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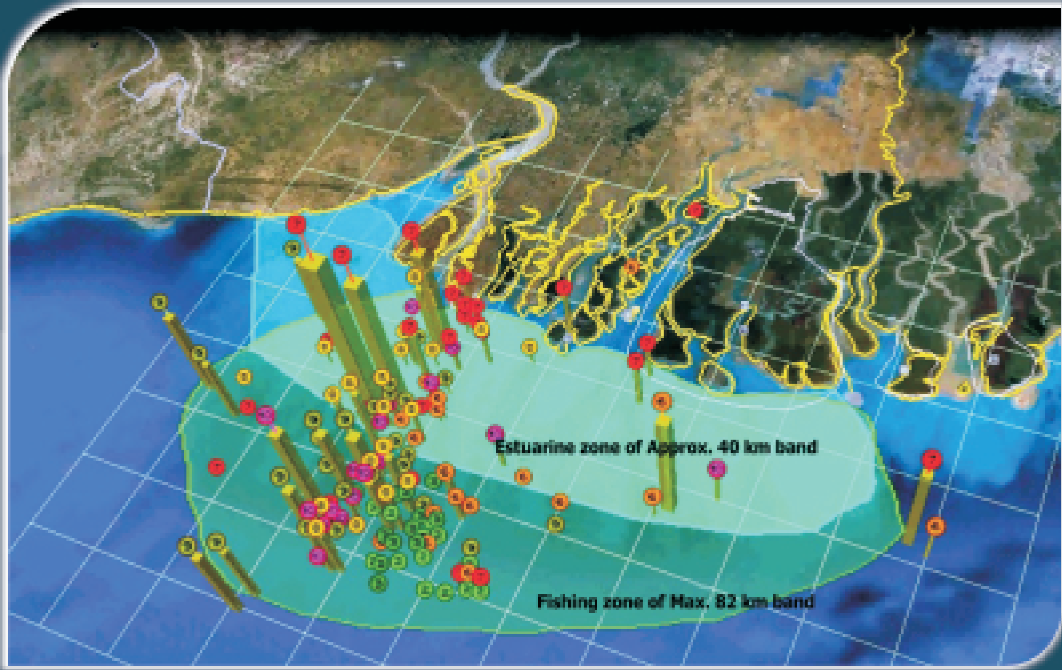


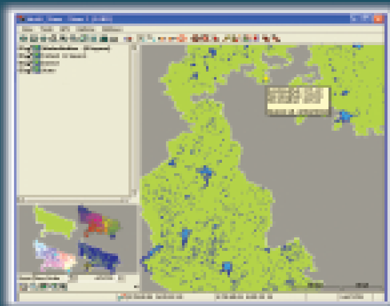

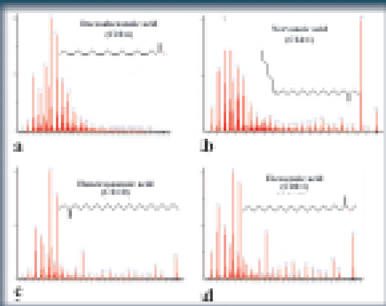

# CIFRI 2012-13 ANNUAL REPORT

# Annual Report
# 2012-2013

Central Inland Fisheries Research Institute
Barrackpore, Kolkata - 700 120

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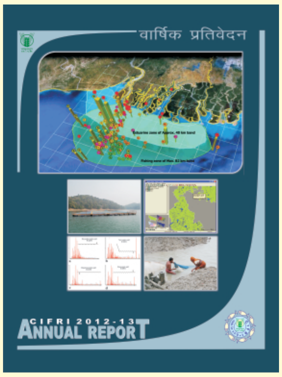


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# Contents

# Preface

Central Inland Fisheries Research Institute (CIFRI) has generated a vast dynamic knowledge base through decades of multidisciplinary research for sustainable production enhancement in inland fisheries sector. Mandated resources are mostly multi-stake inland aquatic ecosystems comprising of diverse ephemeral, seasonal and persistent lentic and lotic habitats viz. rivers, estuaries, wetlands and reservoirs that provide both ecosystem services and fisheries and livelihood to millions. CIFRI has changed its research focus to address issues related to ecosystem function and services, biodiversity, fisheries and resource conservation. Fisheries in natural aquatic ecosystem are complex interplay of multiple abiotic and biotic factors of habitat which were earlier not dealt with analytically resulting into a wide gap. Ecosystem and its fish stocks are also affected by fishing efforts, various enhancement options, institutional arrangements, governance etc. In recent days climate change is found to affect all aspects of inland aquatic resources including fish spawning behavior, feeding behavior, fish diversity, disease occurrence, carbon sequestration potential etc. In concert with the contemporary necessity, CIFRI has reoriented its research base in two directions: from only fisheries to natural resource management based fisheries, and use of modeling to delineate influential factors for production, sustainability, biological interactions etc.

CIFRI has envisioned research for the 12th plan period to address multifarious environmental issues in fisheries in a holistic manner to ensure long-term ecological integrity and sustainability of production of open water ecosystems. The Institute envisages achieving a stature of formidable authority for research support and guidance on sustainable utilization and conservation of open freshwater resources in the country and looks forward to work and contribute on major issues in natural resource management. It is hoped that our focused research efforts will help in meeting the emerging challenges of climate change, biodiversity threats, resource shrinking, and alternate livelihood options in the inland open water sector.

During the years the institute has opened new vistas through innovative research methods bolstering deeper community partnerships. CIFRI has also strengthened research and development linkages with different research institutes, universities, state governments and national and international organizations like Food and Agriculture Organization, Rome, Department of Aquaculture Development, Combodia, Aquatic Ecosystem Health and Management Society, Canada, Wetland International, New Delhi, NOFIMA, Norway, Bangladesh Fisheries Research Institute, Bangladesh etc.

The institute has also organized a number of training programmes, mass awareness camps and exhibitions to share its know-how, achievements and experiences at its headquarter and regional centres to build the capacity of fishers, fish farmers, tribal people, state fishery officials, university faculties on various aspects of inland fisheries. The Institute has organized Pillay Aquaculture Foundation Congress, 100th Indian Science Congress (Animal, Veterinary and Fisheries sciences Section), Satellite symposium on river health, workshop on environmental flows, etc. that received overwhelming response at national and international levels.

I have the privilege of acknowledging the profound support I have received from the Secretary DARE and DG ICAR. I'm also grateful to Dr. B. Meenakumari, DDG (Fy.), Dr. S. D. Singh (ADG, I. Fy.), Dr. Madan Mohan, (ADG, M. Fy.) as well as to the team of scientists and other members of the CIFRI fraternity for their unstinted support. The efforts of Dr. S. K. Manna and his team in preparation of this document is commendable and acknowledged.

Barrackpore, Kolkata - 700120
July, 2013

A P Sharma
Director

# Acronyms

| | |
|---|---|
| 2-D | Two dimensional |
| ADG | Assistant Director General |
| ADG (I. Fy) | Assistant Director General (Inland Fisheries) |
| ADG (M. Fy) | Assistant Director General (Marine Fisheries) |
| av. | Average |
| avg. | Average |
| BLAST | Basic Local Alignment Search Tool |
| BOBLME | Bay of Bengal Large Marine Ecosystem |
| BOD | Biochemical Oxygen Demand |
| C.P. | Crude Protein |
| C/A | Reservoir catchment area ratio |
| $calm^{-2}day^{-1}$ | calorie per meter square per day |
| CART | Classification and Regression Tree |
| Cd | Cadmium |
| CD | Compact disc |
| CDA | Chilika Development Authority |
| cDNA | Complimentary deoxyribonucleic acid |
| CFU | Colony Forming Units |
| CIBA | Central Institute of Brackish Water Aquaculture |
| CIFA | Central Institute of Fresh Water Aquaculture |
| CIFRI | Central Inland Fisheries Research Institute |
| CISCO | Computer Information System Company |
| cm | Centimeter |
| CPUE | Catch per unit effort |
| cu | Copper |
| DAHD&F | Department of Animal Husbandry, Dairying and Fisheries |
| DARE | Department of Agricultural Research and Education |
| DDG | Deputy Director General |
| DDG (Fy) | Deputy Director General (Fishery) |
| DG | Director General |
| DHA | Docosahexaenoic acid |
| DM | Data mining |
| DN | Digital number |
| DNA | Deoxyribonucleic acid |
| DO | Dissolved oxygen |
| DSS | Decision Support System |
| DVC | Damodar Valley Corporation |
| EFC | Expenditure Finance Committee |
| EPA | Environmental Protection Agency |
| ERNET | Educational and Research Network |
| FAO | Food and Agriculture Organization |
| Fig. | Figure |
| FRL | Full reservoir level |
| FW | Freshwater |
| $gC/m^2/d$ | Gram carbon per square meter per day |
| GE | Gel electrophoresis |
| GIS | Geographical information system |
| GSI | Gonadal somatic index |
| ha | Hectare |
| HDPE | High density polyethylene |
| HEP | Hydro-electric project |
| HSP | Heat shock proteins |
| HTML | Hyper Text Markup Language |
| ICAR | Indian Council of Agricultural Research |
| ICZM | Integrated Coastal Zone Management |
| IDA | International Depository Authority |
| IL | Interleukin |
| IMC | Indian major carps |
| IRC | Institute Research Committee |
| ISI | Indian Standards Institute |
| IUCN | International Union for Conservation of Nature |
| kg | Kilogram |
| kHz | kilohertz |
| Lat. | Latitude |
| LIC | Life Insurance Corporation of India |
| long. | longitude |
| m | meter |
| m/sec | meter per second |
| $m^3sec^{-1}$ | Cubic meter per second |
| MALDI-TOF-MS | Matrix-assisted laser desorption ionization – Time of flight –Mass spectrometry |
| MCM | Million cubic meter |
| $mgCm\text{-}^3hr^{-1}$ | Milligram carbon per cubic meter per hour |
| $mgl^{-1}$ | Milligram per liter |
| Mn | Manganese |
| MoEF | Ministry of Environment and Forest |
| msl | Mean sea level |
| MTCC | Microbial type culture collection |
| N | Number of sample |
| NAIP | National Agriculture Innovation Project |
| NCBI | National Center for Biotechnology Information |
| NGO | Non Governmental Organization |
| NIR | Near infrared |
| NJCHEP | Nyamjang Chhu Hydro-electric Project |
| $nm^{-2}$ | Number per meter square |
| NMDS | Non-metric multidimensional scaling |
| $NO_3$- | Nitrate |

| | |
|---|---|
| ORF | Open reading frame |
| PAN | Panchromatic |
| Pb | Lead |
| PCR | Polymerase chain reaction |
| PGS | Parganas |
| PIX | Private internet exchange |
| PMF | Peptide mass fingerprinting |
| $PO_4$ | Phosphate |
| PUFA | Poly unsaturated fatty acid |
| QRT | Quinqennial Review Team |
| RAC | Research Advisory Committee |
| RPF | Research project format |
| rRNA | Ribosomal ribonucleic acid |
| RS | Remote sensing |
| SD | Stocking density |
| SFA | Saturated fatty acid |
| SHG | Self Help Group |
| sq.ft. | Square feet |
| SQL | Structured query language |
| SWIR | Short wave infra red |
| t | tonne |
| TL | Trophic level |
| TLR | Toll like receptor |
| TRT | Tail res tunnel |
| u/l | Units per liter |
| $ucm^{-2}$ | Units per centimeter square |
| USEPA | United States Environment Protection Agency |
| VSAT | Very small aperture terminal |
| WHO | World Health Organization |
| yr | Year |
| Zn | Zinc |
| ZSI | Zoological Survey of India |
| $\mu Scm^{-1}$ | Micro siemens per centimeter |

# Executive Summary

Central Inland Fisheries Research Institute (CIFRI) is recognized at national and international levels as a premier research organization in the field of inland fisheries and aquatic ecology. At present the Institute has 57 scientists, 62 technical, 52 administrative and 93 supporting personnel posted at the Institute Head Quarter at Barrackpore and regional centres/stations at Allahabad in the North, Bangalore and Kochi in the South, Vadodara in the West and Guwahati in the North-Eastern part of the country.

During the year 2012-13, CIFRI conducted research under five Institute funded research programmes with number of projects, implemented through Riverine Ecology and Fisheries, Reservoir and Wetland Fisheries, Fisheries Resource and Environmental Management Divisions and Agricultural Economics Section. Besides, different externally funded projects, training and extension programmes were also excecuted successfully. The major research findings of these projects are precised below:

## Riverine & Estuarine Fishery Resources

- In the Farakka-Fraserganj stretch of Bhagirathi-Hooghly river system the size of Hilsa catch ranged between 130 and 927 g (av. 377.5 g) in winter, as compared to 125 and 935 g (av. 435.1 g) during monsoon migration, primarily due to rampant use of smaller mesh size drift gill net of 70 - 80 mm during winter months. Critical analysis of body-morphometry of the captured hilsa revealed that to avoid catching hilsa smaller than 500 g, use of gill net below 90 mm mesh size must be avoided.

- Economic analysis of hilsa fishers revealed that most of their income (56%) is spent for food purpose. Fishers also spend a considerable amount of money for the purpose of hilsa fishing operation. The boat hire charge is maximum (76%), followed by net and gear repairing charge and license fee.

- Survey in selected areas of Sunderbans revealed reduction in occurrence/catch of native fish species like *Ompok pabda, Heteropneustes fossilis, Clarias batrachus, Anabas testudineus, Glossogobius* sp., *Anguilla bengalensis, Amblypharyngodon mola, Colisa fasciata, Notopterus notopterus, Mystus vittatus, Mystus guilo, Channa marulius, C. striata, C. punctata, C. gachua, Mastacembelus armatus, Macrognathus pancalus, Puntius sarana, Pethia ticto, Chanda nama, Nandus nandus* etc.

- The sediment of Herobhanga River was found to have significant amount of soil organic carbon (0.87-0.99%) due to detrital loading from nearby mangrove areas. In Jharkahli mangrove ecosystem, the litter fall estimation through the litter trap showed an uniform and good amount of litter production from Kal bain (*Avicennia alba*). Geon (*Excoecaria agallocha*) produced maximum litter in April. Sufficient foliage drop was also recorded in Jat bain (*Avicennia officinalis*) and Keora (*Sonneratia apetala*).

- A total of 102 fish species belonging to 39 families and 11 orders were recorded from Herobhanga river area. Significant changes in catch structure was observed with dominance of low valued fish like *Escualosa thoracata*, *Thryssa purava* etc. Yellow-fin sea bream (*Acanthopagrus latus*), sardines (*Sardinella gibbosa*, *S. melanura*), groupers (*Epinephelus coioides* being the major species) and snappers (*Lutjanus johni*) have emerged as new fishery resources in the area, due to increased salinity. A larger size specimen of catfish, *Hexanematichthys sagor* (*Arius sagor*) (99.4 cm TL, ~ 16 kg weight) was recorded. The green tiger prawn (*Penaeus semisulcatus*) is also an emerging resource and is now common in the Herobhanga creek.

- Based on critically low dissolved oxygen regime, P/R raio, $CO_2$, nutrient contents and biodiversity the Sabarmati estuarine system is defined as organic rich and highly stressed eco-system. Biodiversity indices viz. Shannon's index (H'), Evenness index (J), Margalef's index(d) and Simpson's index

(1-λ) indicated varied environmental conditions at identified sites during different seasons. Bayesian Belief Networks based on evidences as inputs has revealed that Sabarmati estuarine system is environmentally degraded to the tune of 79.26%.

- Watershed analysis of Mahanadi basin was carried out using the TNT Microimage software for delineating current flow path network, watershed boundaries and basins as separate Vector. Two ecological assets alongside the course of Mahanadi, viz. Ansupa floodplain wetland and Satkosia reserved forest for aquatic animals were identified as some of the key indicators for environmental flows studies.

- The upper zone of river Mahanadi was dominated by *Tor tor*. There was predominance of large size Indian major carps in the middle stretches having features like deep and wide river stream. Small bodied fishes, freshwater catfishes and a variety of prawn species were recorded in the lower stretches. A succession of deep pools and riffles along the 350 km Cuttack to Sambalpur stretch served as breeding and nursery environment for a number of fish species, including Indian major carps and catfishes.

- In river Ganga, sizeable presence of Myxophyceae and Euglenophyceae groups in the middle stretch indicated pollution load and their absence reflected better water quality in upper stretch. In terms of higher microbial load Kanpur, Sangam, Chunar and Rajght-Dashwashmedh ghat stretches of the river Ganga indicated poor water quality.

- Total fish landing in the river at Allahabad during 2012 was estimated at 203.68 t, with major contributions from major carps (14.90%), catfishes (12.43 %) and exotics (33.59 %).

- A total of 110 fish species belonging to 74 genera 30 families and 10 orders were recorded from the river Ganga between Tehri to Vindhyanchal during the period under report. A rare cobitid, *Pangio pangia* was recorded for the first time from the river Ganga at Narora.

- Fourteen species of catfishes, representing four families, were recorded from from Hirakud to Naraj stretch of river Mahanadi. *Rita chrysea* was found to be endemic to the river. Larger specimens of *Wallago attu*, *Sperata seenghala* and *Pangasius pangasius* were recorded from inside Satkosia reserve forest area.

## Wetland Fishery Resources

- Five wetlands viz. Takmu pat, Ungamlen pat, Utra pat, Sana pat and Waithou pat from Manipur have been characterized for their habitat variables, aquatic communities and fisheries.

- Higher levels of carbon and phosphorus mineralizing sediment enzymes, total heterotrophic bacteria, phosphatase producing bacteria, organic matter and potential of availability of phosphorous were recorded in a natural wetland (Khalsi) than a sewage fed wetland (Jhagrasisa) in West Bengal.

- Pen culture demonstration in Takmu pat of Manipur, in collaboration with the Directorate of Fisheries, Govt. of Manipur indicated technological feasibility of culturing *Osteobrama belangeri* (a high-demand indigenous minor carp), grass carp and catla up to advanced fingerling size for their subsequent release into wetland proper.

- Stocking density of *Cirrhinus mrigala* fry in cages in Charan beel, Assam has been standardized at 150-200 nos/$m^3$ of cage area based on unaffected growth performance of the species, beyond which there was decline in growth for a rearing period of 45 days.

- Survey-based primary data and available secondary information from selected rivers, estuaries, reservoirs and wetlands revealed the presence of 15 species of exotic fishes with abundance index of 0.2 to 65%.

- *Oreochromis niloticus, Cyprinus carpio, Hypophthalmichthys molitrix, H. nobilis, Ctenopharyngodon idella* and *Clarias gariepinus* contributed 65% of the total catch in the Ganga and Yamuna rivers at Allahabad, while in culture-based East Kolkata wetlands exotics contributed 55-65% to the total production.

## Reservoir Fishery Resources

- Krishnarajasagar reservoir recorded an estimated catch of 523.5 t with highest landings in June and lowest in November comprising of carps (79%), *Ompok bimaculatus* (11%), miscellaneous species (6%), *Oreochromis mossambicus* (3%), and murrels (1%).

- Experimental fishing in three reservoir areas and at a downstream site could record 28 fish species, of which *Catla catla, Labeo rohita* and *Cirrhinius mrigala* do not exhibit natural recruitment and are being stocked.

- Fish species composition at Manchanbele reservoir revealed domination of *Oreochromis niloticus* (36.9%), followed by *Catla catla* (23.9%), *Labeo rohita* (18.2%), *Cirrhinus mrigala* (9.7%), *O. mossambicus* (4.9%), *Heteropneustes fossilis* (2.2 %) and *Channa marulius* (1.4%).

- Preliminary surveys conducted in nine reservoirs of Kerala indicated prevalence of mesotrophic condition with estimated algal biomass of 3.58 to 68.88 g/m$^3$ and varied management and governance systems.

- Data collected from Department of Fisheries on the large reservoirs of Karnataka indicated that stocking and new system of governance using guidelines developed by CIFRI have led to five-fold increase in fish yield from 2009-10 to 2011-12 with corresponding increase in CPUE from 2 to 12 kg.

- Gut content analysis of endemic fish, *Puntius wynaadensis* from Karapuzha reservoir presented a diverse diet (N = 7) with phytoplankton (FO = 0.78), molluscan shells (0.4) and insects (0.2) as important prey.

- Target strength estimation for different fishes was done using hydroacoustics in Kelavarapalli reservoir in Tamil Nadu.

- A prototype of the Data Acquisition System (DAS) has been designed to capture data through SMS from mobile phones directly into a database in the computer system.

## Fish & Environment Health

- In river Narmada a total of 90 fish species belonging to 35 families and 67 genera were recorded. Cyprinid was the dominant group (31.1%), followed by Bagrid (10%) and Mugilid (5.5%). Important fish species were *Labeo rohita, Catla catla, Cirrhinus mrigala, Clupisoma garua, Sperata aor, Sperata seenghala, Tenualosa ilisha, Harpodon nehereus, Liza tade, Liza macrolepis* etc. Canonical corresponding analysis explained fish species distribution variation in terms of $PO_4$-P, water temperature, total alkalinity, pH, transparency, $CO_2$, BOD, T-$NH_3$, DO, COD, Depth and $NO_3$-N.

- The upper stretch of river Narmada showed substantially high sediment dehydrogeanse activity at Amarkantak, Mandla and also in Jabbalpur, indicating organic matter pollution at these sites.

- In river Mahanadi the water and sediment quality characters were optimal with nil or negligible presence of Cd, Cu, Mn, Pb, Zn. However, DDT and endosulfan were recorded both in water and in fish flesh, but the levels were below the tolerance limit and safe for human consumption. A total of 55 fish species, belonging to all habitat guilds were recorded.

- Twenty seven bacterial isolates have been isolated from river Hooghly using general culture procedures. Some of the bacteria were identified as: *Acinetobacter junii, Achromobacter xylosoxidans*, *Chryseobacterium* sp., *Comamonas* sp., *Pantoea agglomerans, Ochrobactrum* sp. etc.

- Complete genomes of two important phenol degrading bacteria were sequenced, annotated and their important genes were identified.

- Higher heterotrophic bacterial count (CFU/100ml) was estimated at Manaya ($1.5x10^{11}$), Sirsha ($1.1x10^{11}$) and at Rajghat-Dasheswamedh ghat, Varanasi ($2.8x10^{11}$). Water quality index indicated that water from all river stretches are unsuitable for human consumption. Most stretches of River Ganga, Gomti and Mandakini are moderately polluted, but mid-lower stretches of River Yamuna (Delhi-Etawa) are polluted. Mahakumbh at Allahabad was not found to have much impact on river water quality.

- Protein and lipids are being examined as aquatic health biomarkers. The fatty acid composition of *Rita rita* eye lens was observed to vary with age: decosahexanoic acid, nervonic acid and heneicosanoic acid are present exclusively in upper age group fishes. Fatty acids from foot and mantle tissues from bivalve molluscs have also been analyzed by GC/MS.

- For the first time, muscle proteome map for IMC *Catla catla* has been generated.

- *Microcystis aeruginosa* was the most dominant (50.6-75.5%) plankton species showing noxious algal population in peri-urban lakes of West Bengal. Three planktivorous fishes namely, *H. molitrix, O. niloticus niloticus* and *B. gonionotus* have been incorporated as bloom controlling bio-agent.

## Fisheries Resource Assessment

- LISS III imageries of Oct 2010, Oct 2009, May 2009, Oct 2004 and March 2004 were geo-referenced and delineated for water area estimation of Matatila, Barua Sagar, Magarpur, Kamlasagar, Pahuj and Barahawar reservoirs in district Jhansi, UP. The imageries revealed marked seasonal variations in water area of these reservoirs. The largest reservoir, Matatila had 12202 ha water area in Oct 2009 and 6855 ha in May 2009.

- A quantitative assessment framework of fish biodiversity in mesohabitat of the middle stretch of Narmada river on the basis of secondary data was derived. Species-mesohabitat model developed under logistic regression framework made the following predictions with 69.5% overall accuracy: (i) Significant association between species, family and mesohabitat, (iii) chance of encountering species in Pool-Run is 14.49 times more than that in Run-Riffle, and (iv) there was a positive association in occurrence probability between Bagridae and the reference family (i.e. Ambassidae ) in the Run-Riffle mesohabitat.

- Time series analysis techniques viz., Structural Time Series Models, Unobserved Component Models (UCM) and Seasonal Autoregressive Integrated Moving Average models were used to forecast daily and monthly fish seed and tiger shrimp seed collection from the Hooghly estuary. The UCM model for monthly forecasting data predicted the monthly landings with high precision ($R^2 = 0.85$). The trend plus cyclical models were used to estimate lunar effects, trend and seasonality from daily collection data and can also be applied for forecasting of future values.

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## Socio-Economics

- Madhya Pradesh reservoirs were studied for their institutional arrangements and governance. The study revealed that Gram Panchayat leased out water bodies with area <10 ha, Janpad Panchayat - 10-100 ha, Zila Panchayat - 100-1000 ha, State Fisheries Department (DoF) - 1000-2000 ha and M.P. Fisheries Federation (FISHFED) > 2000 ha.

- There are nine major stakeholders of Indira Sagar reservoir with no major conflicts among them. Madhya Pradesh Fish

Federation (Cooperative) Limited (FISHFED) is the nodal agency of fisheries of the reservoir. FISHFED leases the reservoir to the highest bidder for stocking, harvesting and marketing of fish. The total numbers of fishermen cooperative societies are 66 having approximately 2670 fishers. The fish catch from the reservoir has increased from 495t to 1023t during last 5 years primarily due to better institutional arrangements and governance.

- The goods and services provided by the mangrove ecosystem of Sundarban have been listed. An attempt is being made to estimate the value of mangroves as a breeding grounds & habitat for various off shore and inshore fisheries.

- Based on secondary data it was estimated that the per ha value of carbon stored in aerial parts of three species of mangroves viz, *Avicennia* sp., *Sonneratia* sp., *Excocaria* sp. ranged from Rs. 53,773 to Rs. 1,00,824. The total values of these three species ranged from Rs.564 to Rs.1058 crores.

- Primary data have been collected from 195 fisher families of 14 blocks in four districts of Bihar on different stretches of Ganga and its tributaries and different *Chaurs* and *Mauns* to develop fishers's livelihood asset maps. A data structure has been developed for creation of livelihood database.

## Outreach Projects

- Indoor experiments have shown that artificial creation of flow by flow machine improved 6% higher live weight gain and 52 % higher feed consumption in IMC under captive condition. Similarly, inclusion of probiotics, attractant and anti-stressor agent in fish feed led up to 58% increase in weight gain. Experiment with stocking advanced fingerlings of common carp at two densities of 90 g/m$^3$ and 390 g/m$^3$ in Maithon reservoir showed higher growth performance in cages with low fish density during all the periods of monitoring.

- Truss morphometry showed that population of *C. catla* in Ganga at lower stretch (Nabadwip and Farakka) were clearly different from that of upper stretch (Patna, Allahabad) and Narmada, while *L. rohita* and *C. mrigala* showed no such difference. Partial cytochrome b (307bp) gene sequence analysis of *L. rohita* from Allahabad, Patna, Farakka, Nabadwip, Guwahati, Bharuch revealed that 92.16% of the total variation was contributed due to variation within population and 7.84% was attributed to differentiation among populations and population structuring in the species.

- *Catla catla, Labeo rohita, Cirrhinus mrigala, Labeo fimbriatus* and *Macrobrachium rosenbergii*, collected from the Ganga, Brahmaputra and Narmada rivers showed difference in relative fecundity among the river systems with higher fecundity for *C. catla*, and *C. mrigala* in Ganga and for *L. rohita* from Brahmaputra. The length and age at maturity of the target species in Ganga and Narmada showed difference among the rivers.

- Nutrient profiling of river catfish *Sperata seenghala* revealed that the fish flesh is rich in essential amino acid histidine, threonine and leucine and that the ratio of essential to non-essential amino acid is 0.89 indicating its superior protein quality. The species is rich in zinc, iron and calcium also.

- The medium-sized Hilsa, *Tenualosa ilisha*, contains the highest amount of unsaturated fatty acids as well as ω-3 PUFAs, EPA and DHA and the lowest amount of saturated fatty acids making it the best for human health and nutrition.

## ICAR Network Projects

- The VII$^{th}$ stage of maturity of *Tenualosa ilisha* in Hooghly estuary is best attained in water temperature range of 30-31°C. For spawning the conducive temperature range is 29-32°C. Increase in water temperature was found to affect habitat, metabolism, growth and reproduction of the fish.

- Hatchery survey data comprising of various aspects of the breeding and spawning of the IMC has been compiled in the form of E-Atlas. E-Atlases for West Bengal and Assam have been prepared.

- The usefulness of phosphorus solubilizing/mineralizing bacterial isolates have been examined in vitro and in sediment microcosm. Despite their low activity in vitro, a good number of isolates were effective in P regeneration in sediment indicating their biofertilization potentiality in freshwater systems.

## NAIP & NFBSFARA Projects

- Proteomic analysis of heat-stressed liver of *Channa striatus* revealed over-expression of several proteins like glyceraldehydes-3-phosphate dehydrogenase, ferritin, glutathione S-transferase, superoxide dismutase, HSP-60, -actin and, phosphoglycerate kinase indicating generalized up regulation of heat-stress responsive proteins.

- The whole transcriptome sequence analysis of *Staphylococcus epidermidis* grown in 20% salt stress condition identified ESTs of 324 salt stress related genes. Comparative gene ontology has been studied both for the control and the treated *Staphylococcus epidermidis* bacteria with respect to biological process, molecular function and cellular component in order to retrieve GO terms for all the BLASTX functionally annotated transcript.

- The fishes in the arsenic affected areas are contaminated with arsenic. There is a significant positive correlation of arsenic content in fish flesh with that in pond water and sediment. Probability of arsenic exposure to human beings from fishes is relatively less from IMC, as compared to other aquatic food like gastropod and bivalves.

## Central Sector Scheme

- The E-Atlases of water bodies in Uttar Pradesh have been prepared using remote sensing imageries. District-wise and block-wise compiled information of water area are also provided by the atlas in different categories.

- In Barpeta district of Assam, a total of 7,452 ponds and community tanks with water spread area of 1565.08 ha approx have been documented.

## Other Projects

- To reduce the capture of juvenile hilsa a BRD consisting of a square mesh window of size 1m x 0.75m, made of 50 mm mesh, has been introduced near the cod end in the stationary bag nets. Experimental fishing showed that a total of 41 species could escape through the BRD. The length of the excluded Hilsa ranged from 37 mm to 55 mm.

## Human Resource Development

- The Institute organized 23 training programmes, 13 mass awareness campaigns, organized/participated in 15 exhibitions, two mass awareness and training programmes for tribal fishers, Pillay Aquaculture Foundation Congress, $100^{th}$ Indian Science Congress (Animal, Veterinary and Fisheries sciences Section), workshop on environmental flows, review meeting on catch assessment methodology in inland fisheries etc. for capacity building, advisory and fisheries development activities in the country and in the region.

# Introduction

## Brief History

The sub-committee of Central Government on Agriculture, Forestry and Fisheries recommended the establishment of the Central Inland Fisheries Research Station in Calcutta under the Ministry of Food and Agriculture, Government of India on 17 March 1947. Based on performance of the Station, it was elevated to Central Inland Fisheries Research Institute (CIFRI) in 1959 and shifted to Barrackpore (West Bengal) in its own building. The Institute came under the umbrella of Indian Council of Agricultural Research (ICAR), New Delhi in 1967. During last five decades, the institute has grown from strength to strength to establish itself as a premier research organisation on inland fisheries and aquatic ecology.

In the beginning, the objective of the institute was to assess inland fishery resources and to evolve strategies to obtain optimum fish production. The research efforts of the institute were devoted to understand and document the ecology and production functions of various inland water bodies in the country.

The plan priorities of Government of India during late sixties and seventies were on aquaculture research and development. In consonance with the priorities, the institute made significant progress and the Planning Commission sanctioned five All-India Coordinated Research Projects, namely, Composite Fish Culture, Riverine Fish Seed Prospecting, Air-breathing Fish Culture, Ecology and Fisheries Management of Reservoirs and Brackish water Fish Farming during 1971-1973. The combined success of the projects Composite Fish Culture & Fish Seed Production initiated in 1974 brought blue revolution in the country and layed down a solid foundation for development of freshwater aquaculture in the country. The splendid success in the field of freshwater aquaculture led to the establishment of the Freshwater Aquaculture Research & Training Centre at Dhauli (Orissa) in 1977, which latter culminated in to a full fledged institute on freshwater fish farming, i.e. Central Institute of Freshwater Aquaculture (CIFA) at Bhubaneswar. Similarly, a specialized instititute on brackish water fish farming, i.e. Central Institute of Brackish-water Aquaculture (CIBA) was established in 1987 at Chennai (erstwhile Madras). The achievements of CIFRI in coldwater fisheries led to the establishment of Directorate of Coldwater Fisheries (erstwhile National Research Centre on Coldwater Fisheries). Further, National Bureau of Fish Genetic Resources was also an outcome of the research coordinated by CIFRI researches. Thus, CIFRI gave birth to four major fisheries research institutions in the country.

After formation of specialised institutes, the mandate of CIFRI was modified to conduct research on fisheries in inland open waters, namely, rivers, reservoirs, floodplain and manmade lakes, estuaries, lagoons and backwaters. Since 1987, the institute is working on fisheries management and enhancement of fish production from these large water bodies. Accordingly, the mandate, vision and mission of the institute were modified time to time. During XI-Five Year Plan these are as follows:

## Mandate

- To undertake basic, strategic and applied research in inland open-water resources *viz*., rivers, reservoirs, lakes, estuaries and associated waters
- To develop technologies and strategies for productivity enhancement in reservoirs and wetlands and conservation of rivers and associated ecosystems
- 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.

## Vision

Sustainable fisheries from inland open waters for environmental integrity, livelihood and nutritional security.

## Mission

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

## Organisational Structure

The Institute research activities are pursued through three divisions and one section. The Heads of Division (HoDs) are the co-ordinators of research programmes undertaken in their division. One research programme is implemented by a section, with in-charge of the section as co-ordinator.

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 centre. The Institute's research activities under various research projects are executed from the headquarters at Barrackpore, Regional Centres at Allahabad and Guwahati and research stations/ centres at Bangalore, Vadodara, Kolkata and Kochi. The aim and functions of divisions, sections and research support services are summarised below.

- **Riverine Ecology and Fisheries Division** with its headquarter at Barrackpore strives to monitor riverine and estuarine ecology and fisheries resources of the country with adequate emphasis on the conservation of fish stocks and develop effective management action plan. The research activities are executed from Barrackpore, Kolkata, Vadodara and regional centres at Allahabad and Guwahati.

- **Fishery Resources and Environmental Management Division** is based at Barrackpore and is working on fish health and environmental issues related to open-water fishery resources *viz.*, rivers, wetlands, reservoirs and estuaries. Monitoring of the ecosystem health and development of mitigation action plan through biochemical, microbiological, and biotechnological approaches for ecosystem restoration is also the responsibility of this division. The division is also addressing the climate change issues related to fisheries and aquaculture. Creating resource management database on fish stocks and fishery resources for developing models for sustainable exploitation of inland fish stocks is also an important area of research of the division.

- **Reservoir and Wetland Fisheries Division** aims at developing management norms for enhancing fish production from large, medium and small reservoirs in the country. The Division also carries out research on the wetland ecosystem production processes for optimising fish yield with special attention to biodiversity conservation and development of environment-friendly technologies. The research activities of this Division are implemented from Barrackpore, Bangalore, Kochi and regional centres at Guwahati and Allahabad.

- **Agricultural Economic Section** is conducting 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-economic aspects of fishers operating in reservoirs, rivers, wetlands and estuaries. The section located at Barrackpore executes projects in different parts of the country.

## Research Support Services

To execute various research activities, the institute has a support system in form of following cells, sections and units.

- **Prioritization, Monitoring and Evaluation (PME) Cell** is the major cell to prioritise, monitor and evaluate the research and other activities of the Institute. It coordinates, synthesize and monitor recommendations of QRT, RAC and IRC. It is responsible for preparation of institute publications including bulletins, annual report, newsletters, brochures, pamphlets, leaflets etc. to disseminate institute achievements among various stakeholders. It maintains RPF files and scientific publications of the institute. It responds to queries raised by parliament, audit, ICAR and any other agencies. Finally, it supports Director and the management in planning and implementation of different activities of the institute. Different research, administration and accounts section assist the cell for these activities.

- **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, fishers, entrepreneurs, extension functionaries, *etc.* It also maintains liason with other agencies. The institute has aimed at manpower development through this cell.

- **Technical Cell** provides technical support in preparation of monitoring reports to ICAR and Subject Matter Division. Different research, administration and accounts sections assist the cell for these activities.

- **IT & ARIS Cell** promotes the use of information technology and provides computer, 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, Cisco Wi Fi, Workstations, printers, scanners and various licensed software. 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. During 2012-13, library added a total number of 837 books out of which 613 books are in Hindi language. This year CIFRI Library has achieved the assigned target regarding purchase of Hindi books. The current total holdings of CIFRI Library are 14,243 books including 2413 Hindi books and a number of miscellaneous publications. During 2012-13, CIFRI library has subscribed to 17 foreign journals and 26 Indian journals. Special effort was given to digitize CIFRI old publications and important literature like bulletins etc. and many are already available through CIFRI website for download. Database regarding the details of all English books was completed during the year and is now available at LIBSYS.

- **Institute Technology Management Unit** executes the IPR related activities of the institute.

- **Aquarium and Hatchery Unit** maintains the institute aquarium and hatchery under the National Seed Project.

- **Hindi Cell** publishes technical documents, reports, magazines in Hindi, translates various technical details in News Letter, Annual Report and other research publications. Quarterly meetings of the Official Language Implementation Committee, chaired by the Director, were held during the year. Under Hindi Teaching Scheme the officers/employees were nominated for training in Hindi Language (Praveen & Pragya). With a view to encourage more and more employees to do their official work in Hindi, Hindi workshops are organised from time to time for officers/employees of the Institute. During the year Hindi Griha Patrika "Neelanjali"-3 has been successfully published.

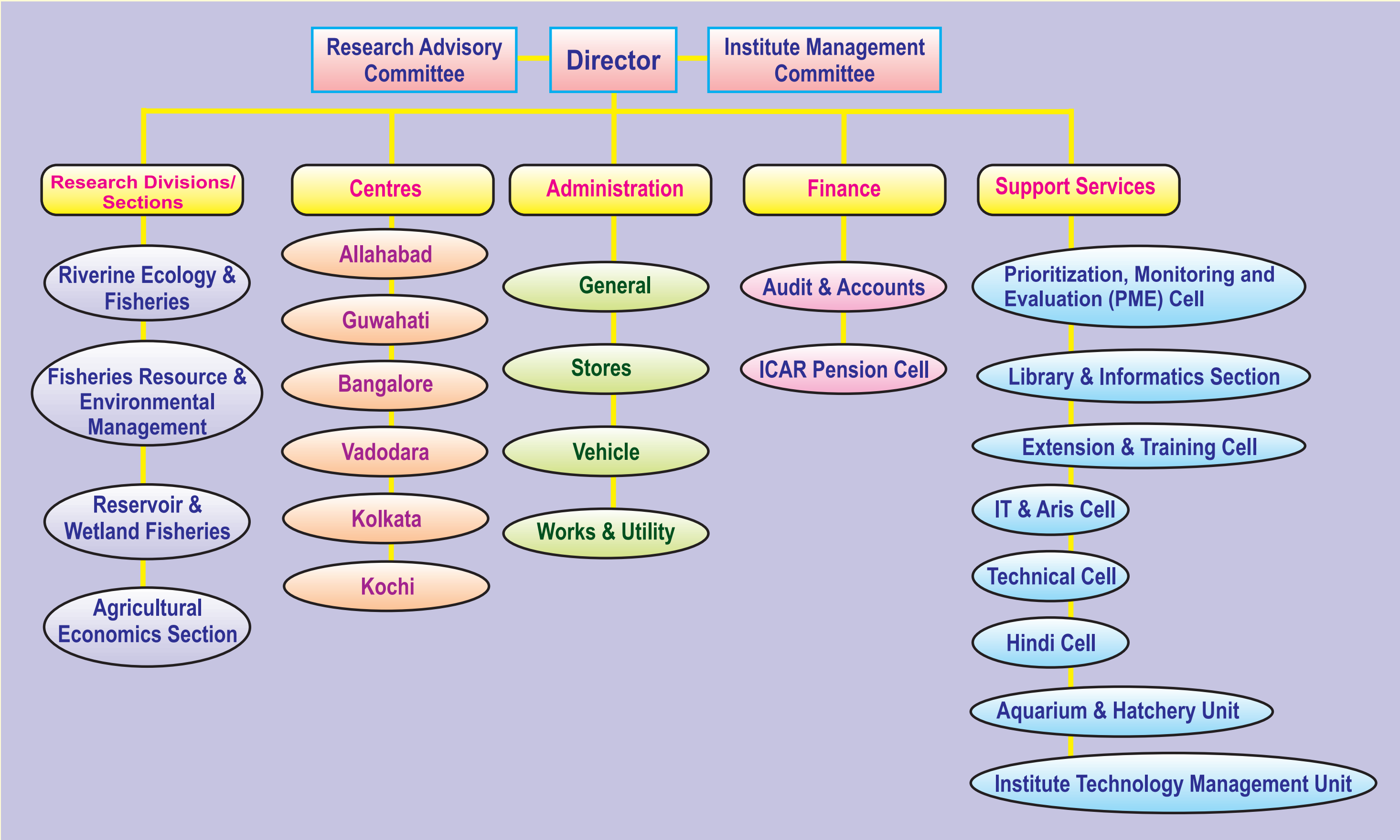
- **Administration Section** is responsible for overall administration in the institute. The section is divided in to a number of sub-sections to support the Director and other research and technical staff for smooth implementation of research, extension and other activities.

- **Finance and Accounts Section** looks after the financial management of the institute and maintains the financial records to provide support to the Director and institute staff to implement different activities as per financial regulations.

The Director heads the Institute and is responsible for the overall management of research and administration with support from Institute Management Committee, the Institute Research Committee and the Research Advisory Committee.

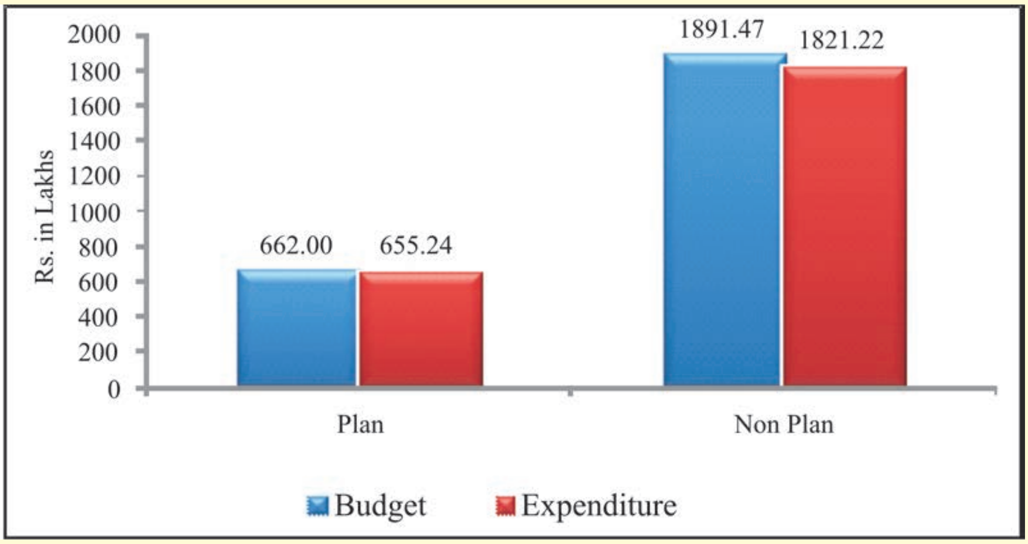
The structural outline of the Institute is depicted in the Organogram.

# Organogram of CIFRI



## Budget Details for the year 2012-13 (Rs. in Lakhs)

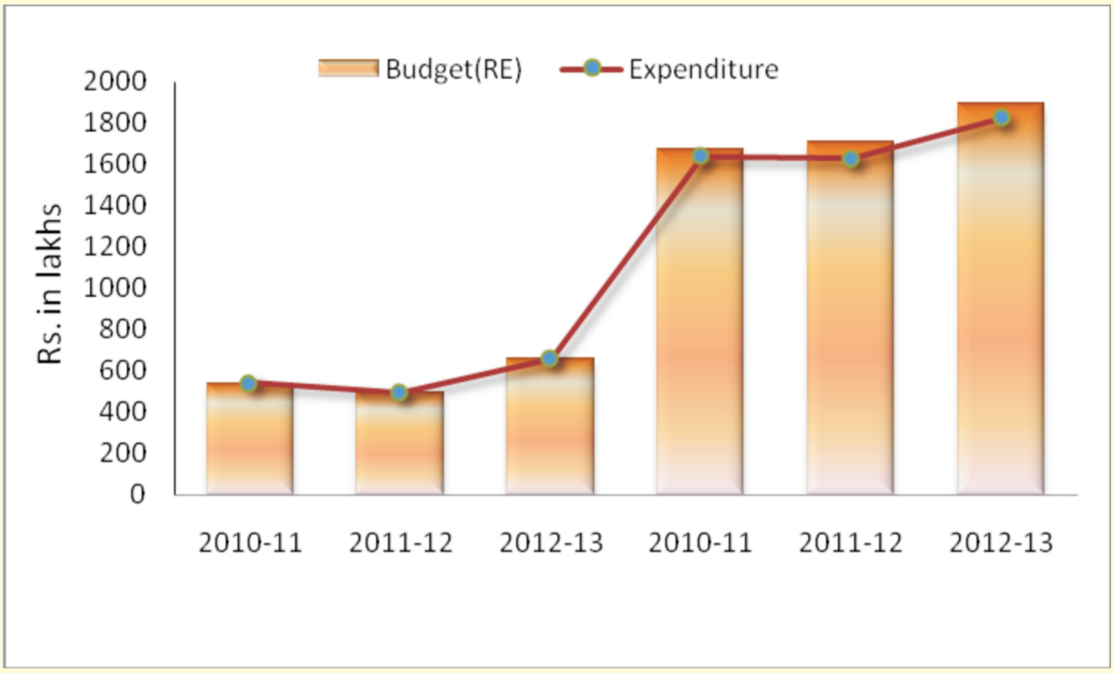
| Head of Account | Budget ( R.E.) | | Expenditure | |
|---|---|---|---|---|
| | Plan | Non Plan | Plan | Non Plan |
| Pay and Allowance Including OTA | 0.00 | 1701.00 | 0.00 | 1634.00 |
| T.A. | 60.00 | 7.00 | 60.00 | 6.99 |
| Other charges including equipment, library books, I.T. and H.R.D | 542.00 | 180.47 | 535.25 | 176.65 |
| Works | 60.00 | 3.00 | 59.99 | 2.98 |
| Grand Total | 662.00 | 1891.47 | 655.24 | 1821.22 |



## Budget Details

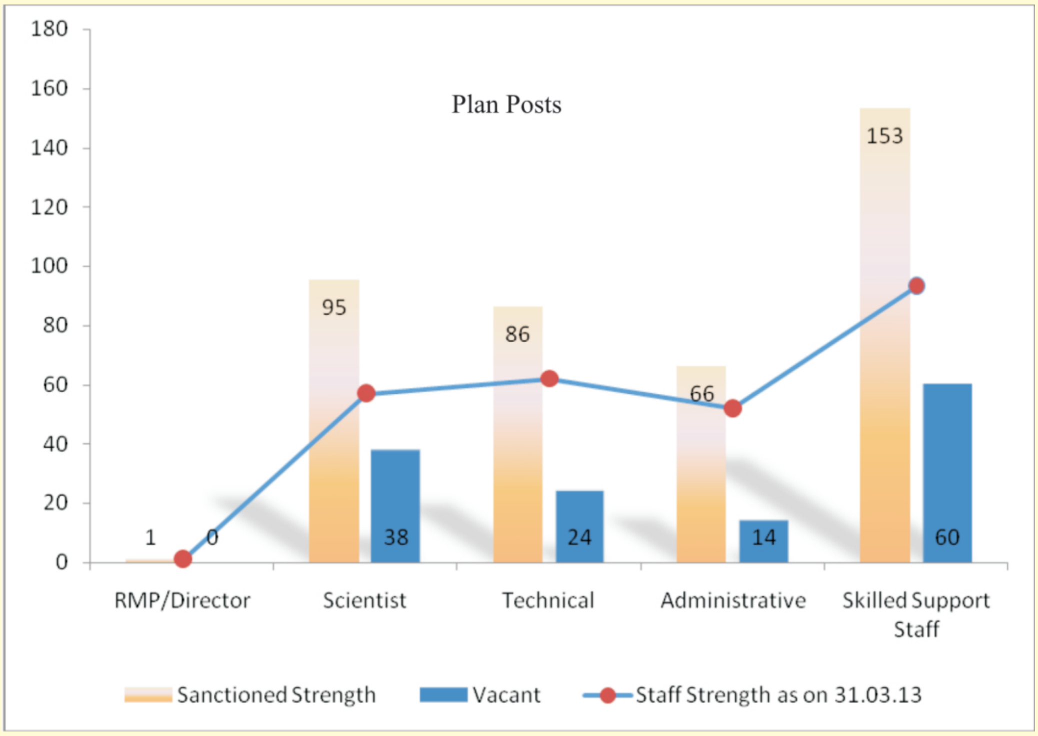
### Comparative budget statement for last three years (Rs. in Lakhs)

| Particular/ Year | Plan | | | Non-Plan | | |
|---|---|---|---|---|---|---|
| | 2010-11 | 2011-12 | 2012-13 | 2010-11 | 2011-12 | 2012-13 |
| Budget(RE) | 540.00 | 496.00 | 662.00 | 1676.80 | 1708.75 | 1891.47 |
| Expenditure | 539.65 | 494.09 | 655.24 | 1633.62 | 1625.60 | 1821.22 |



## Staff Position as on 31 March 2013

| Category | Plan Posts | | |
|---|---|---|---|
| | Sanctioned Strength | Staff Strength as on 31.03.13 | Vacant |
| RMP/Director | 1 | 1 | - |
| Scientist | 95 | 57 | 38 |
| Technical | 86 | 62 | 24 |
| Administrative | 66 | 52 | 14 |
| Skilled Support Staff | 153 | 93 | 60 |
| | **401** | **265** | **136** |



# Research Achievements

## Programme: Restoration of rivers and estuaries for ecosystem integrity and conservation of fish stock (REF/12/01/000)

### Project Title: Studies of Hilsa fisheries in different river systems of India for sustainable management (REF/ER/12/01/01)

**Investigators:** R. K. Manna, U. Bhaumik, B. B. Satpathy, S. K. Das, A. K. Sahoo and A. Roy

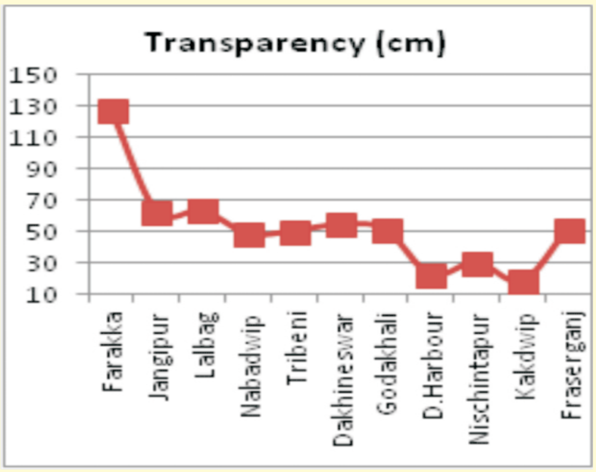
**Technical Support:** C. N. Mukherjee, S. K. Sadhukhan, R. C. Mandi, T. Chatterjee, D. Sanfui, A. Mitra, D. Saha, A. Sengupta, B. N. Das, A. Barui, A. Roychowdhury and S. Mandal

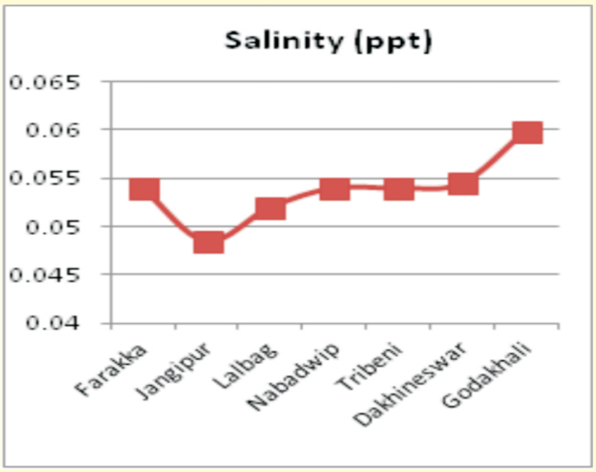
*Tenualosa ilisha* or Hilsa is one of the most commercially important fishes in India. The fish is widely distributed from Arabian Sea to Bay of Bengal. But in recent years the hilsa fishery has greatly declined due to overfishing, habitat destruction and loss of breeding/spawning ground, lack of sufficient freshwater discharge, pollution etc. Present study aims at generating information on different aspects of the hilsa fishery, including reproduction. Data collected from Farakka to Fraserganj stretch of river Ganga during winter run showed appearance of hilsa in lower stretch from 2nd to 3rd week of January while the same was observed in upper stretch from Tribeni upwards from 2nd to 3rd week of February.

**Water quality:** Temperature during winter varied from 21.3 to 24.8°C, while water depth varied from 5.88 to 24.38 m with significantly higher depth from Godakhali to Nischintapur stretch. Transparency ranged from 18 cm at Kakdwip to 127 cm at Farakka with significantly lower values in Diamond Harbour to Kakdwip stretch.

Sufficient dissolved oxygen (6.8 - 8.4 mg/l) was present in river water. Total alkalinity varied in the range of 118 to 146 mg/l with sharply declining trend in transition and saline zone. Total hardness varied in the range of 138 to 156 mg/l in freshwater zone, whereas it increased sharply up to 3300 mg/l in transition and saline

Fishing in estuarine zone



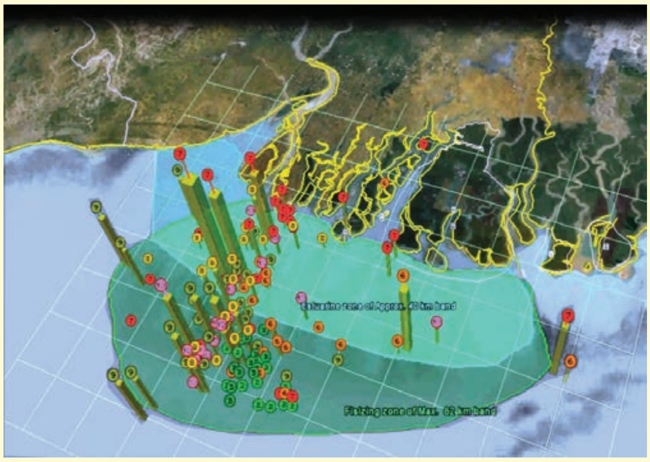

Water quality attributes in studied stretch of River Ganga zone. Salinity starts increasing from Diamond Harbour 1.7 ppt up to 33.8 ppt at Fraserganj. Among available nutrients, $NO_3$-N varied in the range of 0.02 to 0.10 mg/l with declining trend in transition and saline zone. Phosphate-P varied in the range of 0.02 to 0.08 mg/l with significantly higher values at Nischintapur area. Silicate-$SiO_2$ was near constant (5.5 to 6.4 mg/l) up to Nischintapur and then decreased sharply in saline zone at Fraserganj.

**Assessment of catch structure of hilsa:** The catch structure and abundance of hilsa in different salinity zones of the Hooghly estuarine system and its adjacent coastal habitats have been assessed. The hilsa catch data collected during monsoon and winter migration to understand seasonal differences of their catch pattern revealed relatively bigger size fish in monsoon (average of 435.1 g) than in winter (377.5 g). Winter migration included major share of smaller sized fishes caught indiscriminately by smaller mesh gill net of 70-80 mm.

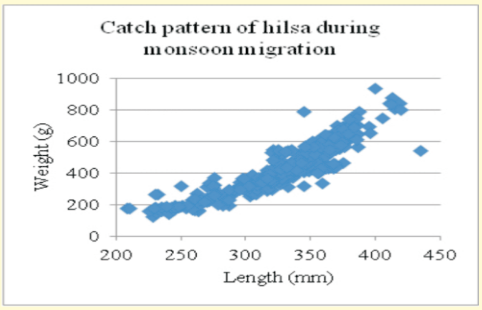
Dorso-ventral lengths of captured hilsa were also measured along with length and weight of hilsa. Critical analysis revealed that to avoid catching of smaller sized hilsa lower than 500 g, use of gill net having mesh size lower than 90 mm must be avoided. However, scanning of hilsa gear presently in use in Hooghly estuary revealed that drift gill net of 70 mm and 80 mm are quite rampant, especially during winter months.

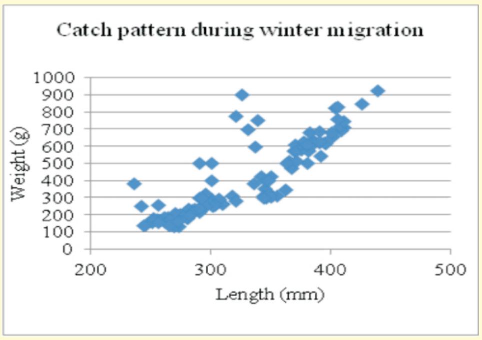
**Livelihood analysis of fisher-folk associated with hilsa fisheries:** Livelihood data of about 400 fishermen collected from various important fish landing centres of Hooghly river using a semi-structured questionnaire showed that most of the income of fishers comes from hilsa fishery during the monsoon and winter migration. However, fishing activity is very low and fishers are forced to engage in other occupations leading to migration during off-season. In lower stretch of Hooghly River fishers get higher catch as it is nearer to the sea mouth.

Analysis of expenditure pattern of the hilsa fishers showed that most of their income (56%) is spent for food purpose. Fishers also spend a considerable amount for the purpose of fishing

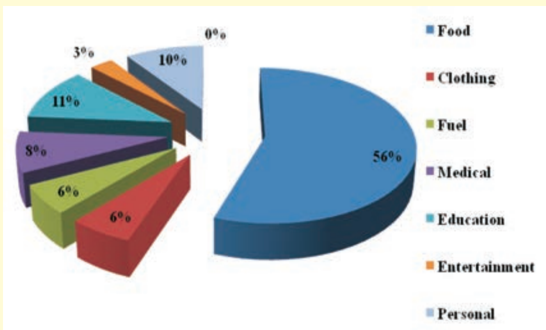


Hilsa abundance in Hooghly estuary

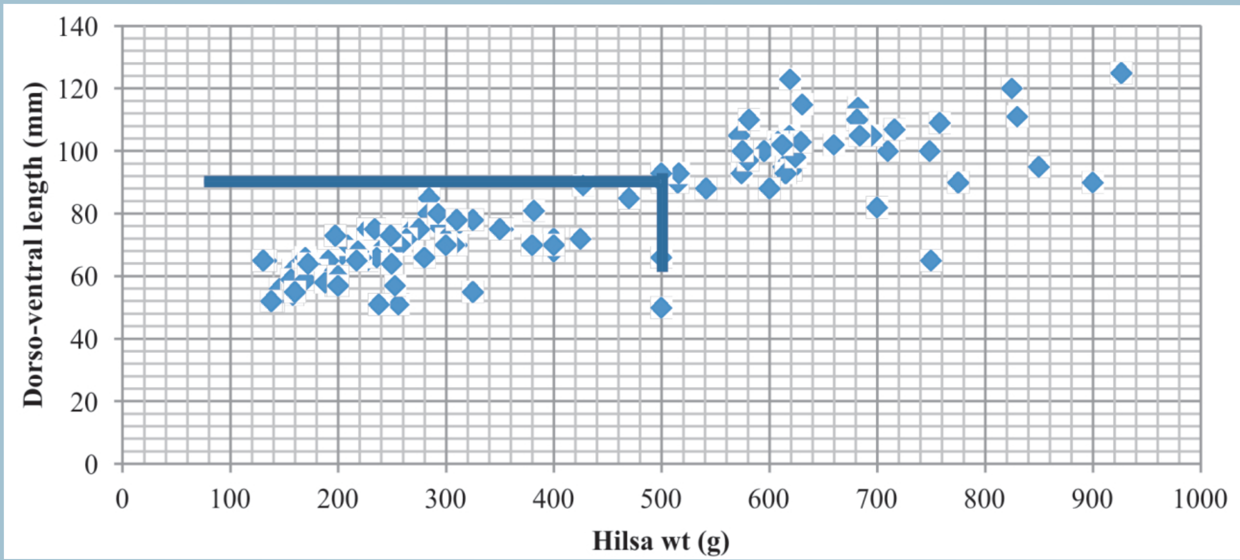



Size distribution of Hilsa caught during monsson and winter migration




Expenditure pattern of the Hilsha Fishers in Household




Dorso-ventral length of Hilsa caught during winter migration

operation where boat hire charge is maximum (76%), followed by net and gear repairing charge and license fee.

**Project Title: Population characteristic of small indigenous fishes in coastal waters of Sundarbans in relation to rural livelihood and nutritional security (REF/ER/12/01/02)**

**Investigators:** A. Sinha, P. K. Katiha, S. K. Das and A. Roy

**Technical Support:** A. Mitra, C. N. Mukherjee, D. K. Biswas, A. Sengupta and S. Majumder

India has the largest number of endemic freshwater fish species, contributing 27.8% of the native fish fauna. Of 765 freshwater fish species, about 450 species could be classified as small indigenous fish species (SIFS). Lack of information has led to limited propagation of the SIFS. However, considering extreme poverty of the human population, as well as abundantly available water resources, SIFS could be daily bread earner in the Sundarbans. The present project aims at identifying various SIFS in the Sunderbans and their role in livelihood of local people.

Interaction with Fishermen Cooperative Society at Madanganj

With the help of local villagers the abundance

Water quality attributes in two water bodies selected for SIFS conservation

| Centre Name | Sp. Cond (m/s) | Chlorinity (ppt) | Salinity (ppt) | Sulfate (ppm) | Hardness (ppm) | Ca (ppm) | Mg (ppm) | $NO_3$ – N (ppm) | $PO_4$ – P (ppm) | Silicate – $SiO_2$ (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|
| Madanganj Canal | 1.018 | 0.222 | 0.43 | 16.5 | 400 | 28.56 | 7.91 | 0.14 | 0.066 | 2.2 |
| Madanganj pond | 1.028 | 3.5 | 6.35 | 30.8 | 1050 | 356.71 | 37.97 | 0.116 | 6.124 | 5.9 |

and availability of following fish species were identified to be reducing for food and marketing from different types of water bodies in Ganeshpur (Namkhana) area: *Ompok pabda, Heteropneustes fossilis, Clarias batrachus, Anabas testudineus, Glossogobius sp.*, *Anguilla bengalensis, Amblypharyngodon mola, Colisa fasciata, Notopterus notopterus, Mystus vittatus, Mystus guilo, Channa marulius, C. striata, C. punctata, C. gachua, Mastacembelus armatus, Macrognathus pancalus, Systemus sarana, Pethia ticto, Chanda nama, Nandus nandus,* etc.

For conservation of SIFS, village Madanganj, situated on the river bank of Hatania Doania, was selected. Water and plankton samples from two water logged areas (approx 1.5 ha) were collected for analysis. Based on water quality parameters, it was observed that pond water was saline in nature, whereas canal water was mostly fresh in nature. Dominance of zooplanktons was observed in both selected pond as well as in canal.

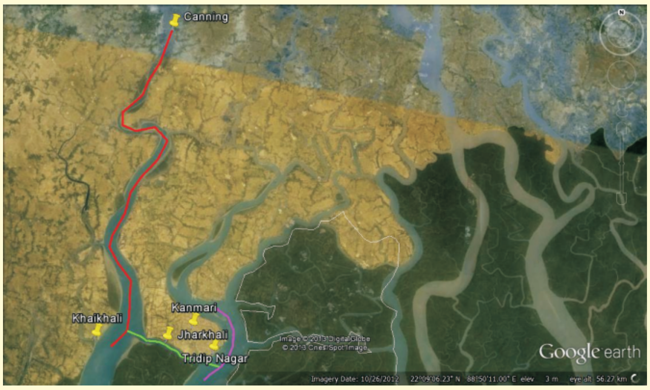
**Project Title : Assessment of environmental variability, nutrient dynamics, biodiversity, fish stock assessment of selected estuarine and mangrove ecosystems (REF/ER/12/01/03)**

**Investigators :** S. K. Das, R. K. Manna, Roshith C. M., Sajina A. M., D. Sudheesan and Sandhya K. M.

**Technical Support :** S. K. Sadhukhan, R. C. Mandi, C. N. Mukherjee, D. Sanfui, A. Mitra, A. Sengupta, B. N. Das, D. Saha, A. Barui, A. Roychoudhury and S. Mandal

Mangroves are integral part of the several estuaries and provide the nutrients and rich feeding and breeding grounds for many marine and brackish water fish species of various trophic levels. However, the estuarine ecosystems are vulnerable to environmental and climatic variables, reduced river discharge, habitat degradation, over-fishing and fish seed destruction affecting the long term yield potential of the resources. The present project aims at understanding role of mangroves in nutrient loading/cycling and nursery functions for estuarine fishes, their abundance and population dynamics.

The present study was conducted in Jharkhali mangrove ecosystem (an area of about 161 km$^2$) located in the Indian Sundarbans that is separated from Herobhanga Reserve Forest by a small creek, locally called 'Herobhanga Khal.' The Herobhanga creek connects two mighty rivers of the Sundarbans, namely the Matla on the West and the Bidya in the East.




River Matla River Herobhanga River Bidya

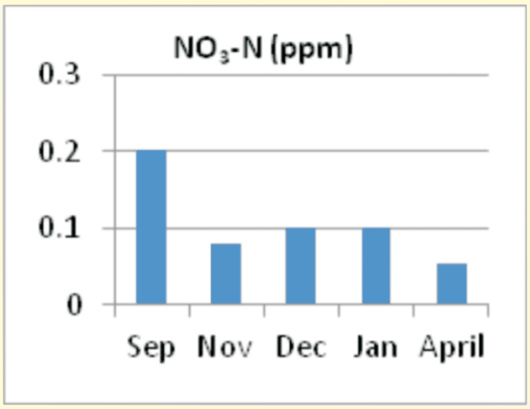
The Jharkhali area in Sunderbans

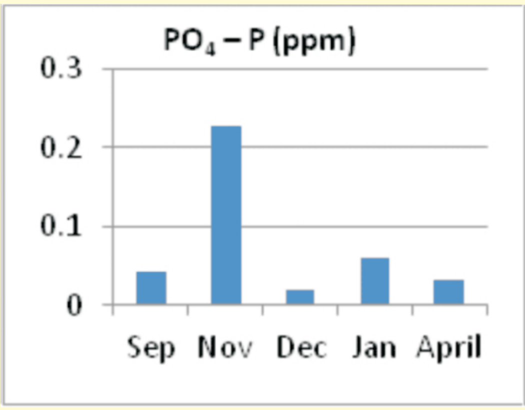
**Water and sediment qualities of Herobhanga river:** Water quality parameters of Herobhanga river in Jharkkhali area were monitored to correlate with seasonal variation of biotic communities, including fishes and for litter decomposition study. Average water depth of the river varied between 9.4-6.5 m during September to April. Water was mostly turbid. Water pH and dissolved oxygen were in favorable range. Total hardness increased to 4412 mg/l during April from a low value of 2258 mg/l during November. Salinity of water increased sharply from 13.2 mg/l during September to 29.8 mg/l during April owing to fresh water cut-off from upstream region.

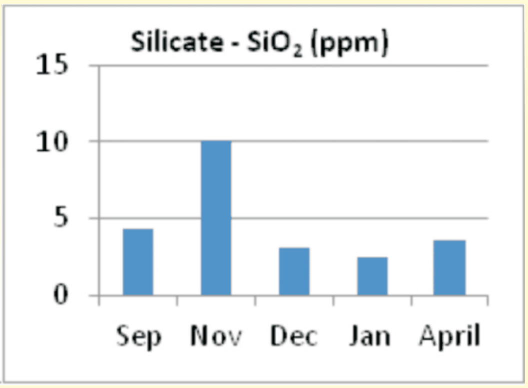
Available nutrients in river water observed significant seasonal variation. During September, $NO_3$-N was higher (0.2 mg/l) probably due to loading from monsoon run-off. $PO_4$-P was mostly low except significantly higher value (0.23 mg/l) during November. Silicate-$SiO_2$ was also low except during November. Significant amount of organic carbon (0.87-0.99%) was present in sediment indicating detrital loading from nearby mangrove areas. Sufficient amounts of silt (42-51%) and clay content (12-19%) were also observed in bottom sediment.

Low primary productivity (39 mgC/$m^3$/hr) was recorded in river water during November, otherwise moderate productivity of 67-112 mgC/$m^3$/hr was recorded.

**Plankton and periphyton diversity:** Phytoplankton density varied from 8,455-35,664 cells/l during November 2012 to February 2013 and was represented by 17 genera belonging to class Bacillariophyceae, Chlorophyceae, Cyanophyceae and Dinophycea with dominance of Bacillariophyceae (91.38%). The dominant diatom species were *Coscinodiscus radiata*, *Asterionella* sp, *Biddulphia* sp, *Pleurosigma* sp, *Rhizosolenia* sp, *Nitzschia reversa, Synedra* sp and *Fragillaria* sp. Zooplankton density varied from 2694-13,354 cells/l and was mostly constituted by Copepods (94.33%), followed by Tintinnids (5.67%). Among copepods *Cyclops* sp., *Diaptomus* sp. and copepod nauplii were most abundant. Periphytic assemblages were mainly constituted by phytoplankton belonging




Water quality of river Herobhanga

Physico-chemical characteristics of Herobhanga river sediment

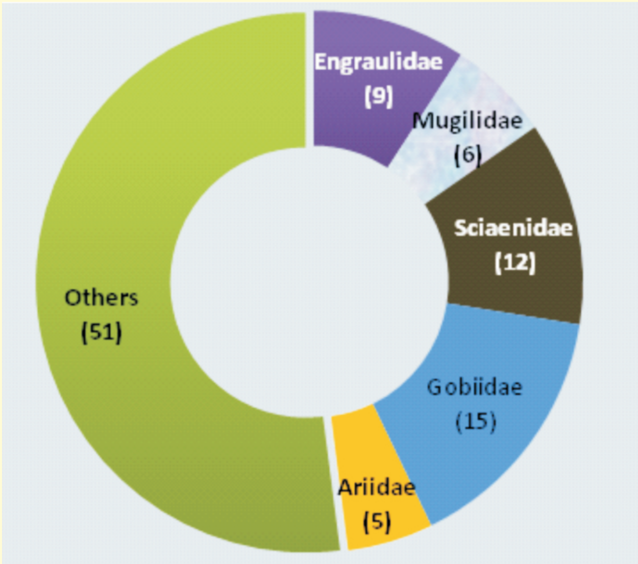
| Centres | pH | Sp. Cond. (mS/cm) | Total Nitrogen (%) | Avail. N (mg/100 g) | Available $P_2O_5$ (mg/100 g) | Organic C (%) | Free $CaCO_3$ (%) | Sand (%) | Clay (%) | Silt (%) | C/N |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Jharkhali-1 | 8.01 | 4.39 | 0.0476 | 12.60 | 1.88 | 0.87 | 9.0 | 42 | 19 | 39 | 18.27 |
| Jharkhali-2 | 8.06 | 4.81 | 0.0420 | 8.68 | 1.36 | 0.99 | 17.0 | 42 | 16 | 42 | 20.68 |
| Jharkhali-3 | 8.13 | 5.34 | 0.0560 | 17.64 | 1.76 | 0.81 | 17.5 | 43 | 19 | 38 | 23.57 |
| Jharkhali-4 | 8.15 | 3.66 | 0.0588 | 7.00 | 1.68 | 0.96 | 15.5 | 51 | 12 | 37 | 14.46 |

to Bacillariophyceae and the density varied from 743 to 7540 cells/ sq.cm.

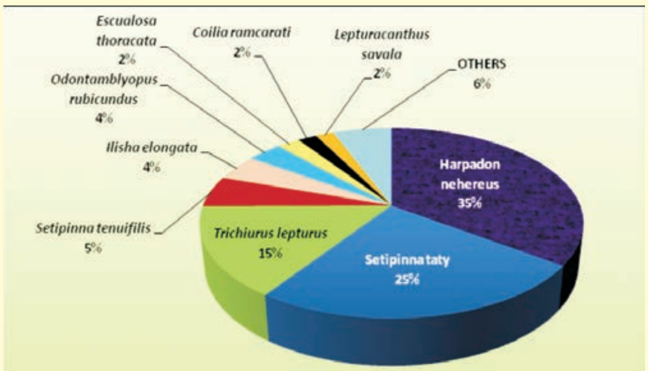
**Fish/shell fish diversity and assemblage in Jharkhali region and their relation to habitat parameters and fishing gears:** Catches of bag net (Been jal/Behundi jal) and set-barriers (Khalpata/Charpata jal), the most widely employed fishing gears, were analysed which showed that a total of 102 fish species belonging to 39 families and 11 orders were recorded with 46.08 % contribution by only five families during summer and winter.

The fish communities exhibited seasonality in abundance and distributional patterns showing higher value in winter than in summer months. The fish catch structure in summer months was different with the introduction of more marine species owing to increased salinity levels and greater tidal influence.

In bagnet, Bombay duck (*Harpadon nehereus*) was the dominant species (35 % of total catch), followed by the hair-fin anchovy (*Setipinna taty,* 25%) and ribbon fish (*Trichiurus lepturus,* 15%)). Among prawns, the spider prawn (*Nematopalaemon tenuipes*) was the major species that contributed to 65.77% of the total prawn catch, followed by the shrimp, *Metapenaeus lysianassa* (28.06%). Catch structure was different for set-barrier, with the grenadier anchovy (*Coilia ramcarati*) dominating the catches (61.81% of total numbers). The prawn species diversity was higher in set-barrier (13 species) than in the bagnet (7 species) due to their venturing into sheltered mangrove areas which makes them vulnerable to set-barriers.



Fish diversity structure of Herobhanga creek



Fish catch composition - Bag net (winter)

**Estimation of Mangrove litter fall:** Mangrove litter supplies nutrients and plays an important role in productivity of estuaries. Nine different mangrove plants, viz. *Avicennia alba* (Kal bain), *Avicennia officinalis* (Jat bain), *Excoecaria agallocha* (Geon), *Rhizophora mucronata* (Garjan), *Ceriops decandra* (Garan), *Aegialitis rotundifolia* (Tora), *Bruguiera gymnorrhiza* (Kankra), *Avicennia marina* (Pyara bain) and *Sonneratia apetala* (Keora) at Jharkhali in Sundarbans were estimating seasonal litter fall using litter trap made of net-bag in a 1 $m^2$ bamboo frame. The study showed that in four-monthly collections *A. alba* produced good amount of litter with nearly uniform pattern. Highest litter fall was observed in *E. agallocha* in April, which was also lowest litter producer in January. Sufficient foliage drop was also occured in *A. officinalis* and *S. apetala* at different periods of monitoring.

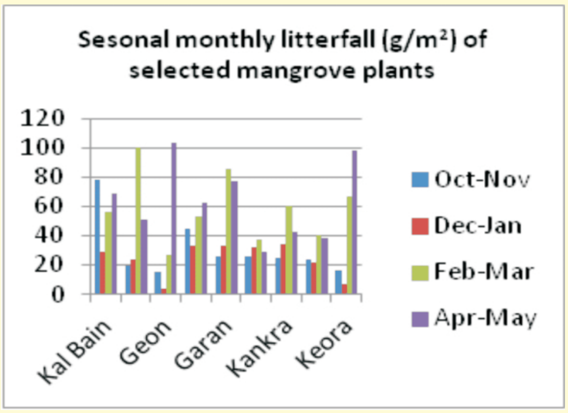
Mangrove litter trap used in the study

**Project Title : Developing and Testing Software based Model as a Forecasting Mechanism for West-coast Estuarine Ecosystems (REF/WR/12/01/04)**

**Investigators :** S. N. Singh and S. Monalisa Devi

**Technical Support :** R. K. Saha and J. C. Solanki

India has estimated estuarine fisheries resources of 2.7 million ha and are important fisheries resources. However, construction of dams, release of effluents etc. have adversely affected the estuarine environment of the country. In present study the Sabarmati estuarine health has been assessed through software based predictive models viz. *Bayesian Belief Networks* using biotic and abiotic attributes as input parameters.




Mangrove litter fall in the Sundarbans

**Abiotic quality attributes:** The Sabarmati estuary was studied at Anandpura, Vataman, Ingoli and Rasikpura representing the lower to middle estuarine expanse and at Paladi and Indira Bridge representing the upper estuarine extent. Dissolved Oxygen(D.O.) was low (nil to 6.89 mg $l^{-1}$) with even low to absence of D.O. from Rasikpura to Anandpura due to effluent discharge. The system also recorded high free

$CO_2$ (up to 85.8 mg $l^{-1}$). There has been recorded spatial demarcation based on total alkalinity (101.0 to 397.0 mg $l^{-1}$) and specific conductance ( 252.75 to 2375.25 µ S $cm^{-1}$) since higher content of these attributes were observed at expanse lower estuarine stretches. The phosphate (0.032 to 0.207 mg $l^{-1}$) and nitrate levels (0.285 to 0.713 mg $l^{-1}$) portrayed the system to be fairly rich.

Like water, the sediment organic carbon (0.26 to 0.49%), available nitrogen (6.02 to 10.54 mg $100g^{-1}$) and available phosphorus (1.53 to 2.59 mg $100g^{-1}$) levels denoted fairly rich status of the system. Specific conductance varied from 382.0 to 2059.25 µS $cm^{-1}$ and a horizontal demarcation was evident since this was high at the stretch represented by Rasikpura to Anandpura as compared to upper stretch.

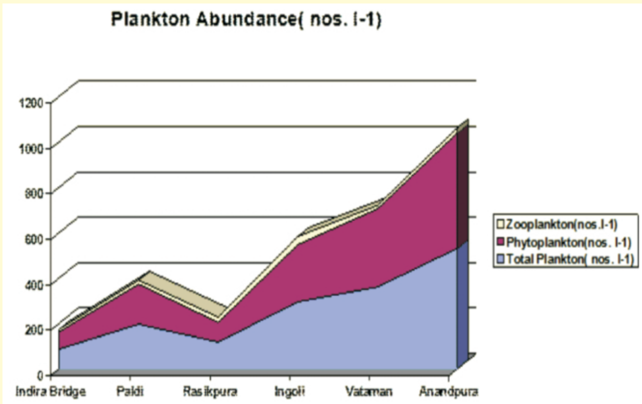
**Biotic Communities:** Plankton, mainly dominated by phytoplankton, was high at Vataman and Anandpura sites. Anandpura experienced high average plankton abundance of 531 nos. $l^{-1}$ and was contributed by blue-green algae (81.73%) followed by diatoms (12.99%). The zooplankton (4.34%) was mostly contributed by protozoans (3.39%) and rotifers (0.57%). Indira Bridge in the freshwater zone recorded the least average plankton abundance of 87 nos. $l^{-1}$ with dominance of phytoplankton (87.35%). Bacillariophyceae (66.67%) and Myxophyceae (11.49%) shared the bulk of phytoplankton assemblage. Protozoans (4.60%) and copepods (3.45%) shared the bulk of zooplankton population.

Anandpura experienced the low average macro-benthic population of 126 nos. $m^{-2}$, dominated mainly by dipterans (92.86%) and annelids (3.96). Ingoli and Rasikpura sites contained very poor macro-benthic population of 4 nos. $m^{-2}$. On the contrary, Paladi, Indira bridge and Vataman sites recorded high average macro-benthic abundance (742-of 1331 nos. $m^{-2}$) which was mainly comprised of dipterans.

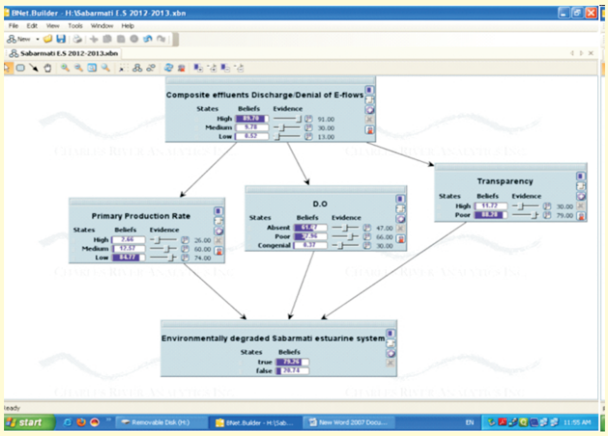
**Primary Production:** The gross primary production varied from nil to 266.67 mgC $m^{-3}$ $hr^{-1}$ for the system as a whole. The net production rate fluctuated from nil to 125.00 mgC $m^{-3}$ $hr^{-1}$. The P/R ratio (0 to 0.73) further confirmed that Sabarmati estuarine system particularly the stretch extending from Rasikpura to Vataman, is organic rich, highly heterotrophic and the most stressed.

**Application of Bayesian Belief Networks Model:** The Bayesian Belief Networks (BBNs) based model was developed considering composite effluents discharge coupled with denial of environmental flows as the main cause of environmental degradation of Sabarmati estuarine system and these affect transparency, D.O and primary production. After incorporation of beliefs, BBNs calculated beliefs to be true to the extent of 76.78%. Inputs of evidences finally calculated that Sabarmati estuarine system is environmentally degraded to the tune of 79.26%.

It is worth mentioning here that there has been reduction in stress level this year as compared to last years due to interlinking of River Narmada through its canal.




Plankton abundance in Sabarmati estuary




Incorporation of evidences in the BBN

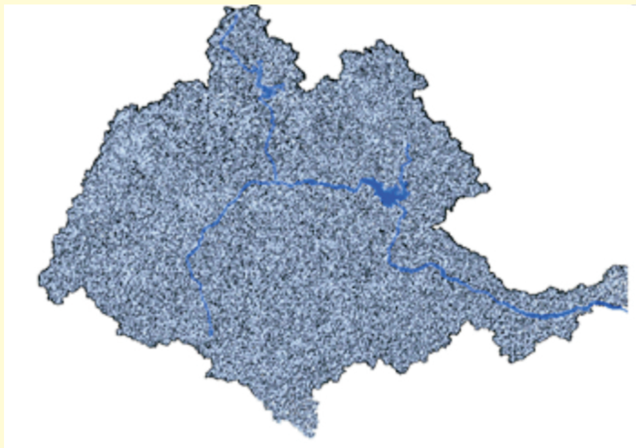
## Project Title: Quantification of environmental flow requirements for ecosystem functions, including biodiversity and fisheries of selected rivers (REF/ER/12/01/05)

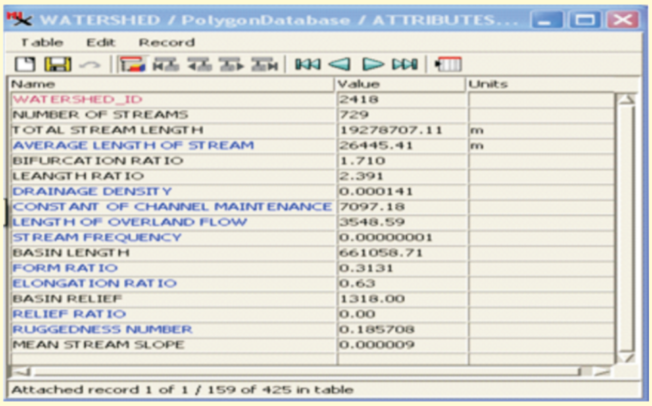
**Investigators:** A. K. Sahoo, U. Bhaumik, B. B. Satpathy, R. K. Manna, D. Karunakaran, Roshith C. M. and S. Das

**Technical Support:** A. Sengupta, B. N. Das, D. Saha, A. Barui, A. Roychowdhury and S. Mandal

Rivers constitute a sizeable part of the total freshwater resource, supporting a range of ecosystem services, fish diversity and livelihood concerns of millions. To meet the growing demands, excessive amount of water is abstracted from rivers by installing dams which cause irretrievable changes to the natural hydrographs of rivers adversely impacting the riverine fish stocks and aquatic biodiversity. To keep the ecosystem function and fisheries viable, generation of realistic estimate of the exact flow needs for riverine fisheries is essential. The present project aims at developing a conceptual model for estimation of environmental flow through integrated study of flow regime, ecological characters and biological assemblages.

The basin area of river Mahanadi is around 1,41,589 km$^2$. Environmental flows in Mahanadi river were studied with respect to the timing, quantity and quality of water flows essential for sustaining the riverine ecosystem. The watershed analysis in Mahanadi basin was carried out, along with delineation of current flow path network, watershed boundaries and basins as separate vector using the TNT Microimage Software. Two hydro-electric power stations at Hirakud and Chipilima at only 35 km distance exercise a drastic control on natural mainstream river flow with a cascading effect on the down - stream deep pools, serving as the critical component of river habitat for shelter for brooders of a large diversity of fish species impacting the river ecosystem process and function.





WATERSHED / PolygonDatabase / ATTRIBUTES...

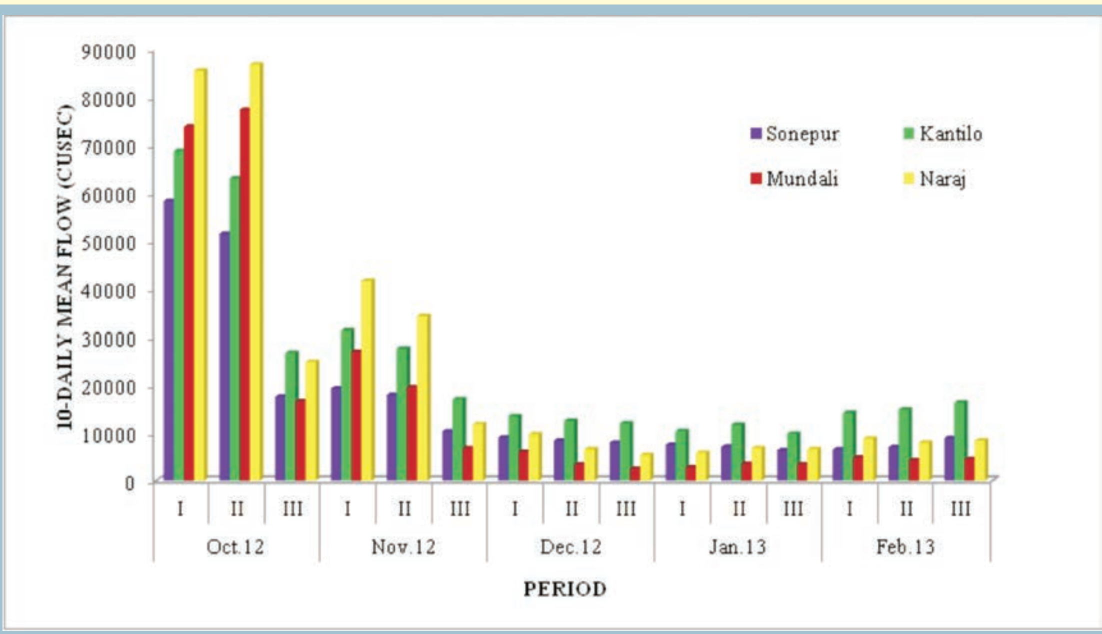
Table Edit Record

| Name | Value | Units |
|---|---|---|
| WATERSHED_ID | 2418 | |
| NUMBER OF STREAMS | 729 | |
| TOTAL STREAM LENGTH | 19278707.11 | m |
| AVERAGE LENGTH OF STREAM | 26445.41 | m |
| BIFURCATION RATIO | 1.710 | |
| LEANGTH RATIO | 2.391 | |
| DRAINAGE DENSITY | 0.000141 | |
| CONSTANT OF CHANNEL MAINTENANCE | 7097.18 | |
| LENGTH OF OVERLAND FLOW | 3548.59 | |
| STREAM FREQUENCY | 0.00000001 | |
| BASIN LENGTH | 661058.71 | |
| FORM RATIO | 0.3131 | |
| ELONGATION RATIO | 0.63 | |
| BASIN RELIEF | 1318.00 | |
| RELIEF RATIO | 0.00 | |
| RUGGEDNESS NUMBER | 0.185708 | |
| MEAN STREAM SLOPE | 0.000009 | |

Attached record 1 of 1 / 159 of 425 in table

Mahanadi basin delineation by TNT Microimage Software

River Mahanadi below Hirakud Dam




Hydrograph of the Mahanadi river stretch

**Geomorphology and discharge:** Based on the geomorphology of river, study stretches were classified into upper zone with hill streams (Hirakud to Sonepur), the middle zone with deep pools and deep gorge (Sonepur to Barmul) and lower zone (Barmul to Naraj). The river bed was characterized by rocks, boulders and gravels in the upper zone, rich presence of organic matter in the middle zone and sand bars in the lower stretches. A sharp decline in the quantity of river discharge from 90,000 cusec to a 4000 cusec was noticed, clearly indicating the impact of seasonality. Water quantity remains higher in the middle stretches, markedly low in the lower zone due to water abstraction for canal irrigation, lift irrigation and various other purposes. During the initial investigation two ecological assets were identified *viz.,* i) Ansupa floodplain wetland at the lower stretch of river Mahanadi and ii) Satkosia reserved forest for aquatic animals, which had the largest importance in environmental flows studies.

Ansupa Lake

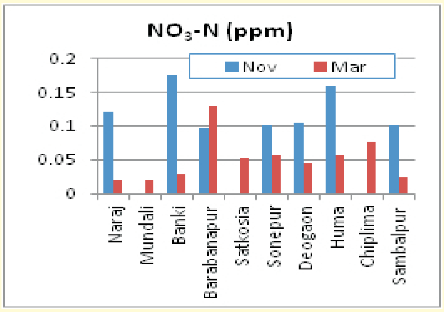
Satkosia Gourge

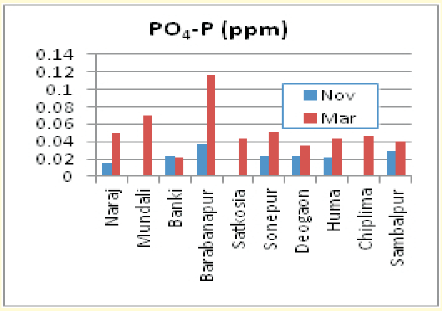
**Water and soil quality parameters:** Water was alkaline with a declining trend while total alkalinity was in increasing trend of 65 - 84 mg/l from upstream to downstream. Total hardness varied in the range of 72 - 96 mg/l and dissolved oxygen levels were favorable. $NO_3$-N varied widely among stations. Silicate silica content was observed to be very low. Soil was mainly sandy in nature in the entire surveyed stretch except significantly low sand content at Naraj and Kunjelpara (Sambalpur). Soil specific conductivity was low in lower stretch, compared to upper stretch. Soil organic carbon was generally low, excepting at Naraj.

**Occurrence and diversity of phytoplankton:** The total phytoplakton count was higher in the lower zone (2.36 x $10^5$ ind.$l^{-1}$) than that in upper zone (2.03 x $10^5$ ind.$l^{-1}$). Post monsoon sampling recorded 61 taxa of phytoplankton belonging to 29 genera. Species richness of class Bacillariophytes, Chlorophytes, Cyanophytes, Desmidiales and Euglenophytes were 37, 10, 6, 7, 1 respectively. Of the diatom taxa, *Nitzschia* and *Navicula* genera were found to be highly species rich.

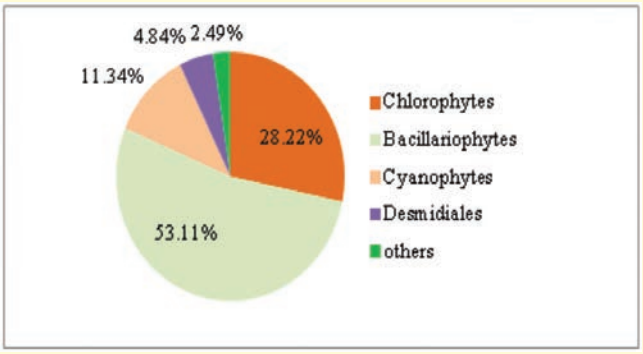
**Macrobenthic distribution:** Among the macrobenthic community, Unionidae dominated (28.57- 41.67%) the entire stretch followed by Corbiculidae, Planoribidae, Thiaridae, Viviparidae and Zymnaeidae. Although Pilidae was found only in the lower zone, however, Zymnaeidae were absent in both middle and lower zones.

**Fish species diversity and distribution:** A distinct fish species diversity characteristic with respect to habitat and flow conditions (three zones) was observed. The river was dominated by *Tor sp.,* locally known as *Kusura* in upper



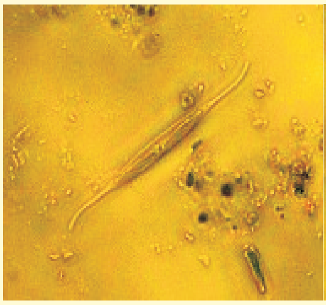

Dissolved nutrient profile in the different study stretches



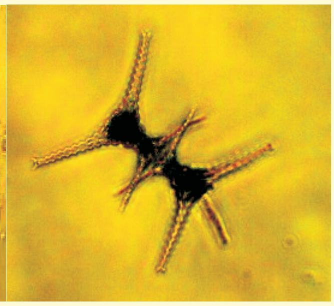

Phytoplankton diversity along three zones of river Mahanadi

Macrobenthic distribution (%) in river Mahanadi

| | Upper zone | Middle zone | Lower zone |
|---|---|---|---|
| Corbiculidae | 7.69 | 14.29 | 8.33 |
| Pilidae | 0.00 | 0.00 | 8.33 |
| Planoribidae | 7.69 | 14.29 | 8.33 |
| Thiaridae | 15.38 | 14.29 | 16.67 |
| Unionidae | 30.77 | 28.57 | 41.67 |
| Viviparidae | 23.08 | 28.57 | 16.67 |
| Zymnaeidae | 15.38 | 0.00 | 0.00 |



*Nitzchia reversa*



*Staurastrum gracile*

Phytoplankton diversity in river Mahanadi stretches, Indian major carps especially *Labeo calbasu* in middle stretches, and small bodied fishes, freshwater catfishes and a variety of prawn species in the lower stretches. The lower stretch apparently did not support fishes of larger size due to inadequate flows and depth.

*Tor malabaricus*

*Tor mussullah*

Endangered *Tor* species recorded from river Mahanadi

**Project Title: Impact assessment of multiple habitat alterations on ecosystem functions and fisheries in rivers (REF/NR/12/01/06)**

**Investigators:** K. D. Joshi, B. K. Singh, S. S. Mishra, R. S. Srivastava, D. N. Jha, M. A. Alam and S. C. S. Das.

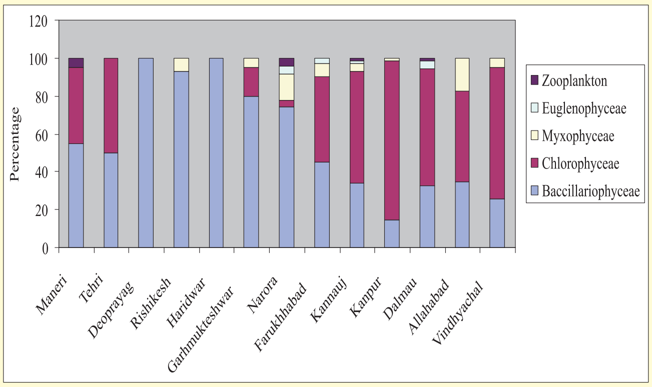
**Technical Support:** S. K. Srivastava, K. Srivastava and V. Kumar

India is bestowed and blessed with rivers. To meet increasing water demand most of the Indian rivers are now dammed at multiple sites causing severe modifications and perturbations to the river flow, velocity, depth, substratum, pools, ecology and fish habitats. Besides, excessive water abstraction, increased sedimentation of river bed, river course modification etc. lead to fish habitat alterations causing long term damage or irreversible loss of fish fauna. The present study aims at assessing impacts of habitat alterations on ecological functions and fishery of river and to suggest restoration measures for conservation of the biodiversity. River Ganga was studied during monsoon and winter seasons from Maneri (upstream) to Vindhyachal.

**Water quality:** There were little variations in the water quality parameters from Tehri to Kanpur during monsoon season due to influx of rainwater. However, considerable deterioration was observed in water quality parameters between Kannauj and Vindhyachal stretch with significant increase in alkalinity (272-454 $mgl^{-1}$) and specific conductivity due to release of industrial and domestic effluent. High values of chloride were recorded at Allahabad (75.4 $mgl^{-1}$). Stretch between Kannauj to Varanasi ghat indicated poor water quality in terms of higher microbial load.

Deprived river flow downstream to Maneri Bhali Phase-I

**Plankton communities:** The plankton population at Tehri and Kannauj during monsoon was mainly contributed by the phytoplankton and ranged between 30 to 240 $ul^{-1}$. Maximum abundance was recorded from Tehri probably because of the lentic condition of the water. During winter planktons in the upper stretch between Tehri and Kannauj were mainly contributed by Bacillariophyceae and ranged between 20 and 1350 $ul^{-1}$. Plankton population in the middle stretch between Kanpur and Vindhyachal varied between 430 and 2700$l^{-1}$. Sizeable presence of Myxophyceae and Euglenophyceae groups in the middle stretch indicate pollution load and absence of these groups from upper stretch reflect better water quality.

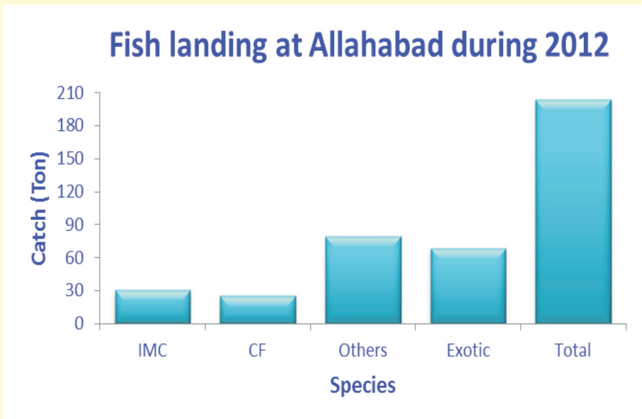



Composition (%) of plankton in the river

**Macrobenthic communities:** The abundance of macrobenthic fauna during winter in the upper stretch between Tehri and Kannauj ranged from 80 to 610 $um^{-2}$ with lowest at Tehri which gradually increased to Haridwar (610 $um^{-2}$). Insects were the only component observed between Haridwar and Tehri. Macrobenthic biota at Kannauj comprised mainly of insect larvae (69%) and annelids (15%). Population varied between 520 and 1710 $um^{-2}$ in the middle stretch between Kanpur and Vindhyachal with maximum abundance at Kanpur followed by Vindhyachal, Allahabad and Dalmau. Dominance of dipteran larvae in this stretch indicates presence of sewage.

*Pangio pangia* – a rare fish recorded for the first time from river Ganga

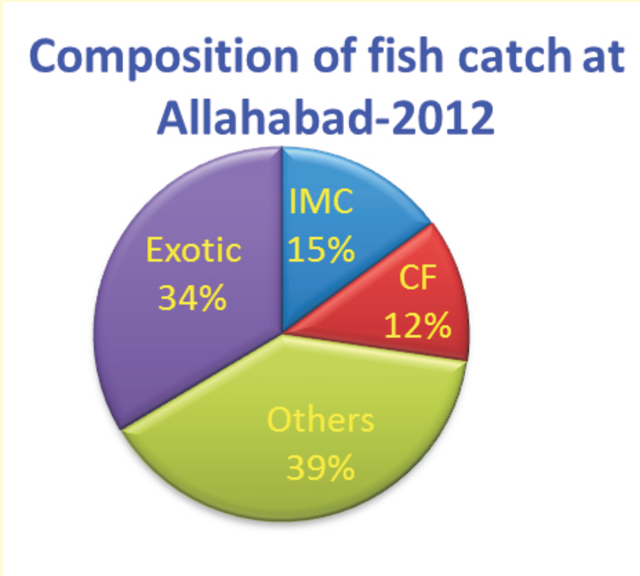
**Fish Communities and catch:** A total of 110 fish species belonging to 74 genera were recorded from the river Ganga between Tehri to Vindhyanchal during the study period. A rare cobitid, *Pangio pangia* (Hamilton, 1822) was collected for the first time from the river Ganga at Narora. Sizeable catch of *Cyprinus carpio* was recorded from Narora, which was not observed earlier. Distributional range of *Oreochromis niloticus* has also observed up to Narora. No commercial fishery was recorded in the upstream stretch of the river Ganga above Haridwar, while sizeable fishery exists between Narora to Kannauj. The fishery at Narora, Farukhabad and Kannauj stretches is mainly constituted by miscellaneous fishery groups dominated by *Aspidoparia morar,* followed by *Salmophasia*




Fish landing in the river Ganga at Allahabad *bacaila, Ailia colia, Clupisoma garua, Eutropiichthys vacha, Mastacembelus armatus, Gudusia chapra* etc.

Total fish landing in the river at Allahabad during 2012 was estimated at 203.68t, consisted of major carps (14.9%), catfishes (12.4%), other fishes (39.09%) and exotics (33.59%). There was 12.88 % increase in fish landing in comparison to the preceding year, due to increase in fishing efforts due to lesser monsoon phase. Not a single specimen of Hilsa could be recorded during the period.

**Socio-economics of fishers:** Study of socio-economic status of fishers along the river Ganga between Devprayag and Kanpur stretch indicated that about 28000 fishermen were dependent on river with employment dependence of around 42%. As per fishers' perception, the important indigenous and commercially important species, including major carps, have gone down to the extent of 70-90%, adversely affecting the livelihood of fishermen community.



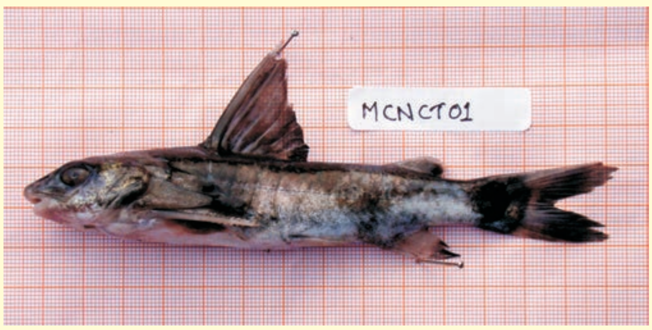

Fish landing and composition (%) in the river at Allahabad

**Project Title : Population status of important catfishes in relation to environmental health of selected rivers in India (REF/ER/12/01/07)**

**Investigators:** Sajina A. M, S. Das, D. Sudheesan and D. N. Jha

**Technical Support:** S. Bhoumick, S. Majumder, S. K. Pal, D. Saha, A. Roychowdhury, A. Barui, A. Mitra, S. Mondal and A. Prasad

Osteichthyian fishes of the Order Siluriformes, commonly called 'catfishes,' form a well diagnosed natural group of freshwater fishes. Catfishes form an important fishery resource of Indian rivers and the extent to which environmental degradation affects the population abundance is less known. River Mahanadi was studied for catfish, considering the ecological issues of the river due to various anthropogenic activities like construction of dams and weirs as well as pollution from factories and domestic usage. The selected




*Rita chrysea,* a catfish endemic to Mahanadi

Catfish species recorded from rive Mahanadi

| Family | Species |
|---|---|
| Bagridae | *Rita chrysea, Sperata aor, Sperata seenghala, Mystus bleekeri, Mystus cavasius, Mystus vittatus, Neotropius atherinoides* |
| Siluridae | *Ompok bimaculatus, Wallago attu* |
| Schilbidae | *Ailia coila, Clupisoma garua, Eutropiichthys murius,Eutropiichthys vacha* |
| Pangasiidae | *Pangasius pangasius* |

sampling stations were Hirakud (21°29.086'N 083°49.703'E), Sambalpur (21°27.784'N 083°58.188'E), Subarnapur (20°50.784'N 083°54.908'E), Tikarpara (inside Satkosia tiger reserve forest) (20°35.898'N 084°46.900'E), Jobra (20°29.683'N 085°54.556'E) and Naraj (20°28.258'N 085°46.697'E).

The sampling survey in river Mahanadi recorded 14 species of catfishes in the river, representing four families. *Rita chrysea* was found to be endemic to the river. Larger specimens of catfishes, such as *Wallago attu, Sperata seenghala* and *Pangasius pangasius* were collected from river stretch inside Satkosia reserve forest, where fishing with nets are prohibited. Images of lateral profile of body as well as dorsal profile of head were being taken for the truss network analysis to explore any morphometric variation. The counts of all fin rays, gill rakers and branchiostegal rays were taken for the meristic analysis. The bilateral asymmetry of paired fins, and gill rakers of first gill arch were observed.

Larger specimens of *S. seenghala* (87 cm) and *P. pangasius* (81 cm) collected from Tikarpada stetch of Mahanadi

## Programme : Environment and health monitoring of Inland open waters for ecosystem amelioration (FREM /12/03/000)

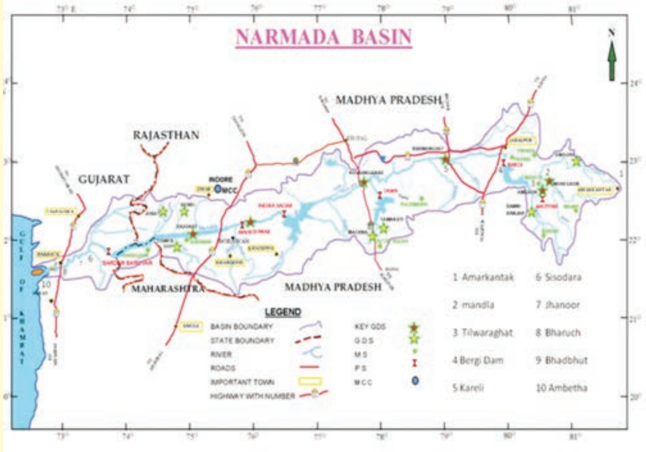
**Project Title: Developing fish-based indicator tools for environmental monitoring (FREM/ER/12/03/01)**

**Investigators**: M. K. Das, S. Samanta, M. K. Bandopadhyay, S. K. Manna, S. K. Sahu and M. Naskar

**Technical Support:** S. Bhowmick, L. R. Mahaver, S. Paul, K. Saha, S. Banerjee and A. Ghosh

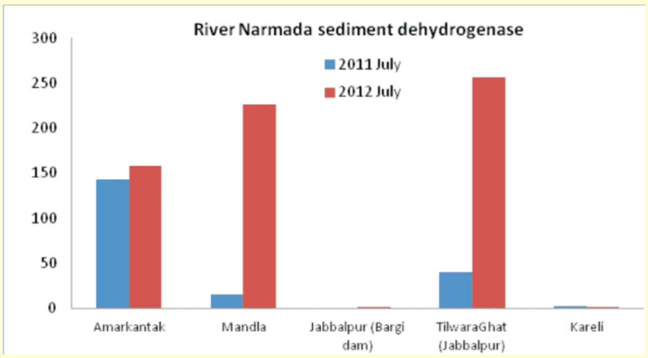
The habitat quality has degraded in majority of the inland aquatic resources in India. As a result the biological integrity of ecosystem is threatened. The project aimed at development of a uniform and comprehensive protocol for addressing the environmental impacts on the health of aquatic organisms and the aquatic ecosystem as a whole.

The river 1,312 km. stretch of the river Narmada from its origin at Amarkantak to Ambetha was assessed for ecological integrity.




Sampling sites in river Narmada

**Monitoring of the riverine health through microbial indicator:** Sediment enzymatic study in upper stretch of the river showed substantially high dehydrogeanse activity at Amarkantak, Mandla and also in Jabalpur (near Tilwara Ghat), indicating organic matter pollution at these sites. The sediment respiration has increased this year, compared to that in the previous year.

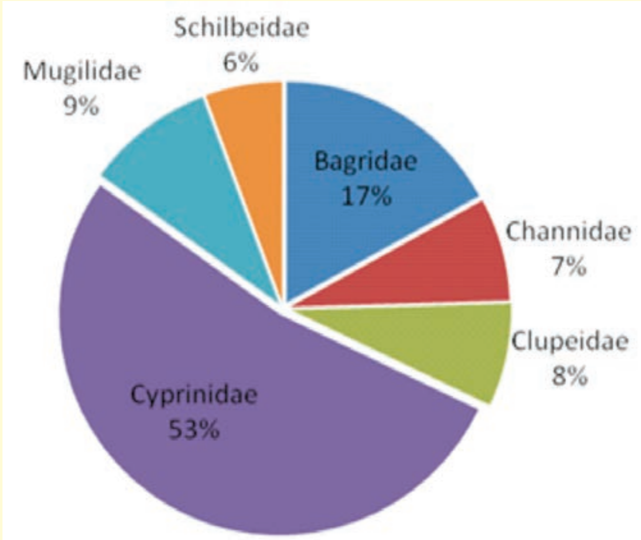



The river Narmada sediment enzyme activity

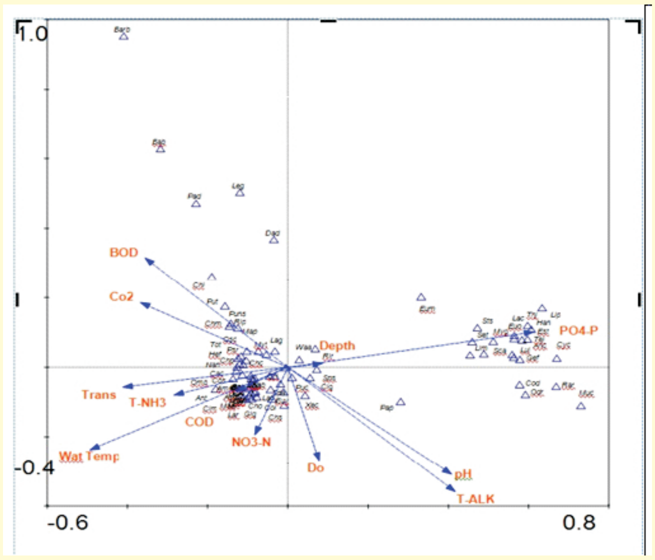
**Variations of plankton and benthos:** *M. aeruginosa* was the most dominant species among phytoplankton (108-240 $ul^{-1}$) and periphyton (200-750 organisms/$cm^{-2}$) samples followed by *Ulothrix zonata*. The presence of pollution tolerant Myxophyceae and Bacillariophyceae spp. in the river stretch from Amarkantak to Bagri dam has indicated highly deteriorated environment. Overall, 16 molluscan species have been recorded from the sampling sites. Based on benthic study there was prevalence of β-mesosaprobic condition indicating moderately polluted condition of bottom zone of Narmada River from Bhatbhat to Sisodra.

**Fish species diversity:** A total of 90 fish species belonging to 35 families and 67 genera were recorded with Cyprinidae as the dominant group, followed by Bagridae and Mugilidae. Important fish species of freshwater were *Labeo rohita, Catla catla, Cirrhinus mrigala, Clupisoma garua, Sperata aor, Sperata seenghala* etc. and brackish water were *Tenualosa ilisha, Harpodon nehereus, Liza tade, Liza macrolepis* etc. Exotic species (*Aristichthys nobilis, Cyprinus carpio and Hypophthalmichthys molitrix*) were recorded from Mandla site of river. The fishes were identified and categorized into trophic habitat, reproductive guilds, conservation status and tolerant levels.

**Habitat characterization:** A data matrix with 12 habitat variables and 77 species present for each sampling sites was constructed. Canonical corresponding analysis (CCA) was used to determine the minimum number of explanatory factors which explain significant ($p<0.05$) proportions of variance in the species. Monte Carlo permutation tests made 12 environmental variables independent with significant contributions to the variance in the species assemblage. Maximum variability in species was explained by phosphate-P (12.65%), water temperature (9.38%), total alkalinity (8.86%), pH (7.93%), transparency (6.88%), $CO_2$ (6.23%), BOD (6.06), total $NH_3$ (3.49%), DO (3.32%), COD (2.97%), Depth (2.79%) and nitrate-N (2.70%). In CCA, variables like water temperature, transparency, total $NH_3$ and phosphate-P are significantly correlated with axis 1. In contrast, inverse correlation between pH and total alkalinity versus BOD are significant with axis 2.



Distribution of major fish families in river Narmada



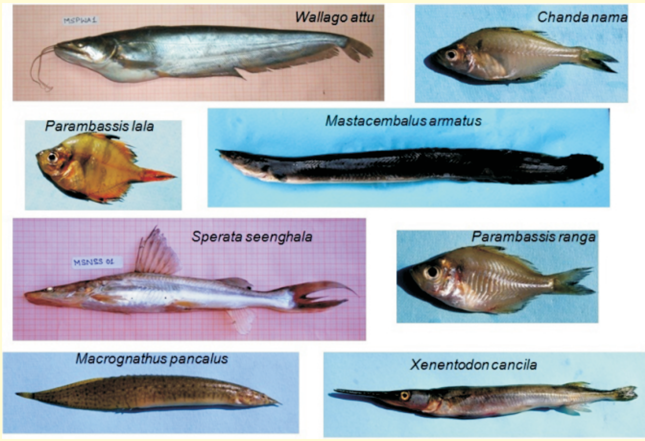
Ordination biplot of species assemblages and environmental variables obtained by CCA for river Narmada. All arrows represent a gradient, where the mean value is located at the origin, and arrows points in the direction of its increases.

**Project Title : Monitoring and benchmarking ecosystem health of major river systems in India (FREM/ER/12/03/02)**

**Investigators :** S. Samanta, S. K. Nag, M. Naskar, D. Sudheesan and Sajina A. M.

**Technical Support :** S. Bhowmick, Mrs. K. Saha, L. R. Mahaver, S. K. Paul, S. Bandyopadhyay and A. Ghosh

Majority of the fresh water ecosystems are now fragmented, degraded and threatened due to growing demand of water (intensive agriculture, urban use and hydropower), pollution and emerging climate change effects. Although toxicants are routinely assayed to measure environmental stress, true reflection of the conditions of ecosystem health may not be obtained. In present study, the indicator approach has been adopted for assessment of river health. A suite of indicators at levels of ecological (water, soil etc) and biological organization (primary, secondary and tertiary) have been utilized to assess the river health.




Carnivorous fish species from Mahanadi river

The river Mahanadi, from Hirakud Dam to Jobra, was surveyed during post-monsoon season at seven sampling stations, viz., Hirakund, Sambalpur, Chiplima, Subarnapur, Satkosia, Mundali and Jobra (Cuttack). There are a number of dams and barrages like Hirakud dam, Jobra barrage, Mundali weir etc. on the river, impacting the physical properties of the river and its habitat.


Herbivorous fish species from Mahanadi river

A total of 55 fish species were recorded through experimental fishing and market survey. The trophic composition analysis of species indicates higher number of omnivores due to human induced alterations of the ecosystem. Also, number of herbivores was observed to be comparatively less indicating deteriorated habitat. Water and sediment quality data were at its desired normal range. For adapting the multimetric Index of Biotic Integrity (originally developed by Karr, 1981) to River Mahanadi, 13 metrices were used for the study with modifications from the 12 metrices used in original IBI. Fishes were categorized into the 13 metrices based on fish composition, fish abundance, trophic composition and condition.

Metal contents (Cd, Cu, Mn, Pb, Zn) in water were in traces and below the level of detection. Both Zn (up to 15.64 µg $g^{-1}$) and Mn (up to 195 µg $g^{-1}$) were recorded in sediment below the pollution level. Only Zn was recorded in fish flesh (up to 15.64 ppm or µg $g^{-1}$) and was safe for human consumption.

Among the pesticides, HCH were absent in the water samples but DDT and Endosulfan were recorded. Residues of pp DDE and pp DDT were detected in samples collected from Hatpara and Hatpara/Chiplima respectively. Endosulfan residues were also detected in the form of endosulfan sulfate in water samples of Hatpara, Chiplima, Subarnapur, Mundali and Tikarpara sites to the extent of 0.443 to 1.537 ppb. No synthetic pyrethroid (SP) and organophosphate residues (OP) were found in samples analysed.

Accumulation of organochlorine residues was also observed in fish tissues. HCH was detected in *L. calbasu* flesh from zero point, Hirakud dam which is well below the tolerance limit (0.25 ppm as per PFA Act, Govt. of India). Among DDTs, pp DDE was found 0.005 to 0.294 ppm in the fish flesh and gills of *L. calbasu*, *P. sarana*, *S. bacaila*. The concentrations of op DDE and pp DDT detected in few samples was well below the tolerance limit of 7.0 ppm (PFA Act, Govt. of India). In water samples, no targeted synthetic pyrethroid residue was found accumulated in any of the fish samples.

Organochlorine pesticide levels in fish from River Mahanadi

| Element/ Location | Fish species | | OC compounds and their concentrations (µg/g) |
|---|---|---|---|
| Hirakud | *L. bata* | flesh | pp DDE (0.005 – 0.294), op DDE (0.017) |
| | | gill | pp DDE (0.019 – 0.278) |
| | *L. calbasu* | flesh | γ-HCH (0.019) |
| Subranapur | *P. sarana* | flesh | pp DDE (0.021) |
| | | gill | pp DDE (0.283), pp DDT (0.065) |
| | *S. bacaila* | flesh | pp DDE (0.018) |
| | | gill | pp DDE (0.149), op DDE (0.075) |
| | *L. calbasu* | flesh | pp DDE (0.0056-0.0072) |
| | | gill | pp DDE (0.015) |
| Tikarpara | *L. calbasu* | flesh | pp DDE (0.157), pp DDT (0.128), op DDD (0.064) |

**Project Title : Developing microbiological protocols for bioremediation of polluted aquatic environment (FREM/ER/12/03/03)**

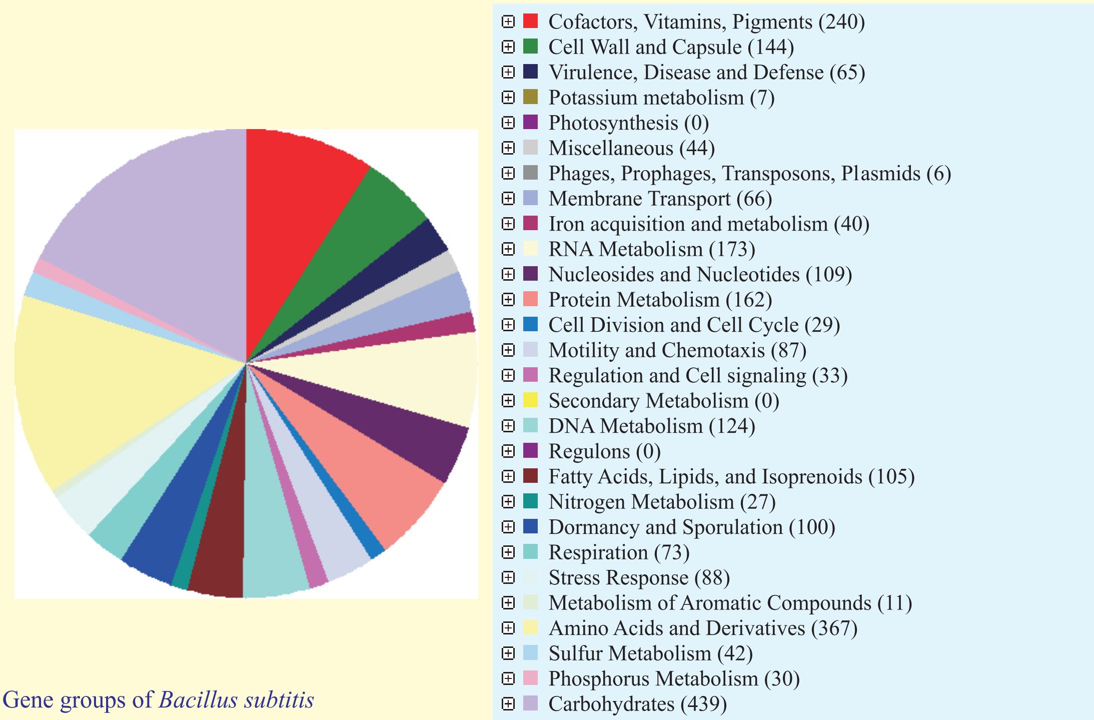
**Investigators :** S. K. Manna, S. Samanta, S. K. Nag, Md. Aftabuddin, P. Maurye and S. Das

**Technical Support :** K. Saha, S. K. Paul, S. Bandopadhyay

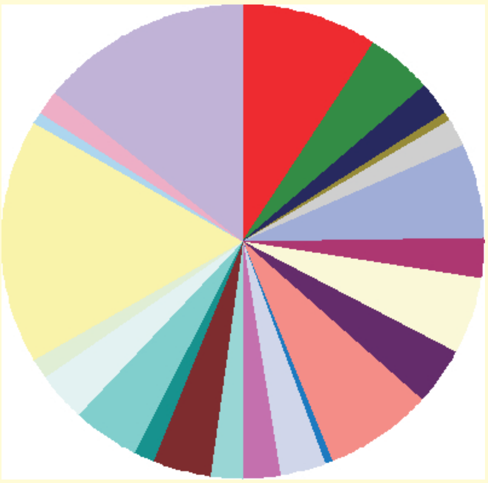
Although there are various means of pollution abatement, bioremediation has been found to be an effective and less costly method. The present project aims at harnessing microbial diversity for development of a pollution mitigation formulation.

**Harnessing microbial diversity:** Twenty seven bacterial isolates have been isolated from river Hooghly near Haldia using diluted $R_2A$ agar, nutrient agar and plate count agar. The cultures are maintained in the laboratory for further testing. Some of the bacteria isolated were identified by 16S-rDNA sequencing method as: *Acinetobacter junii*, *Achromobacter xylosoxidans, Aeromonas hydrophila*, *Bacillus cereus*, *Chryseobacterium sp.*, *Comamonas* sp., *Pantoea agglomerans*, *Klebsiella pneumoniae*, *Pseudomonas putida*, *Ochrobactrum anthropi* and *Ochrobactrum intermedium*.

**Whole genome sequencing:** To examine presence of virulence or beneficial genes in strains of potential field application, whole genome of two phenol degrading bacteria were sequenced in Illumina platform. The complete genome was annotated in RAST server and important genes identified. Whole genome analysis has identified presence of genes involved in Glutathione-dependent formaldehyde detoxification, Salicylate ester degradation, Toluene degradation, Quinate degradation, Benzoate degradation, p-Hydroxybenzoate degradation, Chloroaromatic degradation pathway, Catechol branch of beta-ketoadipate pathway, Salicylate and gentisate catabolism, Protocatechuate branch of beta-ketoadipate pathway, N-heterocyclic aromatic compound degradation, Aromatic Amine Catabolism, Thioredoxin-disulfide reductase, Alkanesulfonates utilization, and Alkylphosphonate utilization in *Ochrobactrum anthropi*, making this a potential candidate in pollution degradation.




Gene groups of *Bacillus subtitis*




Gene organization of *Ochrobactrum anthropi*

**Project Title : Assessment of microbial pollution status and its impact on fish in different riverine ecosystems (FREM / ER / 12 / 03 / 04)**

**Investigators :** S. S. Mishra, B. K. Singh, D. N. Jha and M. A. Alam

**Technical Support :** Dr. K. Srivastava and V. Kumar

Besides chemical and organic matter pollution, microbiological pollution has made the water unfit for use in many cases. The present project aims at assessing microbiological pollution status of different river systems of north India and to examine any interaction between microbial pollution and other biotic and abiotic parameters of the rivers. One year study showed that in terms of microbial load, Rasulabad ghat, Chatnag and Sirsha stretches of the river Ganga indicated poor water quality. The heterotrophic bacterial counts (CFU/100ml) were estimated

The Water quality index of river Ganga during Mahakumbh

| River Ganga/ site | Water quality index | Class |
|---|---|---|
| Sringver pur | 57.69 | B |
| Rasula ghat | 55.83 | B |
| Gau ghat | 67.60 | A |
| Sangam | 52.41 | B |
| Chatnag | 55.16 | B |
| Manaya ghat | 64.50 | A |
| Sirsha ghat | 62.67 | B |
| Mirzapu r | 81.51 | A+ |
| Chunar | 59.17 | B |
| Ramnagar | 82.81 | A+ |
| Rajghat,Varanasi | 66.70 | A |

higher at Manaya ($1.5x10^{11}$) and Sirsha ($1.1x10^{11}$). Composite water quality index categorized different sites in Class A to Class C. The river Yamuna was also studied between Yamunanagar to Allahabad. Improved water quality in terms of lower microbial load was observed at Auraiya to Allahabad zone except at Gaughat stretch at Allahabad. Water quality index categorized the river in Class A to Class C.

Analysis of water samples from 7 sampling sites in the river Ganga-Yamuna before, during and after main bathing days during Mahakhubh 2013 showed no significant changes in water quality in River Ganga at Allahabad zone which may be due to high release/flow rate.

In the river Gomti, fecal coliforms count were higher at Lucknow ($3.0x10^{5}$- $7.3x10^{5}$), while total bacterial load were higher at Gaughat, Lucknow (3.5x109), Sultanpur ($4.2x10^{9}$) and Saidpur ($2.5x10^{9}$). Vibrio counts were significantly low in all the stretches. Water quality index has categorized the river stretch as Class B.

The river Mandakini was studied at 6 sampling centres, from Sati Anusaya to Shardhua/Poolghat where in total coliforms, fecal coliforms and total *Vibrio* counts were recorded significantly low in all stretches. However *Aeromonas* were present in all samples. Fish samples collected from Rajapur and Karvi showed high total bacterial count (2.2 $x10^{9}$ – $1.8x10^{10}$) indicating possible health hazards. Composite water quality index categorized the river stretch as Class A in most sites except Deoghat (Class B). The pure culture isolates of *E.coli, Vibrio* and *Aeromonas* isolated from water and fish samples were tested for their sensitivity to commonly used antibiotics. Most isolates were highly resistant to Penicilin G and Ampicillin and moderately resistant to Cephalothin, Erythromycin, Gentamycin, and Kanamycin.

Sangam during Mahakumbh

Water Quality Index : River Gomti

| Gomati River | WQI | Class |
|---|---|---|
| Rajghat (Neemsar) | 61.754 | B |
| Kudiaghat (LKO) | **50.377** | B |
| Gaughat (LKO) | **52.153** | B |
| Sitakund (Sultanpur) | 58.261 | B |
| Sivghat (Jaunpur) | 57.192 | B |
| Saidpur-Markandaya | 58.832 | B |

**Project Title: Development of Biotechnological Tools for Inland Aquatic Ecosystem Health Assessment (FREM/ER/12/03/05)**

**Investigators :** B. P. Mohanty, B. K. Singh, D. Karunakaran and B. K. Behera

Despite presence of a number of EIA methods, bioindicators are considered to be the most advanced tools. The present project aims at development of biomarkers for rapid and early monitoring of environmental health perturbations.

## Lipid Biomarkers from lens lipids of riverine catfish *Rita rita* for pollution monitoring in tropical rivers

Lipids are important structural components of cell membranes and have profound effect on membrane fluidity. Investigating lipid profiles not only provides insights into the specific roles of lipid molecular species in health and diseases, but can also help in identifying potential preventive or therapeutic biomarkers. Keeping this in view, fatty acids from foot and mantle tissues from bivalve molluscs were analyzed using Gas Chromatography-Mass Spectrometry (GC/MS).

## Muscle proteomics of freshwater catfish *Rita rita*

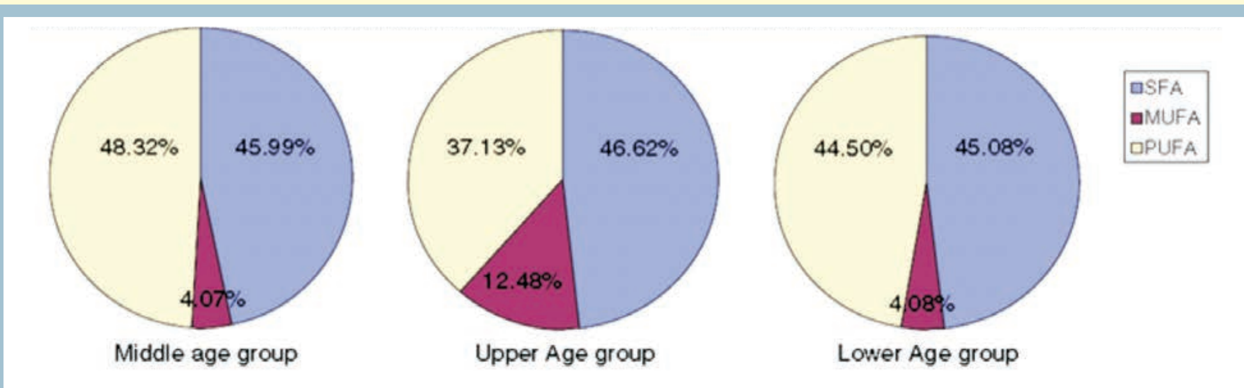
The objective was to search for proteomic biomarkers in muscle and lens proteins of *Rita rita.*


*Rita rita* eye for experimental study

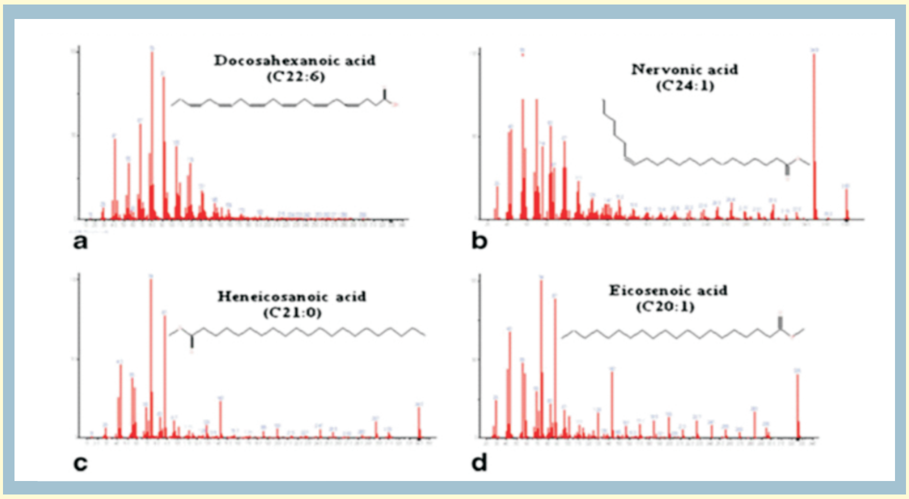
Reference muscle proteome of *Rita rita* was generated and 23 proteins have been identified using proteomic tools like 2-GE, MALDI-TOF-MS and LC-MS/MS. Identified proteins include myosin light chain 2, adenylate kinase, triose phosphate isomerase b, tropomyosin1, L-lactate dehydrogenase A chain, glyceraldehyde 3-phosphate dehydrogenase, alpha actin, peroxisome proliferator-activated receptor beta, heat shock protein 70, alpha-actinin, T-cell receptor delta chain, phosphoglucomutase-1, glycogen phosphorylase, creatine kinase, armadillo repeat-containing protein 8.

## Transcriptomic analysis of *Catla catla* muscle

Reference muscle proteome for IMC *Catla catla* has been generated and 70 protein spots representing 22 proteins have been identified by employing proteomic tools like 2D gel electrophoresis, 2D immunoblotting, MALDI-TOF-MS and LC-MS/MS.The proteins identified include triosephosphate isomerase, pyruvate kinase, aldolaseA, enolase1($\alpha$), phosphoglycerate kinase, glyceraldehyde-3-phosphate dehydrogenase, L-lactate dehydrogenase, glycogen phosphorylase,




Relative abundance of saturated fatty acid (SFA), monounsaturated fatty acid (MUFA) and polyunsaturated fatty acid (PUFA) in eye lens of three different age groups of *R. rita*




GC-MS spectra of lipid biomarkers of aging lens. Three fatty acids viz. docosahexanoic acid (a), methyl nervonate (nervonic acid) (b) and heneicosanoic acid (c) were detected exclusively in lens of fish of upper age group. Eicosenoic acid methyl ester (d) was present in lens of middle age group (adult) lens only and was absent in aging lens (upper age group)

phosphoglucomutase-1, aspartate amino transferase, fructose-1,6-bisphosphatase, glycerol-3-phosphate dehydrogenase 1, muscle-type creatine kinase (M1, M2, M3), actin (α and β), adenylate kinase, transferrin variant F, protesome subunit alpha type 6, alpha-1-antitrypsin homolog, peroxiredoxin, apolipoprotein A-I etc. This is first such study on any commercially important fish species in India. The proteomic information generated can serve as baseline information for identification of biomarkers as well.

**Development of a web-based FishProt database on fish proteomics :** Using the proteomic information generated under this project a web-based database named *Cifri*FishProt was developed. The database contains information on:

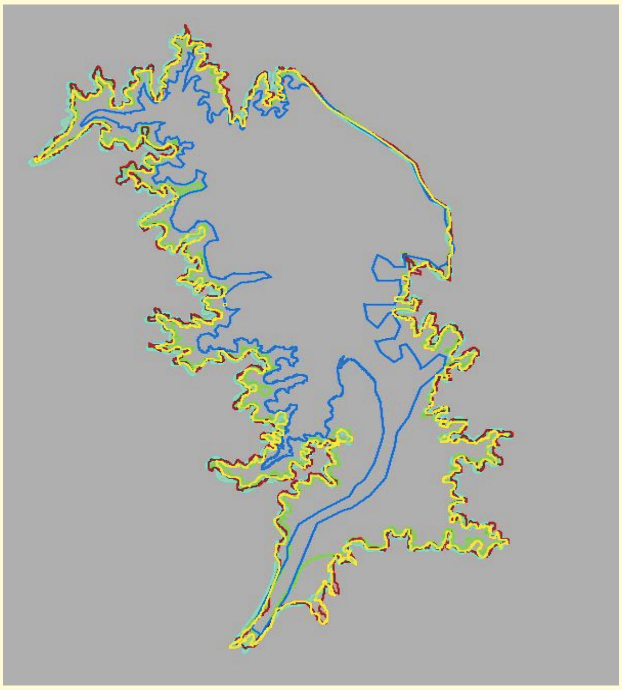
- Muscle proteome of *Catla catla*, *Sperata seenghala* and *Sperata aor*;
- Lens, muscle and plasma proteome of *Labeo rohita*
- Lens and muscle proteome of *Rita rita*
- Liver proteome of *Channa striatus*.

**Project Title : Development of eco-restoration protocols for eutrophic inland aquatic systems (FREM/ER/12/03/06)**

**Investigators** : M. K. Bandopadhyay, M. A. Hassan and D. Das

**Technical Support** : K. Saha and S. Bandyopadhyay

Eutrophication and algal bloom are major problems in many inland water bodies, including urban lakes. Algal blooms not only hamper fish production, but they may secret toxins that are harmful to fish and higher vertebrates. The present project aims at control of algalblooms through environment friendly manner converting the algal biomass into fish biomass. Three urban lakes of above 10 ha water area receiving domestic sewage in West Bengal were monitored for selection of site for biomanipulation studies. The dominance (50.6 – 75.5%) of *M. aeruginosa* in plankton samples of the selected lakes has shown noxious algal saturation. To control the algal biomass, four cage net enclosures (6m x 3m x 1.8m size) have been fabricated with HDPE net. Three planktivorous fishes namely, *H. molitrix, O. niloticus niloticus* and *B. gonionotus* have been incorporated as algal bloom controlling bioagent in the proposed experiment. Seven selected water quality parameters were monitored and recorded on monthly basis from September, 2012.

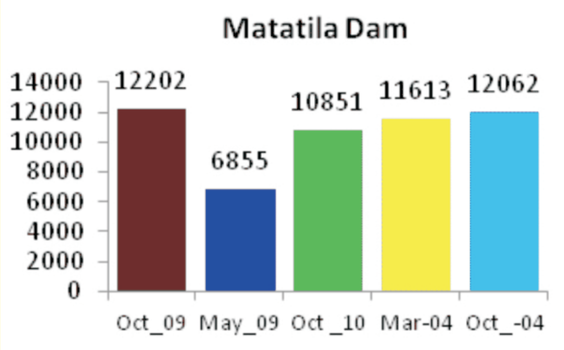


Water area variation in Matatila Dam

**Project Title: Acquisition of fish catch data and resource mapping of inland open-waters on GIS platform, using modern tools (FREM/ER/12/03/07)**

**Investigators:** S. K. Sahu, P. Maurye and D. Karunakaran

**Technical Support :** S. Majumder, S. Mondal and B. Bose

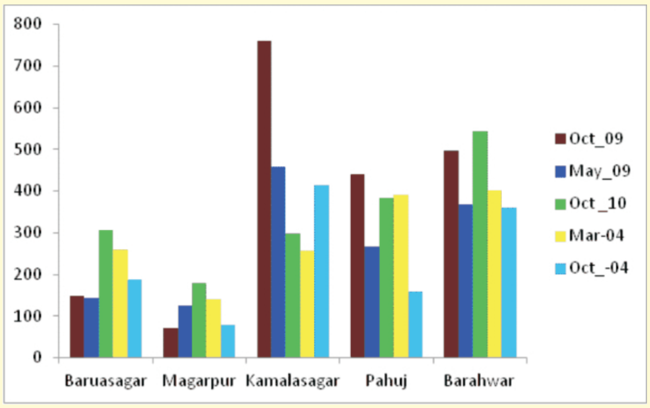



Seasonal water area variation of Matatila Reservoir

Information on variation in water spread area of larger aquatic resources is important for scientific management. Monthly and seasonal water area of reservoirs can be estimated with remote sensing imageries. These appropriate imageries can also be used in mapping of algae and decadal change in water area. LISS III imageries of Oct 2010, Oct 2009, May 2009, Oct 2004 and March 2004, representing different seasons, were geo-referenced and delineated for water area estimation of six reservoirs of district Jhansi of UP State. All the reservoirs, except Matatila, are used for irrigation purpose with fisheries as an integral component.

Barahwar Dam    Pahuj Reservoir    Kamala Sagar

The Matatila Dam, situated 93 km away from Deogarh, was built in 1958 on the Betwa River. The catchment area is around 20 $km^2$ with a maximum storage capacity of 1132 million cubic metres. Besides, irrigation, this is also used for power generation. The full reservoir level (FRL) of the dam is 13885 ha with post monsoon area (Oct 2009) of 12202 ha and pre monsoon area (May 2009) of 6855 ha.




The seasonal water level variations in different reservoirs

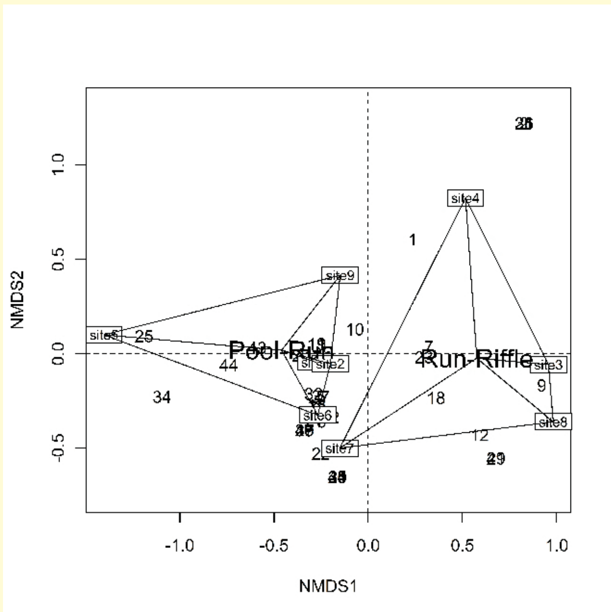
The other five reservoirs of the district were constructed on local rivers. Barua Sagar and Magarpur dam were constructed in 1694 and other three dams were constructed before 1950. As per the National Register of dam the FRL of Barua Sagar is 520 ha and Magrapur 181 ha. The maximum post monsoon areas in Oct 2010 for both the reservoirs were delineated as 58 % and 38 % of FRL. These two reservoirs have the open access while in other three reservoirs, namely Kamlasagar, Pahuj and Barahawar fishing rights are auctioned by state fisheries department.

**Project Title : Inference on fisheries of some selected inland open water through data mining and generalized linear models (FREM/ER/12/03/08)**

**Investigators:** M. Naskar, S. K. Sahu, D. Das and G. Chandra

**Technical Support :** S. Majumder

Inland fisheries resources need to be exploited/ utilized in a sustainable manner and data-driven decision support systems can greatly help in scientific management of these resources. The present project aims at developing computerized database with data mining tools towards formulation of data-driven decision support system for inland fisheries sector.




NDMS of species assemblage with respect to mesohabitat

An investigation on quantitative assessment of fish biodiversity in relation to mesohabitat was carried out, taking the middle stretch of Narmada river as study zone. The mesohabitat (Vyas et al. 2007) and fish diversity information (Vyas et al. 2009) of the river stretch were overlaid with mesohabitat locations on a Remotely Sensed (RS) LISS III image. Emphasis has been given on the techniques of using secondary data obtained from different studies for rapid assessment of fish assemblage in relation to mesohabitat.

## Habitat – fish species interaction analysis

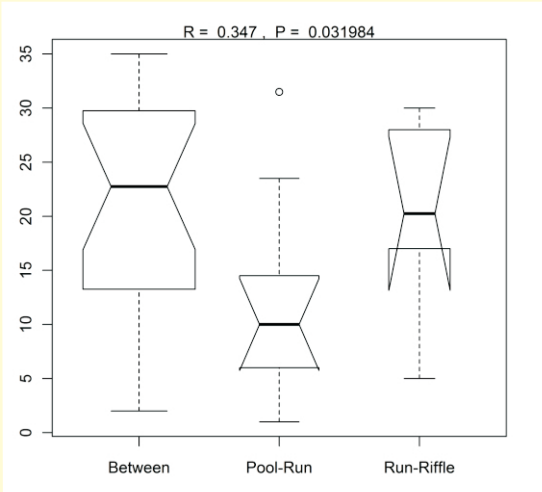
Two hulls joining the vertices of sites corresponding to GIS classification into Pool-Run and Run-Riffle were overlaid in the tri-plot obtained from NMDS results for comparison. Excepting site 7, GIS based classification was reasonably similar and grouped into two major habitat types. NMDS1 clearly separates Pool-Run and Run-Riffle habitat type according to species distribution. In general, species distribution in Pool-Run habitat is more (76.60 %) than that in Run-Riffle (23.40 %) habitat. However, a sizeable number of species are distributed around the center of the biplot indicating that there is a chance of encountering major number of species in all the habitat type pool, run and riffle. The reason is that the stretch under study was mainly dominated by the run with some patches of riffle and pool. Analysis of similarity (ANOSIM) employed to examine difference of species distribution between mesohabitat showed significant (p-value < 0.05) dissimilarity of species composition between Pool-Run and Run-Riffle.

## Family-mesohabitat model

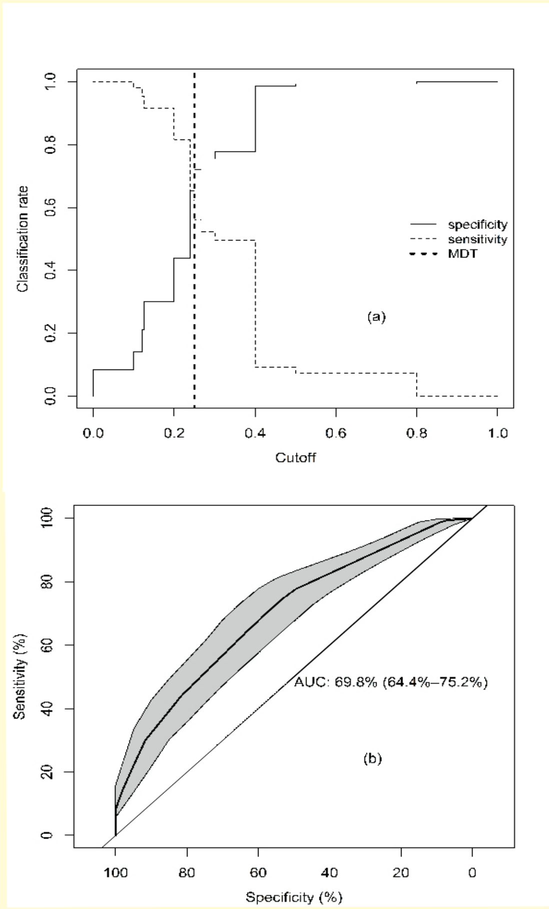
For empirical data analysis, logistic regression model was employed for fish species presence-absence data. The probability of fish species presence is determined by using following logit transformation:

$$\text{logit}(p) = \log\left(\frac{p}{1-p}\right) = b_0 + b_1 x_1 + b_2 x_2 + \ldots\ldots + b_n x_n$$

where $p$ is the probability of presence of a fish species, $x_i$ is the *i-th* explanatory variable with corresponding regression coefficient $b_i$. In the present set up two variables of mesohabitat type and




ANOSIM of species assemblage with respect to mesohabitat

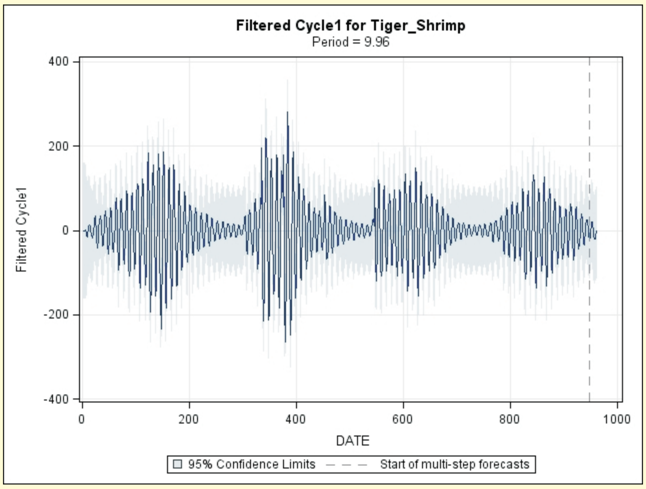



Model evaluation of predictive power based on confusion matrix. (A) denotes cutoff dependent measure and (b) denotes cutoff independent ROC measure taxonomic family were incorporated in the model. The following inferences were made on the basis of fitted model:

i. Mesohabitat has significant ($p < 0.05$) effect on occurrence probability of species
ii. Significant association was found between family and mesohabitat
iii. Chance of encountering species in Pool-Run is 14.49 times more than that in Run-Riffle.
iv. There was a positive association in occurrence probability between Bagridae and the reference family (i.e. Ambassidae) in the Run-Riffle mesohabitat.
v. Occurrence probability of Cyprinidae is relatively higher than that of other families.
vi. The overall predictive accuracy was found to be 69.8%.

### Model Evaluation

The model was evaluated on the basis of Confusion matrix. Cutoff based performance measure of the model produced the optimal classification at probability threshold of presence at 0.25 with overall accuracy of 64%. The similar results with an overall accuracy of 69.8% were obtained in the cutoff independent performance measure based on ROC.

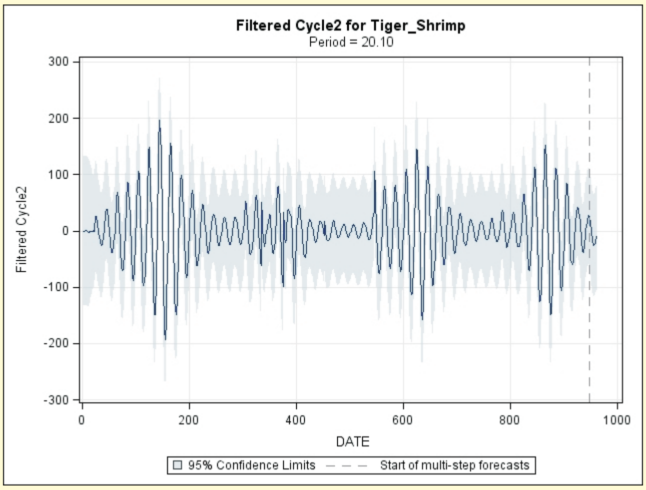



Filter Cycle-1for Tiger Shrimp (Period=9.96)

## Project Title : Development of time series models for the analysis and forecasting of fisheries data (FREM/ER/12/03/09)

**Investigators:** K.K. Goswami, M. Karthikeyan, A.K. Das, B.B. Satpathy and A. Pandit

Forecasting tools are of great importance in fisheries resource management. In elemental form, this forecasting system is composed of an input (e.g., fishing effort), an output (e.g., catch) and a mathematical model which translates values of fishing effort to catch. For development of forecasting models, fish seed collection data generated from 6 estuaries of Sunderbans during 1993-1998 were taken into account.




Filter Cycle-2 for Tiger Shrimp (Period=20.10)

### Structural time series models for daily seed collection:

Unobserved Component Models (UCM)

decompose the response series into components such as trend, seasons, cycles, and the regression effects due to predictor series. The following model shows a possible scenario:

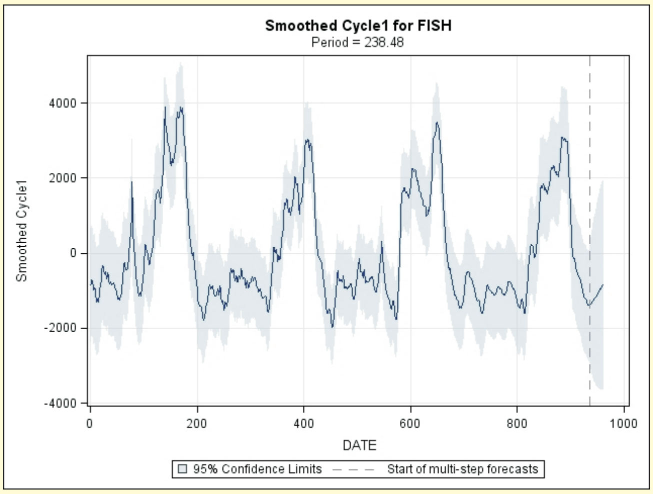
$$y_t = \mu_t + \gamma_t + \psi_t + \varepsilon_t \qquad \varepsilon_t \sim i.i.d.\ N(0, \sigma^2_\varepsilon)$$

The terms $\mu_t$, $\gamma_t$ and $\psi_t$ represent the trend, seasonal and cyclical components, respectively. In fact the model can contain multiple seasons and cycles. The regression term includes contribution of regression variables with fixed regression coefficients. The disturbance term, also called the irregular component, is usually assumed to be Gaussian white noise. Model identification criteria, (ACF) and (PACF) were employed. The procedures of parameter estimation and model validation were carried out and model was found to be:

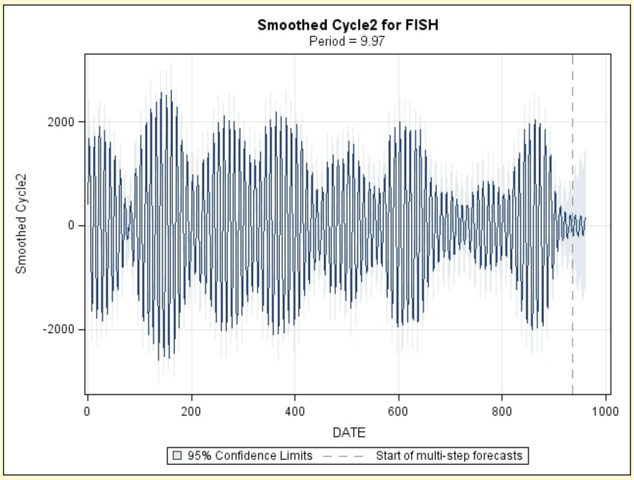
Tiger Shrimp= Sqrt. Trans. + Intercept + Linear Trend + Kakdwip_water_temp + Kakdwip_salinity + Fraserganj_Water_temp + ARIMA (1,0,0)(1,0,0)s ($R^2$ = 0.759),

Fish = Intercept+ Linear Trend+ ARIMA (1,0,0)(1,0,0) s ($R^2$ = 0.0.659).

All the parameters in the models are found to be significant. In case of Tiger shrimp, water temperature at Kakdwip and Fraserganj and salinity at Kakdwip was important contributor. Water temperature were found to be significant contributor as regression variables in tiger shrimp model but in case of fish ,any regressor could not significantly contributed in the model.




Filter Cycle-1for Fish (Period=239.86)




Filter Cycle-2 for Fish (Period=9.97)

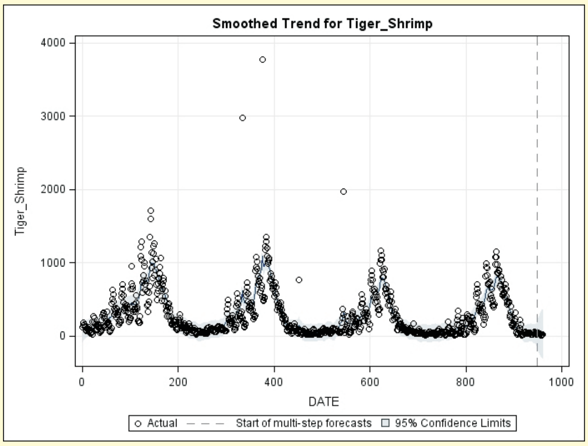
## Model for Tiger Shrimp and fish daily collection:

All the components of the models are significant and both cycles are stationary as damping factor is < 1. Cycle 1 estimated period as 10 days and Cycle 2 estimated period as 20 days representing lunar effect and monthly seasonality respectively for tiger shrimp. In case of fish, Cycle 2 represents lunar effect and cycle 1 represent annual seasonality. As mentioned before, the cycles are very useful as building blocks for constructing more complex periodic patterns. Periodic patterns of almost any complexity can be created by superimposing cycles of different periods and amplitudes.

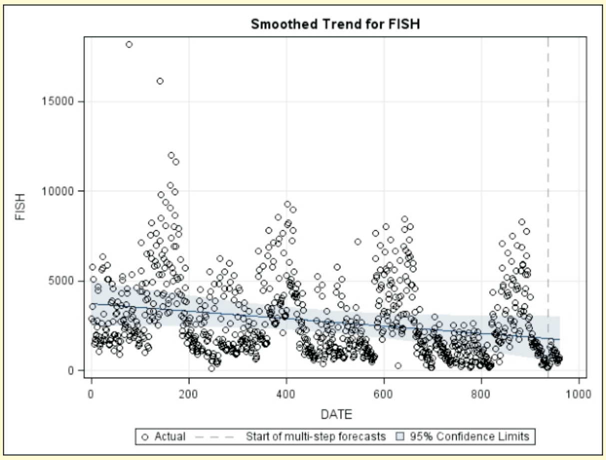
In particular, the seasonal patterns, general periodic patterns with integer periods, can be constructed as sums of cycles like cycle 2 in case of Tiger shrimp and cycle 1 for fish seed collection. The model estimated seasonal patterns period as month for Tiger shrimp and year for fish.

## Trend Curve

Tiger shrimp model has a cyclical trend model and is equivalent to an extended trend plus cycle decomposition of input levels where the long run impact of the cycle remains in the trend, generating hysteresis. The transitory impact of the cycle is responsible for the deviation cycle. Growth rate cycles and deviation cycles are simultaneously present in the model. It is a "dual cycle" model. Fish model shows a linear downward trend.




Smoothed Trend for Tiger Shrimp




Smoothed Trend for Fish

## Programme Title: Ecosystem based fisheries management of reservoirs and wetlands (RWF/12/02/000)

### Project: Sustainable management of floodplain wetlands for enhanced fishery and livelihood (RWF/NE/12/02/01)

**Investigators:** B. K. Bhattacharjya, S. N. Goswami, V. Kolekar, M. A. Hassan, A. K. Das, Md. Aftabuddin, D. K. Meena, K. M. Sandhya, B. K. Singh, S. Yengkokpam, D. Debnath, A. K. Yadav, P. Das and S. C. S. Das

**Technical support**: K. Srivastava, K. K. Sharma, P. Gogoi, A. Kakati, B. K. Biswas, S. Das, (Mrs.) S. Saha and V. Kumar

Floodplain wetlands (*beels*) constitute one of the most potential open water fisheries resources in the Northern, Eastern and North-eastern regions of India. However, the present production level is much below the potential in those water bodies. Fish stock enhancement in many wetlands in recent years has led to increase in production, however, the management inputs like stocking density, species ratio, optimal harvestable size etc. need to be further standardized and refined on location and regional basis.

**Comparing fish yield rates, species composition, aquatic communities and ecology in wetlands managed under stock enhancement regime vis-a-vis under capture fisheries norms:** Stocking influences wetland ecology and fisheries, especially water and soil characteristics, fish food spectrum, macrophyte abundance and diversity, fish assembalge and production. The wetlands in the Nadia and North 24 Parganas districts of West Bengal were surveyed and grouped, based on their hydrological regimes, stocking characteristics, natural fisheries, mangaement regimes etc. into three pairs, viz. Chandania *vs* Marfudanga, Taranipur vs Raja and Berrir *Baor vs* Sashadanga *Baor* for study.

**Characterization of wetlands based on aquatic ecology and fisheries:** Five wetlands viz. Takmu pat, Ungamlen pat, Utra pat, Sana pat and Waithou pat in Manipur were assessed for their habitat variables, aquatic communities and fisheries. Takmu pat and Ungamlen pats were moderately (15-35%) infested while the other three pats were heavily (>80%) infested with macrophytes. The water quality parameters varied widely showing pH (6.6-8.4), DO (2.1-7.4 mg/l), $CO_2$ (3.8-11 mg/l) and alkalinity (25-30 mg/l). Soil was sandy (88-93%), acidic (6.5- 7.3) with organic C ranging between 1.43-1.58 %,

Salient characters of wetlands selected for study

| Name | Chandania | Marfudanga | Berrir Baor | Sashadanga Baor | Taranipur | Raja |
|---|---|---|---|---|---|---|
| Location | North 24 Pgs | Nadia | North 24 Pgs | North 24 Pgs | North 24 Pgs | North 24 Pgs |
| Area (ha) | 45 | 20 | 165 | 67 | 60 | 49 |
| Type | Freshwater open | | Saline open | | Freshwater closed | |
| River Connectivity | Seasonal | Seasonal | Perennial | Perennial | - | - |
| Nearest River | Yamuna | Ganges | Icchamati | Icchamati | Icchamati | Ganges |
| Stocking density (kg/ha) | 1.22 | 1.00 | Nil | 0.30 | 2.08 | Nil |
| Species ratio | IMC-50% Exotic-50% | IMC-60% Exotic-40% | Nil | IMC-60% Exotic-40% | IMC-55% Exotic-45% | Nil |
| Frequency | Twice | Twice | Nil | Once | Once | Nil |
| Ownership | Cooperative | Cooperative | Cooperative | Cooperative | Private | Private |

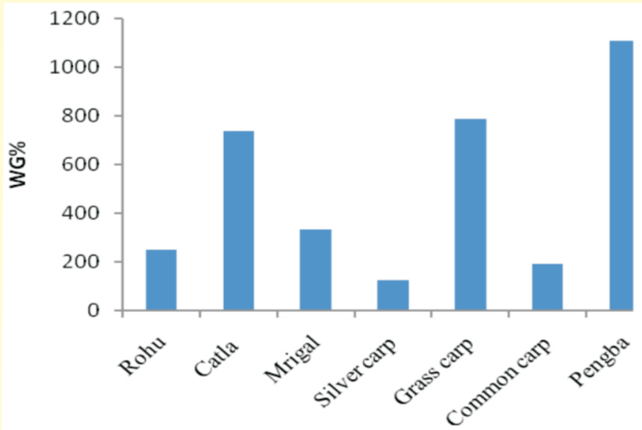
and available $PO_4$-P between 1.3- 1.61 mg/kg. The fisheries comprised of common carp, grass carp, bighead carp, tilapia, IMCs and other small endangered indigenous fishes like *Anabas testudineus, Anguilla bengalensis, Acanthophthalamus punctatus, Channa orientalis, Botia bagarius, Barilius dogarsinghi, Garra graveli, Ompok bimaculatus.*

Two unexplored wetlands, viz. sewage–fed (Jhagrasisa) and natural (Khalsi) with varied ecological regimes and nutrient inputs were examined for their sediment enzyme and biochemical quality. Activity of β- glucosidase varied highly among the wetlands with Khalsi having higher activity than Jhagrasisa. Acid phosphatase and alkaline phosphatase activity showed a greater variation in Jhagrasisa and Khalsi with nearly 3 - 4 times higher activity in Khalsi than in Jhagrasisa respectively. Khalsi had higher organic matter and carbon contents than Jhagrasisa. The potential of availability of sediment phosphorous was thus higher in Jhagrasisa (9.1%) than in Khalsi (8%). Total heterotrophic bacteria was 13 times more in Khalsi than Jhagrasisa, while phosphatase producing bacteria showed marginal variation between the wetlands with higher value in Khalsi than Jhagrasisa.

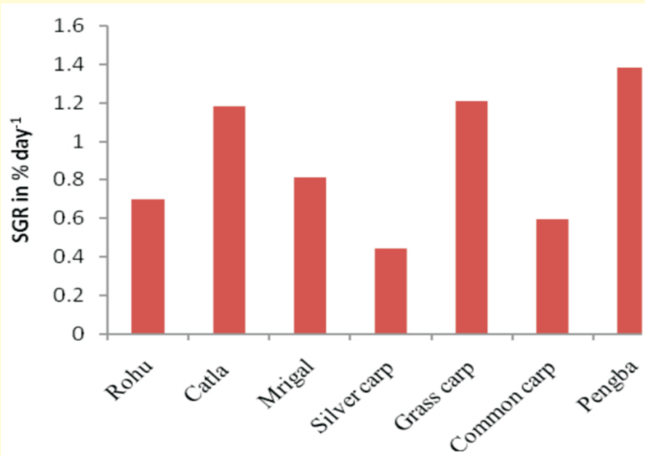
**Demonstration and up-scaling of pen culture technology:** Pen culture demonstration was carried out in Takmu pat of Manipur, in collaboration with the Directorate of Fisheries, Govt. of Manipur, during March 2012 for assessing its technological feasibility. Stocking of all net pen with yearlings of Indian major carp, minor carp and exotic carps (@ 5 fingerlings/ $m^2$) and feeding with commercial pelleted feed (23.4% crude protein) @ 5% of body weight twice a day for 180 days recorded highest percent weight gain for pengba (1107.55±2.92), followed by grass carp (785.42±53.21), catla (738.82±16.78), mrigal (323.39±7.6), rohu (251.19±6.97), common carp (191.08±4.88) and silver carp (123.01±4.6) with benefit-cost ratio of 1.29.

The specific growth rate and percent weight gain indicated suitability of culturing pengba

Pen culture demonstration in Takmu lake, Bishnupur district, Manipur



Weight gain percent (WG%) of the fishes at the end of the experiment



Specific growth rate (SGR) in % $day^{-1}$ of the fishes at the end of the experiment

(*Osteobrama belangeri*), a high-demand indigenous minor carp and state fish of Manipur, grass carp and catla in pen enclosure in Takmu pat, Manipur up to advanced fingerling size for their subsequent release into wetland proper or for table fish production.

An exploratory survey was conducted in Jaunpur, Azamgarh, Mau, Ballia, Varanasi and Sonbhadra districts of Eastern Uttar Pradesh and Gujar tal (25°58′ 40″ N and 82°38′54″ E), a 210 ha wetland of Jaunpur district, was selected for demonstration and upscaling of pen culture technology. The estimated ecological and productivity profile [alkaline pH, moderate oxygen content (4.8mg/l), bicarbonate (172 mg/l), calcium (32.064 mg/l), magnesium (7.74 mg/l), specific conductance (305 µS/cm)] of the wetlands indicated productive nature of the wetland.

Gujartal wetland in Jaunpur district of U. P.

**Refinement of cage culture technology:** A cage culture experiment was set up for standardizing stocking density of *Cirrhinus mrigala* fry at Charan beel, Morigaon District of Assam following randomized block design. *C. mrigala* fry (length $4.17 \pm 0.06$ cm and weight $0.50 \pm 0.02$ g) were stocked at seven different stocking densities, viz. 50, 100, 150, 200, 250, 300 and 350 fry/$m^3$. Experiment of 45 days showed that growth performance of the *C. mrigala* fry was not significantly different among stocking densities ($p>0.05$) upto 20 days of rearing, while at 45 days growth performance was significantly ($p<0.05$) affected by stocking densities. Growth performance remained unaffected up to 150-200 nos/$m^3$ beyond which there was decline in growth (final weight, weight gain percent (WG) and specific growth rate (SGR).

Cage culture in Charan *beel*, Assam

**Project: Habitat characteristics, fish assemblage, stock dynamics and impact of stocking in selected reservoirs (RWF/SR/12/02/02)**

**Investigators :** D. S. Krishna Rao, M. Karthikeyan, R. Palaniswamy, D. Panda and K. M. Sandhya

India boasts of more than 3.0 million hectares of reservoir area having high ecological and economic importance. However, The resource is grossly under-exploited and there by the productivity is much below the potential. Understanding the habitat characteristics, fish assemblages and impacts of stocking would help in better management of the reservoirs and development of strategies for conservation of endemic species.

Experimental fishing at Krishnarajasagar reservoir

**Krishnarajasagar reservoir:** Krishnarajasagar (KRS), a large reservoir of 13 km$^2$ area constructed below the confluence of rivers Cauvery, Hemavathy and Lakshmanathirtha was selected for studying habitat characteristics, fish assemblage and stock dynamics.

**Fish catch:** Monthly fish catch data of the reservoir revealed an estimated catch of 523.5 t during 2012-13 with highest landings (89.5 t) in June and lowest (20 t ) in November comprising of mostly carps (79%), *Catla catla, Labeo rohita, Cirrhinus mrigala and Cyprinus carpio*) followed by *Ompok bimaculatus* (11%), miscellaneous species (mainly minnows, 6%), *Oreochromis mossambicus* (3%) and Murrels (1%).

**Fish assemblage:** Experimental fishing with multi-meshed gillnets from three zones in the reservoir and at a downstream site recorded 28 fish species belonging to 9 families, of which three species, viz. *Catla catla, Labeo rohita* and *Cirrhinius mrigala* did not exhibit natural recruitment and are being stocked. The exotic and autochthonus species were *Cyprinus carpio* and *Oreochromis mossambicus*. The native *Labeo calbasu* bred in the reservoir while other commercially important native carps – *Cirrihnus reba* and *Puntius sarana* were observed in sparse numbers. Among the catfish, *Mystus cavasius* and *Ompok bimaculatus* were abundant. Numerically, *Salmostoma belachi, Pethia ticto, P. sophore* and *Pseudambassis ranga* were abundant in the experimental gillnet catches.

**Kerala reservoirs:** Preliminary survey was conducted in nine reservoirs (Neyyar, Parappar, Chimmini and Peechi - medium size reservoirs and 5 small reservoirs) in Kerala. Study revealed prevalence of mesotrophic condition in most of the reservoirs (seechi depth based Trophic state index) with chlorophyll *a* content ranging from 5.3 to 102.8 mg/l and estimated algal biomass of 3.58 to 68.88 g/m$^3$. Reservoirs are under various types of management and governance like culture-based fisheries by the State Fishery Department (Peechi, Asurankunnu, Neyyar), no fishery activity (Poomala, Pathzhakunnu, Parappar Peppara, Chimmini and Aruvikara) and under the control of forest department. Stocking and harvesting are done by members of fishermen co-operative society in Peechi dam, while leasing to private party by the Fisheries Department is practiced in Asurankunnu reservoir.

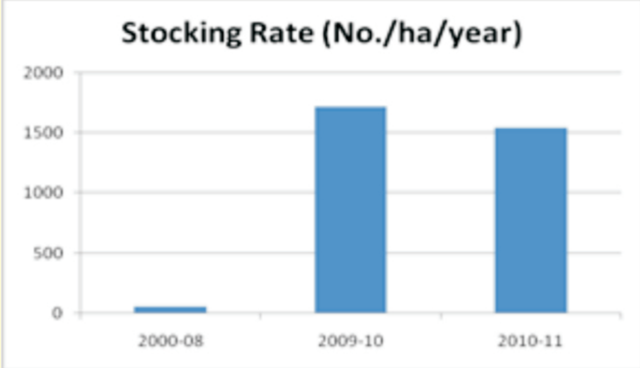
The native fishes observed in the reservoirs are *Puntius* sp., *Channa* sp., *A. mola, Wallago attu, Barbus* sp., *Puntius sarana, P. filamentosus, Garra* sp., *Etroplus suratensis, O. mossambicus*

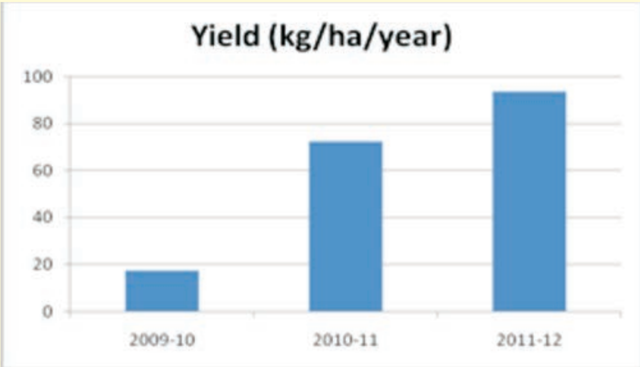
*Parambassis thomassi*

are caught in many Kerala reservoirs. *Parambassis thomassi* is a major fishery in Chimmini reservoir. In some reservoirs the Indian major carps, Catla, rohu, mrigal including common carp and grass carp are stocked by the fishery department and the lessee.

**Impact of stocking:** Analysis of data collected from the Department of Fisheries, Karnataka showed that stocking and new system of governance using guidelines developed by CIFRI led to five-fold increase in the fish yield from 17 kg (2009-10) to 94 kg/ha (2011-12) with the corresponding increase in CPUE from 2 to 12 kg from large reservoirs. Experimental gill net catch revealed that yield in Krishnarajasagar was supplemented mainly by stocked major carps (71%).

**Development of electronic fish catch data acquisition system:** A prototype of the Data Acquisition System (DAS) has been designed to acquire fish catch data through SMS from mobile phones directly into a database in the computer system. Presently, the software has been developed to capture two parameters and is being tested with sample values. Once the processes and protocols are standardized, more parameters would be added in data capturing process in a phased manner. Once perfected, DAS would be used to get fish catch data from reservoirs on daily basis by deploying trained personnel/fishers who will collect and send fish catch data through SMS.




Progressive increase in stocking and yield in large reservoirs in Karnataka

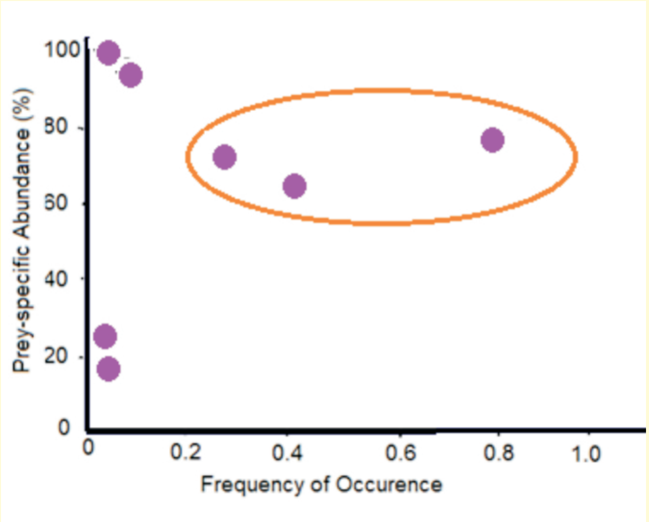
**Project: Application of acoustics and trophic models for ecosystem-based fisheries management in reservoirs (RWF / SR / 12 / 02 / 03)**

**Investigators :** M. Feroz Khan and P. Panikkar

**Technical support:** M. E.Vijay Kumar

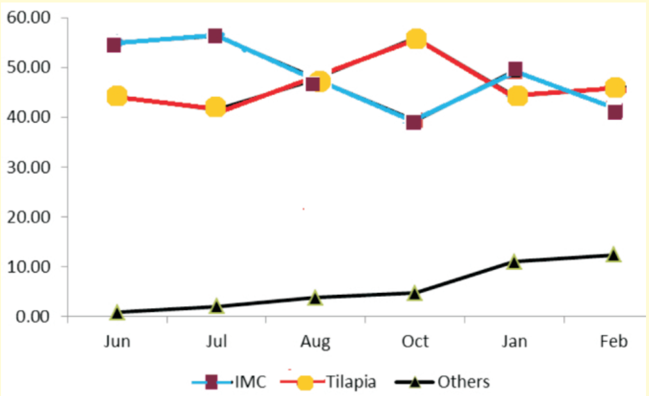
The actual production from reservoirs is much below the production potential. Lack of information and spatio-temporal movements of fish populations are some of the major impediments in increasing fish production from reservoirs. The project aims at scientific management of reservoirs through application of modern tools like acoustics in fish population estimation and modelling.

**Feeding strategy of endemic *Puntius wynaadensis* from Karapuzha reservoir, Wayanad:** Gut content analysis of fish gives a vital clue to trophic relationship in the food web and is being applied in developing trophic models for aquatic ecosystem using endemic fish, *Puntius wynaadensis* as model species. Study revealed a diverse diet (N=7) of the fish species with three types of prey of high importance, in order of phytoplankton (FO = 0.78), molluscan shells (0.4) and insects (0.2). However, all the other prey items presented occurrence frequencies lower than 0.50 suggesting an opportunistic, non-specialized diet. The phytoplankton *(Navicula* sp., *Nitszchia, Gomphonema, Surirella, Cyclotella, Pleurosigma, Pediastrum* and *Ulothrix)* and molluscan shells were dominant items in the food content of *P. wynaadensis* throughout the year.



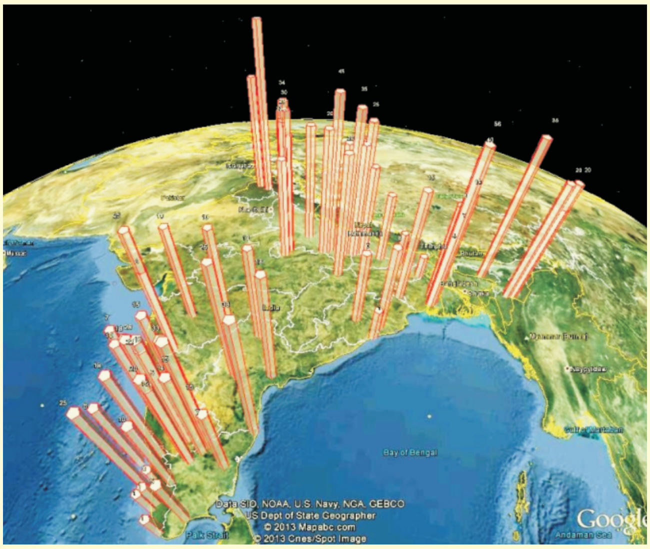

Feeding strategy of *Puntius wynaadensis* in Karapuzha reservoir

**Fish species composition at Manchanbele reservoir, Karnataka:** Manchanbele reservoir (12°53'55"N, 77°19'37"E) in Ramanagara District of Karnataka is built on river Arkavathi with a water spread area of 365 ha at FRL. A landing of 21.2 tonnes of fishes were recorded during June 2012 to February 2013 wit ha CPUE of 9.5 kg. *Oreochromis niloticus* dominated the reservoir catch, forming 36.95 % of the total fish catch, followed by *Catla catla* (23.9 %), *Labeo rohita* (18.2 %), *Cirrhinus mrigala* (9.7 %), *O. mossambicus* (4.89 %), *Heteropneustes fossilis* (2.27 %), *Channa marulius* (1.4%). *Pethia ticto, Systemus sarana*, *Mystus cavasius, Glossogobius giuris* and *Etroplus suratensis* were recorded in meagre quantities.




Monthly catch of Indian major carps, tilapia and other fish groups in Manchanbele reservoir

**Hydroacoustics in Kelavarapalli reservoir to estimate target strength:** Target strength estimation for different fishes was done in Kelavarapalli reservoir of Tamil Nadu using hydroacoustics. Trial runs were made to ensure that the instrument was providing data to the software in all aspects including the geographical positioning. A suitable com port was scanned for permanent connection of GPS receiver and configured, since the port is a USB, 4800 Baud rate was selected. WAAS/EGNOS enhanced the accuracy of positioning. The echo-sounder was driven by a personal computer and all data were immediately stored on the hard disc of the PC. Acoustic survey detected 25-188 nos. of fish in the lotic zone and 16-48 nos. in intermediate zone of the reservoir.



Distribution and abundance index of exotic fishes in inland open waters

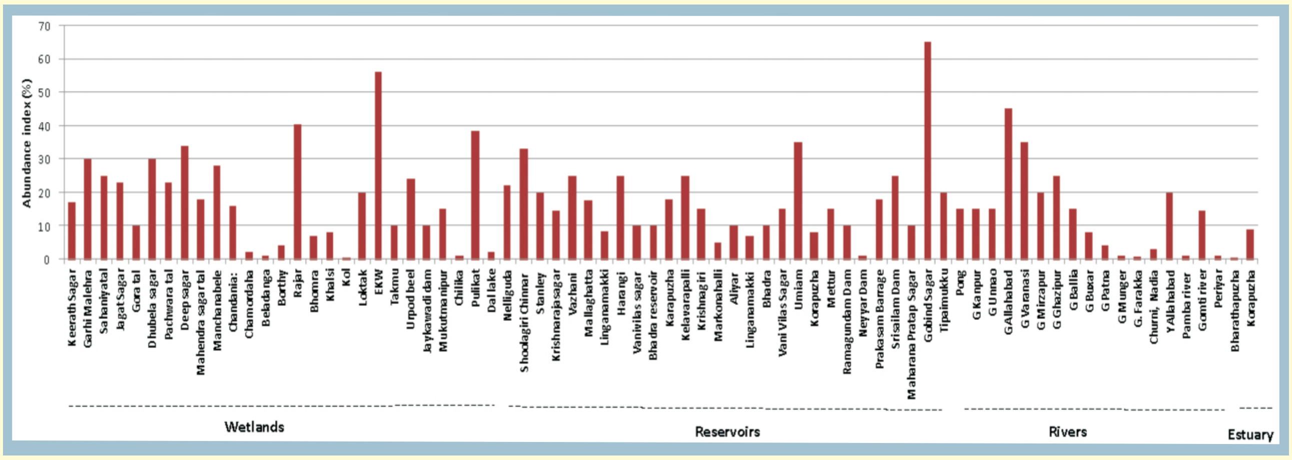
**Project: Assessment of exotic fishes in inland open waters (RWF/ER/12/02/05)**

**Investigators:** V. R. Suresh, B. C. Jha, K. D. Joshi, S. Yengkokpam, F. Khan, P. Panikkar and A. Ekka

**Technical support:** D. K. Biswas, S. Saha, S. Das, Y. Ali, M. E. Vijayakumar, K. K. Sarma, and A. Kakati

Exotic fish species are frequently encountered in open water resources now-a-days impacting the indigenous fish biodiversity. However, there are meagre systematic and reliable information on the resource size, population structure and ecological and socio-economic implications of the exotic fishes in inland open water ecosystems in our country.

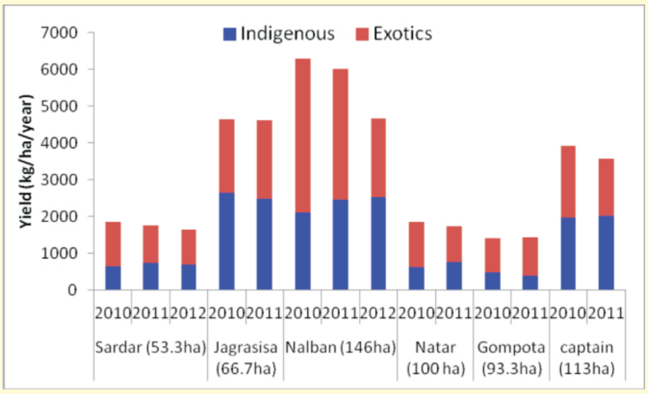
Survey-based primary data and available secondary information from selected rivers, estuaries, reservoirs and wetlands revealed presence of 15 species of exotic fishes with 10 species having food value *(Hypophthalmichthys molitrix, H. nobilis, Ctenopharyngodon idella, Cyprinus carpio, Barbonymus gonionotus, Systomus tetrazona, Oreochromis niloticus niloticus, O. mossambicus, Clarias gariepinus, Piaractus brachypomus, Osphronemus* sp.) and 4 having no food value (*Pterygoplechthys disgunctivus, P. pardalis*, *Gambusia affinis, Barbonymus altus)*. The abundance index of the exotic fishes in 74 open water bodies spread across the southern, northern, eastern and north-eastern states ranged from 0.2 to 65%.



Abundance index of exotic fishes in various open water systems.

Exotics in the Ganga and Yamuna rivers at Allahabad comprised of *Oreochromis niloticus, Cyprinus carpio, Hypophthalmichthys molitrix, Hypophthalmichths nobilis, Ctenopharyngodon idella,* and *Clarias gariepinus),* contributing 65% to the total catch. Presence of all life stages and brooders indicate that common carp and tilapia have established along Allahabad stretch of the rivers. East Kolkata Wetlands, undergoing extensive culture and culture-based fisheries, revealed sizeable presence of exotics to the tune 55-65 % of total production.

Data collected from Dumbur reservoir, Tripura showed *Cyprinus carpio* (common carp) as the only exotic fish with negligible contribution (0.5%) to the total catch.




Contribution of exotic fishes in selected East Kolkata Wetlands

## Programme: Valuation, institutional mechanisms and livelihoods in inland open waters (AES/12/04/000)

### Project: Preparation of inventory of inland open-waters according to their institutional arrangements and governance (AES / ER / 12 / 04 / 01)

**Investigators:** P. K. Katiha, A. Pandit, G. Chandra and A. Ekka

**Technical support**: D. K. Biswas and K. K. Sharma

The objective of this project is to prepare inventory of inland fisheries waters according to their institutional arrangements and governance and undertake detailed case studies to appraise ground situation. During report period information was gathered from state of Madhya Pradesh and a case study of Indira Sagar reservoir was conducted to investigate the stakeholders, institutional arrangements and the interactions among them. It was found that in the state the maximum water area was under reservoirs (3.14 lakh ha), followed by ponds (0.63 lakh ha). Majority of the reservoirs were over 1000 ha (50.6%) followed by 10-100 ha (12.12%) and 100-1000 ha (11.36%).

The major stakeholders of fisheries in M.P. were Department of Fisheries, Fisheries Federation, fisher co-operatives, Gram Panchayat, Janpad Panchayat and Zila Panchayat. Gram Panchayat leases out 0-10 ha water bodies, Janpad Panchayat 10-100 ha, Zila Panchayat 100-1000 ha, State Fisheries Department 1000-2000 ha and M.P. Fisheries Federation has authority to lease water area > 2000 ha. The priority groups for leasing of water bodies are traditional fisherman (<1ha area), fisherman cooperative society, self- help groups or group of fisherman recognized by Fisheries Department (1-5 ha), registered fisherman cooperative society and self-help group/fisherman group (with a condition to register within one year, 5-1000 ha). The lease amount of the rural ponds varied between Rs. 300-500/ha, while for reservoirs it was Rs. 75-200/ha.

In Indira Sagar reservoir the stakeholders included (i) Narmada Valley Development Authority (NVDA) having ownership of the reservoir and responsible for distribution of water for consumptive, industrial and agricultural use, (ii) Narmada Hydropower Development Corporation (NHDC), (iii) M.P. Matsya Mahasangh (MPFF) for development of fisheries in reservoir, (iv) Department of Forest, (v) Department of Revenue, (vi) Department of


The Indira Sagar reservoir

Irrigation, (vii) Gram, Zila and Janpad Panchayat, (viii) Fisher community for fishing in the reservoir and (ix) Lessee for marketing rights of fish produced. Since beginning of the project, downstream has enough water flow, so, no institutional conflicts were observed among different stakeholders. During current year, the reservoir is filled to FRL. Further, for fisheries also the water area has increased and many of the islands were submerged. During fishing season, most of the fishers live on these islands and fish

Fish catch from Indira Sagar reservoir

around the islands. They are shifting from one island to other depending upon the availability of fish catch. No conflict has been noticed among the stakeholders.

Fishery of the reservoir is governed by M. P. River act 1972. MPFF is the nodal agency of fisheries and is responsible for fisheries management and leasing out the marketing rights of the fish catch. Fishing in reservoir is allowed only to the members of fishermen cooperative. The co-operatives were very weak. The members of one society are not living together, but on different islands with members of other cooperatives resulting in little interaction among members of co-operatives. Federation is providing fishers a diary for recording of their daily catch.

For selling of harvested produce lease is given to the highest bidder (Society/Firm/ Individual) in open tender. Closed season is from 16 June to 15 August every year. The size/weight of fish catch restriction was: Catla > 4 kg, other major carp > 1 kg and Pabda > ½ kg. Since the reservoir is in developing stage, the catching of fish is restricted according to quota. The minimum bid price for the present lease was fixed on the basis of restrictive targets (1-3 years: < 5 kg/ha, 4-10 years: upto 20 kg/ha carp dominated, 10-15 years: up to 30 kg/ha catla dominated and 15-20 years; up to 40 kg/ha catla dominated). If the fish catch is more than target, the lessee has to give Rs. 36.86/kg to the Federation along with the wages to the fishermen. The lease amount of the reservoir varied from Rs. 1.605 to 3.946 crore.

Lessee has to stock 300 fingerlings (>50mm) per ha in average available water area (app. 49000 ha) in the ratio of catla 40%, rohu 30% and mrigal and others 30%. The lessee has to purchase the seed preferably from Federation/Department. The fishing year starts from 15 august to 15 June every year. The total numbers of fishermen cooperative society are 66, having approximately 2670 fishers. The lessee has supported the fishers in purchase of fisheries requisites and day to day needs. It has increased number of fishing crafts and gears and overall fishing effort in the reservoir. Gill nets are most prevalent, although cast, drag and hook and line are also in practice.

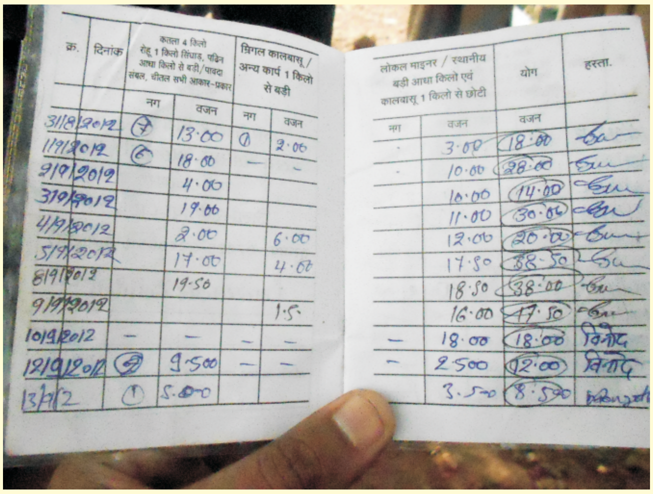



Photo identification diary with entry of daily catch

The fish catch from the reservoir has increased from 495t to 1023t in the last 5 years. The lessee collects the catch from members of fishermen co-operative society and sells it with the restriction that 10% of the catch must be sold in local market. The fishers were satisfied from the existing fisheries management and institutional arrangements. Fishes, smaller than the prescribed size, are seized by the lessee on the order of federation. Rate of wage to the fishers is: major carp and cat fishes above the recommended size : Rs. 25/-, minor carp : Rs. 15/-.

**Project: Valuation of goods and services in inland open-waters (AES/ER/12/04/02)**

**Investigators**: A. Pandit, P. K. Katiha, A. Sinha, A. Ekka

**Technical support:** D. K. Biswas, S. Mandal

The Sundarbans is the largest estuarine mangrove forest in the world, having a forest area of 4263 sq. km[1] in Indian part alone. The mangrove swamp provides an excellent ambience for food and shelter to a wide range of land and aquatic organisms. It acts as nutrient stock for both esturine and marine ecosystems supporting local and commercial yields. Valuation of the mangroves is important not only to make aware of the contributions made by them for the ecology and economy but also to expand and support the decision making horizon on the management of these resources.

The ecosystem has been studied to identify different goods and services providing by this ecosystem. Among them the majors are: production of fish, storage and retention of water for domestic, industrial, and agricultural use; fiber and fuel, medicine, ornamental species, biodiversity and gene pool; climate regulation, mitigation of greenhouse gases, temperature, precipitation and other climatic processes; hydrological flows, groundwater recharge and discharge; storage of water for agriculture or industry; recovery and removal of excess nutrients and pollutants; nursery and breeding grounds for fish; flood control, storm protection; aesthetic appreciation of natural features; carbon sequestration, accumulation of organic matter; storage, recycling, processing, and acquisition of nutrients etc..

The present study attempts to estimate the value of mangroves as a breeding grounds and habitat for various off shore and inshore fisheries. The methodology has been standardized. Production function model would be applied to establish relationship between fish production, effort and mangrove area, which will be estimated over time. The carrying capacity of fish stock is indirectly dependent on mangrove area and may be expressed as:

$CC_t = f(MA_t)$ ........(1)

Where, $CC_t$ = carrying capacity of fish stock at time t

$MA_t$ = Mangrove area at time t

Fish stock at time t is expressed as:

$X_t = f(CC_t, r, X_{t-1}, C_{t-1})$.......... (2)

where, fish stock ($X_t$) is the function of carrying capacity of fish stock ($CC_t$), population growth rate (r), stock size in the previous time period ($X_{t-1}$) and the amount of fish caught in the previous time period, ($C_{t-1}$)

And fish catch is the function of fish stock $X_t$ and fishing effort $E_t$

$Ct = f(E_t, X_t)$...................... (3)

The production return is a function of catch effort, cost of investment ($c_i$) and market price of the fish (p)

$R = f(C_t, E_t, c_i, p_t)$................. (4)

In the above model, return is a function of catch, which depends on stock size. Since stock size is a function of the mangrove area, return is an

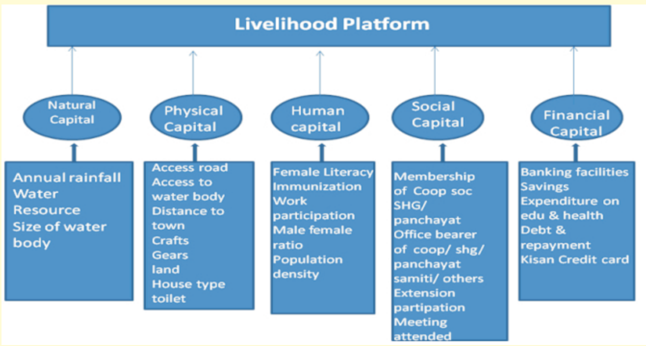
Natural fishery as important resource and livelihood in Sunderbans indirect function of mangrove area. Primary data are being collected through survey in the study area. Two zones were selected for the study *i.e* Bakkhali and Gosaba region in South 24 Parganas. Total 20 Fish species has been identified so far and the study is in progress.

Mangrove - an important carbon reserve

## Economic value of carbon stored in mangroves

Due to high biomass density and productivity, mangroves play a significant role in carbon sequestration. An attempt has been made to give monetary value to carbon stored in aerial parts of mangroves of Sunderbans based on secondary data.

The Gosaba region is dominated mainly by *Avicennia* sp., *Sonneratia* sp., *Excocaria* sp. of mangroves. The average values of carbon stored (t/ha) are *Sonneratia* 106.35±2.86, *Excocaria* sp.19.13 ± 2.45 and *Avicennia* sp. 36.98 ± 3.56. The present study assumes the carbon credit price as 16 pound per ton as on April 2013. The price of carbon is likely to increase to 30 pound per ton. The per ha value of carbon was estimated at Rs. 53,773 in lower value and Rs. 1,00,824 in upper value. The total values of aerial carbon of these three species were worked out to be Rs. 564 at lowest price and Rs.1058 crores at highest price.



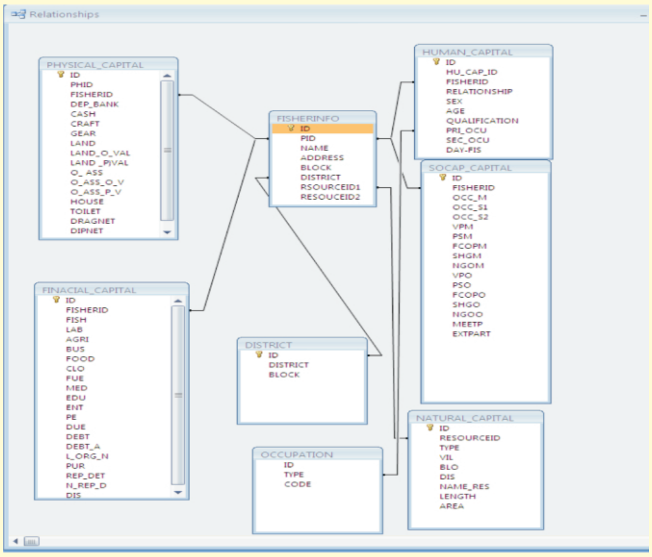

Conceptual Design of Livelihood Asset Mapping

## Project: Mapping of fisher's livelihood assets in inland open waters (AES/ER/12/04/03)

**Investigators**: G. Chandra, M. Naskar, S.K.Sahu and (Mrs.) A. Roy

**Technical support:** S. Majumdar, V. Kumar

Conceptual framework and sampling design of livelihood assets was developed to generate the data on fishers's livelihood assets in open water system. Five livelihood capitals namely natural, social, physical, human and financial were taken for broad mapping of livelihood assets.



Database structure of Livelihood asset mapping

Secondary data were collected from Census report 2011. Primary data on livelihood assets were collected from 14 blocks of four districts of Bihar. One hundred and ninety five fisher families were covered in this year from different stretches of Ganga and its tributaries and different *Chaurs* and *Mauns*.

A data structure has been developed for creation of database in Microsoft access platform on livelihood asset mapping. The database covers all the five capitals of livelihood.

Fishers of Baya River at Patedhi Belsar, Vaishali

# Outreach Activity

**Project: Outreach activity on Carp culture in cages and pens using feed (OR/ER/08/09/001)**

**Investigators:** M. A. Hassan, Md. Aftabuddin and D. K. Meena

**Technical support:** B. Naskar and Y. Ali

**Improving the efficiency of feed by changing culture environment:** Indian Major carps, being riverine species, when confined in enclosures (cages) exhibit reduction in growth performance. Provision of flow in the culture system to simulate riverine condition may induce fish to perform better, thereby improving growth and feed conversion. Water flow (created artificially by flow machine) as experimental variable against control (without flow) tested in indoor experiment using an iso-nitrogenous diet (approximately 34% CP) showed 6% higher live weight gain and 52 % higher feed consumption confirming the role of flow in improving the FCR. The flow inside the culture set up also improved quality of fish carcass by increasing protein content and lowering the lipid content.

**Improvement of growth performance in cages by including additives (probiotics, attractants and anti-stressors) in feed:** Culture of Indian major carps in cages may cause stress-mediated reduction in growth and feed efficiency. Beneficial effect of probiotics and attractant in form of increasing feed intake and utilization has been already established in indoor experiments which were being tested for cage environment in reservoir. The effect of inclusion of probiotics, attractant and anti-stressor agent in fish feed were manifested by marginal increase in weight gain (5%) due to inclusion of probiotics and attractants, markedly higher (58%) weight gain due to addition of anti-stressors and increased crude protein and decreased lipid content in carcass. FCR was observed to be better than in indoor growth trials of feed containing probiotics and attractants as well as growth trials with flow.

**Temperature response of two different carp species for table fish production during winter:** As growth rate of IMC was found to be slow in low temperature during winter, common carp was selected as alternate species that grows well during winter and thereby could replace IMC for continuous operation of cage culture throughout the year. Experiment conducted for 30 days in winter in cages involving stocking of advanced fingerling of *Catla catla* and *Cyprinus carpio* at similar density at Maithon reservoir revealed 22.6 % live weight gain in *C. carpio* against 10.1 % only in *C. catla*.

Cage grown seed being released in Maithon reservoir

**Influence of stocking density on growth performance of common carp:** Growth performance of fishes in cages varied due to variation in stocking density. Experiment with stocking of advanced fingerlings of common carp at two densities, 90 g/m$^3$ and 390 g/m$^3$, in Maithon reservoir and fed with the diet used earlier showed higher growth performance in cages with low fish density during all the periods of monitoring.

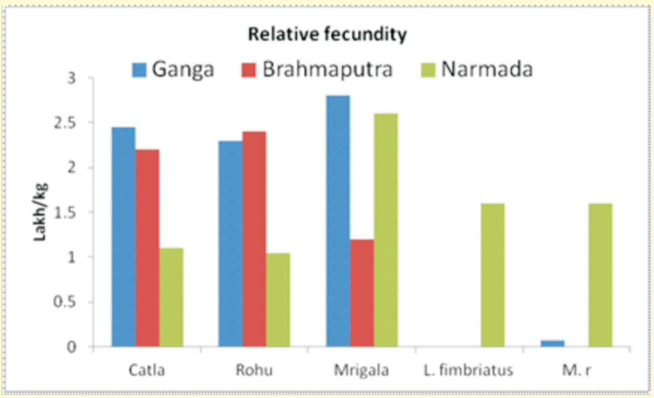
**Project: Outreach activity on Fish genetic stocks (OR/ER/08/09/002)**

**Investigators:** V. R. Suresh, B. K. Behera, S. N. Singh, D. Debnath, D. Panda, D. K. Meena and P. Das

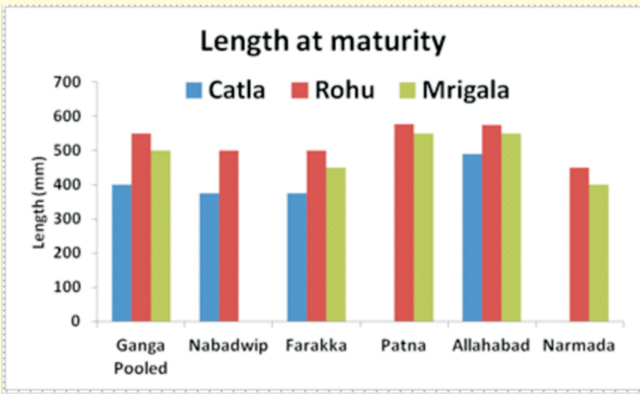
**Technical support**: D. K. Biswas, K. P. Singh, Y. Ali, P. Gogoi, Jayesh, K. Solanki, R. K. Shah and A. K. Jana

**Age and reproductive parameters of targeted IMCs across the river system:** The age estimated by annual rings formed on scales showed that the maximum age of the samples collected from Ganga was six years for *C. catla*, eight years for *L. rohita* and five years for *C. mrigala*, while that from Narmada was two years for *C. catla*, three years for *L. rohita* and two years for *C. mrigala*.

*Catla catla*, *Labeo rohita, Cirrhinus mrigala, Labeo fimbriatus* and *Macrobrachium rosenbergii* collected from the Ganga, Brahmaputra and Narmada rivers showed difference in relative fecundity among the river systems with higher fecundity for *C. catla*, and *C. mrigala* in Ganga and for *L. rohita* from Brahmaputra. The length and age at maturity of the target species in Ganga and Narmada showed differences among the rivers.

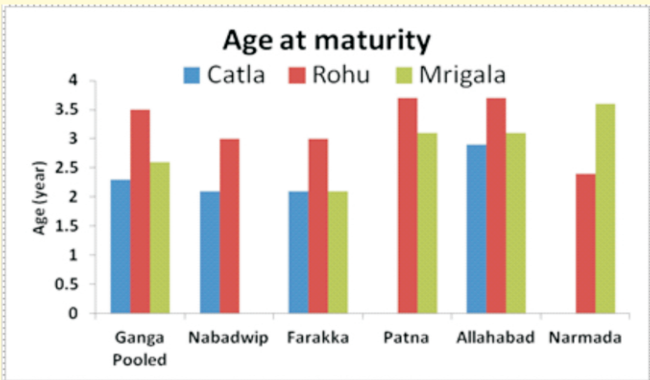



Relative fecundity of *C. catla, L. rohita, L. fimbriatus, C. mrigala* and *M. rosenbergii*.




Comparative length at maturity of IMC

**Stock characterization using morphological characters:** Morphological differentiation using truss morphometry showed that population of *C. catla* in Ganga at lower stretch (Nabadwip and Farakka) were different from that of upper stretch (Patna, Allahabad) and Narmada, while *L. rohita* and *C. mrigala* showed no such difference.



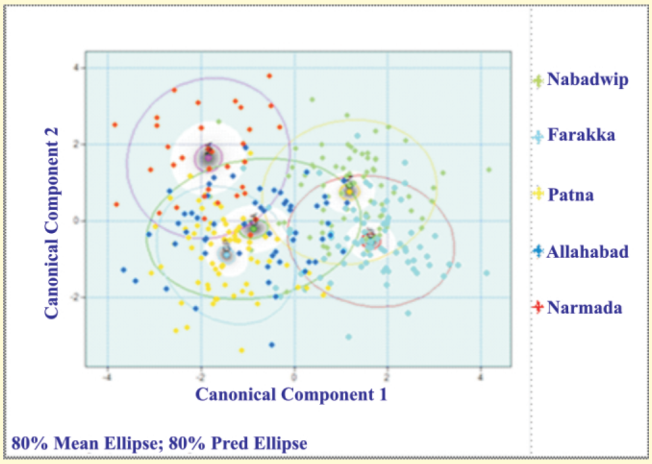

Comparative age at maturity of IMC

**Stock characterization using molecular tools:** Analysis of molecular variance (AMOVA) of PCR-amplified partial cytochrome b (307bp) gene sequence from *L. rohita* (n=133) collected from Allahabad, Patna, Farakka, Nabadwip, Guwahati and Bharuch revealed that in *L. rohita* 92.16% of the total variation was contributed by the variation within population and 7.84% was attributed to differentiation among populations

AMOVA analysis of cytochrome *b* gene sequences for five populations of IMC

| Source of variation | df | Sum of squares | Variance component | Percentage of variation | Fixation index | p-value |
|---|---|---|---|---|---|---|
| *L. rohita* | | | | | | |
| Among population | 5 | 7.043 | 0.04497 | 7.84 | 0.07835 | 0.00782±0.00242 |
| Within population | 127 | 67.175 | 0.52894 | 92.16 | | |
| *C. catla* | | | | | | |
| Among population | 5 | 60.335 | 0.76928 | 30.07 | 0.30074 | 0.0000 ± 0.0000 |
| Within population | 81 | 144.883 | 1.78868 | 69.93 | | |
| *C. mrigala* | | | | | | |
| Among population | 3 | 9.401 | 0.06818Va | 3.55 | 0.03549 | 0.13685 ± 0.01383 |
| Within population | 85 | 157.498 | 1.85291Vb | 96.45 | | |

and population structuring. In the case of *C. catla* (n= 87) 69.93% variation was attributed to variation within populations and 30.07% was attributed to variation among populations and population structuring. AMOVA within four populations (Guwahati, Allahabad, Farakka and Bharuch) of *C. mrigala* (n=89) revealed that 96.45% of total variation was attributed to variation within populations, while 3.55% was attributed to variation among populations and population structuring revealed significant Fst value of 0.03549.




Bi-plot of scores corresponding to two canonical variates expressing morphological difference in *C. catla* in lower Ganga

## Project: Outreach activity on Nutrient profiling and evaluation of fish as a dietary component (OR/ER/07/003)

**Investigators:** B. P. Mohanty, B. K. Behera, D. Karunakaran and D. Debnath

**Technical support**: S. Bhowmick, S. Banerjee, Sk. Rabiul and A. Jana

**Nutrient profile of the giant river-catfish *Sperata seenghala*:** Proximate nutrient profile of *Sperata seenghala* having high consumer preference showed moisture, crude protein, crude fat and ash contents of 79.40 ± 0.09%, 20.06 ± 1.13%, 1.40 ± 0.79% and 0.90 ± 0.08%, respectively. Amino acid analysis showed that the fish flesh is rich in the essential amino acids like histidine, threonine and leucine and that the ratio of essential to non-essential amino acid is 0.89 indicating its superior protein quality. The mineral profiling indicated that the species is rich in zinc, iron and calcium. The present study showed that *Sperata seenghala* is a good source of lean meat and trace elements like zinc and iron.

**Fatty acid profile of Indian shad *Tenualosa ilisha*:** Polyunsaturated Fatty Acids (PUFA) consumption is known to be associated with a number of health benefits. *Tenualosa ilisha*, a highly preferred food fish in South-Asian countries, is rich in oils; however, information on fatty acid profiles of different size-groups of hilsa is scanty. In the present investigation, information on fatty acid profiles of different size groups of hilsa showed that medium-sized fish contained the highest amount of unsaturated fatty acids as well as ω-3 PUFAs, EPA and DHA and the lowest amount of saturated fatty acids (SFAs). PUFA content was highest in small-sized hilsa; however, ω -3 PUFA content was lower and SFAs content was higher than medium-sized fish. In large-sized fish, although ω-3/ω-6 ratio was highest, quantitatively they contained the lowest amount of PUFAs and highest amount of SFAs. Thus, medium-sized hilsa is the best for human health and nutrition.

# External Funded Projects

## NICRA project: Assessment of spawning behaviour of major fish species in inland environment with a view to harness the beneficial effects of temperature

**Investigators**: M. K. Das, U. Bhaumik, K. D. Joshi, B. K. Bhattacharjya, M. Naskar, Md. Aftabuddin, S. K. Sahu, D. Debnath, A. Pandit, S. K. Nag, Soma Das, D. Sudheesan

Based on gamete (oocyte) maturity stages, GSI and related parameters, correlation of the gonadal maturity of Indian major carps from West Bengal, Assam, Tripura, Andhra Pradesh, Madhya Pradesh and *Tenualosa ilisha* and *Liza parsia* of Hooghly-Mathla estuarine system with climate data was attempted. Breeding periodicity of estuarine fishes namely *T. ilisha* and *L. parsia* has been determined based on monthly data of oocyte maturity stages and GSI. The influences of climatic factors (salinity, water temperature and rainfall) upon their breeding behaviour have been investigated. Statistical analysis to identify patterns of different stages of maturity of *T. ilisha* in relation to water temperature in Hooghly estuary indicated that the VII$^{th}$ stage of maturity was attained in the water temperature range of 30°C and 31°C. It ensured that temperature range of 29°C - 32°C would be conducive for spawning, which is a deviation from earlier observations. Increase in water temperature due to global warming will directly affect habitat, metabolism, growth and reproduction of fishes.

A total of 432 fishes of rohu, catla and mrigala collected from Assam and Tripura showed that maturity of IMCs in the area advanced by one month (from April to March) and the period extended by one month (from July to August) during 2012-13. In case of *C. mrigala* incidences of abnormal gonadal development like presence of single-lobed ovary and retarded growth of one lobe of the ovary were observed.

Hatchery survey data comprising of various aspects of the breeding and spawning of the fishes has been compiled in the form of E-Atlas. E-Atlas for West Bengal and Assam have been completed.

Extensive surveys were conducted in different parts of Uttar Pradesh and Uttarakhand to collect the brooders of Indian major carps, mahseer, snow-trout, rainbow trout and also to assess the status of fish breeding and impacts of climate changes on different breeding aspects. Rainbow trout brooders collected from different hatcheries in Uttarakhand were observed to be in full maturity during December end to January while the same was observed during April to June for golden mahseer and August for snow-trout.


E-Atlas of freshwater fish hatchery in Assam

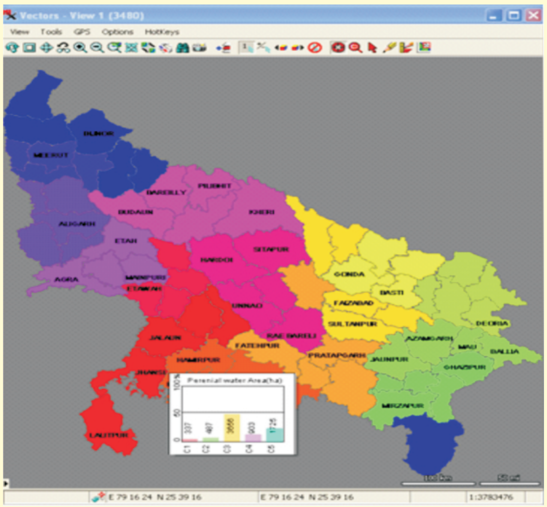
Experiments conducted for comparing thermal tolerance ($CT_{max}$) of IMC *Labeo rohita, Cirrihinus mrigala* and *Catla catla* with respect to species, seasonal acclimation temperature and adaptation revealed no significant variation with respect to species, while $CT_{max}$ of table sized *C. mrigala* significantly showed higher tolerance in warm (29.5±1.5°C) than cold (25±1°C) acclimatized condition and that in slower (3°C /day) than faster (0.75±0.3°C/ 5 min) temperature increment.

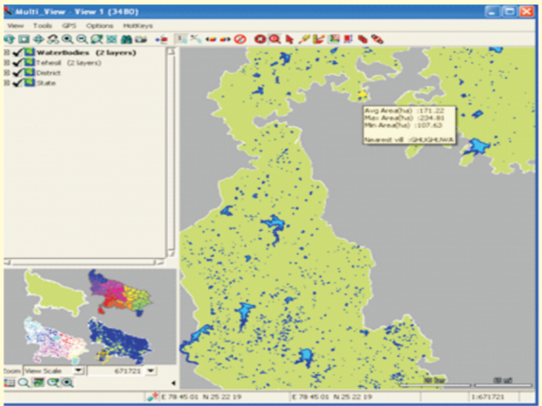
## Central Sector Scheme: Strengthening of database and Geographical Information system of the fisheries sector

**Investigators**: A. P. Sharma, K. D. Joshi, M. Naskar, M. Karthikeya, B. K. Bhattacharjya, S. K. Sahu, D. Karunakaran, D. N. Jha, A. K. Yadav

Water bodies of Maharashtra during post-monsson period were delineated using Pan Imageries. Electronic Atlas on water bodies for Uttar Pradesh was prepared using remote sensing imageries. The atlas shows the pre-monsoon and post-monsoon water area of individual water bodies. District-wise and block-wise compiled information on water area are also provided by the atlas in different categories. Training programmes on "Sampling Methodologies for estimation of Inland fish catch and catch assessment software were organized for state fisheries officials at two centers of CIFRI namely Barrackpore and Allahabad. Training on "Operation of Electronic Atlas" was also given to officials of Sikkim state.

Field surveys in three blocks of Barpeta district, Assam documented a total of 7,452 ponds and community tanks with water spread area of 1565.08 ha approx; majority (80.14%) of the ponds falls in the range of 0.02 to 0.26 ha.





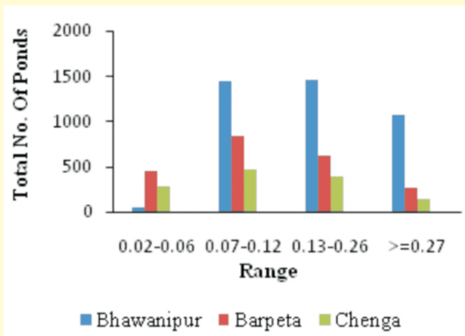
E-atlas of water bodies in Uttar Pradesh

## AMAAS project: Microbial phosphorus transformations in inland open waters

**Investigators**: S. K. Manna, S. Samanta

**Bacterial phosphorus solubilization:** Several phosphate solubilizing (PSB) and phytate mineralizing bacteria (PMB) isolated earlier were examined for their activity *in vitro* and in sediment microcosm. PSB were abundant in water, sediment and fish gut with low to moderate calcium phosphate solubilization activity (6.30-68.87 mgl$^{-1}$).

Several of the PSB had phytase activity and PMB had the P solubilization activity: presence of more than one P release mechanisms would be desirable for a biofertilzer at field level.

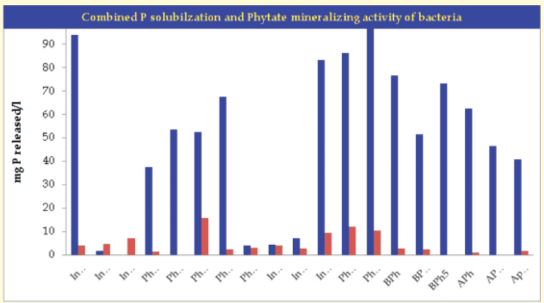



Distribution of ponds in three blocks of Assam

Salient genes involved in P cycling in two strains

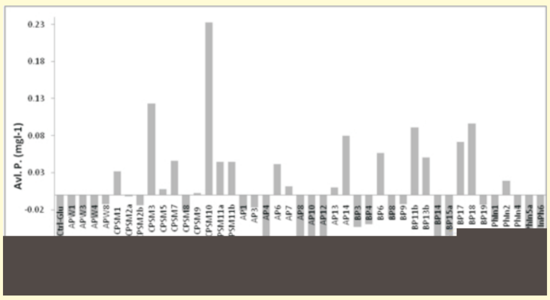
| *Bacillus megaterim* | *Bacillus licheniformis* |
|---|---|
| *P Solubilization*:<br>UDP-glucose dehydrogenase,<br>Glucose-6-phosphate 1-dehydrogenase<br>Glucose 1-dehydrogenase | *P Solubilization*:<br>Glucose 1-dehydrogenase |
| *Phosphatase and phytase activity*:<br>Purple acid phosphatase,<br>Low M.W. protein tyrosine phosphatase | *Phosphatase and phytase activity*:<br>3-phytase,<br>Ser/Thr protein phosphatase,<br>Response regulator aspartate phosphatase,<br>2-hydroxy-3-keto-5-methylthiopentenyl-1-phosphate phosphatase<br>Phosphoserine phosphatase<br>Serine phosphatase<br>Tyrosine phosphatase |

**Sediment P release by bacterial isolates:** To examine the usefulness of bacterial isolates in releasing P from sediment-bound forms, strains having prominent phosphate solubilizing and phytase/phosphatase activities were examined for P release in sediment microcosm. Despite low activity *in vitro*, a good number of isolates were effective in P regeneration, up to the level of 0.233 mgl$^{-1}$, in sediment indicating their biofertilization potentiality in freshwater systems. However, sediment P-fractionation study showed that PSB caused only a short-term drop in Ca-P content in microcosm suggesting that Ca-P might not be the sole or preferred metabolic target of PSB.




Combined Ca-P solubilization and phytate Degradation activity of few bacterial isolates

**Whole genome sequencing of bacteria:** Whole genomes of two P releasing bacteria were sequenced and genes associated with P release/metabolism were identified.



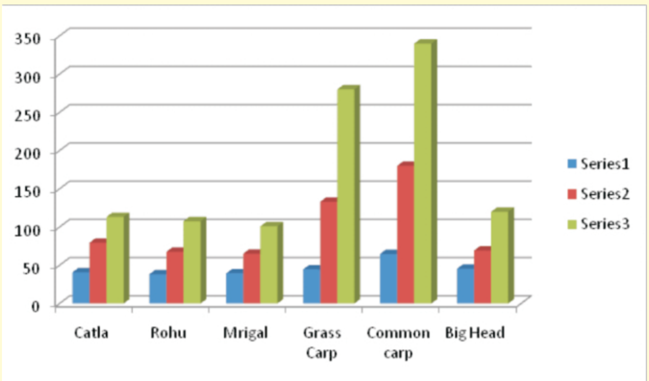

Comparative efficacy of different isolates in increasing the P availability in sediment microcosm. Avl.P values are expressed after subtraction from 'Soil' value (n=15).

## NFBSFARA Project: The nature of impact of abiotic stresses on three diverse freshwater species of fishes

**Investigator**: B. P. Mohanty

The main objective of the CIFRI component of the project is to search for biomarkers for the physiological effects, growth and reproduction,

stocked with 60kg of advanced fingerlings of grass carp, common carp, rohu, mrigal, catla and big head carp in order of their dominance with average weight of 45 g, corresponding to 1250 nos. As a part of management strategy, macrophyte biomass dominated by *Hydrilla* and *Vallisneria* were not removed, to provide trophic support to stocked fishes, barring 10% of the enclosure and no supplementary feed was given. Apprehending the presence of predators, advanced fingerlings (45 g size) that can defend themselves from predators, were stocked. The purpose of stocking grass carp and common carp in greater proportion was to utilize the macrophyte biomass and organic load naturally available in the system, as their food. The demonstration is in progress.



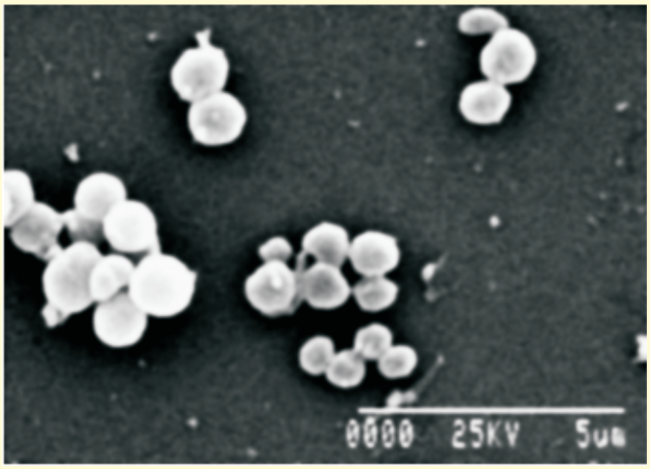
Growth performance of different fish species in the pen

## NAIP: Bioprospecting of genes and allele mining for abiotic stress tolerance

**Investigators**: B. K. Behera, D. K. Meena

For amelioration of increasing salinity, a total of 262 salt stress tolerant bacteria were isolated from water, sediment and salt crystal samples of West Bengal, Orissa and Andhra Pradesh, of which 88 isolates were identified using 16S rRNA gene sequence based molecular tools. Eighty eight bacterial 16S rRNA gene sequences have been submitted to NCBI Gene Bank and the Accession numbers were received. Scanning electron microscopy of 12 isolated halotolerant bacteria have been carried out for morphological study.

Based on physiological study, the number of microbes resistant to 30%, 25%, 20%, 15% , 10% and 5% NaCl concentration were 1, 8, 25, 52, 240 and 245 respectively. The whole transcriptome analysis of *Staphylococcus epidermidis* grown in 20% salt stress condition have identified ESTs of 324 salt stress related genes which have been submitted to NCBI GenBank (JZ198817-JZ198968, JZ198969-JZ199140) while 931 ESTs of *Staphylococcus epidermidis* (JZ347617-JZ348547) have been submitted to dbEST GenBank. Comparative gene ontology has been studied both for the control and the treated *Staphylococcus epidermidis* bacteria with

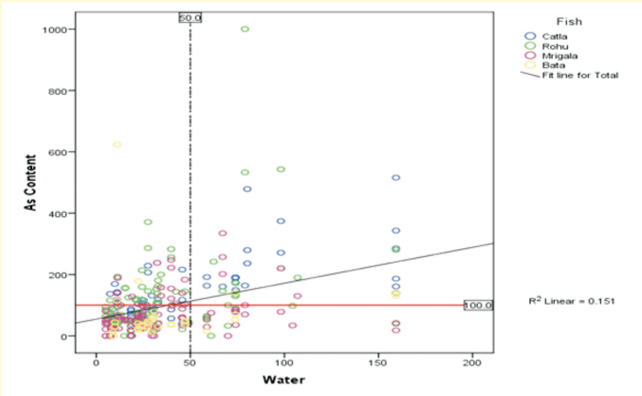


Scanning electron micrograph of halotolerant *Staphylococcus epidermidis* grown in 20% NaCl respect to biological process, molecular function and cellular component in order to retrieve GO terms for all the BLASTX functionally annotated transcript. Four bacterial cultures (*Bacillus cereus, Serratia rubidaea, Pseudomonas aeruginosa* and *Pseudomonas stutzeri)* have been submited to National Bureau of Agriculturally Important Microorganisms (NBAIM), Mau Nath Bhanjan.

## NAIP: Arsenic in food-chain: Cause, effect and mitigation

**Investigators**: S. Samanta, M. K. Das, B. P. Mohanty and S. K. Manna

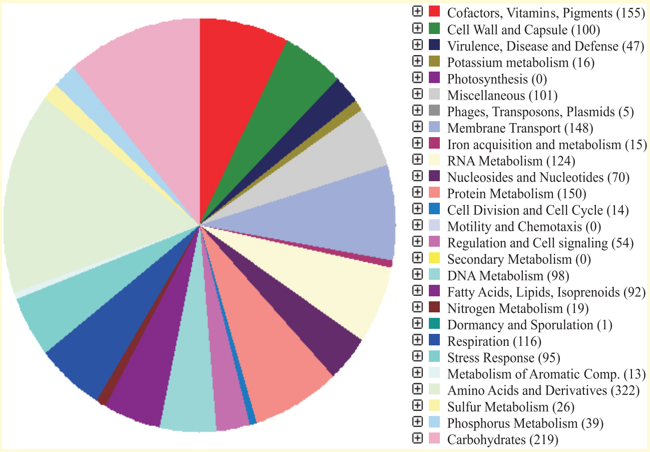
The fishes in arsenic affected villages have been detected with arsenic. Significant positive correlation of arsenic content in fish flesh with pond water ($r = 0.388$, $n= 294$, $p<0.01$) and that with sediment ($r = 0.462$, $n= 294$, $p<0.01$) were observed. Arsenic exposure to human beings from fishes are relatively less (*Catla catla* 147 ppb, *Labeo rohita* 110 ppb, *Cirrhinus mrigala* 72 ppb and *Labeo bata* 69 ppb) compared to other aquatic food like gastropod and bivalve due to their higher arsenic accumulation (260 – 3068 ppb). Use of contaminated groundwater for pisciculture is the main source of arsenic in fish.




Correlation between fish flesh and pond water arsenic content

Based upon findings, rain water harvesting is recommended over storing arsenic contaminated ground water for fish production in ponds. In extreme situations, ground water from deep tube wells should be preferred and water bodies receiving agricultural seepage should be avoided for commercial fish production.

**Whole genome sequencing of bacteria:** To examine presence of virulence and beneficial genes, whole genome of an arsenic transforming bacteria, viz. *Psedochrobactrum* sp. were sequenced. The annotated sequences have been submitted to NCBI.




An overview of genes of *Pseudochrobactrum*

## Project: Norway-India-Bangladesh consortium for *hilsa* aquaculture in South Asia

**Investigators**: A. P. Sharma, U. Bhaumik, B. K. Behera and A. K. Sahoo

The project carried out in 2012 had the following objectives: (a) To contribute selected review papers to be prepared for the workshop, in line with the project requirements, (b) To assist in organization of the workshop in Dhaka, (c) To contribute to the preparation of a detailed research and development concept for achieving a viable hilsa farming industry, (d) To promote and support improved cooperation among consortium partners aiming to create a collaboration platform for future hilsa research activities.

Four review papers on (i) Hilsa: its social, cultural, and religious importance (ii) Status of hilsa fishery in India (iii) Population genetic structure of hilsa, *Tenualosa ilisha* (Ham.) and prospects for genetic improvement (iv) Status of Hilsa, *Tenualosa ilisha* (Ham.) aquaculture in India were contributed in collaboration with other partners for the Regional Workshop held at Dhaka, Bangladesh during 16th and 17th September 2012. The review stressed on importance of Hilsa conservation and aquaculture for livelihood of millions of fishers. From conservation point of view urgent attention is warranted for sustaining the prized hilsa fishery in the country by regulation of selective fishing by adjusting mesh size of the gears. This would ensure the fish, having a length and weight up to 340 mm and 500 g respectively to have a chance to escape for breeding. From aquaculture perspective, detailed reproductive biology, artificial breeding, rearing and culture practices of Hilsa from 1950s were discussed to find out the gaps for the future research work in farming.

A two day workshop on "Hilsa Aquaculture in South Asia" was organized at Bangladesh Agricultural Research Council (BARC), Farm gate, Dhaka, Bangladesh during 16-17 September 2012. In addition, a field visit to the Hilsa farming centre at Chandpur, Bangladesh was organized to observe the hilsa catch and rearing and farming unit of hilsa at BFRI centre. In the workshop a project concept on Hilsa Aquaculture and its possibility in South Asia was developed for the feasibility study between CIFRI, NOFIMA, BFRI and Worldfish centre, Bangladesh.


Regional workshop on Hilsa at BARC, Dhaka, Bangladesh

Hilsa team at BFRI Hilsa Farming Centre at Chandpur, Bangladesh

## CIFRI-CIFT Collaborative project: Development of appropriate fishing systems for rivers

**Investigators**: R. K. Manna and A. K. Sahoo

High value fish like Hilsa is facing threats mainly from indiscriminate fishing. The commercial fishing gear for hilsa in all places is nylon monofilament gill nets with mesh size ranging from 100-150 mm. There is targeted fishery for hilsa sub-adults in all the estuaries using gill nets with smaller mesh size, which is adversely affecting the stock. Besides, tonnes of juveniles of hilsa are being caught by the bag nets along the major hilsa migrating grounds. Milton (2010) has estimated catch of hilsa juveniles from Hooghly estuary to the tune of 44.1 to 151.1 t averaging 85.1 t per year with a size range of 6 to15.5 cm and weight 2.0 to 15.5 g. The fishery may collapse further unless fishermen restrain from this kind of destructive fishing.

To reduce the capture of hilsa juveniles in the stationary bag nets, a BRD consisting of a square mesh window of size 1m x 0.75m made of 50 mm mesh has been introduced near the cod end. Small mesh cover is fixed on top of the windows to study exclusion pattern. These experimental bag nets are under operation in Hooghly river, West Bengal and Narmada river in Gujarat. A total of 41 species was found to escape through the BRD. The mean escapement of all the species from the BRD was found to be 0.65 kg and juveniles of Hilsa formed 11.60% of the total catch excluded from the BRD. The length of the excluded Hilsa ranged from 37 mm to 55 mm. The experiment is in the preliminary stage and seasonal and temporal variations in the catch and size classes need to be studied, for optimizing the mesh sizes and position of the BRD in the net for enhancing the juvenile's escapement from the bag nets.

Insertion of Bye-catch reduction device (BRD) at cod end of bag net

# Training, Mass Awareness Campaign and Exhibition

## Training Programmes

| Sl.No. | Title | Participants | Venue and date |
|---|---|---|---|
| 1. | Inland fisheries production and resource management | 39 Fishers of Gramin Vikash Kendra, Nalanda Bihar | CIFRI, Barrackpore April 20-25, 2012 |
| 2. | Aquaculture management, fish seed raising, wetland management and management of coldwater fisheries | 175 Bodo farmers of Kokrajhar district, Assam | Kokrajhar, Assam April 23-26, 2012 |
| 3. | Stock assessment of Hilsa | 35 scientists and research scholars, ICAR institutes | CIFRI, Barrackpore April 30-May 01, 2012 |
| 4. | Cage and pen culture in inland open waters for producing fingerlings and table fish | 16 Fishery officials, Directorate of Fisheries, Chhattisgarh. (NFDB Sponsored training) | CIFRI, Barrackpore May 7-11, 2012 |
| 5. | Production and management of inland fisheries | Fishers, Nalanda district of Bihar | CIFRI, Barrackpore May 20-25, 2012 |
| 6. | Ecosystem modeling of reservoir fisheries management | 2 Scientists, CIFE, Mumbai. | CIFRI, Bangalore June 21-27, 2012 |
| 7. | Ecology and Fisheries Assessment of Chilika lake | 6 CDA staff | CIFRI, Barrackpore August 21-30, 2012 |
| 8. | Inland fisheries production and resource management | 30 Fish farmers, Vaishali district, Bihar | CIFRI, Barrackpore September 11-17, 2012 |
| 9. | Fishery management in MP reservoirs including enclosure culture | 11Fishery officials , M.P. Fisheries Federation , Bhopal, M.P. | CIFRI, Barrackpore September 21-27, 2012 |
| 10. | Inland fisheries production and resource management | 30 Fish farmers , Siwan district, Bihar | CIFRI, Barrackpore October 03-09,2012 |
| 11. | Sampling methodologies of inland catch and IFMS | 4 Fishery officials, Directorate of Fisheries, Govt of Sikkim | CIFRI, Barrackpore October 09, 2012 |


## Training Programmes

| Sl.No. | Title | Participants | Venue and date |
|---|---|---|---|
| 12. | Model training course on application of GIS in inland fisheries | 18 Fishery Officers from Chhattishgarh, Bihar, MP, UP, Sikkim and Meghalaya | CIFRI, Barrackpore November 08-12, 2012 |
| 13. | Inland fisheries production and resource management | 30 Fish farmers , Gopalganj district , Bihar | CIFRI, Barrackpore December 04-12, 2012 |
| 14. | Molecular Methods of Bacterial Identification | 14 persons including Scientist, Assistant Professor, Post Doctoral Fellows, UGC JRFs,Ph.D Scholars | CIFRI, Barrackpore December10-15, 2012 |
| 15. | Inland fisheries production and resource management | 30 Fish farmers, Saharsha district, Bihar | CIFRI, Barrackpore December14 -20, 2012 |
| 16. | Inland fisheries production and resource management | 28 Fish farmers, Nawada district, Bihar | CIFRI, Barrackpore January 16 -22, 2013 |
| 17. | Inland fisheries production and resource management | 30 Fish farmers, Saran district ,Bihar | CIFRI, Barrackpore February 28- January 03, 2013 |
| 18. | Fisheries enhancement /Culture based fisheries in floodplain wetlands for increasing fish yield on sustainable basin | 12 Fishery officials, State Directorate of Fisheries, India | CIFRI, Guwahati January 29 – February 05, 2013 |
| 19. | Fishery enhancement in large inland waters through enclosed farming | 18 Fishery officials, State Fisheries, Fisheries Corporation & KVK | CIFRI, Barrackpore February18- 22, 2013 |
| 20. | Wetland fishery management techniques | 12 Fishery officials, State Fisheries, India | CIFRI, Guwahati February 19- 23, 2013 |
| 21. | Inland fisheries production and resource management | 28 Fish farmers, Begusari district, Bihar | CIFRI, Barrackpore February 27 to March 05, 2013 |
| 22. | Inland fisheries production and resource management | 30 Fish farmers , Khagaria district, Bihar | CIFRI, Barrackpore March18 to 24, 2013 |
| 23. | Ecology and Fisheries Assessment of Chilika lake | Three CDA staff | CIFRI, Barrackpore March 11 to 23, 2013 |


## Mass Awareness Programmes

| Sl No. | Title | Participants | Venue and date |
|---|---|---|---|
| 1. | Conservation of small indigenous inland fishes | 60 Fishers | Jagulipara, Burdwan, W. B. |
| 2. | Conservation of small indigenous fishes in inland waters | 60 Fishers | Bhomra Beel,Nadia,W. B. |
| 3. | Restoration of Hilsa fishery in Hooghly river | 100 fishermen and 30 fisherwomen | Netaji Nagar (Triveni), Hooghly district, W. B. 25th July.2012. |
| 4. | Training cum mass awareness on fishery development in irrigation canal | 70 SC &ST fish farmers | Jaguli Para, Burdwan district, W. B. 15th August, 2012 |
| 5. | Enclosure culture of fishes in wetlands. | 100 fishers of Saguna FCS Ltd. | Saguna Beel,, Kancharapara, 24-Parganas (N), W. B., 20th September, 2012. |
| 6. | Mass Awareness cum workshop on the occasion of world fisheries day | 100 river fishers | RRC of CIFRI,Allahabad, U.P. 21st November, 2012 |
| 7. | Conservation of Hilsa fishery in Hooghly river. | 80fishers,among them 16 fisherwomen | Namkhana, 24 –Parganas(S), W.B. 24th November, 2012 |
| 8. | Restoration of Hilsa fishery in Rupnarayan river & conservation of other fishes | 100 Rupnarayan river fishers | Banpurhaat, Kolaghat, Purba Medinipur), W.B., 11th December, 2012 |
| 9. | Conservation and Propagation of Mahseers in Cauvery river | 100 fishermen | Harangi, Kodagu District, Karnataka on 15th December, 2012 |
| 10. | Conservation of Hilsa fishery in Hooghly river. | 65 fishermen and 15 fisherwomen | Nabadwip, Nadia district, W.B., 28th December, 2012. |
| 11. | *Ganga Nadee kee bahumulya matsya sampada ke Sanrakshyan evam Sambardhan ke Upay* | 100fishers | Gopalpur, Madguda village Vindhyanchal town, Mirzapur district, Uttar Pradesh.<br>4th February 2013 |
| 12. | Conservation of river fisheries in Uttar Pradesh. | 120 River fishers. | Bioved Research Institute of Agriculture and Technology, Allahabad, U.P., 23rd February, 2013. |
| 13. | Small indigenous fishes for nutritionals security and rural livelihood | 300 fishermen & fisherwomen. | Madanganj, Namkhana, 24-Parganas(S), W.B., 22nd March, 2013. |

## Mass Awareness Campaigns conducted by CIFRI



## Exhibitions

| Sl No | Title | Venue | Period & participating centre |
|---|---|---|---|
| 1. | National Convention Exhibition | Gandhinagar, Gujrat | 3rd to 6th September, .2012 CIFRI, Vadodara Centre |
| 2. | 16th National Exhibition | Baguihati, Kolkata | 7th to 11th September, 2012. Extension & Training Cell, CIFRI |
| 3. | Fish Festival Exhibition of CIFE | Rhotak, Haryana | 22nd September,2012 RRC of CIFRI, Allahabad |
| 4. | BIC Inauguration Exhibition NIRJAFT | NIRJAFT, Kolkata | 25th to 26th September,2012 Extension & Training Cell, CIFRI |
| 5. | National Workshop Exhibition of DCFR. | Bhimtal, Uttarakhand. | 5th to 6th November,2012 RRC of CIFRI, Allahabad. |
| 6. | 9th Jatiya Sanhati Utsav-O-Bharat Mela 2012. | Govindanagar, Canning, 24-Parganas(s), W.B. | 8th to 15th December, 2012. Extension & Training Cell, CIFRI |
| 7. | Sundarban Kristi Mela –O-Lokosanskrati Utsav. | Kultai, Basanti, 24-Parganas(S), W.B. | 20th to 29th December, 2012. Extension & Training Cell, CIFRI |
| 8. | Sundarban Yuba Mela | Taldi,24-Parganas(S), W. B. | 22nd to 31st December, 2012. Extension & Training Cell, CIFRI |
| 9. | Pride of India Expo; 100th Indian Science Congress. | Kolkata, W. B. | 3rd to7th January,2013 Extension & Training Cell, CIFRI |
| 10. | Gighata Block Puspa Krishi –o-Shilpo Mela | Thakurnagar , 24-Parganas (N),W. B. | 12th to 20th January, 2013. Extension & Training Cell, CIFRI |
| 11. | XIth Agricultural Science Congress Exhibition | OUAT, Bhubaneswr, Odisha | 7th to 9th February,2013 Extension & Training Cell, CIFRI |
| 12. | Agricultural Scientists and Farmers Congress Exhibition | Bioved Research Institute of Agriculture and Technology, Allahabad, U. P. | 22nd to 24th February,2013 RRC of CIFRI, Allahabad. |
| 13. | Kerla Agri Food Pro Meet | Kochi, Kerala | 18th to 22nd February,2013 CIFRI Unit, Kochi. |
| 14. | PAF Congress Exhibition | CIFRI, Barrackpore | 9th to 11th February,2013 Extension & Training Cell, CIFRI |
| 15. | Kishan Mela | Katihar, Bihar | 17th March,2013 Extension & Training Cell, CIFRI |



## Awards/Recognitions

| Name(s) of personnel | Name of the Award/ recognition | Place & date |
|---|---|---|
| Prof. AP Sharma | President | President of Animal, Veterinary and Fisheries Sciences,100th Indian Science Congress, Kolkata |
| Dr. Utpal Bhaumik | Fellowship | Zoological Survey of India, Kolkata, India,2012 |
| Dr. Feroz Khan | Excellence in Fisheries | Industrial Fisheries Alumni Association at Department of Industrial Fisheries, Cochin University of Science and Technology on Aug 15, 2012. |
| Dr BP Mohanty | Chaired a Session | World Congress on Biotechnology 2012 at Leonia International Convention Centre, Hyderabad on 4-6 May 2012 |
| Dr. S.K Manna | Recognized as an Expert | National Training program organized by National Institute of Animal Nutrition & Physiology, Bangalore during August 22 – Sept. 04, 2012. |
| Dr. M.K Bandopadhyay | Guest Lecturer | Seva Bharati Krishi Vgyan Kendra, Kapgari, Midnapore (W),W.B. |
| Dr. B.K Bhattacharya | Expert committee member | National Institute of Rural Development, Northeast Regional Centre on September 13, 2012. |
| Dr Sona Yengkokpam | Expert committee member | National Institute of Rural Development, Northeast Regional Centre on September 13, 2012. |

## CIFRI Scientists are Awarded Doctorate Degree During the Year 2012-13

- Dr. Feroz Khan, Scientist (SS) and I/C Bangalore centre was conferred with Ph. D on 22 March 2013 for his doctoral research 'Trophic Modeling For Ecosystems Based Fisheries Management of An Indian Reservoir'.
- Dr. Deepa Sudheesan, Scientist was conferred with Ph.D on 2nd February,2013 for his doctoral research on 'Species differentiation of grey mullets (Family: Mugilidae) from Indian waters'.

## Ganesh Shankar Vidyarthi Hindi Krishi Patrika Purashkar

CIFRI has been awarded the First Prize of Ganesh Shankar Vidyarthi Hindi Krishi Patrika Purashkar 2011 for its publication *Neelanjali*.

# Linkages

The institute has developed and maintained close linkages with several organizations and institutions involved in fisheries research. The institute collaborated with them in research, development, extension, outreach activities, seminars, workshops, publications. The key partners of the institute are:

## International:

- Food and Agriculture Organization, Rome
- Department of Aquaculture Development, Combodia
- Japan International Cooperation Agency (JICA)
- Aquatic Ecosystem Health and Management
- Wetland International, New Delhi
- Worldfish Centre, Malaysia
- NOFIMA, Norway
- Norwegian Research Council
- Bangladesh Fisheries Research Institute (BFRI)

## National:

*State:*

- Assam Fisheries Development Corporation, Guwahati
- Directorate of Fisheries, Assam
- Directorate of Fisheries, Bihar
- Directorate of Fisheries, Madhyapradesh
- Directorate of Fisheries, Maharashtra
- Directorate of Fisheries, Himachal Pradesh
- Directorate of Fisheries, Meghalaya
- Directorate of Fisheries, Rajasthan
- Assam Agricultural University, Jorhat, Assam
- Sundarban Development Board,
- Bidhan Chanchandra Krishi Viswavidyalaya, Mohanpur ,West Bengal
- State Institute of Rural Development (SIRD), Govt. of Assam
- Rajendra Agricultural University, Pusa, Samastipur,Bihar
- West Bengal University of Animal and Fisheries Sciences, Kolkata
- Assam Agricultural University, Jorhat

*Central:*

- NIRD, North-east Regional Centre, Khanapara, Guwahati
- College of Fisheries, CAU, Lembucherra, Agartala
- National Fisheries Development Board, Hyderabad
- National Institute of Animal Nutrition & Physiology (ICAR), Bangalore
- Planning Commission, New Delhi
- Department of Animal Husbandry, Dairying and Fisheries, New Delhi
- Central University of Bihar, Patna
- College of Fisheries, Central Agricultural University, Lembucherra, Agartala
- National Sample Survey Organization
- National Environmental Science Academy

*ICAR:*

- Zonal Project Directorate, Zone II,Kolkata
- Zonal Project Directorate, Zone III, ICAR Res. Complex, Umiam, Meghalaya
- Directorate of Coldwater Fisheries Research (ICAR), Bhimtal
- Indian Agricultural Research Institute, New Delhi
- Indian Veterinary Research Institute, Izatnagar
- Central Research Institute for Dryland Agriculture, Hyderabad
- ICAR Research Complex for NEH, Hill, Umiyam, Meghalaya
- National Research Centre on Yak, Dirang
- National Bureau of Agriculturally Important Microorganisms (NBAIM) Mau
- National Centre for Agricultural Economics & Policy Research, New Delhi
- Central Marine Fisheries Research Institute, Kochi
- Central Institute of Fisheries Technology, Kochi
- Central Institute of Freshwater Aquaculture, Bhubaneswar
- Central Institute of Brackishwater Aquaculture, Chennai
- Central Institute of Fisheries Education, Mumbai
- Directorate of Coldwater Fisheries, Bhimtal
- National Bureau of Fish Genetic Resources, Lucknow

*Others:*

- IIT, Cosortium
- WWF-India, New Delhi
- Bioved Research Institute of Agriculture & Technology, Allahabad
- Madanganj Matsyachasi Samabay Limited, Madanganj, Namkhana, 24 Paraganas (S)
- Calcutta Wildlife Society, Kolkata
- Chilika Development Authority, Bhubaneswar
- Bharatiya Agro Industries Foundation, Patna

# Publications

# Publications

## RESEARCH PAPER

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## BOOK CHAPTER

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## GENOMIC RESOURCES SUBMITTED TO NCBI GENE BANK

- Accession nos. of bacterial 16S gene: JX000001, JX024253, JX134615-134618, JX437940-437942. JQ265998-266008, JQ965767-965768, JQ957862-957863, JQ995148, JX024250, JN172939, JX024251-024252, JX047377-047380, Jx081585.
- 88 Accession numbers received from NCBI GenBank for microbial 16S rRNA gene sequences.
- 324 Salt stress related genes (ESTs) have been submitted to NCBI Gen Bank and accession numbers received (JZ198817-JZ198968, JZ198969-JZ199140).
- 931 other genes (ESTs) have been submitted to NCBI Gen Bank and accession numbers received (JZ347617-JZ348547).
- 310 Accession numbers received from NCBI Gen Bank for Cytochrome b gene of *L. rohita, C.catla, C.mrigala* species.
- 35 Accession numbers received from NCBI Gen Bank for ATPase 6/8 gene of *L. rohita, C. catla, C. mrigala* species.
- GenBank Accession Nos. of *Catla catla* muscle transcriptomes : KC788422, KC788423, Kc788424, KC7887541, KC816537, KC816538, KC816539, KC816540, KC816541, KC816542, KC887542, KC887543, KC887540, Kc887544, KC887545, Am690341.

## Consultancies

The Institute executed the following consultancy projects in interest of national development

| Title | Funding agency |
|---|---|
| Assessment of environmental flows for Shivasamudram Seasonal Power Scheme on river Cauvery, Karnataka | Karnataka Power Corporation Limited (KPCL), Karnataka |
| Study of Aquatic biodiversity in the river Ken | Natioanl Water Development Agency, Gwalior, Madhya Pradesh |
| Study of Minimum Environmental Flow Requirement for Aquatic Life in river Dri and Tagon for Etalin Hydroelectric Power Project | Etalin Hydro Electric Company Limited, Haryana |
| Study of Minimum Environmental Flow Requirement for Aquatic Life in river Dri and Tagon for Attunli Hydroelectric Power Project | Attunli Hydro Electric Company Limited, Haryana |
| Investigation and suggestive measures on fish migration in river Kameng for Londa (Talong) Hydroelectric Project, Arunachal Pradesh | GMR Londa Hydropower Private Limited |
| Post restoration assessment of the ecology and fisheries diversity of Chilika Lake | Chilika Development Authority (CDA), Bhubaneswar |

# Meetings

## Research Advisory Committee Meeting

The Research Advisory Committee Meeting of CIFRI for the year 2012 was convened during April 06-07, 2012 at CIFRI, Barrackpore. Under the chairmanship of Dr. R.K. Sinha the committee suggested to develop appropriate technologies and package of practices to cater to the needs of various stakeholders. The Chairman also urged to modify and initiate programmes to face the challenges in the XII Five Year Plan. Dr. S.D. Singh, ADG (I. Fy). ICAR, stressed upon the sustainability dimension of the technologies. Prof. A.P. Sharma, Director assured the house that the recommendations would be implemented.


## Brainstorming Session on Sunderbans

A brainstorming session was organized in Sunderbans at Pakhirala, Sajnekhali, South 24 pgs on April 08, 2012 on Mangrove & Fisheries of Sunderbans. The programme was attended by many renowned scientific personnels like Prof. R.K. Sinha, Dr. P. Nautiyal, Dr. W. Viswanath, Dr. L.L. Sharma and Dr. S.D. Singh. Prof. A.P. Sharma, Director, CIFRI and Heads of CIFRI Divisional and Regional Centres. Various speakers shared their research experiences in Sunderbans. Several problems related to fisheries like destruction of juveniles, siltation, destruction of mangroves for tourism or aquaculture, recurring cyclonic storm, killing of fishermen by wild animals etc. were highlighted. Indepth studies on different forms of organic matter in water along with detrital food chain dynamics, role of mangrove as nursery ground of fish and prawns and socio-economic issues were suggested. Director CIFRI desired that biodiversity of estuaries may be put in GIS platform. He also suggested taking up a collaborative study on this important mangrove ecosystem with other organizations.

## Institute Research Committee Meeting

The annual meeting of IRC was held during April 09-11, 2012 at Barrackpore. Prof. A.P. Sharma, Director presided over the meeting. Dr. S.D. Singh represented the ICAR Fisheries Division in the meeting. All the Head of Divisions and scientists of all cadres participated in this important meeting. Since this IRC meeting was the last meeting of the 11$^{th}$ Five Year Plan, the Chairman requested all the project leaders to present signnificant achievements of 11$^{th}$ year plan. Scientists also presented their future work plans and proposed projects in this meeting.


## Authors' workshop on Ecosystem Health of Major Rivers of India

India is endowed with rich water resources. Among them, the river Ganga occupies a unique position in history, culture, religion and civilization of the Indian subcontinent. However, data available on fishes, fisheries and health of these rivers are scarce and scattered. Concerted efforts to collect, compile and integrate the available data on the major rivers of India are being felt necessary. In this direction an authors workshop on 'Ecosystem health of major rivers of India' was organized jointly by CIFRI and Aquatic Eco-System Health and Management Society, Canada at Barrackpore on April 22 – 23, 2012. As an outcome of this workshop several papers were submitted to the AEHMS for peer reviewed publication.


## International Training on Stock Assessment of Hilsa

The training programme was conducted under BOBLME, FAO project for building up expertise on Stock assessment techniques with special reference of Hilsa Stock. There were about 20 participants from CIFRI, SAU's etc. Regional stock assessment co-ordinator BOBLME, Dr. Rishi Sharma was invited as an expert resource person for this training programme. The training programme was designed to introduce basic principles of Stock assessments and population dynamics and how to develop management plan relating to Hilsa stock. The participants were exposed to cutting edge tools to evaluate and understand how to analyze data in Excel.


### Inception Workshop on 'Scientific Fisheries Management of Wetlands and Reservoirs of NE Region'

CIFRI Regional Centre, Guwahati organized an inception workshop on 'Scientific Fisheries Management of Wetlands and Reservoirs of NE Region' at Guwahati on June 20, 2012. The basic objectives of the workshop were to prepare an action plan for scientific management of selected wetlands and reservoirs of the Northeast region as well as development/ refinement of model for pig-cum-fish farming through active collaboration with allied agencies. Prof. A.P. Sharma, Dr. B.C. Jha of CIFRI, Dr. M. Sinha, Advisor to the Department of Fisheries, Govt. of Tripura, Dr. A.K. Roy, Secretary (Fisheries), Govt. of Assam were among the speakers on this occasion. It was felt that effective dissemination of CIFRI technologies/ management guidelines could bring appreciable changes in fish productivity scenario of NE region with effective collaboration among various stakeholders. Prof. Sharma requested all the stakeholders viz., state fisheries departments, AFDC, College of Fisheries, Lembucherra to bring in synergy for making effective and functional partnerships with community participation to achieve tangible results. Directors/ officials of state fisheries departments of Arunachal Pradesh, Meghalaya, Manipur, Assam and Tripura, BTC, AFDC and a few farmers were also present in the workshop.


### Consultation on Fisheries and Aquaculture of Hilsa

A national consultation was organized at

Barrackpore on Fisheries and aquaculture of Hilsa on June 27, 2012. Dr. S. Ayyappan, Director General, ICAR graced the occasion. In addition, various experts of fisheries and aquaculture like Dr. S.D. Singh, ADG (Fisheries, ICAR), Dr. J.K. Jena, Director, NBFGR, Lucknow etc made valuable contribution to the meaningful derivations of the consultation.


## ICAR Regional Committee Meeting

The XXI meeting of ICAR regional committee-II was held during 19-20 July 2012 at National Academy of Agricultural Research Management, Hyderabad. His Excellency the Governor of Andhra Pradesh, Shri E. S. L. Narasimhan was kind enough to inaugurate the meeting as Chief Guest. The meeting was attended by dignitaries Padmashree Dr. M. V. Rao, Hon'ble Member, Andhra Pradesh Legislative Council; Dr. S. Ayyappan, Secretary, DARE & Director General, ICAR; Dr. B. Meenakumari, DDG (Fishery) and nodal officer, ICAR Regional Committee-II, Members of the ICAR Governing Body and Society; Senior officers from various states; Regional Heads, Officer-in-Charge & Scientists from the ICAR regional stations/centers; representatives of NABARD, NFDB and other invitees.



Dr. S. Ayyappan, Secretary DARE and Director General, ICAR highlighted the importance of ICAR Regional Committee-II in the field of agriculture and allied sectors in the country and expressed satisfaction on the overall progress made during the last few years. He informed the house that the ICAR Region-II is playing an important role at the national level by contributing sizeably under various crops, such as rice (36%), maize (18%), pulses (13%), oilseeds (9%), fish (40%) and eggs (>35%). Issues related to agriculture and allied sectors were discussed at length, spread over three technical sessions. Other issues like infrastructure status, progress of research and the existing gaps were also discussed with steps needed to address them on priority basis. Prof. A.P. Sharma presented the action taken report on the important recommendations made during the 20th meeting held at Port Blair and also expressed his sincere desire that during the course of the meeting serious attempts would be made to identify the problems, prospects and priorities of agricultural sector in zone-II.


## Training Programme-cum-Workshop on "Fish Production Enhancement from Wetlands of Bundelkhand Region"

CIFRI, Allahabad centre conducted a training programme cum workshop on "Fish production enhancement from wetlands of Bundelkhand region" on Aug 23, 2012. A large number of participants including the officials and members of the fishers' societies operating on Jagatsagar and Dhubela wetlands in Chhatarpur district of MP participated in the programme. The participants were acquainted with the latest developments of wetland fisheries management.

## Interactive Meeting on Ganga River Basin Management Plan

A two days interactive meeting on Ganga River Basin Management Plan was organized by CIFRI, IIT Kanpur and IIT Kharagpur at CIFRI Barrackpore on Sept 03-05, 2012. Discussion focused on formulation of future research projects on biological monitoring and environmental flows in the Ganga river basin. Several presentations were made by the Director, Heads of the Division and Scientists of CIFRI on ecological status, fisheries, livelihood and institutional issues of inland fisheries resources in India. In addition, issues on environmental flows and biodiversity were discussed for future research collaboration with IITs on GRBMP.

## Meeting of Core Committee on National Plan of Action for Hilsa Fisheries

Declining hilsa catch is a serious concern in the country. Meeting of core committee on national plan of action for hilsa fisheries was held at CIFRI, Barrackpore on September 04, 2012. The meeting was chaired by Shri Tarun Sridhar, Joint Secretary, Deptt of AHD&F, Ministry of Agriculture, Govt. of India. The issues of sustainability and conservation of hilsa fisheries were discussed at length. It was felt that focus should be on scientific information, institutional action, ecosystem based management and alternative livelihood to the fishers during conservation period. Prof. A.P. Sharma, Director, CIFRI, Dr. Y.S. Yadava, BOBP, Dr. V. Raghothama Swamy, Deptt of Fisheries, Govt of A.P., Dr. Bharat Saha, Deptt of Fisheries, Govt of W.B. and Dr. Vijay Kumaran, FSI were among the other dignitaries attending the meeting.


## Institute Management Committee Meeting

The 41st Meeting of the Institute Management Committee of CIFRI was held at Barrackpore on Sept 24, 2012. The meeting was attended by the Chairman and all the10 members. At the outset the Chairman briefed the members about activities carried out by the institute in the field of research, extension, overall institute management and linkages established with other stake holders. He stressed upon the requirement for transparent and accountable governance in administration and to develop excellence in research in the institute. The Action taken report, financial achievements, purchase of spillover equipments, status report of audit paras, progress of spillover works, research activities were also presented. Overall, the committee expressed satisfaction on the achievements in all fronts.


## Workshop on Aquatic biodiversity of the river Ken

CIFRI Regional Centre, Allahabad organized a workshop on the "Aquatic biodiversity of the river Ken" on Oct 03, 2012 on completion of the NWDA's consultancy project. Engineers from National Water Development Authority, Gwalior and Lucknow; EIA Consultant, Professors from Allahabad University, Scientists from BSI, Allahabad, NGO representatives; retired scientists and staffs of CIFRI participated in the workshop.

## E-Flow Working Group Meeting

*Mahakumbh* on the confluence of river Ganga and Yamuna at Allahabad attracts millions of devotees from across the globe. The crowd need sufficient quantity of quality water for the holy dip and rituals. Besides the pilgrims' requirements, sufficient flow with desired depth and velocity is also required to sustain the aquatic life in the river. WWF-India, in collaboration with IIT Kanpur & IIT Varanasi, Peoples Science Institute, Dehradun and CIFRI, Allahabad initiated an effort to estimate environmental flow at Triveni Sangam, Allahabad during Mahakumbh 2013 to fulfil above socio-cultural and ecological needs. A Working Group Meeting was organized on November 11, 2012 in which the participants presented their views and ideas about the flow requirements for religious purpose in the Sangam area.

## Review Meeting on Catch Assessment Methodology in Inland Fisheries

One day review meeting on catch assessment methodology in inland fisheries under the Central Sector Scheme on "Strengthening of database and GIS for Fisheries Sector" was held on November 17, 2012. The meeting was attended by Dr. D. Chaudhury, DDG, DAHD&F, Dr. Sud, Head, IASRI, Dr. N. Roy NSSO, Drs. Kartikeyan, Y.P.Singh, M.K.Das, S.K. Sahu, M Naskar and State Fishery Officers from West Bengal, Sikkim, Jharkhand, Chattisgarh, Bihar, Uttar Pradesh and Meghalaya. This meeting was

held soon after the TMC meeting convened in Hyderabad to review the methodology as some states had confusion on data collection schedules. Various decisions were taken for implementation of catch methodology. The board discussed and resolved complicacies in the present survey schedule and data monitoring.

## Fishermen-Scientists Interface Meeting at Kakdwip, West Bengal

Small indigenous fish species provide valuable nutrition to the poor and vulnerable section of the society. However, they are often ignored and as a result the poor are left to their peril. A Fishermen-Scientists interface meeting as a part of the project 'Population characteristics of small indigenous fishes in coastal waters of Sundarbans in relation to rural livelihood and nutritional security' was organized at Kakdwip, West Bengal on November 23, 2012. CIFRI scientists Dr. Archana Sinha, Dr.S.K. Das, Dr. Arun Pandit, Dr. Aparna Roy and Anjana Ekka participated in the meeting. Initially the fishermen were made aware of the importance of small indigenous fishes and the need for their conservation. In addition to these, a number of issues raised by the fishermen were discussed in the meeting.


## Workshop-cum-Training Programme on CeRA

Consortium for e-Resources in Agriculture (CeRA) has been established under the NAIP for providing online access to e-journals and resources in over 120 ICAR libraries with the objective to expand the existing R & D information resource base of ICAR Institutions/Universities, etc. A workshop-cum-training programme was organized at Barrackpore on December 01, 2012. Dr. A.K. Mishra from IARI, New Delhi explained the details of CeRA. He informed that the journals of major publishers of the world like Springer, Annual Reviews, CSIRO, Elsevier, Taylor and

Francis and a number of Indian Journals are included in the CeRA database. The director also informed that most of the agriculture related journals from selected publishers are available in CeRA. At present, more than 2900 journals are accessible. Articles not availabe online in CeRA can be obtained through Document Delivery Request (DDR).

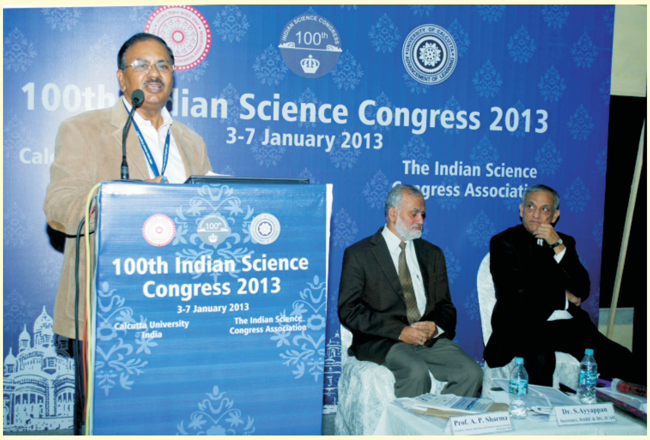
## Regional Training Workshop on Factoring Environmental Flow

The workshop on 'Factoring environmental flow in integrated water resource management' was organized at Department of Zoology and Environmental Sciences, Gurukul Kangari Vishavidhalaya, Haridwar (Uttarakhand) during December 06-11, 2012 by National Institute of Ecology, New Delhi in association with CIFRI, Barrackpore and SaciWaters, Hyderabad. The Workshop was supported by Cap-Net, Pretoria, South Africa. The workshop was attended by scientists from research organizations, engineers from hydropower projects, academicians from universities, and NGO representatives. Many renowned personnel with expertise on river flow delivered lectures on different aspects of environmental flow especially in downstream of the dam. A field tour to selected dams and barrages in Uttarakhand was performed as an on-field experience about the real issues regarding environmental flow. Dr. K.D. Joshi, Pr. Scientist, CIFRI and Dr. K.K. Vass, Ex-Director, CIFRI shared their experiences regarding different flow related issues in Indian rivers, especially Ganga.


## Quinquennial Review Team Meeting (2007-12)

The Quinquennial Review Team Meeting was convened at CIFRI, Barrackpore during February 01-02, 2013 at Barrackpore. Dr. M.V Gupta, World Food Prize Laureate is the chairman of QRT. The eminent scientific personnel like Prof. L. Kannan, Prof. U.C.

Goswami, Dr. Dilip Kumar, Dr. R.S. Biradar, Dr. N. Saringi and Dr. Sathiadhas are the other members of QRT. The committee critically reviewed all the activities and achievements of the institute. The team also expressed their satisfaction regarding the achievements of CIFRI during the year 2007-12.




## 100th Indian Science Congress

The centenary session of the Indian Science Congress was held at Calcutta University, Kolkata during the period January 03-07, 2013. Prof. A.P. Sharma, Director, CIFRI was the Sectional President of Animal, Veterinary and Fisheries sciences in the 100th Indian Science Congress. On this occasion CIFRI, Aquatic Ecosystem Health and Management Society , Canada and Inland Fisheries Society of India collectively conducted a Satellite Symposium on 'Health and Fisheries of the Major river Ecosystems of India with emphasis on river Ganga' during January 05-06, 2013. CIFRI actively participated in the Pride of India Exhibition. The exhibition stall of CIFRI was visited by DG, ICAR and other distinguished visitors. CIFRI also took part in the Public Outreach Session which was conducted by ICAR during the Indian Science Congress. The role and contribution of CIFRI in 100th Science was appreciated by the organizing Committee.


## Seminar on Water Pollution


One day National Seminar, on "Water Pollution" was jointly organized by National Environmental Science Academy, West Bengal and Central Inland Fisheries Research Institute at CIFRI, Barrackpore on January 20, 2013. Dr. Amit Krishna De, Executive Secretary, Indian Science Congress Association welcomed all the participants. Prof. N. C. Dutta, President of National Environmental Science Academy, West Bengal Chapter chaired the Seminar. Dr. M. K.

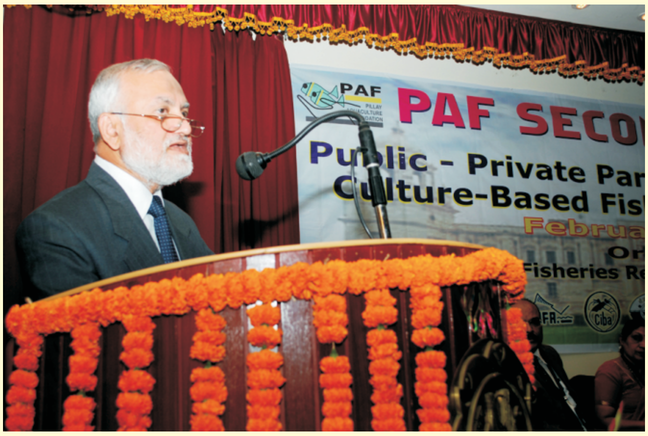
Das, Head, FREM Division, CIFRI delivered the Key Note Address on the Impact of water pollution on Fisheries. Many participants highlighted the various problems of water pollution in the seminar.

## Consultation on 'Prospect of Fish Culture in Sunderbans'

A consultation on 'Prospect of Fish Culture in Sunderbans' was jointly organised by State Government and CIFRI held at CIFRI,Barrckpore on 8th February,2013. It was chaired by Dr. S. D. Tripathi, Former Director CIFE. Eminent scientists, State personnel , fish farmers and fishers from Sundarban area and the NGO personnels also participated in that programme. A lively discussion was held during the session. This consultation meeting was notable for its valuable recommendations.


## Pillay Aquaculture Foundation Congress

II nd Pillay Aquaculture Foundation Congress was jointly organized by Pillay Aquaculture Foundation, Central Inland Fisheries Research Institute and Inland Fisheries Society of India during February 09-11, 2013 at CIFRI, Barrackpore. This congress aimed at providing an effective platform for participation of private agencies, NGOs, fishers, fish farmers, policy makers, investors, researchers and academicians on one platform to discuss and deliberate the emerging issues and opportunities in aquaculture and culture based fisheries. Honorable Minister Sri Giriraj Singh, Department of Animal Husbandry and Fishery, Govt of Bihar was the Chief guest of the programme. Dr. S Ayappan, Secretary DARE and DG ICAR delivered the presidential address in the inauguration of the congress. Several eminent personnel delivered lectures and shared their valuable thoughts on aquaculture and culture based fisheries and ever widening opportunities through PPP mode. On the occasion an exhibition was organized where eight fishery institutes, two publication houses



and two corporate houses participated. This exhibition played a pivotal role to create awareness among the fishers, fish farmers, students and others about the new developments in the field of aquaculture and culture based fisheries. Overall the II$^{nd}$ PAF congress was a successful and significant event in the field of aquaculture and culture based fisheries.

### Inspection by 2$^{nd}$ Sub-commiitee of Parliament on Official Language

Inspections of the Institute by 2$^{nd}$ Sub-committee of Parliament on Official Language were held 1$^{st}$ October 2012 at Bangalore and on 11 February 2013 at Kolkata. The meeting was presided over by Hon'ble Shri Satyavrat Chaturvedi, M.P. (Rajya Sabha) and Convener; the other honourables members present in the meetings were Dr. Prasanna Patsani, M.P. (Lok Sabha), Shri Raghunandan Sharma, M.P., Rajya Sabha. Prof. A. P. Sharma, Director, briefed the Commiitee on progress of works done in the Institute with regard to the use of Official Language. The honourable committee reviewed the progres and appreciated the works done and also recommended ways to improve further.

## Participation of scientists in Meeting, Trainging, Workshop, Symposium etc.

| Sl. No. | Name of the Meeting, Training, Workshop, Symposium etc. | Venue and date | Participant(s) |
|---|---|---|---|
| 1. | Attachment training programme of FOCARS (Phase III) | Central University of Bihar, Patna<br>February 2012 - April 2013 | S.C.S. Das |
| 2. | Attachment training programme of FOCARS (Phase III) | Manipur University<br>February - October 2012 | K. Monalisa Devi |
| 3. | National level brainstorming workshop on “Women in Fisheries” | CIFT, Kochi<br>April 4, 2012 | R. Palaniswamy |
| 4. | Brainstorming Session in Sundarbans | Pakhirala, South 24 pgs, West Bengal<br>April 8, 2012 | S.K. Das,<br>R. K. Manna,<br>A.K.sahoo,<br>C. M. Roshith |
| 5. | 9th Technical Monitoring Committee meeting of Central Sector Scheme | Hyderabad<br>April 16, 2012 | S. K. Sahu,<br>M. Karthikeyan |
| 6 | 4th Annual Review Meeting of Outreach Activities | KAB-II, Pusa, New Delhi<br>April 16, 2012 | B. P. Mohanty |
| 7. | Inaugural function of the office complex of NFDB | Hyderabad<br>April 20, 2012 | A.P. Sharma |
| 8. | Authors’ Workshop organized by CIFRI, IFSI & Aquatic Ecosystem and Health Management Society, Canada | Barrackpore<br>April 22-23, 2012 | A.P. Sharma,<br>B. K. Bhattacharjya,<br>M.A.Hassan,<br>Md.Aftabuddin,<br>R. K. Manna,<br>A. Pandit,<br>S. K. Sahu,<br>G. Chandra,<br>A. K. Sahoo,<br>D. Panda,<br>C. M. Roshith,<br>(Mrs.) S. Das,<br>Sajina A. M. |
| 9. | International Hilsa FAWG meeting under BOBLME programme | FSI, Mumbai<br>24-25th April, 2012 | M. Naskar,<br>D. Panda |
| 10. | International training on “Stock Assessment of Hilsa” sponsored by Bay of Bengal Large Marine Ecosystem (FAO) | CIFRI, Barrackpore,<br>April 30 – May 1, 2012 | A.K. Sahoo,<br>S. K. Sahu,<br>A. K. Yadav,<br>D. Sudheesan,<br>D. Panda,<br>Sajina A. M. |
| 11. | Workshop on ‘Strategic action plan for exploration and characterization of fish germplasm resources and indigenous knowledge in NE region of India” organized by NBFGR & College of Fisheries, CAU, Agartala | Agartala,<br>May 4-6, 2012 | A.P. Sharma<br>B. K. Bhattachrjya |

| Sl. No. | Name of the Meeting, Training, Workshop, Symposium etc. | Venue and date | Participant(s) |
|---|---|---|---|
| 12. | QRT meeting of ICAR Research Complex for Eastern Region | NBSSLUP, Salt lake, May 4, 2012 | A. Sinha |
| 13. | World Congress on Biotechnology - 2012 | Hyderabad<br>4-6 May, 2012 | B. P. Mohanty |
| 14. | Ten days workshop on Expert consultation on Hilsa | CIFRI, Barrackpore<br>28 May- 6 June, 2012 | V.R. Suresh,<br>R. K. Manna,<br>B.K. Behera,<br>D. Panda,<br>Sajina A. M.,<br>(Mrs.) S. Das,<br>D. Sudheesan |
| 15. | Workshop on 'Strategic action plan for exploration and characterization of fish germplasm resources and indigenous knowledge in NE region of India" organized by NBFGR, Lucknow & College of Fisheries, CAU, Agartala | Agartala<br>May 5-6, 2012 | B. K. Bhattacharjya |
| 16. | Reservoir fisheries development meeting with States and NFDB | Ranchi<br>May 9-10, 2012 | A.P. Sharma |
| 17. | Brainstorming Session on "Water use potential of flood affected & drought prone areas of Eastern India" | ICAR Research Complex, Patna<br>May 14, 2012 | A.P. Sharma |
| 18. | Review meeting on project proposal on hilsa under NFBSFARA | Krishi Bhavan, New Delhi<br>May 14, 2012 | R. K. Manna |
| 19. | Attachment training programme of FOCARS (Phase III) | CMFRI, Cochin<br>June 8 –Sept. 8, 2012 | Sandhya K. M. |
| 20. | Annual workshop of National Initiative on Climate Resilient Agriculture organized by CRIDA | Hyderabad<br>June 12 – 14, 2012 | M.K Das,<br>S. K. Sahu,<br>M. Naskar |
| 21. | XXIII meeting of ICAR regional Committee No.VIII Coimbatore | Coimbatore,<br>June 15-16, 2012 | R. Palanisamy |
| 22. | Management Committee Meeting with Hon'ble Chief Minister of Odisha | CDA, Bhubaneswar<br>June 17-18, 2012 | A.P. Sharma |
| 23. | National workshop on "Jayanti rohu and minor carps: exploring the possibilities to enhance fish production in Northeastern India" organized by CIFA | CIFRI, Guwahati<br>June 19, 2012 | B. K. Bhattacharjya,<br>S.C.S. Das,<br>D. Debnath,<br>A. K. Yadav,<br>S. Yengkokpam |
| 24. | Selection Committee Meeting of Indira Gandhi Krishi Vishwavidyalaya | Indira Gandhi Krishi Vishwavidyalaya<br>June 21, 2012 | A.P. Sharma |
| 25. | Brain storming session on post harvest losses of fish | CIFT, Kochi<br>June 22, 2012 | A. Pandit,<br>D.K. Meena |

| Sl. No. | Name of the Meeting, Training, Workshop, Symposium etc. | Venue and date | Participant(s) |
|---|---|---|---|
| 26. | 22nd Board Meeting of West Bengal Biodiversity Board, Department of Environment, Government of West Bengal. | Kolkata<br>June 22, 2012 | A. Sinha |
| 27. | NNRMS Standing Committee meeting | New Delhi<br>June 25, 2012 | S. K. Sahu |
| 28. | Official Research Meeting | University of Mumbai<br>June 30, 2012 | A.P. Sharma |
| 29. | *Rastriya Sangosthi* on *Paryavaran* at Vigyan Parishad, Prayag | Allahabad<br>July 05, 2012 | M. A. Alam |
| 30. | Training Programme on "Technology initiative for sustainable brackish water Aquaculture" | Kakdwip Research Centre, CIBA<br>July 7, 2012 | A. Sinha |
| 31. | Scientist Advisory Committee meeting at Anand Agricultural University | Anand<br>July 07, 2012 | S. N. Singh |
| 32. | International Conference on Trends in Knowledge and Information Dynamics (ICTK-2012) | Bangalore<br>July 10-13, 2012 | P. Panikkar |
| 33. | Interactive workshop of scientists of AEHMS and CIFRI on 'Major Rivers of India' | Barrackpore<br>July 14, 2012 | Md. Aftabuddin,<br>A.K.Sahoo,<br>S.K.Sahu,<br>G. Chandra,<br>M. Naskar,<br>D. Sudheesan,<br>C. M. Roshith |
| 34. | Meeting organized by World Aquaculture Society | Chennai<br>July 21, 2012 | K. D. Joshi |
| 35. | Brainstorming Workshop on Developing protocols for monitoring health of river and its water bodies in the Ganga basin by Ganga River Basin Management | IIT Kanpur,<br>July 24, 2012 | K. D. Joshi |
| 36. | Transboundary policy dialogue on hilsa fisheries management ecosystems for life: A Bangladesh – India initiative organized by IUCN in collaboration with CIFRI, Barrackpore | Salt Lake, Kolkata<br>July 24, 2012 | U. Bhaumik,<br>R. K. Manna |
| 37. | Consultation on 'Methodology of valuation of goods and services of natural resources' held at Kerala Agricultural University | KAU, Thrissur<br>July 24-25, 2012 | A. Ekka,<br>A. Pandit |
| 38. | Brainstorming session on "Flood mitigation strategies" organized by AAU, Jorhat, Assam | Jorhat<br>July 25, 2012 | S.C.S. Das |
| 39. | CIFA workshop | Anand<br>July 25-27, 2012 | A.P. Sharma |

| Sl. No. | Name of the Meeting, Training, Workshop, Symposium etc. | Venue and date | Participant(s) |
|---|---|---|---|
| 40. | Meeting with Mr. Tarun Sreedhar, Joint Secretary, Ministry of Agriculture, Govt. of India to discuss about different aspects of hilsa fisheries in India with special emphasis on its sustainable fisheries and conservation | Salt Lake, Kolkata July 26, 2012 | U. Bhaumik, R. K. Manna |
| 41. | 'Research methodology and biostatistics' organised by Project Directorate on Animal Disease Monitoring and Surveillance | PD-ADMAS, Bangalore July28, 2012 | P. Panikkar |
| 42. | Meeting (SWOT analysis) at state Fisheries Department to develop fisheries development plan of Uttar Pradesh state | Lucknow August 01, 2012 | K. D. Joshi |
| 43. | Brainstorming Session on Fisheries | NASC, New Delhi August 02-05, 2012 | A.P. Sharma |
| 44. | Meeting on Ganga River Basin Management | IIT Kanpur August 02-05, 2012 | A.P. Sharma |
| 45. | Meeting organized by Ganga River Basin Management Plan group of IIT Kanpur on Development of Protocols for monitoring of health of river Ganga and its water bodies | IIT, Kanpur August 04, 2012 | K. D. Joshi |
| 46. | Meeting with Director and Joint Director of Fisheries (Inland), Govt. of Karnataka on Cage Culture under NMPS at Krishnarajasagar Reservoir | Bangalore August 05-06, 2012 | M. Karthikeyan, P. Pannikar |
| 47. | 'International Conference, Biodiversity Asia 2012 - science, policy and governance' organized by Society for Conservation Biology-Asia Section, (SCB-Asia), Ashoka Trust for Research in Ecology and the Environment (ATREE), Indian Institute of Science | IISc, Bangalore August 7-10, 2012 | P. Panikkar |
| 48. | Strategic Workshop on "Sustainable Aquaculture Development and Conservation of Fish Genetic Resources in Uttar Pradesh during XII Plan | NBFGR, Lucknow August 18, 2012 | A.P. Sharma |
| 49. | Knowledge meet organized by ICAR | New Delhi August 20-23, 2012 | A.P. Sharma |
| 50. | RFD Nodal officer meeting of fisheries division | CIBA, Chennai August 24-25, 2012 | S. K. Sahu |
| 51. | State level workshop on "Strategy for harnessing fish production potentialities in flood affected areas of Assam" | Jorhat August 30-31, 2012 | B. K. Bhattacharjya |
| 52. | Project proposal meeting | CIFRI Kolkata centre August 31, 2012 | A. Sinha, S.K. Das |

| Sl. No. | Name of the Meeting, Training, Workshop, Symposium etc. | Venue and date | Participant(s) |
|---|---|---|---|
| 53. | Golden Jubilee Seminar on "Advances in Agricultural Research towards Food Security and Environmental Sustenances" | Visva Bharati Santiniketan Sept 1-2, 2012 | A.P. Sharma |
| 54. | Review meeting on sample survey of Punjab at Department of Fisheries | Chandigarh Sept. 3, 2012 | S. K. Sahu, D.N. Jha |
| 55. | Interactive Meeting on 'Ganga River Basin Management Plan' Jointly by IIT, Kanpur and CIFRI, Barrackpore | Barrackpore Sept. 03-05, 2012 | Md. Aftabuddin, R. K. Manna, A. K. Sahoo, C. M. Roshith, (Mrs.) S. Das |
| 56. | Meeting on " Status of Hilsa fisheries in India and National Plan of Action (NPoA) for its Conservation and Sustainable Development" | New Delhi Sept. 4, 2012 | U. Bhaumik, S. N. Singh, V.R.Suresh, G. Chandra |
| 57. | Meeting on Core Committee on National Plan of Action for Hilsa fisheries | CIFRI, Barrackpore September 04, 2012 | U. Bhaumik, V.R. Suresh, G. Chandra |
| 58. | Consultative workshop, organized by CIFA | Shillong September 11, 2012 | B. K. Bhattacharjya |
| 59. | Workshop on "Aviral and Nirmal Ganga: Environmental Flows, River Health, Legal and Institutional Aspects" | IIT, Kanpur Sept. 11-13, 2012 | A.K. Sahoo |
| 60. | National River Ganga Basin Management Programme meeting with consortium of 7 IITs | IIT, Kanpur September 12, 2012 | A.P. Sharma |
| 61. | National seminar in Hindi on 'Science for shaping the future of India' | Indian Science Congress Association, Kolkata Sept. 18, 2012 | S. K. Sahu Sajina A. M. D. Sudheesan |
| 62. | Meeting on presence of ethoxyquin in shrimp | Directorate of Fisheries, Govt. of West Bengal at Kolkata Sept. 13, 2012. | S.K. Nag, S.K. Manna |
| 63. | Meeting at ISRO office in connection with Parliamentary Committee Visit | Sept. 13, Sept. 21, 2012 | M. F. Khan, P. Panikkar |
| 64. | Workshop on e -Waste Management | Paribesh Bhawan, Kolkata Sept. 19, 2012 | S.K. Nag, K. Karunakaran |
| 65. | Short term course on World trade agreement and Indian fisheries paradigm: a policy outlook | CMFRI, Cochin Sept. 17-26, 2012 | A. Ekka |
| 66. | Fisheries Programme | RAU, Samastipur Sept 22-24, 2012 | A.P. Sharma |
| 67. | Hindi workshop organized by DARE New Delhi | Umiam Sept. 24-25, 2012 | S.N. Goswami, A. K. Yadav |
| 68. | Entrepreneurs' Meet organized by NIRJAFT | Kolkata, September 25, 2012 | A. Sinha |

| Sl. No. | Name of the Meeting, Training, Workshop, Symposium etc. | Venue and date | Participant(s) |
|---|---|---|---|
| 69. | Workshop on Mapping of small water bodies using high resolution images" at Department of Fisheries | Lucknow<br>Oct. 03 , 2012 | S. K. Sahu |
| 70. | 3rd Consortium Advisory Committee (CAC) Meeting, NFBSFARA Project No. AS: 2001 | University of Delhi<br>Oct 3, 2012 | B. P. Mohanty |
| 71. | Seminar on "Ensuring survival of Gangetic dolphin, our national aquatic animal in its natural habitat" conducted by WWF-India | Middleton Chambers, Kolkata<br>Oct. 08, 2012 | U. Bhaumik,<br>R. K. Manna |
| 72. | Review workshop on "Sustainable utilization of mountain fisheries resources: a partnership mode" | CIFRI, Guwahati<br>Oct. 08, 2012 | B. K. Bhattacharjya,<br>S.C.S. Das,<br>D. Debnath,<br>A. K. Yadav,<br>S. Yengkokpam |
| 73. | Meeting on Formulating Training Programmes, Organised by NFDB | Hyderabad<br>Oct. 9, 2012 | M. Feroz Khan |
| 74. | Seminar on "Empowerment of young folk," organised by E Aqua Agro R.M.C.M.S.S.Ltd, | Barrackpore<br>October 18, 2012 | M. K. Bandyopadhyay |
| 75. | Workshop on Management Planning of Chilika | Bhubaneswar, Odisha<br>October 20, 2012 | A.P. Sharma |
| 76. | Mass awareness programme and demonstration of cage culture at Pookote lake in Wayanad District | Wayanad, Kerala<br>Nov. 1, 2012 | P. Panikkar |
| 77. | National Symposium on "Sustainable production of forages from arable and non-arable land and its utilization" organised by Range Management Society of India and Indian Grassland & Fodder Research Institute | IGFRI, Jhansi<br>November 2-3, 2012 | S.K. Nag |
| 78. | Seminar on Mountain Fisheries: Challenges and Opportunity for Livelihood Security | Bhimtal<br>November 5-6, 2012 | A.P. Sharma |
| 79. | LAKE 2012: National Conference on Conservation and Management of Wetland Ecosystems | M.G. University, Kerala<br>Nov. 6 -9, 2012 | P. Panikkar |
| 80. | 23rd Board Meeting of West Bengal Biodiversity Board, Department of Environment, Government of West Bengal. | Kolkata<br>Nov. 8, 2012 | A. Sinha |
| 81. | 81st Annual Meeting and Conference of Society of Biological Chemists, India (SBC-I), organized by the University of Kolkata | Science City, Kolkata<br>Nov. 8-11, 2012 | B. P. Mohanty |
| 82. | ICAR Regional Committee held by CAZRI, Jodhpur. | New Delhi<br>Nov. 16 -17, 2012 | S. N. Singh |

| Sl. No. | Name of the Meeting, Training, Workshop, Symposium etc. | Venue and date | Participant(s) |
|---|---|---|---|
| 83. | 72 nd Annual Conference of Indian Society of Agricultural Economics | BHU, Varanasi<br>Nov. 17-19, 2012 | A. Ekka,<br>P. K. Katiha,<br>A. Pandit,<br>R. S. Srivastava |
| 84. | Meeting with Hon'ble Minister of Fisheries, Govt. of West Bengal | Kolkata<br>Nov. 20, 2012 | U. Bhaumik |
| 85. | National symposium on "Wetland 2012" | Silchar<br>Nov. 21-23, 2012. | B. K. Bhattacharjya,<br>D. Debnath |
| 86. | Workshop on "Prioritization of research and education for fisheries development in North East" organized by CIFE, in association with Assam Agricultural University | Jorhat<br>November 26-27, 2012 | B. K. Bhattacharjya |
| 87. | Workshop on Consortium of e-Resources in Agriculture (CERA) | CIFRI, Barrackpore<br>Dec. 01, 2012 | All Scientists of CIFRI Headquarter |
| 88. | Meeting organized by World Aquaculture Society | Mangalore<br>Dec. 03, 2012 | M. Feroz Khan |
| 89. | Global Symposium on Aquatic Resources for Eradicating Hunger and Malnutrition-Opportunities and Challenges, organized by AFSIB | Mangalore<br>Dec. 03-06, 2012 | A.P. Sharma,<br>B. K. Singh,<br>B. K. Bhattacharjya,<br>D.S.K.Rao,<br>P.K. Katiha,<br>B. P. Mohanty,<br>M. Feroz Khan,<br>S.K. Manna,<br>Md. Aftabuddin,<br>B.K. Behera,<br>P. Panikkar,<br>S. K. Sahu,<br>G. Chandra,<br>D. Debnath,<br>C. M. Roshith,<br>A. K. Sahoo |
| 90. | Review Meeting of AICRPs, Network Projects and Outreach Activities under ICAR convened by DG, ICAR | NBPGR, New Delhi<br>Dec. 4-5, 2012 | B. P. Mohanty |
| 91. | Regional Training Workshop on Factoring Environmental Flow in Integrated Water Resource Management | Gurukul Kangri Vishavidhalaya, Haridwar<br>Dec. 06-11, 2012 | R. K. Manna,<br>A.K. Sahoo<br>(Mrs.) S. Das,<br>D. N. Jha |
| 92. | National Hindi seminar on "Traditional aqua farming system" | Kakdwip Research Centre, CIBA<br>Dec. 11–12 2012 | M. K. Bandyopadhyay |
| 93. | Meeting with officers of Fisheries Department, Govt. of Karnataka on Cage Culture under NMPS | Mysore<br>Dec. 14, 2012 | M. Karthikeyan,<br>D. S. K. Rao |
| 94. | Mass Awareness Programme on 'Conservation and Propagation of | Kodagu, Karnataka<br>Dec. 15, 2012 | P. Panikkar |

| Sl. No. | Name of the Meeting, Training, Workshop, Symposium etc. | Venue and date | Participant(s) |
|---|---|---|---|
| 95. | Seminar-cum-workshop on "Identification of innovative approaches in value-addition to fisheries products," organized by Tuskegee University, USA and College of Fisheries, AAU, Raha | AAU, Guwahati Dec. 17, 2012. | B. K. Bhattacharjya |
| 96. | Satellite Symposium on 'Health and fisheries of major river ecosystems of India with emphasis on River Ganga' | Kolkata January 05-06, 2013 | Md. Aftabuddin, U. Bhaumik, G. Chandra, R. K. Manna, C. M. Roshith, A. Roy, S. K. Manna S. K. Sahu, A.K. Sahoo, Malay Naskar, A. Sinha, S. K. Das , B. P. Mohanty , Sajina A. M. |
| 97. | 100 th Indian Science Congress, organized by University of Kolkata & Indian Science Congress Association | Kolkata January 03-07, 2013 | Md. Aftabuddin, M. A. Alam, M. K. Bandyopadhyay, B.K. Behera, B. K. Bhattacharjya, U. Bhaumik, G. Chandra, A.K. Das, M. K. Das, (Mrs) S. Das, S.C.S.Das, A. Ekka, M. A. Hassan, D. N. Jha, B. C Jha, K. D. Joshi, M. Karthikeyan, D. Karunakaran, P. K Katiha, M. F. Khan, R. K. Manna, S. K. Manna, P. Maurye, D. K. Meena, S. S Mishra, B. P. Mohanty, S. K. Nag, M. Naskar, D. Panda, A. Pandit, A. Roy, Sajina A. M, K. M. Sandhya, S. K. Sahu, S. Samanta, A. Sinha, D. Sudheesan, B. B. Satpathy, B. K. Singh, S. N. Singh, V. R. Suresh, A.K.Sahoo, D.S.K.Rao |

| Sl. No. | Name of the Meeting, Training, Workshop, Symposium etc. | Venue and date | Participant(s) |
|---|---|---|---|
| 98. | Rastriya Sanghosti on भारत के पूर्वी एवं पूर्वोत्तर राज्यों में प्रौद्योगिकी के माध्यम से नील क्रांति '(Bharat ke Purvi evum Purvottar rajyo mein pradhogiki ke madhyam se nil kranti)' | CIFE regional centre, Kolkata January 04-05, 2013 | A.P. Sharma, G. Chandra |
| 99. | Seminar on "*Agribusiness potentiality of West Bengal,"* organised by West Bengal State Marketing Board | Kolkata January 08-09, 2013 | M. K. Bandyopadhyay |
| 100. | International Conference on 'Increasing agricultural productivity and sustainability in India: the future we want,' organized by the National Institute of Advanced Studies, Bangalore and M. S. Swaminathan Research Foundation, Chennai | NIAS, Bangalore January 8- 9, 2013 | P. Panikkar |
| 101. | Chemists Conclave | IARI, New Delhi January 14-15, 2013 | S.K. Nag, S. Samanta, A.K. Das, R.K. Manna |
| 102. | West Bengal Aquaculture GIS Workshop | Vidyasagar University January 17-19, 2013 | A.P. Sharma |
| 103. | National Seminar of National environmental Science Academy on "Water Pollution" | CIFRI, Barrackpore January 20, 2013 | B.K. Behera, A.K. Sahoo, G. Chandra, K. M. Sandhya |
| 104. . | International Symposium on "Genomics in Aquaculture organized by CIFA" | Bhubaneswar January, 22-23 2013 | B.K. Behera, |
| 105. | Seminar on "Effect of climate change on livestock and fish production", organized by Seva Bharati Krishi Vigyan Kendra, Kapgari | Midnapore, W.B. January 23, 2013 | M. K. Bandyopadhyay |
| 106. | Multi-stakeholder consultation towards developing a joint methodology to determine the environmental flows for the Sundarban | Jadavpur University, Kolkata January 25, 2013 | A.K. Sahoo |

| Sl. No. | Name of the Meeting, Training, Workshop, Symposium etc. | Venue and date | Participant(s) |
|---|---|---|---|
| 107. | Nodal Officers meeting of the NAIP project on "Establishment of National Agricultural Bioinformatics Grid in ICAR (NABG)" | NBFGR, Lucknow<br>January 29, 2012 | B.K. Behera |
| 108. | 10 th Technical Monitoring Committee meeting of CSS | Bhubaneswar<br>January 31,2013 | S.K. Sahu,<br>M. Naskar,<br>M. Kartikeyan |
| 109. | Consultation Meeting on "Prospects of Fish Culture in Sundarbans" | CIFRI, Barrackpore<br>February 08, 2013 | A. Sinha,<br>U. Bhaumik,<br>A.K. Sahoo,<br>S.K. Das,<br>K. M. Sandhya,<br>D. Sudheesan,<br>(Mrs.) S. Das,<br>Sajina A. M. |
| 110. | Pillay Aquaculture Foundation (PAF) Congress on Public Private Partnership in Aquaculture and Culture-based Fisheries jointly organized by Pillay Aquaculture Foundation, CIFRI and Inland Fisheries Society of India. | CIFRI, Barrackpore<br>February 09-11, 2013 | Aftabuddin,<br>M. K. Bandyopadhyay,<br>B.K. Behera,<br>U. Bhaumik,<br>G. Chandra,<br>A.K. Das,<br>M. K Das,<br>(Mrs) S. Das,<br>A. Ekka,<br>M. A. Hassan,<br>B. C Jha,<br>M. Karthikeyan,<br>D. Karunakaran,<br>P. K Katiha,<br>M. F. Khan,<br>R. K. Manna,<br>S. K. Manna,<br>P. Maurye,<br>D. K. Meena,<br>B. P. Mohanty,<br>S. K. Nag,<br>M. Naskar,<br>D. Panda,<br>A. Pandit,<br>A. Roy,<br>A. K. Sahoo,<br>Sajina A. M,<br>K. M. Sandhya,<br>S. K. Sahu,<br>S. Samanta,<br>A. Sinha,<br>D. Sudheesan,<br>B. B. Satpathy,<br>B. K. Singh,<br>S. N. Singh,<br>V. R. Suresh,<br>C. M. Roshith |

| Sl. No. | Name of the Meeting, Training, Workshop, Symposium etc. | Venue and date | Participant(s) |
|---|---|---|---|
| 111. | NIAS-DST course on "Future Challenges to Society with thematic of Resources and Development" for Scientists and Technologists at the National Institute of Advanced Studies | Bangalore<br>February 11-15, 2013 | P. Panikkar |
| 112. | First Advisory meeting of the NFBSFARA Project on "Stock characterization, captive breeding, seed production and culture of Hilsa (*Tennulosa ilisha*)" | Krishi Bhavan, New Delhi<br>February 14, 2013 | A.P. Sharma,<br>V. R. Suresh<br>R. K. Manna |
| 113. | Diversification and integration possibilities in inland aquaculture practices | Research Centre of CIFRI, Bangalore<br>February 18-22, 2013 | P. Panikkar |
| 114. | 15th Indian Agricultural Scientists & Farmers Congress on Agriculture and Global Climate Change," organized by Bioved Research Institute of Agriculture & Technology | Allahabad<br>February 22-24, 2013. | M. A. Alam,<br>S.C.S. Das,<br>D. N. Jha,<br>K. D. Joshi,<br>S. S Mishra,<br>B. K. Singh |
| 115. | Training programme on "Basics of Hydroelectric projects" | National Water Academy, Pune<br>February 25- March 01, 2013 | A.K. Sahoo |
| 116. | National Workshop on Foresight and future pathways of agricultural research through youth in India, organized by ICAR | New Delhi<br>March 01-02, 2013 | C. M. Roshith |
| 117. | Meeting on progress and issues of CIFRI-CDA-ICZM project | Chilika, Orrisa<br>March 02, 2013 | A. P. Sharma,<br>V. R. Suresh,<br>R. K. Manna |
| 118. | Workshop on Innovative Practices in Fisheries organized by Centre for Innovations in Public Systems, Hyderabad. | Shillong, Meghalaya<br>March12, 2013 | M. A. Hassan,<br>B. K. Behera,<br>Sajina A. M. |
| 119. | Workshop on, "Development of inland fisheries and aquaculture in the state of Meghalaya" | Shillong<br>March 12-13, 2013 | B.K. Behera |
| 120. | Workshop on 'West Bengal aquaculture and GIS' | Vidya sagar University, Medinipur, W.B.<br>March 17-18, 2013 | A.P. Sharma,<br>S. K. Sahu |
| 121. | Agri Business camp organized by Zonal Technology Management Unit, NIRJAFT, Kolkata | West Bengal National Chambers of Commerce and Industry,<br>March 18, 2013 | R. K. Manna |

| Sl. No. | Name of the Meeting, Training, Workshop, Symposium etc. | Venue and date | Participant(s) |
|---|---|---|---|
| 122. | Seminar on “Advancement in biological sciences” | Panskura Banamali College, W.B. March 23, 2013 | B.K. Behera |
| 123. | Meeting With officers of Fisheries Department, Govt. of Karnataka and QR Team | Mysore March 1, 2013 | M. Feroz Khan, M. Karthikeyan, D. S. Krishna Rao, Preetha Panikkar |
| 124. | Meeting with Cooperative Fisheries Society of Manchanabele and QR Team | Manchanabele March 3, 2013 | M. Feroz Khan, M. Karthikeyan, D. S. Krishna Rao, Preetha Panikkar |

# Events

## Golden Jubilee of CIFRI Bangalore Research Centre


The CIFRI Research Centre, Bangalore celebrated its Golden Jubilee on April 14, 2012 with great enthusiasm and fanfare. Dr. S. Ayyappan, Secretary DARE and DG ICAR, Dr. B. Meenakumari, Deputy Director General (Fy), Prof. A.P. Sharma, Director, CIFRI, Dr. C. Vasudevappa, Chief Executive of NFDB, Ms. V. Manjula, Principal Secretary, Department of Animal Husbandry and Fisheries, Karnataka, Ms. C.A. Latha, Director of Fisheries, Kerala, Dr. A.S. Sidhu, Director, IIHR, Dr. P. Jayasankar, Director, CIFA, Dr. K.V. Devaraj, Former Vice–Chancellor, UAS, Bangalore, Dr. P.S.B.R. James, Former Director, CMFRI, Former Directors of CIFRI like Dr. S.P. Ayyar, Dr. M.R. Sinha and Dr. K.K. Vaas, and Dr. D.S. Krishna Rao, Head of Bangalore Centre were among the dignitaries in the function. They shared their experiences in reservoir fisheries researches. In his presidential address Dr. Ayyappan reiterated that during twelfth plan the focus is on natural resource management and efforts have to be intensified to increase fish production from reservoirs on a sustainable basis. An interactive session on 'Reservoir Fisheries Development and Aquaculture - Issues and Challenges' was organised by CIFRI and CIFA. A number of publications related to the centre were released on the occasion including Golden Jubilee logo, profile of this Research Centre, the Centre's - Past, Present and Future, Souvenir and Bibliography of Publications of Research Centre.

## Sundarban Day


Sundarban Day was celebrated at CIFRI HQ at Barrackpore on June 03, 2012 to commemorate the birthday of Sir William Roxburgh, the Botanist par excellence who worked extensively on Sundarbans biodiversity. A brainstorming Session on "Sundarbans: Issues and Threats" was organized on this occasion. Distinguished Scientists Dr. Amalesh Choudhury, Prof C.S.

Chakraborty, Vice Chancellor, WBUAFS and Dr P Das, Ex-Director, NBFGR, Dr AK Ghosh, Ex-Director, ZSI, Dr SN Biswas, Deputy Director, State Fisheries Dept., Dr. Anindya S. Ghosh, Sunderban Development Board, Dr. Dipankar Saha, NGO, Dr. S.D. Ghosh, Entrepreneur, Dr. B.K. Bandyopadhyay and Dr. Dhiman Burman, CSSRI, Dr. Chand, WBUAFS and several other NGO members and scientists from different organizations like CIFA, CIFRI etc were present on the occasion. Several new records of fishes in recent studies were reported by CIFRI. However, participants expressed concerns about the loss of mangroves in increased salinity scenario, loss of biodiversity, decline of daily income of Sunderban people and migration. Co-ordinated approach was emphasized with involvement of different stakeholders for adopting farming System Model and diversification of agriculture for wholesome development of Sunderbans. “CIFRI Compendium on Sundarbans-Retrospect and Prospects” was released on the occasion.


### Launching of Mobile Research Laboratory under NICRA Project

A Mobile Research Laboratory was launched under the NICRA project by Dr. S. Ayyappan, Hon'ble Secretary (DARE) & DG (ICAR) on June 27, 2012. The state of the art laboratory facility is equipped with essential equipments and facilities like water storage and purifier, long life battery and UPS, generator, fridge, incubator, centrifuge, weighing balance, multiparameter water analyser, UV-Vis spectrophotometer, water and sediment sampler etc. to carry out field research for prolonged period. It will enable scientists to conduct essential tests in field and provide facility for proper storage and analysis of research samples. Prof. A.P. Sharma, Director, CIFRI, Dr. Samir Bhattachariya, INSA Professor, Vishwa Bharati, Kolkata, Prof. Amlesh Choudhary, Dr. M.K. Das, Principal Investigator of the project and scientists of CIFRI were present on the occasion. The DG (ICAR) also inaugurated the biochemistry lab on the same day. He interacted with the Institute scientists and encouraged them to do quality research to compete with the rest in the world.

## National Fish Farmers' Day

National Fish Farmers Day is being celebrated every year to mark the occasion of the first success of induced breeding technique in India by Dr. Hiralal Choudhary in the year 1957. This was one of the remarkable milestones in the annals of Indian fisheries, which created revolution in aquaculture and subsequently the country witnessed blue revolution. Like every year the day was celebrated at CIFRI on 10 July 2012. Honourable Minister for Fisheries, Aquaculture, Aquatic Resources and Fisheries Harbour. Govt. of West Bengal, Shri Subrata Saha graced the occasion as chief guest. Eight fish farmers from West Bengal, Bihar and Jharkhand were awarded certificates of merit for their outstanding contribution in inland fisheries development of the country.


## ICAR Foundation Day

The Indian Council of Agricultural Research (ICAR) was established on 16 July 1929. With 97 ICAR institutes and 47 agricultural universities, this is the largest national agricultural research systems in the world. The ICAR has played a pioneering role in ushering Green Revolution and subsequent developments in agriculture in India making the nation food and nutritionally secure. It has played a major role in promoting excellence in higher education in agriculture. Like every year CIFRI celebrated ICAR foundation day on July 16. Prof. Amalesh Choudhury, retired professor, Calcutta university, Dr. C.K. mukherjee, Professor, IIT Kharagpur, Prof. A. P. Sharma, Director, CIFRI, Head of Divisions, Scientists and other staff members of CIFRI and CIFRI retired Scientists attended the programme. Prof. Amalesh Choudhury delivered the foundation day lecture. On the occasion the dignitaries distributed prizes to the winners of various competitions. In his speech Prof. Sharma remembered the contributions of ICAR to the nation and inspired the staffs to work to their fullest potential.


## Independence Day

Following the tradition CIFRI celebrated the Independence Day with great zeal and enthusiasm on August 15, 2012. Prof. A.P. Sharma, Director of the Institute hoisted the tri-colour and paid rich tribute to patriotic leaders for nation building. He recounted the notable achievements of CIFRI. He urged the staff to work hard with dignity. Prof. Sharma gave a motivational speech to work meticulously and give 100% efforts to contribute towards development of fisheries sector. All the CIFRI staff and members of their family were present on the occasion. The staffs enjoyed the cultural programme in the auditorium of the institute.


## Hindi Week

The Institute observed 'Hindi *Saptah'* during Sept 14-20, 2012. During this week a number of Hindi competitions like N*ibandh lekhan, Tippany lekhan, Shabdawali, Viyakhyan*, Hindi *Patra lekhan*, Quiz etc were conducted. A large number of staff and their family members participated in these competitions and won prizes. It was urged to use more and more Hindi in the office.


## Vigilance Awareness Week

CIFRI observed 'Vigilance Awareness Week' during the period October 29-November 03, 2012. Vigilance Awareness week started with the pledge taking ceremony by all the employees of the Institute. The pledge is aimed at sensitizing and educating the public servants about the dangers of corruption. During the week different competitions related to evils of corruptions were organized. On the concluding day Shri Shankar Kumar Dutta Gupta, Ex-DAG, CAG of India was the Chief Guest. He mentioned that the theme of this year 'Transparency in Public Procurement' is extremely important as the public procurement is a vulnerable source of corruption. His lecture was inspiring and thought provoking where he urged public officials to work with sincerity and integrity in performing public duties without fear or favour.


## World Fishery Day

World Fishery Day was celebrated with much fanfare and enthusiasm both at headquarters and Allahabad

Regional Centre on Nov 21, 2012. A workshop entitled “Nadiyon Mein Videshee Matsya Prajatiyon Ka Atikraman: Karan Evam Nivaran” was organised at Allahabad to mark the occasion to promote fishery fraternity and sensitize the stakeholders on alarming issue of rapid invasion of exotic fishes in major river systems including the river Ganga. More than 120 participants including fishermen and fish traders from Sadiyapur, Daraganj, Mehdauri, progressive fish farmers, retired and serving scientists of CIFRI, representatives of the state fisheries department, representatives of All India Radio, Allahabad, NGO's and students actively participated in the World Fishery Day programme. The participants in general and fishers and fish farmers in particular appreciated the efforts of CIFRI espousing the cause of fisheries development in celebrating World Fishery Day.


## Republic Day

CIFRI celebrated the Republic Day with great enthusiasm on January 26, 2013. Prof. A.P. Sharma, Director of the institute hoisted the tri-colour and paid tribute to the nation. Prof. Sharma delivered a motivational speech to the staff members. All the CIFRI staff and members of the family were present in the occasion.

## Exhibition organized by CIFRI on the occasion of 2nd PAF Congress

On the occasion of the PAF IInd Congress, the institute organized an exhibition during 9th to 11th February, 2013. Eight fishery institutes, two publication houses and two Corporate Houses participated in the exhibition. The exhibition was inaugurated by Sri Giriraj Singh, Honorable Minister for Animal Husbandry and Fisheries, Govt. of Bihar. Dr. S. Ayappan Secretary DARE and DG ICAR and DDG (Fy) Dr. B. Meenakumari visited the stall along with other distinguished personnels. This exhibition played a pivotal role to create awareness among the fishers, fish farmers, students and others about the new developments in the field of aquaculture and culture based fisheries.


## International Women's Day

CIFRI celebrated International Women's Day on

March 08, 2013. Bramhakumari Devi was the Chief guest of the programme. A cultural programme was also organized followed by the deliberation of the Chief Guest and Director, CIFRI. The CIFRI family celebrated the day with full enthusiasm. The staff members enjoyed the cultural programme in the auditorium of the institute.


## CIFRI Foundation Day

Central Inland Fisheries Research Institute, Barrackpore celebrated its 67th Foundation Day on March 17, 2013. Prof. Vinod Tare, IIT, Kanpur and Leader, Consortium of Seven IITs graced this occasion as Chief Guest. In Foundation Day lecture, Prof. Tare expressed concern over the status of the water bodies and cautioned that the water bodies in India are shrinking and getting polluted. He emphasized upon the need of applying modern science and new technologies coupled with traditional wisdom. Dr. K. K. Satapathy, Director of National Institute of Research on Jute and Allied Fibre Technology, Kolkata and Dr. B.S. Mohapatra, Director of Central Research Institute on Jute and Allied Fibre, Barrackpore were the guests of honour. Prof. A.P. Sharma, Director, CIFRI welcomed the dignitaries and gave a brief account of the institute technologies, activities, outreach programmes and researchable issues for the upcoming years. He informed that CIFRI developed several technologies for the sustainable management of the open water bodies. The meritorious children of the CIFRI staff members were also felicitated on this occasion. A cultural programme by the CIFRI staff was organized.

## Tribal Sub Plan (TSP)

Tribal Sub-Plan (TSP) strategy was started during the 5th Five Year Plan with the objective of integrated development of the tribal areas and the communities. In a fast developing world, tribal community required specific attention, not only in monetary terms but also with special interventions to ensure their rapid socioeconomic development. In the year 2012-13 CIFRI took initiatives under TSP for the socio-economic upliftment of the tribal communities.

- CIFRI, organized a mass awareness and training on "*Matsya Palan Evam Matsyikee Vikas"* at Chandan Chouki, Paliya, Lakhimpur district of Uttar Pradesh during 17-20th March under TSP Programme. More than 200 tribal fishers, fish farmers, tribal women and villagers participated in the programme. Drag nets(15), cast net(40) and other fish farming inputs were distributed among the suitable tribal person/ Gram Sabha's.

- CIFRI, Bangalore Centre organised a mass awareness camp at the Karapuzha Reservoir site, Wayanad district of Kerala where more than 225 tribal fishermen/women participated. The Minister for Tribal welfare, Govt. of Kerala Kumari P. K. Jayalekshmi inaugurated the programme and distributed fishing implements to the Members of Karapuzha Tribal fisheries society.


Mass Awareness and training programme organised by Allahabad Centre, CIFRI

Mass Awareness Camp Organised by Bangalore Centre,CIFRI

## Distinguished Visitors


- Shri Subrata Saha, Minister of State (Fisheries), Govt. of West Bengal
- Shri Giriraj Singh, Minister of Animal Husbandry and Fisheries, Govt. of Bihar
- Dr. Charan Das Mahant, Minister of State for Agriculture and Food Processing Industry, Govt. of India
- Shri Basanta Das, Minister of State Fisheries, Govt. of Assam
- Dr. S. Ayyappan, Secretary, DARE & DG, ICAR
- Dr. Ambekar E. Eknath, Director General, NACA, FAO, Bangkok
- Dr. B. Meenakumari, DDG (Fy.), ICAR
- Dr. D. Chaudhury, DDG. DAHD&F, New Delhi
- Shri V. V. Sadamate, Advisor, Planning Commission, Govt. of India
- Dr.S. K. Bandopadhyay, Member, ASRB, New Delhi
- Sh. Tarun Sridhar, Jt. Secretary of Deptt of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India
- Dr. Amit Krishna De, Executive Secretary, Indian Science Congress Association
- Shri Nani Wadekar, Chief Vigilance Officer, ICAR
- Prof. Vinod Tare, Team Leader of Ganga River Basin Management Plan Project, IIT Kanpur
- Ms. V. Manjula, IAS, Principal Secretary, Department of Animal Husbandry and Fisheries, Karnataka
- Dr. Brij Gopal, Coordinator, Centre for Inland Waters in South Asia and former Professor, Jawaharlal Nehru University, New Delhi

- Dr Vijay Kumaran, Director General, Fisheries Survey of India
- Dr. Samir Bhattacharya, INSA Professor, Visva Bharati
- Dr. Hav Viseth, Director of Aquaculture Division Fisheries Administration , Cambodia
- Dr. W.S Lakra, Director, CIFE
- Dr. P. Jayasankar, Director, CIFA
- Dr. J. K. Jena, Director, NBFGR
- Dr. A.K. Singh, Zonal Coordinator, ZPD-II
- Dr. B. S. Mahapatra, Director, CRIJAF
- Dr. Y. S. Yadava, Director, Bay of Bengal Programme of FAO
- Dr. Rishi Sharma, Bay of Bengal Large Marine System, FAO
- Ms C.A. Latha, IAS, Director of Fisheries, Kerala
- Dr. A.K. Ghosh, Ex-Director, ZSI
- Dr. Anindya S. Ghosh, Sundarbans Development Board
- Dr. Dhiman Burman, CSSRI Regional Station, Canning
- Dr. A.S. Sidhu, Director, IIHR
- Dr. K.V. Devaraj, Former Vice-Chancellor, UAS, Bangalore
- Dr. PSBR James, Former Director, CMFRI
- Dr. S.P. Ayyar, Former Director of CIFRI
- Dr. M.V. Gupta, World Food Prize Laureate and Chairman QRT
- Dr. Dilip Kumar, Former Director CIFE & Member QRT
- Dr. R.S. Biradar, Former Joint Director & CIFE Member QRT
- Prof. U.C. Goswami, Guwahati University & Member QRT
- Prof. E. Kannan, Annamalai University & Member QRT
- Dr. S.D. Singh, ADG (I.F.), ICAR, New Delhi
- Shri P.K. Bage, Deputy Secretary ICAR, New Delhi
- Shri N.C. Jain, Superintendent Engineer, National Water Development Agency, Gwalior
- Dr. S.A.H. Abidi, former Member ASRB, ICAR New Delhi
- Saint Swami Gyan Swarup Sadanand Jee (Prof. G.D. Agrawal), Environmentalist River Scientist
- Dr. Suresh Babu, Director River Basins & Water Supply, WWF-India
- Dr. V. N Sharda, Member, ASRB, New Delhi
- Dr. Rabinder Kumar, SWARA, Lucknow
- Dr. I.C. Agarwal, Former Director MNIT, Allahabad
- Dr. B.K. Dwivedi, Director, Bioved Research Institute of Agriculture and Technology, Allahabad

- Prof. Anita Gopesh, Deptt. of Zoology, Allahabad University
- Members of Thengal Kachari Autonomous Council (15 Nos), Titabar, Assam
- Dr. A. K. Roy, IAS, Secretary (Fishery), Govt. of Assam
- Director of Fisheries, Govt. of Assam, Guwahati, Assam
- Dr. H. Tombi Singh, Ex-Vice Chancellor, Manipur University, Imphal
- Dr. L. Kannan, Former Vice Chancellor, Thiruvalluvar University, Tamil Nadu
- Prof. Mohan Bhattacharya, Bodoland University, Kokhrajhar, Assam
- Dr. P. C. Mahanta, Director, Directorate of Cold water Fisheries Research Bhimtal
- Dr. Chandan Rajkhowa, Director, NRC on Mithun (ICAR), Medziphema
- Dr. A. K. Gogoi, Zonal Project Director, ICAR Zone III
- Mr. D. K. Pradhan, Director of Fisheries, Sikkim
- Prof RK Sinha, RAC Chairman, CIFRI
- Dr. P. Das, Former Director, NBFGR
- Dr. Samir Banerjee, Professor, University of Calcutta and RAC member
- Prof. Prakash Nautiyal, Department of Zoology and Biotechnology, Hemwati Nandan Bahuguna Garhwal University, Srinagar, Uttarakhand.
- Prof. N. C. Dutta, Retd. Prof., University of Kolkata
- Dr. Md. Shaha Ali, Sr. Scientific Officer, Bangladesh Fisheries Research Institute
- Dr. Md. Khalilur Rahman, Sr. Scientific Officer & Sub-station Chief, Bangladesh Fisheries Research Institute
- Dr. S. N. Dwivedi, Former Director, CIFE, Mumbai
- Dr. M. Das, Associate Director of Extension Education (Vety.), Assam Agricultural University, Khanapara Campus, Guwahati
- Dr. S. Saikia, Chief Scientist, Horticultural Research Station, Assam Agricultural University, Kahikuchi
- Dr. M. Sinha, Advisor (Fishery), Government of Tripura and Former Director, CIFRI
- Dr. Usha Moza, Principal Scientist, Inland Fisheries, ICAR, New Delhi
- Dr. C. Vasudevappa, Sr. Executive Director, NFDB, Hyderabad
- Mr. Nishat Ahmad, Director, Department of Fisheries, Government of Bihar
- Shri K. S. Sidhu, Chairman, Punjab Fish Farmers and Fisheries Association
- Dr. Dipayan Dey, Chair, South Asian Forum for Environment (SAFE), Kolkata
- Dr. B. N. Pandey, Former Dean & Professor, Magadh University, Gaya
- Dr. S. N. Biswas, Deputy Director, Dept. of Fisheries, Govt. of West Bengal
- Dr V Raghothama Swamy, Deptt of Fisheries, Govt. of Aandhra Pradesh

- Dr. Prabhat P. Ghosh, Director, Asian Development Research Institute, Patna
- Dr. G. Syda Rao, Director, CMFRI, Kochi
- Dr. A. G. Pooniah, Director, CIBA, Chennai
- Dr AK Mishra, IARI, New Delhi
- Shri Shankar Kumar Dutta Gupta, Ex-DAG, CAG of India
- Dr. K. K Vass, Former Director, CIFRI
- Dr. V. V. Sugunan, Former ADG, Fy, ICAR
- Prof. Amalesh Choudhury, retired professor, Calcutta university
- Dr. D. Nath, Former Pr. Scientist and acting Director, CIFRI
- Dr Bharat Saha, Dept. of Fisheries, Govt. of West Bengal

## Promotion

| Sl. No. | Name | Designation | Promoted to | With effect from |
|---|---|---|---|---|
| 1 | Dr. B.B. Satpathy | Senior Scientist | Principal Scientist | 17.03.2010 |
| 2 | Dr. M.K. Bandyopadhyay | Senior Scientist | Principal Scientist | 27.07.2009 |
| 3 | Dr. B.K. Bhattacharjya | Senior Scientist | Principal Scientist | 01.01.2009 |
| 4 | Dr. Subir Kumar Nag | Senior Scientist | Principal Scientist | 31.08.2010 |
| 5 | Dr. Sanjay Kumar Das | Senior Scientist | Principal Scientist | 20.02.2010 |
| 6 | Dr. A.K. Das | Senior Scientist | Principal Scientist | 01.01.2009 |
| 7 | Dr. B.P. Mohanty | Senior Scientist | Principal Scientist | 01.01.2009 |
| 8 | Dr. R. Palaniswami | Senior Scientist | Principal Scientist | 27.04.2010 |
| 9 | Shri K. Majhi | Assistant | Asstt. Admn. Officer | 01.10.2012 |

## Transfer

| Sl. No. | Name & designation | Place of posting | Transferred to |
|---|---|---|---|
| 1 | Mr. R. Sahay | Barrackpore | IIT, Gandi nagar |
| 2 | Mr. A. K. Yadav, Sr. Clerk | Barrackpore | NRC on Litchi, Bihar |
| 3 | Mr. S. K. Singh, LDC | Barrackpore | CICR, Nagpur |
| 4 | Mr. R. Balamurugan, T-3 | Bangalore | CIAE, Bhopal |

## New Appointment

| Sl. No. | Name & designation | Place of posting | Date of joining |
|---|---|---|---|
| 1 | Shri P. K. Nayak, AFAO | Barrackpore | 01.05.2012 |
| 2 | Ms. Sandhya K. M, Scientist | Barrackpore | 02.05.2012 |
| 3 | Shri Navin Kumar Jha, AO | Barrackpore | 12.06.2012 |
| 4 | Dr. K. K. Goswami, Pr. Scientist | Barrackpore | 22.06.2012 |
| 5 | Shri Subir Das, Assistant | Barrackpore | 31.07.2012 (FN) |
| 6 | Ms. Payel Chaudhury, Assistant | Barrackpore | 31.08.2012 (FN) |
| 7 | Ms. Pausali Mukherjee, Assistant | Barrackpore | 26.09.2012 (FN) |
| 8 | Shri Pratyay Sarkar, Assistant | Barrackpore | 25.10.2012 (FN) |
| 9 | Shri Satyabrata Biswas, Asstt | Barrackpore | 24.11.2012 (AN) |
| 10 | Ms. T. T. Paul, Scientist | Bangalore | 05.12.2012 |

## Superannuation

| Sl. No. | Name | Designation | Date of retirement | Place of posting |
|---|---|---|---|---|
| 1 | Shri S. Saha | T(7-8) | 30.04.2012 | Barrackpore |
| 2 | Mr. T.K. Roy | P.S | 30.04.2012 | Barrackpore |
| 3 | Mr. B. Mondal | SSS | 30.04.2012 | Barrackpore |
| 4 | Mr. S. S. Bondra | SSS | 31.05.2012 | Vadodara |
| 5 | Mr. U.K. Chatterjee | T-5 | 31.07.2012 | Barrackpore |
| 6 | Mr. U. Chowdhury | SSS | 31.07.2012 | Barrackpore |
| 7 | Ms. M. R. Bahadur | SSS | 31.07.2012 | Barrackpore |
| 8 | Mr. M. C. Gharami | SSS | 31.07.2012 | Barrackpore |
| 9 | Mr. V. Kolekar | PS | 31.08.2012 | Guwahati |
| 10 | Mr. Suresh Rajak | SSS | 27.09.2012 | Barrackpore |
| 11 | Mr. S. B. Roy | AAO | 30.09.2012 | Guwahati |
| 12 | Mr. T. Chatterjee | T-6 | 31.10.2012 | Barrackpore |
| 13 | Mr. K. P. singh | T-4 | 31.10.2012 | Barrackpore |
| 14 | Mr. G. C. Paramanick | SSS | 30.11.2012 | Barrackpore |
| 15 | Mr. M. C. Das | SSS | 30.11.2012 | Guwahati |
| 16 | Ms. Payel Choudhury | Assistant | 03.12.2012 | Barrackpore |
| 17 | Mr. N.K. Saha | T-4 | 31.12.2012 | Barrackpore |
| 18 | Mr. S. Banerjee | SSS | 14.01.2013 | Barrackpore |
| 19 | Dr. B.C. Jha | Head of Division | 31.01.2013 | Barrackpore |
| 20 | Shri J. K. Patra | SSS | 31.01.2013 | Kolkata |
| 21 | Shri D. Sanfui | T-5 | 28.02.2013 | Barrackpore |
| 22 | Shri S. K. Ghosh | T-5 | 28.02.2013 | Barrackpore |
| 23 | Shri K. K. Dutta | T-5 | 28.02.2013 | Barrackpore |
| 24 | Shri S.K. Sadhukhan | T-8 | 31.03.2013 | Kolkata |
| 25 | Shri S.C. Burman | SSS | 31.03.2013 | Barrackpore |

# हिन्दी सारांश

भाकृअनुप
ICAR

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

Agrisearch with a human touch

केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान
बैरकपुर, कोलकाता – 700120

# प्रस्तावना

केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान का गत् कई दशकों से अंतर्स्थलीय मात्स्यिकी क्षेत्र के उत्पादन संवर्धन में विभिन्न विषयक अनुसंधान रहा है। इन विभिन्न विषयों के अध्ययन से संस्थान के ज्ञान एवं सूचना कोष में अपार वृद्धि हुई है। इन जल संसाधनों में बहु–भागेदारों द्वारा नियंत्रित अंतर्स्थलीय परितंत्रों जैसे, विविध अल्पकालीन एवं दीर्घकालिक, स्थिर और सदैव बहने वाले जल निकाय हैं। ये जल निकाय हैं – नदी, ज्वारनदमुख, आर्द्रक्षेत्र और जलाशय जो पारिस्थितिकी के लिये महत्वपूर्ण एवं लाखों व्यक्तियों की आजीविका के अभिन्न आधार हैं। संस्थान के अनुसंधान का मुख्य केन्द्र अब पारिस्थितिकीय कार्यकलाप एवं सेवायें, जैवविविधता, मात्स्यिकी एवं संसाधनों का संरक्षण है। प्राकृतिक परितंत्रों में मात्स्यिकी विकास बहु जैव एवं अजैव कारको की एक जटिल पारस्परिक क्रिया है। इस पहलू पर पहले सही ढंग से विश्लेषात्मक अध्ययन नहीं किया गया था जिससे संपूर्ण सूचनाओं का अभी भी अभाव है। पारिस्थितिकी एवं मत्स्य स्टॉक मत्स्ययन प्रयास, विभिन्न संवर्द्धन उपाय, संस्थानिक व्यवस्था और संचालन पर पूर्णतः निर्भर करता है। हाल के वर्षों में जलवायु परिवर्तन का अंतर्स्थलीय जलीय संसाधन संबंधी विभिन्न पहलुओं जैसे, मत्स्य अंडजनन, मछलियों की भोजन प्रक्रिया, मत्स्य विविधता, मछलियों में बीमारियों का प्रकोप, कार्बन सिक्वेस्ट्रेशन संभावना आदि पर प्रतिकूल प्रभाव पड़ा है। इन समस्याओं से निपटने के लिये संस्थान ने अनुसंधान कार्यक्रमों को दो दिशाओं में संचालित किया है – मात्स्यिकी से प्राकृतिक संसाधन प्रबंधन आधारित मात्स्यिकी तक और उत्पादन एवं प्रजाति संसर्ग के उत्तरदायी कारकों संबंधी सूचना प्राप्ति हेतु मॉडल पद्धति का प्रयोग।

संस्थान का उद्देश्य 12वीं पंचवर्षीय योजना के दौरान मात्स्यिकी संबंधी विविध पर्यावरणीय मुद्दों को संबोधित करना है जिससे विवृत जल मात्स्यिकी की पारिस्थितिकी और इसके दीर्घकालिक उत्पादन पर अनुसंधान कार्य किया जा सके। इसके लिये देश के समस्त विवृत जल संसाधनों के उत्पादन एवं संरक्षण हेतु संस्थान ने इस परियोजना का मार्गदर्शन और साथ ही प्राकृतिक संसाधन प्रबंधन पर कार्य करने का निश्चय किया है। इन प्रयासों का उद्देश्य जलवायु परिवर्तन से होने वाले दुष्प्रभावों का निराकरण करना है और जैव विविधता, संसाधन क्षेत्रों में कमी, अंतर्स्थलीय विवृत जल क्षेत्रों में आजीविका संबंधी चुनौतियों का सामना करने के लिये योजनाओं को क्रियान्वित करना है।

इन वर्षों के दौरान संस्थान ने उन्नत अनुसंधान पद्धतियों द्वारा अनुसंधान के नये आयाम खोले हैं एवं सामुदायिक भागीदारी मात्स्यिकी को सशक्त बनाया है। संस्थान ने अन्य अनुसंधान संस्थानों, विश्वविद्यालयों, राज्य सरकार के विभागों तथा राष्ट्रीय एवं अंतर्राष्ट्रीय संगठनों जैसे, खाद्य व कृषि संगठन, रोम; जलकृषि विकास विभाग, कंबोडिया; जलीय परितंत्र स्वास्थ्य व प्रबंधन, कनाडा; अंतर्राष्ट्रीय आर्द्रक्षेत्र, नई दिल्ली; नोफिमा, नार्वे; बंगलादेश मात्स्यिकी अनुसंधान संस्थान, बंगलादेश के साथ मिलकर अनुसंधान एवं विकास संयोजनों को सुदृढ़ बनाया है।

वर्ष 2012–13 के दौरान संस्थान मुख्यालय एवं इसके केन्द्रों में मत्स्य पालकों, जनजातियों, राज्य सरकारों के अधिकारी एवं विश्वविद्यालयों के प्राध्यापकों को अंतर्स्थलीय मात्स्यिकी के विभिन्न पहलुओं पर प्रशिक्षण दिया गया है। साथ ही कई जन जागरूकता कार्यक्रम एवं प्रदर्शनियों के द्वारा संस्थान की तकनीकों, उपलब्धियों आदि का प्रचार–प्रसार किया गया। संस्थान ने पिल्लई एक्वाकल्चर फाउण्डेशन कांग्रेस, 100वीं भारतीय विज्ञान कांग्रेस, नदीय स्वास्थ्य पर सैटेलाइट संगोष्ठी एवं नदीय धारा प्रवाह पर कार्यशाला का आयोजन किया। इन कार्यक्रमों के सफलतम आयोजन के लिये राष्ट्रीय एवं अंतर्राष्ट्रीय संगठनों ने संस्थान की बहुत प्रशंसा की है।

मैं अपने इस कार्य निष्पादन के लिये सचिव, कृषि अनुसंधान एवं शिक्षा विभाग तथा महानिदेशक, भारतीय कृषि अनुसंधान परिषद् का हृदय से आभारी हूँ। मैं डा. बी मीनाकुमारी, उपमहानिदेशक (मात्स्यिकी), डा. एस डी सिंह, सहायक महानिदेशक (अंतर्स्थलीय मात्स्यिकी), डा. मदन मोहन, सहायक महानिदेशक (समुद्री मात्स्यिकी) के साथ–साथ संस्थान के सदस्यों का उनके सहयोग हेतु आभार व्यक्त करता हूँ। मैं डा. एस के मन्ना एवं उनके सहयोगियों को इस प्रलेख की प्रस्तुति हेतु धन्यवाद देता हूँ।

ए पी शर्मा
निदेशक

बैरकपुर, कोलकाता – 700120
जुलाई 2013

# विशिष्ट सारांश

## नदीय एवं ज्वारनदमुख मात्स्यिकी

- भागीरथी–हुगली नदी के फरक्का–फ्रेजरगंज क्षेत्र में शीत ऋतु के दौरान पकड़ी गई हिल्सा मछलियों का शारीरिक भार 130 से 927 ग्रा. (औसतन 377.5 ग्रा.) पाया गया जबकि मानसून महीनों में इसका भार 125 से 935 ग्रा. (औसतन 435.1 ग्रा.) पाया गया, जिसका प्रमुख कारण है – शीत ऋतु में केवल 70–80 मि.मी जाल छिद्र वाले ड्रिफ्ट गिल जाल का व्यापक प्रयोग। हिल्सा की शारीरिक संरचना के अध्ययन से यह पता चला है कि 90 मि.मी से अधिक छिद्र वाले जाल के प्रयोग करने से 500 ग्रा. शारीरिक भार वाली हिल्सा जाल में नहीं आ पाती हैं।

- हिल्सा मात्स्यिकी से जुड़े मत्स्य पालकों के आर्थिक विश्लेषण यह बताते हैं कि इन मछुआरों की कुल आय का 56 प्रतिशत भोजन पर व्यय होता है। हिल्सा मत्स्ययन पर भी सबसे अधिक व्यय होता है जिसमें अधिकतम व्यय बोट किराये (76 प्रतिशत) के रूप में होता है। अन्य खर्च जाल एवं गियर की मरम्मत एवं लाइसेंस शुल्क हैं। इन व्यय को देखते हुये यह कहा जा सकता है कि इस व्यवसाय की लागत मूल्य अधिक है।

- सुन्दरवन के कुछ चयनित क्षेत्रों का सर्वेक्षण यह बताते हैं कि स्थानीय मत्स्य प्रजातियों, जैसे, *Ompok pabda, Heteropneustes fossilis, Clarias batrachus, Anabas testudineus, Glossogobius* sp., *Anguilla bengalensis, Amblypharyngodon mola, Colisa fasciata, Notopterus notopterus, Mystus vittatus, Mystus guilo, Channa marulius, C. striata, C. punctata, C. gachua, Mastacembelus armatus, Macrognathus pancalus, Puntius sarana, Pethia ticto, Chanda nama, Nandus nandus* आदि की उपलब्धता एवं उपज में कमी आई है।

- हेरोभांगा नदी के तलछट के विश्लेषण में मृदा में जैविक कार्बन की मात्रा अधिक (0.87 से 0.99 प्रतिशत) पाई गई जिसका कारण निकटवर्ती मैंग्रोव से प्रवाहित होने वाली अपरद का प्रवाह है। झारखाली मैंग्रोव क्षेत्र में लिटर ट्रैप द्वारा एकत्र की गई अपरद के विश्लेषण से यह पाया गया कि काल बेइन क्षेत्र से अधिकतम अपरद (*Avicennia alba*) का प्रवाह हो रहा है। अप्रैल में सबसे अधिक प्रवाह जीओन (*Excoecaria agallocha*) क्षेत्र से हुआ है पर अपतृणों, जाट बेइन (*Avicennia officinalis*) एवं किवरा (*Sonneratia apetala*) के प्रवाह में कमी हुई है।

- हेरोभांगा नदी क्षेत्र से 39 वर्ग एवं 11 आर्डर वाली 102 मत्स्य प्रजातियों का संग्रह किया गया। कम मूल्य वाली मत्स्य प्रजातियों (*Escualosa thoracata, Thryssa purava*) आदि के उत्पादन में महत्वपूर्ण परिवर्तन देखे गये। इस क्षेत्र में जल निकायों में लवणता के बढ़ने से कुछ नई प्रजातियों की उपलब्धता देखी गई है, जैसे, पीले फिन वाली समुद्री ब्रिम प्रजाति (*Acanthopagrus latus*), सारडिन प्रजातियां (*Sardinella gibbosa, S. melanura*), ग्रोपर्स (*Epinephelus coioides* – प्रमुख प्रजाति) एवं स्नैपर्स (*Lutjanus johni*) आदि। कैटफिश प्रजाति की एक बड़ी आकार वाली मछली, *Hexanematichthys sagor* (*Arius sagor*) की उपलब्धता भी देखी गई है। इसका आकार 99.4 से.मी. टी एल और शारीरिक भार 16 कि.ग्रा. है। हेरोभांगा क्षेत्र में हरित टाइगर झींगा मछलियों की उपलब्धता भी बढ़ रही है।

- साबरमती क्षेत्र में घुलित ऑक्सीजन की कम मात्रा, पी/आर अनुपात, पोषक तत्वों की उपलब्धता एवं जैव विविधता के कारण यह क्षेत्र जैविक पदार्थों से भरपूर एवं पर्यावरणीय दाब वाला क्षेत्र बन गया है। जैव विविधता सूचक विभिन्न इंडेक्स जैसे, शैनोन सूचकांक या इंडेक्स (H'), इवेननेस सूचकांक या इंडेक्स (J),

मारगलेफ सूचकांक या इंडेक्स (d) एवं सिम्पसन सूचकांक या इंडेक्स(1-λ) ऋतु परिवर्तन के अनुसार अलग–अलग पर्यावरणीय अवस्थाओं की ओर इंगित करते हैं। बेयसिन बिलीफ नेटवर्क्स सूचक के अनुसार साबरमती ज्वारनदमुख में पर्यावरणीय ह्रास 79.26 प्रतिशत हुआ है।

- महानदी बेसिन के जलाच्छादित क्षेत्रों का विश्लेषण टी एन टी माइक्रोइमेज सॉफ्टवेयर के द्वारा किया गया। इसमें जल प्रवाह धारा तथा बेसिन एवं जलाच्छादित क्षेत्र सीमा संबंधी जानकारी प्राप्त की गई। जलीय प्राणियों के हितकारी, महानदी के दो संसाधन क्षेत्रों, अनसुपा बाढ़कृत आर्द्रक्षेत्र और सतकोसिया संरक्षित वनक्षेत्र को पर्यावरणीय जलधारा के अध्ययन हेतु चुना गया है।

- महानदी के ऊपरी क्षेत्र में *Tor tor* प्रजाति की प्रधानता देखी गई। गहरे और चौड़ाई वाली मध्य क्षेत्र में बड़ी आकार वाली मेजर कार्प प्रजातियों की बहुलता देखी गई। निचले क्षेत्र में छोटी आकार वाली मछलियों, मीठाजल कैटफिश प्रजातियों एवं झींगा की कई प्रजातियों की उपलब्धता दर्ज की गई है। कटक से सम्बलपुर तक, 350 कि.मी के नदीय विस्तार क्षेत्र भारतीय मेजर कार्प एवं कैटफिश प्रजातियों के प्रजनन एवं नर्सरी हेतु अनुकूल है।

- गंगा नदी के मध्य क्षेत्र में मैक्सोफाइसी एवं युग्लेनोफाइसी प्रजातियों की उपलब्धता प्रदूषण, तथा ऊपरी क्षेत्र में इनकी अनुपलब्धता उत्तम गुणवत्ता वाली जल की ओर इंगित करते हैं। गंगा नदी के विस्तार क्षेत्रों, कानपुर, संगम, चुनार एवं राजघाट दशाश्वमेध घाट में सूक्ष्मजीवों की उपलब्धता अधिक पाई गई है।

- वर्ष 2012 में इलाहाबाद का कुल मत्स्य अवतरण (फिश लैंडिंग) 203.68 टन रहा जिसमें मेजर कार्प 14.09 प्रतिशत, कैटफिश 12.43 प्रतिशत एवं विदेशी प्रजातियां 33.69 प्रतिशत थीं।

- गंगा नदी के टेहरी से विन्ध्याचल क्षेत्र तक 74 जेनेरा, 30 वर्ग एवं 10 आर्डर के 110 मत्स्य प्रजातियों की उपलब्धता दर्ज की गई है। एक दुर्लभ कोबिटिड प्रजाति, *Pangio pangia* को प्रथम बार गंगा नदी के नरोरा क्षेत्र में देखा गया है।

- महानदी के हीराकुड से नराज क्षेत्र तक चार वर्ग की 14 कैटफिश प्रजातियों की उपलब्धता दर्ज की गई है। नदी में उपस्थित प्रजातियों की उत्तरजीविता के लिये *Rita chrysea* की उपलब्धता हानिकारक है। सतकोसिया संरक्षित वनक्षेत्र में बड़ी आकार वाली *Wallago attu*, *Sperata seenghala* और *Pangasius pangasius* प्रजातियों को देखा गया है।

## आर्द्रक्षेत्र मात्स्यिकी संसाधन

- मणिपुर के पांच आर्द्रक्षेत्रों – ताकमु पाट, उंगमेल पाट, उतरा पाट, साना पाट और वैथउ पाट को इनके आवास विविधता, जलीय समुदाय एवं मात्स्यिकी को ध्यान में रखते हुये इनका अध्ययन किया गया।

- सामान्यतः अवशिष्ट आधारित आर्द्रक्षेत्रों (झगरसिया) में कार्बन एवं फास्फोरस (जो तलछट एन्जायम के खनिजीकरण में सहायक होते हैं), कुल हेटरोट्रोफिक बैक्टीरिया, फॉस्फेट उत्पादन करने वाली बैक्टीरिया, जैव पदार्थ, एवं फॉस्फोरस उपलब्धता की संभावना अधिक होती है पर रिपोर्ट अवधि में प्राकृतिक आर्द्रक्षेत्रों (खलसी) में उपर्युक्त प्राचलों को दर्ज किया गया।

- मणिपुर के ताकमू पाट में मात्स्यिकी निदेशालय, मणिपुर सरकार के सहयोग से पेन पालन का प्रदर्शन किया गया। इस प्रदर्शन में अधिक मांग वाली देशी प्रजाति, *Osteobrama belangeri*, ग्रास कार्प एवं कतला के बीजों का पालन किया गया जिससे इनकी अंगुलिकाओं को आर्द्रक्षेत्रों में डाला जा सके।

- असम के चरन बील में पिंजरों में सिरहिनस मृगला की अंगुलिकाओं के संचयन घनत्व (150–200 अंगुलिकायें प्रति वर्ग मी.) का मानकीकरण किया गया। इस संचयन घनत्व में अंगुलिकाओं का विकास उत्तम हुआ।

संचयन घनत्व इससे अधिक होने पर विकास दर में कमी होती है और पालन अवधि भी 45 दिन और बढ़ जाती है।

- चयनित नदियों, ज्वारनदमुखों, जलाशयों और आर्द्रक्षेत्रों से प्राप्त आंकड़ों के अनुसार, 15 विदेशी प्रजातियों की उपलब्धता देखी गई। (एबन्डेन्स इंडेक्स – 0.2 से 65 प्रतिशत)

- इलाहाबाद के गंगा और यमुना नदियों से प्राप्त कुल उत्पादन में 65 प्रतिशत *Oreochromis niloticus, Cyprinus carpio, Hypophthalmichthys molitrix, H. nobilis, Ctenopharyngodon idella* और *Clarias gariepinus* प्रजातियां देखी गईं। इसी प्रकार पूर्वी कोलकाता के आर्द्रक्षेत्रों में विदेशी प्रजातियों का प्रतिशत कुल उत्पादन का 55–65 प्रतिशत पाया गया।

## जलाशय मात्स्यिकी

- कृष्णासागर जलाशय से कुल उत्पादन 523.5 टन हुआ है। सबसे अधिक लैंडिंग जून महीने में और सबसे कम नवम्बर महीने में हुई। कुल उत्पादन में कार्प प्रजातियां 79 प्रतिशत, ओम्पक बिमाक्युलेटस 11 प्रतिशत, विविध प्रजातियां 6 प्रतिशत, ओरियोक्रोमिस मोसाम्बिका 3 प्रतिशत और मरेल प्रजातियां 1 प्रतिशत थीं।

- तीन जलाशय क्षेत्र एवं एक निचले क्षेत्र में प्रयोगात्मक मात्स्यिकी की गई है। इसमें 28 मत्स्य प्रजातियों की उपलब्धता को दर्ज किया गया। इनमें से कतला कतला, लेबियो रोहिता और सिरहिनस मृगला का प्राकृतिक रिक्रुटमेन्ट नहीं होता बल्कि इनको स्टॉक किया जाता है।

- मानचेनबेली जलाशय में जिन मत्स्य प्रजातियों की उपलब्धता थीं, वे हैं – *Oreochromis* spp. (36.95 प्रतिशत), *Catla catla* (23.9 प्रतिशत), *Labeo rohita* (18.2 प्रतिशत), *Cirrhinus mrigala* (9.7 प्रतिशत), *O. mossambicus* (4.89 प्रतिशत), *Heteropneustes fossilis* (2.27 प्रतिशत) और *Channa marulius* (1.4 प्रतिशत)।

- केरल के 9 जलाशयों में प्रारंभिक परीक्षण में पता चला कि इन जलाशयों में मेसोट्रोफिक अवस्था पाई गई और अल्गी का बायोमास 3.58 से 68.88 ग्रा. प्रति वर्ग मी. था।

- कर्नाटक के बड़े जलाशयों से प्राप्त आंकड़े यह बताते हैं कि संस्थान द्वारा प्रदत्त दिशानिर्देशों के कारण इन जलाशयों के उत्पादन में पांच गुणा वृद्धि हुई है। CPUE भी 2 से 12 कि.ग्रा बढ़ गया है।

- कारापुझा जलाशय में वास करने वाली पुन्टियस वायनाडेन्सिस प्रजाति की आंत के विश्लेषण से उसमें उपस्थित भोज्य पदार्थ (N = 7) में मुख्य तत्व पादपप्लवक (FO = 0.78), मोलस्क कवच (0.4) एवं कीड़े (0.2) पाये गये।

- तमिलनाडु के केलवरापल्ली जलाशय में हाइड्रोकॉस्टिक सर्वे द्वारा मत्स्य वितरण का अध्ययन किया गया।

- आंकड़ा संग्रहण हेतु एक ऐसी प्रणाली, आंकड़ा अभिग्रहण पद्धति (Data Acquisition System - DAS) का विकास किया गया है जिससे एस एम एस (SMS) द्वारा आंकड़ों को प्रत्यक्षतः कम्प्युटर के डेटाबेस में हस्तांतरित किया जा सके।

## मत्स्य स्वास्थ्य एवं पर्यावरण

- नर्मदा नदी में 35 वर्ग एवं 67 जेनेरा के 90 मत्स्य प्रजातियों को दर्ज किया गया। सबसे अधिक साइप्रिनिड (31.1 प्रतिशत) थे। इसके बाद बाग्रिड (10 प्रतिशत) एवं मुगिलिड (5.5 प्रतिशत) पाये गये। अन्य महत्वपूर्ण प्रजातियां हैं – *Labeo rohita, Catla catla, Cirrhinus mrigala, Clupisoma garua, Sperata aor, Sperata seenghala, Tenualosa ilisha, Harpodon nehereus, Liza tade, Liza macrolepis* आदि। कैनोनिकल का ˘रेस्पोन्डिंग

विश्लेषण द्वारा फॉस्फोरस फॉस्फेट ($PO_4$-P,) जल का तापमान, कुल क्षारीयता, पी एच, जल की पारदर्शिता, कार्बन डाई ऑक्साइड, बी ओ डी, नाइट्रोजन नाइट्रेट (T-$NH_3$), घुलित ऑक्सीजन, गहराई और टी अमोनिया ($NO_3$-N) के संदर्भ में मत्स्य प्रजाति वितरण में विभिन्नता को बताया गया है।

- नर्मदा नदी के ऊपरी स्तर अमरकण्टक, मांडला के जलक्षेत्रों के तलछट की उच्च डिहाईड्रोजीनस कार्यकलापों को और जबलपुर में जैविक प्रदूषण की पुष्टि करते हैं।

- महानदी में जल एवं तलछट के प्राचल, कैडमियम, कॉपर, मैंगनीज, लेड, जिंक (Cd, Cu, Mn, Pb, Zn) कम या शून्य पाये गये। पर डी डी टी और एण्डोसल्फान की उपलब्धता जल एवं मछली, दोनों में ही पाये गये। वैसे इनकी मात्रा कम थी और मानव स्वास्थ्य के लिये हानिकारक नहीं थी। कुल 55 मत्स्य प्रजातियों की उपलब्धता को दर्ज किया गया है।

- हुगली नदी के जल में कुल 27 बैक्टीरिया आइसोलेट की पहचान कर ली गई है। ये बैक्टीरिया हैं– *Acinetobacter junii*, *Achromobacter xylosoxidans*, *Chryseobacterium* sp., *Comamonas* sp., *Pantoea agglomerans*, *Ochrobactrum* sp. आदि।

- फिनोल के प्रभाव को कम करने वाले दो महत्वपूर्ण बैक्टीरिया के जीन–समूह (जीनोम) की पहचान कर ली गई है।

- उच्च हेटरोट्रोफिक बैक्टीरिया की संख्या का आंकलन (सी एफ यु/100 मि.ली.) किया गया। मनाया में यह $1.5 \times 10^{11}$, सिरसा में $1.1 \times 10^{11}$ एवं राजघाट–दशाश्वमेध घाट, वाराणसी में $2.8 \times 10^{11}$ पाया गया। जल गुणवत्ता इंडेक्स यह इंगित करते हैं कि सभी नदी विस्तार क्षेत्र के जल मानव उपभोग के लिये उपयुक्त नहीं है। गंगा, गोमती और मंदाकिनी नदियों के जल आंशिक प्रदूषित एवं यमुना नदी (दिल्ली–इटावा) अधिक प्रदूषित है। जल की गुणवत्ता में सुधार की दिशा में महाकुम्भ का प्रभाव भी अधिक नही पड़ा है।

- जलीय प्राणियों के स्वास्थ्य के सूचक, प्रोटीन और लिपिड की जांच की गई। यह देखा गया कि रीता रीता की आंखों के लेंस के फैटी एसिड संरचना में उनकी आयु के अनुसार परिवर्तन होता रहता है। बड़ी आयु की मछलियों में डिकोसाहेक्सोनिक एसिड, नर्वोनिक एसिड और हिनेइकोसेनोइक एसिड पाया गया। बाइवाल्व मोलस्क के पांव और मैन्टल उत्तकों को जी सी/एम एस द्वारा विश्लेषण किया गया।

- प्रथम बार भारतीय मेजर कार्प प्रजाति, कतला कतला के मांसपेशी प्राटियोम को बनाया गया है।

- प्लवक प्रजातियों में *Microcystis aeruginosa* एक प्रमुख (50.6–75.5 प्रतिशत) प्रजाति है जो पश्चिम बंगाल के अर्द्ध–शहरी क्षेत्रों में हानिकारक शैवाल (अल्गी) की बहुलता को बताता है। इसे निष्क्रिय करने वाली तीन जैव–कारक मत्स्य प्रजातियों, *H. molitrix*, *O. niloticua niloticus* और *B. gonionotus* को प्रभावित जल क्षेत्रों में डाला गया है।

## मात्स्यिकी संसाधन आंकलन

- अक्टूबर 2010, अक्टूबर 2009, मई 2009, अक्टूबर 2004 एवं मार्च 2004 के LISS इमेजरी चित्रों का जीओ–रेफरेन्सिंग कर झांसी जिले की माताटीला, बरूअस सागर, मगरपुर, कमलासागर, पहुज और बराहवार जलाशयों के जल क्षेत्रों का निर्धारण किया गया। प्राप्त चित्रों से इन जलाशयों में ऋतु परिवर्तन के अनुसार होने वाले बदलावों की जानकारी मिलती है। सबसे बड़े जलाशय, माताटीला का जलक्षेत्र अक्टूबर 2009 में 6855 हे. और मई 2009 में 12202 हे. था।

- नर्मदा नदी के मध्य स्तर के मेसोहैबिटेट क्षेत्र के मत्स्य जैवविविधता के क्वांटेटिव एसेसमेन्ट फ्रेमवर्क को प्राप्त किया गया। स्पीसिज–मेसोहैबिटेट मॉडल से किये गये

पूर्वानुमान 69 प्रतिशत तक सत्य प्रमाणित हुये हैं। जैसे, (i) प्रजाति, प्रजाति वर्ग एवं मेसोहैबिटेट के मध्य महत्वपूर्ण संबंध (ii) Run-Riffle की तुलना में Pool-Run में प्रजातियों के एक–दूसरे से संपर्क में आने की 14.49 गुना की अधिक संभावना (iii) Run-Riffle मेसोहैबिटेट में *Bagridae* एवं *Ambassidae* (Reference family) के बीच एक सकारात्मक संबंध।

- हुगली ज्वारनदमुख से प्रतिदिन एवं मासिक तौर पर मत्स्य बीज और टाइगर शिंगटी मछलियों के बीज प्राप्त करने में पूर्वानुमान हेतु कई समयबद्ध आंकड़ा विश्लेषण तकनीक का प्रयोग किया गया। ये तकनीक हैं – Structural Time Series Models, Unobserved Component Models (UCM) और Seasonal Autoregressive Integrated Moving Average माडल। Unobserved Component Models (UCM) से प्रति माह लैंडिंग के बारे में सही अनुमान लगाया गया ($R^2$ = 0.85)। साथ ही, चन्द्र ग्रहण पूर्वानुमान, प्रतिदिन तौर पर आंकड़ा संग्रहण एवं इनके भावी उपयोग संबंधी जानकारी प्राप्त की गई है।

## सामाजिक–आर्थिक अध्ययन

- संस्थानिक तौर पर सुविधाओं का प्रबंध करने एवं संचालन संबंधी सूचना प्राप्त करने हेतु मध्य प्रदेश के जलाशयों का अध्ययन किया गया। अध्ययन के अनुसार, मात्स्यिकी हेतु 10 हे. से कम क्षेत्र वाले जल निकायों को ग्राम पंचायतों को, 10–100 हे. क्षेत्र वाले जल निकायों को जनपद पंचायतों को, 100–1000 हे. क्षेत्र वाले जल निकायों को जिला पंचायतों को, 1000–2000 हे. क्षेत्र वाले जल निकायों को राज्य मात्स्यिकी विभाग को और 2000 हे. से अधिक क्षेत्र वाले जल निकायों को मध्य प्रदेश मात्स्यिकी फेडरेशन को पट्टे पर दिया गया है।

- इंदिरा सागर जलाशय का संचालन 9 मुख्य भागेदारों द्वारा किया जा रहा है पर उनमें एक–दूसरे के प्रति किसी भी मुद्दे पर किसी प्रकार का वैमनस्य नहीं रहता है। मध्य प्रदेश मत्स्य फेडरेशन कोऑपरेटिव लिमिटेड (FISHFED) इस परियोजना का नोडल अधिकारी होता है। FISHFED द्वारा जलाशय में संचयन, मछली पालन एवं मत्स्य विपणन के लिये सबसे अधिक बोली लगाने वाले को पट्टे पर दिया जाता है। इस क्षेत्र में कुल 66 मत्स्यपालक सहकारी सोसायटी हैं जिनमें कुल 2670 मछुआरे कार्यरत हैं। गत् पांच वर्षों में उन्नत सुविधा एवं संचालन के कारण इस जलाशय का उत्पादन 495 टन से बढ़कर 1023 टन हो गया है।

- सुन्दरवन के मैंग्रोव पारिस्थितिकी से प्राप्त उत्पादों एवं सेवाओं को सूचीबद्ध किया गया है जिसमें मैंग्रोव की प्रजनन क्षमता और विभिन्न मत्स्य प्रजातियों के आवास संबंधी सूविधाओं का आंकलन किया गया है।

- सेकेन्डरी आंकड़ों के आधार पर सुन्दरवन के मैंग्रोव क्षेत्र के तीन प्रजातियों, *Vicennia* sp., *Sonneratia* sp. और *Excocaria* sp. का प्रति हे. मूल्यांकन रू. 53,773 से रू. 1,00,824 तक किया किया गया। इन तीनों प्रजातियों से होने वाला लाभ रू. 564 करोड़ से 1058 करोड़ तक है।

- मछुआरों के आजीविका संबंधी चित्रण के लिये गंगा नदी एवं इसके सहायक नदियों और विभिन्न चौर एवं मनों के साथ–साथ बिहार के चार जिलों के 14 ब्लॉक से 195 मछुआरा परिवारों से संबंधित प्रारंभिक आंकड़ों को संग्रहण किया गया। इन आंकड़ों पर आधारित एक आंकड़ाकोष (डेटाबेस) बनाया गया है।

## आउटरीच परियोजना

- भारतीय मेजर कार्प प्रजातियों का घेरे में पालन सफल सिद्ध हुआ है। इससे उनका भोजन ग्रहण 52 प्रतिशत अधिक होने के कारण उनका शारीरिक भार 6 प्रतिशत बढ़ा है। माइथन बांध में कॉमन कार्प प्रजातियों की अंगुलिकाओं को अलग–अलग घनत्व के दो प्रकार पिंजरों में (90 ग्रा. प्रति वर्ग मी. और 390 ग्रा. प्रति वर्ग

मी.) में रखा गया। इसमें यह देखा गया कि कम घनत्व वाले पिंजरे में विकास दर उत्तम था।

- गंगा नदी के निचले क्षेत्र, नवद्वीप से फरक्का में उपस्थित सी कतला का ट्रस मोरफोमेट्री यह दिखाता है इसकी जनसंख्या ऊपरी क्षेत्र (पटना से इलाहाबाद तक) में अधिक है पर एल रोहिता और सी मृगला के जनसंख्या में ऐसा कोई परिवर्तन नहीं देखा गया। इसी प्रकार, इलाहाबाद, पटना, फरक्का, नवद्वीप, गुवाहाटी, भरूच से प्राप्त *L. rohita* के पार्शियल साइटाक्रोम्ब (307bp) जीन सिक्वेंस विश्लेषण यह बताता है कि *L. rohita* में होने वाली 92.16 प्रतिशत परिवर्तन उनके सह प्रजाति की जनसंख्या परिवर्तन पर और 7.84 प्रतिशत परिवर्तन जनसंख्या संरचना पर निर्भर करता है।

- गंगा, ब्रह्मपुत्र और नर्मदा नदियों से *Catla catla, Labeo rohita, C. mrigala, L. fimbriatus* और *Macrobrachium rosenbergii* के नमूनों के अध्ययन से यह जानकारी प्राप्त हुई कि अलग–अलग नदियों में सापेक्ष या पारस्परिक निषेचन भिन्न–भिन्न हैं, जैसे गंगा नदी में *Catla catla* और *C. mrigala* का निषेचन अधिक होता है तो ब्रह्मपुत्र नदी में *Labeo rohita* का निषेचन अधिक है। इसी प्रकार इन नदियों में मछलियों की लंबाई और इनके परिपक्व होने की अवधि में भी भिन्नता देखी गई।

- *Sperata Seenghala* के पोषक तत्व संबंधित प्रलेख (न्युट्रियेन्ट प्रोफाइलिंग) यह बताते हैं कि यह प्रजाति आवश्यक अमीनो एसिड, हिस्टिडीन, थ्रियोनीन एव लियुसीन जैसे पोषक तत्वों से भरपूर होती है। इसमें अनावश्यक अमीनो एसिड की उपलब्धता (0.89) प्रोटीन की उत्तम गुणवत्ता को दिखाता है। इस प्रजाति में अन्य पोषक तत्वों जैसे, जिंक, आयरन और कैल्शियम की प्रचुरता है।

- मध्यम आकार वाली हिल्सा प्रजाति, *Tenualosa ilisha* में असंस्तृप्त (अनसैचुरेटेड) फैटी एसिड, ओमेगा–3 प्युफा, ई पी ए एवं डी एच ए भरपूर होता है तथा संस्तृप्त (सैचुरेटेड) फैटी एसिड की मात्रा कम पाई जाती हैं। इन दोनों ही विशेषताओं के कारण यह प्रजाति मानव स्वास्थ्य एवं उनके पोषण के लिये अत्यधिक लाभकारी है।

## परिषद् की नेटवर्क परियोजना

- हुगली ज्वारनदमुख में हिल्सा प्रजाति, टेनुआलोसा इलिशा की परिपक्वता 30–31 डिग्री सें. में सबसे अच्छी होती है। अंडजनन के लिये 29–32 डिग्री सें. तापमान उपयुक्त होता है। पर तापमान के बढ़ने से मछलियों के आवास, उपापचय, वृद्धि एवं प्रजनन पर प्रतिकूल प्रभाव पड़ता है।

- पश्चिम बंगाल एवं असम राज्यों के हैचरी पालन संबंधी विभिन्न पहलुओं जैसे मछलियों के प्रजनन, पालन, अंडजनन आदि पर सूचनाओं को एकत्र कर ई–एटलस बनाया गया है।

- बैक्टीरिया आइसोलेट को संघटित/खनिजीकरण करने वाली फॉस्फोरस की उपयोगिता का इन वाइट्रो (*in vitro*) एवं तलछट सूक्ष्मजीव (माइक्रोकाज्म) के परिपेक्ष्य में परीक्षण किया गया। इन वाइट्रो (*in vitro*) परीक्षण में इन बैक्टीरिया आइसोलेट की क्रियात्मक क्षमता कम होने के बावजूद भी तलछट के विकास में इनकी महत्वपूर्ण भूमिका है। इससे मीठाजल क्षेत्रों की जैव–निषेचन संभावना बढ़ जाती है।

## राष्ट्रीय कृषि नवोन्वेशी परियोजना एवं एन एफ बी एस एफ ए आर ए

- अधिक तापमान से प्रभावित *Chana striatus* के लीवर का प्रोटियोम विश्लेषण किया गया जिससे अधिक तापमान सहन करने वाले कुछ प्रोटीन के बारे में सूचना प्राप्त हुई है, ये प्रोटीन हैं – Glyceraldehydes-3-phosphate, dehydrogenase, Ferritin, Glutathione S-transferase, Superoxide

Dismutase, HSP-60, -actin और Phosphoglycerate Kinase।

- *Staphylococcus epidermidis* का संपूर्ण ट्रांसक्रिप्टोम सिक्वेंस विश्लेषण 20 प्रतिशत वाले लवणीय जल में किया गया। ऐसे जल में 20 प्रतिशत तक लवणीयता सहन करने वाली 324 बैक्टीरिया की पहचान कर ली गई है। जीन तात्विकी (ओन्टोलॉजी) का तुलनात्मक अध्ययन *Staphylococcus epidermidis* बैक्टीरिया के नियंत्रण और उपचार के लिये किया गया। इस प्रक्रिया को जीवविज्ञान प्रक्रिया, आणविक कार्यकलाप एवं कोशकीय तत्वों के परिपेक्ष्य में किया गया जिससे BLASTX संबंधी जी ओ (GO) शब्दों को प्राप्त किया जा सके।

- आर्सेनिक प्रभावित जल क्षेत्रों में वास करने वाली मछलियों में आर्सेनिक प्रदूषण पाया गया है। यह जलक्षेत्र एवं तलछट तथा मछलियों में स्थापित प्रत्यक्ष संबंध को दिखाता है। पर इस आर्सेनिक का प्रभाव भारतीय मेजर कार्प मछलियों का सेवन करने वाले लोगों में कम होता है जबकि गैस्ट्रोपोड और बाइवाल्व प्रजातियों को खाने वाले मनुष्यों में आर्सेनिक प्रभाव अधिक होता है।

## केन्द्रीय सेक्टर योजना

- सूदूर संवेदन प्रणाली द्वारा उत्तर प्रदेश के जल निकायों पर आधारित एक ई–एटलस बनाया गया है। इस एटलस में विभिन्न वर्गों के अंतर्गत जिलेवार एवं ब्लॉक संबंधी जल क्षेत्रों का विवरण संकलित किया गया है।

- असम के बारपेटा जिले में लगभग 156.08 हे. क्षेत्र में उपलब्ध 7,452 तालाबों एवं सामुदायिक टैंक संबंधी सूचनाओं का संकलन किया गया है।

## अन्य परियोजनायें

- तरूण हिल्सा मछली के शिकार को रोकने के लिये बैगनेट के साथ एक चौकोर एवं जालीदार बी आर डी बक्सा लगाया गया है। इस बक्से का आकार 1 मी. x 0.75 मी. है और इसके जालछिद्र 50 मि.मी. है। परीक्षण के दौरान यह देखा गया कि इस बक्से से कुल 41 प्रजातियां बाहर निकल सकती हैं। बाहर निकलने वाली हिल्सा मछली की औसतन लंबाई 37 मि.मी से 55 मि.मी. थी।

## मानव संसाधन विकास

- रिपोर्ट अवधि के दौरान संस्थान द्वारा 20 प्रशिक्षण कार्यक्रम और 13 जन जागरूकता कार्यक्रम का आयोजन किया गया। इसी प्रकार संस्थान ने 16 प्रदर्शनी, 2 जन जागरूकता कार्यक्रम एवं जनजाति मछुआरों के लिये प्रशिक्षण कार्यक्रम में भाग लिया। वर्ष 2012–13 के दौरान संस्थान की अन्य गतिविधियां रहीं – पिल्लई एक्वाकल्चर फाउन्डेशन कांग्रेस, 100वीं भारतीय विज्ञान कांग्रेस (प्राणीविज्ञान, जंतुविज्ञान एवं मात्स्यिकी विज्ञान सत्र), पर्यावरणीय प्रवाह पर कार्यशाला, क्षमता निर्माण हेतु अंतर्स्थलीय मात्स्यिकी के संग्रहण आंकलन पर पुनरीक्षण बैठक, सलाहकार एवं मात्स्यिकी विकास कार्य संबंधी बैठक आदि।

# 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 इस केन्द्र को अपने कार्यकलापों के बल पर वर्ष 1959 में एक पूर्ण संस्थान का दर्जा प्राप्त हुआ तथा यह बैरकपुर, पश्चिम बंगाल में स्थापित हुआ। कालान्तर से यह संस्थान समूचे राष्ट्र की अंतर्स्थलीय मात्स्यिकी एवं जलकृषि के सर्वश्रेष्ठ अनुसंधान में अग्रणी रहा है। वर्ष 1967 से यह संस्थान भारतीय कृषि अनुसंधान परिषद्, कृषि अनुसंधान एवं शिक्षा विभाग, भारत सरकार के अंतर्गत कार्यरत 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 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 वर्ष 1971–73 के बीच 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।

इन विशेष संस्थानों के बनने के बाद संस्थान का अनुसंधान का केन्द्र विवृत जल मात्स्यिकी की ओर हो गया। विवृत जल क्षेत्र हैं – नदी, जलाशय, बाढ़क्षेत्र एवं मानव निर्मित झील, ज्वारनदमुख, लैगून एवं पश्च जल क्षेत्र। वर्ष 1987 से संस्थान मात्स्यिकी प्रबंधन एवं मत्स्य उत्पादन संवर्धन पर कार्य कर रहा है। अतः 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 एवं इसके अधिदेशों में निम्नलिखित परिवर्तन किये गये हैं :

## पुनरीक्षित अधिदेश

- अंतर्स्थलीय विवृत जल क्षेत्र जैसे नदी, ज्वारनदमुख जिसमें लैगून, जलाशय एवं आर्द्रक्षेत्र भी सम्मिलित हैं, में मूल, युक्तिपूर्ण एवं व्यावहारिक अनुसंधान कार्य।
- 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 खुला जल क्षेत्र मत्स्य प्रबन्धन पर परामर्शक सेवायें उपलब्ध कराना, प्रशिक्षण देना, जन जागृति उत्पन्न करना आदि।

## दृष्टिकोण

अंतर्स्थलीय विवृत जल निकायों से पर्यावरणीय शुद्धता, जीविकोपार्जन और पोषकीय सुरक्षा हेतु प्रतिपालित मात्स्यिकी

## 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।

## संगठन

संस्थान की अनुसंधान गतिविधियाँ तीन प्रभागों एवं एक अनुभाग के अंतर्गत संचालित होती हैं। तीनों प्रभागों के प्रभागाध्यक्ष संस्थान के अनुसंधान कार्यक्रमों के समन्वयक हैं।

इन प्रभागों के विभिन्न अनुसंधान कार्यों में अन्य अनुभाग भी सहायता प्रदान करते हैं। इलाहाबाद, गुवाहाटी, बैंगलोर व वडोडरा प्रादेशिक केन्द्र तथा कोच्चि एवं कोलकाता अनुसंधान स्टेशन के प्रभारी उनके केन्द्रों में चल रही अनुसंधान परियोजनाओं के कार्यान्वयन में प्रशासनिक दायित्व संभालते हैं। इन प्रभागों को विभिन्न अनुभाग, कक्ष एवं इकाई अनुसंधान कार्यों में निम्नलिखित प्रकार से सहायता करते हैं :

## नदीय पारिस्थितिकी एवं मात्स्यिकी प्रभाग

बैरकपुर मुख्यालय स्थित यह प्रभाग देश की नदीय तथा ज्वारनदमुख की पारिस्थितिकी तथा मात्स्यिकी के प्रबंधन हेतु प्रभावकारी योजनाओं के विकास तथा 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

यह प्रभाग 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 संबंधी विषयों पर अनुसंधान करता है। साथ ही इस प्रभाग के दायित्वों में पारिस्थितिकी पुनरूत्थान हेतु जैवरसायन, सूक्ष्मजैविकी एवं जैव प्रौद्योगिकी द्वारा परितंत्र का अनुमापन, मात्स्यिकी एवं जलकृषि संबंधी जलवायु परिवर्तन पर शोध, मत्स्य सम्पदा एवं मत्स्य संसाधन से संबंधित डेटाबेस तैयार करना एवं अंतर्स्थलीय मत्स्य सम्पदाओं के सत्त उपयोग हेतु मॉडल का विकास करना है।

## 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

यह अनुभाग देश के विभिन्न अंतर्स्थलीय जल संसाधनों में सामाजिक–आर्थिक, संस्थागत एवं अन्य विषयों पर अनुसंधान करता है। इस अनुभाग द्वारा जलाशयों, नदियों, आर्द्रक्षेत्रों और ज्वारनदमुखों पर निर्भरशील मछुआरों के सामाजिक–आर्थिक जीवन स्तर का मूल्यांकन करता है। यह अनुभाग बैरकपुर में स्थित है और देश के अन्य कई भागों में इसकी परियोजनायें चल रही हैं।

## अनुसंधान सहायक सेवायें

संस्थान की विभिन्न गतिविधियों में निम्नलिखित अनुभाग/कक्ष/इकाई सहायता करते हैं –

**प्राथमिकता, अनुमापन व मूल्यांकन इकाई (PME Cell) –** इस कक्ष का कार्य संस्थान एवं इसके अनुसंधान कार्यकलापों की प्राथमिकता तय करना और इनका अनुमापन व मूल्यांकन करना है। इस कक्ष द्वारा पंचवार्षिक पुनरीक्षण दल (QRT), अनुसंधान सलाहकार समिति (RAC) और संस्थान सलाहकार समिति (IRC) के समन्वयन और दिये गये सुझाावों के अनुपालन में सहयोग देना है। यह कक्ष विभिन्न प्रकार की तकनीकी रिपोर्ट, छमाही न्यूजलेटर, पैम्फलेट, ब्रोशर, लिफलेट और वार्षिक प्रतिवेदन को प्रकाशित करने का कार्य करता है साथ ही यह आर. पी. पी. फाइल एवं वैज्ञानिक प्रकाशनों आदि की देख–रेख भी करता है। इस कक्ष के अन्य कार्यों में संसदीय प्रश्नों, लेखा परीक्षक प्रश्न और परिषद् द्वारा पूछे गये प्रश्नों का उत्तर देना है। संक्षेप में, यह कक्ष निदेशक को संस्थान के उत्तम प्रबंधन में संस्थान के विभिन्न कार्यकलापों में योजना एवं कार्यान्वयन द्वारा सहयोग प्रदान करता है। इस कक्ष को विभिन्न अनुसंधान विभाग, प्रशासनिक एवं वित्त अनुभाग द्वारा सहयोग दिया जाता है।

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

**तकनीकी इकाई –** तकनीकी कक्ष द्वारा परिषद् तथा मात्स्यिकी प्रभाग को भेजी जाने वाली सभी प्रकार की रिपोर्ट तैयार की जाती हैं। इस कार्य में संस्थान के विभिन्न अनुसंधान प्रभागों, प्रशासनिक एवं लेखा अनुभाग का भरपूर योगदान होता है।

**सूचना प्रौद्योगिकी एवं ऐरिस इकाई –** 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 जैसे कम्प्युटर की खरीद, रख–रखाव, ई–गवर्नेन्स सुविधा, सस्थान के वेबसाइट बनाना एवं इसका रख–रखाव तथा कम्प्युटर/सर्वर के लिये सिक्युरिटी सिस्टम की व्यवस्था की जाती है। इस कक्ष में लाइनक्स सर्वर, डी–लिंक स्विच, सिस्को राउटर, पिक्स फायरवाल, सिस्को वाई फाई, वर्क्सस्टेशन, प्रिंटर, स्कैनर एवं अनेक लाइसेंस वाले सॉफ्टवेयर की सुविधा उपलब्ध है। इस कक्ष द्वारा सभी प्रादेशिक केन्द्रों को अरनेट/वीसैट (ERNET/VSAT) की सुविधा उपलब्ध कराई गई है ।

**पुस्तकालय व सूचना अनुभाग –** संस्थान का पुस्तकालय वस्तुतः मुख्यालय व अनुसंधान केन्द्रों में कार्यरत वैज्ञानिकों की आवश्यकताओं के अलावा अन्य संगठनों के शोधकर्ताओं, प्राध्यापकों, विद्यार्थियों तथा अधिकारियों को भी अपनी सेवायें उपलब्ध कराता है। वर्ष 2012–2013 के दौरान संस्थान के पुस्तकालय में 837 पुस्तकों, जिसमें 613 हिन्दी की हैं, को सम्मिलित किया गया है। इस वर्ष हिन्दी पुस्तकों की खरीद निर्धारित लक्ष्य के अनुसार हुई। इस समय पुस्तकालय में कुल 14,243 पुस्तकें जिनमें 2413 हिन्दी पुस्तकें हैं, और अन्य प्रकाशन जैसे पुनर्मुद्रित लेख, मानचित्र और विविध प्रकाशनों का संग्रह है। इस वर्ष 17 विदेशी जरनल और 26 भारतीय जरनल मंगवाये गये। पुस्तकालय में उपलब्ध पुस्तकों एव अन्य प्रकाशनों का पूर्ण डिजिटाइजेशन कार्य भी किया जा रहा है तथा संस्थान के वेबसाइट पर इन पुस्तकों एव अन्य प्रकाशनों को डाला गया है जिससे इन्हें डाउनलोड किया जा सके। पुस्तकालय आधारित सॉफ्टवेयर, लिबसिस (LIBSYS) को प्रारंभ किया गया है। इसमें अंग्रेजी भाषा वाली पुस्तकों से संबंधित जानकारियाँ उपलब्ध हैं। ।

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

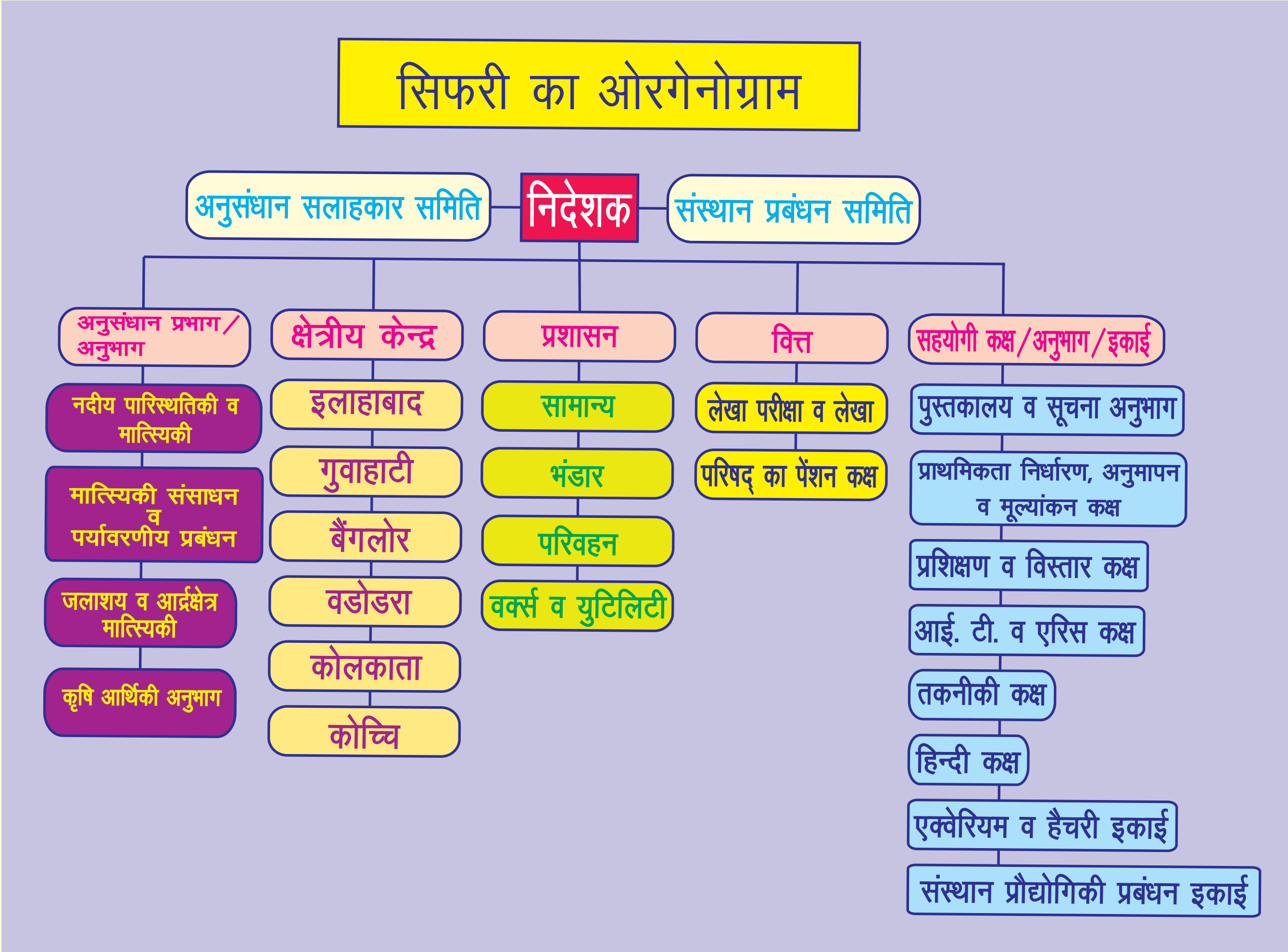
**एक्वेरियम और हैचरी इकाई –** संस्थान में स्थापित एक्वेरियम तथा हैचरी की देख–रेख इस इकाई द्वारा की जाती है।

**हिन्दी इकाई –** यह कक्ष तकनीकी प्रलेखों, 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।

**प्रशासनिक अनुभाग –** यह अनुभाग संस्थान मुख्यालय और इसके विभिन्न केन्द्रों के संपूर्ण प्रशासनिक कार्यकलापों को नियंत्रित करता है। इस अनुभाग के अंतर्गत कार्यरत अन्य भाग संस्थान के अनुसंधान और समस्त अधिकारियों एवं कर्मचारियों के प्रशासनिक कार्यकलाप करता है।

**वित्त एवं लेखा अनुभाग –** इस अनुभाग द्वारा संस्थान एवं इसके विभिन्न केन्द्रों के संपूर्ण वित्तीय रेकार्ड का रखरखाव और वित्तीय कार्यकलापों को नियंत्रित किया जाता है।

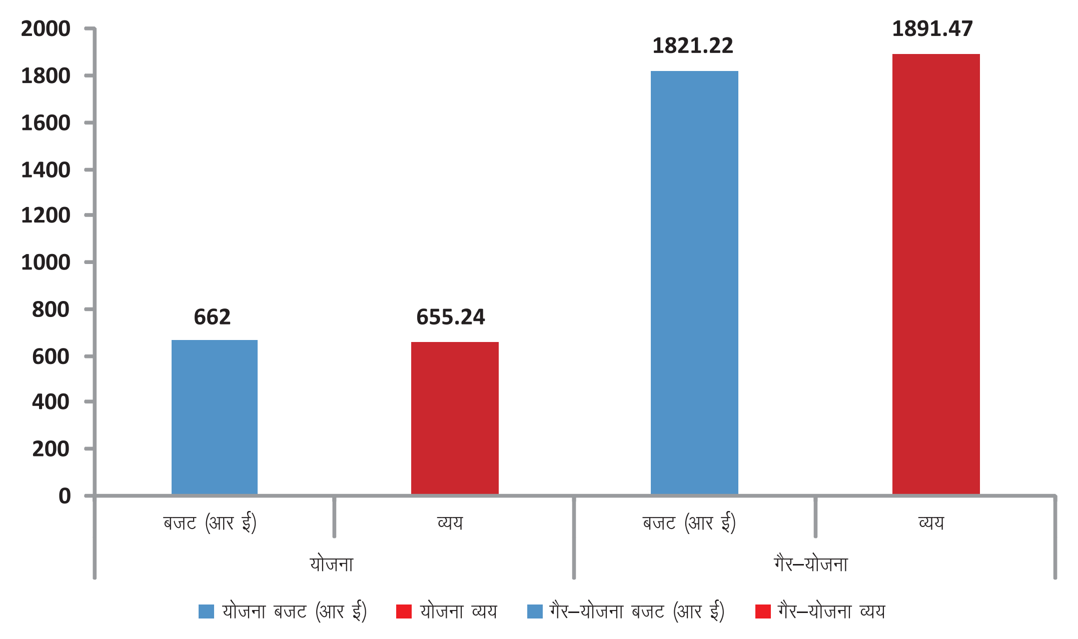
संस्थान का प्रमुख अनुसंधान प्रबंधन पद निदेशक का होता है। संस्थान प्रबंधन का सम्पूर्ण दायित्व निदेशक की अध्यक्षता में गठित प्रबंधन समिति का है। अनुसंधान सलाहाकार समिति, संस्थान के अनुसंधान तथा विस्तार कार्य हेतु विशेष आवश्यक सुझाव देती है जो संस्थान की अनुसंधान परियोजनाओं के विकास एवं सुधार में सहयोग देता है। संस्थान की अनुसंधान परियोजनायें मुख्यालय बैरकपुर तथा प्रादेशिक केन्द्रों इलाहाबाद और गुवाहाटी तथा अन्य अनुसंधान केन्द्र बैंगलोर, वडोदरा, कोच्चि और कोलकाता से कार्यान्वित होती हैं। संस्थान के संगठनात्मक ढांचे को अगले पृष्ठ पर दिखाया गया है –


सिफरी का ओरगेनोग्राम
अनुसंधान सलाहकार समिति
निदेशक
संस्थान प्रबंधन समिति
अनुसंधान प्रभाग/अनुभाग
नदीय पारिस्थितिकी व मात्स्यिकी
मात्स्यिकी संसाधन व पर्यावरणीय प्रबंधन
जलाशय व आर्द्रक्षेत्र मात्स्यिकी
कृषि आर्थिकी अनुभाग
क्षेत्रीय केन्द्र
इलाहाबाद
गुवाहाटी
बैंगलोर
वडोडरा
कोलकाता
कोच्चि
प्रशासन
सामान्य
भंडार
परिवहन
वर्क्स व युटिलिटी
वित्त
लेखा परीक्षा व लेखा
परिषद् का पेंशन कक्ष
सहयोगी कक्ष/अनुभाग/इकाई
पुस्तकालय व सूचना अनुभाग
प्राथमिकता निर्धारण, अनुमापन व मूल्यांकन कक्ष
प्रशिक्षण व विस्तार कक्ष
आई. टी. व एरिस कक्ष
तकनीकी कक्ष
हिन्दी कक्ष
एक्वेरियम व हैचरी इकाई
संस्थान प्रौद्योगिकी प्रबंधन इकाई

# बजट

संस्थान का बजट : वर्ष 2012-2013 (लाख रू. में)

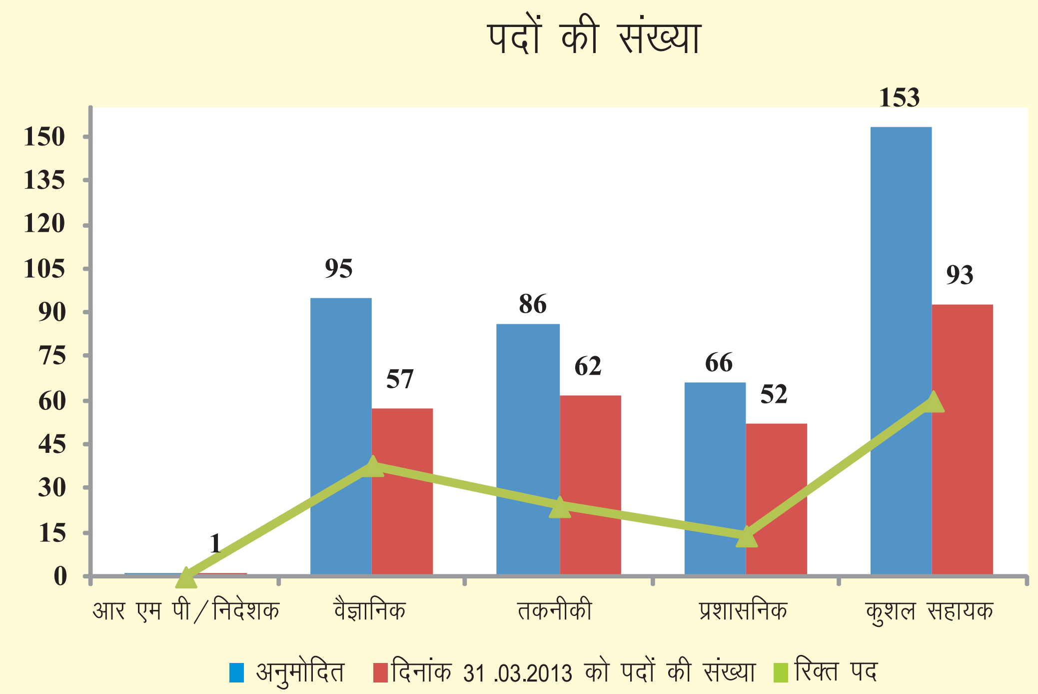
| लेखा शीर्ष | संशोधित बजट | | व्यय | |
|---|---|---|---|---|
| | योजना | गैर–योजना | योजना | गैर–योजना |
| वेतन व अन्य भत्ते (समयोपरि भत्ता सहित) | 00.00 | 1701.00 | 0.00 | 1634.00 |
| यात्रा भत्ता | 60.00 | 7.00 | 60.00 | 6.99 |
| अन्य खर्च (सूचना प्रौद्योगिकी एवं मानव संसाधन विकास सहित) | 542.00 | 180.47 | 535.25 | 176.65 |
| वर्क्स | 60.00 | 3.00 | 59.99 | 2.98 |
| कुल योग | 662.00 | 1891.47 | 655.24 | 1821.22 |



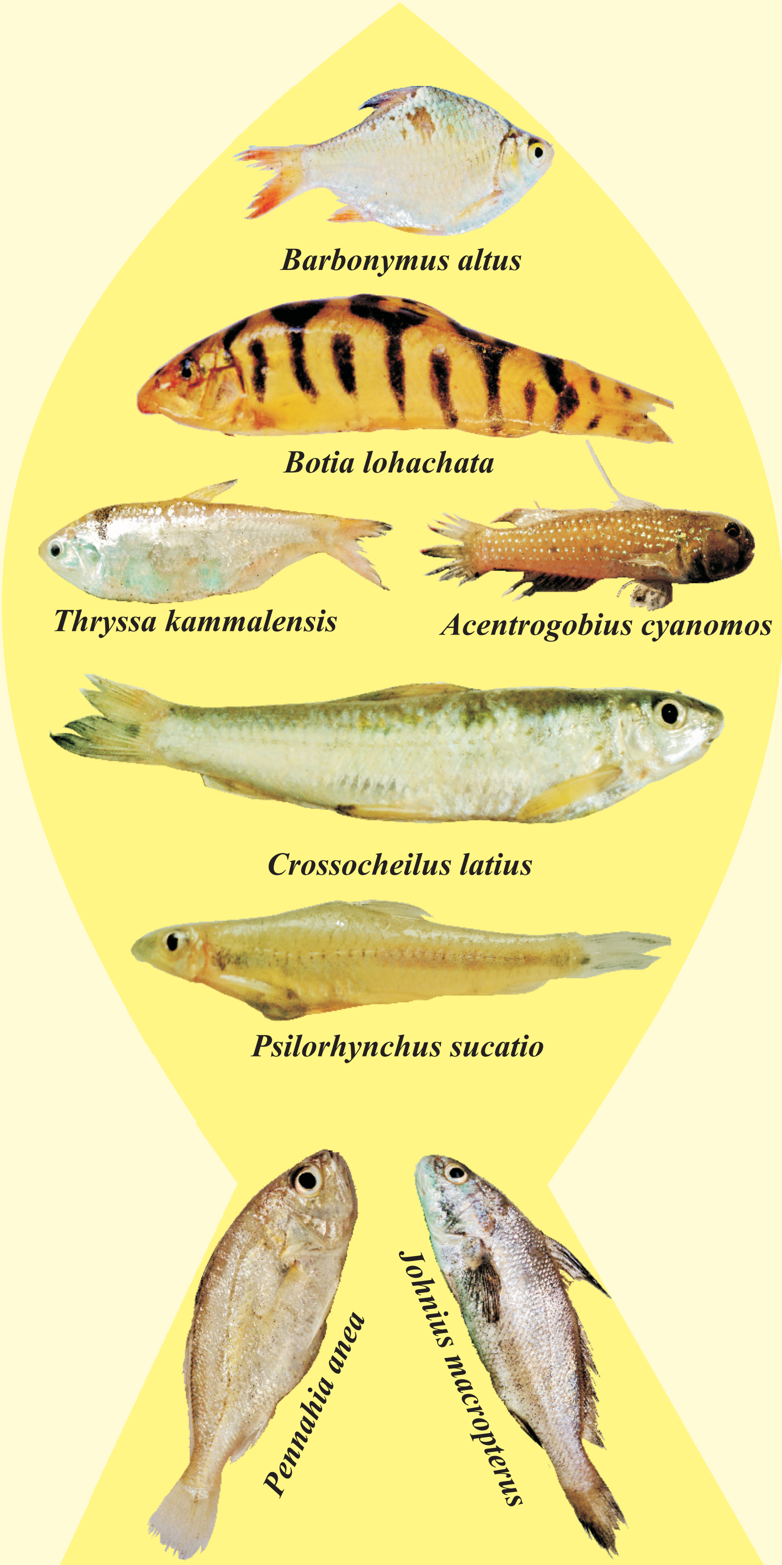
# संस्थान के अधिकारी व कर्मचारी

## दिनांक 31 मार्च 2013 तक संस्थान में अधिकारियों व कर्मचारियों की संख्या

| वर्ग | स्वीकृत पदों की संख्या | भर्ती हुये पदों की संख्या | रिक्त पदों की संख्या |
|---|---|---|---|
| निदेशक (अनुसंधान प्रबंधन पद) | 1 | 1 | - |
| वैज्ञानिक | 95 | 57 | 38 |
| तकनीकी | 86 | 62 | 24 |
| प्रशासनिक | 66 | 52 | 14 |
| सपोर्ट स्कील्ड स्टाफ | 153 | 93 | 60 |
| कुल | **401** | **265** | **136** |



# NEW RECORDS OF FISH FROM HOOGHLY-MATLA ESTUARINE SYSTEM



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