing Centre

The Fish Landing Centre at the Feeder Canal contributed 27.49% to the total fish landing of the Farakka region. Catfishes formed the bulk of the catch of the centre (31.73%) followed by miscellaneous varieties of fishes (29.45%), Indian Major Carps (20.57%), Prawns (6.89%), Hilsa, *Tenualosa ilisha* (5.72%) and Featherbacks (5.64%).

Beniagram Fish Landing Centre

The centre contributed 27.43% to the total fish landing of the region. Catfishes formed the bulk of the catch and contributed about 35.53% to the total catch of this centre followed by miscellaneous varieties of fishes (26.83%), Indian Major Carps (15.44%), hilsa, *Tenualosa ilisha* (8.42%), Prawns (7.57%) and Featherbacks (6.21%).

Taltala Fish Landing Centre

The centre contributed 45.08% to the total fish landing of the region. Major catch of the centre was dominated by the miscellaneous group of fishes (35.59%) followed by catfishes (26.53%), Indian Major Carps (16.03%), Featherbacks (9.15%), Murrels (6.68%) and Prawns (6.02%). Hilsa catch was not recorded during the period under report.

Hilsa Fishery at the Farakka region

The total catch of hilsa, *Tenualosa ilisha* from the Ganga river system at the Farakka region during the period under report has been estimated to the tune of 3.84 t forming 3.88% of the total fish landing from the region. Beniagram Fish Landing Centre contributed 59.49% to the total catch of hilsa from the region followed by Feeder Canal (40.51%). Hilsa was not reported from Taltala Fish Landing Centre.

The adult hilsa population (>200 mm) of 2.07 t formed about 53.91% of the total catch of hilsa from the region. Beniagram accounted for the bulk of the adult hilsa (60.88%) followed by Feeder Canal (39.12%). The juvenile hilsa population (101-200 mm) of 1.40 t formed 36.47% of the total catch of hilsa from the region. Beniagram shared 57.50% of the total landing of juvenile from the region followed by the Feeder Canal (42.50%).

Manickchawk Fish Landing Centre

The centre is about 35 km above the Farakka barrage and the total fish landing from the centre during the period under report has been estimated to the tune of 49.29 t. Miscellaneous fishes formed the bulk (78.36%) of the total fish landing during the period under report. The other major contributions were from catfishes (17.74%), Indian Major Carps (2.69%), Featherbacks (0.59%), Murrels (0.54%). Hilsa, *Tenualosa ilisha* contributed only 0.08%.

The total estimated catch of hilsa during the period has been estimated to be only 39 kg. It was recorded that the adult hilsa contributed only 79/49% of the total hilsa catch and the remaining is shared by hilsa juveniles comprising the size group of 101-200 mm (20.51%).

Rajnagar Fish Landing Centre

The total fish landing from the centre during the period under report has been estimated to be 46.01 t. Miscellaneous varieties of fishes formed the bulk (68.65%) of the total fish landing followed by catfishes (27.94%), Indian Major Carps (2.28%), featherbacks (0.92%) and murrels (0.18%). *Tenualosa ilisha* contributed 0.03% of the total catch. The total catch of hilsa during the period has been estimated to be of 12 kg, solely represented by adults.

Dragnets *(Chatberjal)* and gillnets *(Phansijal)* of different mesh sizes were the main gears operated and the CPUE varied from 0.128 to 1.320 and 0.18 to 2.12 kg/man hr. respectively.

Berhampur Fish Landing Centre

The total estimated landing was recorded to the tune of 18.38 t. Miscellaneous group of fishes dominated the catch (41.04%) followed by catfishes (27.77%), prawns (14.79%), Indian Major Carps (9.94%), hilsa (4.87%), featherbacks (1.35%) and murrels (0.24%). .

The total estimated catch of hilsa during the period was 895.67 kg contributing 4.87% of the total catch and was mostly represented by adults.

Nabawdeep Fish Landing Centre

Landing data of this centre was collected and the total landing was 18.71 t. Miscellaneous fishes formed the bulk (39.82%) of the total catch followed by catfishes (29.52%), prawns (13.91%), carps (10.15%), featherbacks (2.56%) and murrels (0.87%). Hilsa, *Tenualosa ilisha* contributed only 3.17% to the total catch. The total catch of hilsa has been estimated to be of 592.87 kg. The major quantity was shared by the adult hilsa (479.77 kg) and the remaining of 71.1 kg was of the size group of 101-200 mm and 42 kg was found to be of the size group of less than 101 mm.

Delineation of spawning ground

For delineating the spawning ground of hilsa, shooting nets were operated during July to November, 2002 at Nabadweep and Berhampur at the downstream of Farakka barrage and Manickchawk and Taltala at the upstream of Farakka barrage. Hilsa spawn/fry were not found in any of the said centres.

Water and soil quality

Water and soil sediments were collected from different centres in two segments around Farakka barrage i.e. upper and lower stretches of the river Ganga.

Water quality

The water samples from three centres viz. Manikchawk, Taltala and Beniagaram around Farakka barrage and two centres from the lower stretch viz. Nababganj and Diamond Harbour were collected. During summer season the water temperature was slightly higher than the air at all the centres. Transparency were low (16.0-23.0 cm) and free CO_2 was absent. The dissolved oxygen was fairly high (7.8-8.6 mg/l). Bicarbonate alkalinity was moderately good ranging from 84.0 to 142.0 mg/l showing higher value at Diamond Harbour. Chloride values were low at upper stretch (24.0-28.0 mg/l) and high (74.0 mg/l) at Diamond Harbour showing the impact of saline water. Hardness was moderate (97.0-102 mg/l). The water quality showed that this region is free from pollution.

Soil quality

The percentage of sand (58.0-80.0) was high indicating the lowest value at Diamond Harbour and highest at Beniagram. The silt and clay percentage were low (12-27 and 8-15 respectively). The soil was alkaline showing its pH value ranging from 7.5 to 7.8. Specific conductivity was highest (560 µmhos/cm) at Diamond Harbour showing the impact of estuarine water followed by Nawabgunj (300.0 µmhos/cm). The percentage of organic carbon (0.12-0.41) and available phosphorus (0.60-0.80 mg/100 g soil) were moderately low whereas available N was moderate.

Heavy Metal : Soil sediments were analysed for Copper, Chromium, Cadmium, Lead and Zinc. The concenteration of copper and chromium was found to be in the range of 5.22 to 22.66 µg/g and 17.6 to 42.0 µg/g respectively. The ranges of Cadmium (1.62-2.08 µg/g), Lead (27.82-41.92 µg/g) and Zinc (70.84-102.22 µg/g) were also observed.

Histological studies of the kidney of hilsa : In the fishes sampled from different regions most of the *glomerulii* filled half to three-fourth of the Bowman's capsule of the kidney. Presence of dilated Bowman's space and shrinkage of *glomerulii*, though found in Frazergunj sample was found not to be pronounced in most of the units.

PROJECT : RS/A/1

ECOLOGY AND FISHERIES OF FRESHWATER RESERVOIRS

Sub Project : 1 Ecology and fisheries management of Hemavathi reservoir (Karnataka)

Sub Project : 2(a) Raising of stock size fingerlings of cultivable carps in pens and cages in reservoirs
2(b) Ecology and Fisheries of Mettur Reservoir in Tamil Nadu
2(c) Impact of seasonal phosphorus flux on phytoplankton community and growth in a productive reservoir

Sub Project : 3 Ecological investigations in selected reservoirs in Madhya Pradesh

Sub Project : 4 Monitoring of fish catch, recruitment and effort in selected reservoirs of Andhra Pradesh

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Duration : Sub-project 1 August 2000-March 2004
Sub-project 2 April 2000-March 2005
Sub-project 3 April 2002-March 2003
Sub-project 4 August 2001-March 2004

Location : Bangalore/Coimbatore/Hoshangabad/Eluru

Sub Project 1 : Ecology and fisheries management of Hemavathi reservoir (Karnataka)

Hemavathi reservoir

Water quality

The total inflow into the reservoir during the year under report was 1176.5 Mm^3 as against 1653.9 Mm^3 during the previous year and had two peaks–June (317.9 Mm^3) and October (504.93 Mm^3). The annual outflow was 1025.31 Mm^3. The reservoir did not become full this year due to partial failure of rains and the maximum level attained was only 884.43 m (FRL: 890.63 m) and the maximum water spread area was 5985 ha (only 68% of the area at FRL).

Soil quality

Soil reaction was slightly acidic (pH 6.04) to moderately acidic (pH 5.42). Organic carbon content was low to moderate (0.83–1.78%, mean: 1.40%), C/N ratios maintained its moderate productive trend 7-12, (9) with total-N content at 0.095-0.189 % (0.16%). Available-N (mg/100g) maintained its productive trend (52.12-70.10), (64.34) though slightly lower than the previous year.

Biotic communities

Plankton analysis of Hemavathi reservoir revealed the dominance of phytoplankton (86.52%) over zooplankton (13.48%). Myxophyceae (45.40%), Bacillariophyceae (3.35%), Chlorophyceae (27.53%), Desmids (0.16%) and Dinophyceae (10.06%) were encountered among phytoplankton. Among zooplankton, crustaceans (11.53%) and rotifers (1.95%) were recorded. Benthic community remained dominated by molluscs (87.64%) followed by chironomids (12.36%). Gastropods accounted for 74.10% while bivalves constituted 13.54%.

Fishery

Mystus cavasius feeding habit showed that insects formed more than 50% of the diet. Ostracods proportion was a maximum of 25%. Gastropods maximum contribution was 40%. Fish, bivalves, stoneflies, prawns and crabs were found in the diet occasionally and are not a preferred food. The fecundity ranged from around 5000 eggs in fish measuring 19 cm to 70,000 eggs in fish of 26.5 cm length and breeds during the early monsoon season.

The estimated total landing at Hemavathi reservoir during 2002-03 was 124.76 tonnes with a CPUE of 6.94 kg per coracle. *Cyprinus carpio* dominated the fish landings forming 66.2 % of the total landings followed by *O.bimaculatus* (9.7 %), *M.cavasius* (9.6 %) and *L .rohita* (6.4 %) . Miscellaneous fishes constituted 8.1 % of the landings. The landings of Indian major carps were negligible. Though the estimated yield was low (22.43kg/ha), slight increase in yield was observed this year compared to the last year when the yield was only 19.3kg/ha.

Sub Project 2(a) : Raising of stock size fingerlings of cultivable carps in pens and cages in reservoirs

Cage culture : Odathurai reservoir (75 ha at FRL) in Erode district of Tamil Nadu was selected for pen culture. In order to hold the seed purchased in advance when it was available, six cages (4m x 4m x 2m each) were fabricated out of the HDPE woven material (40 x 40 mesh/inch). Bamboo poles were erected in the reservoir and the cages were fixed 0.25m above the bottom of the reservoir. The water level in cages was around 1m. Forty two thousand fry of catla (ave. 18.35 mm/0.05 g) and 50000 rohu (ave. 6.0 mm) were transported, acclimatized to the local water conditions and then released into the cages on 17.8.2002. Catla seeds were stocked in 5 cages @ 8400 no./cage and the entire seed of rohu in an another cage. Supplementary feed with a mixture of rice bran (60.76%), groundnut cake (27.43%) and soya meal (11.8%) was provided twice daily *ad libitum*. Unfortunately, the reservoir level reduced drastically due to release of water for irrigation. Mortality was also noticed in the cages. Hence, the cage culture experiment had to be terminated on 14th day of its commencement. A total of 16000 catla with an average

size of 26.75 mm and 28000 rohu with an average size of 20.3 mm were obtained from the experiment. The survival percentage was 38.1 in case of catla and 56.0 in case of rohu. The percentage growth in length was 45.8 in catla and 238.3 in rohu.

Sub-project 2(b) : Ecology and Fisheries of Mettur Reservoir in Tamil Nadu.

Soil quality

Soil pH of all the zones remained alkaline in reaction (7.29 to 8.03). Conductivity of the soil was 0.403 and 0.314 mS/cm at 0.5 m and 5.0 m respectively in the lentic zone. In the lotic zone, conductivity recorded comparatively low, measuring 0.342 and 0.395 mS/cm at 0.5 m and 1.0 m depth respectively. The soil contained 1.1(0.5 m), 0.97 (5.0 m) and 1.9 (10.0 m) available phosphorous (mg/100 g) in the lentic zone. In the intermediate zone, the values were 1.4, 1.58 and 1.56 mg; lotic zone recorded 1.8 and 1.6 mg available P in 0.5m and 1m depth respectively.

Water quality

There was no thermal stratification though the temperature gradually decreased from surface to bottom. The transparency of water ranged from 75 to 85 cm in lentic zone and from 80 to 110 cm in intermediate zone. However, a lower transparency (55-60 cm) was recorded in lotic zone. pH of water was alkaline in reaction in all the three zones ranging from 7.52 to 8.64 with higher values at the surface, but declined in column waters. Dissolved oxygen (DO) was fairly high (7.4 to 14.3 mg/l) in all the layers of these zones excepting hypolimnion where deficiency in DO was noted. The carbonates ranged from 3.2 to 16.0 mg/l). While the total alkalinity of water ranged from 32.0 to 48.0 mg/l in the lentic zone, it varied from 25.2 to 64.0 mg/l in the intermediate zone

and from 22.4 to 67.2 mg/l in the lotic zone. The values for conductivity of water were higher in the lentic (319-367 µS/cm) and intermediate (343-398 µS/cm) zones than that of lotic zone (277 -287 µS/cm).

Biotic communities

Plankton population remained very poor. Lentic and intermediate zones depicted some stray specimens of Bacillariophyceae and Myxophyceae in phytoplankton and protozoans, copepods and rotifers in zooplankton but lotic zone went nil. A total of 12 u/l in lentic and 7 u/l in intermediate zones were encountered. Among macrobenthos, molluscs and dipteran larvae were recorded at different centres. Dipteran larvae were rich in intermediate zone varying from 125-3775 u/m^2. The forms encountered although in meagre quantities were *Bellamya bengalensis and Thiara tuberculata* restricted to lentic centres only.

Primary production : The primary production in the surface, 1m and 2 m depths of the reservoir was estimated. Gross production varied from 250-304.6 mgC/m^3/h while respiration ranged from 62.5-140.6 mgC/m^3/h at the surface. At 1 and 2 m depth, the values were 99.75-257.8 mg and 70.3-93.75 mg for GPP and 125.0 & 46.88-62.5 mg for respiration respectively.

Stocking : With a target of 30 lakh fish seed to be stocked, the reservoir is regularly stocked with seeds of cultivable carps (2,12,2000 no. during 2000-01 and 2,91,7600 no. during 2001-02) in addition to natural recruitment.

Exploitation

Due to low water level and shrinkage in area, the nets are laid everywhere in the reservoir. Mostly gillnets and occasionally cast nets are operated. Due to intensive fishing, majority of the large sized fishes have been captured and the fish caught at present is small sized belonging to carps (*L. calbasu, C. reba* & *C. catla*), catfishes (*M. seenghala, O. bimaculatus* & *Mystus* spp.), *E. suratensis* , *O. mossambicus*, *N. notopterus* and spinny eels. The catch per unit of effort (CPUE) has been very low (0 to 8 kg). Out of the total 1400 fishermen families living around Mettur reservoir, only 400 are still continuing fishing in the reservoir reluctantly as they do not find an alternative job. The total fish landings per day range from 80 to 200 kg only. The bulk of the catch is due to uneconomical varieties of fish (*C. reba* & *O. mossambicus*) of smaller size (50 to 120 g). As these fishes do not have any demand in the market, they are dried and disposed off elsewhere. With a target of 450 t to be exploited from the reservoir, 275.9 t during 2000-01 and 213.7 t during 2001-02 were captured.

Sub-project 2 (c) : Impact of seasonal phosphorus flux on phytoplankton community and growth in a productive reservoir.

Sulur reservoir is predominantly enriched by sewage effluent mixed water from Noyyal river. This is also massively polluted by the industrial effluent. About 180 dyeing and processing units at Selvapuram and Telungupalayam in Coimbatore District discharge high phosphorus content water. Urbanization, human wastes, soaps and detergents and municipal waste also form other sources of P to this reservoir. This eutrophic reservoir showed plankton diversity maintained for a

continuous period. However, fluctuations in species spectra was observed. During the study period, the composition of algal taxa varied with respect to P concentration. Increased nutrient input enriched the bio-mass of phytoplankton and the poor supply reduced the growth.

During the month of April and May, the P concentration registered 0.135 mg/l and 0.163 mg/l and it decreased to 0.074 mg/l in the month of June 2002. In April, only two species *viz. Crucigenia* sp. and *Selenastrum* sp. represented Chlorophyceae which increased to several species by the addition of *Scenedesmus* sp., *Protococcus* sp and *Ophiocytium* along with the above two species in May. Myxophyceae dominated by *Spirulina* sp., *Microcystis* sp., *Anabaena* sp., *Merismopedia* sp. and *Polycystis* sp. in April. Whereas in May, except *Spirulina* sp. all the other species were absent. The lone *Cosmarium* sp represented Desmidiaceae in April and *Closterium* sp. in June. During May, Bacillariophyceae was noticed in large numbers, contributed by *Nitzschia* sp., *Synedra* sp and *Cyclotella* sp. In June, lower algal density of Chlorophyceae and Desmidiaceae were only present, represented by poor species diversity.

Sub Project 3 : Ecological investigations in selected reservoirs in Madhya Pradesh

Bargi (27697 ha), also known as Rani Awanti Bai Sagar, constructed across the river Narmada in the District Jabalpur (M.P.) was investigated.

Sediment and Water Quality

Sediment and water qualities reveal that Bargi is a medium productive reservoir. Soil pH was alkaline (7.65-8.01), organic carbon content was 0.23 to 1.32% with productive C/N ratio. Available nitrogen and phosphorus in soil were in the range 23.62 to 36.48 (mg/100g) and.5.25 to 10.84 (mg/100g) respectively. Water reaction was moderately alkaline (pH 8.04-8.4), with total alkalinity in the range (68-112 mg/l). Amongst dissolved nutrients, nitrate nitrogen was encountered at 47 to 469 µg/l while phosphate phosphorus was in the range 8 to 26 µg/l. Silicate silicon was moderate (4.12 to 8.46 mg/l).

Biotic communities

Phytoplankton (56.2%) exhibited an edge over zooplankton (43.8%). Dipterans (50.5%) and gastropods (28.2%) formed the mainstay of macro-benthos. Diatoms (91.2%) were pre-dominant and among periphyton. The occurrence of macrophytes was poor.

Fishery

Fish yield of Bargi reservoir varied from 173.3 t (10.4 kg/ha) to 649.1 t (39.0 kg/ha) during 1995-96 to 2001-02. Major carps (83.0%) were the most important with the dominance of *C.catla* (77.3 %). The contributions of *C. mrigala* (2.8%), *L. rohita* (2.7%) and *T. tor* (0.2%) were insignificant. Local major and local minor accounted for 8.2% and 8.8% respectively.

Mesh-size regulation is strictly followed in Bargi with minimum mesh-bar of 50 mm in the commercial fishing and is well reflected from the average weight of catla (6.0 kg) in the fish

landings. The CPUE was estimated at 12 kg. One fishing unit comprises 1 boat, 2 fishermen and 20 kg of nets. The reservoir is being stocked regularly @ 191 fingerlings/ha with *C. catla* (40%), *L. rohita* (30%) and *C. mrigala* (30%). Based on primary production studies, the potential fish yield of Bargi reservoir was estimated at 63 kg/ha/y.

Sub-Project 4 : Monitoring of fish catch, recruitment and effort in selected reservoirs of Andhra Pradesh

Sediment and water qualities revealed that soil was calcareous with high calcium carbonate content (6.5 %). Water reaction was alkaline (pH 8.36-8.39) with total alkanity in the range 192 to 200 mg/l. Calcium and magnesium contents in water were 25.65-28.86 mg/l and 16.49 mg/l as also reflected in molluscan population in this reservoir with the dominance of *Bellamya bengalensis* followed by *Thiara liniata.*

During the period under report 188.5 t of fishes and prawns were harvested from Wyra reservoir. The bulk of the landings were observed during April-June with maximum in April (59.3 t). The catch declined steadily till October 2002 followed by a marginal increase in November. The lowest catch was recorded in December. There is a self–imposed ban on fishing by the Wyra Fishermen Co-operative Society for three months from January onwards. The ban was introduced in 2001.

Macrobrachium malcolmsonii dominated the catch forming 59.4% of the total followed by Gobids (7.2%), *E. suratensis* (6.1%), *P. ticto* (5.2%), *N. kapirat* (4.0%), *A. aor* (2.0%), *O. bimaculatus* (1.6%), *L. rohita* (2.3%), *Catla catla* (1.8%), *M. gulio* (1.3%) and other miscellaneous groups. The bulk of the dragnet catch consisted of *M. malcolmsonii* constituting 27.8% followed by gobids (12.3%), pearl spot & moon fish (10.5%), barbs (8.5%), tilapia (7.7%) and other miscellaneous groups.

PROJECT : RS/A/3

ECO-STATUS AND PRODUCTION POTENTIAL OF SELECTED RESERVOIRS OF UTTAR PRADESH

Personnel : *Scientific* :

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Technical :

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Duration : May 2002-March 2005

Location : Allahabad

Chandraprabha reservoir

Chandraprabha reservoir is having water area of 780 ha at D.S.L. and 1280.0 ha. Average depth of reservoir is 20' and is situated in the district of Chandauli, U.P.

Physico-chemical features

Water quality

Lowest water temperature was recorded in winter (19.0°C) and highest in summer (30°C). Transparency ranged between 31.0 and 63.0 cm. Dissolved oxygen showed on increasing trend from summer to autumn (6.2-10.88 mg/l). Free CO_2 was present at lower level only in monsoon otherwise it was absent thereby showing the presence of carbonate alkalinity (3.0-6.0 mg/l), bicarbonate alkalinity was quite low in summer (34.0 mg/l) and monsoon (44.0 mg/l) but it was quite high in winter and autumn (68.0 and 90.0 mg/l respectively). Water was moderately hard (30-68 mg/l) and chloride concentration was also low (8.0-18.46 mg/l). The values of other important chemical factors *viz.* Conductance (85.0-180.0 µmhos/cm), total dissolved soilds

(42-90 mg/l), calcium (12.8-23.2 mg/l) and magnesium (6.02-10.8 mg/l) were moderately low. The water was found to be rich in dissolved organic matter (1.10-2.0 mg/l). The nutrient status of the reservoir was fair (Phosphate 0.10-0.16 mg/l, nitrate 0.09-0.10 mg/l). Silicate was also low level (5.6-9.0 mg/l). This reservoir is moderately productive.

Primary production

Gross primary productivity fluctuated between 375.0 and 750 mgC/M^2/day and net production was 93.72 and 450.0 mgC/M^2/day. The respiration was found to be 90.0 and 450.0 mgC/M^2/day.

Biotic communities

Plankton

Plankton population ranged between 500 u/l (August) to 1630 u/l (October) and comprised *Navicula cuspidatea, Synedra ulna, Tabellaria* sp., *Pinnularia gibba, Meridion* sp., *Cymbella* sp., *Ankistrodesmus* sp., *Closteriosis, Spirogonium* sp., *Hormidium* sp., *Cosmocladium* sp., *Scenedesmus* sp., *Aphanizomenon* amongst phytoplankton and *Keratella tropica, bosmina longirostris, Brachionus calyciflorus, Cyclops* sp. and nauplius larva amongst zooplankton.

Periphyton

The periphytic assemblages recorded between 40 (August) and 2030 (March) U/cm^2. Highest density was recorded during summer and the lowest during monsoon. Members of Bacillariophyceae 71.9% was the dominant form followed by Chlorophyceae 17.5% and Myxophyceae 10.6%. Maximum represented species were *Synedra, Cymbella, Navicula, Fragillaria, Scenedesmus, Tribonema, Cosmarium* and *Phormidium* as algal genera.

Bottom Biota

The benthic communities ranged between 308 n/m^2 to 572 n/m^2 and were dominated by chironomid larvae (61.0) and gastropoda (34.1%). The gastropods comprised *B. bengalensis* and *Pila globasa.*

Henauti and Dhandraul Reservoirs

Water quality

Water temperature was recorded in the range of 19.0 to 25.5°C. Water was quite clear in Henauti reservoir (Transparency 625.0 to 49.0 cm) but turbid (Transparency 85.0 to 123.0 cm) in Dhandhraul reservoir. Total alkalinity was higher (128.0 mg/l) in Henauti reservoir as compared to Dhandhraul reservoir where it was found in the range of 74.0-94.0 mg/l. Similar trend were observed in respect of hardness which fluctuated between 96 and 104 mg/l and 58.0 and 92.0 mg/l respectively. Chloride was quite high (22.72 to 24.14 mg/l) in Henauti reservoir whereas it was found in the range of 15.62 to 18.46 mg/l in Dhandhraul reservoir. pH was alkaline in reaction (8.2 to 8.3) with high content of Dissolved oxygen (7.0 to 9.0 mg/l), Sp. conductance, (224.0 to 328 µmhos/cm), TDS (112.64 mg/l), Ca (20.0 to 20.86 mg/l), Mg (7.746 to 1.15 mg/l)

and dissolved organic matter (4.6 to 9.1 mg/l) were also comparatively higher in Henauti reservoir. The nutrient status of reservoirs showed low level of phosphate (0.01 to 0.03 mg/l) and nitrate (0.034 to 0.048 mg/l). Gross primary production fluctuated between 468.4 and 843.6 $mgC/m^2/d$ and net production 205.0 and 345.0 $mgC/m^2/d$, showing that the reservoir is moderately productive.

Soil quality

Among the physical parameters the percentage of sand was found maximum (68.5%) in Dhandhraul reservoir than Henauti reservoir (58.0%). The silt content was high (28.0 to 30.5%) in reservoirs. Moderate (0.74%) to high 1.06%) content of organic carbon was observed in Dhandhraul and Henauti reservoirs, respectively. Sp. conductance, $CaCO_3$ and Av. Phosphate varied from 122 to 171 µmhos /cm, 1.50 to 1.88% and 0.8 to 1.0 mg/100 g soil.

Biotic communities (Dhandhraul)

Plankton

Plankton population ranged between 300 u/l (December) to 1900 u/l (March) and comprised *Navicula cuspidatea, Synedra ulna, Amphora ovalis, Gyrosigma distortum, Spiorogyra* sp., *Pediastrum* sp., *Zygnema* Sp., *Mougeotia* sp., *Cosmasrium* sp., *Staurastrrum* sp., *Microcystis aeruginosa, Coelsphaerium* sp., *Ceratium* amongst phytoplankton. Zooplankton comprised *Keratella tropica, Moina* sp., *Bosmina longirostris, Cyclops* sp. and nauplius larva. Presence of *Ceratium* sp., *Cosmarium* sp., *Staurastrum* sp. indicated allochthonous source of nutrients coming in reservoir through Karamnasha river and hill streams of the surrounding hillocks.

Periphyton

Periphytic population recorded between 140 (August) and 1000 U/cm^2 (March). The periphytic community showed wider algal biodiversity which was dominated by diatoms followed by green and blue-green algae. The dominant algal genera were *Synedra, Navicula, Cymbella, Zygnema, Ulothrix, Cosmarium, Phormidum* and *Microcystis.*

Bottom Biota

The benthic population comprised *B. bengalensis* 17.4%, *Planorbis* sp. 5.8%, *Lymnaea accuminata* 3.7%, Oligochaeta 32.7% and Chironomus larvae 40.4%. Dipteran larvae were dominated over annelidas and molluscan population. The population ranged between 440 n/m^2 to 704 n/m^2.

Biotic communities (Hinauti)

Plankton

Plankton population fluctuated between 500 u/l (October-December) and 1900 u/l (March) comprised *Navicula radiosa, Synedra ulna, Fragilaria* sp., *Tabellaris* sp., *Gyrosigma, Asterionella* sp., *Stauroneis* sp., *Ankistrodesmus* sp., amongst phytoplankton and *Brachionus clariflorus, Moina* sp., *Diatoms* sp., and nauplius larva amongst zooplankton.

Periphyton

The periphytic density ranged between 150 (August) and 1000 (March) Uc/m^2 being highest during summer and lowest during monsoon. As usual, diatom was the dominant group. Dominance of *Synedra, Cymbella* sp., *Melosira, Mougeotia* sp., *Ankistrodesmus* and *Phormidium* as algal genus in all the seasons. Maximum density of periphyton coincided with optimum water temperature, slow waster current and organic load, which cause rapid assemblages of algal during summer.

Bottom Biota

The numerical abundance of macrobenthic organism ranged from 308 n/m^2 to 1320 n/m^2 (average 781 n/m^2) and comprised chironomids 53.5% and oligochaete larvae 42.3% dominated over molluscan population.

PROJECT : RS/A/4

ECOLOGY AND FISHERIES OF SMALL RESERVOIRS OF RAJASTHAN

Personnel : *Scientific :*
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Technical :
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Duration : April 2002-March 2005

Location : Karnal

Ecological investigations of three reservoirs namely Sawan Bhadon, Mundliya Kheri and Bundh Bilas were conducted during the year 2002-03. The distinct characteristics of these reservoirs were :

Soil quality

Soil was loamy and slightly acidic in Sawan Bhadon (pH 6.5) while it was alkaline in other two impoundments (pH 7.1-7.5). Organic carbon (0.52-0.75%) and available phosphorus (1.7-4.4 mg/100g) were of moderate range. The nutrient status of soil thus reflected productive nature.

Water quality

The mean surface temperature ranged between 25.7 in Sawan Bhadon and 27.2°C in Bundh Bilas in general ranging between 18.0 to 31.0°C. The wide variation in water temperature thus had a great bearing on the heat cycle of the reservoir. The mean transparency varied between 62 (Bundh Bilas) and 81 cm (Sawan Bhadon). High turbidity during pre-monsoon period could be attributed to shallowness of the reservoirs coupled with turbulence due to high wind action.

Alkaline nature of water was evident with pH ranging between 7.7 in Sawan Bhadon and 8.2 in Mundliya Kheri indicating favourable condition for fish growth. Free CO_2 was absent in Mundliya Kheri and appeared in Sawan Bhadon (11.1 mg/l) and Bundh Bilas (6.7 mg/l). Dissolved oxygen was in congenial range 8.7-9.0 mg/l. The value of D.O. was low in pre-monsoon and high in post-monsoon. The total alkalinity in all the reservoir is above 90 mgl^{-1} and indicates productive character of these reservoirs. Higher values of alkalinity in pre-monsoon may be due to reduced water levels and more concentration of ions. Low values of alkalinity in winter could be due to winter rains causing dilution of ions. Ionic concentration (µmhos/cm) ranged between 142 in Sawan Bhadon and 262 in Mundliya Kheri. Electric conductance thus supported the productive character of the reservoirs.

Calcium values on an average was 22 mg/l in all the reservoirs. Magnesium, an important component of chlorophyll was moderate and ranged between 11.1 and 12.9 mg/l. Chloride ranged from 9.5 in Sawan Bhadon to 33.0 mg/l in Mundliya Kheri. The concentration of phosphate varied from 0.25 to 0.28 mg/l was favourable for productivity. The concentration of silicate was however low (0.65-0.97 mg/l). The rich water quality reflects the transport of allochthonous dissolved nutrients and their leaching into the system.

Primary productivity

The gross production ($mgC/m^2/hr$) was in the range of 74.0 (Mundliya Kheri) to 105.2 (Sawan Bhadon). The post-monsoon season invariably exhibited low rate that could be due to dilution of ions. The assimilation efficiency was in the range of 50-58%, exhibiting productive character of the reservoirs.

Biotic communities

Plankton

The density of plankton was lowest in Bundh Bilas (1398u/l) while it was maximum in Mundliya Kheri (4611 u/l). Phytoplanktons were predominant varying from 72.0% in Mundliya Kheri to 86.8% in Sawan Bhadon. Myxophyceae occurred significantly in Sawan Bhadon (33.6%) and Bundh Bilas (22.6%). *Microcystis* was dominant constituent of blue-green algae and had maximum abundance (81.5%) during post-monsoon. Chlorophyceae was predominant (53.3%) in Mundliya Kheri, specially in winter season. Dinophyceae was abundant (19.3%) in Sawan Bhadon and was mainly represented by *Peridinium*. The composition of diatoms ranged from 2.7% in Sawan Bhadon to 19.5% in Bundh Bilas. *Syendra, Navicula, Tabellaria, Gyrosigma* and *Diatoma* were common diatoms occurring in all the reservoirs.

Copepoda *(Cyclops, Diaptomus* and their nauplii*)* and cladocera *(Daphnia, Moina, Bosmina)* formed bulk of the zooplankton. *Brachionus, Keratella, Filinia, Trichocerca, Colurella* was the common forms of rotifera occurring in these reservoirs. They appeared significantly in Mundliya Kheri and Bundh Bilas. *Arcella* was common protozoan appearing in these impoundments. Occurrence of *Oscillatoria, Microcystis* and *Pediastrum* indicated eutrophic tendency of the water bodies.

Periphyton

The mean periphytic population varied from 1860 in Mundliya Kheri to 2221 u/cm^2 in Bundh Bilas. Bacillariophyceae formed 69.4% (Sawan Bhadon) to 70.2% (Bundh Bilas) of the periphytic population.

Macrobenthos

The standing crop (No/m^2) of macrobenthos was maximum in Mundliya Kheri (750) followed by Sawan Bhadon (700) and Bundh Bilas. Chironomids were abundant (61.9%) in Sawan Bhadon while molluscs were rich (46.7%) in Mundliya Kheri. Tubificids were absent in Sawan Bhadon and ranged between 4.5 (Mundliya Kheri) and 14.6% of total benthos in Bundh Bilas.

Macrovegetation

Aquatic weeds namely *Hydrilla* and *Vallisneria* were recorded at an average of 0.455 kg/m^2 wet wt. in Mundliya Kheri.

Fishery

The fish yield (kg/ha) in the year 2001-2002 had its high value in Sawan Bhadon (119) followed by Bundh Bilas (81) and Mundliya Kheri (8). Indian major carps contributed 44.5% in Mundliya Kheri while it formed 56.8% in Bundh Bilas.

During the period April 2002-January 2003, the total catch varied from 13.59 t in Mundliya Kheri to 30.173 t in Bundh Bilas. The fish yield has increased in all the reservoirs. Indian major carps constituted 32.7% in Sawan Bhadon to 70% in Mundliya Kheri. The species composition revealed that Indian major carps accounted fairly good proportion in the catches, which could be due to the impact of stocking. The size of *C. catla, L. rohita, C. mrigala, L. calbasu, M. seenghala, L. gonius* and *W. attu* observed from Sawan Bhadon exhibited good growth of these species.

C. catla, L. rohita and *C. mrigala* were dominant in Sawan Bhadon besides the occurrence of *W. attu, M. seenghala, L. gonius, L. bata, L. calbasu, P. sarana, C. reba, Channa sp.* and *C. carpio.* In Mundliya Kheri, the common species thriving are *C. catla, L. rohita, C. mrigala, M. seenghala, W. attu, L. gonius* and *Channa sp.* The fishes thriving in Bundh Bilas are *C. catla, C. mrigala, P. sarana, M. armatus, W. attu* and *Channa sp.*

Productivity status

The potential fish production (kg/ha) on the basis of carbon assimilation has been estimated at 220 kg in Mundliya Kheri, 230 kg in Bundh Bilas and 300 kg in Sawan Bhadon. The conversion efficiency varied from 0.14 (Mundliya Kheri) to 0.39% (Sawan Bhadon). All the impoundment falls under medium productive category. The hydrological features especially total alkalinity, electric conductance and the concentration of calcium, magnesium and phosphate also suggest the productive nature of these reservoirs.

PROJECT : FW/A/7

DEVELOPMENT OF ECO-FRIENDLY MANAGEMENT NORMS FOR ENHANCING FISH PRODUCTION IN FLOODPLAIN WETLANDS OF INDIA IN RELATION TO THEIR RESOURCE CHARACTERISTICS

Sub Project - 1 Assam Centre

Sub-Project - 2 West Bengal Centre

Sub Project - 3 Pen culture technology its adoption in beels

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Technical :
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Duration : April 2002-March 2007

Location : Guwahati, Assam
Barrackpore, West Bengal

Sub-project 1 : Assam Centre

Ecology of beels

Haribhanga and Samaguri *beels* of Nogaon district of Assam were selected to collect baseline information on physical and ecological conditions. In addition, collection of data pertaining to fish species spectrum and stocking pattern have been initiated.

Soil and water quality

Samaguri, a typical horse-shoe shaped ox-bow lake is a semi-live *beel*, whereas Haribhanga is almost a closed *beel*. Acidic soil (pH 5.4-6.0), high organic carbon (1.45 – 2.6%), poor phosphorus content (2.1- 5.85 g/kg), nitrogen (0.12 – 0.24 g/kg) with C/N ratio of 11.0 – 12.5, sandy nature (75-81%) was the range characteristic of soils of both the *beels*. Favourable water temperature (18.8 to 33.0°C) with supporting DO content (3.0– 9.7 mg/l) indicated congenial environment for fish growth. Free CO_2 total alkalinity, specific conductivity ranged from 2.4 – 5.9 mg/l, 31.4 – 73.5 mg/l and 70.0 – 132.0 respectively.

Silicate values ranged from 3.5 to 4.5 mg/l. Nitrates varied widely among the seasons and centers, within a range of 0.04 to 0.07 mg/l. Dissolved organic matter remained almost same in both the beels and varied in a range of 1.94 to 2.50 mg/l.

Biotic communities

Plankton : Plankton density of Samaguri *beel* (89 – 127 u/l) was lower than that of Haribhanga (111-412 u/l). Phytoplankton dominated both in Samaguri (72%) and Haribhanga *beel* (78%) during monsoon season.

Fishery

Jang fishing is the dominant fishing method in both the *beels*. However, gill and cast nets are also used. 17.5 t of fishes were caught from Haribhanga *beel* and miscellaneous species (31.44%) dominated the catch followed by *Labeo rohita* (30%), *Catla catla* (18.48%) and *C. mrigala* (4.74%). Whereas only 4.8 t of fishes were harvested from Samaguri *beel* consisting of *Labeo rohita* (21.90%), *G. chapra* (21.6%), *C. mrigala* (19.91%) and *C. reba* (10.73%).

Fabrication of cages and culture

Locally available bamboo and fine mesh nylon net were used for designing and fabricating the cage with empty oil drums as float. A platform made of split bamboo inter-oven by nylon thread was fitted as base of the cage. To prevent escape of small fishes, nylon nets were placed on the upper surface of the platform. The constructed cage was fitted with four empty oil drums so that out of 2 m height of the cage, 1.5 m remains deep inside the water.

240 numbers of major carps seeds (R:C:M :: 5:4:1) were stocked during December, 2002. They were fed with detritus in conjunction with a mixture of rice bran and mustard oil cake (2 : 1). At the end of 95 days, excellent growth was registered (rohu, 1875% and catla, 764%) indicating suitability of cage culture in *beels*.

Management of macrophytes

Commonly available thick black polythene sheets covering 50 m^2 area was spread over a thick mass of floating macrophyte during August – September. The plants started wilting and became limp within 4-5 days and became yellowish-brown and collapsed leafstalk within fortnight. In the following week, the biomass completely became brown and started decaying and sinking. Similar experiment on submerged plants was also carried out where, the foliage colour below the cover turned almost brown on the eighth day and started disintegrating in the following week. Both the experiments proved the effectiveness of this simple method of controlling aquatic macrophytes.

Economics of beel fishery

The salient finding of the market system revealed that 2,000 fish retailers operate allover Guwahati, 50% of which are linked to Uzanbazar. On an average, each vendor sales approximately 20 kg/day. 50 – 80 boats/day carry fish (av. 200 kg/boat/day) to Uzanbazar fish assembly center from places like Morigaon, Nagaon etc besides 50 – 60 trucks carry fishes from other states like Andhra Pradesh, Uttar Pradesh, West Bengal and Bihar. On an average, 5 – 6 trucks are sold in Paltanbazar, Guwahati. Prices of these fishes ranged from Rs. 30 – 50/- per kg depending on size. Hilsha from West Bengal fetches price ranging from Rs. 100 – 180/- per kg.

The management system in the *beels* involves i) public sector such as AFDC, ii) private sector without ownership rights, iii) community based approach involving community living with resources and iv) open access management having no control or exclusive right on the water body. The fish production of the open access *beels* is the lowest (30-40 kg/ha) followed by community based approach (200 – 250 kg/ha), private (400 kg/ha) and public sector management (400 –500 kg/ha).

Sub-Project 2 West Bengal Centre

Ecology of beels

As a part of stock enhancement studies baseline information pertaining to ecological conditions from Chamordaha and Saguna beels have been collected with a view to initiate stock enhancement programme. The soil and water of both the beels were found to be productive.

Primary Productivity

The rate of primary production by phytoplankton varied widely depending upon climatic factors and turbidity of water. The net production in both the lakes ranged within 50.79-174.48 $mgC/m^3/hr$ and the average carbon fixation rates were 95.92 $mgC/m^3/hr$ in Chamordaha and 117.19 $mgC/m^3/hr$ in Saguna beel.

Biotic communities

Plankton : The total plankton was found to be 274 u/l in Saguna *beel* and 142 u/l in Chomardaha *beel*. In both the oxbow lakes, zooplankton dominated (Saguna: 55.2%, Chamardaha: 51.4%) over the phytoplankton group.

Benthos : The benthic community of the lakes comprised molluscs, annelids and insect larvae. In the molluscan group, the common species among the lakes were *B. bengalensis* and *T. tuberculata*. Similarly, the tubifex worm and dipteran larvae were found to be common in both the lakes.

Fishing practices

In both Saguna and Chamordaha *beels*, the fishing is done by using traditional gill nets (different meshes), cast net, dragnet as well as hooks and lines. No special fishing method was noticed in these lakes.

Stocking practices

Both the lakes are stocked with IMC and exotic carps. The stocking is done in a cyclic way i.e. 3-4 times in a year. Similarly harvesting is also done when the fishes attain marketable size (above 250 g).

Cage culture for rearing of stocking material

Under cage culture activity a floating cage (41.805 sq. m.) was designed and constructed. The upper portion of each net enclosure was tied at four corners with the bamboo frame. Earthen sinkers were attached all around the bottom sides at gaps of 15 cm for straight floating of the net enclosure in the water column.

With this cage trial on rearing of carp seeds was done.This experiment was conducted in the Mathura *beel* of 24-Parganas (N) district, West Bengal for a period of 120 days (14.11.2002 to 15.3.2003). Two cages (each 9.10 sq. m.) were stocked with a mixture of exotic and Indian carp seeds @ 0.1 million/ha as total stocking density. Good growth and survival of the reared fishes were recorded in this experiment.

Development of ornamental fishery

A total of 10 indigenous species were collected from different districts of West Bengal. They are *Notopterus notopterus, Notopterus chitala, Oreichthys cosuatis, Puntius conchonius, Puntius gelius, Puntius phutunio, Puntius sophore, Puntius terio, Puntius ticto, Salmotsoma phulo, Amblypharyngodon mola.*

Biology of fishes

Biological studies of 2 fish species *Puntius sophore* and *Amblypharyngodon mola* were conducted.

The Length-weight relationship of *P. sophore* worked out as $W = 0.00002\ L^{2.8998}$ and this species was a plankton feeder. The equation obtained for length-weight relationship of *A. mola* was Y = 0.1037 X - 3.832 (R2 = 0.8558). This species was a phytoplankton feeder feeding mainly on algae. The distribution of ova-diameter as well as the gonado-somatic index studies indicated that this is a prolonged breeder.

Fisheries and ecological survey of *beels* in Bihar.

The study of physico-chemical characteristics (soil & water) of Manika and Motipur mauns showed that both the beels are productive. The heavy metal concentration in water of both the beels were well within permissible limit.

Primary Productivity

The rate of primary production by phytoplankton varied greatly depending upon climatic factors and turbidity of water. The gross production, net production and respiration were 62.5 $mgC/m^3/hr$, 20.83 $mgC/m^3/hr$ and 50.0 $mgC/m^3/hr$ respectively

Macrophytes, associated fauna and benthos

Samples collected during winter revealed that 40-60% of the beel area were infested with macrophytes. Submerged weeds dominated in both. Motipur beel dominated by *Najas* where as Manika with *Ceratophyllum.*

Macrophytes associated fauna were dominated by gastropods (*Gabia* and *Gyraulus*), followed by insects belonging to Hemiptera, Diptera and Odonata.

Benthic population represented by *Gabia orcula, Gyraulus convexiusculus,Lymnea accumunata, L. ovalis, Segmentina calatha and Indoplanorbis exhustus*. SDI value (2) in respect of associated fauna and benthos indicating congenial condition of the lakes. However, the higher SDI value (10) in Manika beel is due to unusual population of *Gabia* (444/m2) followed by *Gyraulus* (192/m2) in comparison to others.

Econometric model development for *beel* fishery resources at Monika-Bishnupur

Five fisher villages, namely, Manika-Bishnupur, Narsighpur, Manika Harikash, Nawada and Radha Nagar Mushahari were located in the vicinity of the lake. The number of fishers in the villages was 3500, out of which only 750 were active fishers. The fish-marketing channel was Fisher-Co-operative-Local Dealer- Wholesaler- Retailer – Consumer. Mostly the price received by the co-operative was Rs 50/- per kg.

Motipur

The Motipur oxbow lake was located at village Harauna, block Motipur, Tehsil Baryarpur in Muzzafarpur. The number of fisher community villages in the vicinity of the lake was 8 having over 100 fishers including 70 active fishers. The marketing was done through co-operative. The

marketing channels were Fisher-Cooperative - Consumer, Fisher-Co-operative - Local dealer – Wholesaler – Retailer -Consumer. The price received for the catch was around Rs 50/- per kg.

Sub-project 3 Pen culture and Cage culture

A demonstration programme on Pen and Cage culture was undertaken at Mathura beel, North 24-Parganas district of West Bengal.

The demonstrations on pen culture of giant freshwater prawn, *Macrobrachium rosenbergii* and polyculture of carps with catla *(Catla catla),* rohu *(Labeo rohita)* and mrigal *(Chirrhinus mrigala)* were conducted in a pen of 0.1 ha area each.

A production of 620 kg/ha was obtained in 150 days of culture operation in the case of *M. rosenbergii.*

A crop of 327 kg of carps (Catla, Rohu, Mrigal) was harvested from the pen after 177 days of culture operation.

Cage culture of Magur

Cage culture operations were conducted to demonstrate the possibilities of fish production from the cages installed in open water systems.

The production of magur obtained from the Cage was estimated at 8.8 $4m^2$ ($8m^3$)/120 days.

Out of the three experiments, maximum fish production was observed at a stocking density of 16 nos. per sq.m.

PROJECT : FW/A/8

ECOLOGY AND BIODIVERSITY OF KAYAMKULAM LAKE

Personnel : *Scientific :*
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Technical :
C.K. Vava

Duration : May 2002-March 2005

Location : Alappuzha, Kerala

Ecological characteristics

The Kayamkulam backwater with an area of 1652ha.,(Lat. 9^0 09 & 9^0 15' N Long. 76^0 02' & 76^0 28' E), is an important brackish water ecosystem on the south west coast of India.

Seven stations were selected from the backwater for regular monthly sampling. They are *Ayiramthengu* (St.1), *Ayiramthengu- Mangroves* (St.2), *Kochiyudaejetty* (St.3), *Keerikadu*(St.4), *Kallikkadu*(St.5), *Choolatheruvu*(St.6), *Valiyazhikkal* (St.7).

The average depth of the backwater was 1.14m during the present investigation The transparency was also generally low due to the shallow nature of the system, ranging from a mean of 0.60m in St.2 to 159.2 m in St. 6. The NTPC zone represented by St. 6, showed comparatively higher depth and transparency values due to the intense dredging activity that had taken place for construction of the Power plant. The water temperature recorded a mean value of 24.49^0C with the highest mean value of 29.27 ^{0}C in St. 6. pH was on the alkaline side in all the study sites, with mean values ranging from 7.44 at St. 6 to 8.28 at St. 7. The salinity in the backwater was mixo-mesohaline in nature. The carbon dioxide concentration showed a mean value of 2.79mg/L in the backwater, whereas a very high mean value of 6.18 mg/L was recorded at St. 6 the NTPC zone of the backwater. The lowest value of dissolved oxygen was at St. 2 (2.25mg/L), whereas the highest mean value was at St.1 (5.82) in August 2002. The hydrogen sulphide values ranged from 1.3 mg/L at St.2 to 8.28 at St.4. The BOD showed wide variations in all the seven stations with the highest of 42 mg/L in the surface water at St.4 and the lowest of 4 mg/L at St.2 in the bottom water. The NTPC zone represented by St. 6 also showed high BOD_5 mean values of 9 mg/L. The nutrients represented by nitrate-nitrogen, phosphate-phosphorus were low, whereas the silicate-silicon values was comparatively higher. The sediment pH regime showed mean acidic value (6.88). The sediment organic carbon varied from 0.86% at St. 2 to 3.05% at St.5. The mean value for the backwater was 2.09%. The generally higher value of organic carbon and available nitrogen at Sts. 3 & 5 could be due to the high organic load in the water due to the retting activity prevalent in these zones and adjacent regions. The sediment texture indicated that the fine sand fraction showed the highest mean percentage in the backwater followed by coarse sand, clay fraction and silt.

Primary Productivity and Chlorophyll content

The gross primary productivity in the surface water varied from 0.375 at St.1 to 0.969 gC/m^3/day at St. 6, where as it varied from 0.00 at St.6 to 2.207 gC/m^3/day at St. 3. The net productivity also showed wide variations with values ranging from 0.156 at St. 7 to 1.118 at St. 2 in the surface water and from 0.00 at St. 6 to 1.79 gC/m^3/day at St. 3 in the bottom water. The chlorophylla content also showed wide fluctuations in all the stations with the peak value (49.60 mg/m^3) in the surface water at St.5 and the lowest at St.3 in the bottom water (0.846 mg/m^3). The biomass values were generally low in the seven stations of the Kayamkulam backwater.

Biodiversity

The phytoplankton of Kayamkulam kayal was composed of 14 genera of green algae, 13 genera of blue green algae, 1 genera of yellow brown algae, 9 genera of desmids, 24 genera of diatoms and 6 genera of dinoflagellates. The general diversity of phytoplankton population represented by a total of 64 species in the present investigation was highest at Sts.1, 3, 4 & 5. The

comparatively low diversity of algae, diatoms and dinoflagellates at Sts. 6 could be due to the impact arising from the thermal discharge at this zone.

The zooplankton composition in the Kayamkulam backwater was composed of 16 groups. Rotifera contributed the highest mean percentage incidence (34.76) followed by Copepod nauplii (21%), Tintinnida (20.15%) and Calanoid copepoda (8.44%). Rotifiers showed the highest percentage incidence at St.1 (51.01) and the lowest at St. 7 (14.81).

The benthic population was composed of 11 groups contributing a total of 318663 No./m^2 in the 7 stations in Kayamkulan backwater. The faunal composition showed a maximum mean of 30.14% (Polychaeta), followed by Bivalvia (21.93%), Gastropoda (19.51%) and Oligochaeta (9.57%).

PROJECT : FW/A/9

ASSESSMENT OF ECOLOGICAL STATUS AND ENERGY DYNAMICS OF FLOODPLAIN WETLANDS IN CENTRAL AND WESTERN UTTAR PRADESH

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Duration : May 2002-March 2005

Location : Allahabad, U.P.

Investigations were made in 8 jheels spread over four districts of Central and western Uttar Pradesh. The morphometric features of which are given below.

District	Name of the jheel	Area(ha)	River basin
Barabanki	Bhaghar jheel	80.0	Ghaghra
	Sangara jheel	252.0	
Sitapur	Ratnapur jheel	900.0	Ghaghra
	Sonari jheel	62.5	
Farukhabad	Kuthala jheel	410.0	Ganga
	Bahausi jheel	250.0	
Mainpuri	Aheerawanjheel	110.0	
	Saman jheel	200.0	Yamuna

Sediment and water quality

Physical composition of the sediment showed dominance of sand (64.25 to 89.5%) with silt and clay ranging from 5.75to 25.5% and 3.0 to 18.25% respectively. Sediment was neutral to alkaline in reaction with pH ranging from 6.85 to 8.1 and conductance 136.0 to 578.5 µmhos. Free calcium carbonate was in the range of 3.21 to 5.01%. Both the available nutrients; nitrogen and phosphorus as well as organic carbon all were quite high in the studied jheels with the values ranging from 39.5 to 63.5 mg/100g, 1.8 to 10.3 mg/100g and 1.2 to 3.91% respectively. However the rich nutrient status of the sediment was not reflected in the water phase which was found to be always low in all the jheels (nitrate 0.178 to 0.35 mg/l and phosphate 0.114 to 0.36 mg/l), except for the high values of dissolved organic matter (1.85 to 3.59 mg/l). Comparatively lower values of nutrients in the water phase of all the jheels was due to the fact that large amount of nutrients were locked by the growing macrophytes and removed from circulation. Water was neutral to alkaline in reaction with pH ranging from 6.9 to 7.95. The water quality parameters alkalinity, conductance, dissolved solids hardness and chloride all showed considerable variations in jheels ranging from 60.0 to 217.3 mg/l, 128.0 to 437.7 umhos, 64.0 to 218.5 mg/l, 61.1 to 152.3 mg/l and 6.3 to 16.3 mg/l. The variations in the water quality parameters in different jheels was due to the qualitative difference in the catchment and the feeding rivers. Clarity of water in all the jheels ranged from 23.7 to 112.0 cm.Water was quite rich in respect of dissolved oxygen (4.86 to 7.73 mg/l)even in the presence of free carbon dioxide (6.7 to 16.3 mg/l).

The water quality parameters like dissolved oxygen, pH, fee carbon dioxide and bicarbonte all showed considerable diurnal variations. The rich sediment and water quality parameters in general reflect the productive nature of jheels under study.

Biotic communities

Plankton : The average plankton density ranged between 207 u/l and 1433 u/l being maximum in Kuthla jheel and minimum in Aheerawan jheel. Among the various groups chlorophyceae was most dominant (13.98 to 35.76%) followed by diatoms (2.94 to 18.67%) and desmids (4.22 to 18.47). Among the zooplankton rotifers were most dominant (11.05 to 33.9%) followed by protozoans (5.42 to 22.2%) and cladocerans (1.47 to 12.26%).

Macrobenthos : The abundance of benthos ranged from 396 to 953 n/m^2 being minimum in Ratnapur and maximum in Saman jheels. Diptera was most dominant among insecta ranging from 13.79 to 75.93% followed by mollusca (7.5 to 48.28%) and Anelida (4.09 to 29.3%).

Periphyton : Periphytic organisms were maximum in Sonari (3360 u/cm^2) followed by Saman (2966 u/cm^2), Bahausi (2940 u/cm^2) Aheerawan (2670 u/cm^2), Bhaghar (2560 u/cm^2) Kuthala (2253 u/cm^2) Sangara (2036 u/cm^2) and Ratnapur (1960 u/cm^2). On an average diatoms contributed maximum (43.79 to 71.59%), green algae (19.48%), blue greens (20.62%) and desmids (16.89%) where as protozoans, rotifers and crustaceans contributed less than 1%.

Macrophytes : The quantitative abundance of macrophytes was found to be maximum in Kuthala (6750 g/m^2) followed by Bahausi (5625 g/m^2) Ratnapur (4970 g/m^2), Sonari (4035 g/m^2), Saman (3030 g/m^2), Sangara (1771 g/m^2), Aheerawan (1305 g/m^2) and Bhaghar (840.2 g/m^2) on freshweight basis. The species prevalent were *Eichornia sp., Hydrilla, Chara, Polygonum, Ipomia* and *Ceratophyllum.*

Macrophyte associated flora and fauna : Macrophytic associated flora and fauna were maximum in Sonari (3795 u/cm^2) followed by Kuthala (3143 u/cm^2) Sangara (2953 u/cm^2) Saman (2772 u/cm^2) Bahausi (2469 u/cm^2), Bhaghar (1720 u/cm^2), Aheerawan (1410 u/cm^2) and Ratnapur (1093 u/cm^2).

Rate of energy transformation by producers

In all the jheels energy transformation was contributed both by phytoplankton and macrophytes. The rate of gross and net energy transformation on average ranged from 29300 to 57815 cal/m^2/day and 20327 to 38298 cal/m^2/day respectively, being maximum in Bahausi jheel and minimum in Ratnapur jheel. Out of the above total energy fixed by producers, phytoplankton contributed only 3560 to 12113 cal/m^2/day (gross) and 2209 to 8163 cal/m^2/day ^{1} (net) while the rest 26180 to 46709 cal/m^2/day (gross) and 18492 to 34748 cal/m^2/day (net) was contributed by macrophytes. Thus on average only 15.7% of the total energy fixed through primary production was contributed by phytoplankton while the rest 84.3% by macrophytes. Studies in 8 jheels have shown that almost 64.2% of the gross energy fixed by phytoplankton was stored by them while macrophytes stored almost 72% of the gross energy fixed by them. The rate of energy transformation by producers was very high in jheels under study when compared with many other aquatic ecosystems.

Bottom organic deposits and detritus energy

The constant loading of organic matter due to death and decay of macrophytes caused heavy deposition of detritus at the bottom. The dry weight of organic matter deposited as detritus ranged between 155.1 and 340.0 g/m^2. The detritus energy was also very high in these waters being 9.3 x 10^4 cal/m^2 in Bhaghar, 12.9 x10^4 cal/m^2 in Sangara, 11.3 x 10^4 cal/m^2 in Ratnapur, 9.4 x 10^4 cal/m^2 in Sonari, 11.7 x 10^4 cal/m^2 in Kuthala, 7.0 x 10^4 cal/m^2 in Bahausi, 6.2 x 10^4 cal/m^2 in Aheerawan and 7.5 x 10^4 cal/m^2 2 in Saman with an average of 8.4 x 10 cal/m^2.

Fish production potential and actual fish production (Extent of utilization)

Based on the energy flow studies the fish production potential was estimated as 1309 kg/ha in Bhaghar, 926.5 kg/ha in Sangara 703.8 kg/ha in Ratnapur, 881.5 kg/ha in Sonari, 1258.3 kg/ha in Kuthala , 13265.0 kg/ha in Bahausi, 739.5 kg/ha in Aheerawan and 898.3 kg/ha in Saman jheel. Thus all the jheels have tremendous fishery potential but the actual harvest from them was very poor ranging from 98.4 to 294.5 kg/ha. Comparison of potential with the actual fish harvest shows that only 10.9 to 24.2% of the potential is being harvested from these jheels. The energy output as fish from 8 jheels was of the order of 1,18,080 to 3,53,400 k cal/ha and comparison of this energy with the promary energy resource gives a conversion efficiency in the range of 0.089 to 0.212%. Low conversion efficiency clearly shows that the primary energy resource is not fully utilized leaving a big gap between potential and actual energy output which must be bridged to get better energy return. One of the reason for poor harvest from these jeels was dominance of catfishes and miscellaneous species due to lack of stocking support.

PROJECT : EM/B/1

ASSESSMENT OF ENVIRONMENTAL IMPACT ON BIOTIC COMMUNITY IN RIVERS AND ASSOCIATED ECOSYSTEMS

Personnel : *Scientific :*
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Technical :
S. Bhowmik, Keya Saha, Ranjana Sinha, S. Bandopadhyaya,
Arijit Ghosh, L.R. Mahavar/J.P. Mishra, R.C. Mandi, Subrato Das

Duration : April 1998-March 2003

Location : Barrackpore, Allahabad, Karnal, Vadodara

To assess the environmental perturbation and its impact on ecology of rivers Ganga, Yamuna, Hooghly, Haldi, Tapti and Sutlej, studies were undertaken seasonally on physico-chemical, hydrobiological, ecological, histopathological, bio-chemical and toxicological parameters.

Water and sediment quality

In general, water and sediment qualities were at the desired levels except the effluent out fall areas of the studied stretches. At Patikhali, Haldia, high phosphate level (up to 0.54 mg/l) along with high BOD (up to 60 mg/l) was noticed frequently. In certain occasion, effluents has been found to make the sediment phase acidic as was observed at Okhla (Delhi) with pH of 5.02.

Biotic communities

In the river Yamuna, seasonal fluctuations in plankton population were not observed due to the failure of monsoon during 2002-2003. At Varanasi, highest density of plankton was recorded at Rajghat. *Microcystis* sp. and *Spirulina* sp. were present in more number due to the greater organic load at the centre. Dominance of the Chlorphyceae was noticed in Patna and Farakka stretch followed by Bacillariophyceae in lower stretch. In general, other than Bhagalpur, dominance of phytoplankton over zooplankton was observed. Plankton population was moderate except Haldia where it was low.

Macrobenthic population was moderate at Patna and Bhagalpur. Overwhelming dominance of molluscan fauna was witnessed. *Tubifex* and chironomids, the indicator of organic pollution were restricted to out fall and downstream of river Hooghly. In the Patna to Haldia stretch, the Shannon Index (H) ranged between 1 to 2 indicates mesosaprobic to mesosaprobic categories of water.

Fishery

In the fish species composition and diversity studies, appearance of the exotic fish species *C. garipienus* (11.95%) and Silver carp (1.03 %) at Okhla indicates that attention be given to restore the indigenous population.

Assessment of toxicants

The organochlorine pesticide residue levels were studied in fish flesh. DDT and its metabolites DDE and DDD dominated the residues. HCH, Heptachlor and their isomers were present in moderate levels. The highest residue was detected in *Rita rita* (46.6 g/kg in 3 kg fish) of Farakka. It was interesting to notice that even at Haridwar, like previous year, the residue of organochlorine pesticides was recorded at moderate level (14 g/kg in *Labeo reba*).

Heavy metal residue studies showed high level of manganese in the water phase (up to 356 g/l) in the rivers Mandovi and Zuari due to mining activity at the zone. In the river Sutlej, high amount of Mn (638 mg/kg) was recorded in the sediment of Harike sampling site. The bioaccumulation of metals in fish organs like gill, liver, kidney and flesh was also recorded.

Histopathology : Histology of gills of fishes from Haldia sampling site showed intra and inter lamellar hyperplasia, degeneration of secondary lamellae and widening of luminary space in primary gill of *A. gagora* and *P. pama*. Kidney showed tubular degeneration and glomerular swelling in *A.gagora*..

Biochemical markers : Studies on bio-chemical markers in stressed environment were also undertaken. Blood glucose was found to remain elevated at polluted sites. Blood serum protein, liver and muscle protein, liver and muscle glycogen, total lipid levels, blood and brain acetyl cholinesterase (AchE), Na+-K+ - ATPase activities were found to decrease at the polluted sites.

Macrophytes for removal of toxicants

In order to develop mitigation action plan for removal of heavy metals from contaminated aquatic environment, experiment was conducted with aquatic weeds (*Eichornia* and *Pistia*). *Eichornia* has very high efficiency to remove lead within a short contact period (about 90% in one day). Up to 80% of the accumulated lead could be recovered from the root fraction of *Eichornia*.

PROJECT : EM/B/2

AETIOLOGY AND PATHOPHYSIOLOGY OF ENVIRONMENTAL STRESS AND DISEASES IN FISH/PRAWN. DEVELOPMENT OF HEALTH ASSESSMENT AND CONTROL METHODS

Personnel : *Scientific* :
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Duration : April 1998-March 2003

Location : Barrackpore

Application of an index of biological integrity (IBI) to fish assemblages of river Hooghly.

(i) IBI study was conducted in Zone-I (freshwater zone) of Hooghly river. Six sites Nabadwip (S1), Balagarh (S2), Tribeni (S3), Hooghly Ghat (S4), Nawabganj (S5), Barackpore (S6) covering a distance of 100 km was selected and fishes were collected and sampled during the months of October, November and December.

(ii) A multimetric index of fish assemblages integrity was developed for fish species in river Hooghly and the effects of municipal and industrial effluents and physical conditions on those indices were evaluated.

(iii) The physico-chemical parameters and heavy metal content of the sites are given in Table.

Parameters	Nabadwip	Balagarh	Tribeni	Hooghly Ghat	Nawabganj	Barrackpore
pH	6.28	6.01	7.1	7.1	7.2	7.1
Sp.Cond. (AS/am)	343	296.00	360	539	359	352
Alkalinity (mg/l)	152	100	110	97	92	160.0
Hardness (mg/l)	148	106	128	152	158	154
Cu (mg/l)	0.002	0.007	0.001	0.002	0.007	0.006
Zn (mg/l)	0.018	0.021	0.01	0.04	0.009	0.10
Cd (mg/l)	0.001	0.001	0.002	0.077	0.038	0.001
Pb (mg/l)	0.006	0.009	0.006	BDL	0.002	0.008

(iv) Based on our modification of the IBI, only 3 of the 6 sites or 50% of the sampled sites supported fish assemblages in acceptable condition and it is

concluded that the biological integrity of the fish assemblages in the river at these stretches are not being maintained.

Standardizing 17ß Estradiol as a bioindicators of reproductive response to pollutants (phenol, sulfide, cadmium and lead).

- Sexually mature *R. rita* were exposed for 30 days during the period (May & June, 2002) to sub lethal concentration of phenol (3mg/l). sulfide (1mg/l), lead (0.587 mg/l) and cadmium (0.56 mg/l). The parameters measured were cholesterol levels in ovary and liver and 17ß Estradiol and Cortisol level in plasma., Al the contaminants caused an increase in Hepatosomatic Index and a decrease in Gonado Somatic Index. There was an increase in the cholesterol contents of both ovary and liver whereas there was a gradual decrease in 17ß Estradiol levels. The accumulation of ovarian and hepatic cholesterol and decrease in Estradiol levels indicate reduced steriodogenesis.

Use of integumentary chromatophores and mucous gland for stress diagnosis.

- *L. rohita* were exposed to (i) stress due to crowding @ (90g/L) for 4 hrs and (ii) unionized ammonia (UIA) of 0.13 mg/l for 24 hrs. The changes in structure of chromatophores and mucous glands in the skin and the influence of the hormone prolactin on mucous production was investigated.

- It is concluded that UIA has aggregating action on the chromatophores during the period of exposure. Mucous glands on the other hand gradually decrease in number and increase in area with increasing exposure period. The changes in the number and area of mucous gland is due to the effect of UIA or crowding on the pituitary gland which enhances the release of prolactin hormone stimulating excess mucous secretion.

Isolation and identification of microbial pathogens in fish and shellfish

A total of 55 fish and water samples collected from different fish farms located at Bauripur, Bangaon, Bhora Beel, Kancharapara, were analysed microbiologically. Samples were inoculated to general and selective bacteriological media. Cultural and biochemical tests were also carried out. Samples were analysed using BIOLOG Automated Bacteriological identification system. Following bacterial stains/species/genus were identified.

(i)	*Aeromonas hydrophila DNA group 1*	:	6 nos.
(ii)	*Aeromonas veronii b.v. sorbia DNA group 8*	:	11 nos.
(iii)	*Vibrio metschnikovii*	:	2 nos.
(iv)	Genus : *Vibrio*	:	8 nos.
(v)	*Pseudomonas fluorescens*	:	3 nos.
(vi)	*Aeromonas hydrophila like DNA group 2*	:	5 nos.
(vii)	Genus : *Aeromonas*	:	8 nos.

Besides above pathogen isolated two typical pathogens (not reported earlier in cases of fish disease) viz. *Aeromonas enchelia* and *Aeromonas icthiosmia* (two each) were also identified.

Antibiotic sensitivity assay of selected bacterial pathogens

Antibiotic sensitivity of selected bacterial isolates was also carried out. Results indicated higher sensitivity of isolates to Ciprofloxacin, Chloramphenicol, Norfloxacin but resistant to Ampicillin and Oxytetracycline.

Antibacterial used	V. metschnik 0-vii	*A. hydrophila DNA group 1*	*A. veronii b.v. sorbia DNA-8*	Ps. Fluores cens
Bactorid (Pefloxacin, Enrofloxacin & Zincbacitracin)	50 ppm	20 ppm	20 ppm	20 ppm
Avitech (Chlorine diioxide)	> 100 ppm	> 100 ppm	100 ppm	20 ppm
BKC 365	50 ppm	100 ppm	> 100 ppm	50 ppm
Iodol-20 (2% active chlorine)	50 ppm	100 ppm	50 ppm	50 ppm
Bromophor (4% active bromine)	100 ppm	> 100 ppm	> 100 ppm	50 ppm
Mizuphor (10% Available iodine)	100 ppm	> 100 ppm	50 ppm	20 ppm

PROJECT : BT/B/1

GENETIC CHARACTERIZATION AND MIGRATION RELATED BIOCHEMICAL CHANGES OF INDIAN SHAD, *TENUALOSA ILISHA*

Personnel : *Scientific* :
V. V. Sugunan, A. Hajra, P. Maurye, Brahmane M.P.

Duration : April 2000-March 2005

Location : Barrackpore

From rivers Ganga, Hooghly, Padma, Yamuna, Narmada and Tapti sampling of hilsa blood, liver, muscle, gonad tissue were done for genetic studies. The extraction and purification of the genomic DNA from the hilsa samples was used for PCR amplification to generate RAPD profiles. The screening for polymorphic decamer primers was done and a set of five primers giving reproducible polymorphic banding patterns were selected.

Primer	Sequence	No. of Bands
OPA10	GTG ATC GCAC	11
OPA11	CAA TCG CCGT	14
OPA19	CAA ACG TCGG	8
OPD11	AGC GCC ATTG	7
OPC12	TGT CAT CCCC	7

The analysis of the samples from rivers Hooghly (Nawabganj and Feeder canal), Padma (Lalgola and Beniagram), Ganga (Allahabad) and the marine zone samples from Digha were analysed using RAPD marker. The decamer primers OPA-10, OPA-11, OPA-19. P{D-11 were used for the PCR amplifications. In all the samples analysed intrapopulation differences are seen from the presence and absence of bands in the RAPD profiles of individual samples collected at different locations from the individual rivers. Intrapopulation differences in the river Hooghly and also from the river Ganga, at Lalgola were seen. The decamer primer OPA-10, gives bands of the amplified RAPD products of variable size in the same population of river Hooghly indicating presence of intrapopulation differences. Similar is the case in the river Ganga (Lalgola) samples. The amplified DNA band size using OPA-10 in the samplesw of Hooghly and Ganga (Lalgola) also tentatively indicates presence of differences in these two populations. Further analysis using more number of samples from the above-mentioned locations is in progress.

PROJECT : BT/B/2

DEVELOPMENT OF IMMUNOLOGICAL AND MOLECULAR TECHNIQUES FOR RAPID DIAGNOSIS OF BACTERIAL AND VIRAL DISEASES OF FISH AND SHELLFISH

Personnel : *Scientific :*
S.S. Mishra, P. Maurye, Brahmne M.P.

Duration : April 2000-March 2005

Location : Barrackpore

Bacterial whole cell protein and bacterial DNA study

Samples collected from infected fish with skin ulceration, haemorrhages and mass mortality, were processed using different bacteriological media. Cultural and biochemical tests were carried out to identify the pathogens. The pathogens were further analysed using BIOLOG system and different pathogens like *Aeromonas hydrophila, Aeromonas veronii b.v. sobia DNA group 8, Vibrio metchsnikovii, Aeromonas* spp., *Pseudomonas fluorescens, Vibrio* spp. etc. were obtained. *Aeromonas isolates* were used for molecular characterization on the basis of their protein profile, genomic DNA restriction pattern and plasmid profile. Whole cell proteins and sonicated extracts of bacterial isolates were analysed on 12% SDS-PAGE and protein banding pattern and molecular weight were estimated. Protein bands of *A. hydrophila* were transferred to nitrocellulose paper and developed as per Western blotting technique and 8 major immunogenic bands were revealed. *A. hydrophila* isolates revealed presence of 2-4 plasmids and 12 plasmids were recorded in standard *E. coli*. RAPD analysis of plasmids was carried out using different OPA primers. OPA 2 and OPA 10 primers revealed polymorphism, which can be used for characterization of plasmids. Genomic DNAs were extracted from all above bacterial isolates and were digested with restriction endonucleases. A variation in DNA banding pattern were recorded with bacterial isolates, although there were many overlapping bands. Antiserum raised against a standard *A. hydrophila* isolate was used in Nitrocellulose Enzyme immunoassay or Dot immunoassay (DIA) for screening of bacterial isolates. Positive detection of *A. hydrophila* was obtained in DIA.

Standardization of Molecular diagnostic techniques

Development of DNA probe for detection of *V. parahaemolyticus* isolates using PCR based technique, was further evaluated to test its suitability in application. PCR was used for detection of both Kanagawa positive (K+) and Kanagawa negative (K-) *V. parahaemolyticus* isolates, which are responsible for gastroenteritis. Primers specific for a specific 387 bp gene in genomic DNA was used as the target gene for PCR amplification. The results indicated successful

amplification of all *V. parahaemolyticus* isolates but not *A. hydrophila* isolates. The amplified 387 bp fragment of *V. parahaemolyticus* was labeled *in vitro* using Alkphos direct labelling and detection system (Amersham Pharmacia Biotech, UK Ltd.). A number of bacterial samples spotted on Nylon membrane and the membranes were kept in hybridization tubes containing hybridization buffer with labelled probe and kept over night at 50 °C in a hybridization incubator. After thorough washing, the results were recorded on X-ray film using autoradiography. Results indicated high sensitivity and specificity of labelled probes for detection of *V. parahaemolyticus* in tissue/culture samples.

RAPD-PCR based technique was further evaluated to be used for characterization, detection and differentiation of A. *hydrophila* isolates using a number of random primers. Out of 20 primers screened, 5 were found to give polymorphic banding pattern. Great variation in DNA banding pattern indicated a high genomic variation in 11 *A. hydrophila* isolates used in the study.

Cell culture study

Different organs of fish like gill tissue, liver, kidney, gonadal tissue and haemolymph and gills of shellfish, were used for *in vitro* primary cell culture using L-15 medium containing 10% fetal calf serum. Initial trials indicated multiplication of gills cells and formation of monolayer by haemocytes in culture flasks. Best results were obtained with haemocytes and gills tissues.

PROJECT : RA/A/2

ASSESSMENT OF FISH CATCH AND CATCH STRUCTURE FROM DIFFERENT INLAND OPEN WATER SYSTEMS IN INDIA

Personnel : *Scientific* :
S.K. Mandal, Debabrata Das, S.K. Sahu,

Technical :
Sucheta Majumder, K. Jacquiline, B.K. Biswas, B.N. Das, Ramji Tweari, J.P. Misra, Alok Sarkar, M.F. Rahman, R.C. Mandi, C. Lakra, C.K. Vava.

Duration : April 1999-March,2004

Location : Barrackpore

Different sampling methodologies were adopted for data collection at various centres of the Institute depending on the fishing and landing patterns. Generally multistage sampling and systematic sampling are being adopted for catch data collection. The data on catch and effort are being utilized for the development of database under the project.

It is revealed from the estimates of monthly catch for Hooghly-Matlah Estuarine system that the species *Pama pama*, *Setipinna* sp. *T. ilisha*, *Trichiurus* sp. are the major contributors to the fishery. The gear-wise catch composition shows that bagnet is the dominant gear operated in the system.

Monthly data on fish catch were recorded at Allahabad for Ganga river system. The species like *Cyprinus carpio* (12.15 t), *C. garua* (6.34 t) and *M. aor* (5.79 t) are the dominant species in the catch.

The fish catch data for Yamuna river and West Yamuna Canal were recorded at Karnal. *C. carpio* is the dominant species in the catch from Yamuna river. The total catch from four centres has been estimated at 46.76 t. This species is also dominant in the catch from West Yamuna Canal. The estimated catch from two landing centres has been worked out at 9.1t. *M. seenghala* and *L. gonius* are also significant species.

The catch data from Narmada river are collected at various landing centres and markets. The catch data collected from markets show that *L. rohita*, *C. catla* and *T. ilisha* are the dominant species. The catch per unit effort is the highest for gillnet(0.785 kg) followed by bagnet (0.67 kg) and castnet (0.32 kg) respectively.

PROJECT : RA/A/2

INVENTORY OF RESOURCE AND DATABASE DEVELOPMENT IN INLAND FISHERIES THROUGH REMOTE SENSING TECHNIQUES

Personnel : *Scientific* :
R.A. Gupta, D. Kumar, D. Nath, S.K. Mandal, Debabrata Das, S.K. Sahu
Technical :
Sucheta Majumder, K. Jacquiline, A. Sengupta

Duration : April 1999- March, 2004

Location : Barrackpore

The data on water quality and soil characteristics were collected from the selected water bodies of Nalanda, Samastipur, Vaishali, Begusarai and Darbhanga, during pre monsoon and post monsoon season. Digital base maps were prepared for the five districts of Bihar. These base maps have been prepared with the help of district and block maps, which have been procured from Govt. agencies. Location of rail crossing, road crossing, important place, chaur, man, river bridge and land use pattern have been observed with the help of GPS. These location are very important for geo-referencing the images, image analysis and land cover map preparation.

Observations on water quality and soil characteristics were taken from sixteen selected water bodies during pre-monsoon and twenty-seven water bodies during post-monsoon in the state of Bihar. The parameters of study are Temperature, Transparency, Dissolved Oxygen, Sp.Conductivity, pH,Total Dissolved Solid, Total Alkalinity, Free CO_2, chlorinity, Salinity, NO_3, Total Nitrogen, PO_4, Sulphate, Silicate, hardness, Ca, Mg, Gross Primary Production, Net Primary Production and Respiration. Observations on soil characteristics were made on sand, silt, clay, pH, sp. conductivity, organic Carbon, total Nitrogen, available Phosphate, Free $CaCO_3$ and available-N. The maximum and minimum values observed are presented in Table I(a) to Table IV.

Since the cloud free satellite data are not available for the pre-monsoon period, the feasibility of development of model for prediction of water quality parameters has not been studied. However, the satellite data for post monsoon period have been procured and the analysis is in progress.

Table I (a):-Maximum and Minimum values of Physcio- Chemical Parameters of Different Wetlands of Bihar (Post Monsoon)

	Air Temp. oC	Water Temp. °C	Transperency (c.m.)	D.O. (ppm)	pH	Sp Cond. (milli mhos)	TDS g/L	T.A. (ppm)	Free CO_2 (ppm)	Choloronity (ppt)
Max. value	28.8	26.2	190	10	8.2	0.9	0.585	226	10	0.142
Min.value	20.5	17.0	25	4	7.1	0.2	0.130	50	0	0.0016

Table I (b):- Maximum and Minimum values of Physcio- Chemical Parameters of Different Wetlands of Bihar (Post Monsoon)

	Salinty (ppt)	NO_3 (ppm)	Total N (PPM)	PO_4 (ppm)	sul phate (ppm)	Silicate (ppm)	Hard- ness (ppm)	Ca (ppm)	Mg (ppm)	Gross P.P. mg/l	Net P.P. m3/hr	Resiperation hrs
Max.value	0.286	0.372	0.936	1.104	16.33	12.6	288	72.14	26.0	792	625	300
Min.value	0.033	0.116	0.164	0.030	0.33	1.70	60	12.83	1.9	70.8	37.5	35

Table II(a):- Maximum and Minimum values of Physcio- Chemical Parameters of Different Wetlands of Bihar (Pre Monsoon)

	Air Temp. °C	Water Temp. °C	Transperency (c.m.)	D.O. (ppm)	pH	Sp Cond. (milli mhos)	TDS g/L	T.A. (ppm)	Free CO_2 (ppm)	Choloronity (ppt)
Max.value	26.8	32	160	19.2	9.6	1.0	0.65	250	8.4	127.6
Min.value	20.5	25	20	5.44	7.8	0.3	0.19	76	0	5.6

Table II (b):-Maximum and Minimum values of Physcio- Chemical Parameters of Different Wetlands of Bihar (Pre Monsoon)

	Salinty (ppt)	NO_3 (ppm)	Total N (ppm)	Po4 (ppm)	sul phate (ppm)	Silicat e (ppm)	Hard- ness (ppm)	Ca (ppm)	Mg (ppm)	Gross P.P. mg/l	Net P.P. m3/hr
Max.value	260.3	0.192	0.312	1.066	43.0	9.7	160	56.11	18.0	683	508
Min.value	40.1	0.028	0.027	0.032	3.33	1.0	36	2.83	0.9	104	58.3

Table III:- Maximum and Minimum values of Soil Characteristics of different Wetlands of Bihar for the Month of June , 2002(Pre-monsoon)

	Soil composition			pH	Sp cond. (m mhos / cm)	Organic carbon (%)	Total Nitrogen (%)	Available - P (mg / 100g)	Free CaCO3 (%)	Available - N (mg/ 100 g)
	Sand (/%)	Silt (%)	Clay (%)							
Max.value	55	44	17	9.91	0.8	2.16	1.2	32.1	37	29.68
Min.value	42	35	10	7.82	.3	.57	.051	1.32	8	7.84

Table IV:- Maximum and Minimum values of Soil Characteristics of different Wetlands of Bihar for the Month of Nov , 2002(post-monsoon)

	Soil Composition			pH	Sp cond. (m mhos / cm)	Organic carbon (%)	Total Nitrogen (%)	Available-P (mg / 100g)	Free $CaCO_3$ (%)	Available- N ((mg/ 100 g)
	Sand (/%)	Silt (%)	Clay (%)							
Max.value	52	46	18	9.16	0.7	2.94	0.284	19.1	27	30.24
Min.value	38	35	8	7.2	0.3	1.2	0.084	1.08	8	10.64

5 TECHNOLOGY ASSESSED AND TRANSFERRED

KRISHI VIGYAN KENDRA

Impact study of introduc tion of summer moong cultivation in rice-fallow cropping system in Sundarbans, West Bengal

The study covered randomly selected 60 farmer beneficiaries under FLD of three blocks using Before-After analysis through PRA, Formal household survey and focussed group discussion. The triangulation of data has been done through using all three methods.

The results of this study show that the number of farmers having net income above Rs. 1000-2000 has gone down from 40% before to 5% at present. Before the intervention no farmers has net income above Rs. 5000, but at present 30% of the farmers have been earning more than Rs. 5000/Year. The study reveals that the income of farming community has increased after the adoption.

The productivity of Moong in this area before the intervention was only 1-5 q/ha. which has now gone in the range of 5 to 9 q/ha. and 45% farmers are getting yield of more than 8 q/ha. . Only 30 % farmers had access of medicare facilities earlier and has now gone upto 60% because of an increase in net income.

On farm testing

Varietal Suitability in Rice-cum fish culture

The experiment on Varietal suitability in rice-cum-fish culture was done using Randomized Block Design during Kharif season of 2002-03. The results obtained are given as under.

Results Obtained

Treat-ment	Replication (No. of farmers)	Variety	Production(q/h)			Cost of production	Return from OFT	Income above control
			Rice	Fish	Prawn			
1	6	IET-5656	47.50	22.90	4.90	1,46,250	2,14,750	68,200
2	6	NC-492	43.20	24.90	4.10	1,42,000	2,17,000	57,200
3	6	MTU-7029	47.89	24.80	4.90	1,53,000	2,17,200	57,200
4	6	CR-1017	46.59	24.00	4.90	1,50,000	2,34,000	74,200
5	6	IET-5656	47.50	23.200	-	1,26,000	1,60,000	control

Technology assessed and transferred

Front line demonstrations

I. OILSEEDS :

Crop: Sesamum & Mustard

Krishi Vigyan Kendra has conducted FLD on Sesamum in 3 adopted villages i.e. Nandabhaga, Debnibas and Kusumpukur taking 35 farmers as beneficiaries in summer 2001-2002.

Crop	Variety	Area	No. of Demonstrations	Demonstration Yield (Q/ha.)			Local checks (Q/ha.)	% Increase over Local check
				Max.	Min.	Avg.		
Sesamum	**Improved Selection -5**	05	35	**8.75**	6.35	**8.0**	6.0	**33.33**
Mustard	**RW-351** **Sanyukta acech**	6 4	45 30	**11.5** **11.9**	7.5 7.9	**10.30** **10.75**	7.0 7.0	**47.14** **53.57**

The feedback received for Sesamum that Improved Selection-5 has given satisfactory average yield of 8.0 q/ha. without showing any sign of stem rot and phyllody in the field. Crop matured in 80-85 days after sowing.

II. PULSES

Crop - Green gram

Krishi Vigyan Kendra has conducted FLD on Green gram in 2 adopted villages namely Moondapara and Buddhakhali taking 30 farmers as beneficiaries in summer 2001-2002.

Production Performance

Crop	Variety	Area	No. of Demonstrations	Demonstration Yield (Q/ha.)			Local checks (Q/ha.)	% Increase over Local check
				Max.	Min.	Avg.		
Moong	**6 K-851**	03	30	**8.85**	6.8	**7.8**	6.5	**20**

The feedback received is the green gram variety K-851 has shown profuse vegetative growth with uniform maturity of pods and has given 20% more yields over local check in Sunderban region. The response of farmers is in affirmative as well as satisfactory.

Crop : Green gram 2002-2003

This year crop Green gram Variety PDM-54 has been sown in 5.0 ha. land of 35 farmers in the second week of February in 4 adopted villages namely Bhuban nagar, Kumarpur, Debnibas and Arunberia. At present the growth of crop is satisfactory. The crop will mature and ready for harvesting in the month of May 2003.

III Other than Oilseeds and Pulses

***Crop* : Rice**

Under FLD other than oilseeds and pulses, demonstrations of Kharif Rice varieties Swarna (IET 5656), Dharitri (CR-1017), Sabita (NC-492), Ranjit and Swarna mashuri (MTU-7029) were conducted on the field of 30 farmers in the 2 adopted villages namely Gangadharpur and Bhuvannagar. The Rice varieties Swarna (IET-5656), Dharitri (CR-1017) Sabita (NC-492), Ranjit and Swarna Mashuri (MTU-7029) have given 55.73,52.45, 41.36, 41.36 and 56.70 percent higher yield over control variety Dudheswar in the Sundarban region of West Bengal.

Production Performance

Crop	Variety	Area	No. of farmers demonstration	Duration	Grain/Seed Character	Grain Yield	Percent age increase over Control
Kharif rice	Swarna (IET 5656)	1.0	6	142	Bold Coarse	47.50	55.43
	Dharitri (CR-1017)	1.0	6	158	Bold Coarse	46.59	52.45
	Sabita (NC-492)	1.0	6	157	Long Fine	43.20	41.36
	Swarna mashuri (MTU-7029)	1.0	6	155	Long Fine	47.89	56.70
	Ranjit	1.0	6	145	Bold Fine	43.20	41.36
	Dudheswar	control	-	145	Bold Fine	30.56	Control

***Crop* : Chilli**

This year the demonstrations of Chilli variety Pusa Sadabahar have been conducted on 10.0 ha. land of 50 farmers in 4 adopted villages namely Mainapara, Kumarpur, Moondapara and Bhuvannagar of KVK under Frontline Demonstration Programme on other than Oilseeds and Pulses. The crop is at present standing in good condition and the growth is satisfactory.

EDUCATION AND TRAINING

ABSTRACT OF TRAINING PROGRAMMES

Sl. No.	Type of Trainees	On- / Off-Campus	No. of Training Courses	Total No. of Participants			Scheduled castes			Scheduled tribes		
				M	W	T	M	W	T	M	W	T
1.	PF	On	21	105	104	209	44	41	85	9	3	12
2.	PF	Off	48	477	441	918	167	171	338	36	21	57
3.	PF	Total	69	582	545	1127	211	212	423	45	24	69
4.	RY	On	17	82	88	170	37	36	73	5	5	10
5.	RY	Off	37	325	366	691	123	142	265	5	15	20
6.	RY	Total	54	407	454	861	160	178	338	10	20	30
7.	EF	On	1	-	10	10	-	2	2	-	-	-
8.	EF	Off	12	94	56	150	33	25	58	7	8	15
9.	EF	Total	13	94	66	160	33	27	60	7	8	15
TOTAL (A)			**136**	**1083**	**1065**	**2148**	**404**	**417**	**821**	**62**	**52**	**114**
10.	FLD on Rice		6	80	40	120	25	10	35	10	7	17
11.	FLD on Chilli		3	40	20	60	10	6	16	8	2	10
12.	FLD on Mustard		7	85	60	145	30	16	46	15	9	24
13.	FLD on Sesamum		5	65	35	100	15	10	25	10	7	17
14.	FLD on green gram		5	65	35	100	20	11	31	10	6	16
TOTAL(B)			**26**	**335**	**190**	**525**	**100**	**53**	**153**	**53**	**31**	**84**
GRAND TOTAL(A+B)			**162**	**1438**	**1255**	**2673**	**504**	**470**	**974**	**115**	**83**	**198**

FIELD EXTENSION EDUCATION ACTIVITIES

Activities	Date/ days (No)	No. of beneficiaries			No. of Extension Functionaries		
		Men	Women	Total	Men	Women	Total
i) Field days	10	400	275	675	20	10	30
ii) Oil seed Day	08	160	80	240	08	05	13
iii) Pulse Day	02	52	30	82	06	02	8
iv) Fish Farmers Day	03	50	20	70	06	05	11
v) Kisan Mela/Exhibition	02	400	250	650	08	06	14
vi) FLD Training	26	335	190	525	53	34	87
vii)Film/Slide Show	10	100	70	170	03	02	05
TOTAL	**61**	**1587**	**915**	**2492**	**101**	**64**	**165**

EXTENSION ACTIVITIES

Advisory services

Necessary advice/suggestions on various aspects of Inland fisheries were rendered to:

Individuals who called on office : A total of 196 clientele owning 216 ponds and 14 bheries ,12 entrepreneurs, 6 extension functionaries of State Fisheries Departments and 8 officers of State Development Departments/NGOs who called on at Institutes, headquarters Barrackpore, were provided with solutions to their respective problems.

Individuals through letters : Necessary advice was rendered through letter to the clientele who sought necessary advice for their problems.

Fish farmers/fishermen	: 78
Entrepreneur	: 16
College/University	: 10
Non Govt. Organization	: 4

Individuals over telephone : Necessary solution on fish mortality, management of practices were rendered to 22 clientele over phone.

Individuals through farm visit : Necessary advice were rendered to 6 fish farmers for their problems after visiting their farm.

Training

1. A 10-day On -Job training course on Inland fisheries was organized for the students of Industrial Fisheries course of SNS College, Motihari, Bihar, during May 24 and June 4, 2002.

2. A 7-day On- Job training course of Inland fisheries was organized for the students of Ramnagar College, Midnapore, West Bengal during June 7-13, 2002.

3. A 7-day training course on Inland fisheries was organized at Madhubani, Bihar during September 2-9, 2002 for the benefit of rural resource poor fish farmers of the region. The training infrastructure facilities were provided by Agriculture Technology Management Agency (ATMA). A total of 90 (ninety) fish farmers including four farmwomen participated in the training course.

4 A 10-day training programme on Ornamental Fishery was organized under NATP during March 17-27, 2003. Twenty women of the fishermen community underwent the training course.

- A training programme on Fisheries Management of Floodplain Wetlands (Beels) of Assam was organised from 25-30 November, 2002. Officers of the Fisheries Department of Assam participated in the training programme.

- A 10 day training programme on Inland Fisheries Development for fish farmers of Meghalaya was organised jointly by CIFRI, CIFA at ICAR Complex for North Eastern Region, Barapani from January 20-30, 2003. A total of 30 fish farmers from different districts of the state participated.

- Central Inland Fisheries Research Institute organised a 3 day training programme on Pen Culture in Beels at its Northeastern Regional Centre at Guwahati from February 4-6, 2003. The training was meant for disseminating the latest technology on various aspects of pen culture in beels to 50 prospective fish farmers of Assam.

Exhibition

1. The Institute participated in Aqua- Fair 2002 organised in connection with National symposium on Fisheries enhancement in inland waters- challenges ahead at Barrackpore, during April 27-28, 2002.

2. The Institute participated in the National Science and Culture Expo. 2002 at Nazrul Maidan, Kolkata during September 4-11, 2002.

3. The Institute participated in the Exhibition- Matsya Prodarsani held at Nainital during October 4-5, 2002.

1. The Institute participated in the Agrotech.- India and Gramin Mela 2002,organised at Subash Sangha Maidan, Kolkata during September 29 and October 10, 2002.

2. The Institute participated in the 2nd Indian Fisheries Science Congress Exhibition held at Bhopal during October 23-26, 2002.

3. The Institute participated in an exhibition on Jatiya Prani Sampad Vikash at State level at Barasat during November 13-17, 2002.

4. The Institute participated Gramin Mela organized by Srijani Sanstha at Chhoto Jagulia during January 4-8,2003.

5. The Institute participated in the 6th Banga Sanskriti Utsab at Kalyani during January 3-12,2003.

6. The Institute participated in the "Fishcovery 2002" organized by Sixth Indian Fisheries forum at CIFE, Mumbai during December 17-20,2002.

7. The Institute participated in the First Indian Pearl Congress Exhibition organized by CMFRI, Cochin during February 5-8,2003.

Communication Service : Extension literature, Video -cassette and Audio-Visual Aids were provided to the officials of Govt. Agencies, Non Govt. Organizations, Entrepreneurs, Farm Science Clubs in various occasions as per their request.

Talks delivered : 32 talks on different aspects of Inland Fisheries and Extension were delivered to the Trainee farmers, Govt. Officials, Extension Functionaries, Undergraduate, and Postgraduate and students of various Colleges, Universities of the country.

Mass Awareness Campaigns : 12 mass awareness campaigns were organized at Farakka and coastal districts of West Bengal for creating awareness towards conservation of Hilsa and other fish/ prawn seed. Sizeable fish seed collectors of the area were educated to stop destruction of fish/shell fish seed. Proper linkage was established with the local Panchyat bodies to monitor the same. Leaflets were distributed to the general public for strengthening the approach.

6 EDUCATION AND TRAINING

Man Power Development

Training

Dr. M.A. Khan and Dr. (Mrs.) Usha Moza, Principal Scientists, CIFRI, participated in a course on "MS Office (Basic)" from 30th September, 2002 to 5th October, 2003 at IASRI, New Delhi.

Dr. P.K. Katiha, Senior Scientist, participated in ICAR short course on Gender perspectives in research, extension and education for Agricultural development, organised by Centre for Studies on Gender concern in Agriculture, Kerala Agricultural University, Thrissure, Kerala & M.S. Swaminathan Research Foundation, Chennai at KAU, Thrissure from October 21-30, 2002.

Dr. (Mrs.) K. Mitra, Principal Scientist, attended National Convention on Sexual Harrassment and Gender Justice at Bangalore on 22 & 23 November, 2002.

Mr. Praveen Maurye, Scientist, CIFRI has undergone a training programme on DNA integrity test/comet assay at Indian Toxicology Research Centre, M.G. Marg, Lucknow, from December 9-20, 2002.

Deputation (abroad)

Dr. P. K. Katiha, Senior Scientist, CIFRI, participated in special session on "Strategies and Options for increasing and sustaining fisheries and aquaculture production to benefit poor household in Asia during the 2002 meeting of the World Aquaculture Society (WAS-2002) 24-27 April, 2002 at Beijing, China.

Dr. V.V. Sugunan, Director, participated in Stakeholder consultation on Fish to 2020 : Global outlook for developing countries, fish for all summit and third meeting of the Asia-Pacific group of fisheries and aquatic research (GoFAR) at Penang, Malaysia from 2-5 November, 2002.

Dr. P. K. Katiha, Senior Scientist, CIFRI was deputed to Malaysia for attending the Second Regional Workshop on Aquaculture Technologies and Fishing Practices in Asia of ICAR-ICLARM ADB Project entitled "Strategies and Options for increasing and sustaining fisheries and aquaculture production to benefit poor household in Asia" from 17-27 March 2003.

7 AWARDS AND RECOGNITIONS

Dr. V. V. Sugunan, Director CIFRI, was conferred award of Nature Conservators, **Environmental Conservators Excellency Gold Medal** by the Nature Conservators, Muzaffarnagar-251 001.

Dr. V. V. Sugunan, Director CIFRI and Dr. R.N. Seth, Principal Scientist, Riverine Division, CIFRI were awarded the F.Z.S.(Cal.) by the Zoological Society, Kolkata in its 56th Annual General Meeting. The awarded was conferred to them for their outstanding contribution in the field of fishery.

Dr. P. K. Sukumaran, Principal Scientist, CIFRI, has been nominated for the Honorary Fellowship (F.S.Sc.) of the Society for Science, Dumka, for his outstanding contributions in the field of sciences.

On-Campus Training Programme in Home Science

Scientific Advisory Committee Meeting
at Krishi Vigyan Kendra

Frontline demonstration on Kharif Rice

Farmers Awareness Programme on Rural Godown Subsidy Scheme at Narayanpur

Inaugural session of the training programme in progress

Hon'ble Minister of Fisheries, Govt. of Assam
Shri Etuwa Munda inaugurating the training programme

Training Programme of Barapani in progress

Exhibition organised by CIFRI

Shri Birendra Kumar Bhattacharjya, Scientist, CIFRI, Guwahati was awarded Dr. Hiralal Chaudhuri Gold Medal of the Central Institute of Fisheries Education, Mumbai for securing the first rank with distinction among the successful Ph.D.(Fish & Fisheries Science) students of the Institute (1998-2001 batch). Shri Bhattacharjya carried out his doctoral research on the topic "Trophic structure and fishery potential of selected floodplain wetlands (*beels*) of Brahmaputra Valley.

Mrs. Keya Saha and Shri Dipak Kumar Biswas, Technical Officers, CIFRI were awarded M.Sc. in Ecology and environment by the Sikkim Manipal University of Health, Medical and Technological Sciences, Gangtok, Sikkim.

8 LINKAGES AND COLLABORATION IN INDIA AND ABROAD INCLUDING EXTERNALLY FUNDED PROJECTS

Collaborative project

ADB sponsored ICAR-ICLARM collaborative project "**Strategies and options for increasing and sustaining fisheries and aquaculture production to benefit poor households in Asia".**

The Floodplain Wetlands Division is a collaborating Centre for the NATP Project, Germplasm inventory and gene banking of freshwater fishes run by the National Bureau of Fish Genetic Resources, Lucknow. The project comprises a systematic survey of the fisheries resources of the North-Eastern region. The scheme gives special emphasis on the topical and commercial importance of fish germplasm of the region, which needs to be carefully conserved and protected.

CIFRI is collaborating with NBFGR, Locknow for studying the population genetic structure of hilsa *Tenualosa ilisha* from different river systems.

NATP Projects

1 Household food and nutritional security for tribal, backward and hilly areas
– Programme No.4.

2 Household food and nutritional security for tribal, backward and hilly areas
– Programme No.6.

3. Germplasm inventory evaluation and gene banking of freshwater fishes.

Bhaumik, Utpal (2003). Hatchery management for carps. *In* Training on Inland Fisheries Development for the Fish Farmer of Meghalaya, Jan. 20-30, 2003. Cent. Inland Fish. Res. Inst., Barrackpore & ICAR Res. Complex for NEH, Barapani, 2003. : 21-24.

Bhaumik, Utpal (2003). Role of extension in conservation of aquatic environment for maintenance of optimum fish health and production. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 171-177.

Bhaumik, Utpal & Tapas Paria (2003). Management status of reservoirs and its utilization for increasing fish production in the country. *In* Workshop on Fisheries Management in the Lentic Water System : Stocking of Reservoirs with Fish Seed. Feb. 19-20, 2003 Under National Agriculture Technology Project, CIFRI, Barrackpore : 46-58.

Biswas, B. K. & S. K. Konar (2002). A sorry state of the river Ganga at Hatidah in Bihar. *In* Ecology & Conservation of Lakes Reservoirs & Rivers.Vol. I : (*ed.*) Arvind Kumar, ABD Publishers, Jaipur : 189-203.

Chandra, K. (2003). Principles governing bio-assay and use of toxicity tests on fish as a tool. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 127-131.

Das, A. K. (2002). Phytoplankton primary production in some selected reservoirs of Andhra Pradesh. *Geobios*, 29 (1) : 52-57.

Das, A. K. (2002). Stratification in Karnataka reservoirs. *Fish Technol.*, 39 (1) : 70-77.

Das, A. K., D. S. Krishna Rao, P. K. Sukumaran & M. Karthikeyan (2002). Strategies for management of Karnataka reservoirs. *Fishing Chimes* 22 (2) : 17-21.

Das, A. K. (2003). Habitat status of reservoirs in India in relation to fish health. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 32-37.

Das, A. K. (2003). Role of abiotic factors in enhancing fish production from small reservoirs of India. *In* Workshop on Fisheries Management in the Lentic Water System : Stocking of Reservoirs with Fish Seed. Feb. 19-20, 2003 Under National Agriculture Technology Project, CIFRI, Barrackpore : 113-127.

Das, M. K. (2002). Fish diseases and their remedial measures. *In* Training Programme on Development of Reservoir Fisheries in India, CIFRI, Barrackpore, March 12-16. : 78-85.

Das, Manas K., R. K. Das & S. K. Mandal (2003). Some stress sensitive parameters of young major carp *Labeo rohita* (Hamilton – Buchanon). *Indian J. Fish.*, 49 (1) : 73-78.

Das, Manas Kr. (2003). Bioindicator approach for assessing impact of environmental stress on fish health. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 151-153.

Das, M. K. (2003). Fish diseases and their remedial measures. *In* Training on Inland Fisheries Development for the Fish Farmer of Meghalaya, Jan. 20-30, 2003. Cent. Inland Fish. Res. Inst., Barrackpore & ICAR Res. Complex for NEH, Barapani, 2003. : 61-68.

Das, Manas Kr. (2003). Fish diseases in small reservoirs and its remedial measures. *In* Workshop on Fisheries Management in the Lentic Water System : Stocking of Reservoirs with Fish Seed. Feb. 19-20, 2003 Under National Agriculture Technology Project, CIFRI, Barrackpore : 164-170.

Das, Manas Kr. (2003). The fish and its environment – methods for stress diagnosis in fish. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 114-119.

Das, Manas Kr. (2003). Integrated fish farming with livestock, poultry and duck. *In* Training on Inland Fisheries Development for the Fish Farmer of Meghalaya, Jan. 20-30, 2003. Cent. Inland Fish. Res. Inst., Barrackpore & ICAR Res. Complex for NEH, Barapani, 2003. : 35-45.

Das, Sukla, Anjali De & Fatik Manna (2003). Bibliography on Estuarine Fisheries of India, 1948-2000. Bull. Cent. Inland Fish. Res. Inst. Barrackpore, No. 114, 172p.

Datta, Tanusree, Subhendu Acharya & Manas Kr. Das (2002). Physiological effect of cold shock in juvenile *Labeo rohita* (Hamilton-Buchanon). *Indian J. Fish.*, 49 (2) : 223-227.

Ghosh, Amitabha (2003). Environmental status of sewage-fed and estuarine wetlands in relation to fish health. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 45-48.

Gupta, R. A. (2003). Methods for assessment of fish population in inland water bodies. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 154-164.

Hajra, A. (2003). Status and use of biochemical markers in fish for assessing fish and ecosystem health. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 128-131.

Hassan, M. A. (2003). Cage/pen culture of fish. *In* Training on Inland Fisheries Development for the Fish Farmer of Meghalaya, Jan. 20-30, 2003. Cent. Inland Fish. Res. Inst., Barrackpore & ICAR Res. Complex for NEH, Barapani, 2003. : 73-76.

Hassan, M. A. (2003). Ecological status of wetlands in India as suitable fish habitat – case studies. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 38-44.

Hassan, M. A. (2003). Feed preparation for semi-intensive fish culture. *In* Training on Inland Fisheries Development for the Fish Farmer of Meghalaya, Jan. 20-30, 2003. Cent. Inland Fish. Res. Inst., Barrackpore & ICAR Res. Complex for NEH, Barapani, 2003. : 69-72.

Jha, B. C. (2002). Fish diversity in Indian reservoirs – issues, threats and conservation needs. *In* Training Programme on Development of Reservoir Fisheries in India, CIFRI, Barrackpore, March 12-16. : 16-21.

Jha, B. C. (2003). Fish diversity in small reservoirs – issues, threats and conservation needs. *In* Workshop on Fisheries Management in the Lentic Water System : Stocking of Reservoirs with Fish Seed. Feb. 19-20, 2003 Under National Agriculture Technology Project, CIFRI, Barrackpore : 149-158.

Jha, B. C. (2003). Use of plankton and periphyton as bioindicators of optimum water quality for fish health. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 100-109.

Katiha, P. K. (2002). Socio-economic conditions in reservoir fisheries management. *In* Training Programme on Development of Reservoir Fisheries in India, CIFRI, Barrackpore, March 12-16. : 58-70.

Katiha, Pradeep K., Y. S. Negi & S. C. Tewari (2002). Economics and constraints of reservoir fisheries in Himachal Pradesh. *In* 5th Indian Fisheries Forum : Proceedings, 17-20 January, 2000, Bhubaneswar, Orissa, (*eds.*) S. Ayyappan, J. K. Jena & M. Mohan Joseph 2002. Asian Fisheries Society, Indian Branch, Mangalore & Association of Aquaculturist : Bhubaneswar : 385 – 390.

Kathia, P. K. (2003). Economic impact of environmental degradation vis-a-vis fisheries. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 178-188.

Kathia, Pradeep K, U. P. Singh, A. K. Mandloi & H. S. Sehgal (2003). Socio economic status of fishermen of three adopted reservoirs under NATP. *In* Workshop on Fisheries Management in the Lentic Water System : Stocking of Reservoirs with Fish Seed. Feb. 19-20, 2003 Under National Agriculture Technology Project, CIFRI, Barrackpore : 33-45.

Kaushal, D. K. & V. K. Sharma (2003). Management of fisheries in the reservoirs of Punjab and Haryana. *In* Workshop on Fisheries Management in the Lentic Water System : Stocking of Reservoirs with Fish Seed. Feb. 19-20, 2003 Under National Agriculture Technology Project, CIFRI, Barrackpore : 128-134.

Khan, M. A. (2002). Biological monitoring of environmental quality of reservoirs. *In* Training Programme on Development of Reservoir Fisheries in India, CIFRI, Barrackpore, March 12-16. : 34-46.

Khan, M. A. (2002). Length weight relationship relative condition index of *Notopterus notopterus* (Pallas), Tilaiya reservoir, Bihar. *Rec. Zool. Surv. India,* 101 (pts. 1&2) : 1-7.

Khan, M. A. (2003). Environmental status of rivers in India as suitable fish habitat. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 17-25.

Khan, M. A. (2003). Optimisation fish yield in small reservoirs of India. *In* Workshop on Fisheries Management in the Lentic Water System : Stocking of Reservoirs with Fish Seed. Feb. 19-20, 2003 Under National Agriculture Technology Project, CIFRI, Barrackpore : 183-191.

Khan, M. A. (2003). Pollution indices – their use for evaluating aquatic ecosystem in relation to fish health. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 120-126.

Khan, M. A., R. S. Panwar, A. Mathur & Rekha Jetly (2003). Monitoring of toxicity of heavy metals in the river Ganga. In Sediment Quality Assessment : Insight and Progress (Ecovision World Monograph Series) : 1-10.

Kumar, Dhirendra (2003). Physico-chemical characteristic of two ecologically different ponds. *In* 5th Indian Fisheries Forum : Proceedings, 17-20 January, 2000, Bhubaneswar, Orissa, (*eds.*) S. Ayyappan, J. K. Jena & M. Mohan Joseph 2002. Asian Fisheries Society, Indian Branch, Mangalore & Association of Aquaculturist : Bhubaneswar : 193-198.

Kumar, D (2003). Use of benthos as bioindicator of water quality in relation to fish health. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 110-113.

Mandal, S. K. (2002. Fisheries statistics in reservoir fishery. *In* Training Programme on Development of Reservoir Fisheries in India, CIFRI, Barrackpore, March 12-16. : 86-91.

Mandal, S. K. (2003). Fisheries statistics for reservoir and concept of maximum sustainable yield. *In* Workshop on Fisheries Management in the Lentic Water System : Stocking of Reservoirs with Fish Seed. Feb. 19-20, 2003 Under National Agriculture Technology Project, CIFRI, Barrackpore : 139-142.

Mandal, S. K. (2003). Statistical methods for interpreting data on environmental stressors and its impact on fish health. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 165-170.

Mishra, R. N. (2003). Methods of assessment of industrial waste and sewage on the ecosystems in relation to fish health. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 96-99.

Mishra, S. S., A. Panigrahi & S. K. Mishra (2001). Towards development of diagnostic kit based on nitrocellulose enzyme immunoassay for rapid detection of WSSV in shrimp. *Fishing Chimes,* 21(2) : 19-21.

Mishra, S. S. (2002). Recent advances in shrimp disease diagnosis. *In* 5th Indian Fisheries Forum : Proceedings, 17-20 January, 2000, Bhubaneswar, Orissa, (*eds.*) S. Ayyappan, J. K. Jena & M. Mohan Joseph 2002. Asian Fisheries Society, Indian Branch, Mangalore & Association of Aquaculturist : Bhubaneswar : 151-157.

Mishra, S. S., M. S. Shekhar, S. K. Mishra & V. Thiagarajan (2002). Development of gene probe for rapid detection of white spot syndrome virus in shrimp using dot-blot hybridization technique : scope for field application. *Fishing Chimes.* 22 (7) : 44-48.

Mishra, S. S. (2003). Microbial assessment of water quality for fish health management. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 145-150.

Mishra, S. S. (2003). Prevalence of microbial pathogens and occurrence of disease in fish in reservoirs. *In* Workshop on Fisheries Management in the Lentic Water System : Stocking of Reservoirs with Fish Seed. Feb. 19-20, 2003 Under National Agriculture Technology Project, CIFRI, Barrackpore : 171-182.

Mitra, Krishna (2003). Histopathology – an effective tool for assessing environmental impact on fish health. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 140-142.

Mohanty, Bimal P, Sasmita Mohanty, Subas C Parija & Rabidra N. Seth (2002). Piscine cytochrome P 4501 A – a sensitive biomarker for aquatic environmental monitoring. *Proc. nat. Acad. Sci. India,* 72B(1) : 1-24.

Moza, Usha (2002). Status and distribution of coldwater fisheries in Indo-gangetic system. *In* Highland Fisheries & Aquatic Resource Management (eds.) K. K. Vass & H. S. Raina. National Research Centre on Coldwater Fisheries, Bhimtal : 208-219p.

Moza, Usha & D. N. Mishra (2002). Effect of environmental perturbations on the fishery – a case study of river Ghaggar in Haryana. *In* 5th Indian Fisheries Forum : Proceedings, 17-20 January, 2000, Bhubaneswar, Orissa, (*eds.*) S. Ayyappan, J. K. Jena & M. Mohan Joseph 2002. Asian Fisheries Society, Indian Branch, Mangalore & Association of Aquaculturist : Bhubaneswar : 313-318.

Mukhopadhyay, M. K., Utpal Bhaumik, S. K. Saha & A. K. Das (2002). Sustainable production of prawn in tide wetland and communication approach. *J. Curr. Sci.* 2(1) : 27-34.

Mukhopadhyay, M. K. (2003). Biological monitoring of aquatic environmental quality with special reference to small reservoirs. *In* Workshop on Fisheries Management in the Lentic Water System : Stocking of Reservoirs with Fish Seed. Feb. 19-20, 2003 Under National Agriculture Technology Project, CIFRI, Barrackpore : 159-163.

Mukhopadhyay, M. K. (2003). Status and methods of assessment of heavy metals in aquatic ecosystems in India in relation to fish health. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 70-73.

Mukhopadhyay, M. K. (2003). Stress effect evaluation on fish – organ indices and growth assessment methods. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 137-139.

Nath, D. (2002). Methods of evaluating primary production in reservoirs. *In* Training Programme on Development of Reservoir Fisheries in India, CIFRI, Barrackpore, March 12-16. : 8-15.

Nath, D. (2003). Estuaries in India – their present ecological status in relation to fish health. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 26-31.

Nath, D. (2003). Physico-chemical parameters of water in aquatic ecosystems in relation to fish health. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 59-65.

Paria, Tapas & Sushil Kanta Konar (2002). High production strategies in impounded waters of South and North 24 Parganas, District of West Bengal. *In* Ecology & Conservation of Lakes, Reservoirs & Rivers. Vol. I : (*ed.*) Arvind Kumar, ABD Publishers, Jaipur : 527-543.

Pathak, V. Balbir Singh, L. R. Mahavar & B. D. Saroj (2002). A comparative study of hydrological status and energy dynamics of beels in eastern Uttar Pradesh. *Proc. nat. Acad. Sci. India*, 72B (1) : 47-57.

Pathak, V. (2003). Energy dynamics in relation to fish production of small reservoirs. *In* Workshop on Fisheries Management in the Lentic Water System : Stocking of Reservoirs with Fish Seed. Feb. 19-20, 2003 Under National Agriculture Technology Project, CIFRI, Barrackpore : 106-112.

Rao, D. S. Krishna, A. K. Das, M. Ramakrishniah & M. Karthikeyan (2002). Primary production and fishery potential of reservoirs of Karnataka. *Indian J. Fish*, 49(2) : 123-133.

Saha, P. K. (2002). Effect of lime on the transformation of organic nitrogen in sewage fed fish pond soil. *In* 5th Indian Fisheries Forum : Proceedings, 17-20 January, 2000, Bhubaneswar, Orissa, (*eds.*) S. Ayyappan, J. K. Jena & M. Mohan Joseph 2002. Asian Fisheries Society, Indian Branch, Mangalore & Association of Aquaculturist : Bhubaneswar : 239-240.

Saha, P. K. (2003). Possibilities of development of fisheries in reservoirs of north eastern region. *In* Workshop on Fisheries Management in the Lentic Water System : Stocking of Reservoirs with Fish Seed. Feb. 19-20, 2003 Under National Agriculture Technology Project, CIFRI, Barrackpore : 135-138.

Saha, P. K. (2003). Role of physico-chemical parameters of soil and water for enhancing fish production from the water bodies. *In* Training on Inland Fisheries Development for the Fish Farmer of Meghalaya, Jan. 20-30, 2003. Cent. Inland Fish. Res. Inst., Barrackpore & ICAR Res. Complex for NEH, Barapani, 2003. : 57-60.

Saha, P. K. (2003). Soil characteristics of importance in aquatic ecosystem in relation to fish health. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 66-69.

Samanta, S. & S. K. Das (2002). Abiotic factors and their significance in reservoir fisheries management. *In* Training Programme on Development of Reservoir Fisheries in India, CIFRI, Barrackpore, March 12-16. : 47-57.

Samanta, S. (2003). Status and methods of assessment of pesticides in aquatic ecosystems in India in relation to fish health. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.115 : 74-82.

Sen Neera & Kumudranjan Naskar (2002). Algal communities in the intertidal mangrove niches of Sunderbans. *J. Interacad,* 6 (4) : 420-433.

Seth, R. N. (2003). The rhythmic breeding behaviour of two giant size freshwater catfishes of India. *Fishing Chimes,* 22 (10&11) : 100-102.

Seth, R. N. & Pradeep K. Katiha (2002). Observations on duration of brood care and breeding activities of large size catfish *Aorichthys seenghala* (Sykes) in nature. *In* 5th Indian Fisheries Forum : Proceedings, 17-20 January, 2000, Bhubaneswar, Orissa, (*eds.*) S. Ayyappan, J. K. Jena & M. Mohan Joseph 2002. Asian Fisheries Society, Indian Branch, Mangalore & Association of Aquaculturist : Bhubaneswar : 1-4.

Shree Prakash, S. K. Srivastava & Balbir Singh (2000). Macrophytic association of flora and fauna in oxbow lakes (beels). *Bioved,* 11 (1-2) : 1-5.

Shree Prakash (2002). Studies on affinities of Ganga river prawn *Macrobrachium gangeticum* (Choprai). *In* 5th Indian Fisheries Forum : Proceedings, 17-20 January, 2000, Bhubaneswar, Orissa, (*eds.*) S. Ayyappan, J. K. Jena & M. Mohan Joseph 2002. Asian Fisheries Society, Indian Branch, Mangalore & Association of Aquaculturist : Bhubaneswar : 241-244.

Singh, B. K. (2001). Ovaprim as an inducing agent in silver carp breeding. *Punjab Fisheries Bulletin,* 12 (2) : 67-69.

Singh, B. K. (2002). Indices of fecundity in the silver carp *Hypophthalmichthys* molitrix (Valenciennes) from a pond near Pune, Maharashtra. *In* 5th Indian Fisheries Forum : Proceedings, 17-20 January, 2000, Bhubaneswar, Orissa, (*eds.*) S. Ayyappan, J. K. Jena & M. Mohan Joseph 2002. Asian Fisheries Society, Indian Branch, Mangalore & Association of Aquaculturist : Bhubaneswar : 259-262.

Singh, D. N., A. K. Das, D. S. Krishna Rao & P. K. Sukumaran(2002). Management measures to develop fish production in rivers, reservoirs and lakes of Karnataka. *In* Present status and future challenges of Indian aquaculture in Karnataka in the new millennium. Proc. National Seminar (eds.) C. Seenappa & C. Vasudevappa, UAS, Bangalore : 14-22.

Sugunan, V. V. (2002). *Clarias gariepinus* (African Catfish) gravitates into Yamuna, Sutlej, Godavari-angst comes true. *Fishing Chimes* **22** (7) : 50-52.

Sugunan, V. V. (2002). Fish seed stocking – a useful tool for fisheries enhancement. *In* Training Programme on Development of Reservoir Fisheries in India, CIFRI, Barrackpore, March 12-16. : 22-29.

Sugunan, V. V. (2002). Reservoir fisheries in India – prospects and problems. *In* Training Programme on Development of Reservoir Fisheries in India, CIFRI, Barrackpore, March 12-16. : 1-7.

Sugunan, V. V. (2003). Biological monitoring tools for aquatic ecosystem and fish health. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish Res. Inst.*, Barackpore. No.**115** : 49-58.

Sugunan, V. V. (2003). Inland Aquatic resources of India and their relevance to fisheries development. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish. Res. Inst.*, Barackpore. No.**115** :1-16.

Sugunan, V. V. (2003). Management of reservoir fisheries. *In* Training on Inland Fisheries Development for the Fish Farmer of Meghalaya, Jan. 20-30, 2003. Cent. Inland Fish. Res. Inst., Barrackpore & ICAR Res. Complex for NEH, Barapani, 2003. : 82-86.

Sugunan, V. V. (2003). Modelling approach towards management of fisheries of small reservoirs stocking with fish seed. *In* Workshop on Fisheries Management in the Lentic Water System : Stocking of Reservoirs with Fish Seed. Feb. 19-20, 2003 Under National Agriculture Technology Project, CIFRI, Barrackpore : 59-73.

Sukumaran, P. K. (2002). Coliform bacteria - an index of aquatic pollution. *Trends in Life Science,* 17 (1) : 19-24.

Sukumaran, P. K. (2002). Growth of major carps in a lentic habital having permanent microcysts blooms. *Environ & Ecol.*, 20(1) : 191-195.

Sukumaran, P. K. (2002). Primary production dynamics of a perennial tank in Bangalore , Karnataka. *Geobios*, 29(1) : 41-46.

Sukumaran, P. K. & A. K. Das (2002). Plankton, abundance in relation to physico-chemical features in a Peninsular man-made lake. *Environ & Ecol.*, 20 (4) : 873-879.

Sukumaran, P. K. & H. C. Joshi (2002). Studies on river pollution in Tungabhadra with special reference to biotic organisms. *In* Conservation and Management of Aquatic Ecosystem (ed.) K. Shankaran Unni, Daya Publishing House, Delhi : 139-149.

Sukumaran, P. K., S. Parameswaran, & K. Sakuntala (2002). Observation on the limnological aspects of perennial tank in Bangalore. *In* Conservation and Management of Aquatic Ecosystem (ed.) K. Shankaran Unni, Daya Publishing House, Delhi : 90-100

Vinci, G. K. (2002). Role of pen and cage culture in reservoir fisheries. *In* Training Programme on Development of Reservoir Fisheries in India, CIFRI, Barrackpore, March 12-16. : 71-77.

Vinci, G. K. (2003). Eutrophication and its impact on fish health. *In* Summer School on Methods of Assessment of Aquatic Ecosystem for Fish Health Care, 18 July to 16 August 2002. (*eds.*) V. V. Sugunan, M. K. Das, G. K. Vinci & Utpal Bhaumik. *Bull. Cent. Inland Fish. Res. Inst.,* Barackpore. No.115 :83-95.

Vinci, G. K. (2003). Scope of pen and cage culture in small reservoirs. *In* Workshop on Fisheries Management in the Lentic Water System : Stocking of Reservoirs with Fish Seed. Feb. 19-20, 2003 Under National Agriculture Technology Project, CIFRI, Barrackpore : 143-148.

11 LIST OF APPROVED ON-GOING PROJECTS (TITLE ONLY)

Project No.	Name of Project
RI/A/1	ECOLOGY AND PRODUCTION RELATIONSHIPS IN PENINSULAR RIVER SYSTEMS
RI/A/2	BREEDING BIOLOGY AND FISHERY OF SILVER CARP, *HYPOPHTHALMICHTHYS MOLITRIX* (VAL.) IN SUTLEJ RIVER
RI/B/2	ASSESSMENT OF ECOLOGY, BIODIVERSITY AND PRODUCTION POTENTIAL OF INDUS RIVER SYSTEM
RI/B/3	EVALUATION OF HABITAT DEGRADATION IN THE CONTEXT OF FISHERIES ECOLOGY IN RIVER GANGA
ES/B/1	INVESTIGATIONS ON THE FISHERIES OF HOOGHLY ESTUARINE SYSTEM AND ITS WETLANDS
ES/B/2	ECO-STATUS OF SELECTED WEST COAST ESTUARIES OF INDIA
ES/B/3	STUDIES ON HILSA FISHERIES IN THE STRETCH BETWEEN FARAKKA AND SAGAR ISLAND
RS/A/1	ECOLOGY AND FISHERIES OF FRESHWATER RESERVOIRS
RS/A/3	ECO-STATUS AND PRODUCTION POTENTIAL OF SELECTED RESERVOIRS OF UTTAR PRADESH
RS/A/4	ECOLOGY AND FISHERIES OF SMALL RESERVOIRS OF RAJASTHAN
FW/A/7	DEVELOPMENT OF ECO-FRIENDLY MANAGEMENT NORMS FOR ENHANCING FISH PRODUCTION IN FLOODPLAIN WETLANDS OF INDIA IN RELATION TO THEIR RESOURCE CHARACTERISTICS
FW/A/8	ECOLOGY AND BIODIVERSITY OF KAYAMKULAM LAKE
FW/A/9	ASSESSMENT OF ECOLOGICAL STATUS AND ENERGY DYNAMICS OF FLOODPLAIN WETLANDS IN CENTRAL AND WESTERN UTTAR PRADESH
EM/B/1	ASSESSMENT OF ENVIRONMENTAL IMPACT ON BIOTIC COMMUNITY IN RIVERS AND ASSOCIATED ECOSYSTEMS

EM/B/2	AETIOLOGY, PATHOPHYSIOLOGY OF ENVIRONMENTAL STRESS AND DISEASES IN FISH/PRAWN. DEVELOPMENT OF HEALTH ASSESSMENT AND CONTROL METHODS
BT/B/1	GENETIC CHARACTERIZATION AND MIGRATION RELATED BIOCHEMICAL CHANGES OF INDIAN SHAD, TENUALOSA ILISHA
BT/B/2	DEVELOPMENT OF IMMUNOLOGICAL AND MOLECULAR TECHNIQUES FOR RAPID DIAGNOSIS OF BACTERIAL AND VIRAL DISEASES OF FISH AND SHELLFISH
RA/A/2	ASSESSMENT OF FISH CATCH AND CATCH STRUCTURE FROM DIFFERENT INLAND OPEN WATER SYSTEMS IN INDIA
RA/A/4	INVENTORY OF RESOURCE AND DATABASE DEVELOPMENT IN INLAND FISHERIES THROUGH REMOTE SENSING TECHNIQUES

12 CONSULTANCY, PATTENTS COMMERCIALISATION OF TECHNOLOGY

Consultancy projects

- A consultancy project captioned **"Fish conservational and hydrobiological perspectives of River Narmada with reference to Sardar Sarovar Project"** is being pursued at Estuarine Fisheries Research Centre of CIFRI, Vadodara, Gujarat.
- The Commissionerate of Fisheries, Government of Gujarat, Gandhinagar has identified a sponsored project on **"Feasibility Studies for Fish Production Enhancement in Selected Reservoirs of Gujarat State"** and is being executed at Vadodara Centre of the Institute and two reports have already been submitted.
- A Consultancy Project **"Feasibility studies for fisheries development in Kurichhu reservoir, Bhutan",** completed.

13 RAC, MANAGEMENT COMMITTEE, SRC, QRT, ETC. MEETINGS

Management Committee

29th meeting of the Institute Management Committee was held at Alappuzha Centre of CIFRI on 31 December, 2002. The meeting was attended by Dr. V. V. Sugunan, Director & Chairman of the committee, and other members *viz.* Shri K.D. Tripathi, Shri Narendra Pratap Mishra, Shri Ashok Kr. Bhattacharjee, Dr. D. Nath, Shri D. Moitra, S.A.O., CIFRI (Member-Secretary) and Shri V.S. Subramanian, F&AO, CIFRI (as co-opted Member).

Annual Staff Research Council Meeting

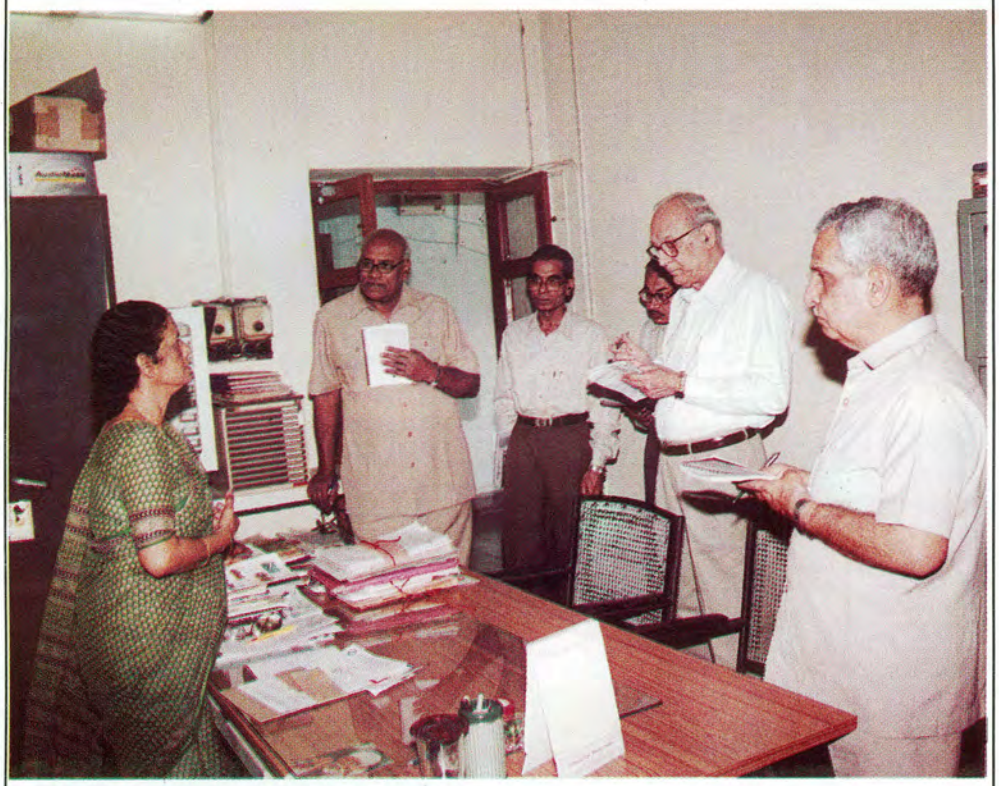
The Annual Staff Research Council meeting of the Institute was held on 22nd & 23rd April, 2002 at CIFRI, Barrackpore. The meeting commenced with the welcome address by Dr. V. V. Sugunan, Director, CIFRI. The Project leaders presented the progress achieved under all the seventeen projects implemented during 2001-2002. After extensive deliberation work programme for 2002-2003 were finalised. Discussion were also held on the monthly targets for individual scientists and the Institute. All the Heads of centers, sections presented the monthly target of individual scientist and centres.

Annual Research Advisory Committee Meeting

The Annual Research Advisory Committee meeting of the Institute was held on 24th & 25th April, 2002 at Barrackpore under the Chairmanship of Prof. J.S. Dutta Munshi. The other members of the committee who attended the meeting were Dr. N. N. Singh, Dr. P. Das, Dr. S.P. Ayyar, Dr. B.B. Jana, Sri Ashoke Kr. Bhattacharya, Dr. V. V. Sugunan and Sri R.A. Gupta While extending a warm welcome to the Chairman and Members of the RAC, Dr. V. V. Sugunan, Director, CIFRI briefly mentioned the new initiative made by the Institute to honour commitments made to the members during the previous meeting. He stated that the Institute is in the process of finalising its project programmes for the coming year and the guidance and advice of the members at this juncture will help the scientists to incorporate their suggestions in formulating and restructuring the project programmes. After two days comprehensive discussion the Committee identified research priorities and gave recommendations for future research programme.

QRT Meeting

The QRT of CIFRI for the period 1997-2002 constituted under the chairmanship of Dr. M.Y. Kamal and Prof. Y. Sreekrishna, Dr. K.L. Sehgal, Prof. H.R. Singh, Prof. Brij Gopal and Dr. V.R. Chitranshi and Dr. M.K. Das, CIFRI as Member Secretary held their first meeting with Director and other scientists of CIFRI from 3rd to 7th March, 2003. at CIFRI, Barrackpore.



The QRT members discussing with scientists

Scientists deliberating in the Staff Research Council Meeting

Research Advisory Committee Meeting in progress

Joint Staff Council Meeting

The meeting of the Joint Staff Council of CIFRI was held on 7th August, 2002 at Barrackpore under the Chairmanship of Dr. V. V. Sugunan, Director. The members, official side as well as the staff side attended the meeting and deliberated on the agenda.

14 PARTICIPATION OF SCIENTISTS IN CONFERENCES, MEETINGS, WORKSHOPS, SYMPOSIA, ETC. IN INDIA & ABROAD

The scientists and technicians of the Institute participated in various conferences/symposia/seminars/workshops and meetings held during April 2002 to March 2003, wherein they presented their research findings and exchanged views with the other delegates. List of scientists who participated/presented papers in such gatherings are given below :

Conference/Symposium/Seminar/ Workshop, etc.	Paper presented	Authors/Participants
National Symposium on Fisheries Enhancement in Inland Waters – Challenges ahead, jointly organized by IFSI & CIFRI, Barrackpore from 27-28 April, 2002	-	V. V. Sugunan
-do-	Status of benthic community in River Cauvery	D. N. Singh, P. K. Sukumaran & A. K. Das
-do-	-	M.A. Hassan
-do-	Oxycline – a prime productive criteria for Manchanbele reservoir (Karnataka)	A.K. Das
-do-	Possibilities for conservation and development of mahseer in selected reservoirs of Madhya Pradesh (NPS, BLP & VRD).	N. P. Shrivastava, B. L. Pandey and V. R. Desai
-do-	-	S.N. Singh, and M.K. Mukhopadhyay

-do-	-	A,K. Laal, R.K. Tyagi, Balbir Singh, R.K. Dwivedi, B.K. Singh, B.P. Mohanty, and D. Karunakaran,
-do-	-	R.L. Sagar, J.G Chatterjee. and Ganesh Chandra
State Level Workshop for Finalisation of Action Plan 2002-2003 held at Ram Krishna Ashram KVK, Nimpith, 24 Parganas (S), on 30 April, 2002	Action Plan of KVK, Kakdwip for 2002-2003	Ganesh Chandra
Workshop cum Training Programme on Impact Studies of technologies for KVKs of Zone II, held at Rathindra KVK, Sriniketan, Viswa Bharati, West Bengal from 11-13 April, 2002	-	Ganesh Chandra
National level workshop-cum-training programme on Jute/Mesta/Sunhemp/Ramie held at CRIJ&AF, Nilganj, on 6.5.2002	-	V. V. Sugunan
Brain-storming Session on Riverine Fisheries, held at CIFRI, Allahabad, on 19.5.2002	-	V. V. Sugunan
National Seminar on Relevance of Biosphere Reserve, organised by Nature Conservators, held at Haridwar on 25 & 26 May, 2002	-	V. V. Sugunan
Workshop on Kharif Frontline Demonstration on Oilseeds and Pulses 2002 held at Rajendra Agricultural University, :Pusa, Bihar from 28-30 May 2002	Progress Report of Rabi and summer FLD on oilseeds and pulses 2001-2002	R.L. Sagar and Ganesh Chandra
NATP Review Workshop of Mission mode Project on Household Food and Nutritional Security, held at NBPGR, New Delhi, from 30th May to 1st June, 2002	-	V. V. Sugunan
Workshop on Impact Study of KVK Technologies held at Ram Krishna Ashram KVK, Nimpith, 24 Parganas (S) from 8-9 June, 2002	Impact Study on Introduction of Summer Moong *(Vigna radiata)* Cultivation in Rice Fallow System of Sunderbans, West Bengal	Ganesh Chandra
Krishak Sangosthi, organised at CIFE, Powarkheda, on 29 June, 2002	-	N.P. Shrivastava

Summer School on Methods of Assessment of aquatic ecosystem for fish health, organised at CIFRI, Barrackpore, from 18 July to 16 August, 2002	Habitat status of reservoirs in India in relation to fish health.	A.K. Das
National Seminar on Official Language on Indian Fisheries – Challenges & Prospects, held at CIFT, Cochin, on 17th August, 2002	-	V. V. Sugunan
56th Annual General Meeting of Zoological Society, Kolkata on 25th September, 2002	-	V. V. Sugunan
Brain storming Session on Global Warming & Climate Change, held at IARI, New Delhi, on 26th September, 2002	-	V. V. Sugunan
Seminar on Feed based Aquaculture, organized by American Soyabeen Association and University of Agriculture Sciences, Bangalore on September 29, 2002	-	M. Feroz Khan
National Seminar on Aquatic resources management in hills, organized by NRC on Cold Water Fisheries (ICAR), Bhimtal, during 4-5 October, 2002	-	V. V. Sugunan
-do-	Fishery resources of R. Yamuna in Himalayas	Usha Moza, D.N. Mishra and A. Hajra
Workshop on Rabi Frontline Demonstration on Oilseeds and Pulses 2002 held at KVK, Deoghar from 7-9 October, 2002	Action Plan of Rabi FLD on oilseeds and pulses 2002-2003	R.L. Sagar and Ganesh Chandra
Second Indian Fisheries Science Congress, and the National Symposium on Enhancement of fish production from Indian reservoirs – An immediate priority, Bhopal, from 23-25 October, 2002	Limnological features and fisheries management of Chikkapadasalgi Barrage on river Krishna (North Karnataka).	D.S. Krishna Rao, P.K. Sukumaran and M. Ramakrishniah
-do-	Ecology and fisheries of Halali reservoir (M.P.)	N.P. Shrivastava, B.L. Pandey and A.K. Das,
National Symposium on Biodiversity. A scientific approach – agenda for the 21st Century organized by National Academy of Sciences, India at NEHU Shillong from 25-27 October, 2002	Periphyton production in a peninsular river	P.K. Sukumaran and H.C. Joshi
-do-	Plankton diversity in Hemavathy reservoir of Karnataka.	D.N. Singh and A.K. Das

Stakeholder Consultation on Fish to 2020 : Global outlook for developing countries, Fish for All Summit and third meeting of the Asia-Pacific Group of Fisheries and Aquatic Research (GoFAR) held at Penang, Malaysia, from 2-5 November, 2002		V. V. Sugunan
Discussion on Activities Achievement, Infrastructure and Future programmes of KVKs and TTCs under Fisheries Division of ICAR held at Krishi Anusandhan Bhavan II, Pusa, New Delhi on 29 November, 2002	Activities Achievement, and Future Programmes of KVK of CIFRI, Kakdwip	R.L. Sagar
Farmer's Day at Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar on 12 December, 2002	-	S.N. Singh
VI Indian Fisheries Forum, held at CIFE, Mumbai, on 17th December, 2002	-	V. V. Sugunan
Workshop on Combinatories and optimization Techniques in Statustics, held at Department of Statistics, University of Allahabad, from 18-20 December, 2002	-	R.K. Tyagi
Aqua Show and International Seminar on Aquaculture and Ornamental Fisheries, held at Kochi, on 30th December, 2002	Paper presented	V. V. Sugunan
90th Indian Science Congress, Bangalore	Dynamics of two crustacean zooplankters in a tropical man-made lake (Bangalore, South India).	D.S. Krishna Rao and Shakuntala Katre
5th Indian Agricultural Scientists and Farmers' Congress, organized by Bioved Research and Communication Centre, Allahabad	Delivered guest lecture on Prospects and constraints of fisheries development in U.P.	R.N. Seth
Brain Storming Session on Prodeuction Status and Potential of Fisheries in U.P., organized by U.P. Council of Agricultural Research	Prospects and problems of riverine fisheries sof Uttar Pradesh	R.S Panwar and R.N. Seth
Brain Storming Seminar on Fisheries Development in Karnataka, organized by Department of Fisheries, Govt. of Karnataka and University of Agriculture Sciences, Bangalore on January 8, 2003		D.S. Krishna Rao and M. Feroz Khan
Workshop on Central Sector Scheme held at CIFRI, Barrackpore, on 17th January, 2003	-	V. V. Sugunan

Kick of Workshop on Challenge Programme on Water & Food, held at National Agriculture Research Complex (NARC), New Delhi, on 23 & 24 January, 2003	-	V. V. Sugunan
Inter University Symposium in Zoology, held on 4 February, 2003 at Trivandrum	-	S. Bijoy Nandan
National Workshop cum training programme on Application of Bio-informatics and statistics in Aquaculture, organized by Bio-informatics Centre on Aquaculture, CIFA, from February 4 to 7, 2003 at CIFA, Bhubaneswar	-	M. Feroz Khan
Regional Workshop on Wetland Conservation – Strategy and issues (western region) sponsored by Ministry of Environment and Forests, Government of India, New Delhi and Gujarat Ecological Education and Research (GEER) Foundation, Government of Gujarat, Gandhinagar from 9-11 February, 2003	-	S.N. Singh
National Symposium on the ecology and biodiversity of aquatic environments, organized at Deptt. of Zoology, University of Allahabad, U.P. from 15-17 February, 2003	-	D.N. Singhand R.K. Manna,
-do-	-	A.K. Laal, Seth, R.N., Shree Prakash, B.K., Singh, B.P. Mohanty and Kalpana Srivastava
NATP Workshop organized by CIFRI on Fisheries management in the lentic water system : stocking of reservoirs with fish see, held at Department of Fisheries, JNKVV, Jabbalpur, from 19-20 February, 2003	Delivered lecture on Possibilities sof development of fisheries in the reservoirs of northeast region	P.K. Saha
-do-	-	D.K. Kaushal
Seminar on Ramsar Sites of Kerala, conducted by CWRDM, Kozhikode on 21 February, 2003	-	S. Bijoy Nandan
Workshop on Jaliya Paryavaran Evam Matsyiki : Samasyayen Evam Samadhan Par Rashtriya Sangosthi, held at CIFRI, Barrackpore, from 23-24 February, 2003	-	V. V. Sugunan
-do-	-	R.L. Sagar

Conference/Symposium/Seminar/ Workshop, etc.	Paper presented	Authors/Participants
Workshop on Sustainable Fisheries Development of Loktak Lake, held at Imphal, Manipur, on 8 & 9 March, 2003	-	V. V. Sugunan
Annual Zonal Workshop of KVKs of Zone II held at Rajendra Agricultural University, Pusa, Bihar from 10-12 March, 2003	1. Annual Report of KVK, Kakdwip for 2002-2003 2. Annual Action Plan of KVK, Kakdwip for 2003-2004	Ganesh Chandra
Kick of Workshop Challenge Programme on Indo-Gangetic Basin, held at Centre of Water Resources, New Delhi, on 24 March, 2003	-	V. V. Sugunan

15 WORKSHOPS, SEMINARS, SUMMER INSTITUTES, FARMERS' DAY, ETC.

Workshop

Strategies and Options for Increasing and Sustaining Fisheries and Aquaculture Production to Benefit Poor Households in Asia

The Institute organised a Workshop under ICAR-ICLARM project on **Strategies and Options for Increasing and Sustaining Fisheries and Aquaculture Production to Benefit Poor Households in Asia** from July 10-12, 2002. The project is funded by Asian Development Bank. The workshop was attended by all the project team members in India. Dr. M. M. Dey, Senior Scientist, International Centre for Living Aquatic Resource Management (ICLARM), Penang, Malaysia participated in the workshop. Dr. V. V. Sugunan, Director, CIFRI lauded the efforts made by the project in taking up two most important issues in fisheries sector *i.e.* sustainability of the fish farming system and benefit to the poor households. He expressed the hope that these issues would be adequately addressed. The event coincided with the Fish Farmers' Day and the participants could interact with a cross section of fish farmers at the Institute. The participants also visited bheries in the Salt Lake area.

Symposium

- **A National Symposium on Fisheries Enhancement in Open Water – Challenges Ahead** was organised at the Central Inland Fisheries Research Institute, Barrackpore. Sponsored jointly by the Inland Fisheries Society of India and CIFRI, the symposium was formally inaugurated by Dr. S.Z. Qasim, former member of Planning Commission, on 27th April, 2002 at Barrackpore. A galaxy of renouned fishery scientists, academicians,

extension functionaries, researchers, students, progressive fish farmers from different parts of the country were present.

Seminar

- A one day **seminar on IPR** was organised on May 23, 2002 at Institute's Headquarters, Barrackpore in collaboration with IPR-Aid Institute organisation to create awareness about patent and IPR among scientific community of the Institute.

Summer School

Methods of assessment of aquatic ecosystem for fish health care

A Summer School on **Methods of assessment of aquatic ecosystem for fish health care** was conducted at the CIFRI, Barrackpore, from 18 July to 16 August, 2002. Twentyfive participants from various states representing Fisheries Departments, Universities, Agriculture Universities and Research Organizations took part in the one-month programme. The Summer School was inaugurated by Dr. N.C. Dutta at a function attended by Dr. P. Das, Ex-Director, NBFGR and Dr. M. Sinha, Ex-Director, CIFRI. During the inaugural function, Dr. V. V. Sugunan, Director welcomed the participants and explained the background and relevance of the Summer School. The course covered five important areas (1) Environmental status of aquatic resources in relation to fish health. (2) Chemical pollutants viz., heavy metals, pesticides in aquatic habitat and methods of their assessment in relation to fish health. (3) Status and methods of evaluating plankton, benthos, periphyton in the ecosystem for fish and ecosystem health. (4) Various methods of assessment of stress biochemically, physiologically, histopathologically and at population level through various indicators. (5) Extension and methods for fish health care and socio-economic aspect of fish health management..

In the valedictory function the certificates were distributed by Prof. B.B. Mullick.

National fish farmers' day

National fish farmers' day was observed on July 10, 2002 at CIFRI. Honorable Minister of Fisheries, Government of West Bengal, Shri Kiranmay Nanda inaugurated the celebration in a function where Prof. A.N. Bose, Advisor IIT, Karagpur was the Chief Guest. Dr. Mruthyunjaya, Director NACP, New Delhi and Shri Debaditya Chakraborty, Principal Secretary, Department of Fisheries, Government of West Bengal were the Guests of honour. About 400 fish farmers, fishermen, fish farmwomen, fish farm youth participated in the function. A large number of Scientists of ICAR Institutes, Academicians from the various Universities, officials of the State Fisheries Department were also present.

From this, the Institute has launched a Scheme to confer awards to outstanding fish farmers, entrepreneurs in the form of ***"Young Fish Farmer Award"*** to encourage and motivate the young fish farmers who have been working in various fields of fisheries. Six young fish farmers of West Bengal who have established themselves in respective fields of fisheries have been honoured. ***Mr. Bablu Majumder*** for his contribution towards production of seed of cat fishes.***Mr. Dipak Roy*** for his contribution towards seed production of endangered fish species

Pabda (*Ompok pabo*), Nandas (*Nandas nandas*), Chital (*Chitala chitala*), Punti (*Puntius sarana)* etc.***Mr. Ranjit Mondal*** for his outstanding contribution towards producing fish utilizing domestic sewage.***Mr. Gopal Chandra Biswas***, Kancharapara Fishermen Cooperative Society for his contribution towards production of fish & prawn under Pen and Cage culture system. ***Mr. Swpan Maity*** for his contribution on Brakishwater fish farming in Sundarbans.

Fish Farmers' Day

Three Fish Farmers' Days were organized where about 446 fish farmers/fishermen and interested persons were present and took part in the discussions.

Kisan Divas

To commemorate the birth Centenary of Late Choudhary Charan Singh Ji, Former Prime Minister of India, the CIFRI organized a ***Kisan Divas*** at Mundapara, a tribal village of Sundarbans on December 23, 2002. About 700 tribal farmers and farmwomen participated in the ***Kisan Divas.***

The main thrust of the Kisan Divas was to identify the constraints faced by the resource-poor farming community through PRA tools. This was followed by discussions and demonstrations on various aspects to overcome some of those constraints for the benefit of the downtrodden populace of the area. A Quiz contest on agriculture and allied subjects was arranged where the farmers and farmwomen participated with great enthusiasm. The Technical Officers of Home Science of Krishi Vigyan Kendra demonstrated the preparation of low-cost nutritious diet for the children.

Hindi Week

The Institute observed the Hindi Week during 14-20 September, 2002 by organising meetings and various competitions like essay writing, official letter writing and drafting in Hindi. The week long celebrations culminated in a meeting attended by all members of the staff. While addressing the gathering the Director appealed for progressive use of Hindi in the day to day activities of the Institute.

Vigilance Awareness Week

The **Vigilance Awareness Week** was observed at CIFRI from 31 October to 6 November, 2002. The function was inaugurated by Sri M.G. Mukhopadhyay, Chairman, Human Rights Commission. Sri M.H. Verma, S.P., 24 Parganas (North), was the Guest of Honour.

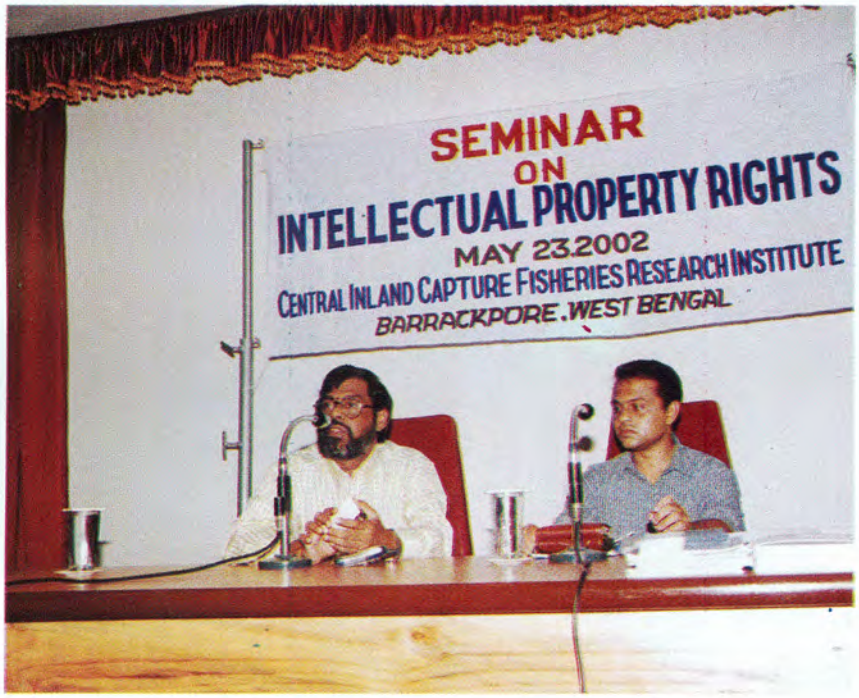
Dr. S. Ayyappan, DDG (Fy) receiving the Honorary Fellowship of IFSI

A section of dignitaries participating in the symposium

The technical session of the workshop in progress

Dignitaries at the inaugural function of Summer School

A recepient of young fish farmer award addressing
in National Fish Farmers' Day



Director CIFRI explainning the importance of IPR

Fish Farmers' day is in progress at Madhubani, Bihar

Kishan Divas Celebration at Village Mundapara, Sundarbans

Mass awareness campaign for conservation of fish

Hon'ble Chief Justice of Human Rights Commission
Shri M.G. Mukhopadhyay inaugurating
Vigilance Awareness Week

CIFRI celebrates Hindi Week

16 DISTINGUISHED VISITORS

Distinguished visitors who visited the Institute and its centres during the period were :

Mr. Hukumdev Narayan Yadav, Hon'ble Minister of State for Agriculture, Govt. of India and Vice-President, ICAR, New Delhi
Lt. General (Rtd.) S.K. Sinha, Hon'ble Governor of Assam
Mr. Etuwa Munda, Hon'ble Minister of State (Fisheries), Govt. of Assam
Dr. Mangala Rai, Director General, ICAR, New Delhi
Ms Sashi Mishra, Secretary, ICAR , New Delhi
Dr. B.N. Singh, ADG(Fy-I), ICAR, New Delhi
Prof. T.J. Pandian, ICAR National Professor, Madurai Kamraj University, Madurai
Dr. S.N. Dwivedi,
Dr. P. Das, Rtd. Director, NBFGR, Lucknow, U.P.
Prof. N.C. Datta, Dept. of Zoology, Calcutta University, Kolkata
Dr. S.P. Ayyar, Rtd. Director, CIFRI
Dr. K.V. Devaraj, Former Vice-Chancellor, UAS, Bangalore
Dr. S.Z. Qasim, A-15, Defence Colony, New Delhi
Dr. J.V.H. Dixitulu, Editor, Fishing Chimes
Dr. G.P. Dubey, 11/1, Byasan Road, Ram Chandra Nagar, Indore
Dr. P.K. Lahiri, Managing Director, Madhya Pradesh Consultancy Org. Ltd., Gangotri, T.T. Nagar, Bhopal
Dr. S.B. Medhi, President, Assam Inst. of Sustainable Development, P.O. Kharghuli, Guwahati, Assam
Mr. K.P. Das, Retd. Co.M, Metro Railway, Kolkata
Mr. M.H. Varma, IPS, Supdt. Of Police, North 24-Parganas, Barasat
Mr. Hiranya Bora, Chairman, Assam Industrial Development Corpn. Ltd., Guwahati
Mr. Santosh Kumar Himatsingka, Guwahati, Assam
Mr. Binoo Sen, Krishi Bhavan, New Delhi
Dr. (Capt.) A.G. Bandyopadhyay, DDARD (PM) SPF, Tollygunje
Justice M.G. Mukherji, Chairman, West Bengal Human Rights Commission, Kolkata
Prof. Mohan Joseph, Director, CMFRI, Kochi
Mr. K.N. Kumar, Director, DARE, Govt. of India, New Delhi
Dr. S.A.H. Abidi, Member, A.S.R.B., New Delhi
Mr. K.D. Tripathi, Commissioner & Secretary, Fisheries, Govt. of Assam
Mr. S. Barua, Director of Fisheries, Assam
Mr. J. Ahmed, Managing Director, Assam Fisheries Development Corporation, Guwahati
Dr. B. Lahon, Project Director, AFDC, Guwahati
Dr. S.C. Mukherjee, Director, CIFE, Mumbai
Dr. D.N. Barthakur, Ex-Vice Chancellor, Assam Agricultural University, Jorhat
Dr. S.S. Vaghel, Vice Chancellor, Central Agricultural University, Imphal
Prof. Amalesh Dutta, Professor & Head, Deptt. of Zoology, Gauhati University

Dr. J.S. Dutta Munshi, Ex.Professor and Head, Dept. of Zoology, Bhagalpur University and Chairman of RAC, CIFRI, Barrackpore
Dr. Anoop K. Dobriyal, Professor and Head, Dept. of Zoology, Pauri Garhwal University, Uttaranchal
Dr. B.P. Singh, Joint Director, Central Potato Research Institute Campus, Modipuram, Meerut, U.P.
Prof. Santosh Kar, Deptt. of Immunology, Centre for Biotechnology, Jawaharlal Nehru University, New Delhi
Dr. B.K. Dwivedi, Director, Bioved Research Soiciety, Allahabad
Dr. Satya Mishra, Professor, Dept. of Mathematics, University of Alabama, USA
Dr. S.C. Aggarwal, Joint Director, Haryana Fisheries
Mr. V.K. Goel, CEO, FFDA, Yamunanagarm Deptt. of Haryana Fisheries
Dr. K.D. Tripathi, Commissioner & Secretary, Fisheries Department, Govt. of Assam
Dr. K.G. Sunny, Associate Professor, Fisheries College, Kochi
Dr. K.V. Jayachandran, Associate Professor, Fisheries College, Kochi
Dr. T.M. Jose, Associate Professor, Fisheries College, Kochi
Dr. K.G. Padmakumar, Associate Professor, Regional Agricultural Research Station, Kumarakom
Shri K.R. Narayanan, Fisheries Consultant, Sardar Sarovar Narmada Nigam, Gandhinagar
Dr. S.S. Ghosh, Zonal Coordinator, Zone II (TOT Projects), Kolkata
Shri Ganesh Bhaval, Lead District Manager, Lead Bank (United Bank of India), District South 24 Parganas

17 PERSONNEL *(MANAGERIAL POSITION ONLY)*

Director, CIFRI, Barrackpore, West Bengal

Dr. V. V. Sugunan, Director (Acting)

Riverine Division, Allahabad, Uttar Pradesh

Dr. R.S. Panwar, Principal Scientist, Head of Division (Acting)

Reservoir Division, Bangalore, Karnataka

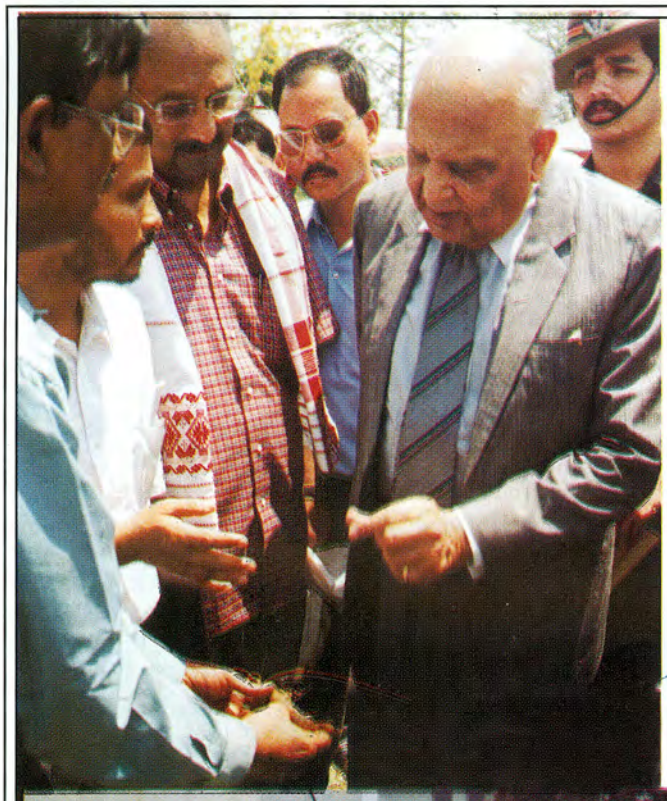
Dr. D.N. Singh, Principal Scientist, Head of Division (Acting)

Estuarine Division, Barrackpore, West Bengal

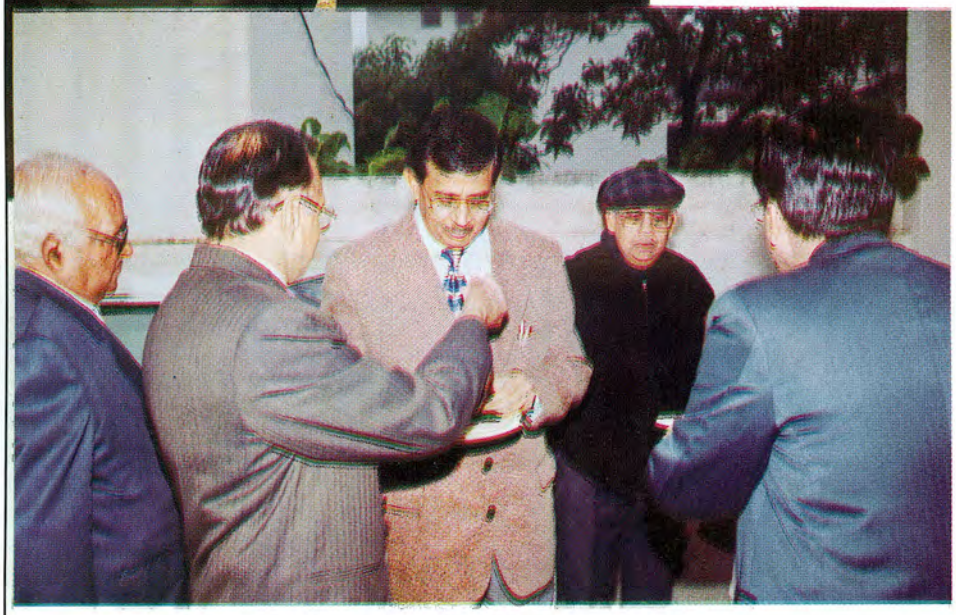
Dr. D. Nath, Principal Scientist, Head of Division (Acting)

Fish Health & Environment Division, Barrackpore, West Bengal

Dr. Manas Kr. Das, Principal Scientist, Head of Division (Acting) from 18.9.2001



His excellency the
Governor of Assam
visits pen culture site
of NATP
of Guwahati Centre



Director General ICAR and Secretary DARE,
Dr. Mangala Rai visits CIFRI Centre at Karnal

Hon'ble Minister of Fisheries, Govt. of Assam
Shri Etuwa Munda visits CIFRI, Barrackpore

Dr. Chriss Meel and Catherine O'Neill of DFID, U.K. visit CIFRI

Secretary cum Commissioner of Fisheries,
Govt. of Orissa visits Fish Pathology Laboratory

Mr. A. K. Patnaik, Principal Secretary, Dept. of Fisheries,
West Bengal visits GIS Laboratory at CIFRI

Scientist from Bangladesh visits CIFRI Library

Floodplain Wetlands Division, Guwahati, Assam

Dr. V.V. Sugunan, Principal Scientist, Head of Division (Acting)

Resource Assessment Division, Barrackpore, West Bengal

Shri R.A. Gupta, Principal Scientist, Head of Division (Acting)

Senior Administrative Officer, CIFRI, Barrackpore

Shri D. Moitra

Finance & Accounts Officer, CIFRI, Barrackpore

Shri V.S. Subramanian

18 ANY OTHER RELEVANT INFORMATION SUCH AS SPECIAL INFRASTRUCTURAL DEVELOPMENT

Nil.

19 SUMMARY IN HINDI

केन्द्रीय अंतर्स्थलीय मात्स्यकी अनुसंधान संस्थान
(भारतीय कृषि अनुसंधान परिषद)
बैरकपुर, कोलकाता-700120, पश्चिम बंगाल

1. प्रस्तावना

संस्थान के वार्षिक अनुवेदन (2002-2003) में संस्थान द्वारा प्रायोजित अनुसंधान परियोजनाओं की उपलब्धियों तथा दूसरे अन्य कार्यों को व्यापक रुप से किया गया है ।

इस वर्ष संस्थान के कार्यों में निम्नलिखित विषयों को महत्व दी गई है:-

1. जलाशयों, बाढ़कृत आर्द्र क्षेत्रों एवं गंगा, व्यास और कृष्णा नदियों से प्राप्त संभावित मत्स्य उत्पादन व मात्स्यकी संसाधनों का आंकलन ।

2. हुगली-नर्मदा और अन्य ज्वारनदमुखों के पारिस्थितिकी तथा मात्स्यकी का मूल्यांकन ।

3. गंगा और यमुना नदियों के पर्यावरण एवं मात्स्यिकी स्तर का अनुवीक्षण ।

4. हिल्सा मछलियों के अनुवांशिकी पर अध्ययन ।

5. मछलियों और झींगा के स्वास्थ्य अनुमापन एवं मत्स्य रोगों के प्रादुर्भाव के नियंत्रण के लिए विभिन्न प्राचलों का मानकीकरण ।

6. अंतर्स्थलीय मात्स्यिकी संसाधनों का आंकलन ।

इनके अतिरिक्त संस्थान ने संसाधनों के विकास के लिए परामर्शक सेवाओं को भी प्राप्त किया तथा विभिन्न विशिष्ट विषयों पर प्रशिक्षण कार्यक्रमों द्वारा आर्थिक संसाधनों में वृद्वि की । साथ ही तदर्थ योजनाओं के अन्तर्गत भारतीय कृषि अनुसंधान परिषद एवं दूसरे अभिकरणों/संगठनों से भी विभिन्न परियोजनाओं हेतु आर्थिक सहायता प्राप्त किया ।

संस्थान ने दूसरे राष्ट्रीय एवं अंतर्राष्ट्रीय संगठनों से संपर्क स्थापित कर अपने आनुसंधानिक कार्यों को और भी मजबूत बनाया है । संस्थान द्वारा विकसित तकनीकों एवं प्रणालियों का अब तक सफलतापूर्वक हस्तांतरण हो चुका है ।

निदेशक

2. महत्वपूर्ण उपलब्धियाँ

1. हुगली नदी में मत्स्य प्रजातियों के लिए मत्स्य समाहार इटीग्रीटी से संबंधित मल्टीमेट्रिक सूचक का विकास किया गया । साथ ही इन प्रजातियों पर औद्योगिक एवं दूसरे बहिःस्त्रावों से पड़ने वाले प्रभाव का भी अध्ययन किया गया । आई.वी.आई. द्वारा किये गये अध्ययन के अनुसार, चयनित नदी (100 कि.मी. क्षेत्र) के 6 स्थलों में से केवल 3 स्थलों अर्थात कुल क्षेत्र का मात्र 50% क्षेत्र में ही इस पद्धति को अपनाया गया । इससे निष्कर्ष यह निकलता है कि मत्स्य समाहार के जैविक इंटीग्रीटी का इन क्षेत्रों में पूरी तरह पालन नहीं किया ।

2. आई.आर.एस-1 डी की सहायता से डिजिटल इमेज प्रोसेसिंग द्वारा बिहार राज्य के जल निकायों का मानचित्रीकरण किया गया ।

3. गंगा, यमुना और नर्मदा नदियों के विभिन्न केन्द्रों से प्राप्त मत्स्य आंकड़ों पर डटाबेस तैयार किया गया ।

4. बील में उपस्थित जलीय मेक्रोफाइट के आंशिक निष्कासन के लिए एक अनूठा व प्रभावी पद्धति का विकास कर इसे असम राज्य के बीलों में सफलतापूर्वक कार्यान्वित किया गया ।

5. बील में पेन पालन पद्धति द्वारा मछली व झींगा मछलियों का उत्पादन किया गया । 150 दिन में *मेक्रोब्रेवियम रोजनबर्जी* का उत्पादन 620 मि.ग्रा./हे. तथा 171 दिन में आई.एम.सी. का उत्पादन 327 कि.ग्रा. हुआ । इसी प्रकार *क्लेरियस बेट्राकस* का उत्पादन केज कल्चर द्वारा 120 दिन में 8.8 कि.ग्रा. प्रति वर्ग मी. एवं कार्प मछलियों के संग्रहण का घनत्व 16 मछलियों प्रति वर्ग मी. था ।

6. राजस्थान के 3 जलाशयों, तमिलनाडु के 2 तथा मध्य प्रदेश, आन्ध्र प्रदेश एवं कर्नाटक राज्य के एक-एक जलाशय में पारिस्थितिकी, मात्स्यिकी स्तर व संभावित उत्पादन का अध्ययन किया गया । साथ ही इनके प्रबंधन की दिशा में भी आवश्यक कदम उठाये गये ।

7. गंगा, कृष्णा, ब्यास व यमुना नदियों के पारिस्थितिकी, उत्पादन तथा आवास में कमी जैसे विषयों का भी अध्ययन किया गया ।

8. हुगली तथा मांडवी-जुराइ ज्वारनदमुखों के पारिस्थितिकी एवं मात्स्यकी के साथ ही ज्वारनदमुखी झीलों में संभावित उत्पादन का आंकलन भी किया गया । हुगली ज्वारनदमुख का मत्स्य उत्पादन बहुत ही अधिक अर्थात 62554.7 टन हुआ । साथ ही हिल्सा, जो इस ज्वारनदमुख का एक अभिन्न व प्रमुख अंग है उत्पादन कुल उत्पादन का 10.4% हुआ ।

3. भूमिका

भारत सरकार ने सन् 1943 के अपने एक ज्ञापन में देश के मात्स्यिकीय संसाधनों के विकास के लिए एक केन्द्रीय विभाग की स्थापना पर विशेष बल दिया था । तत्पश्चात्, केन्द्रीय सरकार की कृषि, वानिकी तथा मात्स्यकी से संबंधित उप-समिति ने भी इस प्रस्ताव का पृष्ठांकन किया था । फलस्वरूप भारत सरकार के खाद्य एवम् कृषि मंत्रालय के अन्तर्गत केन्द्रीय अन्तर्स्थलीय मात्स्यिकी अनुसंधान केन्द्र की स्थापना 17 मार्च 1947 को कलकत्ता में हुई । एक अंतरिम योजना के रूप में प्रवर्तित यह केन्द्र अब देश की अन्तर्स्थलीय मात्स्यकी क्षेत्र में एक प्रमुख अनुसंधान संस्थान का रूप ले चुका है तथा यह संस्थान 17 मार्च 2002 को 55 वर्ष पूरा किया । वर्ष 1959 में इस केन्द्र को केन्द्रीय अन्तर्स्थलीय मत्स्य अनुसंधान संस्थान का पूर्ण दर्जा प्राप्त हुआ तथा पश्चिम बंगाल के बैरकपुर स्थित नवनिर्मित भवन में इसका स्थानान्तरण हुआ । वर्ष 1967 में यह संस्थान भारतीय कृषि अनुसंधान परिषद् का विधिवत् सदस्य बना ।

संस्थान का मुख्य उद्देश्य देश के अन्तर्स्थलीय मात्स्यिकी संसाधनों का उचित मूल्यांकन एवम् इनके संरक्षण तथा अधिकतम समुपयोजन के लिए उपयुक्त प्रणालियों को विकसित करना था। इस उद्देश्य की पूर्ति के लिए संस्थान ने देश में उपलब्ध अन्तर्स्थलीय जल संसाधनों जैसे नदी, झील, पोखर, टैंक, जलाशय तथा बाढ़कृत-आर्द्र क्षेत्र आदि के पारिस्थितिकी तथा इनकी उत्पादन क्षमताओं का अध्ययन किया तथा इन अध्ययनों द्वारा विभिन्न प्रकार के जलीय परितंत्रों की जटिल पोषी संरचना एवम् पर्यावरणीय प्रकार्यों को सुलझाया ।

1970 के दशक में संस्थान ने चार अतिविशिष्ट समन्वित राष्ट्रीय परियोजनाओं पर कार्य आरंभ किया, ये परियाजनाएँ थीं *मिश्रित मत्स्य पालन व मत्स्य बीज उत्पादन, वायुश्वासी मत्स्य पालन, जलाशयों की पारिस्थितिकी* एवम् *मात्स्यिकी प्रबंधन* तथा *लवणीय जल मत्स्य पालन* ।

इस संस्थान को निम्नलिखित मत्स्य पालन तकनीकों के विकास करने एवम् उन्हें लोकप्रिय बनाने का श्रेय प्राप्त है ।

- नदीय संसाधनों से मत्स्य बीज संचयन,
- मत्स्य बीज परिवहन संबंधित तकनीक,
- कार्प मछलियों का प्रेरित प्रजनन एवम् नर्सरी प्रबंधन प्रणाली,
- चाईनिज कार्प मछलियों का बंध प्रजनन,
- मिश्रित मत्स्य पालन,
- जलीय खरपतवारों का नियंत्रण,
- वायु-श्वासी मछलियों का पालन,
- एकीकृत मत्स्य पालन,

- मलजल पर आश्रित मत्स्य पालन,
- छोटे जलाशयों में मात्स्यिकीय प्रबंधन,
- लवणीय जल में मत्स्य पालन,
- घोंघा पालन आदि ।

उपर्युक्त तकनीकों एवम् शोध प्रणालियों के फलस्वरूप ही आज देश का अन्तर्स्थलीय मत्स्य उत्पादन 2.2 लाख टन 1950-51 से बढ़कर 28 लाख टन 1999-2000 ।

7वी. पंचवर्षीय याजना के आरंभ में ही इस संस्थान ने तीन अन्य संस्थानों *(केन्द्रीय अलवणीय जलीय कृषि संस्थान, केन्द्रीय खाराजल कृषि संस्थान* और *राष्ट्रीय शीतजल मात्स्यिकी केन्द्र)* को जन्म दिया तथा इस मूल संस्थान का पुनर्नामकरण 1.4.87 से **केन्द्रीय** अन्तर्स्थलीय प्रग्रहण मात्स्यिकी अनुसंधान संस्थान हुआ । इस परिवर्तित व्यवस्था में केन्द्रीय अन्तर्स्थलीय प्रग्रहण मात्स्यिकी अनुसंधान संस्थान का दायित्व उन विवृत जल संसाधनों में शोध कार्य करना है, जिनमें मत्स्य प्रबंधन कार्य पर्यावरणीय अनुमापन तथा उसके संरक्षण से संबंद्ध है ।

अधिदेश

केन्द्रीय अन्तर्स्थलीय मात्स्यकी अनुसंधान संस्थान का अधिदेश निम्नलिखित है :

1. 10 हेक्टर क्षेत्रफल से बड़े जलीय संसाधनों में मत्स्य संख्या गतिकी का अध्ययन ।
2. उक्त प्रकार के जलीय संसाधनों से अधिकतम मत्स्य उत्पादन प्राप्त करने हेतु प्रबंध प्रणालियों को विकसित करना ।
3. इन जलीय संसाधनों में अपकर्षण, प्रदूषण के कारण एवम् उनके प्रभाव का अध्ययन कर इन जलीय संसाधनों का संरक्षण के लिए कार्य करना।
4. नदीय परियोजनाओं के कारण संबंधित बेसिन की मात्स्यिकी पर पड़ने वाले दुष्प्रभावों का अध्ययन के लिए प्रणालियों को विकसित करना ।
5. अन्तर्स्थलीय मात्स्यकी से संबंधित आंकड़ों के संदर्भ में राष्ट्रीय केन्द्र के रूप में कार्य करना ।
6. प्रशिक्षण कार्यक्रमों का आयोजन, परामर्शक सेवाएँ उपलब्ध कराना आदि।

संगठन

उपर्युक्त अधिदेश की पूर्ति एवम् देश की मात्स्यिकी विकास हेतु केन्द्रीय अन्तर्स्थलीय मात्स्यिकी अनुसंधान संस्थान के अनुसंधान कार्यों को प्रमुख मात्स्यिकीय स्त्रोतों के अनुरूप सात प्रभागों के अनुरूप सात प्रभागों के अन्तर्गत संगठित किया गया है ।

नदीय प्रभाग का मुख्यालय इलाहाबाद में स्थित है और यह प्रभाग नदीय पर्यावरण के संरक्षण पर पर्याप्त ध्यान देते हुए देश के मात्स्यिकी संसाधनों के प्रभावशाली प्रबंधन हेतु तकनीकी प्रणालियों को विकसित करने का प्रयास कर रहा है । इस प्रभाग के अनुसंधान प्रकल्प गंगा, ब्रह्मपुत्र, महानदी एवम् नर्मदा नदियों तथा उनके मुख्य परितंत्रों से संबंधित है ।

बंगलोर स्थित ***जलाशय प्रभाग*** के केन्द्र तमिलनाडु, आंध्रप्रदेश एवम् मध्यप्रदेश राज्यों में हैं । इस प्रभाग की कार्य दिशा छोटे मध्यम तथा बड़े जलाशयों में मत्स्य उत्पादन की वृद्धि हेतु प्रबंधन प्रणालियों को विकसित करने की ओर है ।

बैरकपुर स्थित ***ज्वारनदमुखी प्रभाग*** इस समय हुगली-मातलाह तथा नर्मदा ज्वारनदमुखी परितंत्रों पर कार्य कर रहा है । अनेक औद्योगिक इकाईयों से प्रवाहित वहिःस्त्राव, कृषि एवम् नगरपालिकाओं के अपरद्द आदि ने गंगा नदीय तंत्र के हुगली ज्वारनदमुख को एक अति प्रदूषित क्षेत्र बना दिया है । यह प्रभाग इसका अध्ययन कर रहा है । सुन्दरवन के ज्वारनदमुख एवम् मैंग्रोव परितंत्रों में जैविक एवम् अजैविक अध्ययन भी यह प्रभाग कर रहा है ।

हिल्सा मछलियों की जैविकी, स्वभाव तथा आचरण आदि पर भी अनुसंधान कार्य आवश्यक है जिससे गंगा नदीय क्षेत्र से कम हुई इन मछलियों की पुनर्स्थापना हेतु उपाय किये जा सके । इनकी अनुवांशिकी पर भी अध्ययन किया जा रहा है ताकि इनकी संख्या का आकलन किया जा सके ।

बैरकपुर स्थित ***मत्स्य स्वास्थ्य एवम् पर्यावरण प्रभाग*** को अधिदेश दिया गया है कि नदीय, जलाशय एवम् ज्वारनदमुखी परितंत्रों में मानवकृत परिवर्तनों का अनुमापन करे, एवम् उपयुक्त सुधारात्मक उपायों को विकसित करें । प्राकृतिक स्त्रोतों से प्राप्त सूचनाओं के निर्धारण के लिए प्रयोगशाला स्थितियों में भी अन्वेषण कार्य किया जा रहा है । प्रभाग द्वारा किए गए अध्ययनों से मत्स्य निवास स्थान की विभिन्नता, जैव-विविधता तथा ज्ञात सूचकों के माध्यम से दुष्प्रभाव का शिनाख्त करना, नियंत्रित परिस्थिति में विषैले पदार्थों का आंकलन, जलीय पर्यावरण में कार्बनिक

पदार्थों के परिमाण के लिए सूक्ष्म जैविकी का अध्ययन और मत्स्य रोगों की पहचान तथा इनके उपचार से संबंधित मौलिक सूचनाएँ भी सम्मिलित हैं । इस प्रभाग को जलीय परितंत्रों के सुधार के लिए एक कार्य योजना तैयार करने का दायित्व भी सौंपा गया है।

बाढ़कृत मैदानी आर्द्र-क्षेत्र प्रभाग का मुख्यालय गुवाहाटी में स्थित है । इस प्रभाग के अन्तर्गत गंगा तथा ब्रह्मपुत्र तलक्षेत्र के आर्द्र-क्षेत्रीय झीलों की पारिस्थितिक गतिकी का अध्ययन किया जा रहा है, ताकि इनके विकास के लिए उपयुक्त प्रणालियों को विकसित किया जा सके । गंगा तथा ब्रह्मपुत्र तलक्षेत्र के आर्द्र-क्षेत्र अपनी जैव-विविधता के कारण महत्वपूर्ण ही नहीं, बल्कि बिहार, पश्चिम बंगाल तथा असम राज्यों के मात्स्यिकी का प्रमुख अंग हैं । यह प्रभाग इन पारिस्थितिक परितंत्रों की प्रक्रिया एवम् इनकी मत्स्य उत्पादन क्षमता का अध्ययन करता है, जिससे

इनकी जैव-विविधता को नुकसान पहुँचाए बिना पर्यावरण के अनुकूल तकनीकी प्रणालियों को विकसित किया जा सके ।

मत्स्य स्त्रोत मूल्यांकन प्रभाग बैरकपुर में है और इस प्रभाग का लक्ष्य मत्स्य सम्पदा और मात्स्यिकीय स्त्रोतों में उपलब्ध मछलियों की संख्या निर्धारण कार्य का दायित्व सौंपा गया है ताकि इन अन्तर्स्थलीय मत्स्य स्त्रोतों का वैज्ञानिक समुपयोजन किया जा सके ।

बैरकपुर स्थित ***मानव संसाधन विकास एवम् प्रौद्योगिकी हस्तांतरण प्रभाग*** संस्थान में विकसित प्रौद्योगिकियों के हस्तांतरण, जनजागरण कार्यक्रम तथा प्रशिक्षण कार्यक्रमों द्वारा कुशलता बढ़ाने की दिशा में कार्य करती है । प्रौद्योगिकी हस्तांतरण शाखा प्रशिक्षण कार्यक्रम, प्रदर्शनी, सलाहकार सेवा, मत्स्य पालक दिवस, फिल्म प्रदर्शनी आदि द्वारा नित्य ही विभिन्न मत्स्य पालकों, मछुआरों, उद्यमियों, विस्तार कार्यकर्ताओं तक प्रौद्योगिकियों को पहुँचाती रहती है ।

संस्थान का अनुसंधान कार्य कुल 19 अनुसंधान परियोजनाओं में विभाजित किया गया है । इन अनुसंधान परियोजनाओं का कार्य मुख्यालय के अलावा 10 राज्यों में फैले संस्थान के 12 अनुसंधान एवम् 6 सर्वेक्षण केन्द्र तथा एक कृषि विज्ञान केन्द्र से किया जा रहा है ।

पुस्तकालय सेवाएँ

संस्थान का पुस्तकालय मुख्यालय एवम् अनुसंधान केन्द्रों में कार्यरत वैज्ञानिक की आवश्यकताओं के अलावा अन्य संगठनों के शोधकर्ताओं, अध्यापकों, विद्यार्थियों तथा अधिकारियों को भी अपनी सेवाएँ मुहैया कराती है । इस रिपोर्ट की अवधि के दौरान पुस्तकालय में अपने भंडार में 308 पुस्तकें, 87 विविध प्रकाशनों तथा जनरलों के 650 अंक संग्रहित किया तथा 20 विदेशी एवम् 66 भारतीय जनरलों के लिए शुल्क जमा दिया । इस समय पुस्तकालय में कुल 9296 पुस्तकें, 4277 पुनर्मुद्रित लेख, 1225 मानचित्र, 4137 विविध प्रकाशनों का भंडार है ।

संस्थान का पुस्तकालय विभिन्न संगठनों, विश्वविद्यालयों, उद्यमियों एवं मत्स्य पालकों को संस्थान में होने वाले विभिन्न अनुसंधान विकास संबंधी सूचनाओं को निःशुल्क प्रदान करता है साथ ही इसका कार्य दूसरे पुस्तकालयों को आर्थिक संसाधन भी मुहैया करवाता है । इस वर्ष पुस्तकों व अन्य पठन संबंधी सामग्री हेतु 2910357,00 रुपये खर्च किए गये हैं । पुस्तकालय द्वारा इंडियन फिशरीज एब्सट्रेक्ट का खंड 35(2-4), 2001 एवं 36(1), 2002 तथा जनवरी-दिसम्बर, 2000 से संबंधित करेंट कंटेंटस का भी प्रकाशन किया गया है ।

परियोजना अनुमापन व प्रलेखन सेवाएँ

यह अनुभाग संस्थान के विभिन्न अनुसंधान परियोजनाओं का अनुमापन तथा स्टाफ रिसर्च कांउसिल की बैठकों का आयोजन करता है । विभिन्न प्रकार के रिपोर्ट, लेख, बुलेटिन, परियोजनाओं कार्यक्रमों के प्रकाशन के अलावा यह अनुभाग निदेशक महोदय को अनुसंधान योजनाओं के निर्धारण

में सहायता प्रदान करता है । वैज्ञानिको द्वारा लिखे गए लेखों को विभिन्न देशी-विदेशी जरनलों में प्रकाशित करवाने या किसी सेमीनार, वर्कशाप आदि में प्रस्तुत करने के लिए आवश्यक प्रक्रिया इसी अनुभाग से होती है ।

इस अनुभाग में अघु प्रकाशन प्रणाली, फोटोकॉपी, लेमीनेशन, साइक्लोस्टाइलिंग, जिल्दसाजी आदि की भी सुविधाएँ उपलब्ध है ।

रिसर्च प्रोजेक्ट फाइल

सभी अनुसंधान परियोजनाओं से संबंधित वार्षिक प्रगति तथा वैज्ञानिकों का निजी योगदान प्राइमरी प्रोजेक्ट फाइल, साइंटिस्ट फाइल द्वारा रखा जाता है । अनुसंधान परियोजनाओं की प्रगति का अनुमापन आर.पी.एफ. ए ब तथा ब्ए एक्टिविटी माइलस्टोन, मासिक, त्रैमासिक, वार्षिक रिपोर्ट के माध्यम से किया जाता है ।

तकनीकी रिपोर्ट/क्वेरिज

संस्थान के अनुसंधन कार्य के विकास से संबंधित 20 तकनीकी रिपोर्ट से अधिक परिषद्, कृषि मंत्रालय के दूसरे अभिकरणों/संगठनों को भेजा जाता है, साथ ही यह अनुभाग देश विदेश से भेजे गये अनेक तकनीकी प्रश्नों का समाधान भी प्रस्तुत करता है ।

वैयक्तिक सूचना प्रणाली

रिपोर्ट की अवधि के दौरान 75 वैज्ञानिक के वैयक्तिक सूचनाओं को पी.आई.एस. डेटाबेस के अन्तर्गत डाला गया ।

प्रकाशन

इस अवधि के दौरान संस्थान द्वारा निम्नलिखित विभागीय प्रकाशनों को प्रकाशित किया गया है :

1. वार्षिक प्रतिवेदन 2001-2002
2. इनलैंड फिशरीज न्यूज (खण्ड 7, सं.1, जनवरी 2002 से जून 2002)
3. इनलैंड फिशरीज न्यूज खण्ड 7 सं. 2 जुलाई 2002 से दिसंबर 2002
4. इनलैंड फिशरीज न्यूज (विशेष अंक अप्रैल 2002)

बुलेटिन

1. बुलेटिन संख्या 107 : Ecology and fisheries investigation in Vembanad lake.
2. बुलेटिन संख्या 108 : Ecology-based fisheries management in some reservoirs of Eastern Rajasthan.
3. बुलेटिन संख्या 109 : Fisheries of Hooghly Matlah estuarine system-further appraisal (1994-95 to 1999-2000)
4. बुलेटिन संख्या 110 : (हिन्दी) मछलियों की बीमारियां-पहचान एवं उपचार
5. बुलेटिन संख्या 111 : Management of Estuarine wetlands
6. बुलेटिन संख्या 112 : Pen culture in floodplain lakes.
7. बुलेटिन संख्या 113 : Culture-based fisheries for inland fisheries development
8. बुलेटिन संख्या 114 : Bibliography on estuarine fisheries of India 1948-2000.
9. बुलेटिन संख्या 115 : Methods of Assessment of aquatic ecosystem for fish health care.

विविध प्रकाशन

1. मेघालय के बारापानी में मत्स्य किसानों के लिए *अंतर्स्थली मात्स्यकी विकास* पर प्रशिक्षण कार्यक्रम (जनवरी 20-30, 2003) सी.आई.एफ.आर.आई., उत्तरी-पूर्वी क्षेत्र में स्थित परिषद अनुसंधान कम्पलेक्स एवं सी.आई.एफ.ए. द्वारा किया गया ।
2. Fishery Management in Lentic Water Systems: stocking of reservoir with fish seed नामक कार्यशाला आयोजित (फरवरी 19-20,2003) किया गया ।
3. एन.ए.टी.पी. प्रोजेक्ट के अन्तर्गत Development of Reservoir Fisheries in India नामक विषय पर सी.आई.एफ.आर.आई. द्वारा प्रशिक्षण कार्यक्रम (मार्च 12-16, 2003) आयोजित किया गया ।
4. वी.वी.सुगुणन, पी.के.साहा एवं एन.के.बारिक द्वारा सम्पादित Hand book on pen culture of fish and prawn

पुस्तक

1. पश्चिम बंगाल के ऑरनामेंटल मत्स्य प्रजातियाँ

करेंट कंटेंटस

जनवरी-दिसम्बर, 2002

अंतर्स्थलीय मात्स्यिकी एब्स्ट्रेक्ट

खण्ड 35(2-4),2001 एवं 36(1),2002

वर्ष 2002-2003 का वित्तीय विवरण (रूपये लाख में)			
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योजना	250.00	190.00	189.98
एन.ई. भाग	150.00	100.00	99.71
गैर योजना	785.00	777.75	769.69
कुल	**1185.00**	**1067.75**	**1059.38**

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के. अ. मा. अनु. संस्थान का संगठनात्मक ढांचा