CIFRI

वार्षिक प्रतिवेदन
Annual Report
2009 - 2010

भा.कृ.अनु.प
ICAR

केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान
Central Inland Fisheries Research Institute

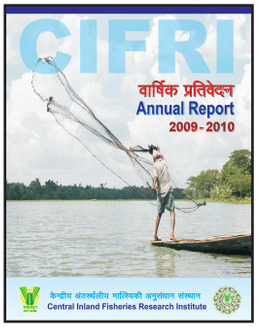
वार्षिक प्रतिवेदन
Annual Report
2009-10

भा.कृ.अनु.प
ICAR

केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान
बैरकपुर – 700 120

Central Inland Fisheries Research Institute
Barrackpore – 700 120

CIFRI Annual Report 2009-10



ISSN: 0970-6297

Published by:
Dr. A. P. Sharma, Director,
Central Inland Fisheries Research Institute, Barrackpore-700 120, West Bengal

Edited and Compiled by:
A. P. Sharma
P. K. Katiha
S. K. Manna
B. K. Behera
R. K. Manna
A. Ekka

Assistance:
Sunita Prasad, M. Quasim, S. Choudhuri

Hindi Translation:
P. R. Rao and Sunita Prasad

Cover Design: P. K. Katiha and S. Choudhuri

Designed & Printed at:
M/S Florence Offset Process, Private Limited, 6A, S. N. Banerjee Road, Kolkata – 700 013

The activities and achievements reflected in this Annual Report covers the period April 2009 and March 2010 only.

CONTENTS

PREFACE

Fisheries in inland open waters is one of the main sources of livelihood for the rural poor, particularly the inland fisher community. These waters have high potentials for production enhancement and addressing equity issues for rural poor. The traditional fishers operating in open-waters get comparatively low returns from fisheries now. For past few decades, fisheries from these waters are following declining trends. Most of the inland open water bodies in India have multiple uses, ownerships and stakeholders. At times, these constrain adoption of technologies for realising the full potentials of the waters and result in low levels of fish production. Therefore, concerns of property regime, overexploitation of natural fish stocks, ecosystem degradation, manmade modifications for water diversion, economic losses, *etc*., require immediate attention. With perceptible climatic changes as well as anthropogenic pressures, these waters need to be protected for sustained fisheries. Sustainable exploitation of fish stocks in such water bodies can be achieved through Sustainable exploitation of fish stocks in such water bodies can be achieved throughcommunity participation and co-management. It is high time to appraise the existing governance and policies to provide congenial production environment for inland fisheries sector.

Keeping these facts in mind, CIFRI has undertaken a number of institute-based, sponsored and network research projects to address these issues through research activities on fisheries enhancement and management in reservoirs and floodplain wetlands, assessment and conservation of threatened fishes in riverine and estuarine systems, impact assessment of hydrological changes on fish stocks and food-chain, environmental impact assessment and fish health, sensitization of stakeholders on various aspects of environment and conservation, reliable assessment of open-water inland fishery resources through remote sensing, evaluation of socio-economic and institutional status of fishers and valuation of goods and services provided by these waters. One international project sponsored by CGIAR on reservoir fisheries was successfully completed during the year. Its research outputs brought wide acclaim to the institute at national and international levels. Institute has also implemented a number of sponsored and NAIP projects, consultancies and out-reach projects during the year. CIFRI has strengthened its research and development linkages with different research institutes, universities and other organisations like State Governments of Madhya Pradesh, Jharkhand, Uttar Pradesh, Haryana, Assam, Kerala, Tamil Nadu, Gujarat, DVC, CPCB, NFDB, *etc*.

Besides, the research activities, CIFRI has organised various training programmes and exhibitions to share its research achievements at different levels of clientele starting from grass root level fishers to planners and policy makers at national and international level.

I want to take this opportunity to congratulate our own Dr. S. Ayyappan, for taking over as Secretary DARE & D.G., ICAR and wish him all the success in his unparallel efforts to develop agriculture and allied activities in the country. I express my sincere thanks to him and Dr. Mangala Rai, Former Secretary DARE & D.G., ICAR for their support and encouragement. I am grateful to Dr. V.V. Sugunan (ADG, I. Fy), Dr. Madan Mohan, ADG (M.Fy), Dr. U. Moza, Shri Anil Agarwal and Smt. Kamala Bisht, from Fishery Division, ICAR for their guidance and continued support to implement various activities of the Institute.

I am thankful to Dr. P. K. Katiha, his team and Sri N.P. Shrivastava in compiling the basic draft of the document. The help and assistance from Ms Sunita Prasad, Shri P. R. Rao and M. Quasion in formatting the document and preparation of Hindi section of the report is duly acknowledged.

Barrackpore, Kolkata
June, 2010

A. P. Sharma
Director

EXECUTIVE SUMMARY

The Central Inland Fisheries Research Institute (CIFRI) with a modest beginning as a Research Centre on March 17, 1947 at Calcutta has grown as a premier research organization in the field of inland fisheries and aquatic ecology at national and international level. Many of its scientists have achieved excellance in fisheries sector at global level. The most prominent during current year is Dr. S. Ayyappan's taking over as Secretary, Department of Agricultural Research and Education, Ministry of Agriculture, Government of India and Director General Indian Council of Agricultural Research, New Delhi. Hon'ble Dr. Ayyappan joined ICAR services at CIFRI.

With headquarters at Barrackpore, CIFRI has regional centers/stations at Allahabad in north, Bangalore and Kochi in south, Guwahati in North-east and Vadodara in West. Besides, the institute has a centre at Kolkata also. The institute has sanctioned Strength of 98 scientists, 87 technical, 80 administrative and 153 supporting staff. At present the institute has 51 scientists, 80 technical, 60 administrative and 123 supporting staff. The institute has effectively utilized 100% budget allocation in both plan and non-plan. Since last year the institute has three regular divisions approved by ICAR. These are Riverine Ecology and Fisheries, Reservoir and Wetland Fisheries and Fisheries Resource and Environmental Management.

As per the recommendations of Research Advisory Committee (RAC), and Quinquennial Review Team (QRT), CIFRI has eight institute funded research programmes with number of projects. The projects are as per approved VISION 2025 and EFC for XI Five year Plan. The institute has successfully implemented all the institute and externally funded/sponsored projects, besides undertaking number of capacity building, advisory and fisheries development activities. The major research findings of these projects are précised below.

Riverine fisheries

- The water quality of river Yamuna between Delhi to Etawah has deteriorated to great extent. The uppermost stretch of the river now is expected to be dominated by smaller and exotic fish species like common carp and tilapia.
- The annual water discharge from Indrapuri Barrage over river Sone has been drastically curtailed which has changed the river in to vast sand dune and some pools and pockets with feeble current during most part of the year. This has severely affected the riverine biotic communities including fishery. Spawn prospecting of the river has also collapsed.

Estuarine fisheries

- Subarnarekha estuary dried up in pre-monsson months, while inundated only during monsoon. A total of 135 species of fishes belonging to 17 orders and 53 families were recorded with maximum number in high saline zone. Total annual fish production from saline zone, transitional zone and freshwater zone were estimated as 575, 31.5 and 10.3 t respectively. About 50% of total catch was harvested during monsoon months. In lower estuary, Hilsa contributes to >35% of the total catch.
- In river Mahanadi, most part of the year fish migration remained elusive because of highly regulated flow regime, loss of stream width and depth, exposed river bed and spatial fragmentation of habitat. The fish pass facility in two barrages was defunct. Majority of migratory fishes were recorded up to 35 km from sea mouth.
- In Hooghly estuary, hilsa catch in saline zone was high (>5 t / day in Fraserganj in July and August), but meager in transitional and upper zones. Field observations indicated that the favourable conditions for hilsa migration are: > 4 m depth, c 20 m/minute current velocity. There is continuous availability of hilsa in sizeable numbers, from juveniles to maturing adults, round the year at all places along the entire stretch of Hooghly estuary.

Reservoir fisheries

- In Suvarnavathy reservoir, Karnataka, fish yield has increased from 116 kg/ha in 2007-08 to 197

kg/ha in 2009-10 through stocking of advanced fingerlings of Indian major carps, scientific stocking rate, harvesting of bigger size carps, and increase in effort. The CPUE has also increased from 14.5 kg in 2007-08 to 15.8 kg in 2009-10. This increased fish production has been translated into increase in gross income of Rs. 22,000/fisher in 2009-10 over 2007-08.

- In Kanhiraphuza reservoir of Kerala the growth performance for *Catla catla* was very good and it was poor for *Cirrhinus mrigala*. Stocking of *L. rohita* and grass carp in this reservoir was ineffective.
- The static mass balance model developed for Kelavarappalli reservoir showed trophic flows primarily in the first four trophic level (TL) and the food web structure characterized by dominance of low TL organisms. The results showed that increase in the abundance of African catfish would negatively impact the major fish groups, while Nile Tilapia does not impact major carps in this reservoir.
- The Kelavarapalli reservoir ecosystem is immature and can be utilised for enhancement options to increase fish production. In this reservoir, fishing is beyond MSY level and for sustainable fishery a reduction of fishing effort to Fmsy levels to 6748 No/year would be ideal.
- In Karapuzha reservoir 24.2 t of fishes were landed with a CPUE of 6.7 Kg. *Oreochromis mossambicus* dominated the catch (61.3%). Data suggested for increase of fishing effort of the reservoir to a Fmsy level of 4946 to exploit the potential resources. The total stock in reservoir is estimated as 135 t and MSY is 94.1 t. The current yield was far below the MSY level at 24.2 t. Food and feeding habits and reproductive biology of various fish species in the Karapuzha reservoir were studied.
- Suitable models, using several functional relationships of yield with other parameters were developed from the available secondary data to facilitate the estimation of fish yield in any given reservoir. A modified Verhulst-Schaffer model that considers impact of fingerlings stocking in reservoirs on fish population growth is being proposed to stock reservoirs.

Wetland fisheries

- A yield prediction model describing yield (dependent variable) and bio-physical and chemical attributes (independent variables) was developed using data collected from 17- wetlands of West Bengal.
- A pilot trial was conducted in a *chaur* in Bihar to assess the feasibility of pen culture in *chaurs* to encourage public private partnership. Circular pens, made of cheap HDPE net, supported the growth of IMC. The new method of pen fabrication being easy to handle, cost effective and socially acceptable was adopted by the local farmers.
- The impact of different biotic communities on wetland health and biodiversity was studied through mesocosm experiment. Results showed that submerged macrophytes provided congenial environment for nutrient regeneration in soil besides physico-chemical and nutrient status in water, which in turn positively influenced the growth of fish food organisms, such as plankton, periphyton and molluscs.
- Study across 8 wetlands of different categories in West Bengal showed total fish yield ranging from 86 to 1794 kg/ha/year with major share of stocked major carps. However, sample survey indicated that the fishers received higher income from wild fish stocks compared to the stocked fishes. The number of wild fish species exploited from the wetlands ranged from 5 to 28. A total of 79 species of fin fishes under 57 genera and 32 families have been identified, besides four species of prawns and one species of crab.
- A fish based farming system was established in seasonally flooded area in West Bengal. The technical know how of fish farmers was improved. The fish productivity increased to 3377 kg/ha from 2540 kg/ha last year. The benefit cost ratio was 2.23 confirming the viability of the technology.

- Various aspects of stock enhancement, *viz.*, fish species stocked, size, stocking density, period of stocking etc. were studied in 26 *beels* spread over Assam. Stocking density was the single most crucial factor determining 99% of variation in fish production from stocked fishes in closed *beels* and 66% of variation in fish production from stocked fishes in open *beels*.

Fish health and environment

- Based on Bacillariophyceae domination (36.0 to 54.7%) in total periphyton, Damodar river water from Durgapur to Burnpur was found to be suboptimal. A total number of 63 fish species, belonging to 20 families were recorded in river Damodar, out of which 3 species are exotic.
- Metal study showed that Damodar river was free from arsenic pollution. However, presence of DDTs exceeding the permissible limit of EPA for aquatic life was noticed in all the water samples in river Damodar.
- EIA indicated river Yamuna as a stressed environment. In present rapid survey, total 72 fish species were recorded, out of which 4 species were exotic with their dominant presence at Agra, Wazirabad and Allahabad. The IBI matrix indicated that Yamuna Nagar and Allahabad were found to be in a acceptable category, whereas Wazirabad was moderately impaired and Agra was impaired on account of significant disposal of wastes and high pollution rates.
- Nine bacterial strains were isolated for degradation of dichlorophenol, trichlorophenol, or pentachlorophenol for bioremediation purpose. Under laboratory culture condition, five strains were strongly degrading pentachlorophenol indicating their potential for bioremediation. Some of the pentachlorophenol degrdading strains were identified as *Ochrobactrum anthropi*, *Pseudomonas (viridilivide)*, *Chryseobacterium gleum/indologenes*.
- Specific gene sequences from various fish species from different stretches of river Damodar were compared to examine genetic differences at polluted and less-polluted sites. The RAPD data of genomic DNA of *Gudusia chapra* did not suggest existence of differences in *Gudusia chapra* from upstream and downstream stretches. Further, mitochondrial cytochrome *b* gene sequence study showed presence of 3 haplotypes each in *Cirrhinus mrigala* and *Catla catla* samples from river Damodar.
- Proteome map of muscle and lens proteins of Indian major carp *Labeo rohita* were generated for the first time. 2-D proteome map for *Rita rita* lens crystallins was generated.

Fisheries resource assessment

- Ground truthing of remote sensing imagery was done to develop linear and multiple linear regression models that could be able to estimate water and soil quality parameters. It was observed that Free CO2 was significantly correlated with IR, Red & Green band, NO3 in IR and NIR band and DO and pH with Red band, Ca with Red band, Sp. Conductivity, TDS, TA, hardness & Ca with Green band.
- Imagery was analyzed to estimate the Chlorophyll pigment concentration from the spectral reflectance signature. It was observed that in the Infra red band chlorophyll *a*, chlorophyll *b*, chlorophyll *c* and chlorophyll were significantly correlated R^2=0.526 R^2=0.589, R^2=0.611 and R^2= 0.615 respectively and capable of predicting chlorophyll pigment concentration from this band.
- Based on the landscape matrix Multiple Linear Regression model for Sp. conductivity was developed (R^2=0.9, $P < 0.01$). The compositional attribute (%) Grass land and settlement could be considered as the first and second important explanatory variables, Sp. cond = -204.24 + 13.70 x g + 13.32 x s where g = grass land (%) in the watershed and S =settlement (%) in the watershed.
- The catch data collected from Ganga river system at Allahabad and from Brahamputra River at Guwahati were scrutinized, analyzed and stored in web-GIS platform to know the catch and catch structure.

Fisheries socio-economics

- The information on physical features, socio-economic characteristics of fishers, institutional arrangements and governance, livelihood and community interactions with the resources was gathered from Charan *beel* Assam. Various uses, goods and services provided by the beel were valued at Rs 50.24 lakh with highest share for fish (45%) followed by natural resource use (34%).
- Similar exercise in estuarine area around Gosaba block revealed 77% farmers, 18% fishers cum farmers and remaining business personnel and tourists using the resources. Valuation exercise is in progress and expected to complete by 2010-11.

Other projects

The institute has executed number of externally funded/sponsored projects during this period. These are:

ICAR Network

- Impact adaptation and vulnerability of Indian agriculture to climate change-Impact assessment of climate change on Inland Fisheries.
- Microbial Phosphorus Transformations in Inland Open Waters.

National Agriculture Innovation project

- Arsenic in food chain: Causes, effect and mitigation.
- Bio-prospecting of genes and allele mining for abiotic stress tolerance.
- Toll-like receptors in phylogenetically divergent fish species–Their contribution in modulating the innate immunity.
- Sustainable livelihood improvement through need based integrated farming system models in disadvantaged districts of Bihar.

Central sector Scheme

- Strengthening of database and geographical information system of the fisheries sector.

Department of Animal Husbandry Dairying & Fisheries

- Assessment of literacy, income and health status of fishers in India.

Central Pollution Control Board

- Assessment of fisheries with regard to water quality in the river Ganga and Yamuna.

INTRODUCTION

Brief History

Based on the recommendations of the Sub-committee of the Central Government on Agriculture, Forestry and Fisheries, the Central Inland Fisheries Research Station was formally established on 17 March 1947 in Calcutta under the Ministry of Food and Agriculture, Government of India. From this modest beginning, the station expanded its activities and was elevated to the status of an Institute (CIFRI) in 1959 and moved to its own building at Barrackpore (West Bengal). Over the years, the organization has grown & established itself as a premier research institution in the field of inland fisheries and aquatic ecology in the country. Since 1967, the Institute is under the administrative control of Indian Council of Agricultural Research (ICAR), DARE, Ministry of Agriculture, Government of India.

Initially the main objective of the Institute was to conduct investigations for proper appraisal of all inland fishery resources of the country and to evolve suitable methods for their optimal utilisation for fish production. While fulfilling the above objective, the Institute directed its research efforts towards understanding the ecology and production functions of different types of inland water bodies in the country. Investigations were also conducted to understand pond ecosystem, its bearing on fish production, which eventually led to development of farming practices to obtain high fish yield from unit water area.

CIFRI during late sixties and seventies, focussed its attention on aquaculture research and development in consonance with the plan priorities of Government of India. Having achieved significant progress in fishery research & farming practices in the country, the planners between 1971-1973 approved All-India Coordinated Research Projects, one each on "Composite Fish Culture", "Riverine Fish Seed Prospecting", "Air-breathing Fish Culture", "Ecology and Fisheries Management of Reservoirs" and "Brackish water Fish Farming". The success of combined project of "Composite Fish Culture & Fish Seed Production" initiated in 1974 was the turning point in the history of fish culture in India and provided a solid foundation for the development of freshwater aquaculture in the country. This resulted in the establishment of the Freshwater Aquaculture Research & Training Centre at Dhauli (Orissa) in 1977, which in 1987 became, Central Institute of Freshwater Aquaculture (CIFA). Simultaneously, Central Institute of Brackish-water Aquaculture (CIBA) and National Research Centre on Coldwater Fisheries (NRCCWF) were carved out from this Institute to carry out research on brackish-water aquaculture and coldwater fisheries respectively. Thus, CIFRI gave birth to three major fisheries research Institutions in the country.

As a consequence of creating specialised institutes and keeping in view the emerging issues like sustainability in open water fisheries and aquatic resource management, the mandate of CIFRI was modified.

Vision

Eco-friendly enhanced fish production and productivity from inland open waters for livelihoods and societal benefits.

Mission

Knowledge based fisheries management for enhanced production, biodiversity conservation and integrity of ecological services to derive social benefits from inland open waters.

Mandate

- To undertake basic, strategic and applied research in inland open-water fisheries viz. rivers, reservoirs, lakes, estuaries and associated waters.

- To develop ecosystem-based technology and strategies for productivity enhancement in mandated waters.
- To monitor environmental changes, their impacts on fisheries and developing mitigation action plans in collaboration with other organizations
- To create awareness, provide training and consultancy in inland open-water fishery management.

Organisational Structure

Since February, 2009 the Institute research activities are organised under three divisions. The divisional Heads are the technical head with overall In-charge of the scientific programmes. The regional Heads of the centres of CIFRI at Allahabad and Guwahati are the administrative heads and look after the implementation of the projects of all the divisions at respective regional centres. The institute is pursuing its research activities through these divisions and Agricultural Economics Section, which are in turn supported by different research support services / sections:

- **Riverine Ecology and Fisheries Division** with its headquarters at Barrackpore strives to monitor and develop effective management action plan for riverine and estuarine ecology and fisheries and resources of the country with adequate emphasis on the conservation of fish stocks. The research activities are executed from Barrackpore, Kolkata, Vadodara and Regional Centres at Allahabad and Guwahati.
- F**ishery Resources and Environmental Management Division** is based at Barrackpore and is working on (i) Fish health and environmental issues related to open-water fishery resources viz., rivers, wetlands, reservoirs and estuaries. Monitoring of the ecosystem and development of mitigation action plan through biochemical, microbiological, and biotechnological approaches for ecosystem restoration is also the responsibility of this Division. (ii) Creating resource management database on the fish stocks and fishery resources in easy accessible formats. The aim of this database management is to develop models or tools for sustainable use of inland fish stocks.
- **Reservoir and Wetland Fisheries Division** aims at developing management norms for enhancing fish production from large, medium and small reservoirs of the country. The Division also carries out research on the wetland ecosystem production processes and optimising fish yield providing special attention to biodiversity conservation and development of environment-friendly technologies. The research activities of this Division are carried from Barrackpore and Bangalore, and Regional Centre Guwahati and Allahabad.
- **Agricultural Economic Section** was constituted during the current year to conduct research on socio-economic, institutional and other relevant issues across different inland resources. The section is conducting research on valuation of inland resources and socio-economics aspects of fishers operating in reservoirs, rivers, wetlands and estuaries. The section is located at Barrackpore and executing projects in different parts of the country

Research Support Services

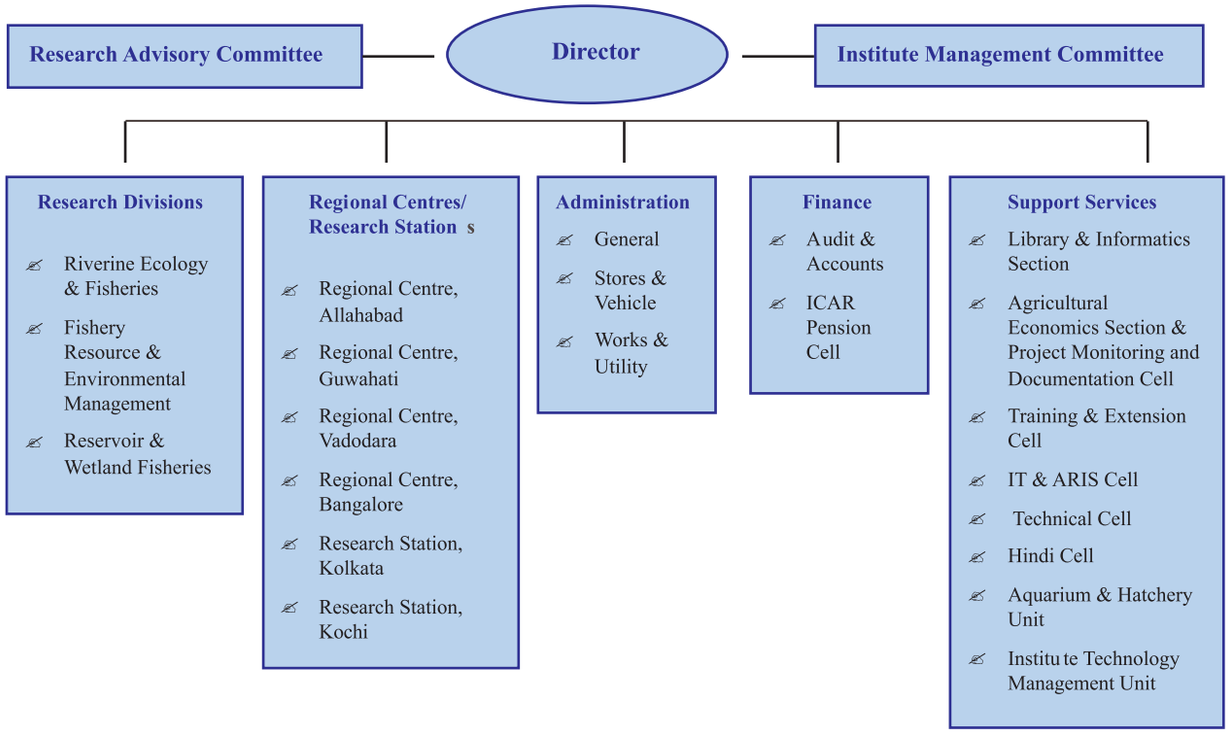
To execute various institutional activities and supporting the research few sections, cells or units were created or re-organized.

- **Extension & Training Cell** undertakes/organizes on regular basis various trainings, demonstrations, exhibitions, Fish Farmers' Day, and other extension activities for dissemination of various technologies of inland fisheries to the fish farmers, fishermen, entrepreneurs, extension functionaries, *etc*. It also maintains liaison with other agencies. The institute is aimed at manpower development through this cell.
- **Technical Cell** provides technical support relating to monitorable reports to ICAR/SMD/other agencies, answers the technical queries from Parliament, ICAR and other agencies, replying audit queries.
- **Project Monitoring and Documentation Cell** publishes various technical reports, maintains RPF files and scientific publications of Institute. This section during 2008-09 published six bulletins, annual report, newsletters, brochures, *etc*.

- **IT & ARIS Cell** promotes the use of information technology and provides 24 hours LAN and internet facility to staff members. The cell provides technical expertise for computer application and related items procurement and maintenance, e-governance, e-procurement, Institute web hosting and server/computer security. The cell is equipped with infrastructure like Linux server, D-Link managed and unmanaged switches, CISCO Router, PIX Firewall, Workstations, printers, scanners and various licensed softwares. ERNET VSAT facility has also been provided to all research stations.
- **Library and Informatics Section** facilitates various research activities through procurement, maintenance and issuing of books, journals, project reports, institute publications etc. This year, library added 656 books for the year 2009-10 and subscribed to 17 foreign journals and 25 Indian journals. The current total holdings are 12,662 books, 4320 reprints, 1252 maps and 4350 miscellaneous publications. Complete digitization of books and other materials is under process.
- **Institute Technology Management Unit** executes the IPR related activities of the Institute.
- **Aquarium and Hatchery Unit** maintains the institute aquarium and hatchery under National Seed Project.
- **Hindi Cell** publishes technical documents, reports, magazines in Hindi, translates various technical details in News Letter, Annual Report *etc.* into Hindi. The Cell also carries out various social activities to popularize Hindi as the official language.

The Director in Research Management position heads the Institute. The responsibility of overall management of the Institute lies with Management Committee under the chairmanship of the Director. The Institute Research Committee (IRC) and the Research Advisory Committee (RAC) make specific recommendations pertaining to research and extension activities of the institute. The Institute's research activities are organised under various research projects, which are executed from the headquarters at Barrackpore, and Regional Centres at Allahabad, Bangalore, Vadodara, and Guwahati. The organizational structure of the institute is depicted in the Organogram.

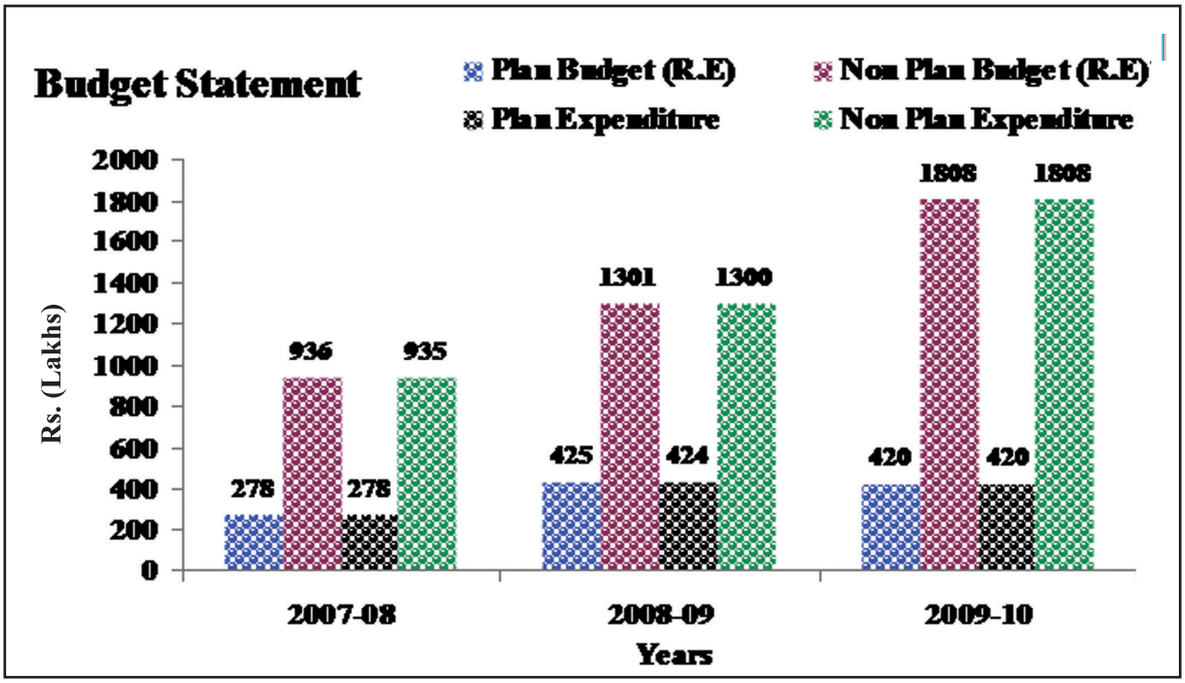
ORGANOGRAM OF CIFRI



BUDGET DETAILS

Budget statement for the year 2009-2010 (Rs. In Lakhs)

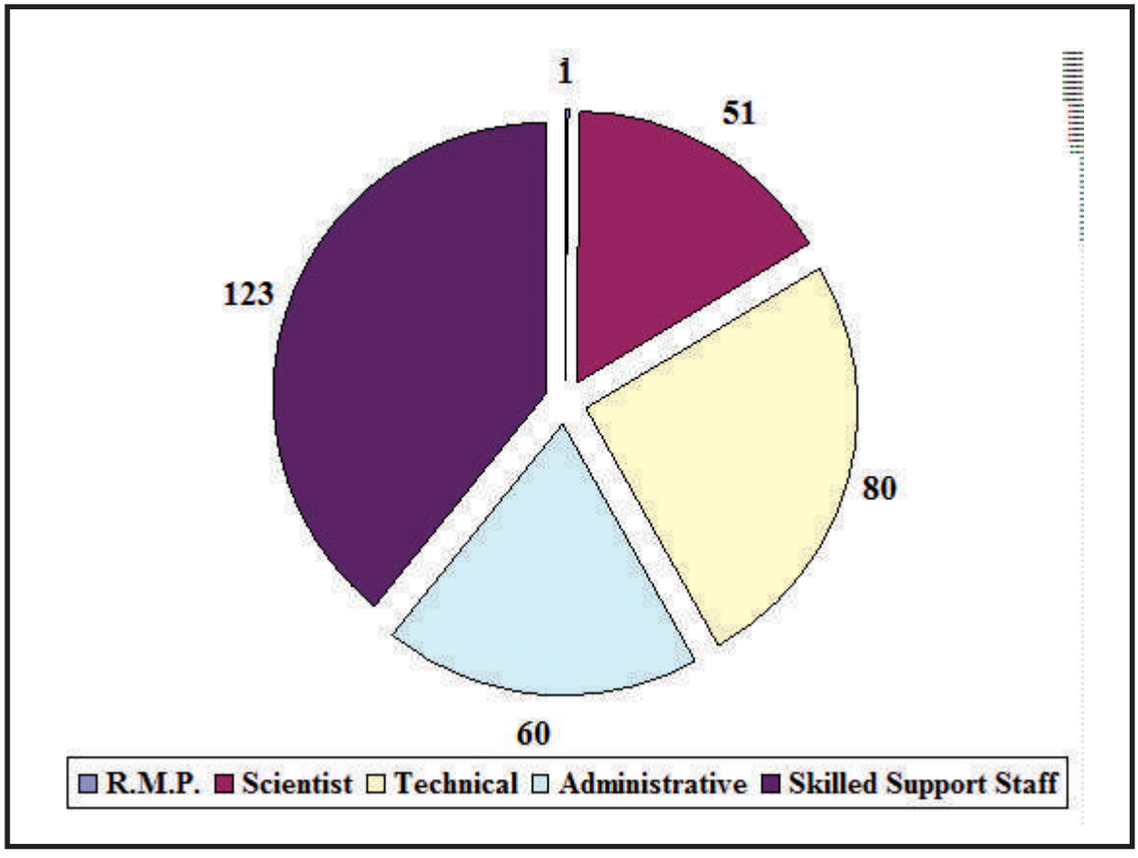
Head of Account	Budget (R.E.)		Expenditure	
	Plan	Non-Plan	Plan	Non-Plan
Pay & Allowance Including OTA	-	1723.67	-	1723.67
T.A.	28.00	4.14	28.00	4.14
Other charges including equipment, library books, I.T. and H.R.D.	287.00	64.19	286.67	64.19
Works	105.00	15.67	105.00	15.67
Grand total	**420.00**	**1807.67**	**419.67**	**1807.67**



STAFF POSITION

Staff Position as on 31 March, 2010

S. No.	Catagory	Sanctioned Strength	Filled up	Vacant	Remarks
1.	R.M.P.	1	1	-	
2.	Scientist	98	51*	47	* Including 2 (two) Technical personnel of KVK
3.	Technical	87	80	7	
4.	Administrative	80	60	20	
5.	Skilled Support Staff	153	123	30	
Total		**419**	**315**	**104**	



Staff Strength

RESEARCH ACHIEVEMENTS

INSTITUTIONAL PROJECTS

Programme: Developing fish stock and management protocols of rivers and associated ecosystems

Programme Co-ordinator: Dr. Utpal Bhaumik

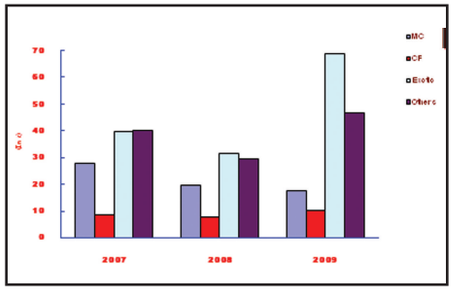
Generating Benchmark Information on Ecology and Fisheries of the Yamuna River

H. P. Singh, R. K. Tyagi, V. Pathak and B. K. Singh

Information was generated on hydrology and ecological parameters, flow pattern, potential energy resource and fishery in Yamuna river to formulate policies to achieve the goal of sustainable fishery from the system. The sediment was alkaline in reaction (pH 7.3-7.5) with dominance of sand (85-95.5%) in the upper stretch. Clay and silt were comparatively higher in the lower stretch. Organic carbon was poor (0.028-0.5%) but available phosphorus was high (4.3 to 9.0 mg/100 g). The water in upper most stretch Badwala was rich in dissolved oxygen (10.4 mgl^{-1}) and showed comparatively lower values of alkalinity (72.6 mgl^{-1}), conductance (184 $iScm^{-1}$), dissolved solids (93 mgl^{-1}), hardness (70 mgl^{-1}) and chloride (12.8 mgl^{-1}). From Yamuna Nagar the water quality started deteriorating due to discharge of effluents and reduction in flow rate. The condition was worst between Delhi and Etawah stretch where all the chemical parameters showed abrupt increase. The condition improved significantly below Hamirpur after the confluence of Chambal, Betwa, Ken and other tributaries. The rate of energy transformation by producers indicated that the net energy was 1360 Cal m^{-2} day^{-1} at Badwala which increased gradually reaching maximum at Mathura (6400 Cal m^{-2} day^{-1}), with fluctuations between Hamirpur and Arail. It is interesting to note that the water quality of the river showed maximum deterioration between Delhi-Etawah stretch, whereas, the energy transformation was much higher (4180-6400 Cal m^{-2} day^{-1}) reflecting positive impact of organic loading on energy fixation whenever the river was in a fluviatile condition. On the basis of energy transformation the estimated fish production potential was also observed to be high (145-221 kg ha^{-1}) between Delhi and Etawah stretch. The average plankton population was maximum at Agra (1952 ul^{-1}) and minimum at Panipat (113 ul^{-1}). Among phytoplanktons *Bacillariophyceae* was predominant followed by *Chlorophyceae*, and among zooplanktons rotifera and crustacea were predominant. The periphytic population was maximum at Badwala (9160 ucm^{-2}) and minimum at Arail (580 ucm^{-2}). The dominant algal species were *Synedra* sp and *Navicula* sp. at all the centres. The benthic fauna investigations revealed abundance of macrobenthic organisms, which were maximum at Mathura (2678 nm^{-2}) followed by Delhi (1059 nm^{-2}) and minimum at Badwala (169 nm^{-2}). Dominance of chironomids and tubifex in the middle stretch (Delhi-Etawah) clearly reflected organic loading in the system. Between Hamirpur and Arail the benthic population being dominated by molluscs (*Compeloma* sp., *Sphaerium* sp. and *Lymnea* sp.) indicated reduction in pollution load and improvement in water quality. Study in river Yamuna showed drastic decline in fishery, both in quality and quantity.

Pristine Yamuna at Badwala

Highly polluted stretch below Wazirpur in Delhi



Fish landings at Allahabad

The fish landings at Sadiapur and Daraganj were estimated at 143.14 t and 37.79 t, respectively. At Sadiapur, common carp and *Tilapia* contributed to almost half and others contributed 34.4% of the total catch. Major carps (12.1%) and large sized catfishes (7.1%) also contributed to the catch. As compared to preceding year, the fishery showed an increase of 62.5% with three times higher landing of common carp; Tilapia and others groups registered an increase of 46 and 59%. This may be due to monsoon failure in the region causing the river more exposed for fishing for a longer period. However, Daraganj landings did not reflect much change over the preceding year. At uppermost zone the fishery was dominated by *Schizothorax* sp. and *T. putitora*, although the catches were of low order. In Yamunanagar-Delhi stretch (above Wazirabad barrage) fishery was dominated by smaller species and among exotics only a few specimens of common carp was recorded. In Delhi-Etawah stretch the fishery was dominated by *Tilapia* (84 to 95%). In Hamirpur-Allahabad stretch, the fishery was mainly composed of smaller species and exotics, and contribution of *Tilapia* was around 13%.

Invasion of *Tilapia* in river Yamuna

Understanding the Impact of Specific River Links on the Ecology and Production Functions

H. P. Singh, R. K. Tyagi, V. Pathak, B. K. Singh, R. S. Srivastava, D. Debnath and A. K. Sahoo

The investigations to know probable impact of interlinking of the rivers on genetic variability among fish populations/stocks endemic to the native riverine habitat were done. The abiotic and biotic parameter studies on pre-linking phase in Ken and Betwa rivers were conducted to generate information to evaluate the likely impact of linking of these rivers on hydrology, ecology and fisheries of the system. The investigations on abiotic parameters indicated that sediment was alkaline in reaction (pH 7.4-7.6) with poor organic carbon (0.05-0.07%) and rich available phosphorus in both Ken and Betwa rivers. Soil was dominated by sand (78-82%) with silt ranging from 14.0-18.1%. The common feature of the rivers was rich oxygen (7.0 & 6.5 mgl^{-1}), alkaline pH (7.4 & 7.6) and poor nutrients (phosphate 0.04 & 0.06, nitrate 0.06 & 0.08 mgl^{-1}), and high dissolved organic matter (1.2 & 1.6 mgl^{-1}) contents. However, levels of alkalinity, conductance, dissolved solids, hardness and chloride all were higher in Ken (128 mgl^{-1}, 265 Scm^{-1}, 133 mgl^{-1}, 122 mgl^{-1} and 24 mgl^{-1} respectively) than Betwa (94 mgl^{-1}, 218 $iScm^{-1}$, 110 mgl^{-1}, 89 mgl^{-1} and 18 mgl^{-1} respectively). The average rate of energy transformation was 3280 Cal m^{-2} day^{-1} in Ken and 2312 Cal m^{-2} day^{-1} in Betwa. The studies on Biotic community revealed that plankton population ranged from 50 to 460 ul^{-1} in Ken and 180 to 880 ul^{-1} in Betwa. Dominant forms encountered were *Cymbella, Synedra, Selenastrum* and *Ankistrodesmus*. Periphyton density ranged from 230 ucm^{-2} to 2300 ucm^{-2} in Ken and 460 ucm^{-2} to 1300 ucm^{-2} in Betwa. Benthic population was in the range of 50 to 600 nos m^{-2} in Ken while it was between 50 to 530 nos m^{-2} in Betwa. The population was dominated by molluscs in both the rivers.

Sampling in river Ken

Ganguo weir on river Ken

Studies on the Environmental Flow Requirements of Various Categories of Rivers in India

V. Pathak, R. N. Seth, R. K. Tyagi, D. Debnath and A. K. Sahoo

Indrapuri Barrage on river Son

The importance of environmental flow and lack of its information for sustainable fisheries in riverine system led to implementation of this project to generate information on water flow abundance of biotic communities, production potential and fisheries of the system with respect to water flow at Indrapuri barrage on the river Sone. The total discharge from the Indrapuri barrage was very low at 18, 772x10^7 m^3 during current year as compared 1976 at 105, 772x10^7 m^3. A total of 87,034 x10^7 m^3 was discharged during flood season (July-October) in seventies reduced to 14,034x10^7 m^3. During lean period water discharge was drastically reduced, even to zero. The severe reduction in discharge rate and heavy siltation has reduced the river to pools and pockets for a long period in a year. In the present study period, even during peak flood season (Aug-Sep) the river below the barrage has shown only 10-15% riverine condition and the rest only sand dunes.

The water quality of river indicated rich oxygen (7.2 mgl^{-1}), alkaline pH (7.6), and moderate alkalinity (68 mgl^{-1}), conductance (190 ìmhos), dissolved solids (98 mgl^{-1}), hardness (62 mgl^{-1}) and very little intra stretch variations indicating pollution free status of the river. Sediment showed complete domination of sand (88-99%) with poor nutrients. The biotic setup revealed poor abundance of macrobenthic organisms during monsoon, which significantly improved (50 nm^{-2} at Koilwar to 592 nm^{-2} at Dehri-on-Sone) during winter when the river became almost stagnant. Mollusc was the dominant group throughout the stretch mainly represented by *Spharium* sp., *Comploma* sp., *Goniobasis* sp., *Lymanea* sp. followed by insect which mainly comprised of dragonfly nymphs. The average commercial catch around the barrage was 45-50 kg day^{-1} at Dehri-on-Sone, followed by 15-20 kg day^{-1} at Tilathu and 20-25 kg day^{-1} at Koilwar. The catch showed considerable seasonality with dominance of small trash fishes like *Gagata cenia* during post-monsoon period. During winter fingerlings of *Aorichthys* sp. and young ones of *Rita rita, E. vacha, C. garua, M. armatus, M. aculeatus, B. bagarius etc*. formed the main catch. Major carp and minor carps were poor. Gill nets of various mesh sizes and hook and line were the major gears used. A total of 37 fish species belonging to different genera were recorded in commercial fishing and various fish markets. In sixties and seventies an average of 4787 *hundis* (earthen pots with red soil) of spawn were collected from Koilwar stretch of the river which has drastically reduced to 10 to 12 *batis* only (150 ml aluminum cup) at the present time. As such, the spawn trade has totally collapsed from the Sone river.

Programme: Development of sustainable fisheries management protocols for estuaries and associated water bodies

Programme Co-ordinator: Dr. Utpal Bhaumik

Generating information/data on ecology and fisheries from east coast estuarine systems (Subarnarekha)

B. B. Satpathy, K. R. Naskar and A. K. Sahoo

The estuarine span of Subarnarekha river is about 45 km from sea face to Jaleswar, constituting about 9.8% of the total length of the river. The whole estuarine zone was divided into three stretches based on salinity regime – High saline (Kirtaniya and Ramnagar), 8 km from mouth with 1-3 m depth; Transitional zone (upstream of Ramnagar to Dahamunda), 23 km long with 3-8 m depth and Freshwater zone (upstream of Dahamunda to Jaleswar).

Suburnarekha estuary at Kirtanya

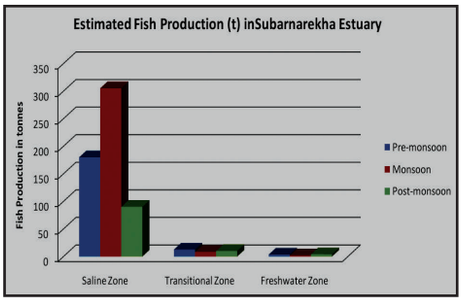
Seasonal flow pattern experienced several flood pulses during monsoon. The inter-annual difference in rain and intensity of flood had noticeable effect on fisheries of the estuary. The dry spell from January– June led to development of a lean flow and dried up conditions even at the estuary mouth. The freshwater discharge to estuary at high flow was estimated to be 2400 m^3s^{-1} and it was reduced almost by an order in post monsoon at the transitional zone. The transitional zone being the deeper part of the estuary retained water all through the year and contributed substantially to the fishery. The water salinity ranged from 1.04-27.10 ppt at Kirtanya, 0.05-2.45 ppt at Dahamunda and 0.04-0.09 ppt at Jaleswar. The entire Subarnarekha estuary, barring only the mouth region, turns in to freshwater during July to September due to rain and floods. A recovery phase is set off only in late October with the return of salinity gradient in the lower estuary and a stable freshwater flow, low turbidity and higher nutrient concentration in water in the middle and upper estuary. With reduced riverine inflow, distinctly different zonal trends in physico-chemical and biological modes became obvious within the estuary in post-monsoon and pre-monsoon period. The tidal amplitude was 1.8 m at the high saline zone in post-monsoon. Turbidity was lowest in the freshwater end but increased from transition zone to the saline zone. Moderate salinity and higher concentrations of nitrate, phosphate and silicate, apparently caused by an active release and exchange mechanism in the transitional zone positively influenced phytoplankton, zooplankton and benthic invertebrates compared to other zones.

Haul of *Strongylura* sp., *Hyporhamphus* sp.

Plankton concentration was highest in the high saline zone ranging between 350 and 500 u l^{-1} and lowest in the transitional zone, save and except during August. Phytoplankton had an overall dominance throughout the stretch. In the freshwater zone zooplankton was dominated mostly by *Mesocyclops* sp., *Diaptomus* sp., *Brachionus* sp. and Nauplii of Copepods. The high saline zone however, exhibited dominance of Nauplii of Copepods, *Mesocyclops* sp., *Diaptomus* sp. and *Tintinopsis* sp. in zooplankton community. Molluscs contributed more than 50% to macro-zoobenthos population, followed by polychaetes. Thirteen species of prawns and seven species of crabs have been recorded. In the saline zone *Metapenaeus brevicornis* and *M. monoceros* were the principal contributors to prawn fishery. *Penaeus monodon, Fenneropenaeus indicus* and *Parapenaeopsis stylifera* were the other penaeid prawns encountered. Crabs do not have significant contribution to the decapod crustacean fishery.

Haul of Prawn species

A total of 135 species of fishes belonging to 17 orders and 53 families have so far been documented. Of the total number of fish species (barring euryhaline migratory fishes) around 60% is contributed by the lowermost high saline segment of the estuary, between sea face and Ramnagar. *Liza parsia* has been found to be present both in saline and transitional zones up to about 2 km downstream of Dahamunda. All the members of the order cypriniformes were restricted to the freshwater stretch from Jaleswar to 5-6 km downstream. The transitional zone forms a kind of resort for the fishes. Even during dry season this lake-like formation provides immense fishery resource. *Rhinomugil corsula* constitutes a sizeable fishery in the transitional zone. The mid-estuary region at and around Dahamunda was identified as important spawning and nursery habitat, supported by observed catch of larval and juvenile fishes as well as huge quantity of planktonic eggs, in the wet season. Monsoon migration of hilsa, *Tenualosa ilisha* is restricted only up to Ramnagar, though stray catch of hilsa is reported up to Dahamunda and rarely at Jaleswar. Hilsa contributes to >35% of the total catch of about 10 t d^{-1} at the estuary mouth during monsoon months.



Fish catch in three salinity zones

Migratory Pattern and Behaviour of Important Migratory Fish Species for Designing Fish Passes/ Hydraulic Structures

Utpal Bhaumik, N.P. Shrivastava, P.K. Katiha, B.B. Satpathy, R. K. Manna and D. Debnath

Fish passes in the eastern region and their functional status was documented towards fisheries and fish migration. The survey of Mahanadi indicated several barrages and weirs on the river from Raipur to Cuttack. But, fish passes were at only two barrages, namely, Jobra and Naraj. These were also grossly insufficient for upstream fish migration. Downstream the barrage there was a good diversity of 20 migratory fish species including hilsa, but none of them could be encountered above the barrage. An excessively elevated basement of the fish passes relative to the immediate upstream river-bed is observed to hinder continuity of water flow through the fish pass channel and as such the pass becomes inoperative beyond brief period of high flow in the wet season. Majority of migratory fishes of estuarine and marine origin are encountered at the lower Mahanadi estuary up to 35 km from the mouth. They included *Mugil cephalus, Lates calcarifer, Liza tade*, *Liza parsia, Pama pama, Rhinomugil corsula, Tenualosa ilisha, Sillago sihama, Sillaginopsis panijus, Glossogobius giuris, Brachygobius nunus, Pseudopoeryptes lanceolatus, Xenentodon cancila.* The catch as well as number of fish species were reduced in the freshwater zone.

View of Naraj barrage in dry season

Inner view of fish pass at Naraj barrage

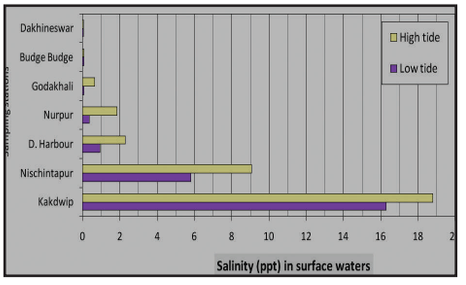
The observations on Hilsa migration pattern in Hooghly estuary suggested that hilsa catch in saline zone was high (>5 t / day in Fraserganj in July and August), and 2 to 3 orders less in the transitional zone (50 kg and 10 kg / d at Diamond Harbor and Nababganj respectively). The catch was still lesser in the upper stretch. To a large extent, hilsa seemed to complete the breeding run within the estuary, with favourable influence of high freshwater flow and reduction of salinity. It appeared that the breeding habitat is found all along the longitudinal axis from Diamond Harbour to the Head of the estuary.

Only a relatively smaller group of fish in a lesser maturity stage moves upstream into the riverine stretch. The field observations tend to indicate that the favourable conditions for hilsa migration are: > 4 m depth, c 20 m/minute current velocity (during high turbulence and high water current, the fish moves closer to river banks), larger size of the estuary, especially deeper and wider estuarine mouth, adequate freshwater flow, low salinity and moderate turbidity *etc*. These served as cue for migration. High siltation at the estuarine mouth, as found in smaller estuaries like Mahanadi, Devi and Subarnarekha, seemed to have adverse impact on hilsa migration.

Cruise in Hooghly estuary for hilsa distribution was done from Nabadweep to Kakdweep established that depth and width of the river stretch have effect on the fishing effort and hilsa yield. The zones with <3 m depth were devoid of fishing activity, while fishing intensity was higher in deeper water (10 m depth). Hilsa was evenly distributed over the observed >100 km freshwater stretch. There was no visible difference in catch at midstream or near the banks. There was no indication of movement of hilsa in shoals during the observed period of the non-spawning season. Fishers survey indicated availability of hilsa throughout the year with peak in monsoon. The observations may lead to possible occurrence of a resident stock of hilsa in Hooghly in addition to regular seasonal influx of migrant groups from sea seeking freshwater for breeding. It lends credence for further investigation on whether the freshwater stretch is serving as rearing ground for early fry up to adulthood.

Scientific expedition in River Hooghly

Salinity used to be one of the major controlling factors for fish species availability and their migration in an estuary. Salinity varied in the range of 18.8 to 0.05 ppt in the stretch of Kakdwip to Dakhineswar. Significantly higher salinity was recorded during high tide as compared to low tide from Kakdwip up to Godakhali. The most important fish *Tenualosa ilisha* was caught in the entire stretch.



Salinity status in lower Hooghly estuary

Tenualosa ilisha

Setipinna phasa

The socio-economics features of fishers revealed that majority of fishers were in age group of 20-50 years. The average family size was 5.09, with both male-female and adult minor ratio at 1.56. The gill nets were the most prevalent gears and most of the fishers had their own boat. The lean fishing season was during November-January; medium in February-April and peak during June-September. The average catch per gill net in the studied stretch was 2.21 kg/day during lean, 2.42 kg/day during medium and 3.12 kg/day during peak season.

The total estimated catch of winter Migratory Bag Net Fishery in Lower Hooghly Estuary during November, 2009 to January, 2010 was 36427.9 t with average CPUE of 37.39 kg /net/man as compared to 19935.5 t and CPUE at 36.14 kg /net/man during last winter. This substantial increase in catch might have attributed due to increase in number of fishing camps, bag nets, mechanized and non-mechanized boats and man power. The fish catch was dominated by H. nehereus (27.3%), followed by Setipinna spp. (21.4%), Trichiurus spp. (11.5%) and misc. prawn (10.2%).

Developing and testing software-based model as a forecasting mechanism for west-coast estuarine ecosystems

S.N. Singh, K. Chandra and A. K. Prusty

Sabarmati estuarine system has been explored from eco-health perspective. The dissolved oxygen regime (nil to 6.24 mg l^{-1}) indicated stressed environment in the system. The dissolved oxygen was critically low at the stretch extending from Rasikpura to Vataman. The water clarity (5.0 to 105.0 cm) demarcated the system horizontally. Water temperature (22.0 to 32°C) exhibited seasonal relevance. The water reaction was alkaline (pH - 7.1 to 7.5). High free CO2 (up to 42.0 mg l^{-1}) corroborated the above observations. Nutrient status with major nutrients, phosphate (0.061 to 0.435 mg l^{-1}), nitrate (0.973 to 2.857 mg l^{-1}) and silicate (7.51 to 16.43 mg l^{-1}) portrayed the system to be quite rich and may be categorized under highly fertile side. Fairly high organic carbon, available nitrogen and available phosphorus content in sediments further confirmed the rich status of the system. Total alkalinity exhibited zonal relevance as lower to middle estuarine extents recorded high content (155.85 to 287.6 mg l^{-1}) as compared to upper (69.45 to 88.0 mg l^{-1}). Specific conductance (lower expanse - 2046.25 to 2475.0 µScm^{-1} and upper expanse - 256.0 to 416.75 µS cm^{-1}) reflected spatial pertinence. Sediment reaction was alkaline (pH - 7.32 to 8.62). Organic carbon content denoted fairly rich status (0.12 to 0.97%). The available phosphorus corroborated the above inference (1.10 to 3.98 mg100 g^{-1}). Available nitrogen also reflected fairly rich status of the system (5.60 to 9.20 mg 100g^{-1}). Qualitative texture of planktonic communities has been assessed. Average plankton abundance of the system varied from 113 to 5721 nos.l-1. Blue-greens excelled as major group except at Indira Bridge site. Phytoplankton had the mainstay (53.36 to 99.39%). Myxophyceae excelled as the eminent floral component (27.78 to 97.69%). The zooplankton assemblage (0.44 to 46.64%) mainly comprised of Protozoa and Rotifera. Spatio-temporal variations relevant to macro-benthic abundance have been delineated. Dipterans and molluscans were important at lower stretch while annelids and dipterans were conspicuous at upper stretch. Organic

Sabaramati at Rashikpura with nil dissolved oxygen

Effluent discharge at Vasna Barrage

River bed at Anandpura

production could not be recorded at certain sites. As a whole, Sabarmati Estuarine System may be considered as environmentally degraded entity. Based on the P/R ratio, heterotrophic condition prevailed at most of the representative sites. Incidence of bacterium, Zoogloea ramigera (0.58 to 1.81%), a bio-indicator of waters contaminated with sewage and industrial wastes inferred environmental degradation. Higher numerical abundance of dipterans represented by Tendipes tentans and Tubifera tubifera, the rat-tailed maggot further confirmed the above inference. Biodiversity indices, viz. Shannon-Weiner index (H'), Evenness index (J) , Simpson's index (1- ?) and Margalef's index (d) computed based on macro-benthos abundance. The computed values reflected environmental degradation of varying levels.

Fishing activities were quite subdued and confined to stretch above Vasna barrage. Total fish was computed to be 103.47 t. The fish catch was high during summer. The fish catch was mainly comprised of minor carps (45.5%) and major carps (22.7%). The main gear used was cast net. Bayesian Belief Networks (BBNs) have been employed to develop a model and its efficacy as a tool for forecasting has been explored.

The fish catch at Indira Bridge on Sabarmati

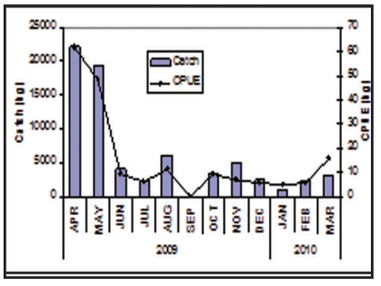
Programme: Improving the fish productivity of Indian reservoirs
Programme Co-ordinator: Dr. B. C. Jha

Multi-location trials on improving fish yields in small reservoirs located in different agro-climatic zones

D. S. Krishna Rao, R. N. Seth, B.K. Singh, P.K. Katiha, Rani Palaniswamy and M. Karthikeyan


Suvarnavathy reservoir

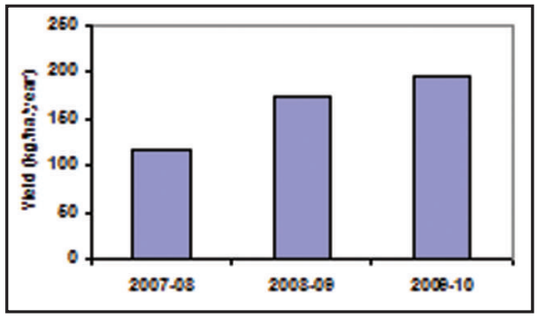
The project was implemented in the reservoirs of Karnataka (Suvarnavathy), Kerala (Kanhiraphuza) and Uttar Pradesh (Arjun Sagar). Suvarnavathy reservoir (Chamarajnagar, Karnataka) across river Suvarnavathy, a tributary of river Cauvery, is a small reservoir with an area of 490 ha. Limnological features of water indicated productive nature with dissolved oxygen (5.2-8.2 mg/l), water temperature (24.0 - 29.8°C), pH alkaline (7.3-8.2), ionic concentration medium (78 to 210.0 µS/cm), and slightly low transparency (0.4 - 1.4 m) due to organic and inorganic turbidity. The reservoir exhibited thermal stratification with clinograde distribution of oxygen during most part of the year. Chlorophyll '*a*' concentration was high (18.8 - 235.8 µg/l). Daily integral gross primary production ranged between 0.82 and 5.59 gC/m^2/d, with average of 2.5 gC/m^2/d, indicated high productivity of the reservoir. The net primary production (NPP) had a high of 2.1 gC /m^2/d in August and a low of 0.41 gC/m^2/d in October (Mean of 1.1 gC/m^2/d 0.52 mg).



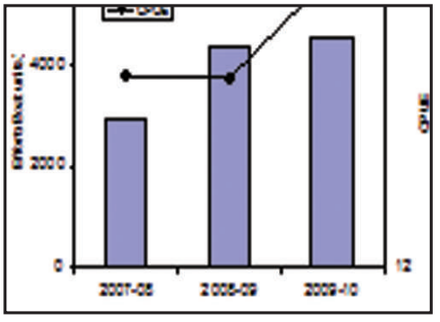
Monthly variation in fish catch and CPUE

The average fish seed stocking rate was 838 No./ha/year with catla 42%, rohu 19%, mrigal 11%, common carp 24% and grass carp 4%. The stocking size was only 3 to 5 cm. A total catch of 78.1 t was recorded being the highest landings in April 2009 (22.1 t) and the lowest in January 2010 (0.83 t). All the three species of IMC exhibited good growth. Indian major carps contributed to the tune of 95.5% to the total catch and the rest mainly by tilapia. The fish productivity was 197.0 kg/ha as compared to 172.0 kg for the same period of last year. The number of fishing days was 195 days/year The CPUE was maximum in April and the minimum in January.

Assessment of impact of scientific management indicated an increase in fish yield by 48.3% over the last year because of i) stocking of advanced fingerlings of major carps of 8 to 10 cm size in 2007, ii) regulated mesh size and iii) increase in effort. The increase in gross income to the society was Rs. 11,72,000/- and to individual fisher at Rs. 22,000/- per annum.



Fish yield trend



Effort vis-à-vis CPUE

The inter-correlations between hydro-biological parameters indicated positive correlations of alkalinity with conductivity (r = 0.677) and fish catch (r = 0.521). A functional relationship of catch with effort and water level was also estimated and the estimated multiple regressions was

$Ln\ Y = 71.38718 + 0.002905072\ X_1 - 0.026305230\ X_2$ (n=33; $R^2 = 0.52$)

(0.000784) (0.007837) where Y – Catch; X_1 – Effort; X_2 – Water Level

The estimated standard partial regression coefficients concluded that effort influenced the catch the most, followed by water level. To study the effect of hydrobiological parameters on catch, a multiple regression was estimated as

$Ln\ Y = 7.90164 - 0.6656668\ X_1 + 0.01221287\ X_2$ (n=16; $R^2 = 0.48$)

(0.29707) (0.00463) where Y – Catch; X_1 – Transparency; X_2 – Alkalinity

Figures in brackets denote the standard error of respective regression.

The major recommendation for fisheries development in Suvarnavathy reservoir were: harvesting carps of only 1.0 kg and above as against the present harvesting of even less than 0.5 kg; stocking of fingerlings of IMC of 10 cm and above @ 300-500 fingerlings/ha; Less importance to stocking of common carp and grass carp and reducing the fishing holidays.

The Kanhiraphuza reservoir in Kerala was stocked @ 1698 Nos/ha with 35% *Catla catla*, 37 % *Cirrhinus mrigala* and 28% *Labeo rohita*. The growth of *Catla catla* was excellent (320 -370 mm with corresponding weight of 825 - 1125 gm in seven month). Compared to *C. catla*, the growth of *Cirrhinus mrigala* was low (200-250 mm and 180-390 gm). The *L. rohita* and Grass carp failed to appear in catches, indicating their unsuitability in this reservoir. The fish catch composition of the reservoir was primarily of native fishes, *viz*. *A. mola, G. curmuca* and *Puntius* spp. During January-March the landings of *C. catla* and *C. mrigala* have gradually increased. *G. curmuca* contributed significantly to the fish catch and its guts showed detritus and decayed matter (62.4%) and sand (25.3%). The other constituents in the diet were below 2%.

Fish catch at Kanhiraphuza

Arjun Sagar reservoir

Arjun Sagar reservoir, Uttar Pradesh, with a total area of 1190 ha was rich in oxygen 8.6 mgl^{-1}, alkaline pH (7.8-8.0), but moderate in alkalinity 95.3 mgl^{-1}, conductance 196 ìmhos, dissolved solids 106 mgl^{-1}, hardness 94 mgl^{-1} and dissolved organic matter 1.23 mgl^{-1} indicating good productive character of the reservoir. The sediment quality of the reservoir with rich organic carbon (1.4mgl^{-1}), alkaline pH and rich nutrient status (av. phosphorus 2.4 mg/100g and nitrogen 28 mg/100g) also supported productive character of the reservoir. The average plankton population was 453ul^{-1} with phytoplankton population contributing 88%. Myxophyceae (*Microcystis*, *Phormidium*) were dominant during post-monsoon months and diatoms (*Synedra*, *Navicula*) during winter months. Zooplankton population (av.53 ul^{-1}) was represented mainly by rotifers (*Brachionus*, *Lecane*). The macrobenthic population was, on an average, 210 um^{-2} dominated by molluscs. The average net carbon production was 405 $mgCm^{-2}d^{-1}$. Based on photosynthetic rate the fish production potential of the reservoir was estimated at 140 kg ha^{-1} yr^{-1}. Based on the productivity a stocking density of 330 nos/ha was suggested. Five lakh advanced fingerling of

Gears used at the reservoir

IMC (20% *Catla catla*, 40% *Labeo rohita* and 40% *Cirrihinus mrigala*) both from riverine collection and from hatchery, besides common carp and grass carp. Natural breeding of major carps was recorded too occasionally, after a gap of 2 to 3 years. Fish production from the reservoir during the years 1992-2001 was 51.4 kg ha^{-1} yr^{-1} which declined to 18.3 kg ha^{-1} yr^{-1} during 2008. Fishing by gill-net during summer and winter months yielded 200-250 kg day^{-1} with *C. mrigala* as dominant species followed by *L. rohita* and *C. catla*. The production is expected to increase following scientific fisheries management.

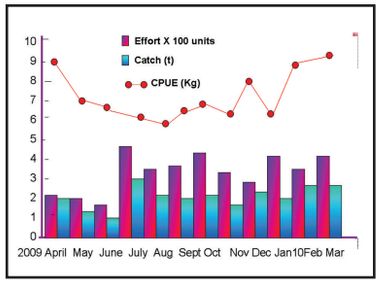
Characterization of fishery and population trends using acoustics and experimental fishing

Firoz M. Khan and Preetha Panikkar

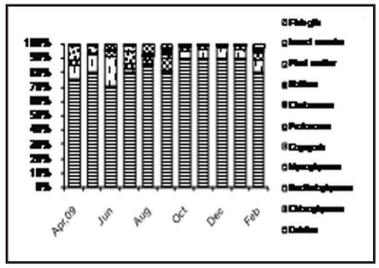
The Karapuzha in Kerela and Kelavarappalli reservoir in Tamil Nadu were selected for this research activity. Karapuzha was 855 ha at FRL with more or less congenial water quality parameters (temperature 24.5-29.3 ^{O}C, pH 7-8.4, Dissolved oxygen 12-7.36 mg/l, transparency 90-190 cm, specific conductance 84-217 S/cm, nitrate 10.93-12.3 g at./l, phosphate 10-16.0 g at. /l and silicate 6.4-11.8 (g at. /l). Low primary productivity values were recorded with GPP of 52.5 mg C m^{-3} h^{-1} and NPP of 33.68 mg C m^{-3} h^{-1}). The dominance of phytoplankton over zooplankton was round the year except during June - July and January- February. Phytoplankton dominance (91%) was highest in November due to the bloom of *Microcystis sp* (94.0% of the total phytoplankton) and also in December (77%). Zooplankton had the predominance of copepods (calanoid copepods) during June-Julay (40%-73.4% to the total plankton), followed by September dominance of cladocerans (24.4%). The abundance of rotifers remained low during the period of study. Protozoans were also observed during the period (2.6 – 22.7%).

Fishing traps used at Karapuzha

The fish production in the reservoir was 24.2 t during 2009-10 with a CPUE of 6.7 Kg. The maximum catch and CPUE were recorded in the month of March 2010. The fish landings were higher during July and October in the year 2009 and January and March in 2010. The fluctuations in catch and CPUE in this reservoir were mainly due to intermittent fishing ban by the irrigation department. *Oreochromis mossambicus* dominated the catch in Karapuzha reservoir, 61.3 % to the total fish catch followed by *Clarias gariepinus* (14.1 %), *Labeo fimbriatus* (8.8 %). The contribution of remaining species had less than 5% share.

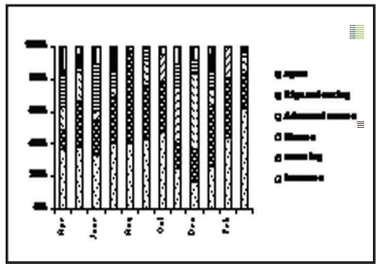


Estimated fishing effort and catch



Monthly percentage composition variation of food of *O. mossambicus*

Food and feeding habits of *Puntius ticto, Puntius wynaadensi, Puntius sarana, Barilius bakeri, Mastacembelus armatus, Labeo fimbriatus and Oreochromis mossambicus* were studied. In case of *O. mossambicus* detritus form the major component during all the months. The reproductive biology of some of the prominent fish species like *P. wynaadensis, Mastacembelus armatus, Oreochromis mossambicus* were studied too.

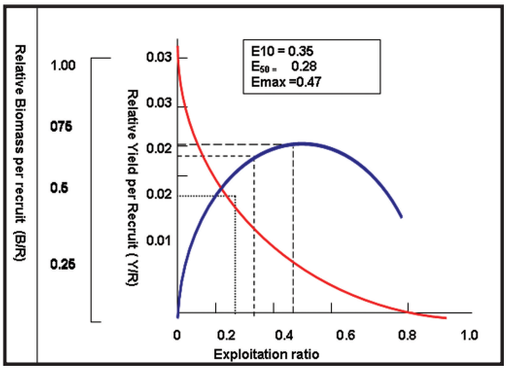


Maturity stages of *O. mossambicus*

The analysis of population parameters of *Oreochromis mossambicus* at Karapuzha Reservoir indicated that length-weight relationships conformed to the isometric formula $W = a L^{b}$. A regression for both sexes separately based on all available data gave the following length-weight relationships:

Females - W = 0.00001 $L^{3.1}$ (r = 0.95) (n = 200)
Males - W = 0.0001 $L^{2.75}$ (r = 0.80) (n = 200)
O. mossambicus showed differential growth rates as males growing faster than females. The VBGF equations for the species:
L(t) = 39.7 * [1- exp (- 0.44*(t + 0.01))] (Males)
L(t) = 38.8 * [1- exp (- 0.38*(t + 0.01))] (Females)
The recruitment pattern showed that this species was recruited with peaks in March and August. The breeding period of *O. mossambicus* extends over a period of eight months from July to February. There are at least two peaks of spawning, June-July and again in October /November. The Total Instantaneous mortality coefficient for *O. mossambicus* at Karapuzha Reservoir was estimated using Length converted catch curve method (Z = 1.43.) The Natural Mortality coefficient estimated using Pauly's empirical formula with a mean temperature at 26.5 was 0.94. The Fishing Mortality at Karapuzha for *O. mossambicus* was only *0.49.*

Relative yield per recruit and Biomass per recruit: The biomass of *O. mossambicus* at Karapuzha Reservoir reduces to half at an E value of 0.28. The maximum sustainable yield is obtained at an E value of 0.47. The present exploitation ratio at Karapuzha is much below the MSY limit i.e. only 0.34. *There should be 38 % increase in the exploitation ratio from the present level and more coracles should be operating in this reservoir to exploit the potential resources. The fishing effort at Karapuzha reservoir may be increased from the present level of 3617 units to an Fmsy level of 4946.* The total stock in this reservoir is estimated as 135 t and maximum sustainable yield is 94.1 t. The current yield is far below the MSY level at 24.2 t. For Experimental Fishing *i*n the lotic, intermediate and lentic zones *Oreochromis mossambicus* dominated the catch in experimental gill nets forming 69.3 %.



Relative yield per recruit of *O. mossambicus*

Kelavarapalli reservoir in Tamil Nadu, has a water spread of 430 ha FRL. A static mass balance model was constructed for the reservoir using Ecopath software and was used to analyze the food web structure and ecosystem properties of the reservoir. The trophic flows primarily occurred in the first four trophic level (TL) and the food web structure was characterized by the dominance of low TL organisms, with the highest TL of only 3.57 for the top predator. Highest System Omnivory Index was observed for other catfishes (0.422), followed by the exotic fish Mozambique Tilapia (0.402). Nile Tilapia and other Cichlids show the highest niche overlap which suggests high competition for similar resources. The most interesting observation is that the most invasive fish, the Nile Tilapia does not negatively impact the commercially important species such as major carps here. The ecosystem is in a developing stage with TPP/TR ratio much greater than 1. The low TB/TST ratio indicates that this reservoir ecosystem is immature. The estimates of net system production and total primary production by total biomass ratio also indicated that the ecosystem is immature. The system overhead value shows that the ecosystem does not have sufficient reserve energy and all the ecosystem property indices show that the reservoir is in developmental stage. This immature ecosystem can be utilised for enhancement options to increase fish production. In this reservoir, fishing is beyond the MSY level and for sustainable fishery a reduction of fishing effort to Fmsy levels to 6748 Nos/year would be ideal. September and February fishing may be closed to prevent recruitment overfishing. If the fish is allowed to grow to above 20.0 cm than the present 12.5 cm the fish yield can be enhanced by 28 %. The use of bottom set gill net, uduvala may be banned as this is responsible for the present growth overfishing in this reservoir. The diversification of fishing gear such as introduction of hook and lines with large hooks can be adopted for eradication of large predators in the reservoir such as African cat fish.

Development of models for fish yield estimation in reservoirs

M. Karthikeyan, D. S. Krishna Rao, B.K. Singh, P.K. Katiha and Rani Palaniswamy

Suitable models based may be developed to facilitate the estimation of fish yield. These models require secondary data on fish landings and other physical, limnological, biological parameters. Several such functional relationships of yield with other parameters (mean-depth, area, primary production, etc.) were estimated from the secondary data available on different reservoirs. From the analysis, it was observed that the relationship between yield and area of the reservoir obtained separately for individual states could provide more precise estimates than pooling the data of from several states. This is evident from the following results as the coefficient of determination (R^2) is more for data from 15 Tamil Nadu reservoirs than the pooled one.

Relationship between area and yield for Indian reservoirs with x = Area, y = Yield

$y = - 35.377 \text{ Ln}(x) + 336.56$ ($R^2 = 0.338$; n = 47)

Relationship between area and yield for15 Tamil Nadu Reservoirs

$y = - 74.1049 \text{ Ln}(x) + 548.257$ ($R^2 = 0.527$; n = 15)

Furthermore, from the analysis of models developed for different categories of reservoirs [small (<1000 ha) and large (>1000 ha)] with varying productivity levels [low (<50 kg/ha/yr) and high (>50 kg/ha/yr)], it was observed that the following estimated relationships between yield and area could be used to get the first approximation of yield from the reservoirs.

Relationship between area and yield for small reservoir with high yield

$y = - 67.694 \text{ Ln}(x) + 556.25$ ($R^2 = 0.661$; n = 9)

Relationship between area and yield for large reservoir with low yield

$y = - 5.7809 \text{ Ln}(x) + 69.003$ ($R^2 = 0.327$; n = 14)

Since stocking is resorted to enhance fish production in reservoirs these days, focus was given to the development of models for sustainable fishery exploitation in stocked reservoirs. Data collected from several reservoirs (secondary data) are being used to evolve suitable model (logistic growth) for sustainable fishery exploitation in stocked reservoirs. A modified Verhulst-Schaffer model – that takes into account the impact of fingerlings stocking in reservoirs on fish population growth - is being proposed to Indian stocked reservoirs.

Programme: Developing Fishery Management Norms for Sustainable Fisheries in Floodplain Wetlands
Programme Co-ordinator: Dr. B. C. Jha

Testing and Refinement of Fish Yield Enhancement Strategies in Flood-Plain Wetlands

B.C. Jha, A. Mukherjee, G. K. Vinci, S. R. Das, V. R. Suresh, M.A. Hassan, A. Hajra and *D. Das*

The project was implemented in wetlands of Bihar and West Bengal. Floating, submerged, emergent and marginal macrophytes remained to be the most dominant biotic communities in all most all the wetlands, barring Sikandarpur *maun* where it was negligible (3% of the surface coverage only). In other wetlands the coverage ranged from 50 to 88%, mainly submerged types like *Hydrilla verticillata* and *Ceratophyllum demersum*. Interestingly, the abundance of the nuisance weed *Eichhornia crassipes* was much low (3-6%) in Bihar wetlands as compared to West Bengal and Assam. Low abundance (207 and 8194 ul^{-1}) of plankton has been the hallmark in all the wetlands of Bihar due to massive stands of submerged macrophytes. The macrophyte infestation and plankton abundance indicated an inverse relationship. The volumetric data of plankton also followed a similar trend. Cyanophyceae, Bacilariophyceae, Chlorophyceae and Dinophyceae, in order of their abundance contributed to the phytoplankton community. The abundance of zooplankton, represented by rotifers, copepods, cladocera and ostracoda and dominated over the phytoplankton, which is a typical example of weed choked aquatic systems. Bihar wetlands showed grater abundance of *Microcystes aeruginosa*, a bloom forming cyanophyceae, unlike the West Bengal and Assam wetlands. Zoobenthic population was mainly represented by the members of Gastropoda, a hallmark of weed infested water bodies, followed by Dipterans. The abundance of bivalves like *Lamellidens marginalis*, was observed rarely, restricted to certain lakes only.

Bhusera Maun in Bihar

Sikandrapur Maun in Bihar

A deterministic model describing yield (dependent variable) and bio-physical and chemical attributes (independent variables) was developed using data collected from 17- wetlands of West Bengal. Additional information from five more wetlands of Bihar, however, was generated during the period under report to refine the model.

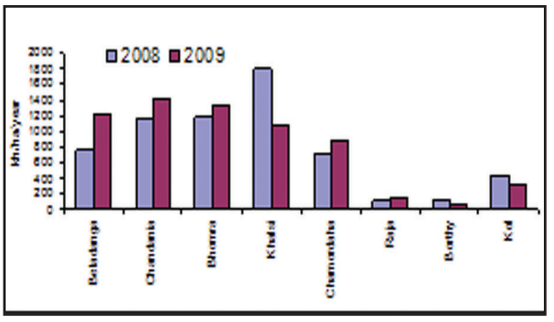
Pen in Chaur of Bihar for fish seed raising

After the standardisation of new method of pen construction in ox-bow lakes, using material like coarse HDPE net as pen wall, a pilot trial was conducted in Tilaur chaur, Sikandarpura, Block Mahua, District Vaishali, Bihar to assess its feasibility in Chaurs in collaboration with a progressive farmer to encourage public private participation. Two circular pens measuring 0.1 ha each were installed and stocked with fry (35-40 mm) @15000/ha to produce stocking materials (fingerlings). The trial was of 60 days duration with encouraging results as all the three species of IMC indicated good growth being the highest weight gain in *L. rohita* (312%) where as the growth of *C. catla* was the lowest (231%). The survival rate was recorded to the tune of 60-70%. The new method of pen fabrication was well taken by the local farmers being easy to handle, cost is low and economically acceptable.

Fish Stock Assessment in Wetlands and Application of Population and Biomass Models for Sustainable Fishery Management

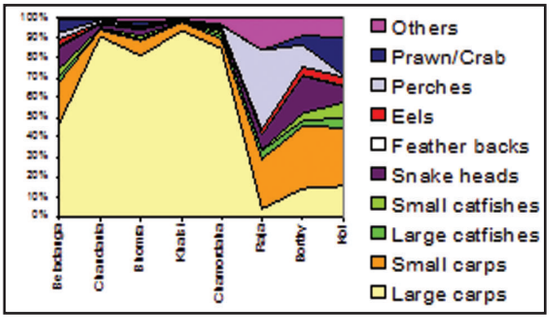
V. R. Suresh, B. C. Jha, A. Mukherjee, G. K. Vinci, A. K. Das and S. K. Sahu

Eight wetlands of various categories spread across three districts in west Bengal were studied. The total fish yield from the wetlands during January to December 2008 and March 2009 ranged from 86.5 to 1794.1kg/ha/year during 2008 and 2009. The yield did not show significant fluctuation during the period, except in Beladanga and Khalsi wetlands.



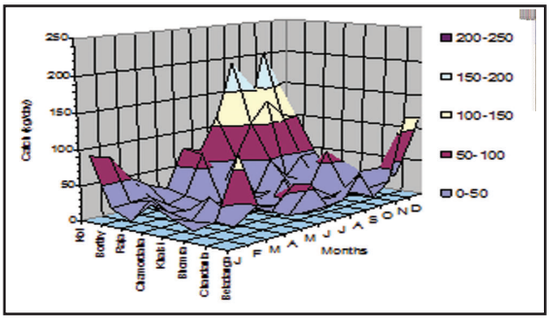
Annual fish yield from West Bengal beels

The major contributors were IMC wherever stocking of major carps was done, while small carps, snake heads, perches and others were the major contributor in wetlands where stocking was not done. The catch from these wetlands were highly variable. The daily catch ranged from 1.0 to 202kg/day. The fishing effort for wild fish stocks ranged from 2940 to19635 kg/fisher/year across the systems. The CPUE for wild fish stocks was 0.9 to 9.4kg/fisher/day with higher CPUE in wetlands having direct riverine connection. Maximum catch was recorded during August to December when the monsoon floods starts receding. These wild fish stocks support livelihoods of hundreds of fishers, whose primary income is from fishing.



Percentage contribution of important groups of fishes to the total yield

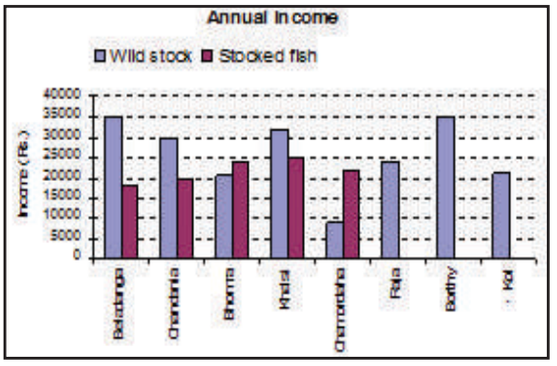
The number of wild fish species exploited from the wetlands ranged from 5 to 28. Of this *Puntius* spp. were the major contributors (20%), followed by *Channa* spp. (18%) and prawns (12%). Among *Puntius* spp., *P. conchonius*, *P. sophore* and *P. ticto* were the major contributors. A total of 79 species of fin fishes under 57 genera and 32 families have been identified, besides four species of prawns and one species of crab. Fish diversity (Shannon index H') ranged from 1 to 3, richness index (d) ranged from 1.8 to 5.8 and evenness index (j') 0.4 to 0.8 across the systems with higher values in wetland with direct riverine connection.



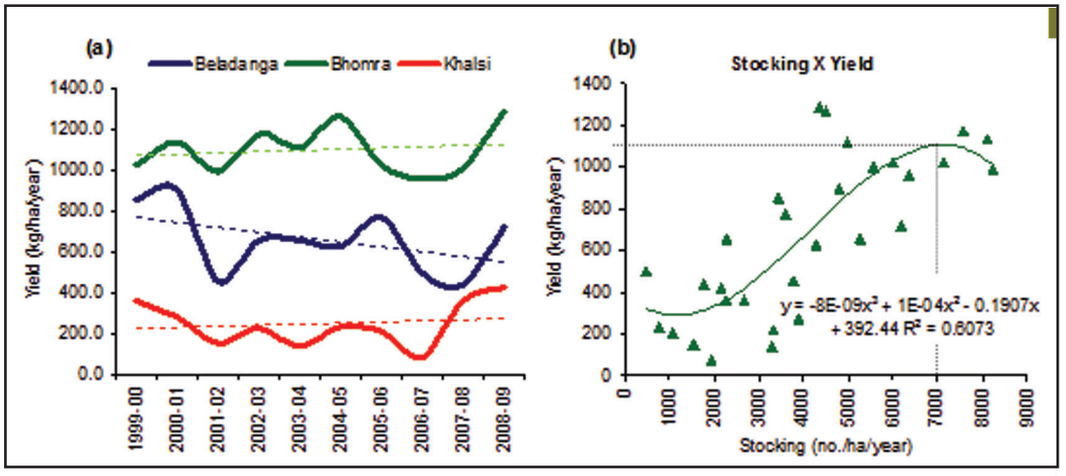
The daily catch of wild fish stocks from the wetlands

Sample surveys of these wetland fishers indicated higher income from wild fish stocks compared to that coming from stocked fishes, which are fished 2-3 times in a year. The wild stocks are fished every day and fetch higher market price.

Analysis of long term production trend of stocked fishes in three wetlands (Beladanga, Bhomra and Khalsi) having similar ecological, social and management characteristics revealed that the yield (kg/ha/year) remained more or less steady for last one decade, indicating sustained fisheries. Establishing the stocking and yield relations to arrive at appropriate stocking density for obtaining best yield, revealed that the fitting relationship was of a third order polynomial; the regression model being $y = -8E\text{-}09x^3 + 1E\text{-}04x^2 - 0.1907x + 392.44$; $R^2 = 0.6073$. It indicated that the yield declined beyond stocking density of 7000nos./ha (25g size). From the analysis moderate stocking rate of 4000 to 5000 fingerlings/ha may be suggested. This is however needs to be further verified by increasing the number of samples and pilot scale trials.



Fishers income from wild fish stocks and stocked fishes from the wetlands.



Yield trend of stocked fishes during 1999-2000 to 2008-2009 and stocking and yield relationship from three wetlands.

The growth coefficient (*K*) as an index of rate of growth and growth performance index (GPI) for *A. mola*, *C. fasciata*, and *P. ticto* showed higher values in closed and seasonally connected wetlands than those having direct riverine connection indicating conditions that favor faster growth in those wetlands. The exploitation rate of *A. mola* in Beladanga, Bhomra, Chandania and Kol wetlands are higher than the maximum allowable level. The exploitation rate of *C. fasciata* is higher than the allowable level in Borthy wetland. Like wise, the case of *P. sophore* is same in Chandania, Kol and Raja wetlands. The data suggested overexploitation of these species in most of the wetlands.

Developing Site Specific Fish Based Farming System in Seasonally Flooded Area through Community Participation

U. Bhaumik, P. K. Katiha, R. K. Manna, Ganesh Chandra and *D. Debnath*

The fish based farming system was developed with community participation in seasonally flooded area at Janki Chak of Purba Midnapur district in West Bengal. The aqua-ecosystem analysis using with stakeholder participation revealed water flows down in the area from May and remained for whole year.

Seasonally flooded area with rice crop and full of water

The average water depth during the period was 1.45 m with minimum in June and March and maximum in September. The physico-chemical properties of water and soil indicated highly eutrophic in nature of water body as evidenced by high pH (10.4), low transparency (17 cm) and supersaturated dissolved oxygen (19.4 mg/l). Concentration by evaporation led to high total alkalinity (170 mg/l), high sp. conductivity (5510 µS/cm) and high chloride values (2050 mg/l). Sediment organic carbon was quite high due to remaining of paddy root system and varied in the range of 1.56 to 1.77%. Institutional and governance arrangements indicated that farmers organised themselves into a co-operative society with 29 members. Gram Samiti, an informal Local Governance Institution leased out the areas through open auction to society for one year for fish culture during May-April with lease amount of Rs 12 lakh. Fish catch disposal was also similar to last year. It was sent to Annapurna, Moyna block and Moyna market. But due to sequential catch disposal from different flooded areas in the block, the fish supply is regulated to have better prices. The major constraint was availability of funds for production activities over time and space. Sometimes fish disease and good remuneration were also the problems, particularly in the peak months. The viability of scientific production practices for fish production indicated total production at 111.48 t with maximum share of *C. catla* (56.55 t) followed by *L. rohita* (22.86 t) and other fishes (16.66 t). The fish and water productivity was estimated at 3377 kg/ha and 242 gm biomass/m^3. The economics of fish production revealed total cost of fish production at Rs 38.23 lakh and total income at Rs 85.32 lakh with net profit of Rs 47.09 lakh. The overall Benefit cost ratio was estimated at 2.23.

Fish seed stocking

Fish haul from Janki Chak flooded area

Fish Yield Enhancement Approaches in Uttar Pradesh Wetlands

B.K. Singh and R. S. Srivastava

Mahane at full water level

A location specific experiment cum demonstration was attempted in Uttar Pradesh Mahane wetland, located in Ganga river basin in Unnao district. The 40 ha wetland had an average depth of 1.3 m. It has lost connectivity with the parent river and catchments runoff remains as the main source of water for this wetland. The sediment was sandy (91.00%) and alkaline (pH: 7.5) in nature. Specific conductivity was (147-487 µmhos), free $CaCO_3$ (0.25 %) and organic carbon (0.36-0.45 %). The available Phosphorus was 4.2-12.4 mg /100g and available nitrogen was 8.5 mg/100g. The water quality reflected high productive nature of the wetland.

Transparency was low to moderate (5.0-71.0 cm). The water was alkaline (pH: 7.4-7.5) in nature and dissolved oxygen was low to high (2.7-11.5 mgl^{-1}). Free CO_2 was nil to 39.0 mgl^{-1}. Carbonate alkalinity was (Nil-28.0 mgl^{-1}) while bicarbonate alkalinity was high (154-398 mgl^{-1}). Chloride was moderately high (15.6-51.1 mgl^{-1}). The water was moderately hard with 136-264 mgl^{-1} hardness and specific conductance (309-1267 µmhos). The plankton density was 770 ul^{-1} in summer, 400 ul^{-1} in post monsoon and in winter 330 ul^{-1} in winter. Phytoplankton productivity was significantly higher (94.9%) with dominance of diatoms 43.2% followed by euglenophyceae (34.5%), chlorophyceae (14.2%) and myxophyceae (3.0 %). Zooplankton represented by protozoa (2.5%) and rotifers (2.6 %) constituted 5.1% of the total planktonic abundance. Periphyton population was maximum (1540 ucm^{-2}) in summer and minimum (450 ucm^{-2}) in winter. Diatoms (72.2%) were predominant group followed by green algae (15.9%), blue-green algae (7.2%) and euglenophyceae (4.7%). Macrobenthic population was 80 nm^{-2} (winter and summer) and 360 nm^{-2} in post monsoon. The biota was dominated by insecta (65.7 %) followed by mollusca (34.3 %). The biota was dominated by molluscs in summer and insects in winter and post-monsoon. The molluscs in the jheel were solely represented by gastropods. The encountered forms were *Bellamya bengalensis* and *Gyraulus rotula* amongst gastropods and chironomus among insect. Infestation of macrophytes was moderate and the wetland showed growth of *Eichhornia*, *Hydrilla* and *Ceratophyllum*. The wetland was stocked in July-August with 3.5 lakhs fry and fingerlings of Indian major carps and exotic carps. 17 fish species were recorded from the wetland. Fish yield of the wetland was estimated 225.0 kg ha^{-1} yr^{-1} in 2008 and 417 kg ha^{-1} yr^{-1} in 2009. This year about 20.8 tones of fish were harvested and the enhanced fish yield of the wetland was estimated to be 520 kg ha^{-1} yr^{-1} in 2010. It was due to adoption of scientific enhancement practices.

Stocking of fingerlings in Mahane

Study beel in Assam

Standardizing Fish Stock Enhancement Protocols

B. K. Bhattacharjya and *Sona Yengkokpam*

Field data on various aspects of stock enhancement was collected from 26 beels of Assam to understand the existing stocking practice and impact of stocking on fish production from those beels, both qualitative and quantitative. The main criteria for selection of candidate species for stocking in the selected beels were growth performance (e.g., grass carp, catla), consumer preference and market price (e.g., chital>rohu>catla>kuhri>bata>mrigal>Common Carp>Grass Carp>Silver Barb>Bighead Carp> Silver Carp), availability of seed and catchability (e.g., common carp and mrigal are less preferred in deep and perennial beels owing to low recapture rates). Stocking in the selected beels was practiced during two seasons. In most beels located in Lower and Central Brahmaputra Valley, carp fingerlings were stocked during the pre-monsoon months of February-March. These yearlings grew rapidly in the beels taking advantage of warm temperature regimes and abundant natural food and grew to marketable size by the first half of January next year during

Fish seed arrival and stocked at the beel

Catch of a fisher

Bhogalee bihu (local food festival). As carried-over fingerlings were not available in Barak valley; fresh carp fingerlings were stocked in beels of Barak valley during August September. In four beels, both fresh and carried-over carp fingerlings were stocked. For shallow beels (post-monsoon season depth range 3-4 m) a tentative species ratio of 40 Surface Feeder (SF): 30 Column Feeder (CF): 30 Bottom Feeder (BF) was suggested, whereas for deeper beels (depth >4 m), a tentative species ratio of 2 SF: 1 CF: 1 BF was suggested. However, species ratio followed in the selected beels varied widely. Higher stocking density was practiced in closed beels than that in seasonally open ones. Stocking density in the selected closed beels varied from 2190 no./ha to 10000 no./ha. In seasonally open beels, stocking density ranged from 833 no./ha to 8750 no./ha. Fish production from closed beels ranged from 149.3 to 1387.8 kg $ha^{-1}yr^{-1}$ in which more than 60% contribution from stocked fishes indicating that culture-based fisheries was practiced in these beels. In seasonally open beels, total fish production varied from 41.0 to 528.8 kg $ha^{-1}yr^{-1}$ in which contribution of stocked fishes varied widely in the range of 25-80%.

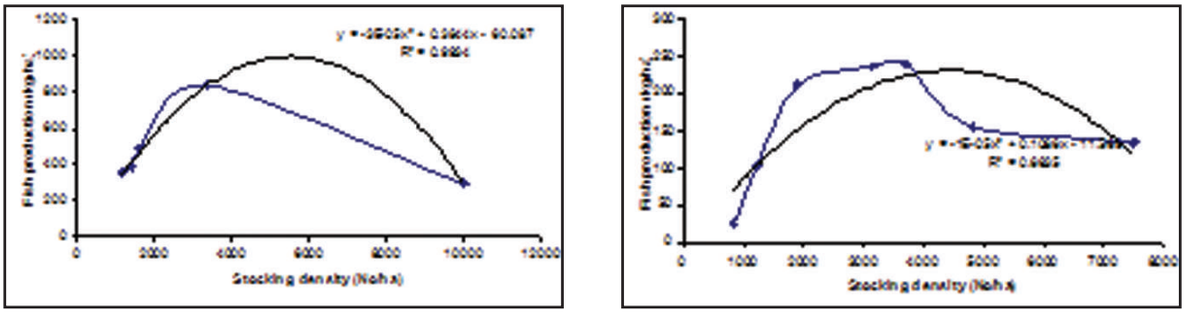
Fish production from stocked fishes was plotted against stocking density in closed beels. It followed second-order polynomial regression resulted in a curvilinear diagram, which indicates that 99.34% of variation in fish production from stocked fishes was dependent on stocking density.

$$y=-3E-5x^2+0.3844x-60.087$$

In seasonally open beels, similar regression of stocking density and fish production yielded the equation:

$$y=-1E-5x^2+0.1086x-11.569$$

which indicates that 66.35% of variation in fish production from stocked fishes was dependent on stocking density.



Stocking and fish production relationship in closed and seasonally open beels

Enclosure culture technology was demonstrated in Damal beel in Assam. A rectangular pen of 741 sq. m (46 m x 16.1 m) was constructed using net lined split-bamboo screens in Damal beel, Morigaon, Assam. The pen was stocked with carried-over seed of Indian major and exotic carps @ 5 fingerlings/m^2. during the last week of February, 2009. The species ratio followed for stocking in pen was 2: 1 : 1 (catla: rohu: mrigal). with 5% grass carp and 1% silver carp. After 70 days of rearing, the highest specific growth rate (SGR) in terms of average length (from 9.6 cm to 16.2 cm) was recorded by rohu (SGR 68.8%) followed by mrigal (SGR 59.8%; av. length increased from 10.2 cm to 16.3 cm) whereas catla recorded the lowest SGR (26.8%; av. length increased

Pen culture in Damal beel

from 14.2 cm to 18.0 cm) indicating that catla was the least suitable IMC species to be reared as carried-over seed in pens in Assam beels during the pre-monsoon season. Water in the pens was characterized by favourable temperatures (26.7 27.1^{0}C), clear water (Secchi disc visibility 58-64 cm), moderately acidic pH (6.2-6.5), favourable dissolved oxygen (6.0-8.4 mg/l), free carbon dioxide (<2 mg/l) concentrations and medium total alkalinity (30-38 mg /l). The stocked fishes in pen are being fed with rice polish and mustard oil cake mixture (1:1) fortified with vitamin-mineral admixture (1%) at the rate of 5% of body weight. The effect of feeding fish with this traditional mixture will be compared with an improvised feed formulation in the present demonstration.

Fish harvesting in pen

Evaluation of Health and Biodiversity Implications of Different Enhancement Regimes

Md. Aftabuddin and *V. Kolekar*

The impact of different biotic communities on wetland health and biodiversity, a mesocosm experiment was conducted in Samaguri beel of Assam to understand the effect of floating and submerged aquatic macrophytes on physico-chemical properties of water, enzymes, biochemical properties of soil and biodiversity. Significant differences were recorded in water quality parameters like transparency, water temperature, pH, specific conductivity, free CO_2, dissolved oxygen, total alkalinity, BOD etc between enclosures with submerged and floating macrophytes. Floating macrophytes were characterized with lower transparency, water temperature, water pH, DO, and higher sp. conductivity, free CO_2 as compared to submerged variety. Sediment enzymes and associated biochemical properties on 130th and 230th day of the experiment revealed gradual decrease in sediment microbial acid phosphatase, â glucosidase and dehydrogenase was observed up to 130th days, but increased during 230th day. The alkaline phosphatase, however, showed gradual decrease up to 230th day. The activity of all the enzymes was more intense in submerged macrophytes. Gradual decrease in soil pH and specific conductivity and increase in temperature, reducing condition and organic matter was observed during the period under study. Although pH and the conductivity increased with times, the soil indicated reducing properties. Submerged macrophytes supported higher mass of periphyton in terms of total counts, biomass, organic mass and chlorophyll a, b and c as compared to floating types, but the values decreased gradually with the progression of the experiment. Plankton communities showed variations with time and macrophyte types. Benthic organisms with greater dominance of molluscs were higher with submerged types of macrophyte than floating ones. Submerged macrophytes found providing congenial environment for nutrient regeneration in soil besides physico-chemical and nutrient status in water, which in turn positively influenced the growth of fish food organisms, such as plankton, periphyton and molluscs. A survey was conducted to

Water hyacinth plantation in enclosure

Enclosure with floating macrophytes

Enclosure with submerged macrophytes

study the impact of effluents on metal level in fishes. The copper content in fish was higher (15.76 to 86.9 µg/g) in Etila beel, receiving paper mill effluents.

Socio –Economic Evaluation and Delivery Mechanism in Floodplain Wetlands

Ganesh Chandra, V. Kolekar, B. K. Bhattacharjya. and *Sona Yengkokpam*

Socio-economic aspects of five beels (39 -121 ha) in Morigaon and Nagaon districts under the ownership of the Assam Fisheries Development Corporation (AFDC) and which were leased for 7 years, either to local co-operatives or local group of fishermen. Different kind of management arrangement was lessees working as managers in Sonduba and Lali beel; secretary of fishermen cooperative society as manager in Deorah and 46 Morakolong. Culture based fisheries with adoption of stock enhancement measures were followed in 46 Morakolong, Deorah and Shivasthan potakolong beel. In Lali and Sonduba beel only capture fisheries was practiced. Mainly carp species like IMC (rohu, catla, mrigal, *Labeo gonius*) and exotic carps (grass carp, silver carp) were stocked as candidate species under stock enhancement practices. The production and productivity of culture-based fisheries in the selected beels increased after adoption of stock enhancement measures. Contribution of stocked fish was much higher as compared to natural fish in beels with stocking support. The sharing arrangements, between fisher and cooperatives, in selected beels are given in following Table.

Lali beel

Shivasthan beel

Katal in Sonduba beel

Beel	For operating dragnets	For operating gillnets	For katal on first	For subseqeent harvest
Deorah	50:50	50:50	50:50	70:30
Shivasthan	50:50	50:50	60:40	-
Lali	60:40	50:50	50:50	60:40
Sonduba	60:40	50:50	50:50	60:40

Programme: Environment and Fish Health Management in Inland Open Waters

Programme Co-ordinator: Dr. M. K. Das

Measuring the extent of pollution and its biological effects are essential for adoption of suitable mitigation options. The principal objective of this study is to monitor the ecosystem health of the Indian rivers using a suite of established techniques and to develop new tools of environmental monitoring and management.

Developing Fish-based Indicator Tools for Environment Monitoring

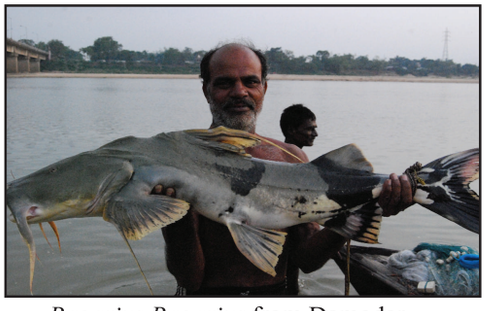
M.K. Das, P.K. Saha, M.K. Bandyopadhyay, S.S. Mishra, S. Samanta, B. P. Mohanty, S.K. Manna, P. Maurye, M.P. Brahmane and S. K. Sahu

This year investigations were carried out in river Damodar (150 km stretch with sampling sites Jamalpur, Randhia, Ashish Nagar, Namo-Mejia, Burnpur, Panchet and Ramgarh) and river Yamuna (1200 km stretch with sampling sites Kulhal, Dakpathar, Yamunanagar, Wazirabad, Agra and Allahabad) to assess the ecological integrity of the rivers applying different bio-indicators standardized under the project.

Damodar river at Ramgarh

River Damodar

Study of physico-chemical water quality attributes in river Damodar have shown presence of high levels of phosphate (av. 0.10 ppm) and nitrate (1.2 ppm) at Ramgarh indicating moderate amount of anthropogenic pollution. At the reservoir site of Panchet relatively higher value of conductance (281 µs/cm), COD (23 ppm) and phosphate (0.05 ppm) were recorded. As a whole, the phosphate content (traces to 0.07 ppm) indicated moderate level of pollution in the river stretch studied.



Bagarius Bagarius from Damodar

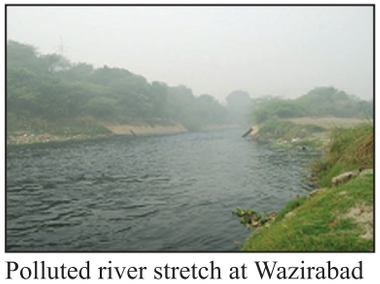
Based on Bacillariophyceae domination (36.0 to 54.7%) in total periphyton, Damodar river water from Durgapur to Burnpur was also found to be subopptimal. A reduction in variety of periphyton species was noted from Durgapur to Namo-Mejia (d=0.015-0.016) as compared to the non-industrial site (Jamalpur: d=0.041).

In river Damodar water enzyme activities did not change significantly in the river course, except there was a drastic increase in glucosidase activity at Durgapur and Panagarh. The soil glucosidase activity also increased at these two sites. However, soil phosphatase activity and microbial respiration decreased in the industrial areas, as an impact of industrial pollution on the river microbial community. The microbial activities increased at downstream Jamalpur indicating recovery in the downstream.

River Yamuna at Dakpathar

River Yamuna

During the present investigation, a total number of 63 fish species, belonging to 20 families, were recorded in river Damodar, out of which 3 species are exotic. IBI study showed Panchet and Durgapur



Polluted river stretch at Wazirabad

stretches in acceptable condition in terms of fish assemblages and support a healthy grade of fisheries. The rest of the sites as per the IBI were moderately impaired. Various anthropogenic activities viz., effluents released from coal washeries, mining, thermal power plants and extensive sand mining have altered the habitat status for fishes.

Fish catch in river Yamuna at Yamuna Nagar

Fish catch in river Yamuna at Agra

The stretch of Wazirabad (Delhi) of the Yamuna river was polluted with moderately high specific conductance (456 µs/cm) and phosphate (0.06 ppm). Agra was found highly polluted with very high specific conductance (1560 µs/cm), low dissolved oxygen (3.2 ppm), moderate COD (52 ppm), high alkalinity (314 ppm) and hardness (298 ppm) and very high phosphate (1.49 ppm) indicating severely stressed environment due to anthropogenic activities. Allahabad site was also found to be moderately polluted with moderate COD (51 ppm), high alkalinity (228 ppm) and phosphate (0.05 ppm). This stretch has, however, recovered from the worst affected Agra stretch.

In river Yamuna water phosphatase slightly increased and glucosidase activity slightly decreased at Yamunanagar, Wazirabad and Agra. However, the soil enzyme activities were drastically reduced, indicating strong negative effect of pollution at these sites, as compared to the upstream sites (13-53 units for different enzymes). Worryingly, soil respiration was alarmingly low indicating very low microbial activity at the river bottom. An appreciable amount of enzyme activity was noticeable at Allahabad, indicating some recovery of the river at this site.

In river Yamuna, 72 fish species were recorded, out of which 4 were exotic with their dominant presence at Agra, Wazirabad and Allahabad indicating that the exotic species are having their recruitment in these habitat. The IBI indicated that Yamunanagar and Allahabad stretches were found to be in Acceptable in terms of fish assemblages and less environmental stress. Whereas, the Agra stretch was found to be Impaired and the stretch of Wazirabad was Moderately Impaired. Dissolved oxygen in these sites was low to support fish species of different types and as a result exotic and tolerant fish species have dominated.

Monitoring and Bioaccumulation of Metal and Pesticide Contaminations in the Food Chain of Inland Openwaters

S. Samanta and P.K. Saha

Heavy metals and pesticides are known pollutants in aquatic environments with deleterious health impacts on fish as well as its consumers, including humans. In Damodar river water there was absence of any appreciable amount of Cd, Cu, Mn, Pb and Zn. At the Durgapur stretch, Zn (up to 51 ppb) and Mn (up to 85 ppb) were detected sometimes. Cd and Pb were absent

Organ	Fish	Cu	Mn	Zn
Gill	*M. seenghala* *L. calbasu* *L. bata*	Nil	0- 4.7	5.2 – 173.2
Liver	*M. seenghala* *L. calbasu* *L. bata*	0-108.9	0-12.7	11.5 – 172.1
Kidney	*M. seenghala* *L. calbasu* *L. bata*	Nil	Nil	0 - 376

Metal content (ppm) range in different organs of fishes of river Damodar

in the sediment samples. Cu (3.2-8.9 ppm) and Zn (15.0-26.2 ppm) were detected but these were below pollution limits (Cu <25; Zn<90 ppm).

In flesh of fishes collected from this river, occurrences of Mn and Zn were below the permissible limits. Cd, Cu and Pb were not detected in fish flesh. However, higher contents of Cu, Zn and Mn were noticed in the internal organs of the fishes. Like in fish fleshes, Cd and Pb were absent in the studied organs. Arsenic poisoning is a serious human health concern in West Bengal. Inland surface waters are not considered as significantly polluted with this toxic metalloid. However, some reports depict occurrence of arsenic in the river Damodar and this might pose a human health problem. With this background, river Damodar was examined for this toxicant. Our data indicated presence of only traces of arsenic in water and fish, and only a small amount in sediment (0-2.05 mg kg^{-1}) and as a whole, the river was found to be free from arsenic pollution.

Presence of organochlorine pesticide, particularly DDTs, were noticed in all the Damodar water samples. The detected levels exceeded the permissible limit of EPA (1 ppt) for aquatic life by 9 times. Occurrences of other organochlorine pesticides were also noticed in fish but those were below the permissible limit of pollution.

Place	DDTs	HCHs	Endosulfans	Heptachlors	Aldrins	Total OCs
Panchet	33.16	7.47	6.18	0.00	1.23	48.04
Barnpur	33.38	13.27	8.63	0.44	0.50	56.22
Raniganj	22.00	8.02	3.47	0.74	0.35	34.60
Durgapur	25.60	6.19	1.46	0.14	1.42	34.80
Burdwan	31.41	4.25	1.28	1.17	1.28	39.35

Organochlorine pesticide residues (ppt or ng l^{-1}) in Damodar water

Microbial Diversity Assessment and Their Role in Environmental Mitigation in Inland Waters

S. S. Mishra, M. K. Bandopadhyay, S.K. Manna, B.K. Behera, P. Maurye

Microorganisms are integral part of biotic community in any aquatic environment, including river. They play very important roles in nutrient transformations, productivity and in pollutant degradation leading to overall health management of aquatic environments.

Microbiological analysis of water samples from river Damodar showed that the total aerobic heterotrophic bacterial load ranged between 1.9 x 10^3 CFU/ml in Raniganj to 4.2 x 10^5 CFU/ml water in Jamalpur. Sediment microbial load was low, ranging between 1.5 x 10^4 in Burnpur and 7.0 x 10^5 CFU/gm. Presence of *Aeromonas* was detected in industrial areas, but not in Jamalpur and Panagarh. The total *Vibrio* count ranged between 2.2 x 10^1 and 2.7 x 10^3 CFU/ml. *E. coli*, an indicator of sewage/faecal matter pollution, ranged between 1.6 x 10^2 and 4.1 x 10^3 CFU/ ml water. Presence of a good number of *Pseudomonas* was also detected in the river, count ranging between 2.6 x 10^1 in Panagarh and 5.1 x 10^3 CFU/ml. Although the total plate counts of bacteria were higher at downstream Jamalpur, levels of *Pseudomonas* and *Vibrio* were higher in industrial areas possibly due to presence of both domestic sewage and industrial effluents at these sites. *Pseudomonas* is known to have degradation capability and may be important in self-purification of river. Several pollution tolerant algal genera, *viz*., *Anacystis, Anabaena, Oscillatoria, Pediastrum, Scendesmus, etc.* were encountered in river Damodar. *Phytoplanktons like Anabaena, Closterium, Ulothrix, Phormidium, Microspora, Navicula, Oscillotoria and Spirogyra* were identified from Haldi river and adjoining industrial effluents polluted canal at Haldia. Pure culture of *Oscillatoria* was standardized for molecular characterization.

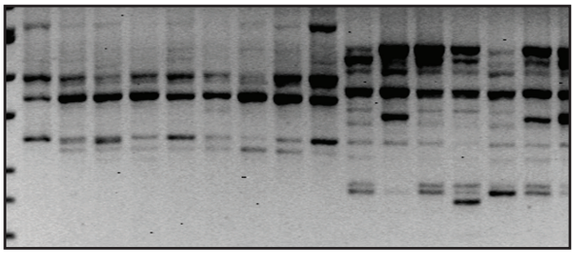
Investigations on isolation of bacteria capable of degrading phenolic compounds from pollution sites could isolate nine bacterial strains resistant to and capable of degrading dichlorophenol, trichlorophenol, and pentachlorophenol were isolated from sewage treatment plants and Haldia industrial area. The pentachlorophenol (PCP) degradation by 12 bacterial isolates was examined in mineral medium containing 100 ppm PCP. PCP remaining in culture broth, or in other word, PCP degradation was measured spectrophotometrically. Out of 12 strains tested, 5 strains were strongly degrading PCP than the other strains and may have potential application in bioremediation. Three strains could be identified, viz.

Ochrobactrum anthropi, *Pseudomonas (viridilivide)*, *Chryseobacterium gleum/indologenes* by BIOLOG method. Protein profile of 20 phenol degrading bacteria was examined by 1-D and 2-D gel electrophoresis techniques. Our study suggested expression of some specific, but yet unidentified, proteins by the bacteria at different concentrations of phenol. These proteins may be important for tolerance of the bacteria and/or may form part of the metabolic/enzymatic pathway for degradation of the toxicant.

Estimation of Stress Mediated Genetic Contamination in Fishes from Different Stressed Ecosystem

M. P. Brahmane and S.K. Manna

Specific gene sequences of various fish species from different stretches of river Damodar were compared to examine their differences at polluted and less-polluted sites. Different fish species were sampled from different locations in the river Damodar representing the upstream reference site with low pollution and downstream of industrial site. The 8 RAPD-PCR oligo-degenerate primers were used for amplification of genomic DNA of the fish species *Gudusia chapra*. The RAPD data, analysed using population genetic software *PopGene 3.2*, did not suggest existence of differences in *Gudusia chapra* from upstream and downstream Damodar. The measures of genetic identity and genetic distances calculated were 0.9918 and 0.0882, indicating more than 99% identity in the upstream and downstream populations. This may be because of the migration of fishes and flow of water in the river causing admixture of the two populations and hence homogenization.



RAPD profile of G. chapra using OPA-1 and OPB-1 primer

Further to detect the impact of pollution stress on fish populations at the DNA level more number of fish species were selected and sampled. The cytochrome *b* gene sequencing was initiated. Amplifications were performed in Applied Biosystems GeneAmp PCR system 9700 machine programmed for one cycle at 94C for 4 minutes, 35 cycles of 94C for 1 min, 50C for 1 min, 72C for 2 min and final extension at 72C for 10 minutes. The cytochrome *b* gene amplification resulted in a fragment of 360 bp. The DNA sequence analysis of 324 bp region of the gene of *Cirrhinus mrigala* from Panchet and Durgapur revealed 3 mutations, two Thymine to Cytosine (T - C) and one Adenine to Guanine (A - G). The mutations were

Cluster diagram of *Cirrhinus mrigala* from Panchet and Durgapur in river Damodar

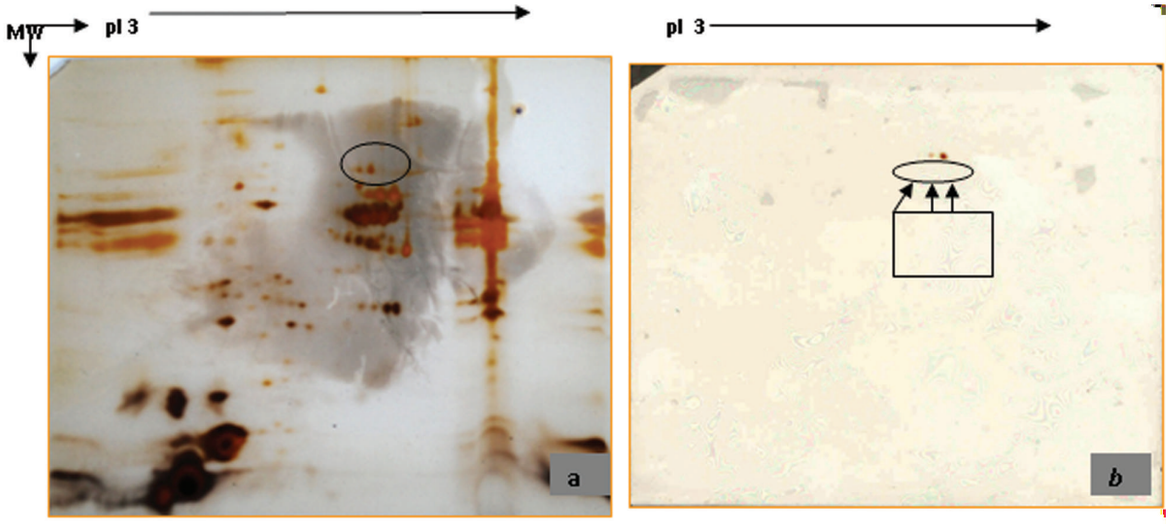
all at degenerate codon site (third base pair of the triplet codon) hence not contributing to any change in the amino acid sequences. Three haplotypes were found in mrigala samples from river Damodar. Further analysis by increasing the sampling size and DNA sequencing of more mtDNA genes would elaborate on the impact of industrial contamination on the fish populations of river Damodar.

The DNA sequence analysis of 316 bp region of cytochrome *b* gene of *Catla catla* from Panchet and Durgapur revealed 26 mutations, one Adenine to Cytosine (T - C), five Adenine to Guanine (A - G), and 19 Thymine to Cytosine (T - C). Three haplotypes were found in *Catla catla* from the river. The mutation resulted in 22 amino acid changes. The mean of genetic distances between group 1 to 2 is 0.003, group 1 and 2 is 0.091, group 2 and 3 is 0.088. The mean genetic distance between all samples is 0.045. The samples of *Labeo calbasu* collected from the same stretches of the river exhibited no mutations in the mitochondrial DNA cytochrome b region.

Developing Health Management Protocols for Inland Aquatic Ecosystems through Proteomics

B. P. Mohanty, M.K. Bandyopadhyay, B. K. Behera, *D. Karunakaran* and *P. Maurye*

The project aims at identification of biomarkers in fish that would be suitable for environmental monitoring in the large, tropical open-water system. Indian major carp *Labeo rohita* and the freshwater catfish *Rita rita* were used as the test animal. Sampling was carried out in the river Ganga and Damodar at different sites. The muscle and lens proteins were analyzed by 1- and 2-dimensional gel electrophoresis (1-and 2-D GE), and 1- and 2-D immunoblot analysis using monoclonal anti-HSP70 antibody. The HSP70 expression was detected by 1-D immunoblot. However, the 2-D immunoblot analysis of soluble white muscle protein extract of *R. rita* revealed some interesting patterns: in many samples a single spot was seen; however, in some cases two spots and in few cases a third light spot was seen. Also, proteome map of muscle and lens proteins of Indian major carp *Labeo rohita* were generated for the first time.

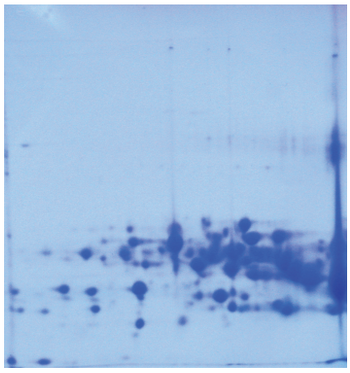


(*a*) 2-D Proteomic map of soluble white muscle protein extract of *Rita rita*. For the first dimension run (IEF), the proteins were resolved on IPG strip 7cm, pH 3-10 on a Protean IEF Cell and second dimension run was carried out on 12% SDS-polyacrylamide gels on a Mini-Protean3. The gels were Coomassie-silver double stained for visualization of the proteins. (*b*) 2-D Immunoblot showing HSP70

The distribution of different crystallin families of proteins in *Rita rita* was examined by generating 1- and 2-D GE profile of commercially available purified α- and γ-crystallin and comparison of profile with that of *Rita rita*, identification of possible α- and γ-crystallin spots in *Rita* crystallin proteome by pattern comparison. Similarly, 1- and 2-D immunoblot of crystallin with anti α-A and anti-phospho-α-B crystallin was used to confirm specific crystallins in the *Rita* crystallin proteome. Two protein bands, molecular weight 19-20 kDa, were identified as αA-crystallins by 1-D immunoblot analysis on basis of their reactivity with the anti-α A-crystallin antibody. 2-D immunoblot analysis revealed that these two bands separated in to ten discrete protein spots and were designated as αA-1 to αA-10 crystallin. Anti-áA-crystallin antibody was developed in rabbit and rat which specifically recognizes ~20 kDa protein representing áA- crystallin from bovine lens samples. We observed strong reactivity of this antibody

with *Rita rita* lens extracts. Our results indicate that the áA-crystallin proteins of bovine and this catfish share strong homology although phylogenetically fish belong to a clade much distant from the bovine.

2-D gel images of *Rita* lens soluble proteins were analyzed using the 2-D image analysis software (PD Quest, Bio-Rad): 75 protein spots were visible on the Coomassie-stained gels. Different crystallin family members were identified with immunoreactivity with specific antibodies and profile comparisons with commercially available purified bovine crystallins. We identified about 32 crystallin spots out of total 75 spots seen on the crystallin proteome map.



2-D Gel Electrophoresis profile of soluble lens protein extracts of *Rita rita*. First dimension run was carried out with IPG strips (11 cm, pH 5-8) and second dimension run was carried out on 12% SDS-polyacrylamide gels.

Programme: Assessment of Resources and Database Development in GIS Platform for Inland Fisheries Using Remote Sensing Techniques
Programme Co-ordinator: Dr. M. D. Das

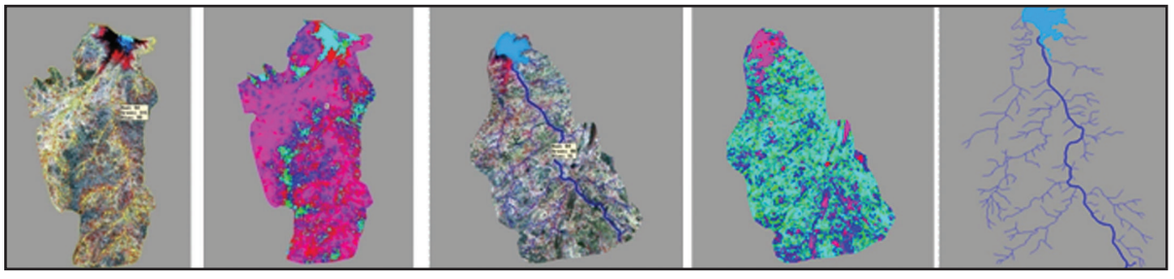
Assessment of Inland Resources Using Remote Sensing Technique

D. Karunakaran, S. K. Sahu and *D. Das*

Soil and water quality parameter were estimated from the remote sensing imagery. Thirty three samples of soils and water were collected among 8 water bodies across the Jhansi district of Utter Pradesh. Observations on soil characteristics were made on 11 parameters and 22 parameters were considered for water quality. Remote sensing data of IRS P6 LISS-III images were procured for pre-monsoon (2 June 2009) and post-monsoon (10 October 2009) exactly matched with the sampling dates. All the bands of imagery were tested to find out degree of relationship with ground truthing water quality and soil parameters. It was observed that Free CO_2 was significant in 0.01 levels in IR, Red and Green band, NO_3 0.05 degree of correlation in IR and NIR band and Dissolved Oxygen and pH had significant correlation (0.05 %) with Red band during pre-monsoon and in the post monsoon data Dissolved Oxygen correlated in Infra Red band, Ca in Red band, Sp. Conductivity, TDS, TA, hardness and Ca from Green band was correlated significantly. All the parameters which were correlated with the highest degree were converted into the mathematical model to estimate water quality parameters from the imagery. Following Linear model were developed

Depth = -0.1933 DN value of IR band + 19.03
Free CO_2 = 0.0516 DN value of IR band + 1.5105
Dissolved oxygen (DO) = 0.0956 DN value of red band +4.81

The pre-monsoon imagery was classified based on supervised image processing methods and landscape matrix was prepared particularly percentage of forest, settlement, agricultural land, water body and grass land in the catchment area. Based on land matrix Multiple Leaner Regression model for specific conductivity was developed. In the model (R^2=0.9, P < 0.01), compositional attribute (%) grass land and settlement were found as the first and second important explanatory variables. Specific conductance = -204.24 + 13.70 g + 13.32 s, where g = grass land (%) in the watershed, s=settlement (%) in the watershed.



Images of delineated catchment area Digitized streams

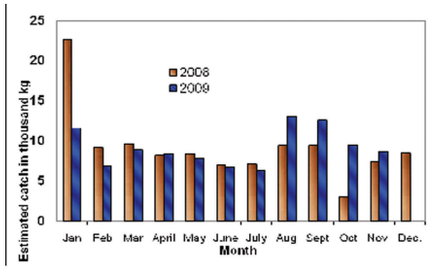
Post monsoon Imagery was analyzed to predict the Chlorophyll pigment concentration from the spectral reflectance signature of all four bands. It was observed that in the Infra red band chlorophyll a, chlorophyll b, chlorophyll c and chlorophyll significantly correlated R^2=0.526 R^2=0.589, R^2=0.611 and R^2= 0.615, respectively and capable of predicting Chlorophyll pigment concentration from this bands.

Development and Standardisation of Database on Web GIS Platform for Capture Fisheries

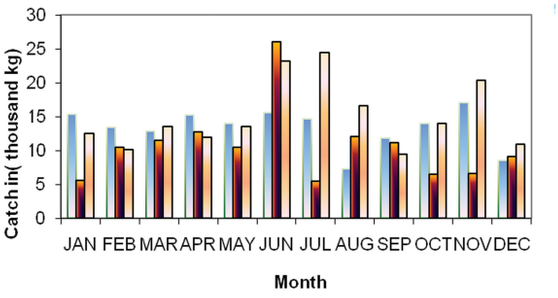
S. K. Sahu and *D. Karunakaran*

Systematic sampling was adopted for data collection at Allahabad and Guwahati depending on the fishing and landing patterns. The data on catch were utilized for the development of database under the project.

Monthly data on fish catch recorded at Uzan Bazar Guwahati for Brahamaputra showed dominance of *A.morar, T.ilisha*, *A.coila* and *L.dora* are the dominant species in the catch. The estimated total catch



Fish landings of Brahmaputra at Guwahati



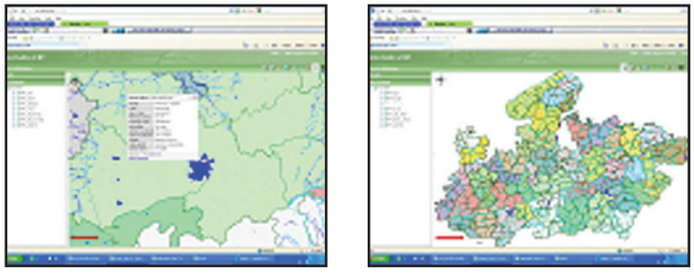
Monthly fish production of River Ganga

is worked out at 109.78 t at the centre during 2009. In previous year (2008) the catch was 108.59 t from the same landing Centre. It is observed that monsoon and post monsoon catch is little higher in comparison to previous year. Catch composition shows that IMC and Cat fish contribution in year 2009 is high in comparison to previous year. Composition also showed that medium carp and others were less in comparison to previous year. Last 10 years landing of Uzan bazar (from 2000) revealed downward trend, but there was a cyclic pattern of 4 years.

The catch data recorded from the Ganga river system at Allahabad observed common carp as the major contributor during 2009. Total river Ganga catch was estimated at Allahabad at 180.9 t, the highest in last 6 years (2004 onwards). The production was 41 % more in comparison to previous year. *C. mrigala* in IMC and *M. seenghla* in catfish were the main contributor. Last three years productin data showed decline in IMC production.

Catch contribution of *Tilapia* increased by three fold this year in comparison to year 2007. In 2007 tillapia catch was 5606 kg and wich reaches to 21851 kg at the cost of IMC which decreases from 32261 to 19909 kg. Combined production of common carp and tilapia had gone up in last 3 years. In year 2007 it was 29 percent now it reaches to 40 % of total production.

Towards web based Geographical Information System, Arc IMS (Internet Map Server) was installed on workstation and maps for Monthly landing Information of River Ganga and Brahamputra and Water body information of West Bengal and Madhya Pradesh were uploaded



Water body information of Madhya Pradesh

Programme: Economic valuation of Inland Fisheries Resources in India

Programme Co-ordinator: Dr. P. K. Katiha

Economic valuation of Inland Fisheries Resources in India

P. K. Katiha, R. S. Srivastava and *Anjana Ekka*

The physical features, socio-economic characteristics fishers, institutional arrangements and governance, livelihood and community interactions with the resources are integral part of valuation exercise undertaken in Charan floodplain wetland (beel) in Morigaon district, Assam and estuarine zone around Gosaba block in sunderbans, South 24 Parganas, (West Bengal). Located at about 80 Km from Guwahati, Charan beel has average area of 60 ha and five fisher villages, namely, Aujhari, Salanpar, Baghora, Tarani Kalbari and Simibari in its vicinity. Major crops grown in the area are paddy, potatoes, vegetables and cucurbits. Socio-economic features of fishers revealed that most of the fishers were scheduled caste. Their family size was 6.71 with sex ratio -1:0.85, adult minor ratio - 1:0.90 and earner dependent ratio at 1:3.89. Most of the fishers had Kaccha houses. Their major occupation was fisheries with agriculture and daily labour as the secondary source of income. Only 25% of fishers had their own non-mechanised wooden boat, but most of them had one or other type of gears (gill net, cast net, traps, hook and line, vessel etc.). The institutional arrangements at the beel revealed its ownership with State Revenue Department. But, AFDC leased it out for fisheries purposes for a period of 7 years at lease amount of Rs 4250/ha/year. The lessee fisher society is Morigaon Matsya Vyavsayi Samanvya Samiti Ltd having with 56 active fishers and 74 non-member fishers. Average fishing effort per fisher was 170 days/year. Fishing practices primarily included gill and drag net and Katal fishing. The results of Livelihoods and community interaction in resources indicated that out of total area about 105 Km^2 around the beel, Agriculture land is 68 Km^2 and others including forests, pastures, domestic lands, Arc nut trees, etc. About 800 of households living around beel has 70% farmers, 20% fishers, and remaining in service or business. About 50% families from immediate adjoining areas of beel use it directly for domestic purposes for bathing; washing clothes; tending cattle; dumping of domestic waste, fuel wood, fodder, etc., while remaining 50% of the families were either indirect or non users. Various uses, goods and services provided by the beel were valued at Rs 50.24 lakh with highest share for fish (45%) followed by natural resource use (34%).

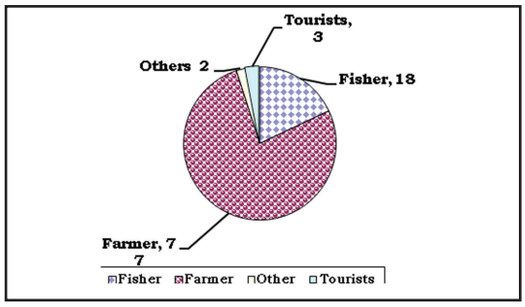
Fishing in Charan beel

The other water body studied for the valuation is Gosaba block of South 24 parganas in Sundarbans located at about 110 km from Kolkata. The Gosaba Island is connected by water ways only. The block had 44478 households with population at 2.23 lakh. The family

Katal fishing

Fish harvest of katal in Charan

size was estimated at 5.0 with sex ratio 956 female per 1000 male. The block had 22761 agricultural cultivators, 40516 agricultural labour and approximately 12500 fishers. The earner dependent ratio was 1:4.2. The block has 14 Gram panchayat (self governing unit) of which five are facing the Sunderban Reserved Forests separated by Sajina, Gomor and Melmel rivers. The Panchayat samiti having representatives of all the panchayats is the governing body controlling the block and island. The block has also Block development officer. The fisheries is although in open access, but due to fishing pressure and decreasing catch per unit effort transition towards common property is inevitable. The DoF issued licenses to fishers to fish in reserved forest areas, but, complaints of snatching of nets and boats and prohibition for fishing were common. The observations on livelihood and community interaction in resources revealed 77% farmers, 18% fishers cum farmers and remaining business personnel and tourists. The fisheries waters of the area included eight rivers - Hoogli, Bartala (Mooriganga), Saptamukhi, Thakuran, Matla, Gosaba, Vidyadhari, Ichhamati-kalini-Harinbhanga. Valuation exercise is in progress and expected to complete by of 2010-11.



Community at Gosaba block

The Sundari plant

The path of Royal Bengal Tiger

Programme : Outreach Activities

Development of a Viable and Effective Feed for Culture of Carps in Cage(s) & Pen(s)

Three types of feed using different ingredients (with 25% protein level in each) were tried in cage culture at Poka and Kalindi wetland in Bankura District of West Bengal. The compounded feed-3 (moisture content 9.8%, protein content 25%, P/E ratio 80.5 mg protein/Kcal, percent protein energy 32.2 and gross energy 318.0 Kcal/100 g), compounded and pelletized from ingredients of mustard oilcake, linseed oilcake, corn powder, rice bran and fortified with vitamin and mineral mixtures exhibited better growth performance than the other two feeds. Among the wetlands, Poka wetland exhibited better growth of Indian Major Carps than Kalindi wetland. Economics of cage culture operation showed a cost: benefit ratio of 1.29.

Growth performance of IMC in Poka fed with traditional and formulated feeds

Diet	Initial Av. Wt. (g)	Final Av. Wt. (g)	Av. Wt. gain (g)	Mean Feed Conversion Ratio (FCR)	Mean Percent Survival
Traditional feed (MO C:RB=3:1)	3.3	18.2	14.9	4.3	62
Compounded feed-1	3.3	25.9	22.6	3.2	59
Compounded feed-2	3.3	24.1	20.8	3.05	63
Compounded feed-3	3.3	31.02	27.72	2.49	65

Growth performance of IMC in Kalindi fed with traditional and formulated feeds

Diet	Initial Av. Wt. (g)	Final Av. Wt. (g)	Av. Wt. gain (g)	Mean Feed Conversion Ratio (FCR)	Mean Percent Survival
Traditional feed (MOC:RB=3:1)	3.3	13.1	9.8	4.6	57
Compounded feed-1	3.3	20.2	11.9	3.7	59
Compounded feed-2	3.3	21.5	18.2	3.3	65
Compounded feed-3	3.3	23.9	20.6	3.1	61

Fish Stock Characterization and Description

Quarterly sampling was carried out at selected stations along the Ganga, Brahmaputra and Narmada rivers for collection of sample of *Catla catla, Labeo rohita, L. fimbriatus, Cirrhinus mrigala, Clarias batrachus, Macrobrachium rosenbergii.* A total of 1245 samples of different categories of the target species were collected. Length and weight of collected samples were measured and tissue, fin clippings, blood, haemolymph, scales and truss images were collected. *Clarias batrachus* has not been recorded from the riverine catch of these rivers. *L. fimbriatus* was recorded from one station along the river Narmada. Digital truss images of all the specimens were taken on the background of standard graph paper for morphometry analysis and archived. The tps digi software for truss image analysis has been initiated and the tress land mark data is being uploaded in the analysis format. A total of 80 images have so far been digitized and the tress land marks measured.

Fish samples were collected from four stations along the river Ganga *viz.* Nabadwip, Farakka, Patna and Allahabad. A total of four *C. catla*, 22 *L. rohita*, 16 *C. mrigala* and 21 specimens of *M. rosenbergii* were collected from river Ganga.

Length and weight measurements of target species

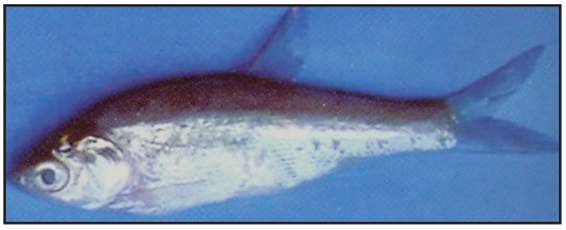
Station	*C. catla*		*L. rohita*		*C. mrigala*		*M. rosenbergii*	
	L (mm)	W (kg)	L (mm)	W (kg)	L (mm)	W (kg)	L (mm)	W (kg)
Nabadwip	550	2.35	355-607	0.5-2.75	--	--	170-190	0.06-0.1
Farakka	--	--	380-800	0.75-8.0	349-755	0.49-5.3	190-250	0.1-0.24
Patna	775-895	9.5-11.3	--	--	--	--	--	--
Allahabad	--	--	750-855	7.25-8.75	755-820	5.5-6.0	--	--

A total number of 34 fish specimens comprising of nine *L. rohita*, six C. *catla*, 13 *C. mrigala*, six *L. fimbriatus* and 30 *M. rosenbergii* were collected from selected centers of river Narmada. Length and weight of the collected specimen were recorded. Most of the specimens collected were in the spent stage, where ever ovaries present, the fecundity range was 1.8-4.7 lakh for 1.4-1.5 kg females of *L. rohita* collected from Farakka; 0.7 lakh for 5.74 kg female of *C. mrigala* Allahabad. At Narmada the fecundity of *L. fimbriatus* was 4.0 lakh for female weighing 0.35 kg; the ova diameter range was 1.2 to 1.3 cm. All the scale samples collected so far have been measures for growth rings using profile projector for scale reading. Preliminary estimate of the age groups of the fishes revealed that specimens belongs to the following age groups: Catla: <1-6; Rohu: <1-6; Mrigala: <1-3 year from Ganga. Samples for other rivers are being analyzed. Samples of muscle, blood and fin clippings were collected and preserved in absolute alcohol. DNA was extracted using Sambrook and Russels protocol modified to local conditions. The polymerase chain reaction was conducted to amplify the cytochrome *b* region of the mitochondrial DNA. The PCR of the mtDNA cytochrome *b* region in *L. rohita*, *C. catla* and *C. mrigala* resulted in amplification of 300-350 bp fragments. This DNA fragment is to be further analyzed by DNA sequencing. The 300 bp cytochrome b gene sequence for *L. rohita*, *C. catla* and *C. mrigala* collected from Nabadwip, Ganga has been completed. Analyses of sequences for samples of other stations are in progress.

Nutrient Profiling and Evaluation of Fish as A Dietary Component

Nutrient profiling of Hilsa, *Tenualosa ilisha* and Mola, *Amblypharyngodon mola* was completed. Three size groups of hilsa, *Tenualosa ilisha*, viz. small, medium and large (352..77 ± 4.39 g , 797.00 ± 6.54 g, 1150.10 ± 6.72 g) were analysed for proximate composition, amino acid and fatty acid profiles. Higher protein level (21.48 ± 0.04 g/100 g) was observed in case of large size hilsa in comparison to other size groups. Similarly, higher fat content (19.15 ± 0.29 g/100 g) was observed in large size Hilsa. However, ash content (0.54 ± 0.03) was highest in case of smaller size hilsa. The major amino acids in medium size hilsa are glutamic acid (13.10 g / 16 g N_2), aspartic acid (10.25 g / 16 g N_2), Lysine (10.18 g / 16 g N_2), Alanine (8.45g / 16 g N_2), Glycine (8.08 g / 16 g N_2) and Leucine (8.08 g / 16 g N_2). The lowest available amino acid in hilsa was Arginine (0.73g / 16g N_2). The fatty acid analysis of medium size hilsa are presented: total saturated fatty acid: 57.708 ± 1.977%, monounsaturated fatty acids: 28.095± 1.574% and polyunsaturated fatty acids 14.197 ± 0.048%. The major fatty acids detected were C16:0 (38.310 ± 1.600%), C18:1 (25.729 ± 1.547%). The level of Eicosapentanoic acid (EPA) was 8.497 ± 0.020% and Decosahexanoic acid (DHA) was 2.307± 0.4%. The minerals analysed in medium size hilsa were iron, manganese, sodium, potassium and zinc at ppm level were 4.4612 ± 0.000589, 0.347± 0.002, 889.784 ±4.984, 0.9832 ±0.001, 0.9832 ±0.002, respectively.

Hilsa, *Tenualosa ilisha*



Mola, *Amblypharyngodon mola*

The small indigenous fish *Amblypharyngodon mola* were analysed for proximate composition of amino acid and fatty acid and minerals analysis. The protein level (16.89 ± 0.47 g/100 g), low fat content (2-3 g/100 g) was observed in mola. The ash content (3.21 ± 0.17 g/100 g) was observed in case of mola. The major amino acids were as stated: Glutamic acid: (6.20 ± 0.016 g / 16g N_2); Aspartic acid (3.49 ± 0.011 g / 16 g N_2); Leucine (3.26 ± 0.008 g / 16g N2); Lysine (3.64 ± 0.001 g/16g N_2). The fatty acid profile of mola revealed that, total saturated, monounsaturated and polyunsaturated fatty acids content were 55.865 ± 0.2167%, 20.19 ± 2.32%, and 23.944 ± 0.627%, respectively. The major fatty acids detected were C16:0 (36.755 ± 0.119%), C18:1(18.100 ± 2.259%), C18:3 (9.362 ± 0.244%). The level of Eicosapentanoic acid (EPA) was found to be 4.504 ± 0.080%. In mola, seven minerals were analyzed and potassium content was in very moderate amount (630 ± 2.074 mg/100 g) followed by calcium and magnesium 630 ± 2.074 mg/100 g and 230 ± 5.263 mg/100 g respectively. Iron quantity was (34.8 ± 1.119 mg/100 g) also good enough and copper was present at 2.67 ± 0.206 mg/100 g.

SPONSORED PROJECTS

Impact Adaptation and Vulnerability of Indian Agriculture to Climate Change - Impact Assessment of Climate Change on Inland Fisheries

Drought condition prevailed in West Bengal during 2009 had impacted fisheries. Most of the hatcheries (23 out of 25) in districts of South Bengal were affected by deficient rainfall during March to September as well as increasing trend of temperature. About 61% and 73% loss of fish seed was observed in North 24 Parganas and Bankura districts as compared to last four years average. The vulnerability index for the fisheries sector developed for 6 districts of West Bengal indicated more exposure of fisheries activity to climatic events. The adaptive capacity of these activities was less in terms of limited opportunities for occupational diversification. Impact of extreme event like cyclone Aila affected human lives, properties, fishing equipments, agriculture and aquaculture enterprises. Freshwater fishes in ponds died due to salinity rise. Adoption options tried included stocking of these ponds with salt tolerant fish species.

Assessment of Fisheries with regard to Water Quality in the River Ganga and Yamuna

A total of 143 species of fishes belonging to 40 families was recorded from main channel of river Ganga from Haridwar to Dakshineswar. The relative contribution of major groups of fishes, *viz*., carps, catfishes, miscellaneous and exotic fishes was 33%, 20%, 43% and 4%, respectively indicating increasing presence of miscellaneous fishes and invasive exotic fish species *Cyprinus carpio* and *Oreochromis niloticus.* An updated list of fishes available in river Ganga is presented with clear lively photographs and salient diagnostic characters for reference of interested workers in identifying the available species. In river Ganga, twelve stretches were assessed in relation to their fish biotic integrity taking Farrakka as reference site. It indicated that majority of the stretches (8) were in acceptable condition in terms of fish assemblages, three sites were moderately impaired. In river Yamuna from Yamunanagar to Allahabad, six stretches were assessed in relation to their fish biotic integrity with Allahabad as reference site. It indicated that 50% of the stretches were moderately impaired and the rest were in acceptable condition in terms of fish assemblages. The final report has been submitted to CPCB.

Bio-prospecting of Genes and Allele Mining for Abiotic Stress Tolerance

Water and sediment samples were collected from 15 different sampling sites in three states of east coast of India *i.e.* in West Bengal, Orissa and Andhra Pradesh. A total of 140 microbes were isolated from the collected soil, sediment and water samples. All these collected microbial isolates were subjected to 10%, 15%, 20% and 25% NaCl concentrations in media for salt stress physiological study. In this study, 80 microbial isolates were found resistant to 10 -25% NaCl concentrations. Out of that, molecular typing for seven microbial isolates was done through 16S rDNA gene sequence analysis using 16S universal primer (8F: 5/ AGAGTTTGATCCTGGCTCAG 3/, 1492R: 5/ ACGGCTACCTTGTTACGACTT 3/).

Salt tolerant microbes identified using 16S rDNA gene sequence

Place of sample collection	Bacteria identified
Digha (West Bengal)	*Pseudomonas aeruginosa NO 5*
Haldia (West Bengal)	*Staphylococcus haemolyticus*
Haldia (West Bengal)	*Shewanella sp.62*
Yanam (Andhra Pradesh)	*Staphylococcus pasteuri strain BQN3N - 02d*
Yanam (Andhra Pradesh)	*Staphylococcus saprophyticus*
Vizag (Andhra Pradesh)	*Vibrio alginolyticus*
Vizag (Andhra Pradesh)	*Vibrio sp. K380*

Microbial Phosphorus Transformations in Inland Open Waters

Various forms of phosphorus and related chemical and microbiological parameters were studied in two

beels. In both the *beels*, the total sediment P-pool was very high, amounting up to 6215 mg/kg in Akaipur *beel* and 5356 mg/kg in Bhomra *beel*. Organic form of phosphorus formed the bulk (75-95% of total P content) signifying that the major pool of P is associated with the sediment organic matter and may be potentially released through microbial decomposition. Results indicated that temperature induced microbial decomposition reduced the organic matter and organically-bound P load in sediment with release of P in summer, as compared to winter season. The level of mineral-bound P did not differ greatly in different seasons indicating their less significance in P release with change in season. A total of 26 bacterial strains capable of releasing P from inorganic P source were isolated. Sediment followed by fish gut was the major source of these microbes. Most of these strains lacked phosphatase activity and local acid production seemed to be their mechanism of P release. A comparison of the isolates indicated higher P release activity of the strains isolated from wetland sediment than those from other sources. For studying microbial decomposition of organically bound P in sediment, inorganic forms were chemically removed from sediment samples and remaining organic-bound P fraction was used as C and P source for isolation of bacteria. So far, seven strains have been isolated capable of growing on these substrate sources and the study is in progress.

Arsenic in Food Chain: Causes, Effect & Mitigation

Status of arsenic contamination in abiotic and biotic component of fish pond from arsenic affected and unaffected area has been studied. Four hatcheries were surveyed from affected area. The study showed water As range 19 - 68 ppb, sediment As range 2.4 - 68.7 ppm. As content in fish fries were traces to 60 ppb. Average level of pond water from affected area was 31 ppb (Range 3 - 120) and that of sediment was 7.96 ppm (Range 2.04 – 17.17). *C. catla* exhibited maximum accumulation (62% samples >100 ppb, Range: 27-516 ppb) followed by *L. rohita* (46% samples >100 ppb, Tr.-371 ppb) and *C. mrigala* (29% samples >100 ppb, Tr.-335 ppb). Arsenic was also noticed in the fleshes of *Channa sp* (28% samples >100 ppb). The bivalve and gastropod samples exhibited arsenic in the range of 260-1354 ppb with average value of 719 ppb. Average level of pond water in unaffected area was 4 ppb (Range 1 – 8) and that of sediment was 3.22 ppm (Range 1.42 – 5.25). Most of the fish samples collected from control area and those non-local fishes transported from out of West Bengal had traces of arsenic. From previously isolated arsenic transforming microbial strains, three strains were identified as *Vibrio diazotrophicus*, *Pseudomonas* sp., *Flavobacterium flevense*. On the basis of oxygen requirement, out of 32 strains tested, 28 were found aerobic and 4 micro-aerophilic. Study on clinically important serological parameters were carried out in the Indian Major Carps (*Labeo rohita* and *C. mrigala*) from arsenic contaminated and uncontaminated areas. An alteration in A/G ratio was observed in the fishes collected from As-contaminated zones (1: 1.6) with respect to control zone (A/G ratio 1.5: 1).

An experiment on short term exposure to arsenic was conducted for 10 days to detect the fish mortality dose and significant pathological changes in *L. rohita*. Pigmentation and depigmentation developed on fish body, akin to human arsenicosis, at arsenic concentration of 10 ppm and higher. Scars with fin necrosis were also observed. Fish mortality occurred at conc. 15 to 60 ppm. Histopathological study of different organs of exposed fish showed several abnormal changes. Increased cytoplasmic granularity, necrotic hepatocyte, congested central vein and portal vessels and vacuolated degeneration were observed in liver tissue and glomerular necrosis with tubular degeneration were found in kidney above 10 ppm. Arsenic exposure induced cataract formation and altered the lens αA-crystallin protein profile *in vivo*.

Skin lesion induced by arsenic in fish

Sustainable Livelihood Improvement through Need Based Integrated Farming System Models in Inland Open Waters

The village Pirapur of Jandaha block in Vaishali district of Bihar was selected for livelihood improvement. Sakri *chaur* in Pirapur, a 52 acre shallow depression, was selected for management intervention. For raising advanced fingerlings for stocking in the *chaur*, seed raising in pens and cages was attempted. A total of three pens and 35 cages were installed in the *chaur*. Also, to make carp seed easily available, a portable eco-hatchery was established at the site.

Toll-like Receptors in Phylogenetically Divergent Fish Species-Their Contribution in Modulating the Innate Immunity

The TLR-2, TLR-20 and TLR-21 have been identified from the catfish, *Heteropneustes fossilis* and TLR-20 and TLR-21 from *Clarias batrachus*. The constitutive expression in different tissues for TLR-20 and TLR-21 was observed in liver, kidney and heart tissue and was not observed in skin and gill of *H. fossilis*. The DNA sequence information of the three TLR genes in *H. fossilis* has been generated for conducting $3^{/}$ and $5^{/}$ RACE analysis.

Strengthening of Database and Geographical Information System (GIS) for Fisheries Sector

Mapping of water bodies of seven states was completed using 5.8 m resolution data. Based on sampling methodologies, Software was developed for catch estimation using visual basic and MS Access. Training was imparted to the State fisheries officials on knowhow to use the software and methodologies for estimation of fish catch. Water bodies (>0.5 ha) have been identified and mapped using LISS III (23.5) and PAN (5.8 m) imageries for two state namely Tamil Nadu and Jharkhand. Ground truthing was done for verification of water bodies identified by satellite data. This was carried out in the water bodies (>10 ha) in Karnataka state using GPS and preliminary based map of water bodies. Throughout survey of two district of Haryana (Hissar with 151 village and Faridabad with 452 village) were performed with the help of GPS to prepare frame list of water bodies.

TECHNOLOGIES ASSESSED AND TRANSFERRED

Technology assessed and transferred	Site	Beneficiary	By the centre
Fisheries enhancements and Pen culture	Damal beel, Assam	Fishers, Fisher co - operative, AFDC, DoF	Regional Centre, Guwahati
Fisheries enhancements	Mahane Wetland, Uttar Pradesh	Fishers, DoF	Regional Centre, Allahabad
Fish culture	Janki chak seasonally flooded rice field, West Bengal	Fish farmers	CIFRI Barrackpore
Fisheries enhancements and Pen culture	Kanhiraphuza reservoir, Kerela	Fishers, DoF	CIFRI Station, Kochi
Fisheries enhancements	Pahuj reservoir, Uttar Pradesh Dahod reservoir, Madhya Pradesh	Fishers, DoF	CIFRI, Barrackpore
Fish seed production in cages	Pahuj reservoir, Uttar Pradesh Dahod reservoir, Madhya Pradesh	Fishers, DoF	CIFRI, Barrackpore

TRAININGS

Name of Programme	Participants	Place and Date
Inland Fisheries Development	5 Fisheries Officers from the State of Punjab	CIFRI, Barrackpore for, during 29 April - 3 May 2009
Administrative Rules and Procedures	Officers of CIFRI	CIFRI, Barrackpore for, during 29 April - 1 May 2009 by NAARM, Hyderabad
Administrative Rules and Procedures	Administrative staff of CIFRI	CIFRI, Barrackpore for, during 2-5 May 2009 by NAARM, Hyderabad
Administrative Rules and Procedures	Administrative staff of CIFRI	CIFRI, Barrackpore for, during 1-6 June 2009 by ISTM, New Delhi
National Fish Farmer's Day	25 progressive fish farmers	CIFRI, Barrackpore on 10 July, 2009
Rice fish farming	47 fish farmers from Kalna	Kalna, Burdwan on 17 Jul y, 2009
Seed Collection Technique	41 fish farmers	Tribeni, Hooghly on 27 July, 2009
Fish conservation	45 fish farmers	Frazergunj, South 24 Parganas during 5 August, 2009
NFDB sponsored on training on "Reservoir Fisheries Management"	15 Officers from six states	CIFRI Regional Centre Bangalore during September 7 -16, 2009
Catch Assessment Survey (IFMS) Software	Officers from different states	Hyderabad during 7-16 September 2009
Pen and Cage Culture in Inland Open Water	23 State fishery officers from nine states	CIFRI, Barrackpore during 9 -18 November, 2009
Floodplain wetland management	Faculty and Students of Cachar College, Silchar	NERC, CIFRI, Dispur, Guwahati, December 17-23, 2009
Fisheries Development	fish farmers from A&N islands	CIFRI, Barrackpore during January 7 -8, 2010
Inland fisheries development	30 fish farmers from Bihar	CIFRI, Barrackpore during 11 -20 March 2010
Management of *Chaur* (Wetland) for livelihood improvement"	12 fishers from Bihar	CIFRI, Barrackpore during 29-31 March 2010

MASS AWARENESS CAMPAIGNS

Name of Programme	Participants	Place and Date
Mass awareness campaign on conservation of Hilsa juveniles	33 fishers	Nabadwip, Nadia during 5 April 2009
Fish Conservation	42 fishers	Kachuberia, South 24 Parganas, West Bengal during 16 June 2009
Conservation of destruction of fish/shrimp juveniles	56 fish farmers	Kulpi, South 24 Parganas on 28 July, 2009
Destruction of fish/shrimp juveniles	62 fishers	Kulpi, South 24 Parganas, West Bengal during August 3 -6, 2009
Con servation of fishery	150 fishers	Frezargaunj, South 24 Parganas during August 4 - 6, 2009
Fish conservation	30 fish farmers	Jaleshwar, Orissa during August 20, 2009
Juvenile Hilsa fish destruction	52 fish farmers	Frezargaunj, South 24 Parganas on 23 September, 2009

EXHIBITIONS

Name of Programme	Venue
Fisheries Minister's Conference	Bhubaneswar during 4 -5 July,2009
INFISH 09 organized by NFDB	Hyderabad during July 11 -13, 2009
Aqua Fair' organized by the Directorate of Coldwater Fisheries Research (I CAR), Bhimtal	Nameri National Park in Sonitpur district of Assam during October 2 - 4, 2009.
National Expo XIII	Salt Lake during September, 2 - 6, 2009
Science & Technology fair -09	Salt Lake during November 20 - 30, 2009
Sundarban Krishi Mela – O-Loko Sanskriti Utsab	Kultali, South 24 Parganas, during December, 20 -21, 2009
Manmahan Mela 'O' Lok Sanskriti Utsab	Gaighata, North 24 Parganas during 3 -10 January 2010
Puspo 'O' Krishi Mela	Gaighata, North 24 Parganas during 4 -10 January 2010
Assam Matsya Mahotsav, 2010	January 30 to February 1, 2010

Prof. T. K. Sreshtha at CIFRI at Aqua Fair

Hon'ble Sri. Sharad Pawar at CIFRI Exhibition

AWARDS

Name(s) of personnel	Name of the Award/Recognition	Place & date
Ms. Anjana Ekka	Best Trainee Award	87 Foundation Course Training for Agricultural Research Service Training (FOCARS) at NAARM, Hyderabad
Dr. B. P. Mohanty	Professor E. P. Odum Go ld Medal for 2009 and Honorary Fellowship by the International Society for Ecological Communication for outstanding contribution in the field of Ecological and Environmental Sciences (Environmental Biotechnology)	Vinobha Bhabe University, Hazaribag, Jharkh and, India during 27-29 June, 2009
Dr. P. K. Katiha	Honorary Fellowship of International Society for Ecological Communication.	Vinobha Bhabe University, Hazaribag, Jharkhand, India
Dr. R. N. Seth	Charles Darwin Gold Medal along with Honorary Fellowshi p of the International Society for Ecological communications.	Vinobha Bhabe University, Hazaribag, Jharkhand, India during 27-29 June, 2009
Dr. S. N. Singh	Best Presentation Award for the paper, "Jalasaya Matsyiki Prabandhan Mein Pinjaro Mein Machchali Pa lan Ke Mahatva Ki Ek Vaighyanik Vivechana"	National Seminar on "Pinjaro Mein Machchali Palan' at CMFRI, Kochi.

Ms. Ekka honoured by Dr. Mrithyunjaya

Governor of Jharkhand honouring Dr. R. N. Seth

LINKAGES

The institute maintains close linkages with several national and international organisations involved in fisheries research and development. The institute collaborated with them in research, development, extension, outreach activities, seminars, workshops and publications. Key partners of the institute are:

International

- CGIAR Challenge Program on Water and Food, International Water Management Research Institute, Colombo
- International Food Policy Research Institute, Washington
- International Water Management Institute, Colombo,
- Lake Nasser Development Authority, Aswan, EGYPT
- National Institute Of Oceanography and Fisheries, Inland Water & Aquaculture Branch, Kanater Research Station, Cairo, Egypt
- University of Bergen, Dept. of Fisheries and Marine Biology, Bergen, NORWAY
- Water Research Institute, Achimota, Ghana
- World Fish Centre, Cairo, Egypt; and Penang, Malaysia

National

- All the State Department of Fisheries (DoFs),
- Barkatullah University, Bhopal,
- Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia,
- Bharatiya Agro Industries Foundation, BAIF (Bihar Programme),
- Bundelkhand University, Jhansi,
- Central Institute of Agricultural Engineering, Bhopal,
- Central Institute of Brackishwater Aquaculture, Chennai,
- Central Institute of Fisheries Education, Mumbai,
- Central Institute of Freshwater Aquaculture, Bhubaneswar,
- Central Marine Fisheries Research Institute, Kochi,
- Central Pollution Control Board, New Delhi,
- Central Potato Research Station, Patna,
- Central Rice Research Institute, Cuttack,
- Central Statistical Organisation, New Delhi,
- Chilka Development Authority, Bhubaneswar,
- Department of Animal Husbandry Dairying & Fisheries, Ministry of Agriculture, New Delhi,
- Directorate of Cold Water Fisheries Research, Bhimtal,
- DNGM Research Foundation, Kolkata,
- Fisheries Survey of India, Mumbai,
- ICAR Regional Centre for Eastern Region, Patna,
- Indian Agricultural Research Institute, New Delhi,
- Indian Agricultural Statistics Research Institute, New Delhi,
- Indian Grass and Fodder Research Institute, Jhansi,
- Indian Veterinary Research Institute (Eastern Regional Station), Kolkata,
- Inland Fisheries Society of India, Barrackpore,
- International Collective in Support of Fishworkers (ICSF) Trust, Chennai,
- Madras Veterinary College, TANUVAS, Chennai,
- Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya Chitrakoot, Satna,

- M. S. University of Baroda,
- Narmada Development Authority, Gandhi Nagar,
- National Academy of Agricultural Research Management, Hyderabad,
- National Agricultural Innovative Project, New Delhi,
- National Bureau of Agriculturally Important Micro-organisms, Mau,
- National Bureau of Fish Genetic Resources, Lucknow,
- National Centre for Agricultural Economics and Policy Research, New Delhi,
- National Fisheries Development Board, Hyderabad,
- National Hydro-Power Corporation, Ghaziabad,
- National Research Centre for Plant Biotechnology, New Delhi,
- National Research Centre for Groundnut, Junagarh,
- National Remote Sensing Agency, Hyderabad,
- National Sample Survey Organisation, New Delhi,
- Rajendra Agriculture University, Pusa, Samastipur,
- Sardar Sarovar Narmada Nigam Limited, Gandhinagar,
- Space Application Centre, Ahmadabad,
- Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar,
- Vidya Sagar University, Medenipur,
- West Bengal University of Animal & Fishery Sciences, Kolkata

PUBLICATIONS

Research papers

- Baruah, K., Pal, A. K., Sahu, N. P., Debnath, D., Yengkokpam, S., Norouzitallab, P. and Sorgeloos, P. 2009. Dietary crude protein, citric acid and microbial phytase interacts to influence the hemato-immunological parameters of rohu, *Labeo rohita*, juveniles. *Journal of the World Aquaculture Society* 40: 824-831.
- Bhaumik U., Singh, U. P and Paria, T. 2009. Ecology and management of the Dhara Reservoir, Uttaranchal for enhancing fish production. *Indian Journal of Fisheries* 56(3): 189-193.
- Das, B., Das, S. C., Manna, S. K. and Sarkar, P. 2009. Antimicrobial susceptibility of *Vibrio parahaemolyticus* isolated from fish and shellfish in Kolkata. *Journal of the Inland Fisheries Society of India* 41(1): 73-76.
- Das, D., Pal, S., Bhaumik, Utpal, Paria, T., Mazumder, D. and Pal, S. 2009. Modeling Fish catch in presence of Lunar Periodicity. *Journal of Interacademicia* 13(2): 206-215.
- Das, P., Behera, B. K. and Prakash N. 2009. Role of Bioremediation in Aquaculture Systems. *Fishing Chimes* 29(3): 44-47.
- Desai, V. R. and Shrivastava, N. P. 2009. Ravishankar Sagar reservoir (Chhattisgarh State)-impact of water level and monsoon inflow on its macrobenthos. *Fishing Chimes* November 2009: 20-21.
- Desai, V. R. and Shrivastava, N. P. 2010. Tawa reservoir (Madhya Pradesh) - Its cooperative fisheries development involving fishing community. *Fishing Chimes* 29(11): February 2010: 52-54.
- Dutta, R. and Bhattacharjya, B. K. 2009. A traditional fishing method of Assam for catfishes using duck meat as an attractant. *Indian Journal of Traditional Knowledge* 8(2): 234-236.
- Khan, Feroz M., Panikkar, P., Das, A. K., Manna, R. K. and Singh, D. N. 2009. Population dynamics of monsoon river prawn *Macrobrachium malcolmsonii* (Milne Edwards) in Wyra, a tropical reservoir in India. *Asian Fisheries Science* 22(4): 1201-1210.
- Khan, Feroz, M. and Panikkar, P. 2009. Assessment of impacts of invasive fishes on the food web structure and ecosystem properties of a tropical reservoir in India, *Ecological Modelling* 220: 2281-2290.
- Kolekar, V. 2008. An account of observations on fishing gears and crafts of Mandovi Estuary of Goa. *Journal of Inland Fisheries Society of India* 41(1): 41-46.
- Kolekar, V. 2009. Length-weight relationship, condition factor and food & feeding of *Harpodon nehereus* (Ham.) in Mandovi Estuary of Goa. *Journal of Indian Society of Coastal Agricultural Research in India* 27(1): 69-70.
- Kumar, R., Kushwaha, B., Nagpure N. S., Behera B. K., Srivastava S. K. and Lakra W. S. 2009. Physical maping of rRNA gene in endangered fish *Osteobrama belangeri* (Valenciennes, 1844) (Family: Cyprinidae). *Indian Journal of Experimental Biology* 47: 597-601.
- Mani, I., Kumar, R., Singh, M., Kushwaha, B., Nagpure, N. S., Srivastava, P. K., Murmu, K., Rao, D. S. K. and Lakra, W. S. 2009. Karyotypic diversity and evolution of seven mahseer species (Cyprinidae) from India. *Journal of Fish Biology* 75: 1079-1091.
- Manna, R. K. and Aftabuddin M. 2009. Comparative limno-chemical study of brush park (katal) and macrophyte free area in a wetland of Assam. *Environment and Ecology* 27 (4A): 1796-1800.
- Manna, R. K. and Aftabuddin, M. 2009. Impact of city sewage on selected water parameters of the sacred Basistha river along Guwahati city and Deepor beel, a Ramsar wetland. *Environment and Ecology* 27(4A): 1763-1766.

- Manna, R. K. and Bhattacharjya, B. K. 2009. Incorporation of new construction material into indigenous technological knowledge – A case study of V shaped fish trap of eastern India. *Indian Journal of Traditional Knowledge* 8(4): 848-850.
- Manna, R. K., Aftabuddin, M., Hassan, A. and Sarkar, A. 2009. Limno-chemical characteristics of a scroll meander depression in comparison with other sectors of a floodplain wetland of Assam, India. *Asian Fisheries Science* 22(1): 27-39.
- Manna, S. K., Manna, C., Batabyal, K., Das, B., Golder, D., Chattopadhyay, S. and Biswas, B. K. 2010. Serogroup distribution and virulence characteristics of sorbitol-negative *Escherichia coli* from food and cattle stool. *Journal of Applied Microbiology* 108: 658-665.
- Mishra, S. S., Brahmane, M. P., Mishra, S. K. 2009. PCR detection and DNA restriction profile analysis of *Vibrio parahaemolyticus* isolates. *Indian Veterinary Journal*. 86: 229-233.
- Mishra, S. S., Brahmane, M. P., Mishra, S. K. 2009. PCR detection and genomic characterization of *Aeromonas hydrophila* isolates. *Indian Veterinary Journal* 86: 1000-1003.
- Mohanty, S. and Mohanty, B. P. 2009. Global Climate Change: A cause of concern (*Science & Technology Policy Issue*) *National Academy Science Letters* 32 (5&6): 149-156.
- Palaniswamy, R. Manoharan, S. and Krishnakumar, P. K. 2009. Influence of Phosphorus on Phytoplankton diversity in a shallow eutrophic reservoir. *Asian Fisheries Science* 22: 505 -510.
- Panikkar, P. 2008. Characterising trophic interactions using mass balanced models to assess the impact of fishing ban on a reservoir ecosystem in India. *Journal of Inland Fisheries Society of India 40* (1: Special Issue): 1-7
- Paul, R. K., Prajneshu and Ghosh, H. 2009. GARCH nonlinear time series analysis for modelling and forecasting of India's volatile spices export data. *Journal of the Indian Society of Agricultural Statistics* 63(2): 123-131.
- Sahu, B., Behera, B.K., Singh, S. D. and Mohanta, K. N. 2009. Potential of Molecular Methods-for Seafood quality control. *Fishing Chimes* 29(7): 37-39.
- Sarma, K., Pal, A. K., Ayyappan, S., Das, T., Manush, S. M., Debnath, D. and Baruah, K. 2010. Acclimation of *Anabas testudineus* (Bloch) to three test temperatures influences thermal tolerance and oxygen consumption. *Fish Physiology and Biochemistry* 36: 85-90.
- Satpathy, B. B. and Ray, A. K. 2009. Effect of dietary protein and carbohydrate levels on growth, nutrient utilization and body composition in fingerling rohu, *Labeo rohita* (Hamilton). *Journal of Applied Ichthyology* 25: 728-733.
- Sukumaran, K., Pal, A. K., Sahu, N. P., Debnath, D. and Patro, B. 2009. Phosphorus requirement of catla (*Catla catla* Hamilton) fingerlings based on growth, whole-body phosphorus concentration and non-faecal phosphorus excretion. *Aquaculture Research* 40: 139-147.
- Vass, K. K., Das, M. K., Srivastava, P. K. and Dey, S., 2009. Assessing the impact of climate change on inland fisheries in River Ganga and its plains in India. *Aquatic Ecosystem Health & Management* 12 (2):138–151.

Abstracts/ Presentations in Conferences/Symposia/Seminars etc.

- Bhattacharjya, B. K., Chandra, G., Gogoi, P., Kolekar, V., Sarma, K. K., Yengkokpam, S. and Debnath, D. 2009. Dissemination of Scientific information through various media for conservation and sustainable use of fisheries resources of northeast India. *In:* Abstracts, 9th Indian Science Communication Congress 'Science Meets Communication'. December 20-24, 2009. pp. 33.

- Chandra, G., Bhattacharjya, B. K., Kolekar, V., Sarma K. K. and Gogoi, P. 2009. Dissemination of Scientific know-how for sustainable fisheries in Wetlands of Northeastern India: a comparative study of Media use by fishers and extension functionaries of Assam. *In:* Abstracts, 9th Indian Science Communication Congress 'Science Meets Communication'. December 20-24, 2009. pp. 34.
- Chandra, G. 2010. Success stories in Beels of Assam: CIFRI efforts. In: Proceeding of state level workshop on fisheries development through credit in Assam. NABARD, Assam Regional Office, Dispur, Assam. pp 44-47.
- Das, M. K. 2010. Climate change Impacts on Inland fisheries- Issues and strategies –Lead Papers, National Symposium on Climate Change and Rainfed Agriculture, February, 18-20, 2010, CRIDA, Hyderabad, India.
- Golder, D**.,** Manna, S. K., Samanta, S. and Maitra, N. 2009. Role of arsenic reducing bacteria in arsenic mobilization in aquatic environments. *In*: Abstracts, 'II National Seminar on Earthworm Ecology and Environment & IX National Symposium on Soil Biology and Ecology,' organized by Soil Testing Laboratory, Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati, Sriniketan-731236. p.69.
- Katiha, P. K., Sarkar, S.and Biswas, D. K. 2009. Valuation of ecosystem goods and services of a floodplain wetland in West Bengal. *In:* Abstract, 'National Seminar on Ecological Economics: An Approach towards Socio-Economic and Environmental Sustainability' during 30 September to 1 October 2009, at Centre for Ecological Economics and Natural Resource, Institute for Social and Economic Change, Bangalore.
- Katiha, P. K., Chakraborty, S., Chakraborty, C., Sarkar, S. and Ekka, A. 2009. "Livelihood issues associated with Fish Market and Industry in West Bengal" *In:* Abstract, National seminar on 'Fisheries Based Livelihoods in India: Present Status, Problems and Prospects.' The Livelihood School, Eastern India Region Centre, Kolkata.
- Maitra, N., Manna, S.K., Samanta, S., Banerjee, M. and Golder, D. 2010. Phosphate solubilizing bacteria in wetland ecosystems. *In*: Book of Abstracts, 'National Seminar on Recent Trends in Biotechnology,' organized by Department of Biotechnology, the University of Burdwan, Burdwan – 713 104. p.30.
- Maitra, N., Banerjee, M., Manna, S. K., Samanta, S. and Golder, D. 2009. Seasonal variation in Alkaline Phosphatase and Other Hydrolytic Enzymes in Water and Sediment in *beel*s in West Bengal. *In*: Abstracts, 'IInd National Seminar on Earthworm Ecology and Environment & IXth National Symposium on Soil Biology and Ecology,' organized by Soil Testing Laboratory, Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati, Sriniketan-731236. p.71.
- Manna, S. K. 2010. Microbes in aquatic environments under normal and pollution conditions. *In*: Souvenir, 'A one-day seminar and a state level poster competition on Recent Advancement of Biological Sciences and 1st Annual Convention of the BRSI-VU Unit Midnapore.' pp. 18-23.
- Manna, R. K., Aftabuddin, Md., Baruah, J., Islam, M. and Kolekar, V. 2009. Impact of aquatic macrophyte and river connectivity on fish diversity of floodplain wetlands of Dhubri districts of Assam, India. National symposium on Recent advances in biodiversity of Indian subcontinent. Zoological Survey of India, Kolkata (Ed. Director, ZSI). p.73
- Sharma**,** A. P., Katiha, P. K. and Suresh, V. R. 2010. Fisheries status and implications of property and management regimes on fisher's livelihoods in Ganges. *In:* Abstract, Seminar on 'Integrated Management of water resources with reference to biodiversity and livelihood.' Academy of Science, engineering and Technology, Bhopal during January 16-17, 2010

- Sharma, A. P., Katiha, P. K., Koshy. N and Prasad, S. (eds). 2010. Abstracts and selected readings. Workshop on Small indigenous freshwater fish species: Their role in poverty alleviation food security and conservation of biodiversity. ICSF Trust, Chennai and IFSI, Barrackpore. February, 2010.
- Singh, B. K. and Srivastava, K. 2010. Amazing algal food *Spirulina platensis.* National Symposium on Health and Sanitation: Rural perspective 7-8 Feb 2010, Organised by Institute of Applied Sciences, Allahabad, Abst p. 52.
- Singh, B. K. and Srivastava, K. 2010. Limnological studies of Jarmorhara reservoir, In 12th Agricultural Farmers and Scientist Congress, 20-21 Feb, Allahabad, p. 96.
- Srivastava, K. and Singh, B. K. 2010. On the bloom of blue green algae in fresh water lakes, National Symp. on Health and Sanitation: Rural perspective, 7-8 Feb 2010, Organised by Institute of Applied Sciences, Allahabad, Abst. p. 66.

Technical Bulletin/Training Manual/ Policy Paper/ Book/ Book Chapter/ Popular Articles

- Bhattacharjya, B. K. and Sharma, A. P., 2010. Factors affecting abundance of fish stocks in Brahmaputra river. *In*: Haque, I. and Dutta, A. C. (eds.), Souvenir of Assam Matsya Mahotsav 2010, January 30-February 1, 2010. Department of Fisheries, Govt. of Assam, Guwahati. pp. 28-32.
- Bhaumik, U. and Paria, T. 2010. Review of Eco-dynamics of the Floodplain Wetland (Beel) Ecosystem and Strategy for Enhancing the Fish Production, In: Vijaykumar, K and Vasanthkumar B, Ed. *Aquatic Ecosystem and its Management,* Daya Publishing House.; 388-440.
- Chandra, G. and Debnath, D. 2009. Floodplain Wetland Management, Training Manual No. 6, Central Inland Fisheries Research Institute, Regional Centre, Housefed Complex, Dispur, Guwahati. 133 p.
- Das, A. K., Vass, K. K., Shrivastava, N. P. and Katiha, P. K. 2009. Cage culture in Indian reservoirs. CIFRI, Barrackpore.
- Das, A. K., Vass, K. K., Shrivastava N. P. and Katiha P. K.. 2009. Cage Culture in Reservoirs in India. (A Handbook), WorldFish Center Technical Manual No. 1948. The WorldFish Center, Penang, Malaysia. 24 p.
- Das, M. K. 2009**.** Impact of recent changes in weather on Inland fisheries in India. In Aggarwal, P.K. (ed) Global Climate change and Indian Agriculture- Case studies from the ICAR Network Project. Published by Project Director (DIPA), Indian Council of Agricultural Research, New Delhi. pp.101-103.
- Khan, Feroz M. 2009. Inland fishing crafts, gears and harvesting methods with special reference to reservoir fishing. In. *Reservoir Fisheries Management. Training Manual* (Eds. M. Feroz Khan and Preetha Panikkar), Central Inland Fisheries Research Institute, Barrackpore.
- Khan, Feroz M. 2009. Dynamics of fish populations. In. *Reservoir Fisheries Management. Training Manual* (Eds. M. Feroz Khan and Preetha Panikkar), Central Inland Fisheries Research Institute, Barrackpore.
- Manna, S. K. 2010. Microbes in aquatic environments under normal and pollution conditions. *In*: Souvenir, A one-day seminar and a state level poster competition on Recent Advancement of Biological Sciences and 1st Annual Convention of the BRSI-VU Unit Midnapore. pp. 18-23.
- Manna, R. K., Aftabuddin, Md., Gogoi, A., and Kolekar, V. 2010. Role of aquatic macrophyte type on fish biodiversity in floodplain wetlands of Barpeta district of Assam. In: Biodiversity and Human Welfare (Eds. U.C. Goswami, D.K.Sharma, J. Kalita and P.K. Saikia), 2010, Narendra Publishing House, New Delhi.

- Manna, R. K., Aftabuddin, M., Rahman, A., Gogoi, P. and Kolekar, V. 2010. Role of aquatic macrophyte type on fish biodiversity in floodplain wetlands of Barpeta district of Assam. In: U.C. Goswami, D.K. Sharma, J. Kalita and P.K. Saikia (Eds),ÊBiodiversity and Human Welfare. Narendra Publishing, 478 p.
- Mohanty, B. P., Behera, B. K. and Sharma, A. P. 2010. Nutritional Significance of Small Indigenous Fishes in Human Health. *CIFRI Bulletin No. - 162.*
- Katiha, P. K. 2009. Economics of pen and cage farming in Indian reservoirs. *In*: Das, A. K. and Saha P. K. (eds). Training Manual for NFDB sponsored training programme on "Pen and cage culture in inland waters". Central Inland Fisheries Research Institute, Barrackpore pp 131-137.
- Katiha, P. K. 2010. Socio-economic aspects in Inland fisheries. *In*: Katiha P. K., Vass, K. K., Sharma, A. P., Bhuamik, U. and G. Chandra. (eds), Issues and tools for social sciences research in inland fisheries. Bulletin 163, Central Inland Fisheries Research Institute, Barrackpore pp 46-59.
- Katiha, P. K. 2010. Issues in fisheries policy research. *In*; Katiha P. K., Vass, K. K., Sharma, A. P., Bhaumik, U. and G. Chandra. (Eds), Issues and tools for social sciences research in inland fisheries. Bulletin 163, Central Inland Fisheries Research Institute, Barrackpore, pp 133-148.
- Katiha, P. K., Vass, K. K., Das, A. K. and Shrivastava, N. P. 2009. Improved productivity of reservoir fisheries in India, Central Inland Fisheries Research Institute, Barrackpore, 98 p.
- Khan, M. Feroz. 2009. Dynamics of fish populations. In. *Reservoir Fisheries Management. Training Manual* (Eds. M. Feroz Khan and Preetha Panikkar), Central Inland Fisheries Research Institue, Barrackpore
- Khan, M. Feroz. 2009. Inland fishing crafts, gears and harvesting methods with special reference to reservoir fishing. In. *Reservoir Fisheries Management. Training Manual* (Eds. M. Feroz Khan and Preetha Panikkar), Central Inland Fisheries Research Institute, Barrackpore
- Krishna Rao, D. S. 2010. Reservoir Fisheries management. In vernacular Kannada daily Vijaya Karnataka. 1 February 2010.
- Krishna Rao, D. S. and Karthikeyan, M. (eds.) Eco-friendly management of reservoirs - Kannada language
- Moza, U. and Mishra, D. N. 2009. River Beas, Ecology and Fisheries. Bulletin 159, CIFRI, Barrackpore, 55 p.
- Panikkar, P. and Feroz Khan, M. 2009. Tropho-dynamic modeling for ecosystem based fisheries management. *In*: Modelling, Forecasting, Artificial Neural Network and Expert System in Fisheries. Eds. A.K. Roy and N. Sarangi. pp 148-154.
- Pathak, V. and Tyagi, R. K. 2010. Riverine ecology and fisheries vis-à-vis hydrodynamic alterations: Impacts and remedial measures, *CIFRI Bull.,* 161, pp. 35.
- Rani Palaniswamy, 2009. Fisheries management in small reservoirs - case studies. Training manual on Reservoir Fisheries Management, CIFRI, Bangalore.
- Rani Palaniswamy, 2009. Prospects of pen culture in reservoirs. Training manual on Reservoir fisheries management, CIFRI, Bangalore.
- Sharma, A. P. and Katiha, P. K. 2009. Research issues and strategies for inland fisheries development: The role of CIFRI. *In*: Souvenir, PFGF's VII Annual National Meet – 2009, (Eds) Riji John *et al*., PFGF Mumbai, pp 51-58.
- Sharma, A. P. and Katiha, P. K. 2009. Prospects of enhancing rural livelihoods through eco-friendly fish production in Indian reservoirs. *In*: Souvenir, National seminar on bio-resources and its management for food, livelihood and environment security and National Helminthological Congress, 20th All India Congress of Zoology, (Eds) Purushothaman, C.S. *et al*., CIFE, Mumbai, pp 48-55.

- Singh, B. K. and Srivastava, K. 2009. Periphyton of river Tons. *In*: Water: Ensuring safety and management. (eds) F. Rizwi and A. Pant, The Institute of Applied Sciences, p. 60-62.
- Singh, S. N. 2009. River Narmada: Its environment and Fisheries, Bulletin 157, CIFRI, Barrackpore, 64 p.
- Shrivastava, N. P., Jha, B. C., Nath, D. and Karmakar, H. C. 2009. Krishna Estuary - Ecology and Fisheries. Bull. No.158. CIFRI, Barrackpore. p 22.
- Shrivastava, N. P. 2009. Jalashayon main matsya utpadan (in Hindi). *Kheti*: 21-24, & 36.
- Tyagi, R. K. 2009. Socio-economic status of fishers of river Ganga, CIFRI Bull., 160, pp. 55.
- Vass, K. K., Shrivastava, N. P., Katiha, P. K. and Das, A. K.. 2009. Enhancing fishery productivity in small reservoir in India. A Technical Manual. WorldFish Center Technical Manual No. 1949. The WorldFish Center, Penang, Malaysia. 19 p.
- Vass, K. K., Shrivastava, N. P., Katiha, P. K. and Das, A. K. 2009. Enhancing fishery productivity in small reservoir in India. A Technical Manual. WorldFish Center. Technical Manual No.1949. The WorldFish Center, Penang, Malaysia. 19 pp.
- Vass, K, K., Bhattacharjya, B. K., Chandra, G., Das, M. K., Debnath, D., Katiha, P. K., Pathak, V., Samanta, S., Shrivastava, N. P., Suresh, V. R. and Tyagi, R. K. 2009. Fish and fisheries in the Indian part of the Ganga-Brahmaputra river basin and strategies for the conservation and rehabilitation of their habitats: Draft status paper. Regional scoping workshop on "Development of habitat conservation and mitigation measures for ensuring sustainable fisheries in the Ganga Brahmaputra basin" organized by FAO-NIE-ICAR at New Delhi. FAO, Rome.

CONSULTANCY PROJECTS

Projects	Sponsors
Down-stream fishery development in Sardar Sarovar	Narmada Development Authority
Study of migration of fishes in the river Subansiri and creation of fish hatchery	National Hydro-Power Corporation
Study on enviro nmental flow (Biological component) Teesta, Sikkim	National Hydro-Power Corporation
Assessment of fisheries with regard to water quality of rivers Ganga and Yamuna.	Central Pollution Control Board
Biodiversity of fin and shell fish rivers of Madhya Pradesh	Government of Madhya Pradesh
Assessment of fisheries and fish yield potential of Chilka lagoon	Chilka Development Authority

MEETINGS

Post Aila Brainstorming on Sunderbans

A brainstorming session on alternative livelihood option for fishers folk of Sunderbans was held on 24 April, 2009 at Sunderban, Dhamakhalli jointly sponsored by the Faculty of Fisheries Science (WBUAFS) and Sunderban Development Board. Dr. S. Ayyappan, Deputy Director General (Fy), ICAR was the Chief guest and Dr. K. K. Vass, Director, CIFRI was Special guest. Prof. C.S. Chakarborti, Vice Chancellor, WBUAFS presided over the function. Scientist, NGOs, Farmers, fishers and other Government officials deliberated on issues pertaining to improvement of livelihood of fishers of Sunderbans and a work plan for implementation of the recommendation was developed.

NHPC Subansiri consultancy project

A meeting of the NHPC Subansiri consultancy project 'Study on migration of fishes in the river subansiri and creation of fish hatchery" was organized on April 28, 2009 at CIFRI Regional Center, Guwahati to finalize the draft report. Dr. K. K. Vass, Director, CIFRI, other scientists of the project and Mr. Vipin Kumar, CE (Environment) and Mr. B. Kumar from NHPC, Lower Subansiri Hydro Electric Power Project participated in the discussions. The report was discussed and necessary suggestions made for its finalization.

Final Workshop of International project on reservoir fisheries

CIFRI successfully completed prestigious CGIAR Challenge Program on Water and Food project on "Improved Fisheries Productivity and Management in Tropical Reservoirs". Final workshop of the project was held at CIFRI, Barrackpore on May 26, 2009. The workshop was attended by Dr. S. Ayyappan, DDG (Fy), ICAR, New Delhi; Dr. V. V. Sugunan, ADG (Fy), ICAR, New Delhi, Shri R. Pattar, Director (Finance), ICAR, New Delhi, Dr. G. N. Sai, Executive Director, NFDB, Hyderabad, project partners from Bundelkhand and Barkatullah Universities and Departments of Fisheries of the States of Uttar and Madhya Pradesh.

Release of project documents

The core team of the project

The project publications including manuals, guidelines, pamphlets and CDs were released at the workshop. The Project scientists and research staff shared the project achievements with the delegates. The delegates elaborately discussed the achievements and future course of action of reservoir fisheries development in the country. Dr. Ayyappan expressed great satisfaction on the outcomes of the project and stressed on wide publicity, and scaling up and out the project achievements.

Review of other foreign aided projects

CIFRI convened Fisheries Division meeting to review the progress of foreign aided projects. It was held at Barrackpore on 27 May 2009. Dr. S. Ayyappan, DDG (Fy), ICAR chaired the meeting. Dr. V. V.Sugunan ADG (I Fy), Dr. A. E. Ekanath, Director, CIFA, Shri R. Pattar, Director Finance, ICAR also attended the meeting. The progress of foreign aided projects executed at Central Institute of Fisheries Education, Mumbai, Central Institute for Brackishwater Aquaculture, Chennai; Central Institute for Freshwater Aquaculture, Bhubaneswar and Central Inland Fisheries Research Institute, Barrackpore was presented by the principal investigators at the workshop. Dr. S. Ayyappan expressed satisfaction for the high level of performance and quality output of these projects.

NFDB/CIFRI initiative on reservoir fisheries development

NFDB orientation workshop on "Fisheries development on Reservoirs" was organized in collaboration with Tamil Nadu Fisheries Development Corporation, Coimbatore on 13-14 June, 2009 at Coimbatore. The workshop was attended by high officials from ICAR, NFDB, Department of Fisheries of the states of Maharashtra, Karnataka , Andhra Pradesh, Tamil Nadu, Gujarat, Rajasthan, Jharkhand, West Bengal, Chattisgarh, Orissa; Damodar Valley Corporation, Tamil Nadu Fisheries Development Corporation, *etc.* CIFRI provided the technical expertise in the workshop and shared practical experiences reservoir fisheries development with the delegates. All the orientation presentations were very interactive and created lots of interest among the NFDB and state officials.

Summer School on "Cage and pen culture in inland waters"

ICAR sponsored summer school on "cage and pen culture in inland waters" during August 18- September 07, 2009 at was attended by 20 participants from the state Gujarat, Punjab, Uttrakhand, Bihar, West Bengal, Assam, Arunachal Pradesh, Mizoram, Tripura, Karnataka and Tamil Nadu belonging to two ICAR institutes, nine universities, three Krishi Vigyan Kendras and one State Department of Fisheries. The trainees were exposed to various technical aspects of cage and pen culture and hand on field exercises at Mathura *beel*, and Poka bundh in West Bengal. The school was appreciated at various quarters of fisheries research and development.

Inaugural Session of Summer School

NAIP workshop on Procurement and Financial management

CIFRI has organised NAIP workshop on Procurement and Financial management held at CIFRI on 12-13 October, 2009. The workshop was for the Project CCPIs of eastern and North-eastern region. The CCPIs of most of the NAIP projects in the states of West Bengal, Orissa, Assam, Mehgalaya, Sikkim and other North-eastern states participated in the workshop. The experts from finance and accounts briefed the participants about the NAIP and ICAR norms for Procurement and Financial Management.

The workshop in progress

Mid-term review of DARE/ICAR for XI Five Year Plan

The Mid-term review meeting of DARE/ICAR for XI Five Year Plan was organized by CIFRI, Barrackpore at IndiSmart Hotel, Kolkata on 30 October 2009. The participants of the meeting were from Planning Commission and Central Research Institutes, State Agriculture Universities, Private Sector and other institutions located in eastern and north-eastern region of the country. The meeting was chaired by Dr Kasturi Rangan, Hon'ble Member, Planning Commission. The progress of the current Five Year Plan was assessed. The meeting concluded on: i) Good potential for agriculture with good soils and water availability; ii) Lot of scope for co-ordination among institutions of the region to work together/collaboration for the common goal of agriculture growth and improving quality of education; iii) One concept note may be prepared with lead from AAU for establishment of Inter-university Advanced

A session on progress

Dr. Vass briefed the Chairman about CIFRI

Centre for agriculture and consortium of all universities for nano-science; iv) Research focus on horticulture, agriculture crops, animal, fishery, jute and allied science, Yak, Mithun and gender in agriculture; v) Issues of land use, water quality, biodiversity, climate change, remote sensing, biotechnology, nanotechnology should be given priority; vi) Seed certification and quality should get more emphasis in research.

Institute Management Committee meeting

38th Institute Management Committee meeting

The 38th Meeting of the Institute Management Committee of the CIFRI was held at Barrackpore on 16 November, 2009. The meeting was chaired by Dr. K.K. Vass, Director and attended by representatives from ICAR Fisheries Division - Dr. V.V. Sugunan, Assistant Director General (I.Fy.) and Dr. Usha Moza, Principal Scientist, Prof. A. P. Sharma, Dean, College of Fisheries, G.B. Pant University of Agriculture and Technology, Pantnagar and other members. The Chairman briefed the members regarding the achievements made by the Institute under different Research Projects. The Committee discussed the agenda items for different administrative and financial items. Progress of civil works since last meeting was also reviewed.

Regional consultation on preparation of management Plan for Hilsa Fisheries

Regional consultation on preparation of Management Plan for Hilsa fisheries was held on 1st February 2010 at Central Inland Fisheries Research Institute, Barrackpore, Kolkata. The programme was attended by Dr. Y. S. Yadava, Director, BOBP-IGO, Chennai and many Scientists of CIFRI and Officers from State Fisheries Department. The meeting reviewed the information on distribution, biological status, migratory behavior, habitat ecology, fishery and its natural recruitment which are directly or indirectly effecting the sustainable development of Hilsa fisheries in India as presented by Indian Representatives.

Regional consultation in progress

Regional Advisory Commttee meeting

Research Advisory Committee meeting

The meeting of CIFRI Research Advisory Committee (RAC) was convened during 7-8 February, 2010 in Barrackpore and was attended by Dr. M. V. Gupta, the Chairman , RAC and members, besides, Dr. A. P. Sharma, Director CIFRI, Heads of Division and PI and Co-PIs of different projects from Head quarter and outstations. Dr. M.K. Das, Member Secretary, RAC, presented the Action Taken Report on the recommendations of RAC for the year 2009-2010. After this brief discussion on ATR it was accepted by the RAC. Dr. Sharma, briefed the activities and achievements of the Institute during the period. After his presentation division wise progress for current period was presented by respective Heads of Division/ Programme Co-ordinators. The Committee was satisfied with the progress of the research conducted, but opined that scope exists for improvements and made number of suggestions.

NAIP Workshop on Arsenic contamination and its mitigation strategies

Inaugural session of workshop

A workshop was organized on “Arsenic contamination and its mitigation strategies” sponsored under NAIP project on “Arsenic in food-chain: Cause, Effect and Mitigation” at Central Inland Fisheries Research Institute, Barrackpore during February 11 - 12, 2010. Prof. A. P. Sharma, Director, CIFRI; Prof. Saroj Kumar Sanyal, Vice-Chancellor, BCKV; Dr. D. N. Guha Mazumder, Director, DNGM Research Foundation, Dr. B. S Mahapatra, Director, CRIJAF, Consortium Advisory Committee Members- Dr. S. Bandopadhyay, Head, Ceramic Membrane Division, CGCRI, Dr. J. K. Malik, Joint Director (Research), IVRI, Dr. A. K. Giri, Deputy Director, IICB, Prof. A. Santra, IPGMER, Kolkata, Prof. S. C. Santra, Department of Environmental Science, Prof. Supradip Sarkar, BCKV, CPI of the project and all the CCPIs including Prof. S. Sarkar, WBUAFS; Dr. A. K. Bera, IVRI, ERS; Dr. D. Mukherjee, UBKV and Dr. S. Samanta attended the workshop. Prof. Sharma focused on the scope of the workshop with detailed information on its present status in the state. Prof. Sanyal presented a brief account on the arsenic problem emphasizing its widespread distribution and adverse effect on the common mass. Dr. D. N. Guha Majumdar made the keynote address highlighting the factors responsible for this severe menace. Dr. A. K. Giri in his lecture on “Arsenic Induced Health Effects, Genetic Susceptibility and Its Preventive Measures” highlighted various significant findings on arsenic induced genetic damage and carcinogenicity in exposed individuals. He informed that arsenic can even induce anemia and can cause immunological changes in exposed individuals. He stressed on the issue that rice is found to be a major route of chronic exposure to arsenic and also gives rise to significant DNA damage and suggested that supply water by treatment plants could a safe option for arsenic mitigation.

Inaugural session of workshop

Technical session

Workshop on "Small Indigenous Freshwater Fish Species (SIFFS)"

The International Collective in Support of Fishworkers (ICSF) and Inland Fisheries Society of India (IFSI) have organized a Workshop on "Small Indigenous Freshwater Fish Species (SIFFS): Their Role in Poverty Alleviation, Food Security and Conservation of Biodiversity", from 23-25 February 2010 at the Central Inland Fisheries Research Institute (CIFRI), Barrackpore, West Bengal, India. It brought together about 60 people from the fisher and aquaculturist community, concerned central and state government departments, NGOs, environmental groups, researchers and experts from India and abroad. The workshop included a field trip to visit farmers practicing culture of small indigenous freshwater fish species along with polyculture of carps, and engaged in conservation of the small indigenous freshwater fish species. The workshop has formulated the road map for fisheries development of SIFFS in the country and addressed the related policy and other issues to provide congenial environment for the development.

PARTICIPATION OF SCIENTISTS IN CONFERENCES, MEETINGS, WORKSHOPS, SYMPOSIA

Participation of Scientists in Meetings/ Workshops Abroad

Name(s) of personnel	Name of the meeting/ workshop / conference/ training programme	Place & date/duration
Dr. A. K. Das, Dr. K. K. Vass, Shri N. P. Shrivastava, Dr. P. K. Katiha	Final Restitution/Wrap Up Meeting of CPWF Project "Improving Fish Productivity and Management In Tropical Reservoirs"	Aswan, Egypt, 3-7 May 2009
Shri M. Karthikeyan	Meetings of Indian Experts on Fishery and Aquaculture Statistics with Officials of Food and Agricultura l Organisation (FAO)	Rome, Italy, 14-18 December 2009

Participation of Scientists in Conferences, Meetings, Workshops, Symposia, *etc*. in India

Name(s) of personnel	Name of the meeting/ workshop / conference/ training programme	Place & date/duration
Dr. A. K. Das	Final Restitution/Wrap Up Meeting of CPWF Project "Improving Fish Productivity and Management In Tropical Reservoirs"	Aswan, Egypt, 3 - 7 May 2009
	Final Workshop of the CGIAR - CP Water & Food Project	CIFRI, Barrackpore, 26 May 2009
	Review of Foreign Aided Projects in ICAR Fisheries Division	CIFRI, Barrackpore, 27 May 2009
	NFDB Sponsored orientation workshop for fisheries development in reservoirs	Coimbatore, 13 - 14 June 2009
	NFDB sponsored Training programme on "Reservoir Fisheries M anagement"	CIFRI Bangalore, 7 - 16 September 2009
	Mid-term Review Meeting of XI Five Year Plan of DARE/ICAR for Eastern and North - eastern region	CIFRI, Kolkata, 30 October 2009
Dr. A. K. Sahoo	Mid-term Review Meeting of XI Five Year Plan of DARE/ICAR for Eastern and North - eastern region	CIFRI, Kolkata, 30 October 2009
Ms. Anjana Ekka	Workshop on "Fisheries Based Livelihoods in India: Present Status, Problems and Prospects"	NBSSLUP, Kolkata, 28 - 29 November 2009
Dr. Aparna Roy	Television talk on "Importance of participatory problem identification in Kankutia village of Birbhum District"	Telecasted on Kolkata Doordarsan, 2 September 2009
Prof. A. P. Sharma	National Seminar on "Integrated Management of water Resources with Reference to Biodiversity and Livelihood"	Regional Museum of Natural History, Bhopal 16 - 17 January, 2010
	Meeting of ICAR Divisions	Krishi Bhavan, New Delhi 29 - 30 January, 2010
	Meeting of Ministers of State for Agriculture	Krishi Bhavan, New Delhi February 5 - 6, 2010
	ICAR Direc tors' Meeting	Krishi Bhavan February 15 - 16, 2010

Name(s) of personnel	Name of the meeting/ workshop / conference/ training programme	Place & date/duration
	FAO – NFDB Consultative Meeting on Development of Fisheries Sector in India	NFDB, Hyderabad, 23-25 March 2010
Dr. B. C. Jha	Mid-term Review Meeting of XI Five Year Plan of DARE/ICAR for Eastern and North-eastern region	CIFRI, Kolkata, 30 October 2009
	FAO – NFDB Consultative Meeting on Development of Fisheries Sector in India	NFDB, Hyderabad, 23-25 March 2010
Dr. B. K. Bhattacharjya	Meeting for Finalization of Draft Fisheries Policy of Assam	Guwahati, 3 August 2009 and 30 October 2009
	Regional Consultative Workshop organized by CIFA, Bhubaneswar	Shillong, 16-17 September 2009
	Live (Phone-in) programmes on Fisheries	'Krishi Darshan' Door Darshan Kendra, Guwahati on 11.09.09
	19th Meeting of the ICAR Regional Committee No. III	Gangtok, 23-24 October 2009
	Seminar-cum-workshop on "Investment in Fisheries" organized by Assam Fisheries Investment Facilitation Centre, Govt. of Assam	Guwahati, 29 October 2009
	FAO-NIE-ICAR Regional Scoping Workshop on "Development of Habitat Conservation and Mitigation Measures for Ensuring Sustainable Fisheries in the Ganga-Brahmaputra Basin"	NASC, New Delhi, 17-20 November 2009
	"State Level Workshop on Fisheries Development through Credit in Assam"	NABARD, Guwahati, 9 March 2010.
Dr. B. K. Behera	ICAR Zonal Technology Management and Business Planning and Development Meeting-cum-workshop	IINRG, Ranchi, 19-20 February 2010
Dr. B.K. Singh	National Symposium in "Health and Sanitation: Rural Perspective"	Institute of Applied Sciences, Allahabad, 7-8 February 2010
	12th Agricultural Farmers and Scientists Congress	Bioved Research Society, Allahabad, 20-21 February 2010
Dr. B. P. Mohanty	International Conference on "Recent Trends in Life Science Researches vis-à-vis Natural Resources Management, Sustainable Development and Human Welfare"	Vinobha Bhabe University, Hazaribag, 27-29 June 2009
	ICAR and IFCPAR sponsored Indo-French Seminar on "Recent Advances in Aquaculture"	Bhubaneswar, 30 - 31 August 2009
	Interface Meeting of Scientists in Nutrition, Biochemistry and Physiology in Fisheries and Researchers	NIANP Bangalore, 19 October 2009
	National Conference on "Biodiversity and Physiology of Aquatic Resources in Sustainable Development for Rural Development"	Dr Babasaheb Ambedkar Marathwada University, Aurangabad, 24-25 October 2009
	Mid-Term Review (MTR) Meeting of the Outreach Activity on Nutrient Profiling and Evaluation of Fish as a Dietary Component	CIBA, Chennai, 19 November 2009.

Name(s) of personnel	Name of the meeting/ workshop / conference/ training programme	Place & date/duration
	5th AOHUPO (Asia - Oceanic Human Proteome Organizatio n) Congress/ 14th ADNAT (Association for the Promotion of DNA Fingerprinting and other DNA Technologies)/1st PSI (Proteomics Society India)	CCMB, Hyderabad, 22 - 25 Feb 2010
Dr. D. S. K. Rao	NFDB sponsored Training programme on "Reservoir Fisheries Manage ment"	CIFRI Bangalore, 7 - 16 September 2009
	Workshop on "Leader transition to NAIS"	NAARM, Hyderabad, 7 - 21 November 2009
	Planning Commission Interface with ICAR Institutes	Bangalore, 16 December, 2009
Dr. Dipesh Debnath	National workshop on "Adv ances in Aquaculture and Fisheries: Perspectives, Prospects and Challenges" (ILDEX 2009)	Pragati Maidan, New Delhi on 03 July 2009.
Mr. Feroz Khan, M	Indian Fish Festival, INFISH 2009	NFDB, Hyderabad, 11 - 13 July 2009
	NFDB sponsored Training programme on "Reservoir Fisheries Management"	CIFRI Bangalore, 7 - 16 September 2009
	FAO – NFDB Consultative Meeting on Development of Fisheries Sector in India	NFDB, Hyderabad, 23 - 25 March 2010
Miss. G. K. Vinci	Mid - term Review Meeting of XI Five Year Plan of DARE/ICA R for Eastern and North - eastern region	Hotel Indi Smart Kolkata, 30 October 2009
Dr. Ganesh Chandra	National Symposium on "Coldwater fisheries management: new strategies and approaches"	Directorate of Coldwater Fisheries Research, Nameri National Park Assam, 2 - 4 October 2009
	"State Level Workshop on Fisheries Development through Credit in Assam"	NABARD, Guwahati, 9 March 2010.
Dr. K. K. Vass	Meeting of Central Pollution Control Board	IWM, New Delhi, 4 - 8 April 2009
	BCKV Convocation	BCKV, Mohanp ur, 9 April 2009
	WBUAFS Convocation	Kolkata, 16 April 2009
	Meeting of NHPC authorities	Guwahati, 28 April 2009
	Final Restitution/Wrap Up Meeting of CPWF Project "Improving Fish Productivity and Management In Tropical Reservoirs"	Aswan, Egypt, 3 - 7 Ma y 2009
	Discussion meeting at Planning Commission	Planning Commission, New Delhi, 18 May 2009
	Chief Guest on International Day for Biodiversity	Zoological Survey of India, Alipore, 22 May 2009
	47th meeting of the Executive Council of WBUASF	WBUASF, Kolkata, 25 May 2009
	Final Workshop of the CGIAR - CP Water & Food Project	CIFRI, Barrackpore, 26 May 2009
	Review of Foreign Aided Projects in ICAR Fisheries Division	CIFRI, Barrackpore, 27 May 2009

Name(s) of personnel	Name of the meeting/ workshop / conference/ training programme	Place & date/duration
	Meeting of Water Commission of India	New Delhi, 28 May 2009
	213th ICAR Governing Body meeting	NASC Complex, New Delhi, 2 June 2009
	48th meeting of the Executive Council of WBUASF	WBUASF, Kolkata, 24 June 2009
	209th (Adj.) meeting of the Executive Council of BCKV, Mohanpur	NBSSLUP, Kolkata, 26 June 2009
	Fisheries Minister's Conference	Bhubaneswar, 4 - 5 July 2009
	Technical Session on Reservoir Fisheries Management : Potentials and Issues in management of reservoirs	Hyderabad, 12 July 2009
	ICAR Foundation Day	NASC Complex, New Delhi, 16 July 2009
	National meet on Conservation Agriculture	NASC complex, New Delhi, 17 July 2009
	Workshop for Convergence of NREGA with the Fisheries Sector under Ministry of Rural Development, Govt. of India	New Delhi, 29 July 2009
	Joint Project discussion with NIH, Roorkee	NHPC Office, Faridabad, 6-7 August 2009
	ICAR of Chair's of QRTs, RACs and Director's of Fisheries Research Institutes of ICAR .	CMFRI, Kochi, 19- 22 August 2009
	214th meeting of Governing Body of ICAR Society	NASC Complex, New Delhi, 27 August 2009
	National Seminar on Enhancing Agricultural Productivity and Profitability	CMFRI, Kochi, 29- 30 August 2009
	Mid-term Review Meeting of XI Five Year Plan of DARE/ICAR for Eastern and North-eastern region	Kolkata, 30 October 2009
	4th National Conference on KVK- 2009	TNAU, Coimbatore, 7 November 2009
	Research Advisory & Monitoring Committee (RAMC) of the Botanical and Zoological Surveys	New Delhi, 8 November 2009
	Inauguration of Winter School	CIFT, Cochin, 12 November 2009
	FAO -NIE-ICAR Regional Scoping Workshop on "Development of Habitat Conservation and Mitigation Measures for Ensuring Sustainable Fisheries in the Ganga - Brahmaputra Basin"	NASC, New Delhi, 17- 20 November 2009
Dr. (Mrs.) Kalpana Srivastava	National Symposium in "Health and Sanitation: Rural Perspective"	Institute of Applied Sciences, Allahabad, 7 -8 Feb 2010,
	12th Agricultural Farmers and Scientist Congress	Bioved Research Society, Allahabad, 20 - 21 February 2010
Dr. M. K. Das	FAO – NFDB consultative meeting on Development of Fisheries Sector in India	NFDB, Hyderabad, 23- 25 March 2010

Name(s) of personnel	Name of the meeting/ workshop / conference/ training programme	Place & date/duration
Shri M. Karthikeyan	NFDB sponsored Training programme on "Reservoir Fisheries Management"	CIFRI Bangalore, 7 - 16 September 2009
	National Workshop on "Sampling Methodology to Survey Socio - economic Conditions of Fi shers and Fish Farmers in India"	CIBA, Chennai, 13 November 2009
Dr. M. P. Brahmane	Workshop and brainstorming on "Bioinformatics applications in fish/shellfish genomics"	CIFA, Bhubaneshwar, 12 -13 January 2010
Shri N. P. Srivastava	Final Restitution/ Wrap Up Meeting of CPWF Project "Improving Fish Productivity and Management In Tropical Reservoirs"	Aswan, Egypt, 3 -7 May 2009
	Final Workshop of the CGIAR -CP Water & Food Project	CIFRI, Barrackpore, 26 May 2009
	Review of Foreign Aided Projects in ICAR Fisheries Division	CIFRI, Barrackpore, 76 May 2009
	NAIP Training/Workshop on "To familiarize with procurement related matters and financial management"	CIFRI, Barrackpore, 12 -13 October 2009
	Second Regional Consultation on Preparation of management plan for hilsa fisheries under BOBP -IGO programme	CIFRI Barrackpore, 01 February 2010
	Stakeholder Consultation on a vision document for the Ganga - Sundarbans Delta by WWF -India	Sundarban Development Board, Kolkata, 16 February 2010
Dr. P. K. Katiha	Final Restitution/Wrap Up Meeting of CPWF Project "Improving Fish Productivity and Management In Tropical Reservoirs"	Aswan, Egypt, 3 -7 May 2009
	Final Workshop of the CGIAR - CP Water & Food Project	CIFRI, Barrackpore, 26 May 2009
	Review of Foreign Ai ded Projects in ICAR Fisheries Division	CIFRI, Barrackpore, 27 May 2009
	NFDB Sponsored orientation workshop for fisheries development in reservoirs	Coimbatore, 13 - 14 June 2009
	Fisheries Minister's Conference	Bhubaneswar, 4 -5 July 2009
	Mid- term Review Meeting of XI Five Year Plan of DARE/ICAR for Eastern and North - eastern region	Kolkata, 30 October 2009
	Workshop on "Sampling design and methodology to assess the socio - economic conditions of fishers and fish farmers in India"	CIBA, Chennai, 13 Nov ember 2009
	FAO -NIE-ICAR Regional Scoping Workshop on "Development of Habitat Conservation and Mitigation Measures for Ensuring Sustainable Fisheries in the Ganga -Brahmaputra Basin"	NASC, New Delhi, 17 -20 November 2009
	Workshop on "Fisheries Based Live lihoods in India: Present Status, Problems and Prospects"	National Bureau of Soil Survey and Land Use Planning, Kolkata, 28 -29 November 2009

Name(s) of personnel	Name of the meeting/ workshop / conference/ training programme	Place & date/duration
	Seco nd Regional Consultation on Preparation of management plan for hilsa fisheries under BOBP -IGO programme	CIFRI Barrackpore, 01 February 2010
Dr. (Mrs.) Preetha Pannikar	NFDB sponsored Training programme on "Reservoir Fisheries Management"	CIFRI Bangalore, 7 -16 September 2009
	Workshop on " Urban lake monitoring and management"	Indian Institute of Science, Bangalore, 23-25 September 2009
	Workshop on "Nanotechnology: Dimensions of Nanoscience, Nanotechnology and Society"	National Institute of Advanced Studies, Bangalore, 14-18 December 2009
Dr. R. K. Manna	Second Regional Consultation on Preparation of management plan for hilsa fisheries under BOBP- IGO programme	CIFRI Barrackpore, 01 February 2010
Dr. R. N. Seth	International Conference on "Recent Trends in Life Science Researches vis - à-vis Natural Resources Management, Sustainable Development and Human Welfare"	Vinobha Bhabe University, Hazaribag, 27-29 June 2009
R. K. Tyagi	FAO -NIE -ICAR Regional Scoping Workshop on "Development of Habitat Conservation and Mitigation Measures for Ensuring Sustainable Fisheries in the Ganga-Brahmaputra Basin"	NASC, New Delhi, 17-20 November 2009
Dr. (Mrs.) Rani Palaniswamy	NFDB sponsored Training programme on "Reservoir Fisheries Management"	CIFRI Bangalore, 7-16 September 2009
Dr. S. K. Manna	"Seminar and a state level poster competition on Recent Advancement of Biological Sciences and 1st Annual Convention of the BRSI -VU Unit Midnapore"	Panskura Banamali College, West Bengal, 6 March 2010
	FAO – NFDB consultative meeting on Development of Fisheries Sector in India	NFDB, Hyderabad, 23-25 March 2010
Dr. S. N. Singh	National Seminar on "Pinjaro Mein Machchali Palan"	CMFRI, Kochi, 25 - 26 August 2009
	National Seminar on "Food Security and Sustainability in India"	GAD Institute of Development Studies, Amritsar, 7-8 November 2009
Dr. S. Samanta	Mid -term Review Meeting of XI Five Year Plan of DARE/ICAR for Eastern and North - Eastern region	CIFRI, Kolkata, 30 October 2009
	FAO -NIE -ICAR Regional Scoping Workshop on "Development of Habitat Conservation and Mitigation Measures for Ensuring Sustainable Fisheries in the Ganga -Brahmaputra Basin"	NASC, New Delhi, 17-20 November 2009
Dr. Utpal Bhaumik	Meeting for Formulation of National training programme for the year 2009 - 2010	NFDB Hyderabad, 11 June 2009
	National Expo XIII	Kolkata, 2 - 06 September 2009.
	Mid -term Review Meeting of XI Five Year Plan of DARE/ICAR for Eastern and North - Eastern region	CIFRI, Kolkata, 30 October 2009

Name(s) of personnel	Name of the meeting/ workshop / conference/ training programme	Place & date/duration
	Second Regional Consultation on Preparation of management plan for hilsa fisheries under BOBP-IGO programme	CIFRI Barrackpore, 01 February 2010
Dr. V. Kolekar	Board of Directors meeting of Assam Fisheries Development Corporation, Guwahati	Guwahati, 01 August 2009
Dr. V. R. Suresh	International conference on "Food Security and Environmental Sustainability"	IIT, Kharagpur, 17-19 December 2009
	FAO-NIE-ICAR Regional Scoping Workshop on "Development of Habitat Conservation and Mitigation Measures for Ensuring Sustainable Fisheries in the Ganga-Brahmaputra Basin"	NASC, New Delhi, 17-20 November 2009
	National Conference on "Scientific strategies for protection and preservation of wetlands in India"	Jawaharlal Nehru University, New Delhi, 11-12th January 2010
	ICAR Zonal Technology Management and Business Planning and Development Meeting-cum-workshop	IINRG, Ranchi, 19-20 February 2010
All Scientists of CIFRI, Bangalore	Workshop on "Peninsular aquaculture: quest for solutions"	CIFA, Bangalore, 26 February 2010
All Scientists of CIFRI, Barrackpore	Workshop on "Arsenic contamination and its mitigation strategies"	CIFRI Barrackpore, 11-12 February 2010.
All Scientists of CIFRI, Barrackpore	Workshop on "Small Indigenous Freshwater Fish Species: Their role in Poverty Alleviation Food Security and Conservation of Biodiversity"	CIFRI, Barrackpore, 23-25 February 2010.

Participation of Scientists in Training Programmes

Name(s) of personnel	Name of the training programme	Place & date/duration
Many scientists and other staff members	NAARM Off - campus Short Term Training programme on "Scientific & Technical Manpower of CIFRI"	CIFRI, Barrackpo re, 29 April – 01 May 2009
Dr. K. K. Vass	Management Development Programme on Leadership for Innovation in Agriculture	IIM, NOIDA, - 10 July 2009
Dr. A. K. Sahoo	Summer school on "Cage and pen culture in inland waters"	CIFRI Barrackpore, 18 August – 07 Sept. 2009
Dr. B. K. Behera	Training programme on "Methodologies (chemical composition of fish)"	CIFT, Cochin, 07 -11 September 2009
	NAIP Training on "Procurement related matters and Financial Management of the World Bank funded project of NAIP"	CIFR I Barrackpore, 12 - 13 October 2009
Dr. S. K. Manna	Summer School on "Recent advances in molecular identification of agriculturally important microorganisms"	NBAIM, Mau, Uttar Pradesh, 01 - 21 September 2009
Dr. P. K. Katiha	Management Development Programme (MDP) on Priority setting, Monitoring and Evaluation for Innovation in Agriculture	IIM, Lucknow, 22 -26 March 2010

EVENTS

CIFRI Team visited Egypt

The final restitution/wrap-up meeting of CGIAR Challenge Program on Water & Food (CPWF) Project on *Improved Fisheries Productivity and Management in Tropical Reservoirs* was held at Aswan (Egypt) during 03-07 May 2009. It was organized by the World Fish Center, Cairo. A team of scientists led by Dr. K. K. Vass, Director, CIFRl & Executive PI of the project for Indo-Gangetic Basin with other scientists Shri N. P. Shrivastava, Dr. P. K. Katiha and Dr. A. K. Das had participated in this meeting. The other participants were from CGIAR-World Fish Center, Malaysia & Cairo (Egypt); Advance Research Institute (ARl) , Norway; Water Research Institute (WRI), Ghana; NIOF and LNDA, Egypt. The CPWF Project Report was finalized during this period. The work done during the project period in one Indo-Gangetic Basin reservoirs in India was highly appreciated. A number of publications prepared under the project like handbook on cage culture in Indian reservoirs, protocols for fisheries enhancement in Indian reservoirs, document on research achievements, methodology manual, pamphlets, leaflets on reservoir fisheries were circulated at national and international fora. The documentaries CDs and posters prepared were also highly acclaimed.

Fish Farmers' Day

CIFRI has organised Fish Farmers' Day on July 10, 2009 at Barrackpore and all its regional centers. The fish farmers, fishers, NGOs and other personnel related to fish production and ancillary activities participated in various interactive sessions. The experts from research and other academic institutions were invited to share their experiences and provide guidance for fisheries research and development. Dr. P. Das, Ex-Director, NBFGR, Lucknow mentioned about the importance of the day and encouraged the scientists towards upliftment of poor fishers.

CIFRI celebrated Fish Farmers Day

Foundation Day of Indian Council of Agricultural Research

CIFRI has organized ICAR Foundation Day on 16 July, 2009. Brainstorming sessions on different aspects of inland fisheries research were held at the institute. The scientific and technical officers and other experts participated in the sessions. A cultural programme was also organised on the occasion.

Cultural programme on ICAR Foundation Day

Independence Day

CIFRI celebrated The Independence Day with great enthusiasm. Dr. K.K. Vass, Director of CIFRI hoisted the National Flag during Independence Day. Staff members attended the function along with their family

members. A half day long cultural function was also organized by the staff members and their family members.

The Independence Day celebration

Hindi Week

The institute has celebrated Hindi week during September 14-19, 2009 at Barracpore and all its centres. Different actrivities, competions, talks and other interactions were held to promote Hindi language in the institute. The incentives have also been provided to the winners of the competitions and the staff members making maximum use of Hindi. During the interactions, number of suggestions have been made to increase the use of Hindi.

Hindi week celebration at CIFRI

'Hindi Saptah' at Vadodara Centre

Vigilance Awareness Week

Vigilance Awareness Week was observed in the Institute during 3-7 November 2009. The staff members of the institute were made aware of various rules and regulations about the vigilance.

Republic Day

The Republic Day was celebrated at CIFRI with due solemnity. Staff members with family members assembled for the hoisting of the National flag by Prof. A. P. Sharma, Director, CIFRI. A painting competition for different age group children and a cultural programme was organised on the occasion.

Republic Day celebration at CIFRI

Sessions during foundation day celebration

CIFRI Foundation Day

CIFRI has celebrated its foundation day on March 16, 2010 in big way by conducting number of academic and other activities. The programs were organized during 17-18 March, 2010. Dr. S. D. Tripathi, Former Director of Central Institute of Fisheries Education, Mumbai and Central Institute of Freshwater Aquaculture, Bhubaneswar delivered the foundation day lecture. Dr. V. V. Sugunan, ADG, Inland Fisheries, ICAR conducted a brainstorming session on 'Inland open water fisheries: the way forward'. A Quiz and cultural program was also organized.

DISTINGUISHED VISITORS

The following distinguished persons visited the Institute during the year 2009-10

Name	Designation /Affiliation
Dr. S. Ayyappan	Secretary, Department of Agricultural Research and Education, and Director General, Indian Council of Agricultural Research, New Delhi
Dr. M. V. Gupta	World Food Prize winner & Former Assistant Director General, World Fish Centre, Penang, Malaysia
Dr. S. H. Thilsted	Faculty of Life Sciences, University of Copenhagen, Denmark
Dr. William J Collis	Director, South Asia, Worldfish Center: Dhaka Bangladesh
Dr. M. A. Wahab	Bangladesh Agricultural University, Mymensingh, Bangladesh
Dr. M. Kunda	Department of Fisheries, Ministry of Fisheries & Livestock, Bangladesh
Ms N. Kawarazuka	Worldfish Centre, Penang, Malaysia
Prof. C. S. Chakarborti	Vice Chancellor, West Bengal University of Animal and Fisheries Sciences, Kolkata
Shri Mohan Kumar	Principal Secretary, Department of Animal Husbandry and Fisheries, Govt. of Orissa, Bhubaneswar
Prof. H. P. C.Setty	Former Dean, College of Fisheries, Mangalore
Dr. K. Gopkumar	Former DDG (Fy.), ICAR, New Delhi
Dr. S. D. Tripathy	Former Director, CIFE, Mumbai
Dr. P. Das	Former Director, National Bureau o f Fish Genetic Resources, Lucknow
Dr. V.V. Sugunan	ADG (I Fy), ICAR, New Delhi
Dr. A. G. Ponniah	Director, CIBA, Chennai
Dr. B. Meena Kumari	Director, CIFT, Cochin
Dr. Y. S. Yadava	Director, BOBP - IGO, Chennai
Prof. R.K.Sinha	Department of Zoology, Patna University
Dr. S. Kaul	Director, Ministry of Environment and Forest, GOI, New Delhi
Dr. C. S. Singh	Former Dean, Fishery College, GBPUAT, Pantnagar, Uttarakhand
Prof. U.C. Goswami	Department of Zoology, Gauhati University
Dr. R.M. Dwivedi	Head, Space Application Centre, Ahmedabad
Shri R. Pattar	Director of Finance, ICAR, New Delhi
Dr. A. E. Eknath	Director, CIFA, Bhubaneswar
Dr. W. Vishwanath	University of Manipur, Canchipur, Manipur
Mr. C. M. Muralidharan	FAO National Consultant, Chennai
Dr. R. J. Ranjit Daniels	Care Earth, Chennai
Dr. Dipankar Saha	Development Consultant, Kolkata
Mr. V. Vivekanandan	Advisor, SIFFS, Karamana
Mr. Sebastian Mathew	ICSF, Chennai Tamil Nadu
Ms Nalini Nayak	ICSF, Chennai Tamil Nadu
Ms Chandrika Sharma	ICSF, Chennai Tamil Nadu
Mr. Shyamalendu Biswas	Disha, Kolkata
Mr. Biswajit Mahakur,	Secretary, Joygopalpur Gram Vikas Kendra, Sundarbans
Dr. D. N. Guha Mazumder	Director, DNGM Research Foundation, Kolkata
Dr. B. S Mahapatra,	Director, CRIJAF, Barrackpore
Dr. S. Bandopadhyay	Ceramic Membrane Division, CGCRI, Kolkata
Dr. J. K. Malik	Joint Director (Research), IVRI, Bareilly
Dr. A. K. Giri	Deputy Director, IICB, Kolkata

PERSONNEL (MANAGERIAL POSITION DURING 1 APRIL, 2009 TO 31 MARCH, 2010)

CIFRI, Barrackpore, West Bengal
Dr. K. K. Vass, Director, (Till 30 November, 2009)
Dr. A. P. Sharma, Director, (From 30 November, 2009 after noon)

Riverine Ecology and Fisheries Division, CIFRI, Barrackpore, West Bengal
Dr. Utpal Bhaumik, Principal Scientist, Head of Division

Fishery Resource & Environmental Monitoring Division, Barrackpore, West Bengal
Dr. Manas Kr. Das, Principal Scientist, Head of Division

Reservoir & Wetland Fisheries Division, CIFRI, Barrackpore, West Bengal
Dr. B. C. Jha, Principal Scientist, Head of Division

Officiating Head, CIFRI Regional Centre, Allahabad, Uttar Pradesh.
Dr. H.P. Singh, Principal Scientist

Officiating Head, CIFRI Regional Centre, Bangalore, Karnataka.
Dr. D.S.K. Krishna Rao, Principal Scientist

Officiating Head, CIFRI Regional Centre, Guwahati, Assam.
Shri V. Kolekar, Senior Scientist,

Officiating Head, CIFRI Regional Centre, Vadodara, Gujarat
Dr. S.N.Singh, Principal Scientist

Officer –In –Charge, CIFRI, Kochi Unit, Kerala
Dr. R. Palaniswami, Senior Scientist

In –Charge, Library & Informatics Section, CIFRI, Barrackpore, West Bengal
Mrs. G. K. Vinci, Principal Scientist (From 5 October, 2009)

In –Charge, Training & Extension Cell, CIFRI, Barrackpore, West Bengal
Dr. P. K. Saha, Principal Scientist (From 5 October, 2009)

In –Charge, Hindi Cell, CIFRI, Barrackpore, West Bengal
Shri N. P. Shrivastava, Principal Scientist

In –Charge, Agricultural Economics Section & Project Monitoring / Documentation Cell, CIFRI, Barrackpore, West Bengal
Dr. P. K. Katiha, Principal Scientist (From 5 October, 2009)

In –Charge, IT & ARIS Cell, CIFRI, Barrackpore, West Bengal
Shri D. Karunakaran, Scientist (Senior Scale) (From 5 October, 2009)

In –Charge, Technical Cell, CIFRI, Barrackpore, West Bengal
Shri N. P. Shrivastava, Principal Scientist (till 11 February, 2009)
Dr. V. R. Suresh, Principal Scientist (From12 February, 2009)

In –Charge, Institute Technology Management Unit, CIFRI, Barrackpore, West Bengal
Dr. V. R. Suresh, Principal Scientist (From 5 October, 2009)

In – Charge, Aquarium & Hatchery Unit, CIFRI, Barrackpore, West Bengal
Dr. V. R. Suresh, Principal Scientist (Till 21 February, 2009)
Dr. B. B. Satpathy, Senior Scientist (From 22 February, 2009)

Senior Administrative Officer, CIFRI, Barrackpore.
Shri U.C.Prasad

Finance & Accounts Officer, CIFRI, Barrackpore.
Shri K. P. Nath

PROMOTIONS, TRANSFERS, SUPERANNUATIONS AND NEW APPOINTMENTS

Promotions

Name the Person	Promoted to	With effect from
Shri Gautam Pathak	T-9	01.07.08
Shri D. K. Biswas	T-(7-8)	01.01.09
Shri B. N. Sah	A.A.O.	01.07.09
Shri S. P. Mondal	Assistant	21.07.09 (A.N.)
Shri B. Barua	Assistant	21.07.09
Shri S. B. Roy	A.A.O.	05.08.09
Shri J. Ray	A.A.O.	01.10.09
Shri S.K. Ghosh	Assistant	03.10.09
Shri R.C. Mandi	T-(7-8)	03.02.05
Shri Sukumar Saha	T-(7-8)	03.02.05
Shri Atanu Das	T-4	01.01.09
Shri Subrata Das	T-4	27.01.09
Shri Sudarshan Bandopadhyay	T-4	01.07.09
S mt. Shuvra Saha	T-4	01.01.09
Shri Debasis Saha	T-4	01.07.09
Shri Sanjay Kr. Das	T-2	11.09.08
Shri Ram Sajiwan	T-3	29.06.06
Shri Ashish Chakraborty	T-3	18.02.08
Shri M.V. Krishnan	T-3	15.07.07
Shri R. Balamurugan	T-3	09.02.08
Shri Arun Mandal	T-3	29. 06.06
Smt. K. Jacquline	T-6	29.04.08
Shri Achintya Kumar De	A.A.O.	08.01.10
Shri Debesh Chowdhury	Assistant	24.02.10
Dr. B. K. Biswas	T-7-8	01.01.08

Transfers

	Name and Designation	From	To
1.	Shri B.N. Sah, AAO	Barrackpore	Guwahati
2.	Shri S.B. Ray, AAO	Barrackpore	Guwahati
3.	Shri S.K. Sadhukhan, T-8	Bangalore	Barrackpore
4.	Dr. Md. Aftabuddin, Sr. Scientist	Guwahati	Barrackpore
5.	Shri S. Mahendran, SSG.III	Kochi	Bangalore
6.	Dr. Depash Debnath, Scientist	Barrackpore	Guwahati
7.	Shri Suranjan Kumar Singh	Vadodara	Barrackpore

Inter Institutional Transfer

1.	Shri Nayan Tara Dalui	Transferred on 30.06.09

Superannuations

Name & Designation	Last place of posting	Date of Superannuation
Shri S.R. Das, Principal Scientist	Barrack pore	30.06.09
Shri Gunadhar Dhibar, SSG.III	Barrackpore	30.06.09
Shri B. N. Sah, A.A.O.	Guwahati	31.07.09
Shri A. B. Biswas, A.A.O.	Barrackpore	30.09.09
Shri Rajdhari Mallah, SSG.III	Allahabad	30.09.09
Dr. K. K. Vass, Director	Barrackpore	31.11.09
Dr . A. Mukherjee, Principal Scientist	Barrackpore	31.11.09
Shri Surendra Kumar, A.A.O.	Allahabad	31.11.09
Shri T. K. Majumder, A.A.O.	Barrackpore	31.12.09
Shri Sankar Bose, SSG.III	Barrackpore	31.12.09
Shri Ambika La l, Assistant	Allahabad	31.01.10
Shri Atiullah, SSG.II	Allahabad	31.01.10
Shri D. K. De. Sarkar, A.A.O.	Barrackpore	31.03.10
Dr. H.P. Singh, Principal Scientist	Allahabad	31.03.10

New Appointments

1. Shri A. K. Sahoo, Scientist joined at Barrackpore on 20.06.09
2. Dr. R. K. Manna, Sr. Scientist joined at Barrackpore on 18.07.09
3. Dr. Ranjit Kumar Paul, Scientist joined at Barrackpore on 30.10.2009
4. Dr. (Ms) Aparna Roy, Scientist joined at Barrackpore on 30.10.2009
5. Ms Anjana Ekka, Scientist joined at Barrackpore on 30.10.2009
6. Dr. A. P. Sharma, Director joined at Barrackpore on 30.11.09
7. Shri Ratan Das, SSG.I joined at Barrackpore on 13.01.2010
8. Shri Anil Kumar Yadav, Scientist joined at Barrackpore on 15.03.2010
9. Dr. Dharm Nath Jha, Scientist joined at Barrackpore on 15.03.2010

SPECIAL INFRASTRUCTURE DEVELOPMENT

Inauguration of new Laboratory Block

Dr. S. Ayyappan, Deputy Director General (Fy), Indian Council of Agricultural Research, New Delhi inaugurated new laboratory block of CIFRI at Barrackpore. The ARIS Cell and laboratories of Divisions of Fishery resource and Environmental Monitoring, Reservoir and Wetland Fisheries and Riverine Ecology and Fisheries are located in the block. The block will provide good infrastructure for better implementation of the institute and externally funded project.

Inauguration of New Laboratory Block by Dr. Ayyappan

वार्षिक प्रतिवेदन
2009–2010

हिन्दी सारांश

केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान
(भारतीय कृषि अनुसंधान परिषद)
बैरकपुर, कोलकाता – 700 120

के. अं. मा. अनु. सं. वार्षिक प्रतिवेदन 2009–2010

ISSN 0970-6297

प्रकाशक
डा. अनिल प्रकाश शर्मा, निदेशक
केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान

संपादन तथा संकलन
ए. पी. शर्मा
पी. के. कटिहा
एस. के. मन्ना
बी. के. बेहरा
आर. के. मन्ना
अंजना एक्का

सहयोग
सुनीता प्रसाद, मो. कासिम एवं एस. चौधरी

हिन्दी रूपान्तरण
पी. आर. राव एवं सुनीता प्रसाद

कॅवर डिजाइन : पी. के. कटिहा एवं एस. चौधरी

डिजाइन व मुद्रण : मेसर्स फ्लोरेन्स ऑफसेट प्रोसेस, प्रा. लिमिटेड, 6 ए. एस. एन. बनर्जी रोड, कोलकाता–700 013

प्रस्तावना

विवृत जल क्षेत्रों में गरीब जनता विशेषकर अंतर्स्थलीय मत्स्य पालकों के लिये मात्स्यिकी जीविकोपार्जन का एक अभिन्न अंग है। इन जल क्षेत्रों में उत्पादन संवर्द्धन और जीविकोपार्जन की असीमित संभावना है। विवृत जल में पारंपरिक रीति से किये जा रहे पालन से लाभ कम होता है। पिछले कुछ दशकों में इन जल क्षेत्रों की मात्स्यिकी में ह्रास हुआ है। देश के अधिकतर अंतर्स्थलीय विवृत जल निकायों का उपयोग अनेक प्रकार से किया जाता है और इनके स्वामित्व एवं लाभ के हकदार एक से अधिक व्यक्ति होते हैं। इसका परिणाम यह होता है कि ऐसे जल निकायों में तकनीकों के प्रयोग में समस्या उत्पन्न होती है और मत्स्य उत्पादन कम होता है। अतः कुछ कठिनाइयों जैसे स्वामित्व, प्राकृतिक मत्स्य संग्रहण का अत्यधिक दोहन, परितंत्र अपकर्ष, मनुष्य द्वारा जल धाराओं के मार्ग में परिवर्तन करना, आर्थिक क्षति आदि का तुरंत निराकरण आवश्यक है। संभावित पर्यावरणीय परिवर्तन और मानवजनित कारणों से प्रतिपालित मात्स्यिकी के लिये इन जल निकायों का संरक्षण आवश्यक है। सामुदायिक भागेदारी एवं सह–प्रबंधन से मत्स्य संग्रहण का प्रतिपालित दोहन किया जाना चाहिये। अतः वर्तमान समय में अंतर्स्थलीय मात्स्यिकी क्षेत्र के लिये मात्स्यिकी संबंधी नीति का अनुपालन और उत्पादन किया जा सकता है।

इन तथ्यों को ध्यान में रखकर संस्थान ने बहुत सी संस्थागत, बाहरी संगठनों द्वारा प्रायोजित एवं नेटवर्क अनुसंधान परियोजनाओं को प्रारंभ किया है जिससे निम्नलिखित अनुसंधान कार्यक्रमों को पूरा किया जा सके :

- मात्स्यिकी संवर्द्धन और जलाशय व बाढ़कृत आर्द्रक्षेत्रों का प्रबंधन
- नदीय व ज्वारनदमुख क्षेत्रों में मात्स्यिकी का आंकलन और विलुप्त हो रही मत्स्य प्रजातियों का संरक्षण
- फिश स्टॉक और फूड चेन में हो रहे जलीय परिवर्तनों के प्रभाव का आंकलन
- मत्स्य स्वास्थ्य पर पर्यावरणीय प्रभाव का आंकलन
- पर्यावरण और संरक्षण के विभिन्न पहलुओं पर स्टेकहोल्डर्स को जागरूक करना
- रिमोट सेंसिंग तकनीक द्वारा खुला जल अंतर्स्थलीय मात्स्यिकी का आंकलन
- जल निकायों द्वारा प्रदत्त सेवाओं और मछुआरों के सामाजिक–आर्थिक और संस्थागत स्तर का मूल्यांकन

साथ ही सी. जी. आई. ए. आर. द्वारा प्रायोजित जलाशय मात्स्यिकी पर एक अंतर्राष्ट्रीय परियोजना को भी सफलतापूर्वक सम्पन्न किया गया। इससे संस्थान को राष्ट्रीय एवं अंतर्राष्ट्रीय तौर पर बहुत ही सराहना मिली है। इस वर्ष संस्थान ने और भी कई प्रायोजित एवं एन. ए. आई. पी. परियोजनायें, परामर्शक सेवायें और आउटरीच परियोजनाओं पर कार्य किया है। संस्थान ने अन्य अनुसंधान संगठनों, विश्वविद्यालय, विभिन्न राज्यों जैसे मध्य प्रदेश, झारखंड, उत्तर प्रदेश, हरियाणा, असम, केरल, तमिलनाडु, गुजरात, डी. वी. सी. और एन. एफ. डी. बी. के सहयोग से अनुसंधान और विकास कार्यक्रमों को और भी सुदृढ़ किया है।

इन अनुसंधान कार्यक्रमों के अलावा संस्थान ने अनुसंधान उपलब्धियों को राष्ट्रीय एवं अंतर्राष्ट्रीय दोनों स्तरों पर मत्स्य पालकों से लेकर योजनाकारों तक पहुंचाने के लिये बहुत से प्रशिक्षण कार्यक्रम, जन जागरूकता कार्यक्रम और प्रदर्शनी का भी आयोजन किया है ।

मैं डा. एस. अय्यप्पन, सचिव, कृषि अनुसंधान व शिक्षा विभाग, कृषि मंत्रालय, भारत सरकार और महानिदेशक, भारतीय कृषि अनुसंधान परिषद् को इस पदभार ग्रहण के लिये हार्दिक रूप से बधाई देता हूं और यह कामना करता हूं कि इन विकास कार्यों में वे सदैव ही सचेष्ट रहें। मै डा. मंगला राय, भूतपूर्व सचिव, कृषि अनुसंधान व शिक्षा विभाग, कृषि मंत्रालय, भारत सरकार और महानिदेशक, भारतीय कृषि अनुसंधान परिषद् का उनके सदैव सहयोग एवं प्रोत्साहन के लिये आभारी हूं। मैं डा. वी. वी. सुगुणन्, सहायक महानिदेशक (अंतर्स्थलीय मात्स्यिकी) डा. मदन मोहन, सहायक महानिदेशक (मैरीन मात्स्यिकी) एवं परिषद् के मात्स्यिकी विभाग की डा. उषा मोजा, श्री अनिल अग्रवाल एवं श्रीमती कमला विष्ट के संस्थान के सभी कार्यकलापों में मार्गदर्शन और सतत् सहयोग के लिये आभारी हूं।

मैं डा. पी. के. कटिहा, उनकी टीम एवं श्री श्रीवास्तव को इस प्रलेख के लिये धन्यवाद देता हूं। सुश्री सुनीता प्रसाद, श्री पी. आर. राव और श्री मो. कासिम को प्रकाशन सहायता एवं हिन्दी अनुवाद के लिये धन्यवाद देता हूं।

बैरकपुर
जून 2010

अनिल प्रकाश शर्मा
निदेशक

विशिष्ट सारांश

केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान (के. अं. मा. अनु. संस्थान) की स्थापना एक छोटे से संस्थान के रूप में 17 मार्च 1947 में कलकत्ता में हुई। अपने अनुसंधान और विकास के बल पर यह केन्द्र अंतर्स्थलीय मात्स्यिकी एवं जलीय पारिस्थितिकी के क्षेत्र में राष्ट्रीय और अंतर्राष्ट्रीय दोनों स्तर पर एक प्रमुख अनुसंधान संगठन में परिणत हो चुका है। इसके वैज्ञानिकों ने अतिशय प्रसिद्धि प्राप्त की जिसका एक प्रबल उदाहरण है, डा. एस अय्यप्पन, जो मात्स्यिकी क्षेत्र के वैज्ञानिक रहे हैं, का सचिव, कृषि अनुसंधान व शिक्षा विभाग तथा महानिदेशक, भारतीय कृषि अनुसंधान परिषद जैसे महत्वपूर्ण पद पर दिनांक 31 दिसम्बर 2009 को आसीन होना। डा. अय्यप्पन ने अपने सेवा काल का प्रारंभ हमारे ही संस्थान, के. अं. मा. अनु. सस्थान से किया था।

के. अं. मा. अनु. सस्थान का मुख्यालय बैरकपुर, कोलकाता में स्थित है। इसके क्षेत्रीय केन्द्र/स्टेशन देश के विभिन्न भागों में फैले हुये हैं जैसे : उत्तर में इलाहाबाद केन्द्र, दक्षिण में बैंगलोर और काच्चि केन्द्र, उत्तर–पूर्व में गुवाहाटी केन्द्र और पश्चिम में वडोडरा केन्द्र। संस्थान में 51 वैज्ञानिक, 80 तकनीकी 60 प्रशासनिक एवं 123 सपोर्टिंग स्टाफ कार्यरत है। संस्थान नें इस वर्ष में योजना व गैर–योजना के अंतर्गत आवंटित वित्त का शत प्रतिशत उपयोग किया। गत् वर्ष में परिषद् द्वारा तीन प्रभागों– नदीय पारिस्थितिकी व मात्स्यिकी, जलाशय व आर्द्रक्षेत्र मात्स्यिकी और मात्स्यिकी संसाधन व पर्यावरणीय प्रबंधन को अनुमोदित किया गया तथा इनमें तीन प्रभागाध्यक्षों की नियुक्ति हुई।

अनुसंधान सलाहकार समिति और पंचवार्षिक पुनरीक्षण दल के सुझावों के आधार पर संस्थान में आठ अनुसंधान कार्यक्रमों का समावेश किया गया है जिनमें कई परियोजनायें सम्मिलित हैं। ये परियोजनायें विजन 2025 तथा 11वें पंचवर्षीय योजना के ई. एफ. सी. के अनुसार अनुमोदित हैं। संस्थान ने अपनी एवं बाहरी संस्थाओं द्वारा प्रायोजित सभी परियोजनाओं का सफलतापूर्वक कार्यान्वयन किया है। साथ की संस्थान ने अन्य महत्वपूर्ण कार्य जैसे मानव संसाधन विकास, सलाहकार व मात्स्यिकी विकास जैसे कार्यों में भी योगदान दिया है।

नदीय मात्स्यिकी

- दिल्ली और इटावा के मध्य यमुना नदी के जल की गुणवत्ता में ह्रास हुआ है। नदी के उपरी स्तर में छोटी और विदेशी मत्स्य प्रजातियां जैसे कॉमन कार्प व तिलापिया की प्रधानता देखी गई।
- सोन नदी पर बने इन्द्रपुरी बांध का वार्षिक जल निस्तारण में ह्रास हुआ है जिससे बालुकामय क्षेत्र बढ़ गया है। नदी के धारा प्रवाह में कमी आई है। इन सबसे नदी के जैव समुदायों विशेषकर मात्स्यिकी पर प्रतिकूल प्रभाव पड़ा है। जीरा संवर्द्धन में भी कमी आई है।

ज्वारनदमुख मात्स्यिकी

- सुवर्णरेखा ज्वारनदमुख मानसून पूर्व प्रायः सूखा रहता है पर मानसून के दौरान इसमें बाढ़ जैसी स्थिति हो जाती है। इस ज्वारनदमुख में 17 आर्डर एवं 53 वर्ग की 135 मत्स्य प्रजातियां की उपलब्धता देखी गई। लवणीय क्षेत्र में प्रजातियों की संख्या अधिक थी। इन लवणीय, परिवर्ती और मीठाजल क्षेत्रों में क्रमशः 575, 31.5 और 10.3 टन मत्स्य उपज हुई। कुल उपज का 50 प्रतिशत मानसून के दौरान रहा । ज्वारनदमुख के निचले स्तर में हिल्सा की प्राप्ति कुल उपज के 35 प्रतिशत से कम हुई।
- महानदी में अधिकतर समय जलप्रवाहों में अत्यन्त नियंत्रण, धारा की चौड़ाई व गहराई में परिवर्तन, नदीय क्षेत्रों का खुला होना तथा मत्स्य आवास में स्थानिक परिवर्तन आदि कारणों से मछलियो का अभिगमन नहीं हुआ। इसके दो बराज, जोबरा एवं नौराज में फिश पास की सुविधा अनुपयोगी देखी गई। समुद्र के मुहाने से 35 कि.मी. क्षेत्र तक मछलियों का अभिगमन दर्ज किया गया।
- हुगली ज्वारनदमुख के लवणीय क्षेत्र में हिल्सा की उपज अधिक हुई (जुलाई और अगस्त में फ्रेजरगंज में >5 टन) पर परिवर्ती और उपरी क्षेत्रों में कम हुई। निरीक्षण से पता चला कि हिल्सा अभिगमन के लिये जल की गहराई 4 मी. से अधिक

और धारा का वेग c 20 मीटर प्रति मिनट होना चाहिये। इस ज्वारनदमुख में प्रायः वर्षभर हिल्सा की उपलब्धता रहती है – बड़े एवं तरूण आकार में।

जलाशय मात्स्यिकी

- कर्नाटक के सुवर्णवती जलाशय में मत्स्य उपज में वृद्धि 116 कि.ग्रा. प्रति हे. (वर्ष 2007–08) से 197 कि.ग्रा. प्रति हे. (वर्ष 2009–10) हुई जिसका कारण था – भारतीय मेजर कार्प के विकसित जीरा मछलियों के संग्रहण, संग्रहण दर, बड़े कार्प मछलियों की खेती और मत्स्ययन प्रयास में अधिकता। यह मत्स्ययन प्रयास 14.5 कि.ग्रा. (वर्ष 2007–08) से 15.8 कि.ग्रा. (वर्ष 2009–10) बढ़ा जिससे वर्ष 2007–08 की तुलना में वर्ष 2009–10 में प्रति मछुआरा रू. 22,000 की अधिक आमदनी हुई।
- केरल के कान्हिरापुर जलाशय में कतला कतला की उपज अधिक हुई पर सिरहिनस मृगला की उपज कम हुई। इस जलाशय में एल. रोहिता और ग्रास कार्प मछलियों की उपज बहुत कम हुई।
- केलावारापल्ली जलाशय के लिये विकसित स्टैटिक मास बैलेन्स मॉडेल से पता चलता है कि प्रथम चार ट्रोफिक लेवेल और फूड वेब स्ट्रक्चर में ट्रोफिक जीवाश्मों की बहुलता है।
- केलावारापल्ली जलाशय पूर्ण रूप से विकसित नहीं है और मत्स्य उपज वृद्धि के लिये इसे संवर्द्धन तकनीक के लिये उपयोग में लाया जा सकता है। इस जलाशय की अधिकतम प्रतिपालित उपज (एम. एस. वाई) का स्तर कम है इसलिये प्रतिपालित मात्स्यिकी के लिये मत्स्ययन प्रयास (6748 प्रति वर्ष) को कम किया जा सकता है।
- कारापुझा जलाशय में 6.7 कि.ग्रा. मत्स्ययन प्रयास से 24.2 टन की उपज प्राप्त हुई जिसमें ओरियोक्रोमिस मोजाम्बिका की बहुलता थी (61.3 प्रतिशत)। पर इस जलाशय की संभावनाओं के पूर्ण दोहन के लिये मत्स्ययन प्रयास 4946 होना चाहिये। कुल संग्रंहण 94.1 टन मत्स्ययन प्रयास से 135 टन दर्ज किया गया । हालांकि वर्तमान उपज अपेक्षाकृत कम थी (मत्स्ययन प्रयास 24.2 टन)। साथ की इस जलाशय की मत्स्य प्रजातियों के खाद्य व संभरण और प्रजनन संबंधी विषयों का अध्ययन किया गया।
- उपज और संबंधित प्राचलों के लिये विभिन्न व्यावहारिक विधियों की सहायता से उपयुक्त मॉडेल को विकसित किया गया। इन मॉडेल का आधार मत्स्य उपज के आंकलन के लिये प्रयुक्त गौण आंकड़ें थे। वारहल्स्ट–शाफर मॉडेल जिसे मत्स्य जनसंख्या विकास पर जीरा मछलियों के संग्रहण के प्रभाव के आंकलन के लिये उपयोग में लाया जाता है को अन्य जलाशयों में भी प्रयोग किया जा रहा है।

आर्द्रक्षेत्र मात्स्यिकी

- उपज (डिपेन्डेन्ट वेरिएबल) और जैव–भौतिकी व रसायनिक गुणों (इनडिपेन्डेन्ट वेरिएबल) के आंकलन के लिये एक मॉडेल का विकास किया गया। इस मॉडेल का विकास पश्चिम बंगाल के 17 जिलों से प्राप्त आंकड़ों के आधार पर किया गया।
- बिहार के चौर में पेन पालन की संभावना को जानने के लिये एक पायलट परीक्षण किया गया जिससे सार्वजनिक और निजी सहभागिता को बढ़ावा मिल सके। गोलाकार पेन जो सस्ते एच. डी. पी. ई जाल से बने होते हैं भारतीय मेजर कार्प मछलियों के विकास के लिये उपयुक्त होते हैं। स्थानीय मछुआरों द्वारा निर्मित इन जालों को आसानी से संचालित किया जाता है साथ ही इनकी लागत मूल्य कम होती है और अधिक से अधिक लोग इसे अपना रहे हैं।
- मेसोकोज्म परीक्षण द्वारा आर्द्रक्षेत्र एवं इसकी जैव–विविधता पर विभिन्न जैव समुदायों से पड़ने वाले प्रभाव का अध्ययन किया गया। इससे पता चला कि जल मे डूबे हुये मेक्रोफाइट्स मिट्टी की पोषकता के संपोषण के लिये अनुकूल स्थिति उत्पन्न करते हैं जिससे मछलियों के लिये खाद्य पदार्थों जैसे, प्लवक, पेरिफाइटन और मोलस्क का भी निर्माण होता है।
- पश्चिम बंगाल के 8 आर्द्रक्षेत्रों के अध्ययन से यह पता चलता है कि कुल मत्स्य उपज 86 से 1794 कि. ग्रा. प्रति हे. प्रति वर्ष हुई जिसमें मेजर कार्प की उपलब्धता अधिक थी। पर नमूनों के परीक्षण से यह तथ्य सामने आया कि संग्रहित मछलियों की तुलना में वाइल्ड प्रजातियों से अधिक लाभ की प्राप्ति हुई। इस आर्द्रक्षेत्र से 5 से 28 वाइल्ड प्रजातियों का दोहन किया गया। 57 जेनेरा और 32 वर्गों के 79 मत्स्य प्रजातियों के साथ–साथ चार झींगा मछली की प्रजातियों और एक केकड़े के प्रजाति की पहचान की गई।

- पश्चिम बंगाल के मौसमी बाढ़कृत क्षेत्र में मछली पालन को प्रारंभ किया गया। मछुआरों के तकनीकी ज्ञान को और भी उत्कृष्ठ बनाया गया। इससे मछली का उत्पादन 3377 कि.ग्रा. प्रति हे. से बढ़कर 2540 कि.ग्रा. प्रति हे. हो गया पर यह प्रौद्योगिकी की उपलब्धता पर निर्भर करता है।

मत्स्य स्वास्थ्य और पर्यावरण

- कुल पेरिफाइटन में बैसिलेरियोफाइसी की प्रधानता (36.0 से 54.7 प्रतिशत) थी, इससे यह पता चला कि दुर्गापुर से बर्नपुर के बीच के दामोदर नदी का विस्तार प्रदूषित है। प्रदूषण को सहन करने वाले पेरिफाइटन पादपप्लवक की उपलब्धता क्रमशः इस प्रकार है– रन्दिहा > बर्नपुर > नामो मेजिया > दुर्गापुर।
- लोअर स्पीशिज इवेननेस इन्डेक्स ($J = 0.030 – 0.059$) से नदी में अव्यस्थित ढंग से वितरित मत्स्य प्रजातियों का पता चलता है। दामोदर नदी में 20 वर्ग के 63 मत्स्य प्रजातियों की उपलब्धता देखी गई जिसमें से 3 विदेशी प्रजाति की थी।
- दामोदर नदी के जल के धातु परीक्षण से पता चला कि इसके जल में आर्सेनिक प्रदूषण नहीं है। पर इसमें डी.डी.टी. की उपलब्धता आवश्यकता से अधिक देखी गई।
- ई. आई. ए. के अनुसार यमुना नदी में प्रदूषण दाब है। वर्तमान सर्वेक्षण के अनुसार, कुल 72 मत्स्य प्रजातियों की उपलब्धता देखी गई जिसमें से 4 विदेशी प्रजाति की थी इन विदेशी प्रजातियों की प्रधानता आगरा, वजिराबाद और इलाहाबाद में दर्ज की गयी। आई. बी. आई मैट्रिक्स के अनुसार यमुनानगर और इलाहाबाद में प्रदूषण निर्धारित सीमा में थे पर वजिराबाद में प्रदूषण अधिक था। आगरा में बहिःस्राव के कारण प्रदूषण का स्तर अधिक पाया गया।
- बायोरिमेडियेशन के लिये डाइक्लोरोफेनोल, ट्राइक्लोरोफेनोल या पेन्टाक्लोरोफेनोल के प्रभाव को कम करने के लिये 9 बैक्टीरियल स्ट्रेन को पृथक किया गया। परीक्षण के बाद यह पता चला कि 5 स्ट्रेन पेन्टाक्लोरोफेनोल के प्रभाव को कम करने में सक्षम हैं तथा बायोरिमेडियेशन के लिये उपयुक्त हैं। कुछ ऐसे ही अन्य पेन्टाक्लोरोफेनोल की पहचान की गई जिनके नाम हैं – ओक्रोबेक्ट्रम ऐन्थ्रोपि, स्युडोमोनास (विरीडिलिवाइड), क्लिसियोबैक्टिरियम ग्लियम/इन्डोलोजीनस।
- दामोदर नदी के विस्तार की विभिन्न मत्स्य प्रजातियों के निर्दिष्ट जीन को क्रम मे सजाया गया जिससे प्रदूषित व कम–प्रदूषित क्षेत्रों के मत्स्य प्रजातियों में पाये जाने वाली अनुवांशिकी भिन्नता का तुलनात्मक अध्ययन किया जा सके। गुडुसिया चापरा के जिनोमिक डी. एन. ए. के आर. ए. पी. डी. आंकड़ों से उपरी और नितल स्तर में पाये जाने वाले गुडुसिया चापरा की भिन्नता का पता नही चलता है। माइटोकोन्ड्रियल साइटोक्रोम बी जीन सिक्वेन्स के अध्ययन से पता चलता है कि इस नदी की प्रत्येक प्रजातियों, सिरहिनस मृगला और कतला कतला में 3 हैपलोटाइप्स उपलब्ध हैं।
- भारतीय मेजर कार्प प्रजाति जैसे लेबियो रोहिता के मांसपेशी और लेंस के प्रोटीन का प्रथम बार प्रोटिओम मैप तैयार किया गया। साथ ही रीता रीता के लेंस क्रिस्टालिन्स का दो–आयामी प्रोटिओम मैप तैयार किया गया।

अंतर्स्थलीय जल संसाधन का आंकलन

- रिमोट सेंसिंग के चित्रों की ग्राउंड ट्रुथिंग की गई जिससे लीनियर और मल्टी लीनियर रिग्रेशन मॉडेल का विकास किया जा सके। इससे जल व मिट्टी के प्राचलों के आंकलन में आसानी होती है। मुक्त कार्बन डाई ऑक्साइड को आई आर, लाल व हरे बैण्ड के साथ, नाइट्रेट को आई आर और एन आई आर बैण्ड के साथ, घुलित ऑक्सीजन और पी एच को लाल बैण्ड के साथ, कैल्शियम को लाल बैण्ड के साथ तथा विशिष्ट चालकता, कुल घुलित ठोस (टी डी एस), कुल क्षारीयता, कठोरता, प्रत्येक को हरे बैण्ड के साथ संबद्ध किया गया।
- स्पेक्ट्रल रिफ्लेक्टेन्स सिगनेचर द्वारा चित्रों का विश्लेषण क्लोरोफिल पिगमेंट सान्द्रता के आंकलन के लिये किया गया। इससे यह तथ्य सामने आया कि इन्फ्रा रेड बैण्ड में क्लोरोफिल ए, क्लोरोफिल बी, क्लोरोफिल सी, और क्लोरोफिल को क्रमशः R^2=0.526, R^2= 0.589, R^2= 0.611 और R^2= 0.615 से संबद्ध किया गया जो इस बैण्ड के क्लोरोफिल पिगमेंट सान्द्रता को बताता है।
- विशिष्ट चालकता के लिये लैण्डस्केप मैट्रिक्स पर आधारित मल्टीपुल लीनियर रिग्रेशन मॉडेल (R^2=0.9, P<0.01) का विकास किया गया। इसके संघटक गुण जैसे ग्रास लैण्ड और सेटलमेन्ट को प्रथम व द्वितीय महत्वपूर्ण व्याख्यात्मक

वेरियेबल के रूप में प्रयोग किया जाता है जैसे– विशिष्ट चालकता = -204.24 + 13.70g + 13.32s जहां g =ग्रास लैण्ड (%) और s = सेटलमेन्ट (%)।

- इलाहाबाद और ब्रह्मपुत्र नदी से एकत्रित संग्रहण आंकड़ों का गुवाहाटी में परीक्षण व विश्लेषण किया गया और इनको वेब–जी आई एस के लिये संग्रहित कर लिया गया।

अंतर्स्थलीय संसाधन का मूल्यांकन

- असम के चरन बील के जलीय संसाधनों के प्राकृतिक आकार, सामाजिक–आर्थिक विशेषतायें, मछुआरा समुदाय, संस्थानिक व्यवस्था व संचालन, जीविका के साधन और समुदायों के बीच पारस्परिक संबंध का आंकलन किया गया। इस बील द्वारा प्रदत्त वस्तुओं और सेवाओं का मूल्य करीबन रू. 50.24 लाख हुआ जिसमें मात्स्यिकी 45 प्रतिशत और अन्य प्राकृतिक संसाधन 34 प्रतिशत थे।
- गोसाबा ब्लॉक के आद्रक्षेत्र में 77 प्रतिशत किसान, 18 प्रतिशत मत्स्य पालक, और शेष व्यावसायी और पर्यटक इन संसाधनों का उपभोग करते हैं। यह मूल्यांकन कार्य अभी भी चल रहा है और वर्ष 2010–11 तक यह पूरा हो जायेगा।

अन्य परियोजनायें

संस्थान में इस रिपोर्ट वर्ष में संस्थागत परियोजना के अलावा निम्नलिखित बाहरी संगठनों द्वारा प्रायोजित कई परियोजनायें भी सम्मिलित थीं :

आइ सी ए आर नेटवर्क

- जलवायु परिवर्तन का भारतीय कृषि पर प्रभाव – अंतर्स्थलीय मात्स्यिकी पर जलवायु परिवर्तन के प्रभाव का मूल्यांकन।
- अंतर्स्थलीय खुले जल क्षेत्रों में मैक्रोबियल फासफोरस ट्रांसफोर्मेशन।

नेशनल एग्रीकल्चर इनोवेशन प्रोजेक्ट **(NAIP)**

- आहार चक्र में आर्सेनिक : कारण, प्रभाव एवं उपचार।
- अजैविक दाब सहनता हेतु जीन का बायोप्रोस्पेक्टिंग एवं अलेली माइनिंग।
- Toll like receptors in phylogenetically divergent fish species their contribution in modulating the innate immunity
- बिहार के पिछड़े जिलों में आवश्यकतानुसार एकीकृत पालन द्वारा जीविका में सतत सुधार।

केन्द्रीय सेक्टर योजना **(CSS)**

- मात्स्यिकी क्षेत्र से संबंधित डेटाबेस एवं भौगोलिक सूचना प्रणाली को सुदृढ़ बनाना।

पशुपालन, डेयरी व मात्स्यिकी विभाग

- भारतीय मछुआरों की शिक्षा, आय तथा स्वास्थ्य का मूल्यांकन

केन्द्रीय प्रदूषण नियंत्रण बोर्ड

- गंगा और यमुना नदी के जल की गुणवत्ता के अनुसार मात्स्यिकी का आंकलन

भूमिका

संक्षिप्त इतिहास

केन्द्रीय सरकार की कृषि, वानिकी तथा मात्स्यिकी से संबंधित उप–समिति के प्रस्ताव पर 17 मार्च 1947 को भारत सरकार के खाद्य व कृषि मंत्रालय के अंतर्गत केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान केन्द्र की स्थापना कलकत्ता में हुई। एक छोटे पैमाने पर प्रारंभ यह केन्द्र अपने कार्यकलापों के बल पर वर्ष 1959 में इसे एक पूर्ण संस्थान का दर्जा प्राप्त हुआ तथा ये बैरकपुर, पश्चिम बंगााल के नवनिर्मित भवन में स्थापित हुआ। कालान्तर में यह संगठन समूचे राष्ट्र की अंतर्स्थलीय मात्स्यिकी एवं जलकृषि के सर्वश्रेष्ठ अनुसंधान संस्थान के रूप में प्रतिष्ठित हुआ। वर्ष 1967 से यह भारतीय कृषि अनुसंधान परिषद्, कृषि अनुसंधान एवं शिक्षा विभाग, भारत सरकार का संस्थान है।

प्रारम्भ में संस्थान का मुख्य उद्देश्य देश के अंतर्स्थलीय मात्स्यिकी संसाधनों का उचित मूल्यांकन तथा इनके संरक्षण व अधिकतम समुपयोजन के लिए उपयुक्त प्रणालियों का विकास करना था। इस उद्देश्य पूर्ति के लिए संस्थान ने देश में उपलब्ध सभी अंतर्स्थलीय जल संसाधनों की पारिस्थितिकी एवं इनकी उत्पादन क्षमताओं के साथ साथ तालाबों की पारिस्थितिकी एवं उत्पादन से संबंधित कृषि पद्धतियों का अध्ययन किया जिससे प्रति यूनिट इकाई मत्स्य उत्पादन में वृद्धि की जा सके।

1960 और 1970 के दशक में संस्थान ने भारत सरकार के योजनागत जलकृषि अनुसंधान एवं विकास पर अपना ध्यान केन्द्रित करना आरम्भ किया। देश की मात्स्यिकी अनुसंधान एवं कृषि पद्धति में महत्वपूर्ण उपलब्धियों को प्राप्त करने के बाद संस्थान ने 4 अखिल भारतीय समन्वित अनुसंधान परियोजनाएं प्रारम्भ कीं। ये परियोजनायें थीं – मिश्रित मत्स्य पालन, नदीय मत्स्य बीज उत्पादन, वायु श्वासी मत्स्य पालन, जलाशयों की पारिस्थितिकी व मात्स्यिकी प्रबंधन तथा खाराजल मत्स्य पालन। वर्ष 1974 में प्रारम्भ की गई मिश्रित मत्स्य पालन व नदीय मत्स्य बीज उत्पादन नामक संयुक्त परियोजना की सफलता भारत में मत्स्य पालन के लिए एक ऐतिहासिक घटना थी जिसे देश के मीठाजल जीव पालन के विकास का आधार स्तम्भ माना जाता है। इस सफलता के परिणामस्वरूप वर्ष 1977 में धौली, उड़ीसा में केन्द्रीय मीठाजल जीवपालन अनुसंधान एवं प्रशिक्षण केन्द्र की स्थापना हुई जो वर्ष 1987 में केन्द्रीय मीठाजल जीवपालन अनुसंधान संस्थान के रूप में परिणत हुआ। इसी प्रकार संस्थान से अलग होकर केन्द्रीय खाराजल जीवपालन अनुसंधान संस्थान तथा राष्ट्रीय शीतजल मात्स्यिकी अनुसंधान केन्द्र की स्थापना हुई जिनका कार्य खाराजल जीव पालन एवं शीतजल मात्स्यिकी अनुसंधान करना है। अतः के. अं. मा. अनु. संस्थान को तीन प्रमुख अनुसंधान संस्थान के जन्म का श्रेय प्राप्त है।

अंतर्स्थलीय मात्स्यिकी संसाधन व उत्पादन में बदलते पर्यावरणीय, संस्थागत एवं संचालन संबंधी परिवर्तन के कारण संस्थान ने अनुसंधान की भावी चुनौतियों के लिये विभागों/प्रभागों का पुनरीक्षण किया है। वर्तमान में संस्थान के मुद्दों मे निम्नलिखित परिवर्तन किये गये हैं।

"इष्टतम उत्पादन" से "धारणीय उत्पादकता"
"मछली ही एकल लाभ" से "पारिस्थितिकी स्वास्थ्य व इससे लाभ"

इस परिवर्तन से संस्थान के दृष्टिकोण और लक्ष्य में भी परिवर्तन हुआ है।

दृष्टिकोण

जीविकोपार्जन और सामाजिक लाभ हेतु विवृत जल निकायों से अधितकम मत्स्य उत्पादन और उत्पादकता में वृद्धि।

लक्ष्य

मात्स्यिकी संवर्धन, जैव–विविधता संरक्षण तथा पारिस्थितिकी संबंधित सेवाओं के समायोजन के लिये सूचना आधारित प्रबंधन और अंतर्स्थलीय विवृत जल निकायों से अधिकाधिक सामाजिक लाभ प्राप्त करना।

पुनरीक्षित अधिदेश

- अंतर्स्थलीय विवृत जल क्षेत्र जैसे नदी, ज्वारनदमुख जिसमें लैगून, जलाशय एवं आर्द्रक्षेत्र भी सम्मिलित हैं, की मत्स्य व मात्स्यिकी पर वैज्ञानिक आंकड़ें तैयार करना ।
- जलाशय एवं आर्द्रक्षेत्र में दीर्घकालिक मात्स्यिकी के लिये पारिस्थितिकी पर आधारित प्रबंधन प्रणाली का विकास ।
- मात्स्यिकी पर बदलते पारिस्थितिकी के प्रभाव का मूल्यांकन तथा उसे कम करने के लिये योजनायें बनाना ।
- अंतर्स्थलीय खुले जल क्षेत्र मत्स्य प्रबन्धन पर परामर्शक सेवायें उपलब्ध कराना, प्रशिक्षण देना, जन जागृति उत्पन्न करना आदि।

संगठन

भारतीय कृषि अनुसंधान परिषद् ने गत् वर्ष संस्थान की अनुसंधान गतिविधियों को तीन प्रभागों के अन्तर्गत विभाजित करने की स्वीकृति दी। इन प्रभागों के अध्यक्ष पद तथा इलाहाबाद एवं गुवाहाटी प्रादेशिक केन्द्र के लिए दो प्रभारी पदों को भी अनुमोदित किया गया। इन पदों पर नियुक्ति हो गयी है। इन प्रभागों को विभिन्न अनुसंधान कार्यों में अन्य अनुभाग भी सहायता करते हैं। इलाहाबाद एवं गुवाहाटी प्रादेशिक केन्द्रों के प्रभारी उनके केन्द्रों में चल रही अनुसंधान परियोजनाओं के कार्यान्वयन में प्रशासनिक दायित्व संभालते है तथा इन परियोजनओं की तकनीकी देख–रेख तीनों प्रभागाध्यक्षों द्वारा किया जाता हैं।

नदीय पारिस्थितिकी एवं मात्स्यिकी प्रभाग

बैरकपुर स्थित यह प्रभाग देश की नदीय तथा ज्वारनदमुख की पारिस्थितिकी तथा मात्स्यिकी के प्रबंधन हेतु प्रभावकारी योजनाओं के विकास तथा उनमें मत्स्य संरक्षण पर अनुसंधान करता है। इस प्रभाग की अनुसंधान परियोजनाएं बैरकपुर, कोलकाता, वडोदरा तथा इलाहाबाद प्रादेशिक केन्द्र से कार्यान्वित होती हैं।

मत्स्य संसाधन एवं पर्यावरणीय अनुमापन प्रभाग

बैरकपुर स्थित यह प्रभाग निम्नलिखित विषयों पर अनुसंधान करता है–

1. विवृत जल मत्स्य संसाधन जैसे नदी, आर्द्र क्षेत्र, जलाशय तथा ज्वारनदमुखों में मत्स्य स्वास्थ्य एवं पर्यावरण से संबंधित पहलू, जलीय परितंत्रों का अनुमापन तथा सुधार के उपाय
2. मत्स्य सम्पदा एवं मत्स्य संसाधन से संबंधित डाटाबेस तैयार करना। इस डाटाबेस का मुख्य उद्देश्य है अंतस्थलीय मत्स्य सम्पदाओं के सतत उपयोग हेतु मॉडल का विकास करना।

जलाशय एवं आर्द्र क्षेत्र मात्स्यिकी प्रभाग

इस प्रभाग का मुख्य उद्देश्य देश के बड़े, मध्यम और छोटे जलाशयों में मत्स्य उत्पादन वृद्धि हेतु प्रबंधन प्रणालियों का विकास करना है। यह प्रभाग आर्द्र क्षेत्र परितंत्रों की उत्पादन प्रक्रियाओं पर अनुसंधान तथा जैव विविधता संरक्षण पर पर्याप्त ध्यान देते हुए मत्स्य उपज की वृद्धि हेतु अनुसंधान करता है। बैरकपुर, बैंगलोर तथा गुवाहाटी व इलाहाबाद प्रादेशिक केन्द्रों से इस प्रभाग का अनुसंधान कार्य होता है।

कृषि आर्थिकी अनुभाग

इस अनुभाग की स्थापना इसी वर्ष की गयी है। यह देश के विभिन्न विवृत मत्स्य जल संसाधनों में सामाजिक, संस्थागत एवं आर्थिक विषयों पर अनुसंधान करता है। यह बैरकपुर में स्थित है पर देश की अन्य कई भागों में इसकी परियोजनायें चल रही हैं।

अनुसंधान सहायक सेवायें

संस्थान की विभिन्न गतिविधियों में निम्नलिखित अनुभाग / सेल / यूनिट सहायता करते हैं –

विस्तार व प्रशिक्षण कक्ष – इस कक्ष से प्रशिक्षण, प्रदर्शनियां, निरूपण कार्यक्रम, मत्स्य पालक दिवस आदि का आयोजन होता है और अंतर्स्थलीय मात्स्यिकी से संबंधित विविध तकनीकी प्रणालियों को मत्स्य पालकों, मछुआरों, उद्यमियों, विस्तार कार्यकर्त्ताओं तक पहुंचाया जाता है। यह कक्ष बाहरी प्राधिकरणों से सम्पर्क बनाये रखता है। संस्थान में यह कक्ष मानव संसाधन विकास कार्य का कार्यान्वयन करता है।

तकनीकी कक्ष – तकनीकी कक्ष द्वारा परिषद् तथा मात्स्यिकी प्रभाग को भेजे जाने वाली सभी प्रकार की रिपोर्ट तैयार किया जाता है एवं संसद एवं परिषद् द्वारा पूछे गए भेजे गए तकनीकी प्रश्नों का उत्तर दिया जाता है।

परियोजना अनुमापन एवं प्रलेखन कक्ष – प्रलेखन कक्ष द्वारा विभिन्न प्रकार की तकनीकी रिपोर्ट, छमाही न्युजलेटर और वार्षिक प्रतिवेदन को प्रकाशित किया जाता है साथ ही यह आर. पी. एफ. फाइल एवं वैज्ञानिक लेख आदि की देख–रेख भी करता है। वर्ष 2009–10 के दौरान इस कक्ष द्वारा छः वैज्ञानिक बुलेटिन एवं वार्षिक रिपोर्ट, न्यूजलेटर तथा कई ब्रोशर इत्यादि का प्रकाशन किया गया।

सूचना प्रौद्योगिकी एवं ऐरिस कक्ष – यह कक्ष सूचना प्रौद्योगिकी के उपयोग हेतु प्रोत्साहित करता है तथा संस्थान के अधिकारियों को 24 घंटे इंटरनेट की सुविधा प्रदान करता है। इस कक्ष द्वारा कम्प्यूटर उपयोग हेतु आवश्यक तकनीकी सहायता भी दी जाती है।

पुस्तकालय व सूचना अनुभाग – संस्थान का पुस्तकालय मुख्यालय व अनुसंधान केन्द्रों में कार्यरत वैज्ञानिकों की आवश्यकताओं के अलावा अन्य संगठनों के शोधकर्ताओं, अध्यापकों, विद्यार्थियों तथा अधिकारियों को भी अपनी सेवायें उपलब्ध कराता है। वर्ष 2009–2010 के दौरान संस्थान के पुस्तकालय में 656 पुस्तकें, 17 विदेशी जरनल, 25 भारतीय जरनल की वृद्धि हुई है। इस समय पुस्तकालय में कुल 12662 पुस्तकें, 4320 पुनर्मुद्रित लेख, 1252 मानचित्र और 4350 विविध प्रकाशनों का संग्रह है। वर्तमान में पुस्तकालय में आधुनिक साफ्टवेयर लगाये गये हैं और उपलब्ध पुस्तकों एव अन्य सामग्री का पूर्ण डिजिटाइजेशन कार्य भी किया जा रहा है।

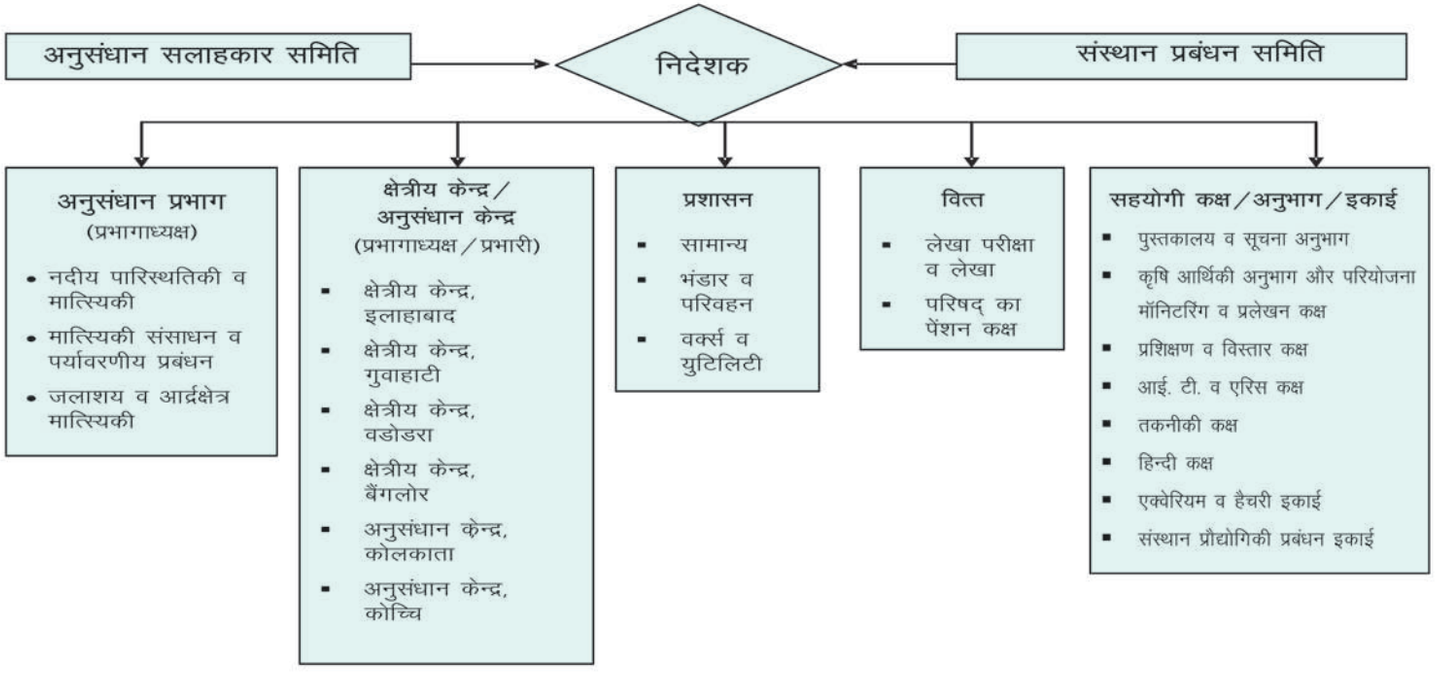
संस्थान प्रौद्योगिकी प्रबंधन इकाई – इस इकाई द्वारा संस्थान के आइ. पी. आर. सम्बधित कार्य किये जाते हैं।

एक्वेरियम और हैचरी इकाई – संस्थान में स्थापित एक्वेरियम तथा हैचरी की देख–रेख इस इकाई द्वारा की जाती है।

हिन्दी कक्ष – यह कक्ष अनेक प्रकार के तकनीकी प्रलेख, वार्षिक रिपोर्ट, न्यूजलेटर तथा अन्य रिपोर्टों को हिंदी में प्रकाशित करता है। यह कक्ष हिंदी को राजभाषा रूप में स्थापित करने एवं इसे लोकप्रिय बनाने के लिए सतत् प्रयासशील है।

संस्थान का प्रमुख अनुसंधान प्रबंधन पद निदेशक का है। संस्थान प्रबंधन का सम्पूर्ण दायित्व निदेशक की अध्यक्षता में गठित प्रबंधन समिति का है। अनुसंधान सलाहाकार समिति संस्थान की अनुसंधान तथा विस्तार कार्य हेतु विशेष आवश्यक सुझाव देती है जो संस्थान की अनुसंधान परियोजनाओं के विकास एवं सुधार में सहयोग देता है। संस्थान की अनुसंधान परियोजनयें मुख्यालय बैरकपुर तथा अन्य प्रादेशिक केन्द्रों इलाहाबाद, बैंगलोर, वडोदरा और गुवाहाटी से कार्यान्वित होती है।

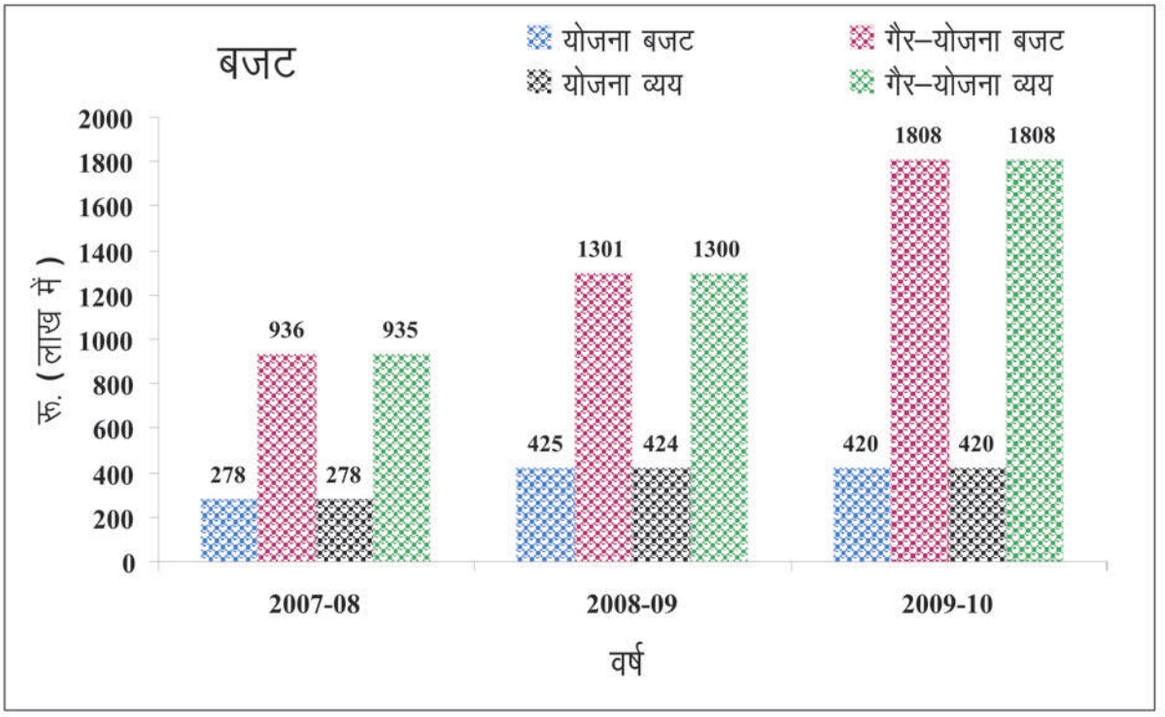
के. अं. मा. अनु. संस्थान का संगठनात्मक ढ़ांचा



बजट

संस्थान का बजट – वर्ष 2009–10 (लाख में)

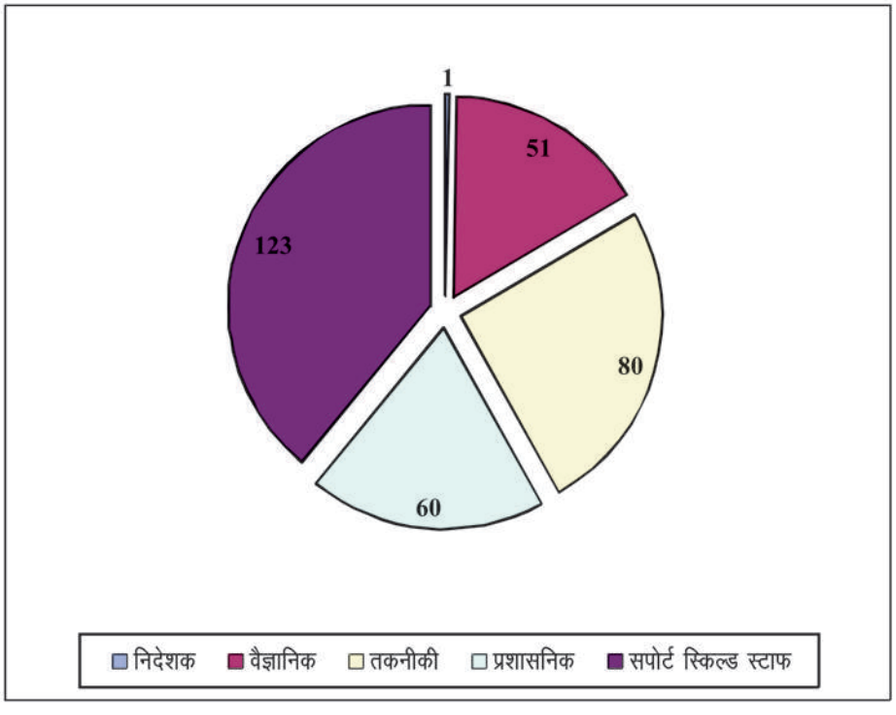
लेखा शीर्ष	संशोधित बजट		व्यय	
	योजना	गैर–योजना	योजना	गैर–योजना
वेतन व अन्य भत्ते समयोपरि भत्ता सहित	-	1723.67	-	1723.67
यात्रा भत्ता	28.00	4.14	28.00	4.14
अन्य खर्च	287.00	64.19	286.67	64.19
सूचना प्रौद्योगिकी एवं मानव संसाधन विकास सहित				
वर्क्स	105.00	15.67	105.00	15.67
कुल योग	**420.00**	**1807.67**	**419.67**	**1807.67**



संस्थान के अधिकारी व कर्मचारी

दिनांक 31 मार्च 2010 तक संस्थान में अधिकारियों व कर्मचारियों की संख्या

क्रम संख्या	वर्ग	स्वीकृत पदों की संख्या	भर्ती हुये पदों की संख्या	रिक्त पदों की संख्या	टिप्पणी
1.	निदेशक (अनुसंधान प्रबंधन पद)	1	1	-	
2.	वैज्ञानिक	98	51*	47	* परिषद् के अनुसार कृषि विज्ञान केन्द्र के 2 तकनीकी अधिकारियों को वैज्ञानिक पदों में सम्मिलित किया गया।
3.	तकनीकी	87	80	7	
4.	प्रशासनिक	80	60	20	
5.	सपोर्ट स्कील्ड स्टाफ	153	123	30	
कुल		**419**	**315**	**104**	



अनुसंधान उपलब्धियां

संस्थागत परियोजनायें

अनुसंधान कार्यक्रम : नदी व संबद्ध परितंत्रों में मत्स्य स्टॉक और प्रबंधन प्रोटोकाल का विकास

यमुना नदी की जलीय पारिस्थितिकी और मात्स्यिकी

एच. पी. सिंह, आर. के. त्यागी, वी. पाठक और बी. के. सिंह

यमुना नदी से प्रतिपालित उत्पादन के लिये जल और पारिस्थितिकी के प्राचलों, जल प्रवाह, संभावित उर्जा संसाधन और मात्स्यिकी पर सूचनायें एकत्र की गई। गाद में क्षारीयता की मात्रा 7.3 से 7.5 पाई गई। उपरी स्तर के गाद में बालु का अंश (85 से 95.5 प्रतिशत) अधिक पाया गया पर निचले स्तर में दोमट और सिल्ट की मात्रा अधिक थी। जैव कार्बन की उपलब्धता कम (0.028 से 0.5 प्रतिशत) थी। यमुना नगर में बहिःस्रावों के प्रवाह और जलप्रवाह में कमी के कारण रसायनिक प्राचलों के गुणवता में कमी देखी गई। पर दिल्ली और इटावा के मध्य यमुना नदी के जल की गुणवत्ता में अधिक ह्रास हुआ है। चंबल, बेतवा, केन और अन्य सहायक नदियों के कारण हमीरपुर संगम में थोड़ा सुधार देखा गया। उर्जा रूपान्तरण (4180 से 6400 कैलरी प्रति वर्ग मी. प्रति दिन) के अनुसार संभावित मत्स्य उत्पादन 145 से 221 कि. ग्रा. प्रति हे. हुआ। प्लवकों की औसत उपलब्धता आगरा में (1952 ul^{-1}) और न्युनतम (113 ul^{-1}) पानीपत में दर्ज किया गया। पादपप्लवको में बैसिलेरियोफाइसी और जंतुप्लवक में रोटीफेरा एवं अरैल (580 ucm^{-2}) की प्रधानता देखी गई। सभी केन्द्रों के शैवालो में सिनेड्रा एस पी और नेविकुला एस पी की उपलब्धता अधिक थी। बेंथिक फौना के अध्ययन से पता चला कि मेक्रोबेंथिक जीवाश्मों अधिक थे एवं इनकी उपलब्धता मथुरा में सबसे अधिक (2678 nm^{-2}) था। इसके बाद दिल्ली (1059 nm^{-2}) और सबसे कम बदवाला (169 nm^{-2}) में दर्ज किया गया।

हमीरपुर और अरैल के बेंथिक में मोलस्क (कॉम्पिलोमा एस पी, स्फेरियम एस पी और लिमेनिया एस पी) की प्रधानता देखी गई। इन क्षेत्रों के जल में प्रदूषण कम था जिससे जल की गुणवत्ता अधिक पाई गई। यद्यपि यमुना नदी के मत्स्य उत्पादन में कमी आई है। सदियापुर और दारागंज में मत्स्य उत्पादन 143.14 टन और 37.79 टन हुआ जिसमें तिलापिया की अधिकता थी और कॉमन कार्प के उत्पादन में वृद्धि हुई। अन्य प्रजातियां 34.4 प्रतिशत, मेजर कार्प 12.1 प्रतिशत और बड़े कैटफिश 7.1 प्रतिशत थीं। पिछले वर्ष की तुलना में इस वर्ष अधिक उपज (62.5 प्रतिशत) हुई जिसमें कॉमन कार्प का उत्पादन तीन गुणा अधिक था। तिलापिया व अन्य प्रजातियों का उत्पादन क्रमशः 46 व 59 प्रतिशत दर्ज किया गया। इसका कारण शायद वर्षाकाल में कमी होने के कारण प्रग्रहण अधिक समय तक किया गया। दारागंज के मत्स्य उत्पादन के कोई परिवर्तन नही था। नदी के उपरी क्षेत्र में सिजोथोरेक्स एस पी और टी पुटिटोरा की प्रधानता थी। यमुनानगर और दिल्ली क्षेत्र में छोटी और विदेशी मत्स्य प्रजातियों का उत्पादन हुआ। दिल्ली और इटावा क्षेत्र में तिलापिया अधिक (84 से 95 प्रतिशत) पाई गई। हमीरपुर–इलाहाबाद क्षेत्र में छोटी और विदेशी मत्स्य प्रजातियों एवं तिलापिया (13 प्रतिशत) का उत्पादन हुआ।

विशिष्ट नदीय लिंक पर पारिस्थितिकी और प्रोडक्शन फंक्सन का प्रभाव

एच. पी. सिंह, आर. के. त्यागी, वी. पाठक, बी. के. सिंह, आर. एस. श्रीवास्तव, डी. देबनाथ और ए. के. साहू

मछलियों के अनुवांशिकता परिवर्तन पर केन–बेतवा के लिंक के संभावित प्रभाव का अध्ययन किया गया। केन व बेतवा नदियों के जैव व अजैव प्राचलों के अध्ययन का उद्देश्य इन नदियों की जलीय स्थिति, पारिस्थितिकी और मात्स्यिकी पर नदीय लिंक के प्रभाव का आंकलन करना था। इस अध्ययन से प्राप्त प्राचल संबंधी परिणाम बताते हैं कि पी. एच. – 7.4 से 7.6, जैव कार्बन – 0.05 से 0.7 प्रतिशत, ऑक्सीजन – 7.0 और 6.5 मि.ग्रा./ली., फॉस्फेट – 0.04 और 0.06 मि.ग्रा./ली, नाइट्रेट – 0.06 और 0.08 मि.ग्रा./ली और घुलित जैव पदार्थ – 1.2 और 1.6 मि.ग्रा./ली. थे।

इन नदियो के मिट्टी में बालु (78 से 82 प्रतिशत) और (14.0 से 18.1 प्रतिशत) सिल्ट की उपलब्धता पाई गई। केन नदी में क्षारीयता, चालकता, घुलित ठोस पदार्थ, कठोरता और क्लोराइड का स्तर बेतवा नदी से अधिक था। केन और बेतवा में उर्जा रूपान्तरण क्रमशः

3280 कैलरी प्रति वर्ग मी. प्रति दिन और 2312 कैलरी प्रति वर्ग मी. प्रति दिन रहा। केन नदी में प्लवक की उपलब्धता 50 – 460 ul^{-1} तथा बेतवा में 180 – 880 ul^{-1} थी। उपलब्ध प्लवक प्रजातियां सिम्बेला, सिनेड्रा, सेलेनास्ट्रम और एंकिस्ट्रोडेस्मस थीं। पादपप्लवक केन नदी में 230 से 2300 ucm^{-2} और बेतवा नदी में 460 से 1300 ucm^{-2} पाये गये। इसी प्रकार जंतुप्लवक भी केन नदी में 50 से 600 ucm^{-2} और बेतवा नदी में 50 से 530 ucm^{-2} पाये गये। दोनों नदियों में मोलस्क की उपलब्धता भी देखी गई।

नदियों के पर्यावरणीय जल प्रवाह का अध्ययन

वी. पाठक, आर. एन. सेठ, आर. के. त्यागी, डी. देबनाथ और ए. के. साहू

देश में पर्यावरणीय जल प्रवाह संबंधी सूचनाओं का अभाव है। इसलिये जैव समुदायों के पर्यावरणीय जल प्रवाह, संभावित उत्पादन का आंकलन और मात्स्यिकी संबंधी सूचनाओं के एकत्रीकरण के लिये इस परियोजना को प्रारंभ किया गया। सबसे पहले सोन नदी पर बने इन्द्रपुरी बराज पर कार्य आरंभ हुआ। वर्ष 1976 की तुलना में वर्तमान में इस बराज का जल प्रवाह बहुत ही कम देखा गया ($18,772 \times 10^7 m^3$) । बाढ़ के महीनों (जुलाई– अक्टुबर) जल प्रवाह $14,034 \times 10^7 m^3$ था। कभी–कभी तो जल प्रवाह की मात्रा बिल्कुल शून्य हो जाती है। इस जल प्रवाह में कमी और गाद के अत्यन्त जमाव के कारण नदी का जल क्षेत्र बिल्कुल घट गया। इस क्षेत्र के जल प्राचल जैसे ऑक्सीजन – 7.2 मि.ग्रा./ली., पी. एच. – 7.6, क्षारीयता – 68 मि.ग्रा./ली., चालकता – 190 µmhos, घुलित ठोस पदार्थ – 98 मि.ग्रा./ली. और कठोरता – 62 मि.ग्रा./ली. दर्ज किये गये।

गाद में बालु का अंश अधिक पाया गया। मानसून के समय मेक्रोबेंथोस जीवाश्म की उपलब्धता कम थी पर शीत ऋतु में कोइलवर (50 nm^{-2}) और देहरी–सोन (592 nm^{-2}) क्षेत्र में ये अधिक पाई गई। मोलस्क की प्रधानता देखी गई जिनमें स्फेरियम एस पी, कोम्पलोमा एस पी, गोनियोबेसिस एस पी और लिमेनिया एस पी प्रमुख थे। औसत उपज देहरी–सोन से 45–50 कि.ग्रा प्रति दिन, तिलाथु से 15–20 कि.ग्रा. प्रति दिन और कोइलवर से 20–25 कि.ग्रा प्रति दिन आंकी गई। उपज में छोटी ट्राश मछलियों जैसे गेगाटा सिनिया उपलब्ध थीं। शीत ऋतु में एओरिक्थस एस पी के जीरे और रीता रीता, ई. वाचा, सी गरूआ, एम. आर्मेटस, एम. एकयुलिएटस और बी. बगारियस के बच्चों की उपलब्धता थी। मेजर कार्प और माइनर कार्प की उपलब्धता कम थी। मछलियों को पकड़ने के लिये विभिन्न आकार के छिद्रों वाले जालों (हुक और लाइन) का प्रयोग किया गया। कुल 37 मत्स्य प्रजातियों का प्रग्रहण किया गया। 60 और 70 के दशक में कोइलवर क्षेत्र से औसतन 4787 मिट्टी के हंडियों में मछलियों के अण्डों को भेजा जाता था पर अब यह केवल 150 मि. ली. वाले अल्युमिनियम के बर्तनों (औसतन 10–12 बर्तन) ही रह गया है जिसका परिणाम यह हुआ है कि सोन नदी क्षेत्र में मछली के अण्डों का व्यवसाय संपूर्ण रूप से समाप्त हो चुका है।

अनुसंधान कार्यक्रम : ज्वारनदमुख व संबंद्ध परितंत्रों में मत्स्य स्टॉक तथा प्रबंधन प्रोटॉकाल का विकास

पूर्वी तट ज्वारनदमुख के पारिस्थितिकी एवं मात्स्यिकी से संबंधित सूचनाओं को एकत्रित करना (सुवर्णरेखा)

बी. बी. सत्पथी, के. आर. नस्कर एवं ए. के. साहू

सुवर्णरेखा ज्वारनदमुख समुद्र से जालेश्वर तक 45 कि.मी. (कुल नदी क्षेत्र का 45 प्रतिशत) के क्षेत्र मे फैला हुआ है। कुल ज्वारनदमुख तीन विस्तार क्षेत्रों में बांटा गया है – उच्च लवणीय क्षेत्र, परिवर्ती और मीठाजल क्षेत्र।

सुवर्णरेखा ज्वारनदमुख मानसून पूर्व (जनवरी – से जून) प्रायः सूखा रहता है पर मानसून के दौरान इसमें बाढ़ जैसी स्थिति हो जाती है। इससे इस ज्वारनदमुख की मात्स्यिकी पर गहरा प्रभाव पड़ता है। सबसे अधिक जलप्रवाह 2400 $m^3 s^{-1}$ तक होता है। यहां जल की लवणीयता किरतनिया मे 1.04–27.10 पी पी टी, दहामुण्डा में 0.05–2.45 पी पी टी और जालेश्वर में 0.04–0.09 पी पी टी तक होती है।

इस ज्वारनदमुख में प्लवक की सान्द्रता लवणीय क्षेत्र में 350 से 500 ul^{-1} और परिवर्ती क्षेत्र में सबसे कम पायी गयी। पादपप्लवक की प्रधानता देखी गई। मीठेजल क्षेत्र में जन्तुप्लवक में मिसोसाइक्लोप्स एस. पी., डायपटोमस एस. पी., ब्रेकोनियस एस. पी और कोपेपोड की प्रधानता थी। मोलस्क 50 प्रतिशत तक पाया गया। झींगा की 13 प्रजातियां तथा केकड़ों की 7 प्रजातियों को दर्ज किया

गया। इस ज्वारनदमुख में 17 आर्डर एवं 53 वर्ग की 135 मत्स्य प्रजातियां की उपलब्धता देखी गई। लवणीय क्षेत्र में प्रजातियों की संख्या अधिक थी। कुल उपज का 50 प्रतिशत मानसून के दौरान किया गया । ज्वारनदमुख के निचले स्तर में हिल्सा की प्राप्ति कुल उपज के 35 प्रतिशत से कम हुई।

फिश पास के निर्माण के लिये अभिगमन वाली मत्स्य प्रजातियों का अध्ययन

उत्पल भौमिक, एन. पी. श्रीवास्तव, पी. के. कटिहा, बी. बी. सत्पथी, आर. के. मन्ना एवं डी. देबनाथ

पूर्वी क्षेत्र में फिश पास की वर्तमान स्थिति का अध्ययन किया गया। रायपुर और कटक तक बहुत से बांध बनाये गये हैं पर फिश पास केवल दो बराज, जोबरा और नराज पर ही हैं। ये फिश पास मछलियों के अभिगमन के लिये प्र्याप्त नहीं हैं । निचले क्षेत्र में 20 मछलियों का अभिगमन हुआ जिसमें हिल्सा भी थी। समुद्र के मुहाने से 35 कि.मी. क्षेत्र तक मछलियों का अभिगमन दर्ज किया गया। अभिगमन वाली मछलियां थीं – मुगिल सेफालस, लेट्स कैलकेरीफर, लिजा टाडे, लिजा पारसिया, पामा पामा, राइनोमुगिल कोरसुला, टेनुआलोसा इलिशा, सिलागा सिहामा, सिलागिनोपिस पैनिजस, ग्लोगोबियस गुरिस, ब्रेकिगोबियस नुनुस, स्युडोपोरिप्टस लैन्टिओलेटस, जेनेन्टोडोन कैन्सिला। हुगली ज्वारनदमुख के लवणीय क्षेत्र में हिल्सा की उपज अधिक हुई (जुलाई और अगस्त में फ्रेजरगंज में > 5 टन/दिन) पर परिवर्ती और उपरी क्षेत्रों में कम हुई (50 किग्रा. एवं 10 कि.ग्रा. /दिन डायमंड हार्बर और नवाबगंज)। निरीक्षण से पता चला कि हिल्सा अभिगमन के लिये निम्नलिखित स्थितियों का होना आवश्यक है :–

- जल की गहराई 4 मी. से अधिक और धारा का वेग c 20 मीटर प्रति मिनट हो
- ज्वारनदमुख का आकार बड़ा हो
- ज्वारनदमुख का मुहाना गहरा और चौड़ा हो
- मीठेजल की धारा पर्याप्त हो
- लवणीयता में कमी और उपयुक्त टर्बिडिटी हो

टर्बुलेन्स और धारा प्रवाह की गति तेज होने से मछलियां किनारे पर आ जाती हैं। इस ज्वारनदमुख में प्रायः वर्षभर हिल्सा की उपलब्धता रहती है। महानदी, देवी और सुवर्णरेखा ज्वारनदमुखों के मुहानों पर अत्यधिक गाद का जमाव होने से हिल्सा के अभिगमन में कठिनाई होती है। नवदीप से काकद्वीप तक किये गये सर्वेक्षण से पता चलता है कि नदी की गहराई और चौड़ाई से मत्स्ययन प्रयास और उपज पर सीधा प्रभाव पड़ता है। 3 मी. से कम गहरे जल में मत्स्ययन कार्य नही देखा गया। 10 मी. की गहराई वाले जल में मत्स्ययन अधिक होता है। बाकी दिनों की तुलना में मानसून में हिल्सा का उत्पादन अधिक हुआ। अन्वेषित 100 कि.मी. मीठेजल क्षेत्र में हिल्सा का वितरण समान रूप देखा गया जो दर्शाता है कि मीठाजल क्षेत्र हिल्सा के जीरों के परिपक्व होने में अधिक उपयुक्त है।

लवणीयता मत्स्य प्रजातियों के अभिगमन और उनकी उपलब्धता के लिये एक महत्वपूर्ण कारक है। काकद्वीप से दक्षिणेश्वर तक लवणीयता का स्तर 18.8–0.05 पी पी टी के बीच था । उच्च ज्वार के समय जल की लवणीयता बढ़ जाती है।

मछुआरों के सामाजिक–आर्थिक जीवन स्तर के अध्ययन से पता चलता है कि अधिकतर 20–50 वर्ष वाले मछुआरे मत्स्यन कार्य से जुड़े हुये हैं। मत्स्यन के लिये गिल नेट, गिअर और नाव का उपयोग किया जाता है। मत्स्यन सबसे अधिक जून–सितम्बर, मध्यम फरवरी–अप्रैल और सबसे कम नवम्बर–जनवरी में होता है। गिल नेट से औसत संग्रहण 2.21 कि.ग्रा./दिन (नवम्बर–जनवरी), 2. 42 कि.ग्रा./दिन (फरवरी–अप्रैल) और 3.12 कि.ग्रा./दिन (जून–सितम्बर) के दौरान दर्ज किया गया। हुगली ज्वारनदमुख से नवम्बर 2009–जनवरी 2010 के दौरान 36427.9 टन उत्पादन हुआ (मत्स्यन प्रयास 37.39 कि.ग्रा./जाल/व्यक्ति) । गत् वर्ष यह उत्पादन 19935.5 टन था (मत्स्यन प्रयास 36.14 कि.ग्रा./जाल/व्यक्ति) । उत्पादन में वृद्धि मत्स्ययन कैम्प्स, बैग नेट, मेकेनाइज्ड और नॉन मेकेनाइज्ड बोट और इससे जुड़े लोगों के प्रयास के कारण हुआ। संग्रहित मछलियों में एच. नेहेरस 27.3 प्रतिशत, सेटिपिना एस पी पी 21.4 प्रतिशत, ट्राइक्युरिस एस पी पी 11.5 प्रतिशत और झींगा 10.2 प्रतिशत थे।

सॉफ्टवेयर मॉडेल का विकास व परीक्षण
एस. एन. सिंह, के. चन्द्रा एवं ए. के. प्रुस्ति

साबरमती ज्वारनदमुख का निरीक्षण पारिस्थितिकी स्वास्थ्य के लिये किया गया। घुलित ऑक्सीजन की मात्रा 0 से 6.25 मि.ग्रा. प्रति ली. थी जो पर्यावरणीय दाब को दिखाता है। निचले तल में घुलित ऑक्सीजन की मात्रा कम थी। इस ज्वारनदमुख से निम्नलिखित परिणाम प्राप्त हुये–

- जल की स्वच्छता – 5.0 से 105.0 से.मी.
- जल का तापमान – 22.0 से 32° सेंटीग्रेड
- पी एच – 7.1 से 7.5
- मुक्त कार्बन डाई ऑक्साइड – 42.0 मि.ग्रा. प्रति ली.
- फॉस्फेट – 0.061 से 0.435 मि.ग्रा. प्रति ली.
- नाइट्रेट – 0.973 से 2.857 मि.ग्रा. प्रति ली.
- सिलीकेट – 7.51 से 16.43 मि.ग्रा. प्रति ली.
- कुल क्षारीयता – 151.85 से 287.6 मि.ग्रा. प्रति ली.
- विशिष्ट चालकता – 2046.25 से 2475.0 μ Scm^{-1}
- जैव कार्बन – 0.12 से 0.97 प्रतिशत
- उपलब्ध फॉसफोरस – 1.10 से 3.98 मि.ग्रा. प्रति 100 ग्रा.
- उपलब्ध नाइट्रोजन – 5.60 से 9.20 मि.ग्रा. प्रति 100 ग्रा.

गाद में पी एच का स्तर 7.1 से 7.5 तक थी। प्लवक के संरचना की जांच से पता चला है कि पादपप्लवक का घनत्व 53.36 से 99.30 प्रतिशत थी जबकि जन्तु प्लवक का 0.44 से 46.64 प्रतिशत थे।

साबरमती ज्वारनदमुख को प्रदूषित माना जा रहा है। जूग्लोइया रैमिजेरा (0.58 से 1.81 प्रतिशत) जो जल की गुणवत्ता का जैव–सूचक है, यह बताता है कि यह ज्वारनदमुख घरेलु व औद्योगिक बहिःस्रावों से प्रदूषित हो चुका है। जैव–विविधता इंडिसेज जैसे शैनोन–विवर इंडेक्स (एच), इवननेस इंडेक्स (जे), सिंपसन इंडेक्स (1–) और मारगालेफ इंडेक्स (डी), से डिप्टेरा के धनत्व का पता चलता है। इस ज्वारनदमुख के मत्स्य उत्पादन में माइनर कार्प 45.5 प्रतिशत और मेजर कार्प 22.7 प्रतिशत दर्ज किये गये।

अनुसंधान कार्यक्रम : भारतीय जलाशयों की मत्स्य उत्पादकता में वृद्धि

विभिन्न कृषि जलवायु में स्थित छोटे जलाशयों में मत्स्य उपज की वृद्धि हेतु विभिन्न स्थानों पर परीक्षण

डी. एस. के. राव, आर. एन. सेठ, बी. के. सिंह, पी. के. कटिहा, रानी पलानीस्वामी एवं एम. कार्तिकेयन

इस परियोजना को कर्नाटक के सुवर्णवती, केरल के कन्हिराफुजा तथा उत्तर प्रदेश के अर्जुनसागर जलाशयों में कार्यान्वित किया गया। कर्नाटक के चरमराजनगर में कावेरी की उपनदी सुवर्णावती पर बना सुवर्णवती जलाशय एक छोटा जलाशय है। जलाशय का सरोवरीय अभिलक्षण, इसकी उत्पादकता को इंगित करता है। इस जलाशय में 838 बीज/हे./वर्ष (कतला 42 प्रतिशत, रोहू 19 प्रतिशत, मृगल 11 प्रतिशत, कामन कार्प 24 प्रतिशत तथा ग्रास कार्प 4 प्रतिशत) की दर से संग्रहित किया गया। संग्रहित बीजों की लम्बाई 3–5 से.मी. थी। इससे 78.1 टन की उपज प्राप्त हुई जो अधिकतम 22.1 टन अप्रैल, 2009 में तथा न्यूनतम 0.83 टन जनवरी, 2010 में थी। भारतीय मेजर कार्प की तीनों प्रजातियों में अच्छी वृद्धि देखी गई। कुल उपज में भारतीय मेजर कार्प मछलियों का योगदान 95.5 प्रतिशत रहा। पिछले वर्ष की उपज दर 172 कि.ग्रा./हे. की तुलना में इस वर्ष यह 197 कि.ग्रा./हे. हुई। वर्ष में कुल 195 दिन मत्स्ययन किया गया। प्रति युनिट उपज दर अप्रैल माह में सर्वाधिक तथा जनवरी माह में न्यूनतम पाया थी। वैज्ञानिक प्रबन्धन के मूल्यांकन से स्पष्ट होता है कि पिछले वर्ष की तुलना में मत्स्य उपज में 48.3 प्रतिशत की वृद्धि हुई जिसका मुख्य कारण हैं– वर्ष 2007 में 8 से 10 से.मी. की मत्स्य अंगुलिकाओं का संग्रहण; मत्स्ययन जालों के छिद्रों के आमाप को नियंत्रित करना; तथा मत्स्ययन प्रयासों में तेजी। इस उपज वृद्धि से मछुआ समिति की सकल आय में रू 11,72,000/– तथा प्रत्येक मछुआरे की वार्षिक आय रू 22,000/– हो गई। इस जलाशय में मात्स्यिकी विकास के लिए सिफारिशें हैं – एक किलोग्राम से अधिक वजनवाली मछलियों को ही पकड़ना; भारतीय मेजर कार्प की 10 से.मी. से अधिक लम्बी अंगुलिकाओं को 300–500 बीज/हे. की दर से संग्रहित करना; कॉमन कार्प एवं ग्रास कार्प मत्स्य बीजों के संग्रहण को कम करना तथा मत्स्ययन दिवसों को बढ़ाना।

कन्हिराफुजा जलाशय – इस जलाशय में 1698 बीज/हे./वर्ष (कतला कतला 35 प्रतिशत, सिरहीनस मृगला 37 प्रतिशत तथा लेबियो रोहिता 28 प्रतिशत) की दर से मत्स्य बीजों का संग्रहण किया गया। सिरहीनस मृगला की विकास की तुलना में कतला कतला का विकास बड़ी तेजी से हुआ। लेबियो रोहिता एवं ग्रास कार्प मछलियां प्राप्त उपज में नहीं पायी गईं जिससे स्पष्ट होता है कि जलाशय इन प्रजातियों के लिए अनुपयुक्त है। प्राप्त मत्स्य उपज में अधिकतर स्थानीय, ए. मोला, जी. करमुका तथा पुटिंयस प्रजातियां थी। जनवरी से मार्च के दौरान कतला कतला तथा सिरहीनस मृगला की उपज में वृद्धि हुई। कुल उपज में जी. करमुका की अधिकता रही और इनके आंतों में अपरद व सड़े पदार्थ (62.4 प्रतिशत) तथा बालु (25.3 प्रतिशत) पाये गए।

अर्जुनसागर जलाशय – उत्तर प्रदेश स्थित इस जलाशय का क्षेत्रफल 1190 हे. है। जलाशय के विभिन्न प्राचलों के अध्ययन से स्पष्ट होता है कि इस जलाशय की उत्पादकता अच्छी है। प्रकाश संश्लेषण दर के आधार पर जलाशय की मत्स्य उपादन क्षमता 140 कि.ग्रा./हे./वर्ष आंकी गयी। इस क्षमता के आधार पर जलाशय में बीज संग्रहण हेतु 330 बीज/हे. दर का सुझाव दिया गया। भारतीय मेजर कार्प की 5 लाख अंगुलिकाओं (कतला कतला 20 प्रतिशत, लेबियो रोहिता 40 प्रतिशत और सिरहीनस मृगाला 40 प्रतिशत) का संग्रहण किया गया। जलाशय में 2–3 वर्षों के अंतराल में मेजर कार्प मछलियों का प्राकृतिक प्रजनन देखा गया। वर्ष 1992–2001 अवधि के दौरान जलाशय की मत्स्य उत्पादन दर 51.4 कि.ग्रा./हे/वर्ष रही जो घटकर वर्ष 2008 तक 18.3 कि.ग्रा./हे/वर्ष हो गई। अब वैज्ञानिक प्रबन्धन से उत्पादन में वृद्धि की आशा की जा रही है।

ध्वनिकी तथा प्रयोगात्मक मत्स्ययन द्वारा मत्स्य जनसंख्या एवं मात्स्यिकी का अभिलक्षणन

एम. फिरोज खान एवं प्रीता पनिक्कर

इस अनुसंधान कार्य के लिए केरल स्थित कारापुझा तथा तमिलनाडु के केलवरापल्लि जलाशयों का चयन किया गया। कारापुझा जलाशय में जल की गुणवत्ता के प्राचल प्रायः अनुकूल हैं पर प्राथमिक उत्पादकता दर कम है। जून–जुलाई तथा जनवरी–फरवरी छोड़कर पूरे वर्ष जन्तु प्लवकों की तुलना में पादप प्लवकों की अधिकता पायी गयी। वर्ष 2009–2010 के दौरान जलाशय का मत्स्य उत्पादन 24.2 टन एवं उपज प्रति युनिट प्रयास 6.7 कि.ग्रा. दर्ज किया गया। अधिकतम उत्पादन व उपज प्रति युनिट प्रयास मार्च, 2010 के दौरान था। वर्ष 2009 में जुलाई एवं अक्तूबर तथा 2010 में जनवरी एवं मार्च में मत्स्य उपज अधिक थी। इस जलाशय में

उपज एवं प्रति युनिट उपज में उतार–चढ़ाव का मुख्य कारण है सिंचाई विभाग द्वारा मत्स्यन कार्य पर समय असमय प्रतिबंध लगा देना। कारापुझा जलाशय में ओरियोक्रोमिस मोज्मबिकस कुल मत्स्य उपज का 61.3 प्रतिशत, क्लारियास गैरीपीनस 14.1 प्रतिशत और लेबियो फिमब्रियाटस 8.8 प्रतिशत पाया गया। अन्य प्रजातियों का योगदान 5 प्रतिशत से भी कम रहा।

कारापुझा जलाशय में ओरियोक्रोमिस मोज्मबिकस की संख्या से संबंधित प्राचलों के अध्ययन से ज्ञात होता है कि लम्बाई–भार सम्बन्ध आइसोमेट्रिक फार्मूला $W = aL^b$ की पुष्टि करता है। उपलब्ध आंकड़ों के आधार पर नर व मादा मछलियों के अलग अलग रिग्रेशन से निम्नलिखित लम्बाई–भार सम्बन्ध आंकड़े प्राप्त हुईं।

मादा – $W = 0.00001\, L^{3.1}$ $(r = 0.95)$ $(n = 200)$

नर – $W = 0.00001\, L^{2.75}$ $(r = 0.80)$ $(n = 200)$

ओरियोक्रोमिस मोजमबिकस प्रजाति के नर व मादा मछलियों की विकास दर में भिन्नताऐं पायी गई।

केलवरापल्लि जलाशय का क्षेत्र 430 हे. है। इकोपाथ साफ्अवेयर की सहायता से एक स्टेटिक बैलेंस मॉडल तैयार कर इसे जलाशय की पारिस्थितिकी एवं आहार चक्र के विश्लेषण के लिए उपयोग किया गया। प्रथम चार पोषण रीतियों में ट्रोफिक फ्लो देखी गई तथा आहार चक्र की पहचान लो टीएल आर्गानिज्मस् के रूप में की गई।

यह जलीय परितंत्र विकास स्थिति में है और इसकी TPP/TR अनुपात 1 से भी अधिक है। TB/TST का कम अनुपात जलीय परितंत्र की अपरिपक्वता को दर्शाता है। इस अपरिपक्व जलीय तंत्र में मत्स्य उत्पादन वृद्धि के उपाय किए जा सकते हैं।

जलाशयों में मत्स्य उपज आकलन हेतु मॉडलों का विकास

एम. कार्तिकेयन, डी. एस. के. राव, बी. के. सिंह, पी. के. कटिहा, रानी पलानीस्वामी

मत्स्य उपज के आकलन हेतु उपयुक्त मॉडलों का विकास किया जा सकता है। इन मॉडलों के लिए फिश लैंडिंग तथा अन्य भौतिक, सरोवरीय, जैविक प्राचलों से संबंधित सेकेन्डरी डाटा की आवश्यकता है। विभिन्न जलाशयों से उपलब्ध उपज एवं अन्य प्राचलों (औसत गहराई, क्षेत्रफल, प्राथमिक उत्पादकता) आंकड़ों में सम्बन्ध का आकलन किया गया। विश्लेषण से यह स्पष्ट होता है कि जलाशय का क्षेत्रफल एवं उपज के बीच का संबंध बेहतर है। प्रत्येक राज्य के लिए अलग अलग आकलन करना, सभी भारतीय जलाशयों के आंकडों को मिलाकर आकलन करने से बेहतर होता है। तमिलनाडु के 15 जलाशयों के आंकड़ों के गुणांक निर्धारण इस बात का प्रमाण हैं –

भारतीय जलाशयों के संदर्भ में क्षेत्रफल एवं उपज का संबंध x = क्षेत्रफल, y = उपज

$Y = -35.377 \ln(x) + 336.56$ $(R^2 = 0.338; n = 47)$

तमिलनाडु के 15 जलाशयों का क्षेत्रफल एवं उपज के संबंध

$Y = -74.1049 \ln(x) + 548.257$ $(R^2 = 0.527; n = 15)$

विभिन्न वर्गों के जलाशयों, [छोटे जलाशय (< 1000 हे.) बड़े जलाशय (> 1000 हे.)] जिनकी उत्पादकता स्तर भी अलग अलग हों, के विश्लेषण से स्पष्ट होता है कि उपज एवं क्षेत्रफल का आकलित संबंध जलाशयों की उपज के अनुमान लगाने में उपयोग किया जा सकता है–

उच्च उपज वाले छोटे जलाशयों में उपज एवं क्षेत्रफल का संबंध

$Y = -67.694 \ln(x) + 556.25$ $(R^2 = 0.661; n = 9)$

कम उपज वाले बड़े जलाशयों में उपज एवं क्षेत्रफल के संबंध

$Y = -5.7809 \ln(x) + 69.003$ $(R^2 = 0.327; n = 14)$

चूंकि वर्तमान समय में मत्स्य उत्पादन की वृद्धि के लिए मत्स्य प्रायः बीज संग्रहण किया जा रहा है, अतः इन जलाशयों से सतत् मत्स्य उपज प्राप्ति के मॉडल विकसित करने पर ध्यान दिया गया।

अनुसंधान कार्यक्रम : आर्द्रक्षेत्रों में सतत् मात्स्यिकी हेतु प्रबन्धन प्रणालियों का विकास

बाढ़कृत मैदानी आर्द्र क्षेत्रों की मत्स्य उपज में वृद्धि का परीक्षण व परिष्कृत करना

बी. सी. झा, ए. मुखर्जी, जी. के. विन्सी, एस. आर. दास, वी. आर. सुरेश, एम. ए. हसन, ए. हाजरा एवं डी. दास

इस परियोजना को बिहार व पश्चिम बंगाल के आर्द्र क्षेत्रों में कार्यान्वित किया गया। सिकन्दरपुर मान (सतही क्षेत्र का 3 प्रतिशत आवरण) को छोड़कर प्रायः सभी आद्रक्षेत्रों में तैरनेवाले, निमज्जित, निर्गत एवं सीमान्त मेक्रोफाइटस् की प्रचुरता देखी गई। अन्य आर्द्रक्षेत्रों में यह सतही आवरण 50 से 88 फीसदी मुख्यतः निमज्जित जैसे हाइड्रिला, वर्टीसिल्लाटा एवं सेराटोफाइलम डिमरसम पादपों से है। रोचक तथ्य यह है पश्चिम बंगाल एवं असम की तुलना में बिहार के आर्द्रक्षेत्रों में न्यूसेन्स वीड, एक्कोरनिया क्रासिपस् बहुत ही कम (3–6%) पाया जाना। बिहार के आर्द्रक्षेत्रों में अत्यधिक खरपतवारों के कारण प्लवकों की कमी रहती है जिससे यह स्पष्ट होता है कि मेकोफाइट इन्फेसटेशन एवं प्लवकों में विपरीत संबंध होता है। प्लवकों में पादपप्लवकों की अपेक्षा जन्तु प्लवकों की अधिकता थी जो खरपतवार भरे जलीय तंत्रों में आम है।

पश्चिम बंगाल के 17 आर्द्रक्षेत्रों से एकत्रित आंकड़ों के उपयोग से एक डिटरमिनिस्टिक मॉडल विकसित किया गया जिससे उपज (डिपेन्डेंट वैरियेबल) तथा जैव भौतिकी व रसायनिक लक्षणों की विवेचना हो सके। इस मॉडल में सुधार लाने हेतु बिहार के पांच अन्य आर्द्र क्षेत्रों से अतिरिक्त सूचनाएं एकत्रित की गयीं।

पेन निर्माण की नई पद्धति को मानक बनाने के बाद बिहार के वैशाली जिला, महुआ ब्लॉक, सिकंदरपुरा स्थित तिलौर चौर में इस मॉडल की उपयुक्ता जानने हेतु परीक्षण प्रारंभ किया गया। इस चौर में 0.1 हेक्टर वाले दो वृत्ताकार पेन संरचनाओं को स्थापित कर 15000/हे. की दर से 35–40 मि.मी. वाली मत्स्य बीजों का संग्रहण किया गया। 60 दिनों की पालन अवधि में भारतीय मेजर कार्प के तीनों प्रजातियों से अच्छे परिणाम प्राप्त हुए। अतिजिविता दर 60–70 प्रतिशत पायी गई। नई पद्धति से निर्मित पेन संरचनाओं को स्थानीय मत्स्य पालकों ने बड़े पैमाने पर अपनाया क्योंकि इसमें लागत कम होती है।

आर्द्र क्षेत्रों का मत्स्य सम्पदा मूल्यांकन तथा सतत मात्स्यिकी प्रबंधन हेतु पॉपुलेशन एवं बायोमास मॉडलों का उपयोग

वी. आर. सुरेश, बी. सी. झा, ए. मुखर्जी, जी. के. विन्सी, ए. के. दास एवं एस. के. साहू

पश्चिम बंगाल के तीन जिलों में स्थित विभिन्न वर्गों के आठ आर्द्रक्षेत्रों का अध्ययन किया गया। आर्द्रक्षेत्रों की कुल मत्स्य उपज जनवरी 2008 से मार्च 2009 तक 86.5–1794.1 कि. ग्रा./हे./वर्ष के बीच आंकी गयी। बेलाडंगा और खालसी आर्द्रक्षेत्रों को छोड़कर शेष सभी क्षेत्रों में पूरी अवधि के दौरान मत्स्य उपज एक समान रही।

जिन आर्द्रक्षेत्रों में कार्प बीजों का संग्रहण किया गया उनमें मेजर कार्प मछलियों की अधिकता तथा जिनमें संग्रहण नहीं किया गया उनमें छोटे कार्प, पर्च की अधिकता पायी गई। इन आर्द्रक्षेत्रों की उपज में काफी भिन्नता देखी गई। अगस्त से दिसम्बर तक की अवधि में सबसे अधिक उपज प्राप्त हुई। इन आर्द्रक्षेत्रों से 5–28 वाइल्ड मत्स्य प्रजातियां प्राप्त हुई। इन आर्द्रक्षेत्रों से कुल 79 पख मछलियों की प्रजातियां, 4 झींगा मछलियों की प्रजातियां तथा केकड़े की एक प्रजाति प्राप्त हुई।

आर्द्रक्षेत्र के मछुआरों में किए गए एक सर्वेक्षण से ज्ञात होता है कि मछुआरों को संग्रहित मछलियों की उपज की तुलना में वाइल्ड मत्स्य उपज से अधिक आय होती है। संग्रहित मछलियों को वर्ष में 2–3 बार निकाला जाता है पर वाइल्ड मत्स्य उपज रोज ही प्राप्त होती है और बाजार में मूल्य भी अधिक प्राप्त होता है।

एक समान पारिस्थितिकी, सामाजिक तथा प्रबन्धन वाले बेलडांगा, भोमरा तथा खालसी आर्द्रक्षेत्रों में संग्रहित मछलियों के उत्पादन से संबंधित एक दशक के आंकड़ों के अध्ययन से स्पष्ट होता है कि उपज दर में कोई कमी नही आयी जिससे सतत् मात्स्यिकी का प्रमाण मिलता है। संग्रहण दर निर्धारण हेतु किए गए अध्ययन के आधार पर 4000–5000 अंगुलिकाऐं/हे. की सिफारिश की गई।

समुदायिक भागेदारी द्वारा मौसमी बाढ़वाले क्षेत्र में मत्स्य आधारित पालन प्रणाली का विकास

उत्पल भौमिक, पी. के. कटिहा, आर. के. मन्ना, गणेश चन्द्रा एवं डी. देबनाथ

पश्चिम बंगाल के पूर्व मेदिनीपुर जिले के जानकीचक नामक मौसमी बाढ़वाले क्षेत्र में सामुदायिक भागेदारी से मत्स्य आधारित पालन प्रणाली का विकास किया गया। स्टेकहोल्डरों के सहयोग से जलीय परितंत्र का विश्लेषण किया गया जिससे स्पष्ट होता है इस निचले क्षेत्र में मई माह से जल आ जाता है तथा वर्षभर जमा रहता है। इस जलीय क्षेत्र की औसत गहराई 1.45 मी. है, जून एवं मार्च माह में न्यूनतम तथा सितम्बर माह में अधिकतम गहराई होती है। संस्थागत तथा कार्य निर्वाहण व्यवस्था से ज्ञात होता है कि यहां के कृषकों ने एक सहकारी समिति का गठन किया जिसके 29 सदस्य हैं। ग्राम समिति ने इस सहकारी समिति को जलीय क्षेत्र एक वर्ष के लिए पट्टे पर दिया और पट्टे की राशि रू 12 लाख प्रति वर्ष थी। यहां की मत्स्य उपज पिछले वर्ष की तरह अन्नपूर्णा, मोयना ब्लाक तथा मोयना मार्केट भेजा गया। चूंकि पूरे क्षेत्र के विभिन्न जलीय स्थानों से मत्स्य उपज लगभग एक ही समय आती है जिससे उपज का अच्छा दाम नहीं मिलता अतः एक नियमित पद्धति विकसित की गयी ताकि मत्स्य पालकों को मछलियों का सही मूल्य प्राप्त हो सके। उत्पादन कार्य के लिए वित्तीय लागत की समस्या रही। मत्स्य उत्पादन के दौरान मत्स्य रोग तथा मछलियों का सही मूल्य प्राप्त न होना भी समस्या रहीं। मत्स्य उत्पादन की वैज्ञानिक प्रणाली अपनाने पर कुल 111.48 टन मत्स्य उपज प्राप्त हुई। इस उपज मेंसी. कतला (56.55 टन), एल. रोहिता (22.86 टन) तथा अन्य प्रजातियां (16.66 टन) पायी गयी। मत्स्य उत्पादन के आर्थिक विश्लेषण से स्पष्ट होता है कि कुल लागत रू 38.23 लाख तथा कुल आय रू 85.32 लाख है जिससे शुद्ध लाभ रू 47.09 लाख प्राप्त हुआ।

उत्तर प्रदेश के आर्द्र क्षेत्रों में मत्स्य उपज वृद्धि हेतु प्रयास

बी. के. सिंह एवं आर. एस. श्रीवास्तव

उत्तर प्रदेश के उन्नाव जिले के गंगा बेसिन में स्थित महाने आर्द्र क्षेत्र में स्थान विशेष प्रयोग व निरूपण का प्रयास किया गया। 40 हेक्टर वाले इस आर्द्र क्षेत्र की औसत गहराई 1.3 मी. है। मुख्य नदी से इसका संबंध टूट चुका है और यह जल ग्रहण क्षेत्र से प्राप्त जल पर ही निर्भर है। आर्द्रक्षेत्र की जलीय गुणवत्ता उच्च उत्पादकता दर्शाती है। इस क्षेत्र में प्लवकों का घनत्व ग्रीष्म काल में 770 यूनिट/लीटर, मानसून के पश्चात् 400 यूनिट/लीटर तथा शीतकाल में 330 यूनिट/लीटर पाया गया। प्लवकों में जन्तुप्लवकों की अपेक्षा पादपप्लवकों की अधिकता देखी गई। इस आर्द्रक्षेत्र में भारतीय मेजर कार्प एवं विदेशी कार्प मछलियों की 3.5 लाख पोना व अंगुलिकाओं का संग्रहण जुलाई–अगस्त के दौरान किया गया। इस आर्द्रक्षेत्र से 17 मत्स्य प्रजातियां प्राप्त हुई। आर्द्रक्षेत्र की मत्स्य उपज क्षमता, 2008 में 225 कि. ग्रा./हे./वर्ष तथा 2009 के दौरान 417 कि. ग्रा./हे./वर्ष आंकी गयी। इस वर्ष 20.8 टन मत्स्य उपज प्राप्त हुई जिससे उपज दर 520 कि.ग्रा./हे./वर्ष बनती है। यह वृद्धि वैज्ञानिक प्रबंधन प्रणालियों के कारण हुई।

मत्स्य संपदा वृद्धि के प्रोटॉकाल का मानकीकरण

बी. के. भट्टाचार्य एवं सोना यंगकोपाम

असम की 26 बीलों से मत्स्य संपदा वृद्धि के विभिन्न पहलुओं से संबंधित आंकड़ों को एकत्रित किया गया ताकि संग्रहण पद्धतियों तथा मत्स्य उत्पादन पर मत्स्य बीज संग्रहण के प्रभाव का मूल्यांकन किया जा सके। संग्रहण करने हेतु मत्स्य प्रजातियों के चयन में वृद्धि दर, उपभोक्ता की पसन्द तथा बाजार मूल्य को प्राथमिकता दी गई। मत्स्य बीजों की उपलब्धता तथा जलीय क्षेत्र से मत्स्य उपज निकाल पाना भी महत्वपूर्ण हैं। कुछ चयनित बीलों में दो ऋतुओं के दौरान मत्स्य बीज संग्रहण किया गया। निचले एवं मध्य ब्रह्मपुत्र घाटी में स्थित बीलों में मानसून पूर्व फरवरी–मार्च के दौरान मत्स्य अंगुलिकाओं को संग्रहित किया गया। ये अंगुलिकाएं तेजी से बढ़ती हुई अगले वर्ष जनवरी तक बेचने योग्य हो गईं। बाराक घाटी में स्थित बीलों में अगस्त–सितम्बर माह में कार्प अंगुलिकाओं को संग्रहित किया गया। उथले बीलों में संग्रहण के लिए (मानसून पश्चात् बील की गहराई 3–4 मीटर) प्रजातियों का अनुपात 40 सतह

पर भोजन लेनेवाली प्रजातियां : 30 जल के मध्य भाग में भोजन लेनेवाली प्रजातियां : 30 निचली सतह पर भोजन लेनेवाली प्रजातियों की सिफारिश की गयी। जबकि गहरे बीलों में (4 मीटर से अधिक गहराई वाले में) मत्स्य प्रजातियों का अनुपात 2 सतह पर भोजन लेनेवाली प्रजातियां : 1 जल के मध्य भाग में भोजन लेनेवाली प्रजातियां : 1 निचली सतह पर भोजन लेनेवाली प्रजातियों को सुझाया गया। चयनित बीलों में संग्रहित मत्स्य प्रजातियों के अनुपात में काफी भिन्नतायें पायी गयी। मौसमी तौर पर खुले बीलों की तुलना में बन्द बीलों में संग्रहण घनत्व अधिक था। कुछ चयनित बंद बीलों में संग्रहण दर 2190/हे. से 10000 बीज/हे. के बीच तथा मौसमी तौर पर खुले बीलों में 833 बीज/हे. से 8750 बीज/हे. के बीच पायी गई। बन्द बीलों से प्राप्त मत्स्य उत्पादन 149.3 –1387.8 कि.ग्रा./हे./वर्ष था जिसमें 60 प्रतिशत उपज संग्रहित मछलियों थी जिससे यह सूचित होता है कि इन बीलों में पालन आधारित मात्स्यिकी अपनाया जाता है। मौसमी तौर पर खुले बीलों की कुल मत्स्य उत्पादन 41.0 – 528.8 कि.ग्रा./हे./वर्ष था जिसमें से संग्रहित मछलियों की उपज 25–80 प्रतिशत थी।

असम के दमाल बील में एंक्लोजर कल्चर टेक्नॉलॉजी का निरूपण किया गया। इस बील में 741 वर्गमीटर आयताकार पेन बनाया गया। इसमें भारतीय मेजर तथा विदेशी कार्प मछलियों के पहलू से पले हुए बीज को 5 अंगुलिकाएं/वर्गमीटर की दर से फरवरी 2009 के अंत में संग्रहित किया गया। पेन में संग्रहित मत्स्य प्रजातियों का अनुपात 2 कतला : 1 रोहू : 1 मृगल अपनाया गया। पेन में 5 प्रतिशत ग्रास कार्प तथा 1 प्रतिशत सिल्वर कार्प भी संग्रहित की गई। इन मत्स्य बीजों के 70 दिनों के पालन के दौरान उच्चतम वृद्धि दर (औसत लम्बाई 9.6–16.2 सेंटीमीटर) रोहू तथा मृगल की तथा निम्नतम कतला की रही। इससे स्पष्ट होता है कि असम के बीलों में मानसून के पूर्व संग्रहण में कतला प्रजाति अनुपयुक्त है। पेन में संग्रहित मछलियां को राइस पॉलीश व सरसों की खली का मिश्रण (1:1) मछलियों की शारीरिक भाग का 5 प्रतिशत की दर से दिया गया। परंपरागत मत्स्य आहार की तुलना में इस परिष्कृत मत्स्य आहार सूत्र के प्रभाव की तुलना की जाएगी।

मत्स्य उत्पादन वृद्धि की विभिन्न पद्धतियों का आर्द्र क्षेत्र की जैव विविधता तथा स्वास्थ्य पर प्रभाव का मूल्यांकन

मो. अफ़्ताबउद्दीन एवं वी. कोलेकर

असम के समागुरी बील में दो घेरे लगाये गये। एक घेरे में तैरनेवाले मेक्रोफाइट थे और दूसरे में निमज्जित मेक्रोफाइट डाले गए ताकि जल के भौतिक व रसायनिक गुण, एन्जाइम, मृदा की जैव–रसायनिक गुण तथा जैव विविधता पर इन मेक्रोफाइटों कें प्रभाव जाना जा सके। दोनों घेरों की जलीय गुणवत्ता के विभिन्न प्राचलों जैसे–पारदर्शिता, जलीय तापमान, पी.एच. विशिष्ट चालकता, मुक्त कार्बन डाइअक्साइड, घुलित ऑकसीजन, कुल क्षारीयता, बी.ओ.डी. आदि में काफी भिन्नताएं पायी गई। निमज्जित मेक्रोफाठट वाले घेरे की तुलना में तैरने वाले मेक्रोफाइट वाले घेरे में पारदर्शिता, तापमान, पी.एच., घुलित ऑक्सीजन में कमी तथा विशिष्ट चालकता, मुक्त कार्बन डाइअक्साइड आदि अधिक मात्रा में पाये गए। प्रयोग के 130 तथा 230वें दिन तक तलछटीय एन्जाइम एवं जैव रसायनिक गुणों से ज्ञात हुआ कि सेडिमेंट मैक्रोबियल फासफेटेज तथा ग्लूकोडेस में धीरे धीरे कमी आ रही तथा डिहाइड्रोजेनेज में 130 वें दिन तक कमी आयी पर 230वें दिन इसमें बढोत्तरी हुई। आलकालैन फासफटेज में 230वें दिन तक कमी आयी। निमज्जित मेक्रोफाइट में एन्जाइम क्रियाओं में तीव्रता देखी गई। प्लवक समुदाय में परिवर्तन पाया गया। निमज्जित मेक्रोफाइट मृदा में पोषक तत्वों के लिए अनुकूल पाये गए जो मत्स्य उत्पादन के लिए लाभदायक है।

अनुसंधान कार्यक्रम : अंतर्स्थलीय विवृत जल क्षेत्रों में पर्यावरण एवं मत्स्य स्वास्थ्य प्रबन्धन

पर्यावरण अनुमापन हेतु मत्स्य आधारित सूचकों का विकास

एम. के. दास, पी. के. साहा, एम. के. बन्धोपाध्याय, एस. एस. मिश्रा, एस. सामन्ता, बी. पी. मोहान्ति, एस. के. मन्ना, पी. मौर्य, एम. पी. ब्राह्मणे एवं एस. के. साहू

इस वर्ष दामोदर नदी (150 कि.मी.–जमालपुर से रामगढ़) तथा यमुना नदी (1200 कि.मी. – कुलहल से इलाहाबाद) में इस परियोजना के तहत मानकीकृत जैव सूचकों के उपयोग से नदियों की पारिस्थितिक समग्रता का अध्ययन किया गया।

दामोदर नदी

नदीय जल की भौतिक व रसायनिक गुणों के अध्ययन से स्पष्ट हुआ कि रामगढ़ में फासफेट एवं नाईट्रेट का स्तर अधिक है जिससे निम्न स्तर का मानवजनित प्रदूषण सूचित होता है। पांचेट जलाशय स्थान पर चालकता, सीओडी और फासफेट का उच्च स्तर दर्ज किया गया। अध्ययन किए गए पूरे नदीय क्षेत्र में हल्का प्रदूषण पाया गया।

दामोदर नदी में एन्जाइम क्रियाओं में कोई परिवर्तन नही हुआ, परन्तु दूर्गापुर एवं पानागढ़ में ग्लूकोसीडेज में विशेष वृद्धि देखी गई। औद्योगिक क्षेत्र में बहिःस्त्राव के कारण नदीय मैक्रोबियाल समुदाय प्रभावित हुआ। जमालपूर क्षेत्र में मैक्रोबियाल क्रियाओं में वृद्धि हुई जिससे निछली प्रवाह में पुनःरूद्धार सूचित होता है।

इस अध्ययन के दौरान दामोदर नदी से 20 फैमिलियों की 63 मत्स्य प्रजातियां दर्ज हुई जिनमें से 3 विदेशी प्रजातियां हैं। IBI अध्ययन से सूचित होता है पांचेत और दुर्गापुर क्षेत्र मात्सियकी के दृष्टि से स्वीकार्य स्थिति में है। शेष पूरी नदी सामान्य स्तर पर क्षतिग्रस्त है। यह क्षेत्र विभिन्न प्रकार के मानव जनित प्रदूषणों से भी प्रभावित है।

यमुना नदी

वजीराबाद के निकट यमुना नदी में उच्च विशिष्ट चालकता और फासफेट के कारण प्रदूषण की उपलब्धता को दर्ज किया गया। आगरा क्षेत्र में अत्यधिक मानव जनित प्रदूषण के कारण उच्च विशिष्ट चालकता, घुलित आक्सीजन में कमी, सामान्य सीओडी, उच्च क्षरीयता व कठोरता, अत्यधिक फासफेट पाया गया। इलाहाबाद क्षेत्र में कुछ सुधार हुआ है परन्तु संपूर्ण रूप से प्रदूषण को खतम नही किया जा सका है।

यमुनानगर, वजीराबाद और आगरा के निकट नदीय जल में फासफेटेज में हल्की वृद्धि तथा ग्लूकोसीडेज में कमी दर्ज हुईं। इन स्थानों पर मृदा में एन्जाइम क्रियाओं में भारी कमी आयी जिससे प्रदूषण का दुष्प्रभाव सूचित होता है। चिन्ताजनक विषय है कि मृदा श्वसन काफी कम है जिससे नदीय तल में मैक्रोबियाल क्रियायें कम हो गयी हैं। इलाहाबाद क्षेत्र में एन्जाइम क्रियाओं में तेजी आयी जिससे इसे क्षेत्र में हुये सुधार का संकेत मिलता है।

यमुना नदी से 72 मत्स्य प्रजातियां प्राप्त हुई जिनमें से 4 विदेशी प्रजातियों की बहुलता आगरा, वजीराबाद और इलाहाबाद में पायी गयी। IBI से सूचित होता है कि यमुना नगर और इलाहाबाद क्षेत्र मात्स्यिकी की दृष्टि से स्वीकार्य स्थिति में है जबकि आगरा क्षेत्र पूरी तरह क्षतिग्रस्त तथा वजीराबाद क्षेत्र सामान्य स्तर से क्षतिग्रस्त है। इन क्षेत्रों में घुलित ऑक्सीजन की कमी है, पर ऐसे कुछ विदेशी प्रजातियों की बहुलता पायी गई जो इस पर्यावरणीय दबाव का सहन कर सकते हैं।

अंतर्स्थलीय विवृत जल क्षेत्र के आहार चक्र में भारी धातुओं का एकत्रिकरण एवं कीटनाशकों का संदूषण

एस. सामन्ता एवं पी. के. साहा

जलीय पर्यावरण एवं मत्स्य स्वास्थ्य के लिए भारी धातुएं एवं कीटनाशक काफी हानिकारक होते हैं जिससे मत्स्य उपभोकताओं का स्वास्थ्य भी प्रभावित होता हैं। इस पर किये गये अनुसंधान से पता चला है कि दामोदर नदी जल में भारी धातुओं की मात्रा कम थी। दुर्गापुर क्षेत्र में जिंक, मैगनेशियम दर्ज किया गया परन्तु यह मान्य स्तर से कम था। इस नदी से प्राप्त मछलियों के मांस में मैगनेशियम और जिंक मान्य स्तर से भी कम थी। आर्सेनिक मानव स्वास्थ्य के लिए हानिकारक है और पश्चिम बंगाल में आर्सेनिक एक समस्या है। अंतर्स्थलीय सतही जल इस विषाक्त तत्व से अधिक प्रभावित नहीं है परन्तु कुछ रिपोर्टों के अनुसार दामोदर नदी में आर्सेनिक की मौजूदगी है जो मानव स्वास्थ्य के लिए समस्या उत्पन्न कर सकती है। इस सूचना से दामोदर नदी जल का परीक्षण किया गया। अध्ययन में पाया गया कि जल एवं मछलियों में इस विषाक्त पदार्थ का कुछ अंश है। कुल मिलाकर नदी आर्सेनिक प्रदूषण से मुक्त है।

दामोदर नदी जल के सभी नमूनों में ओर्गेनिक क्लोरीन कीटनाशक विशेषकर DDT पाई गई। इनका स्तर जलीय जीवों के लिए मान्य सीमाओं से नौ गुणा अधिक है।

स्थान	DDTs	HCHs	Endosulfan	Hepta chlors	अल्ड्रीन	कुल
पंचेत	33.16	7.47	6.18	0.00	1.23	48.04
बारनपुर	33.38	13.27	8.63	0.44	0.50	56.22
रानीगंज	22.00	8.02	3.47	0.74	0.35	34.60
दुर्गापुर	25.60	6.19	1.46	0.14	1.42	34.80
बर्दमान	31.41	4.25	1.28	1.17	1.28	39.35

अंतर्स्थलीय जलक्षेत्रों में मैक्रोबियल विविधता का मूल्यांकन एवं पर्यावरणीय निदान में इसकी भूमिका

एस. एस. मिश्रा, एम. के. बन्धोपाध्याय, एस. के. मन्ना, बी. के. बेहरा एवं पी. मौर्य

सूक्ष्मजीव जलीय पर्यावरण में जैविक समुदाय का एक अभिन्न अंग हैं। इनकी भूमिका पोषण तत्वों के रूपांतरण, उत्पादकता तथा प्रदूषण कम कर जलीय पर्यावरण को स्वस्थ्य बनाने में महत्वपूर्ण है।

दामोदर नदी के जल नमूनों के सूक्ष्म जैविकी विश्लेषण से ज्ञात हुआ कि टोटल एरोबिक हेडट्रोफिक, बैक्टीरियल लोड रानीगंज में 1.9 $X10^3$ CFU/ml से जमालपुर में 4.2 $X10^5$ CFU/ml के बीच पाया गया। सेडिमेन्ट मेक्राबियल लोड 1.5 $X10^4$ से 7.0 $X10^5$ CFU/gm दर्ज किया गया। औद्योगिक क्षेत्र में एरोमोनस पाया गया पर जमालपुर और पानागढ़ में यह नहीं था। कुल वाइब्रियो काउन्ट 2.2 $X10^1$ और 2.7 $X10^3$ CFU/ml के बीच पाया गया। ई. कोली जो मलजल प्रदूषण का सूचक है, 1.6 $X10^2$ CFU/ml और 4.1$X10^2$ CFU/ml के बीच रहा। यद्यपि जमालपुर निचली प्रवाह में बैक्ट्रिया काउन्ट अधिक था परन्तु औद्योगिक क्षेत्र में घरेलू मलजल एवं औद्योगिक बहिस्त्राव के कारण सिडोमॉनस वाइब्रियो स्तर काफी अधिक पाया गया। दामोदर नदी में प्रदूषण सहन करने वाले कई शैवाल भी मिले।

फेनाल तथा अन्य तीन, डाइक्लोरोफेनोल, ट्रइक्लोरोफेलोल या पेन्टाक्लोरोफेनोल के प्रभाव को कम करने में सक्षम नौ बैकटीरियल स्ट्रेस को बहिःस्त्राव शोधन कारखानों और हल्दिया के औद्योगिक स्थलों में पृथक किया गया। 12 बैक्टीरियल आइसोलेट द्वारा पेन्आक्लोरोफेनोल (पी.सी.पी.) के प्रभाव कम हुआ। पी.सी.पी डिग्रेडेशन को स्पेक्ट्रोफोटोमीअर द्वारा मापा गया। 12 बैक्टीरियल स्ट्रेन पर परीक्षण किया गया जिसमें से 5 स्ट्रेन पी.सी.पी. के प्रभाव को कम करने में अधिक सक्षम थे तथा बायोरिमेडियेशन के लिये संभावित कारक थे। इनमें से तीन स्ट्रेन की पहचान की गई जिनके नाम है – ओकोबैक्ट्रम एन्थ्रोपि, स्युडोमोनास (विरीडिलवाइड), किसियोबैक्टिरियम ग्लियम/इन्डोलोजीनस । इनकी पहचान बायोलॉग प्रणाली द्वारा की गई। 1–डी और 2–डी जेल

इलेक्ट्रोफोरेसिस तकनीक द्वारा फेनोल के प्रभाव को कम करने में सक्षम 20 बैक्टीरियया के प्रोटीन प्रोफाइल की जांच की गई। ये प्रोटीन विभिन्न सान्द्रता वाले क्षेत्रों में बैक्टीरिया की सहनशीलता की माप में सहायक हो सकते है या विषैले कारकों के प्रभाव को कम करने वाले मेटाबोलिक / एन्जाइम का हिस्सा हो सकते है।

विभिन्न प्रकार के दबाव वाले परितंत्रों में मछलियों के अनुवांशिक संदूषण का आंकलन

एम. पी. ब्राह्मणे एवं एस. के. मन्ना

दामोदर नदी के प्रदूषित क्षेत्र तथा कम प्रदूषित क्षेत्र के अनेक स्थानों से एकत्रित विभिन्न मत्स्य प्रजातियों में विशेष जीन स्वीकेंस का परीक्षण किया गया। गुडिसिया चापड़ा मत्स्य प्रजाति की जेनोमिक डी. एन. ए. को विस्तृत करने हेतु 8 RAPD-PCR ओलिगो–डिजेनरेट प्राइमर का उपयोग किया गया। इससे स्पष्ट हुआ कि दामोदर नदी के उर्ध्व तथा निचली प्रवाह से एकत्रित गुडिसिया चापड़ा प्रजाति में कोई भिन्नता नहीं है।

मत्स्य प्रजातियों में डी. एन. ए. स्तर पर प्रदूषण से होने वाले दबाव के आंकलन हेतु परीक्षण किये गये। परीक्षण में साइटोक्रोम b gene sequencing किया गया। पंचेट और दुर्गापुर क्षेत्र से एकत्रित सिरहिनस मृगला के जीन का 324 bp region का डी. एन. ए. स्वीकेंस परीक्षण किया गया। इस परीक्षण से 3 म्यूटेशन, 2 थाईमाइन से साइटोसाइन (T↔C) और 1 एडिनाइन से गनाइन (A↔G) पाया गया। इससे अमिनोएसिड स्वीकेंस में कोई परिवर्तन नहीं देखा गया।

अंतर्स्थलीय जलीय परितंत्रों का प्रोटियोमिक्स द्वारा स्वास्थ्य प्रबन्धन प्रोटोकॉल का विकास

बी. पी. महन्ती, एम. के. बन्धोपाध्याय, बी. के. बेहरा, डी. करूणाकरन एवं पी. मौर्या

इस परियोजना का मुख्य उद्देश्य बड़े उष्णकटिबंधीय खुले जलक्षेत्रों के पर्यावरणीय अनुमापन हेतु उपयुक्त बायोमार्कर की पहचान करना है। प्रयोग के लिए भारतीय मेजर कार्प मछलियों में लेबियो रोहिता तथा मीठे जल की शिंगटी मछली रीता रीता चुना गया। गंगा तथा दामोदर नदियों के विभिन्न स्थानों से सैम्पलिंग की गयी। इन मछलियों का मंसल और लेंस प्रोटिनों का विश्लेषण किया गया। भारतीय मेजर कार्प लेबियो रोहिता के मंसल और लेंस प्रोटिनों का पहली बार प्रोटियोम मैप तैयार किया गया।

रीता रीता मछली के प्रोटिन में उपलब्ध विभिन्न क्रिस्टालीन फैमिलियों का परीक्षण किया गया। परीक्षण के परिणामों से ज्ञात होता है कि इस शिंगटी मछली तथा गो–जातीय जीव के αA-crystallin प्रोटिन में काफी सामानता है जबकि यह मछली गो–जातीय जीव से परे है। रीता रीता मछली के 2 डी जेल इमेज का विश्लेषण किया गया। क्रिस्टालीन प्रोटियोम मैप में देखे गये 75 दागों में 32 क्रिस्टालीन दागों की पहचान की गई।

अनुसंधान कार्यक्रम : अंतर्स्थलीय मात्स्यिकी हेतु जी.आइ.एस. प्लेटफार्म पर रिमोट सेंसिंग तकनीक द्वारा संसाधनों का मूल्यांकन एवं डाटाबेस का विकास

रिमोट सेंसिंग तकनीक द्वारा अंतर्स्थलीय संसाधनों का आंकलन

डी. करूणाकरन एवं एस. के. साहू

रिमोट सेंसिंग से मिट्टी और जल की गुणवत्ता का आंकलन किया गया। इसके लिये उत्तर प्रदेश के झांसी जिले के 8 जल निकायों से मिट्टी और जल के 33 नमूनों को एकत्र कर मिट्टी के 11 प्राचल और जल के 22 प्राचलों पर कार्य किया गया। मानसून पूर्व और इसके बाद के चित्रों को आई. आर. एस. पी 6 LISS –III से लिया गया। रिमोट सेंसिंग के चित्रों को भौतिक रूप से प्रमाणित किया जिससे लीनियर और मल्टी लीनियर रिग्रेशन मॉडेल का विकास किया जा सके। सभी बैण्ड के परीक्षण किये गये। मुक्त कार्बन डाई ऑक्साइड (0.01) को आई आर, लाल व हरे बैण्ड के साथ, नाइट्रेट को आई आर और एन आई आर बैण्ड के साथ, घुलित ऑक्सीजन और पी एच को लाल बैण्ड के साथ, कैल्शियम को लाल बैण्ड के साथ तथा विशिष्ट चालकता, कुल घुलित ठोस (टी डी एस), कुल क्षारीयता, कठोरता, प्रत्येक को हरे बैण्ड के साथ संबद्ध किया गया। ह देखा गया कि स्पेक्ट्रल रिफ्लेक्टेन्स सिगनेचर द्वारा चित्रों का विश्लेषण, क्लोरोफिल पिगमेंट सान्द्रता के आंकलन के लिये किया गया। इससे यह तथ्य सामने आया कि इन्फ्रा रेड बैण्ड में क्लोरोफिल ए, क्लोरोफिल बी, क्लोरोफिल सी, और क्लोरोफिल से क्रमशः R^2=0.526, R^2= 0.589, R^2= 0.611 और R^2= 0.615 से संबद्ध है जो इस बैण्ड के क्लोरोफिल पिगमेंट सान्द्रता को बताता है। विशिष्ट चालकता के लिये लैण्डस्केप मैट्रिक्स पर आधारित मल्टीपुल लीनियर रिग्रेशन मॉडेल (R^2=0.9, P<0.01) का विकास किया गया। इसके संघटक गुण जैसे ग्रास लैण्ड और सेटलमेन्ट को प्रथम व द्वितीय महत्वपूर्ण व्याख्यात्मक वेरियेबल के रूप में प्रयोग किया गया जिससे निम्न सम्बन्ध पाया गया
विशिष्ट चालकता = -204.24 + 13.70g + 13.32s जहां g =ग्रास लैण्ड (%) और s = सेटलमेन्ट (%)।

प्रग्रहण मात्स्यिकी हेतु वेब जी.आइ.एस. प्लेटफार्म पर डाटाबेस का विकास एवं मानकीकरण

एस. के. साहू एवं डी. करूणाकरन

इलाहाबाद और गुवाहाटी में मत्स्यन तथा मत्स्य स्थलन के आधार पर आंकड़े एकत्रित करने हेतु क्रमबद्ध रूप से सैम्पलिंग की गई।

गुवाहाटी में ब्रह्मपुत्र नदी से उजान बाजार मत्स्य स्थलन केन्द्र के मासिक मत्स्य उपज आंकड़ों से स्पष्ट हुआ कि उपज में ए. मोरार, टी. इलिशा, ए. कोइला तथा एल. डोरा प्रजातियों की बहुलता थी। वर्ष 2009 में इस केन्द्र में प्राप्त कुल मत्स्य उपज 109.78 टन आंकी गयी। पिछले वर्ष की तुलना में इस वर्ष मानसून तथा मानसून के बाद की अवधि में मत्स्य उपज अधिक पायी गयी। उपज के विश्लेषण से ज्ञात होता है कि पिछले वर्ष की तुलना में इस वर्ष भारतीय मेजर कार्प तथा शिंगटी मछलियों का योगदान अधिक रहा। मीडियम कार्प तथा अन्य प्रजातियां पिछले वर्ष की तुलना में इस वर्ष कम पायी गईं। उजान बाजार मत्स्य स्थलन केन्द्र के 10 वर्षों के आंकड़ों से स्पष्ट होता है कि मत्स्य उपज में कमी आ रही है।

गंगा नदी तंत्र में इलाहाबाद से एकत्रित आंकड़ों से स्पष्ट होता है कि वर्ष 2009 के दौरान कॉमन कार्प मछलियों का विशेष योगदान रहा। इलाहाबाद में गंगा नदी से प्राप्त कुल उपज 180.9 टन थी जो पिछले 6 वर्षों में सबसे अधिक है। पिछले वर्ष की तुलना में इस वर्ष का उत्पादन 41 प्रतिशत अधिक हुआ। उपज में सी. मृगला तथा एम. सिंघाला का मुख्य योगदान बढ़ा। 3 वर्षों के उपज आंकड़ों से ज्ञात होता है कि भारतीय मेजर कार्प मछलियों का उत्पादन घट रहा हैं।

वर्ष 2007 की तुलना में तिलापिया मछलियों की उपज में तीन गुणा वृद्धि हुई। वर्ष 2007 में तिलापिया मत्स्य उपज 5606 कि. ग्रा. थी जो बढ़ कर 21851 कि. ग्रा. हो गयी जबकि भारतीय मेजर कार्प मछलियों की उपज 32261 कि. ग्रा. से घटकर 19909 कि. ग्रा. हो गयी। कॉमन कार्प एवं तिलापिया का उत्पादन पिछले 3 वर्षों में काफी बढ़ गया। इनका उत्पादन वर्ष 2007 में उपज का 29 प्रतिशत था जो बढ़कर 40 प्रतिशत हो गया।

वेब आधारित भौगोलिक सूचना प्रणाली में Arc IMS (Internet Map Server) लगाया गया। गंगा तथा ब्रह्मपुत्र नदियों की मासिक मत्स्य उपज स्थलन सूचनाओं तथा पश्चिम बंगाल व मध्य प्रदेश राज्यों के जलनिकायों से संबंधित सूचनाऐं भी इस पर डाली गईं।

अनुसंधान कार्यक्रम : भारत के अंतर्स्थलीय मात्स्यिकी संसाधनों का आर्थिक मूल्यांकन

भारत के अंतर्स्थलीय मात्स्यिकी संसाधनों का आर्थिक मूल्यांकन

पी. के. कटिहा, आर. एस. श्रीवास्तव एवं अंजना एक्का

असम के मोरीगांव जिले में स्थित चारण आर्द्रक्षेत्र (बील) तथा प. बंगाल राज्य में दक्षिण 24 परगना जिले के गोसाबा ब्लाक स्थित ज्वारनदमुखी अंचल में किए गए मूल्यांकन में संसाधन के भौतिक लक्षण, मछुआरों की सामाजिक व आर्थिक स्थिति, जीविका एवं सामुदायिक अंतर्व्यवहार महत्वपूर्ण थे। गुवाहाटी से 80 किलोमीटर दूर स्थित चारण बील का क्षेत्रफल 60 हे. तथा इस बील के निकट 5 गांव – औझरी, सालनपुर, बघोरा, तरनी कालीबाड़ी तथा सिमीबाड़ी है। इन गांवों में धान, आलू, साग–सब्जियां तथा कुकरबिट की खेती होती है। यहां के अधिकतर मछुआरे अनुसूचित जाति के हैं। परिवार में औसतन 6.71 सदस्य, स्त्री पुरूष अनुपात 1 : 0. 85, बच्चों व बड़ों का अनुपात 1 : 0.90 तथा जीविकोपार्जन व आश्रितों का अनुपात 1 : 3.89 था। अधिकतर मछुआरों के मकान कच्चे थे। उनका मुख्य रोजगार मात्स्यिकी व खेती था, पर वे दिहाड़ी मजदूरी भी करते हैं। केवल 25 प्रतिशत मछआरों के पास ही लकड़ी की नाव थीं, परन्तु अधिकतर लोगों के पास किसी न किसी प्रकार के जाल (गिल नेट, कास्ट नेट, ट्रेप, हुक एण्ड लाईन, वेसल आदि) था। इस बील का स्वामित्व राज्य के राजस्व विभाग के पास है, पर इसे सात वर्षों के लिए रुपये 4250/हे./वर्ष की दर से पट्टे पर दिया गया। पट्टे पर लेनेवाली संस्था मौरीगांव मत्स्य व्यवसायी समन्वय समिति लिमिटेड में 56 सक्रिय मछुआरे तथा 74 गैर–सदस्य मछुआरे थे। औसतन प्रत्येक मछुआरे द्वारा वर्ष में 170 दिन मत्स्यन कार्य किया गया। मत्स्यन कार्य के लिए गिल व ड्रेग नेट तथा कटाल फिशिंग का प्रयोग किया जाता है। अध्ययन से ज्ञात होता है कि बील के आस–पास की कुल 105 वर्ग किलोमीटर क्षेत्र में, कृषि योग्य भूमि 68 वर्ग किलोमीटर तथा शेष भूमि वन्य व घरेलू उपयोग में लायी जाती है। बील के आस–पास स्थित 800 परिवारों में 70 प्रतिशत किसान, 20 प्रतिशत मछुआरे तथा शेष लोग व्यवसायी थे। बील के निकट स्थित 50 प्रतिशत परिवार बील को प्रत्यक्ष रूप से घरेलू कार्यों के लिए उपयोग करता है। शेष 50 प्रतिशत परिवार अप्रत्यक्ष रूप से उपयोग करते हैं या बील का उपयोग ही नहीं करते हैं। बील से प्राप्त उपज व अन्य सेवाओं का मूल्य रुपये 50.24 लाख आंका गया जिसमें से मछलियों का योगदान 45 प्रतिशत तथा प्राकृतिक संसाधन उपयोग 34 प्रतिशत था।

कोलकाता से 110 किलोमीटर की दूरी पर दक्षिण 24 परगना जिले के सुन्दरवन क्षेत्र में गोसाबा द्वीप का भी मूल्यांकन किया गया। गोसाबा द्वीप में जल के रास्ते ही जाना पड़ता है। इस ब्लॉक में 44478 घर थे और इसकी जनसंख्या 2.23 लाख थी। प्रत्येक परिवार में औसतन 5 सदस्य थे एवं स्त्री व पुरूष का अनुपात 956 : 1000 था। इस क्षेत्र में 22761 कृषक, 40516 कृषि मजदूर एवं लगभग 12500 मछुआरे थे। जीविकोपार्जन करनेवाले व आश्रितों का अनुपात 1 : 4.2 है। इस ब्लॉक में 14 ग्राम पंचायत हैं जिनमें से 5 पंचायत सजिना, गोमो तथा मेलमेल नदियों के कारण अलग है। सभी ग्राम पंचायतों के प्रतिनिधियों से गठित पंचायत समिति, ब्लॉक एवं इस द्वीप का नियंत्रण करती है। ब्लॉक में एक प्रखंड विकास अधिकारी भी है। अत्यधिक मत्स्यन दबाव तथा कम होती प्रति यूनिट उपज के कारण यहां की मात्स्यिकी सर्वसामन्य की सम्पति होना तय है। मत्स्य विभाग ने मछुआरों को रिजर्व फोरेस्ट क्षेत्र में मत्स्यन कार्य के लिए लाईसेंस दिया, परन्तु जाल व नाव का छीन लेना, मत्स्यन कार्य रोक देना आदि शिकायतें मिली। इस क्षेत्र में 77 प्रतिशत कृषक, 18 प्रतिशत मछुआरे सह कृषक एवं शेष आबादी व्यवसायी व पर्यटकों की थी। इस क्षेत्र के मात्स्यिकी जल संसाधनों में हुगली, बर्तला (मोरीगंगा), सप्तमुखी, ठाकुरान, मातला, गोसाबा, विद्याधारी, इच्छामति–कालनी–हरिणबंगा आदि नदियां हैं। मूल्यांकन कार्य प्रगति पर है एवं आशा है वर्ष 2010–11 के दौरान यह पूर्ण हो जाएगा।

अनुसंधान कार्यक्रम : आउटरीच एक्टिवीटी

पिंजरा व पेन संरचनाओं में कार्प पालन हेतु व्यवहारिक एवं प्रभावकारी मत्स्य आहार का विकास

पश्चिम बंगाल राज्य में बांकुरा जिले के पोका तथा कालिंदी आर्द्र क्षेत्रों में स्थापित पिंजरों में मत्स्य पालन के दौरान विभिन्न प्रकार के संघटकों से तैयार किये गये 3 प्रकार के मत्स्य आहार का प्रयोग किया गया। तीसरे प्रकार का आहार जो सरसों की खली, अल्सी की खली, मक्का, चावल की भूंसी मिलाकर विटामिन तथा खनिज पदार्थों से तैयार हुआ अन्य दोनों आहारों से बेहतर प्रमाणित हुआ। कालिंदी आर्द्र क्षेत्र में पोषित मछलियों की तुलना में पोका आर्द्र क्षेत्र में पोषित भारतीय मेजर कार्प मछलियां में बेहतर वृद्धि हुई। पिंजरा पालन से संबंधित आर्थिक पहलुओं से ज्ञात होता है कि आय–लागत अनुपात 1.29 है।

पोका आर्द्र क्षेत्र में भारतीय मेजर कार्प मछलियों को परम्परागत तथा सूत्रीबद्ध आहार से मछलियों की वृद्धि

आहार	प्रारंभिक औसत भार (ग्राम)	अंतिम औसत भार (ग्राम)	औसत भार लाभ (ग्राम)	आहार परिवर्तन अनुपात (एफ.सी.आर)	अतिजिविता %
परम्परागत आहार (एम.ओ.सी:आर.बी. =3:1)	3.3	18.2	14.9	4.3	62
सूत्रीबद्ध आहार–1	3.3	25.9	22.6	3.2	59
सूत्रीबद्ध आहार–2	3.3	24.1	20.8	3.05	63
सूत्रीबद्ध आहार–3	3.3	31.05	27.72	2.49	65

कालिंदी आर्द्र क्षेत्र में भारतीय मेजर कार्प मछलियों को परम्परागत तथा सूत्रीबद्ध आहार से मछलियों की वृद्धि

आहार	प्रारंभिक औसत भार (ग्राम)	अंतिम औसत भार (ग्राम)	औसत भार लाभ (ग्राम)	आहार परिवर्तन अनुपात (एफ.सी.आर)	अतिजिविता %
परम्परागत आहार (एम.ओ.सी:आर.बी. =3:1)	3.3	13.1	9.8	4.6	57
सूत्रीबद्ध आहार–1	3.3	20.2	11.9	3.7	59
सूत्रीबद्ध आहार–2	3.3	21.5	18.2	3.3	65
सूत्रीबद्ध आहार–3	3.3	23.9	20.6	3.1	61

मत्स्य सम्पदा अभिलक्षणन व विवरण

गंगा, ब्रह्मपुत्र और नर्मदा नदियों में कतला कतला, लेबियो रोहिता, एल. फिमब्रियाटस, सिरहिनस मृगला, क्लारियस बेट्राकस, मेक्रोब्रेकियम रोजनबर्जी के नमूनों को एकत्रित किया गया। लक्षित प्रजातियों के विभिन्न वर्गों से कुल 1245 नमूने एकत्रित किये गये। एकत्रित नमूनों की लम्बाई व शारीरिक भार मापा गया एवं टिश्यू, फिन, ब्लड, हेमोलिम्प, स्केलस् तथा ट्रस के इमेज एकत्रित किया गया। इन नदियों की उपज में क्लारियस बेट्राकस नहीं पाया गया। एल. फिमब्रियाटस नर्मदा नदी के केवल एक केन्द्र से ही प्राप्त हुआ। आकृतिमान विश्लेषण हेतु सभी नमूनों का डिजिटल ट्रस इमेज मानक ग्राफ पेपर पर लिया गया। अब तक 80 इमेजों को डिजिटाइज कर ट्रस मार्क मापा गया।

गंगा नदी के 4 केन्द्र नबाद्वीप, फरक्का, पटना और इलाहाबाद से मछलियों के नमूने एकत्रित किये गए। गंगा नदी से कुल 4 सी. कतला, 22 एल. रोहिता, 16 सी. मृगला और एम. रोजनबर्जी के 21 नमूनों को एकत्रित किया गया।

नर्मदा नदी के कुछ चयनित केन्द्रों से 9 एल. रोहिता, 6 सी. कतला, 13 सी. मृगला, 6 एल. फिमब्रियाटस के कुल 34 मत्स्य नूमने तथा 30 एम. रोजनबर्जी के नमूने एकत्रित किया गया। नमूनों की लम्बाई व शारीरिक भार दर्ज किया गया। मछलियों की आयु वर्ग के

प्राथमिक आंकलन से स्पष्ट होता है कि नमूने निम्नलिखित आयु वर्ग के हैं – कतला *<1* से *6;* रोहू *<1* से *6;* मृगला *<1* से *3* । अन्य नदियों से एकत्रित नमूनों का विश्लेषण किया जा रहा है।

न्यूट्रियंट प्रोफाइलिंग एवं मछलियों को आहार के रूप में मूल्यांकन

टेन्यूलोसा ईलीशा तथा एम्बलीफेरिंगॉडॉन मोला मछलियों का न्यूट्रियंट प्रोफाइलिंग का कार्य पूरा कर लिया गया। तेन्यूलोसा ईलीशा के तीन आमाप छोटी, मध्यम व बड़ी मछलियों का अनुमानित गठन, अमिनो एसिड तथा फैटी एसिड प्राफाइल हेतु विश्लेषण किया गया। अन्य आमाप की तुलना में हिल्सा की बड़ी मछलियों में प्रोटीन का स्तर अधिक (21.48 ± 0.04 ग्रा. / 100 ग्रा.) पाया गया। इसी प्रकार बड़ी हिल्या मछलियों में फैट भी अधिक था। मध्यम आमाप की मछलियों में अमिनो एसिड, ग्लूटामिक एसिड, ऐसपारटिक एसिड, लैसाइन, एलानाइन और लियोसाइन के रूप में मौजूद थें। इसी प्रकार सेट्यूरेटेड फैटी एसिड, मोनो अनसेट्यूरेटेड फैटी एसिड तथा पॉलीअनसेट्यूरेटेड फैटी एसिड भी मौजूद थे। मध्यम आमाप की मछलियों में लोहा, मैंगनीज, सोडियम, पोटाशियम और जिंक मौजूद थे।

एम्बलीफेरिंगॉडॉन मोला स्थानीय छोटी मछली में अमिनो एसिड, फैटी एसिड तथा खनिज पदार्थों की जानकारी के लिए इसका विश्लेशन किया गया। इस मछली में प्रोटीन स्तर (16.89 ± 0.47 ग्रा. / 100 ग्रा.) तथा वसा की मात्रा कम पाया गया। इस प्रजाति में एश कन्टेंट (3.21 ± 0.17 ग्रा. / 100 ग्रा.) दर्ज किया गया। मोला मछली में मुख्य अमिनो एसिड थे – ग्लूटामिक एसिड, ऐसपारटिक एसिड, लियोसाइन, तथा लैसाइन। इस मछली में पाए गए फैटी एसिड थे – C16:0, C18:1, C18:3। इसमें 7 प्रकार के खनिज पदार्थ पाए गए।

प्रायोजित परियोजनाऐं

भारतीय कृषि पर जलवायु परिवर्तन का प्रभाव – अंतर्स्थलीय मात्स्यिकी पर जलवायु परिवर्तन के प्रभाव का मूल्यांकन

वर्ष 2009 के दौरान पश्चिम बंगाल में सूखे की स्थिति के कारण मात्स्यिकी क्षेत्र पर प्रतिकूल प्रभाव पड़ा। दक्षिण बंगाल की अधिकतर हैचरियां (25 में से 23) मार्च–सितम्बर के दौरान अपर्याप्त वर्षपात एवं बढ़ते तापमान से प्रभावित हुईं। उत्तर 24 परगना तथा बांकुरा जिलों में पिछले 4 वर्ष की तुलना में इस वर्ष क्रमशः 61 प्रतिशत तथा 73 प्रतिशत मत्स्य बीज कम हो गया। पश्चिम बंगाल के छः जिलों के लिए विकसित मात्स्यिकी क्षेत्र की संवेदनशीलता सूचक से स्पष्ट होता है कि जलवायु परिवर्तन की घटनाओं से मात्स्यिकी अत्यधिक प्रभावित होती है। इन परिवर्तनों को समाहित करने की क्षमता काफी कम होती है। जलवायु परिवर्तन की चरम अवस्था जैसे–तूफान, आइला, से मानव जीवन, सम्पतियां, मत्स्यन उपकरण, कृषि व जलीय कृषि उद्योग काफी प्रभावित हुआ। जलवायु में आये परिवर्तनों का सामना करने की दृष्टि से तालाबों में लवणता सहने करनेवाली मत्स्य प्रजातियों को संग्रहित करने का भी प्रयास किया गया।

गंगा व यमुना नदियों की जलीय गुणवत्ता की दृष्टि से मात्स्यिकी का मूल्यांकन

हरिद्वार से दक्षिणेश्वर तक की गंगा नदी के मुख्य चैनल से 40 फैमिलियों से संबंधित 143 मत्स्य प्रजातियां दर्ज की गईं। इस पूरे क्षेत्र से प्राप्त मत्स्य उपज में मछलियों के प्रमुख वर्ग है – कार्प मछलियां, शिंगटी मछलियां, अन्य विविध प्रकार की मछलियां तथा विदेशी प्रजातियां क्रमशः 33%, 20%, 43% और 4% हैं, जिससे यह स्पष्ट होता है कि विदेशी व विविध मत्स्य प्रजातियां जैसे सिप्रीनस कार्पियो एवं ओरियोक्रोमिस निलोटिकस में काफी वृद्धि हुई। गंगा नदी में उपलब्ध मत्स्य प्रजातियों की सूची एवं छाया चित्र भी तैयी किया गया।

एबायोटिक स्ट्रेस सहनता हेतु जीन का बायोप्रोस्पेक्टिंग एवं ऐलीली माइनिंग

भारत के पूर्वी तटीय राज्य पश्चिम बंगाल, उड़ीसा और आंध्र प्रदेश के 15 स्थानों से जल एवं तलछटों के नमूनो को एकत्रित किया गया। एकत्रित मृदा, तलछट तथा जल के नमूनों से कुल 140 माइक्रोबस् को अलग किया गया और इन्हें 10% , 15,%, 20%, 25% सांद्रता वाले सोडियम क्लोराइड में शारीरिक दबाव के अध्ययन हेतु रखा गया। इस अध्ययन में 80 मैक्रोबियल आइसोलेट ने 10–25% सांद्रता वाले सोडियम क्लोराइड को सहन किया।

अंतर्स्थलीय खुले जलक्षेत्रों में मैक्रोबियल फॉस्फोरस ट्रांस्फोर्मेशन

दो बीलों में फास्फोरस के विभिन्न रूप तथा संबंधित रासायनिक व सूक्ष्मजैविक प्राचलों का अध्ययन किया गया। दोनों ही बीलों में टोटल सेडिमेन्ट पी–पूल काफी अधिक पाया गया, अकायपुर बील में 6215 मि.ग्रा/कि.ग्रा. और भोमरा बील में 5356 मि.ग्रा/कि.ग्रा.। फास्फोरस का अधिक भाग (75–90%) जैविक रूप में पाया गया। परिणामों से ज्ञात होता है कि तापमान से प्रेरित मैक्रोबियल विघटन तलछटों में कार्बनिक पदार्थ एवं फास्फोरस को कम कर है। खनिज वाले फास्फोरस में कोई परिवर्तन नहीं हुआ। अजैविक फास्फोरस से फास्फोरस को अलग करने में सक्षम 26 बैक्टीरियल स्ट्रेन की पहचान की गयी। इन मैक्रोबस् का मुख्य स्त्रोत तलछट एवं मत्स्य आंत है। तलछटों में आर्गेनिक बाउंड फास्फोरस का मैक्रोबियल विघटन के अध्ययन हेतु इसके अकार्बनिक रूप को रासायनिक पद्धति से अलग किया गया और शेष आर्गनिक बाउंड फास्फोरस को बैक्टीरिया को अलग करने के लिए उपयोग किया गया, अभी अध्ययन जारी है।

आहार चक्र में आर्सेनिक – कारण, प्रभाव एवं उपाय

आर्सेनिक से प्रभावित तथा प्रभावित नहीं होनेवाले क्षेत्रों में स्थित मत्स्य तालाबों में अजैविक व जैव घटकों में आर्सेनिक संदूषण के स्तर का अध्ययन किया गया। प्रभावित क्षेत्र में 4 हैचरियों का सर्वेक्षण भी किया गया।
लेबियो रोहिता में पैथोलॉजिकल परिवर्तन तथा मछलियों की मृत्यु दर जानने के लिए इन्हें 10 दिनों तक आर्सेनिक में रखा गया। 10 पी.पी.एम.या अधिक सांद्रता वाले आर्सेनिक में रखने पर मछलियों के शरीर पर पिगमेंटेशन एवं डिपिगमेंटेशन होने लगा। फिन निक्रोसिस का दाग भी देखा गया। 15–60 पी.पी.एम. होने पर मछलियों की मृत्यु हो गई। रखी गयी मछलियों के विभिन्न अंगों में असाधारण बदलाव देखा गया। लीवर टिश्यू में साइटोप्लास्मिक ग्रेनुलारिटी, निक्रोटिक हेपाटोसाइट, कंजेस्टेड सेन्ट्रल वेइन आदि देखा गया। 10 पी.पी.एम वाले सांद्रता में रखी मछलियों के गुर्दे में गलोमेरूलार निक्रोसिस पाया गया।

अंतर्स्थलीय खुले जलक्षेत्रों में आवश्यकता पर आधारित एकीकृत पालन प्रणाली मॉडल द्वारा जीवकोपार्जन में सुधार

बिहार के वैशाली जिले में जनदहा ब्लाक पीरापुर गांव को जीवकोपार्जन में सुधार लाने हेतु चयन किया गया। इस गांव के सकरी चौर को मत्स्य प्रबंधन के लिए चुना गया। चौर में संग्रहण के लिए आवश्यक अंगुलिकाओं के उत्पादन हेतु जल निकाय में पेन व पिंजरों को लगाया गया। चौर में कुल 3 पेन एवं 35 पिंजरे स्थापित किए गए। कार्प मत्स्य बीजों के लिए भी इस स्थान पर एक पोर्टेबुल इको–हैचरी स्थापित की गई।

मात्स्यिकी क्षेत्र के लिए डाटाबेस को सुदृढ़ बनाना एवं भौगोलिक सूचना प्रणाली

देश के 7 राज्यों के जल निकायों का मानचित्रिकरण का कार्य 5.8 एम. रिजेल्यूशन डाटा के उपयोग से पूर्ण कर लिया गया। सैम्पलिंग पद्धतियों के आधार पर उपज आंकलन हेतु विजअल बेसिक तथा एम.एस. एक्सेस की सहायता से एक साफ्टवेयर विकसित किया गया। राज्य मत्स्य अधिकारियों को साफ्टवेयर उपयोग तथा मत्स्य उपज आंकलन पद्धतियों पर प्रशिक्षण दिया गया। तमिलनाडु और झारखण्ड के 0.5 हेक्टर से बड़े जल निकायों को पहचान कर मानचित्रित किया गया। सेटलाइट डाटा से पहचाने गए जल निकायों को भौतिक रूप से भी प्रमाणित किया गया। कर्नाटक राज्य में 10 हेक्टर से बड़े जल निकायों पर भी यह कार्य किया गया। सर्वेक्षण के दौरान हरियाणा राज्य के 2 जिलों के जल निकायों पर भी कार्य किया गया।

केन्द्रीय अंतर्स्थलीय मात्स्यि की अनुसंधान संस्थान
Central Inland Fisheries Research Institute
(Indian Council of Agricultural Research)
Barrackpore, Kolkata - 700120
Phone : 91-33-25921190-91, Fax : 91-33-25920388, E-mail : cifri@vsnl.com
Website : www.cifri.ernet.in