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2013-2014

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(भारतीय कृषि अनुसंधान परिषद्)
बैरकपुर, कोलकाता–700120, पश्चिम बंगाल
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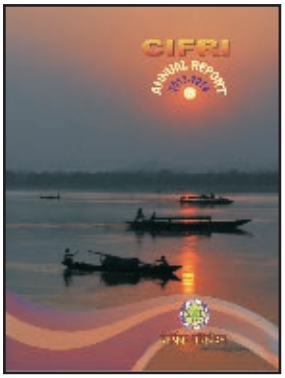

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Preface

The Central Inland Fisheries Research Institute during the year under report consolidated its research programs and other activities, which were started during the 12th Plan. It continued to give major emphasis on research projects dealing with habitat alteration, degradation and invasion of alien species, which affect the ecological integrity of rivers. Efforts were made to estimate the environmental flows in rivers to support policy measures for their eco-restoration. In this context, research data are also collected on water quality of rivers Ganga and Mahanadi to strengthen the database to develop management plans. Estuarine systems support rich biodiversity and therefore the Institute laid importance on its research components on assessment of environment, biodiversity and fish stock dynamics in the selected estuarine systems, both in east and west coasts. There is still good potential for increasing fish productivity from reservoirs in the country. The present focus is on developing protocols which can increase productivity in a responsible manner. The implementation of CIFRI technical guidelines in a large number of reservoirs has led to substantial increase in fish production from reservoirs in a sustainable manner. Further, the Institute could conduct successful trials on cage culture in reservoirs for production of table size fish. The Institute will continue its efforts to disseminate enclosure culture technology at national level for wider adoption. Massive program in partnership mode in north east region was taken up during the year for pen and cage culture by Guwahati centre of the Institute. Floodplain wetlands are ecologically important water resources warranting eco-restoration as well as responsible fish production. Data were collected from a number of wetlands for preparing sustainable management guidelines for fisheries and livelihood enhancement of fishers. Valuation of ecological goods and services of wetlands is also being attended to achieve the above goal. The impact of climate variability on spawning of major fish species has been studied in States of West Bengal, Odisha, Bihar, Chattisgarh, Uttarakhand and Andhra Pradesh. Effect of recent cyclone Phailin on Chilika lagoon, Odisha has been evaluated.

Stock assessment of hilsa has been carried out under BOBLME network project and a major research program has been taken up by the Institute for stock characterization, captive breeding, seed production and culture of hilsa, in network mode with other ICAR fisheries Institutes and Viswa Bharti University, West Bengal. A database on nutrient profile of food fishes has been developed under the outreach activity on nutrient profiling on fish.

Apart from research carried out under Institute based projects, work was also carried out through a number of sponsored projects and consultancies during the year. Institute worked in collaboration with consortia of seven IITs led by IIT Kanpur on Ganga river basin management plan. The consortium drew the historical data generated by the Institute on river Ganga, specially the fish biodiversity, to prepare its management plan for MOEF. Similarly, CIFRI established linkage with NOFIMA, Norway for strengthening its program on hilsa culture in South Asia.

The Institute has also provided technical knowhow to the various States for development of cage culture in reservoirs including demonstration of cage culture in the State of Himachal Pradesh. During the year CIFRI took many HRD initiatives, infrastructure development and capacity building to create conducive working environment.

I have the privilege of acknowledging the constant support received from Dr S. Ayyappan, Secretary, DARE and DG, ICAR. I am also grateful to Dr. (Mrs) B Meenakumari, DDG (Fisheries), Dr. S. D. Singh ADG (I. Fy.), Dr. Madan Mohan ADG (M. Fy.) as well as other scientists and officers at SMD who extended complete support in the execution of the programs of the Institute. All activities furnished in this report have been carried out by the Scientists and other staff members of the Institute. I put on record my profound gratitude to all of them. The efforts of Dr. S. K. Manna and his team in preparation of this document is commendable and acknowledged.

Barrackpore, Kolkata - 700120
Dated 8th July 2014

A P Sharma
Director

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 51 scientific, 60 technical, 50 administrative and 83 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 2013-14, 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 executed successfully. The major research findings of these projects are summarized below:

Riverine and Estuarine Ecosystems and Fisheries

- A field survey conducted in Namkhana block revealed drastic reduction of small indigenous fish (SIF) species in Sunderbans due to natural catastrophy like Aila, intensive carp culture and human activities. Conservation of locally available small indigenous fish has been initiated with community participation at Madanganj, Namkhana. *Amblypharyngodon mola* was found to breed three times in a year, viz. in March, July-August and in October.
- In Sunderbans the mangrove *Avicennia alba* produced highest amount of leaf litter (414.37 g m^{-2}), followed by *Bruguiera gymnorrhiza* (410.43 g m^{-2}). *Avicennia officinalis* litter was richer with respect to phosphorus content than *A. alba, S. apetala* and *E. agallocha* litters. Decomposition study of one month duration revealed that the mangrove *Excoecaria agallocha* leaves lost >80% of its initial weight contributing significantly in available nutrient pool of the ecosystem. Organic carbon accumulation (average 1.49%) in soil was highest in December and lowest (average 0.43%) in summer.
- Dominance of prawns (>90%), over fish, was observed in set barrier catch around Jharkhali, Sunderbans during pre-monsoon with maximum contribution from *Fenneropenaeus indicus*. The size of Bombay duck, which formed a major fishery from bag net catch ranged from 35 mm to 234 mm. Bulk of the fish catch constituted by juveniles are raising concern for sustainable fisheries of the species.
- A record of 70 fish species belonging to 50 genera and 21 families were recorded in the studied stretches representing upper, middle and lower zone of river Mahanadi during early post-monsoon. Interestingly, out of 70 species, 8 species in the lower zone, 6 in the middle zone and 36 in the upper zone were local inhabitants, while 20 species were common to all the zones.
- The hydrograph of river Mahanadi showed peak flow, lean flow and flood pulse representing monsoon flow from late June to early November. In the month of August, there was a flood pulse which helped migration of fish species between main channel and Ansupa wetland.
- Redundancy analysis (RDA) established the association of biotic parameters (fish, macrozoobenthos and periphytic community) with water quality parameters (velocity, silicate and total dissolved solids) showing inclination of abundance of fish, periphyton and macrozoobenthic population

towards total dissolved solids, silicate concentration and water velocity.

- Flow data of the river Ganga at Haridwar for last 34 years showed that the incoming and discharge water volumes during monsoon were 1886.86 and 1618.76 cumecs, and 376.75 and 176.62 cumecs, respectively during non-monsoon months. Significant variation in certain key water quality parameters were observed at upstream and downstream stretches of the river Ganga at Tehri dam and Kanpur barrage sites, due to obstruction of the river and related modifications.
- A total of 123 fish species belonging to 77 genera, 30 families and 10 orders were documented from the river Ganga. Thirteen fish species, viz. *Setipinna brevifilis, Aspidoparia jaya, Garra mullya, G. annandalei, G. gotyla, Salmophasia scinaces, Barilius vagra, B. tileo, B. shachra, B. barna, Nemachelius corica, Badis badis* and *Megarasbora elanga* were recorded for the first time from river Ganga.
- The fish landings from Allahabad stretch of the river Ganga was estimated at 169.72 t during the period. The catch was dominated by miscellaneous group of fishes (33%), followed by exotic (30%), IMC (25%) and cat fishes (12%).

Reservoir and Wetland Ecosystems and Fisheries

- Impact assessment study conducted in two wetlands of west Bengal revealed higher fish species richness (29 species) and lower fish yield (*214-322kg/ha/yr)* in Kholsi compared to Akaipur (15 species; *620.91kg/ha/yr*) with domination of species belonging to Cyprinidae. Indigenous fishery was mainly constituted by *Puntius* spp (56.38%) and *Trichogaster* spp (19.5%) in Kholsi beel and only by*Puntius spp (60%) in Akaipur beel.* Both the wetlands were managed by fishers cooperative following enhancement practices using seeds of IMC and exotic carps. Fishing pressure (active fishermen population, fishing intensity, number of craft and gear used) were higher in Akaipur beel. Closed nature, shallow depth, stocking enhancement and drag netting increased fish yield in Akaipur beel with an adverse impact on indigenous fish diversity showing low Shannon diversity index (H'- 2.01) while seasonally open nature and use of size selective gill net has helped Kholsi wetland to sustain more natural fish diversity (H'- 2.17).
- Impact of fish stock enhancement on fisheries and ecology was assessed in Dhir, Sukdol-Sarubori (unstocked), Tariachara, Mer and Damal (stocked) beels in Assam. In unstocked beels smaller Cyprinids (*Puntius* spp., *Labeo gonius, Cirrhinus reba*, *Psilorhynchus* spp.) were the main contributor to total fish catch followed by *Wallago attu* (10%) and other miscellaneous fishes (e.g., *Colisa* spp., *Mystus* spp.). Indian major carps, grass and common carps contributed only up to 11% of fish catch. Stocked fishes (IMC, exotic carps) were the main contributors (55-70%) in stocked beels.
- Income from fisheries was 47% higher in shallow un-stocked beel over shallow stocked beel and 5% higher over that in deep, stocked beel. Annual employment from fisheries was calculated as 102, 84 and 176 man-days for shallow un-stocked, shallow stocked and deep-stocked beels respectively. Employment from fisheries was 18% and 14% higher in shallow unstocked beel over that from shallow stocked, and deep stocked beels.
- Demonstration and up-scaling of pen culture technology in Uttar Pradesh was carried out in two closed wetlands, viz., Majihar *jheel* (48.00 ha) and Sareni *jheel* (18.00 ha) in Rae Bareilly district. Pens were stocked with advance fry measuring 2.88g (*Labeo rohita*) and 2.1g (*Catla catla*) at the stocking density

of 25 no/m^2 in October 2013 in the beels which increased to 57.2g and 67.38g in Sareni and 54.25g and 65.96g in Majihar *jheel* in March. Feed conversion ratio was 1.08 in Sareni and 1.17 in Majihar while benefit cost ratio was calculated as 1.64 and 1.69 respectively. Return on investment was more for Sareni *jheel* (0.69) than Majihar *jheel* (0.64) indicating that pen culture is beneficial in these wetlands.

- The Krishnarajasagar reservoir on river Cauvery was assessed to be moderately productive. A total of 38 fish species belonging to 13 families were recorded through experimental fishing. The α diversity measured by Shanon-Weiner diversity (H') was 2.26, and increased from lotic (1.78) to lentic zone (2.49). The Pielou's index, a measure of species evenness, was 0.62 for the reservoir and also increased from lotic (0.53) to lentic sector (0.71), indicating that the fish community in the lentic zone is more diverse. The fish richness diversity of the river was similar to that of the reservoir.
- Walayar (259 ha), a small seasonal reservoir in Kerala, was assessed to be eutrophic through Carlsson trophic state index for Seechi disc transparency and chlorophyll *a*. The recorded maximum production was found to be 70kg/ha against production potential of 130 kg/ha. Fourteen fish species were recorded in the experimental fishing with multi-meshed gillnets, with the native species represented by *Puntius filamaentosus, P. sophore, Mystus armatus* and *M. cavasius*. The fish diversity increased from lentic to lotic zone.
- An Electronic Data Acquisition System (e-DAS) has been developed to facilitate faster collection of fish catch data from inland water bodies and is under field trial stage.
- Mass-balance models of Hemavathy reservoir, Karnataka were constructed using trophic status and energy flow estimates for 1982-83 and 2002–2003 and Ecopath software which showed the impact of stocking on stocked fishes, major carp and exotic carp. Catfishes have a negative impact on all other fish species except gobids in post-stocking phase, whereas they exerts a positive impact on eels, exotic carps and minor carps in pre-stocking phase. The higher order indices of ecosystem functioning showed that the pre-stock phase food web was less developed and the post-stock food web was the most developed.

Fish and Environment Health

- Environmental impact assessment study conducted at downstream of Hirakud dam in Mahanadi showed slight impairment in 40% of the studied river stretch with moderate impairment in 60% of the stretches. At the sites with hydrological alterations, the IBI scores were low indicating impacts of impaired flow on ecological and biotic integrity. Comparison of water and sediment quality with that during 1995-96 indicated similar quality with slight increase in phosphate level in water and organic carbon content in sediment of lentic areas.
- The studied stretch of river Mahanadi was free from metal pollution (Cd, Cu, Mn, Pb and Zn). In sediments, only copper was recorded to cross the mild pollution level of 25 ppm in some occasions. Fish fleshes were recorded to be safe from metal and organochlorine pesticide accumulation.
- Two bacterial strains, identified as *Pseudomonas* sp., were found to degrade 600-700 ppm resorcinol in sewage in 2-4 days proving their pollutant degradation capability. Five triclosan (a widely used antimicrobial preservative) degrading bacteria were isolated and identified as *Pseudomonas aeruginosa*, *Citrobacter freundi*, and *Enterobacter* sp.

- Transcript information on heat shock proteins (HSPs) of freshwater catfish *Rita rita* has been generated. GC-MS fingerprints of foot, gill and mantle tissues of bivalve mollusk *Lamellidens marginalis* have been generated which would be used as a baseline data for searching lipid biomarkers for pollution monitoring.
- Proteomic biomarkers for hepatotoxicity and chronic liver disease caused by chronic arsenic toxicity have been identified as Apo-A1 (Apolipoprotein-A1), A2ML (α-2 macroglobulin-like protein) and Wap65 (warm-temperature acclimation related 65kDa protein).

Fisheries Resource Assessment

- Change deduction analysis in Hooghly estuary using IRS - P6 LISS III high resolution satellite sensor data revealed complete change, slight change and no change in 12.35%, 70.43 % and 17.2% of total study area respectively during 2004 to 2012. The predominant change includes land use pattern in the catchment area and estuarine sedimentation. The four islands viz. Gharamara, Nayachar, Gangasagar and Jammu situated in Hooghly sea mouth lost 13.63%, 5.88%, 2.94% and 28.31% of their land areas respectively.
- An ARIMA based forecasting model has been developed to forecast Hilsa fisheries in Narmada estuary. Out of seven hydrological factors, two main factors "spawning habitat availability potential" and "spawning habitat quality potential" were derived to explain total hydrological variability in the Narmada estuary. Spawning habitat availability (maximum observable flood) appears to be the most influential factor of hilsa catch having direct relationship. In present hydrological regime prevailing in the Narmada estuary the hilsa fishery may decline drastically. However, a 5% increase of river flood pulse through water release from dam during spawning migration is predicted to increase the hilsa catch by13% in the Narmada estuary.
- Dual cycle, ARIMAX and Level Shift models have been developed to find out the impact of opening of new mouth in Chilika lagoon on major fish species and for forecasting of finfish and shellfish fisheries in the lagoon.

Fisheries Socio-Economics

- Investigation on institutional arrangement of reservoir fisheries in the state of Uttar Pradesh showed that ownership of reservoirs was distributed between irrigation department (over 45 reservoirs) and Fisheries department (40 reservoirs). Fisheries management rights of reservoirs operates based on revenue system of fisheries governance model with rights distributed in the order of Dept. of Fisheries (75%), > UP Fisheries Development Corporation (14%)> UP Fisheries Cooperative Federation (11%). Lease was granted for three to five years period depending on class of water bodies. The right to fisheries management is granted through open auction system to the highest bidder.
- In Indirasagar reservoir the fisheries is managed on the line of Peoples-Public-Private Partnership (P4) model. The fishing right in the reservoir lies with members of cooperative societies (community) who belong to fishermen community only. Fisheries are governed by the rule and regulation made by the government time to time and monitored by Regional Manager, MP Matsya Mahasangh (public). The private participation came in the form of lessee who collects the fish from the fishers on the rate fixed by the government and sells it to the distant market, with reasonable restriction.

- The potential economic loss through destruction of 28 non targeted fish species while collecting shrimp seeds in just 2 km stretch of Bakkhali region of Sunderbans, was estimated at Rs. 6.72 crores per year.

Outreach projects

- A feed formulation containing 34% crude protein was developed and tested in *Catla catla* and *Cyprinus carpio* during winter and summer. The live weight gain was found to be better in *C. carpio* in winter, while better performance was recorded with *C. catla* in warmer temperature.
- A feed formulation with floating capability of 96 % for 3 hours and 68% for 24 hours has been developed using brewery waste as a cost effective alternative feed ingredient. The feed pellet was found to be stable with minimum swelling after 8 hours of floatation and physically intact for 18-24 hours. The feed formulated with brewery waste showed better performance in terms of higher live weight gain in *Labeo bata*, over the soybean meal based diet, in cages in Maithon reservoir of Jharkhand state.
- A database on "Nutrient Profile of Food Fishes from India" has been developed.
- Analysis of Molecular Variance (AMOVA) of cytochrome *b* gene sequences of *Catla catla* from Guwahati, Allahabad, Patna, Farakka, Nabadwip and Bharuch revealed that out of total variation, 69.93% was attributed to variation within populations, while 30.07% was attributed to variation among populations.
- Gonado-sometic index (0.5-7.8%) and Gastro-somatic index (2.6-4.7 %) of *Labeo gonius* from river Brahmaputra in Assam showed a wide individual variation.

ICAR Network Projects

- An e-Atlas of fish hatcheries of Uttar Pradesh has been developed with district level information of hatcheries that would help in developing climate-smart fish breeding technology in the state.
- With respect to the base year 1980, there is about 30 mm reduction of minimum length for onset of maturity in female fishes. However, more investigation is required to ensure whether such changes are attributed to climatic change or not.
- Gonado somatic index and the reproductive maturity of Indian major carps, *Labeo rohita*, *Catla catla* and *Cirrhinus mrigala* have advanced by approximately one month in Bihar and Assam.
- Economically and nutritionally important minor carp *Labeo bata (*37.10 ±0.30 °C) is more thermo-tolerant ($p<0.05$) compared to *Labeo rohita (*35.4 ±0.3 °C) indicating better adaptability and suitability of the species for aquaculture at higher temperatures.
- Field studies covering 26 fish seed hatcheries of Kamrup, Nalbari and Barpeta Districts of Assam showed that alteration in the seasonal rainfall resulting in flood and drought had adverse effect on fish seed production in the area. Delayed monsoon and deficit rainfall, especially during March-April have resulted in lower fertilization rates in induced breeding of Indian Major Carps. As an adaptive strategy, >40% of hatcheries bred grass carp (*Ctenopharyngodon idella*) which proved to be a suitable candidate species to breed in deficit precipitation.
- Some bacteria with proven phosphorus releasing activity were identified as *Bacillus aryabhattai*, *Brevibacillus borstelensis, Bacillus megaterium*, *Klebsiella oxytoca*, *Pseudomonas aeruginosa*, *Microbacterium* sp., *Arthrobacter* sp., *Curtobacterium luteum*, *Agrobacterium fabrum*, *Enterobacter asburiae*, *Microbacterium oxidans*, *Acinetobacter* spp., *Stenotrophomonas maltophilia*, *Novosphingobium* sp.

NAIP and NFBSFARA Projects

- A highly salt tolerant bacterium isolated from the sediment of Deuli Bunglow of West Bengal was identified as *Halomonas salina*.
- Whole transcriptome profiling of one high salt stress tolerant bacterium *Staphylococcus epidermidis* has identified 152 salt responsive ESTs from control and 172 salt responsive ESTs. GO sequence distribution of both the bacterial samples showed ~85% contigs related to metabolic processes including carbohydrates and secondary metabolites metabolism, which may contribute to salt adaptation of *S. epidermidis*.
- Gene expression analysis in *Channa striatus* indicated that the *hsp* 60, *hsp* 70 and *hsp* 78 are possibly involved in long term survival of the organism at high temperature and appear to be the key players in thermal acclimation response. There was also a significant increase in expression levels of hsp27, hsp70, β, γ-crystallin and triosephosphate isomerase genes in the fish of hot spring runoff origin.
- Dynamic changes in amino acids composition of *Puntius sophore* under high temperature stress in a hot spring runoff were identified. Significant multifold changes ($p<0.01$) in the concentration of amino acids arginine, phenyl alanine, leucine, histidine and glycine were observed which could possibly be a biochemical adaptation for survival in the heat-stressed environment.
- The total Hilsa catch estimated for the mainstream Hooghly, including the marine sector was 16318 t during 2013-14 with maximum catch coming from the marine sector. Average CPUE (per boat per day) was 200 kg in the marine sector (mechanized), while it was 0.5 to 2.5 kg along the freshwater sector (non-mechanized). Under pond culture trials, fingerlings (size of 50-70 mm) stocked in July in a pond at Godakhali grew to 136-178 mm in five months, while medium sized fish (283 mm size) stocked in December grew to 295 mm size in four months indicating good growth of the fish in pond environment.
- Two farmer groups of Bihar *chaur* have adopted pen culture techhnology through the project initiative. HDPE circular pens was installed and stocked by the fishers groups for table fish production. The harvesting after 10 months of first seed release indicated a targeted production of 2890 kg fish from the chaur. The whole seed production activity in pen followed by stocking of *chaur* indicated a 10 fold increase in fish yield, which could create confidence among the stake holders of this water body.

Central Sector Scheme

- Validation of the methodology of developing and maintaining GIS database through field visits showed an image identification accuracy of 98.28%. A new methodology was worked upon by which an accurate identification and estimation of area for fishery resources is possible.

Introduction

Brief History

Central Inland Fisheries Research Institute (CIFRI) started its journey as Central Inland Fisheries Research Station in Calcutta under the Ministry of Food and Agriculture, Government of India on 17 March 1947 following recommendation of the sub-committee of Central Government on Agriculture, Forestry and Fisheries. The Station 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 laid 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. Presently the Institute is working in Natural Resource Management mode with following mandates:

Mandate

- To undertake basic, strategic and applied research in inland open-water resources *viz.,* rivers, reservoirs, wetlands, 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.
- **Fisheries Resource 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. 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 institutional arrangements and socio-economic aspects of fishers operating in reservoirs, rivers, wetlands and estuaries. The section is 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.

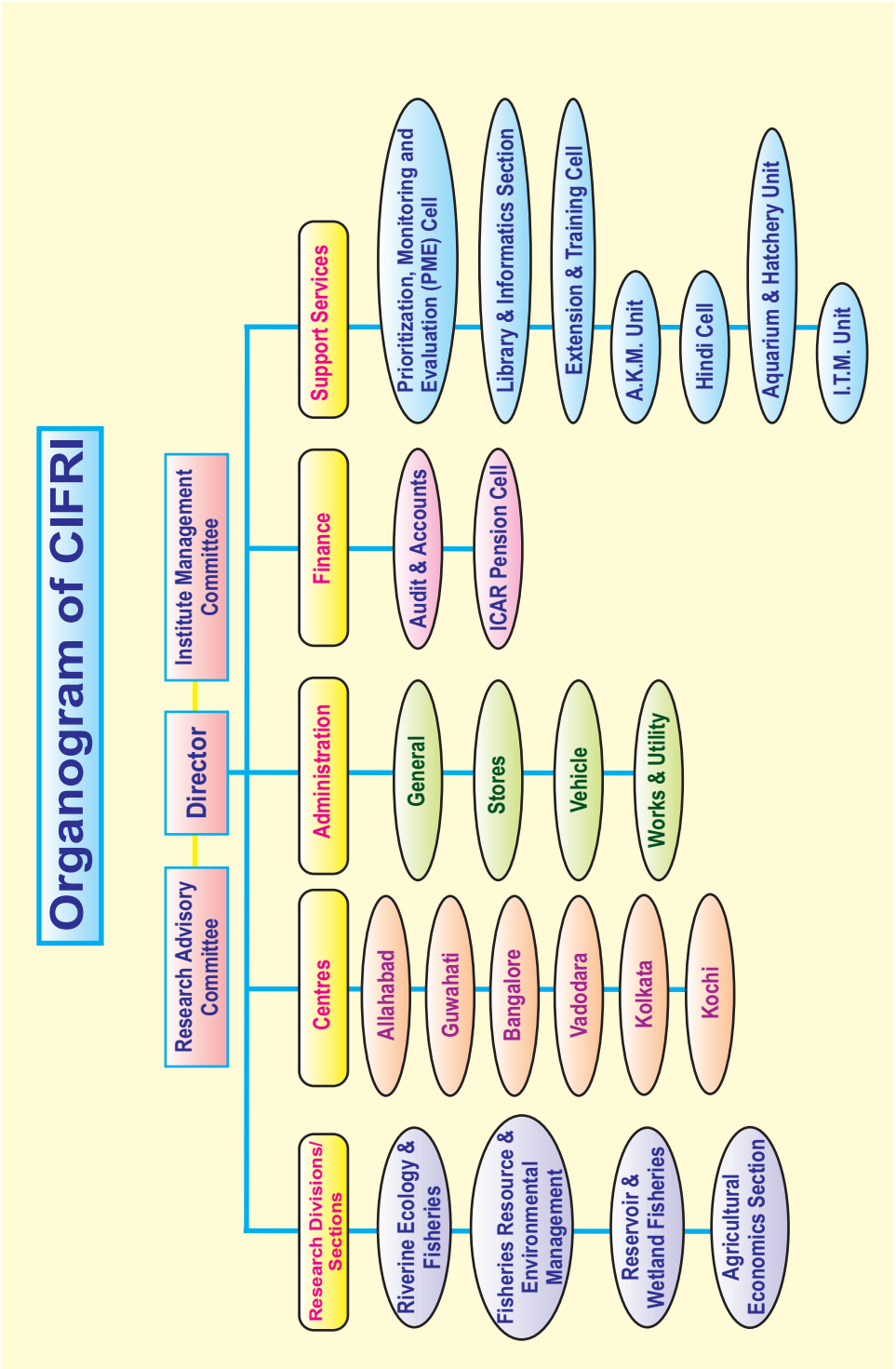
- **Prioritisation, Monitoring and Evaluation (PME) cell** is the major cell to prioritise, monitor and evaluate the research and other activities of the Institute. It coordinates, synthesize and monitor recommendations of QRT, RAC and IRC. It is responsible for coordinating HYPM submission, preparation and submission of Monthly, Quarterly and Half-Yearly Progress Reports to the SMD, management of 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 Subject Matter Division and 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 liaison with other agencies. The institute has aimed at manpower development through this cell.

- **Agricultural Knowledge Management Unit** analyzes the requirements of the Institute and facilitates strengthening of the IT infrastructure by promoting latest IT technologies. 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, managed and unmanaged switches, Router, PIX Firewall and Wi-Fi access points. The Institute is also strengthened with 100 Mbps bandwidth internet connectivity using National Knowledge Network. The Unit is also organizing ICAR ARS/NET examination for ASRB and is strengthened with 100 computers, 2 servers and dedicated 2 Mbps internet connectivity.
- **Library and Informatics Section** facilitates various research activities through procurement, maintenance and issuing of books, journals, project reports, institute publications, etc. During 2013-14, library added a total number of 251 books; subscribed 13 foreign journals and 28 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. All the books have been entered in KOHA under NAIP project for inter-library communication and efficient library management.
- **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. The Cell also carries out various social activities to popularize Hindi language.
- **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
Director
Research Advisory Committee
Institute Management Committee
Support Services
Prioritization, Monitoring and Evaluation (PME) Cell
Library & Informatics Section
Extension & Training Cell
A.K.M. Unit
Hindi Cell
Aquarium & Hatchery Unit
I.T.M. Unit
Finance
Audit & Accounts
ICAR Pension Cell
Administration
General
Stores
Vehicle
Works & Utility
Centres
Allahabad
Guwahati
Bangalore
Vadodara
Kolkata
Kochi
Research Divisions/ Sections
Riverine Ecology & Fisheries
Fisheries Resource & Environmental Management
Reservoir & Wetland Fisheries
Agricultural Economics Section

Budget Details for the year 2013-14 (Rs. in Lakhs)

Head of Account	Budget (R.E.)		Expenditure	
	Plan	Non Plan	Plan	Non Plan
Pay and Allowance Including OTA	-	1701.00	-	1646.12
T.A.	65.00	5.60	65.00	5.55
Other charges including equipment, library books, I.T. and H.R.D	544.50	276.80	531.49	268.10
Works	95.50	-	95.50	-
Grand Total	705.00	1983.40	691.99	1919.77

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

Particular/	Plan			Non-Plan		
Year	2011-12	2012-13	2013-14	2011-12	2012-13	2013-14
Budget(RE)	496.00	662.00	705.00	1708.75	1891.47	1983.40
Expenditure	494.09	655.24	691.99	1625.60	1821.22	1919.77

Staff Position as on 31 March 2014

Category	Sanctioned Strength	Filled up	Vacant
R.M.P	1	1	-
Scientist	95	51	44
Technical	86	60	26
Administrative	66	50	16
Skilled Support Staff	130	83	47
TOTAL	**378**	**245**	**133**

Research Achievements

Programme: Restoration of rivers and estuaries for ecosystem integrity and conservation of fish stock

Project : Population characteristics of small indigenous fishes in coastal waters of Sundarbans in relation to rural livelihood and nutritional security

Investigators: A. Sinha, S. K. Das and A. Roy

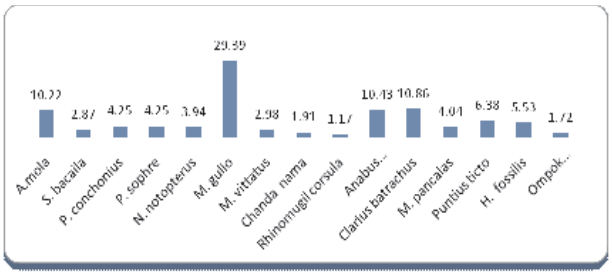
Technical support: A. Mitra, C. N. Mukherjee, D. K. Biswas, A. Sengupta, S. Mazumder and A. Barui

A survey was conducted to analyze the catch and market chain of Small Indigenous Fishes (SIF) in peri-urban and rural fish markets of Sunderbans which revealed an average market arrival of 1.5 to 28.5 kg/month which is much lower than that of IMC and marine fishes. Species wise contribution of different SIF species to market arrival was: *Mystus gulio* (29.39%), C*larias batrachus* (10.86%), *Anabas testudineus* (10.43%), *Amblypharyngodon mola* (10.22%), *Puntius ticto* (6.38%), *Heteropneustes fossillis* (5.53%) and others.

The survey revealed drastic reduction in most of the native fish species following the cyclone Aila in 2009. For conservation and demonstration of SIFs, a community village pond has been developed with community participation and stocked with SIFs (viz. *Anabas testudineus*, *Mystus vittatus*, *Amblypharyngodon mola*, *Puntius ticto, Xenentodon cancila*, *Glossogobius giuris*, *Mastacembelus pancalus*, *Channa punctatus*, *Chanda nama* and *Chanda ranga*), collected from seasonal rain fed canals.

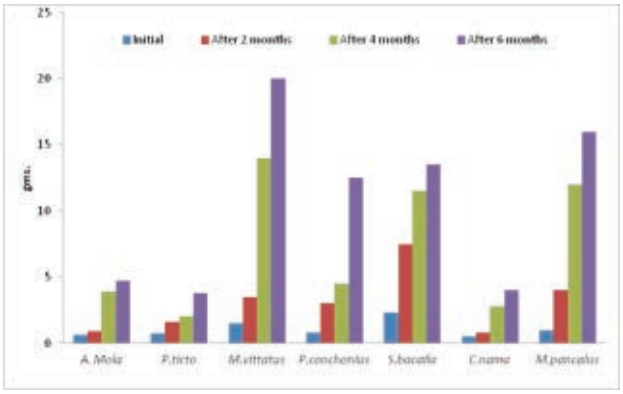
The growth of fish and breeding biology of stocked fishes were studied on monthly basis, alongwith soil and water health studies. Growth of *Amblypharyngodon mola, Salmophasia bacaila and Mystus vittatus* was higher than *Puntius, Chanda and Pancalus*. Highest gonado-somatic index for Mola and Puntius was recorded highest during May-June. Number of young ones was highest for *A. Mola* during January-February. GSI (Gonadosomatic Index), GLI (Gonadal Length Index) and Ova Diameter (OD) frequency indicated that *Amblypharyngodon mola* breeds thrice a year, during July- August, October and March. Female dominated significantly over male throughout the year and overall sex ratio of male and female was 1.00:2.078. Fecundity varied from 1,200 to 13,679, with high fecundity factor (995 eggs g^{-1} of body weight) indicating that the fish is highly fecund. Fecundity was highly correlated ($p < 0.01$) with body length, ovary weight and ovary length.

Market arrivals of SIF in Namkhana area



Species wise contribution of SIF to annual market supply in Namkhana area (in kg)

SIF conservation in ponds at Sundarbans



Growth rate of SIFs

Project : Assessment of environmental variability, nutrient dynamics, biodiversity and fish stock assessment of selected estuarine and mangrove ecosystems

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

Technical Support : R. C. Mandi, C. N. Mukherjee, A. Mitra, A. Sengupta, D. Saha, A. Barui, A. Roychoudhury, S. Mandal, R. K. Shah and J. K. Solanki

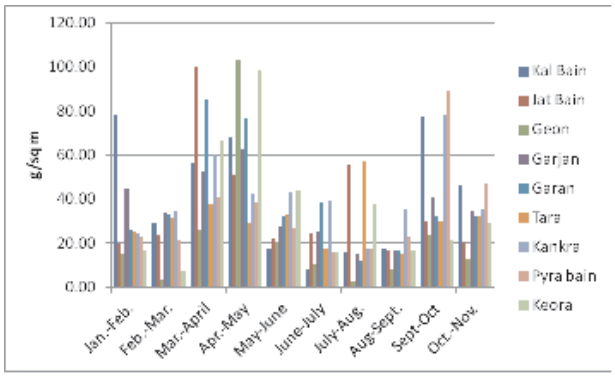
Nutrient dynamics

Availability of nutrients through mangrove litter decomposition was investigated at Jharkhali Island in Sundarbans, South 24 Paraganas, West Bengal. Mangrove plants considered for the study were Kal Bain (*Avicennia alba)*, Jat Bain (*A. marina)*, Pyra Bain (*A. officinalis)*, Garan (*Ceriops decandra*), Garjan (*Rhizophora mucronata)*, Geon (*Excoecaria agallocha)*, Kankra (*Bruguiera gymnorrhiza)*, Taura (*Aegialitis rotundifolia*), Keora (*Sonneratia apetala).* Dry litter masses collected through litter traps from nine predominant species were estimated periodically over the year. *Avicennia alba* was found to shed maximum litter (414.37 g/sq m). The different litter samples were also analyzed in the laboratory for their carbon, nitrogen and phosphorus contents. An *in situ* litter bag decomposition study was made to find out the mass loss from the various litter biomasses on decomposition over time.

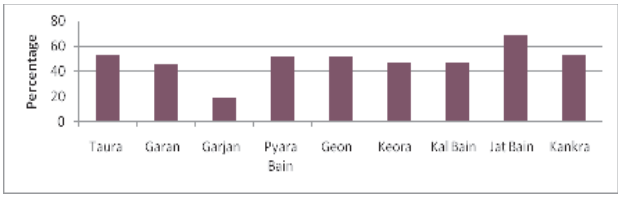
Nutrients load in river were higher during monsoon months as rain washes those nutrients from the adjacent agricultural fields and also from mangrove forest floor. Accumulation of organic carbon in soil was observed in December due to low temperature and higher litter fall whereas in April rise in temperature leads to increased mineralization and loss of soil carbon.

Environmental variability and biological diversity

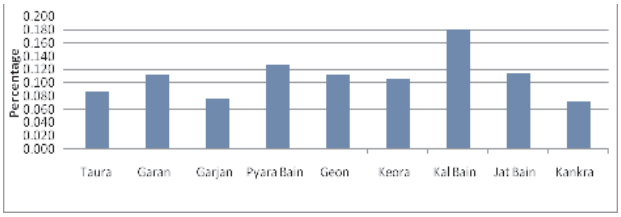
Salinity of river water was highest in April due to low or almost nil freshwater discharge. It declined during monsoon and post-monsoon months. The phytoplankton, *Coscinodiscus* sp. (Bacillariophyceae) was dominant during most of the months. Amongst other phytoplankton families, the Cyanophyceae (*Oscillotoria, Lyngbya, Spilulina* etc.) was recorded in higher density during November. Among the zooplankton, Copepoda (*Cyclops, Diaptomus* etc.) was found to be in higher density, followed by *Cladocerans* and *Nauplii*.



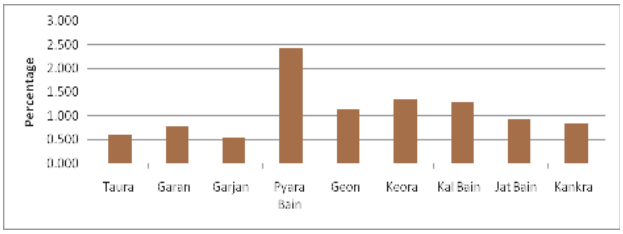
Litter fall at different periods (30 days basis, dry weight)



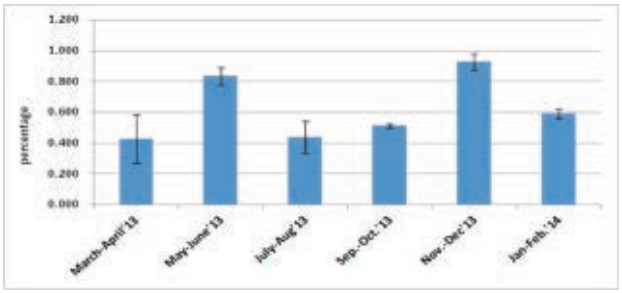
Carbon content (percent) in collected leaf litter



Total nitrogen content (percent) in collected leaf litter



Total phosphorus content (percent) in collected leaf litter



Organic carbon content of soil samples at Jharkhali

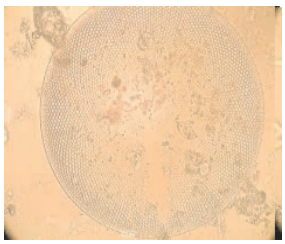
Benthos diversity was recorded less in the Herobhanga river. However, the benthic population was dominated by Gastropod, *Littorina melanostoma* (41.7- 62.5 %), followed by *Nerita articulate* (8.3-50%), *Clithon reticularis, Neritina smithi* and *Pugilina cochlidium*, which are associated with mangroves.

The prawns (>90%), were observed to be higher in set barrier catch around Jharkhali area during pre-monsoon with maximum contribution from *Fenneropenaeus indicus*. The major contributors among fishes were *Coilia ramcarati, Eleutheronema tetradactylum, Thryssa purava, Scatophagus argus, Otolithoides pama, Lutjanus johnii, Anodontostoma chacunda, Ilisha megaloptera, Acanthopagrus latus*, and mullets like *Liza parsia, Liza macrolepis*, etc. Dominance of juveniles of most of the fishes in the catch indicated use of small mesh size net. Dominance of *Setipinna taty*, *Harpadon nehereus* and *Trichiurus lepturus* is indicative of higher salinity regime (13.8 to 29.8 ppt) of Jharkhali area.

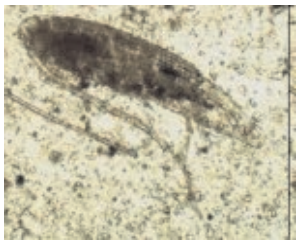
Fish stock assessment

Harpadon nehereus, commonly known as Bombay duck, is one of the main fish species caught by bag net (*behundi jal*) in the Sunderbans, particularly in the winter bag net. The cod end mesh size of the bag nets usually used in the Sunderban area is 1 cm. The length range of the Bombay duck from bag net catch was recorded between 35 mm to 234 mm. The bulk of the catch was constituted by juveniles. About 59% of the Bombay duck catch was in the length range of 51-70 mm. Since first maturity of *H. nehereus* is at 214.5 mm size and a large majority of catch is of smaller fishes, it is a real concern for sustainable fisheries of the species.

Food and feeding habit study of the fish showed that, fish (50%) including juveniles of Bombay duck (indicating cannibalism), shrimps (37%) and semi-digested matter (13%) are the main foods. The fish species observed in the gut contents were *Coilia* spp., ribbon fish, mullets (*Liza* spp.), clupieds, *Bregmaceros mcclellandi* etc.



Coscinodiscus sp.



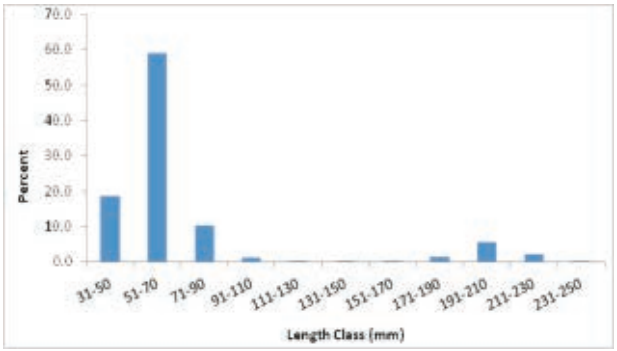
Diaptomus sp.

Littorina melanostoma

Nerita articulata

Setipinna taty *Harpadon neherius* *Trichiurus lepturus*

Bagnet catch with dominance of *Harpadon nehereus*



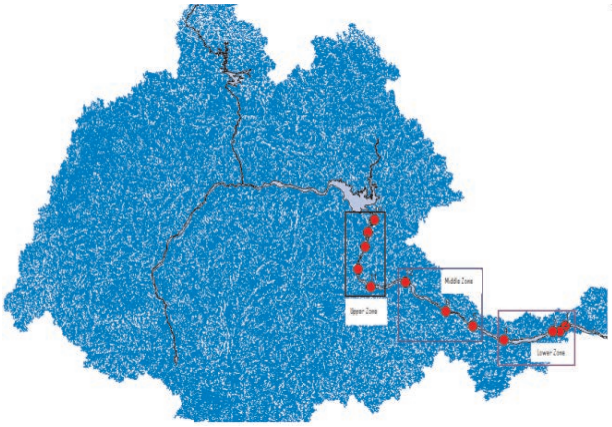
Size composition of Bombay duck from bag net catch

Project : Quantification of environmental flow requirements for ecosystem functions, including biodiversity and fisheries of selected rivers

Investigator : A. K. Sahoo, D. Karunakaran, Anjana Ekka, Roshith, C. M. and Soma Das

Technical Support: A. Sengupta, D. Saha, A. Barui, A. Roychowdhury and S. Mandal

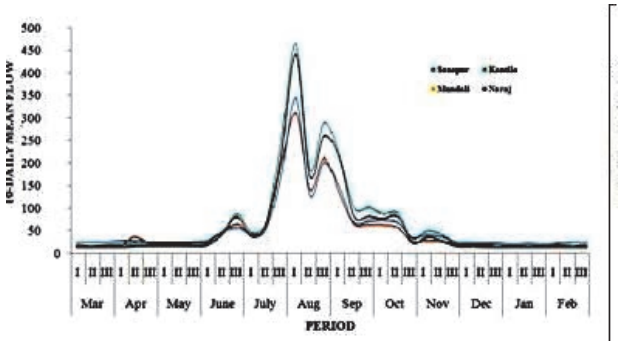
The Mahanadi, one of the major east flowing rivers originates from Dhamtari district of Chhatttisgarh at an elevation of 442 m with basin area of about 1,41,589 km^2. A number of water resource projects are proposed in the basin in addition to ongoing projects such as Hirakud and Chiplima power house in Sambalpur, Odisha. Realizing the importance of the environmental flows, a stretch of about 350 km from Hirakud, Sambalpur to Naraj, Cuttack was selected for estimating the flows requirement. The study stretch was classified into three zones, viz. upper zone (Hirakud to Sonepur) represented by rocky river bed and moderate vegetation, middle zone (Sonepur to Barmul) represented by boulders, pebbles and sandy clay and deep forest and gorges, and lower zone (Barmul to Naraj) represented by Sandy bed with deep pools covering 12 stations.



Mahanadi river basin showing 12 sampling stations from Hirakud to Naraj

Hydrograph of river Mahanadi

The river flow paths and watersheds along the main river channel were delineated on NASA shuttle radar topographic mission (SRTM) 90 m digital elevation imageries and the physico-chemical parameters of all the stations were attached to attributed data base. Hydrograph of the river showed peak flow, lean flow and flood pulse representing monsoon flows from late June to early November during 2013. The flood pulse during early August help migration of several fish species into Ansupa floodplain wet-land, and several small streams, which are identified as ecological assets in the study stretch.



Hydrograph of river Mahanadi in the year 2013-14

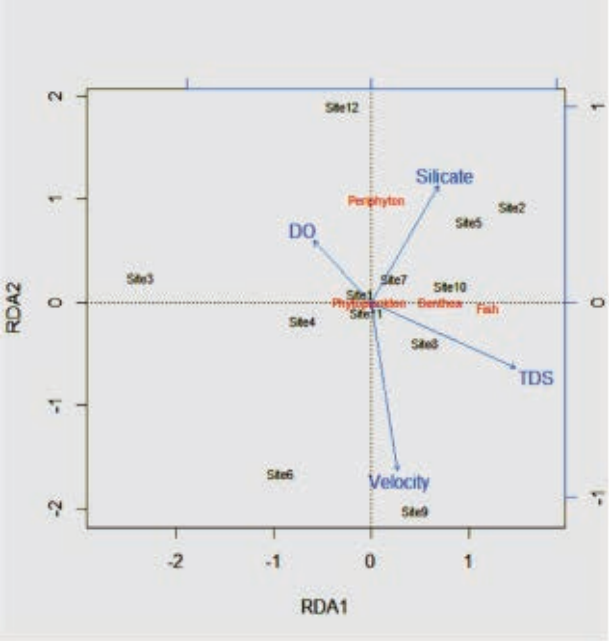
Water quality variables and biological association

A total of 70 fish species belonging to 50 genus and 21 families were recorded in the entire study stretch representing upper, middle and lower zone during early post-monsoon. Of the 70 species of fishes identified, 8 species in the lower zone, 6 species in the middle zone and 36 species in the upper zone were local habitants. Twenty species were common to all the zones. In lower zone, fishing activity is

River mouth connection of Ansupa floodplain wetland, A) Pre-monsoon B) Monsoon

carried out throughout the year and average fisheries income was calculated at Rs. 200-300 per day per boat. In middle zone, fishing activity is maximum in winter and summer season. During monsoon, due to rising water levels, fishing activity is confined to specific zones. The average income was recorded Rs. 150-200 per day per boat. In upper zone, fishing activity is completely discontinued during monsoon season and, as a result, most of the fishermen are engaged in agriculture as cultivator or agricultural labor. The average income from fishing recorded from this zone was 200-250 per day per boat.

Abundance of zooplankton was dominated by *Moina* sp., *Bosmina* sp., followed by *Mesocyclops* sp. and *Daphnia* sp. in lower stretches of the river during pre-monsoon period. Whereas, *Cyclops* sp. and *Moina* sp. were predominant in the upper stretches. Periphyton was dominated by *Nitzschia* sp. followed by *Navicula* sp. and *Cymbella* sp. Abundance of periphyton was higher in upper rocky habitat such as Deogaon and Sonepur. Total count was 0.76 x 100000 ind.100 cm^{-2} on the upper zone, whereas the count was less in the lower zone i.e. 0.48 x 100000 ind. 100 cm^{-2}. Among benthic communities, *Thiara lineata* dominated (78%) in the lower zone, 43% in the middle zone, 62% in upper zone during early post-monsoon (September). The middle zone was dominated by *Corbicula striatella* contributing 16% of the total diversity, while the species was absent in the collection in the upper zone. In addition, total diversity of the macro-benthic species was higher in upper (11) than the middle (9) and lower (6) zone. While the genus wise diversity showed higher in middle (6) than upper (5) and lower (4) zone. Twelve water quality parameters including pH, Temperature, DO, Hardness, BOD, Nitrate, Phosphate, Silicates and TDS were analyzed. As water quality parameters measured were more than the number of sampling sites, variance inflation factor (VIF) with VIF<15 was used to select the water quality parameters interaction with biotic communities. In the study, Redundancy analysis (RDA) was preferred over canonical correspondence analysis (CCA) because of unimodal response of biotic community to the gradient of water quality. The analysis showed that the fish community was inclined towards TDS, and periphyton inclined towards silicate value. Sites viz. Satkosia, Munduli and Sambalpur had higher Silicate and periphyton than other sites. The rocky habitat in these sites might have favored the distribution of periphyton. Current



Tri-plot of biotic and abiotic interaction at different stations

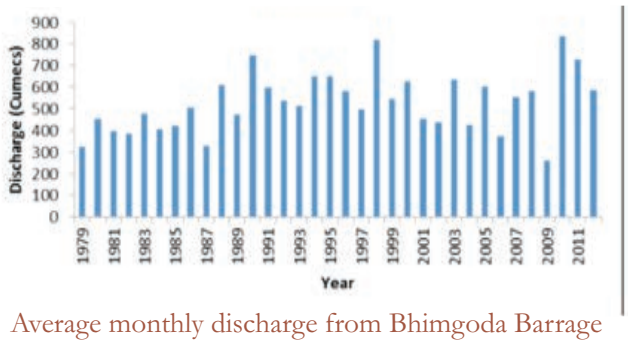
velocity at sites Harvanga and Sonepur is relatively higher than that that of other sites, indicating that the higher the velocity, (>0.8m/s) the lesser the diversity of *Thiara lineate*.

Project : Impact assessment of multiple habitat alterations on ecosystem functions and fisheries in rivers

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

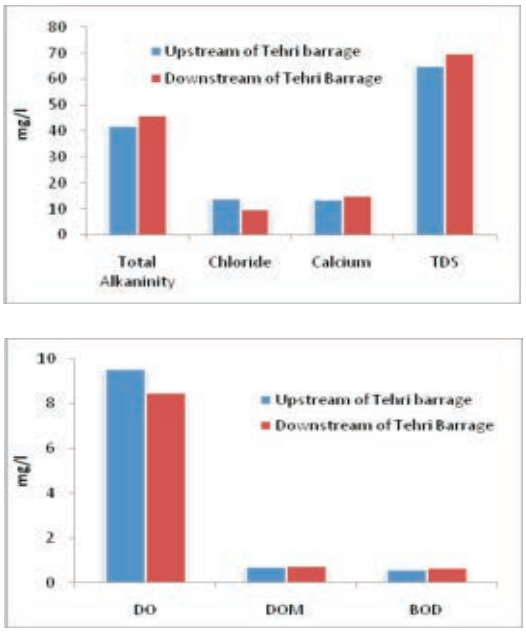
Technical support: S. K. Srivastava, K. Srivastava and V. Kumar

Water discharge in river Ganga: Water discharge data collected from the river Ganga at Bhimgoda barrage, Haridwar, Uttarakhand for last 34 years indiacted that the average incoming and discharge during this period was 752.43 and 529.11 cumecs respectively. Incoming water in flood and non-flood season were 1886.86 and 376.75 cumecs. While that for discharge was 1618.76 and 176.62 cumecs.



Average monthly discharge from Bhimgoda Barrage

Water quality variations at different stretches: Considerable variation in certain key water quality parameters was observed at upstream and downstream stretches of the river Ganga at Tehri dam and Kanpur barrage, due to obstruction of the river discharge and related modifications. The variations in dissolved oxygen (9.52 and 8.48 mg l^{-1}), total alkalinity (22.0 and 42.0 mg l^{-1}), hardness (68.0 and 76.0 mg l^{-1}), total dissolved solids (65.11 and 69.83 mg l^{-1}), calcium (13.63 and 15.23 mg l^{-1}) and conductance (114.2 and 122.4 µs/cm) were observed at upstream and downstream of the Tehri dam. Likewise the variations in dissolved oxygen (7.84 and 5.2 mg l^{-1}), total alkalinity (122.0 and 136.0 mg l^{-1}), hardness (252.0 and 216.0 mg l^{-1}), total dissolved solids (209.9 and 352.0 mg l^{-1}), calcium (51.30 and 38.48 mg l^{-1}) and conductance (367.0 and 615.0 µs/cm) were observed at upstream and downstream of the Kanpur barrage.



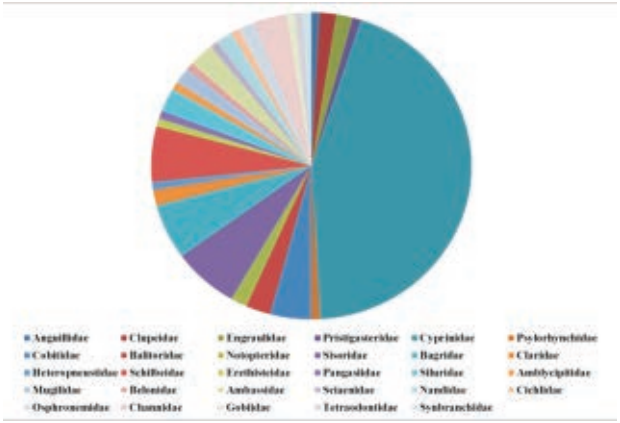
Variations in water quality parameters upstream and downstream of Tehri dam

Biotic variations in different stretches : Due to copious rains in the river catchments during 2013-14, plankton population was affected, ranging between 73 ul^{-1} (Haridwar) and 450 ul^{-1} (Tehri). Bacillariophyceae dominated in the whole stretches of the river Ganga and ranged from 60 ul^{-1} (Haridwar) to 333 ul^{-1} (Tehri), followed by Chlorophyceae (7 ul^{-1} - 113 ul^{-1}) and Myxophyceae (3 ul^{-1}-27 ul^{-1}). Total 50 planktonic taxa were recorded in which most

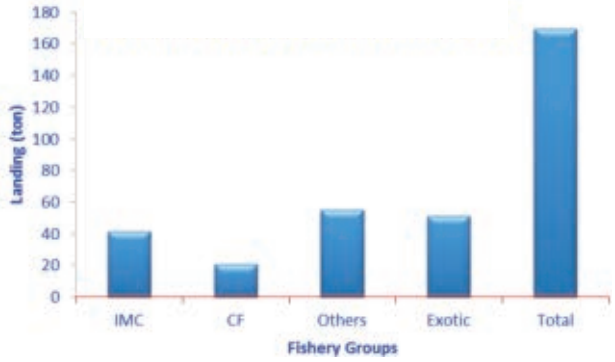
abundant were *Synedra, Cyclotella, Cymbella* and *Navicula. Tryblionella* and *Diatoma*. The abundance showed significant variation in upstream (155-390 ul^{-1}) and downstream (65-726 ul^{-1}) stretches at Maneri, Srinagar, Haridwar, Bijnore and Narora.The periphytic assemblage varied from 60 (Chinyalisaur) to 10770 ucm^{-2} (Kanpur). A total of 47 periphytic taxa were encounterd. A total of 25 macrobenthos forms were recorded from the river during the period. Numerical abundance varied from 145 (Haridwar) to 755(Kanpur) $no.m^2$. Dominance of chironomids at Kanpur indicated organic pollution. Molluscan forms dominated in most the centres except Kanpur and above Haridwar. Shannon-Weaver diversity index ranged from 1.07 to 2.36 in summer and 2.41 to 0.97 in winter with minimum values being at Kanpur in both the season. Pielou's measure of species evenness varied from 0.55 to 0.95 and 0.54 to 0.97 and in summer and winter respectively with values being minimum at Kanpur.

Fish and fisheries in different stretches : Thirteen fish species, viz. *Setipinna brevifilis, Aspidoparia jaya, Garra mullya, G. annandalei, G. gotyla, Salmophasia scinaces, Barilius vagra, B. tileo, B. shacra, B. barna, Nemachelius corica, Badis badis* and *Megarasbora elanga* were recorded for the first time from river Ganga. Due to geographical and climatic conditions the fishery in the river is noncommercial and mainly constituted by *Schizothorax richardsonii, Labeo dyocheilus, Labeo dero, Crossochelius latius, Barilius spp., Garra spp., Mastcembalus armatus* etc. The resilient exotic fishes viz. *Cyprinus carpio* and *Oreochromis niloticus* were contributing substantially in the river stretch between Narora to Vindhyanchal.

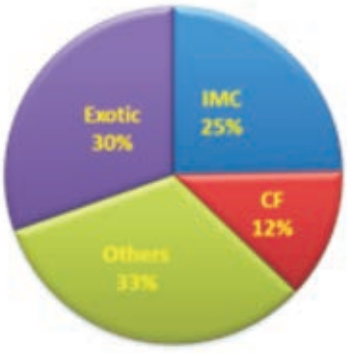
Fish landing from Allahabad stretch of the river Ganga was estimated at 169.72 t during 2013. Contribution of the miscellaneous group of fishes was maximum, 55.576 t (33%), followed by exotic (51.576 t 30%), IMC (41.875 t 25%) and cat fishes (21.061 t 12%). The Common carp dominated among exotics. The fish catch registered decrease of about 16.67% in comparison to preceding year, which may be attributed to decrease in fishing efforts due to longer monsoon period spreading from mid-June to mid-October. Hilsa fishery is completely absent in Allahabad stretch of the river Ganga.



Abundance (%) of fish species of different families



Fiish landing at Allahabad-2013



Fish catch composition at Allahabad-2013

Programme : Ecosystem based fisheries management of reservoirs and wetlands

Project : Sustainable management of floodplain wetlands for enhanced fishery and livelihood

Investigators: B. K. Bhattacharjya, S. N. Goswami, Sona Yengkokpam, D. Debnath, A. K. Yadav, P. Das, M. A. Hassan, A. K. Das, Md. Aftabuddin, D. K. Meena, K. M. Sandhya, B. K. Singh, Md. Absar Alam, D.N. Jha, S. C. S. Das and K. M. Sandhya

Technical support: K. K Sharma, P. Gogoi, A. Kakati, K. Srivastava, V. Kumar, D. Kr Biswas, S. Das and S. Saha

Assessment of impact of fish stock enhancement on fisheries and ecology

Assam

Based on survey carried out in wetlands under different fishery management practices, five beels of Assam viz. Dhir and Tariachara beel in Dhubri district, Mer beel in Nagaon district, and Damal and Sukdol-Sarubori (Dhalai) beel in Morigaon district were selected to understand changes of water/sediment characteristics and biotic community structures with stocking regime.

Soil and water quality

Water quality parameters assessed in all the beels indicated favourable condition for fish production. Dhir and Tariachara beel have similar water quality parameters with acidic pH (6-7-6.9), high dissolved oxygen (7.2-7.8 mg/L), low alkalinity (16-20 ppm), moderate free CO_2 (4-6 ppm), low specific conductivity (18-36 µS/cm) and high Secchi disc visibility (45-100 cm). Mer beel have alkaline pH (7.5-7.6), high alkalinity (90-115 mg/l), DO (5.2-9.2 mg/l) and Secchi disc visibility (137-165 cm). Damal and Sukdol-Sarubori beel have similar water quality parameter with near neutral pH (6.9-7.4) and favourable DO (4.8-7.2 mg/l), however alkalinity in Sukdol-Sarubori beel (75-168 mg/l) was higher than in Damal beel (68-78 mg/l). The waterspread area and depth of Sukdol-Sarubori beel (0.6 to 0.91 m) was considerably reduced during March due to lack of sufficient pre-monsoon rains in the region. Reduced water depth coupled with intensive fishing

Mer beel, Nagaon district of Assam

Damal beel, Morigaon district of Assam

Sukdol-Sarubori beel, Morigaon district of Assam

operations during March apparently resulted in slight deterioration of water quality (increase in free CO_2 and decrease in DO concentrations) in the shallow beel. Similar trend was also observed in Damal beel in pre-monsoon season. Soil of Tariachara beel was sandy in nature, whereas as it is muddy in Dhir beel. The soil of Mer, Sukdol-Sarubori and Damal beel were sandy-clayey in nature

Infestation intensity and species richness of aquatic macrophytes

Macrophyte infestation was heavy in Dhir beel (>80%), moderate in Mer (25%), Damal (20%) and Sukdol-Sarubori (30%) beel, whereas in Tariachara beel it was sparse (8-10 %). In all the beels, submerged/ emergent macrophyte forms the major percentage of the infestation with dominant species being *Vallisneria* sp. in Dhir beel whereas it was *Hydrilla* sp. in the other four beels. Other species of submergent/ emergent weeds found were *Nymphea* sp., *Saragrassum* sp., *Trappa* sp., etc. Among the surface macrophytes, *Eichhornia* sp. was the most dominant one (>90%) in all the beels and meagre amount of *Salvania* sp. and *Azolla* sp. were also found. The marginal macrophytes found in the beels were *Ipomea* sp., *Colocasia* sp., *Christella* sp., etc.

Numerical abundance and generic diversity of plankton, periphyton and macrozoobenthos

Chlorophyceae dominated the plankton population in Tariachara and Dhir beels, (42.86 % and 60% respectively), whereas Bacillariophyceae was dominating the other three beels (75% in Mer, 77% in Dhamal and 61.5% in Sukdol-Sarubori beel). The periphyton population also follows the same trend as that of plankton in the respective beels. Higher benthos population was observed in Dhir and Sukdol-Sarubori beel (84-100 Nos. / sq. m) while it was moderate in the other beels (14-20 Nos./ sq. m).

Fish yield rate and catch composition

Tariachora, Mer and Damal beel are stocked mainly with seed of Indian Major Carps (Catla, Rohu and Mrigal) and exotic carps (Grass carp, Silver carp and Common carp) for enhancing fish production from the beel. Whereas, Dhir (668 ha) and Sukdol-Sarubori (20.07 ha) beel are managed under capture fisheries norms and wholly dependent on natural fish stocks. The major contribution of the fisheries in Dhir beel comes from Cypriniformes (48 %) followed by Perciformes (25 %), Clupeiformes (25 %), Decapoda (4 %) and Misellaneous (6 %). *Gudusia chapra is the* single most dominant species (25 %) in the beel. In Tariachora beel, marjor contribution comes from stocked fishes (78 %) and natural harvest (22 %). The major contributing group in beel is Cypriniformes (70 %) and *Hypophthalmichthys nobilis* (Bighead carp) alone contribute 25 % of the total catch. In Sukdol-Sarubori, major contribution comes from Cypriniformes (63 %) followed by others. *Puntius* alone contribute 30% of the total catch. In Mer and Damal beel, the major contribution of fisheries also comes from stocked fishes (70-75 %) and natural harvest (20-25 %). The major contributing group in the beel is Cypriniformes (70 %). The present fish yield rate of the beels has been estimated at 454.40, 43.89, 480, 810 and 800 kg / ha / yr in Dhir, Tariachora, Mer, Damal and Sukdol-Saruboribeel respectively.

West Bengal

Two wetlands viz. Akaipur (32 ha) and Khalsi (62 ha) under Nadia and 24 Paraganas (N) districts respectively of West Bengal with similar ecological regimes were selected to understand changes of water/sediment characteristics, sediment enzyme and biochemical quality and biotic community structures with stocking regime. Akaipur beel was found to be a closed and shallow water body with higher degree of management interventions including practice of drag netting while Khalsi was shallow but seasonally open beel where selective fishing by gill netting was the mode of harvesting with higher fishing days compared to Akaipur beel. The samples were collected during September 2013 and Janauary, 2014.

Sediment and water quality characteristics

Sandy loam soil prevailed in both the wetlands having sand content of 76-78%, silt 12-13% and clay (10-11%). Soil reaction of the wetlands studied reflects medium productive trend. Specific conductivity (mS/cm) was maximum in Khalsi (0.54) and lowest in Akaipur (0.15), while organic carbon encountered very high values in Khalsi (4.8-8.6, av.6.7 %) and moderate in Akaipur (1.70-3.66, av. 2.68%). Presence of available-P was higher in Khalsi (22.7 mg/100g)) and moderate in Akaipur (11.3 mg/100g), while available-N was also observed more in Khalsi (52 mg/100 g) than in Akaipur. The controlling factor for available N, C/N ratio was in favourable range of production in both the wetlands, Khalsi showing good trend in mineralization

processes. Water level fluctuation is normally very drastic in both the wetlands during 'Boro' paddy season due to lifting of water for irrigation reducing water coverage to 30-40 % in summer. Analysis of water during monsoon and winter revealed higher water turbidity in Akaipur than Khalsi with more value in monsoon than winter and opposite trend for gross nutrient pool. Nutrients were observed to be higher in Khalsi than Akaipur for both available phosphorous and nitrate. Silicate-Si was noticed in Khalsi and Akaipur which can support a good crop of Bacillariophyceae.

Primary production and fish production potential

Gross primary production was more in Akaipur than Khalsi. Assimilation efficiency was also more in Akaipur (77.6%) than Khalsi (66.9%) representing highly productive ecosystems. Oxygen balance was significantly higher in Akaipur (3.68) than Khalsi (2.55) showing more autotrophic dominance in Akaipur beel. Fish productions potentials (kg/ha/y) in two wetlands of West Bengal estimated through phytoplankton primary production (1.6% GPP) were 300 kg in Khalsi and 940 kg in Akaipur. Although the level of exploitation was very good in both the wetlands (>70%), there is further scope for fisheries enhancement following sustainable stocking programme in these wetlands.

Enzymatic and microbiological quality in sediment

Analysis of sediment biochemical profiles during monsoon revealed 2 fold higher overall microbial activity, 3.25 fold higher phosphorous solubilizing activity and 3 fold higher carbon mineralizing activity in Khalsi than in Akaipur wetland. Sediment reaction moved from moderate acidic to neutral from winter to monsoon with higher value for Khalsi than Akaipur. Analysis of sediment bacteria during monsoon and winter revealed higher total heterotrophic bacteria, phosphatase positive bacteria and nitrifying bacteria in Akaipur than Khalsi with higher abundance in monsoon than winter.

Abundance and generic richness of plankton and macrozoobenthos

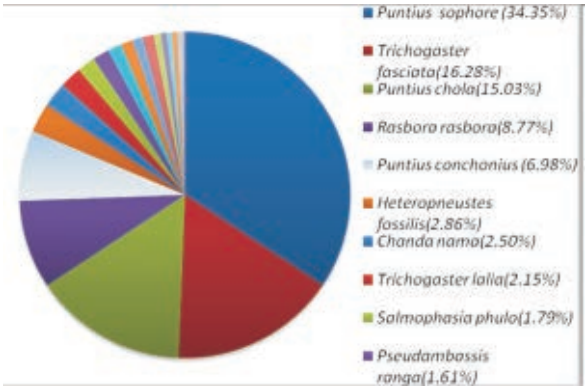
Analysis of plankton samples showed higher abundance in Khalsi beel (51 u/l) than in Akaipur (30 u/l) with dominance of zooplanktonic community (67-84%) comprising of Cladocera and Copepoda in winter season which took drastic shift during post monsoon periods (1085 u/l). Phytoplankton community contributed 16-33% and mainly represented by Bacilliriophyta and Chlorophyta in Khalsi and Chlorophyta, Euglenophyta and Bacilliriophyta in Akaipur. Macrozoobenthic community showed an increase in abundance in winter (2274 nos/m^2) than post monsoon (1789 nos/m^2) in Khalsi while opposite trend was observed in Akaipur.

Intensity, biomass and species richness of aquatic macrophytes

The infestation of macrophyte was higher in seasonally open Khalsi beel. Despite being shallow, the practice of drag netting and periodic clearance has reduced the macrophyte infestation to 3-8% in Akaipur beel. The biomass of macrophyte was expressed in terms of ash free dry matter (AFDM) per unit area and higher values were recorded during summer and winter season in both the beel. The growth trend of macrophyte biomass was not discernible in any beel because of management manipulation and fisheries activity. A total of 13 macrophyte species was recorded from Khalsi beel, while only 6 species was recorded from Akaipur beel. *Eichhornia crassipes* was found to be the most abundant macrophyte species observed in both the beels.

Fish diversity and catch composition of wetlands

Assessment of fish species spectrum revealed higher fish species richness in Khalsi (29 species) compared to Akaipur (15 species) with dominance of species belonging to Cyprinidae family, followed by Anabantidae and Ambassidae. Indigenous fishery in Khalsi beel was mainly constituted by *Puntius* spp (56.38%), followed by *Trichogaster* spp. (19.5%)



Indegenous fish species diversity in Khalsi beel, West Bengal

while it was constituted *by Puntius* spp. (60%) in Akaipur beel.

Both the wetlands were managed by fishers' cooperative and stock enhancement was practised using seeds of both IMC and exotic carps. The fish yield recorded from Akaipur was higher (620.91kg/ha/yr) compared to Khalsi beel (322kg/ha/yr). Fishing was mainly carried out using drag net in Akaipur beel while gill netting was the most common fishing method in Khalsi beel. Fishing pressure in terms of active fishermen population, fishing intensity, number of craft and gear were observed higher in Akaipur beel. Closed type, shallow depth, stocking enhancement and drag netting increased fish yield in Akaipur beel with an adverse impact on indigenous fish diversity showing low Shannon diversity index (H'-2.01). However, seasonally open nature and use of size selective gill net has helped Khalsi to sustain natural fish diversity (H'-2.17) despite having more fishing pressure in terms of higher fishing days.

Split bamboo traps (*Ghuni*) for catching small indigenous fishes

Demonstration of pen culture in wetlands of Uttar Pradesh

Two closed wetlands namely Majihar jeel (48.00 ha) and Sareni jheel (18.00 ha) in Rae Bareli district of Uttar Pradesh were selected for demonstration and up-scaling of pen culture technology in Uttar Pradesh after through scientific investigation. Pen structures of HDPE net were installed on 1378 M^2 area in Sareni Jheel and 2014 M^2 area on Majihar Jheel and stocked with advance IMC fry @ 25 nos./m^2 in October 2013. Mean weight at stocking of Labeo rohita and Catla catla was 2.88g and 2.1g which increased to 57.2g and 67.38g in Sareni and 54.25g and 65.96g in Majihar jheel. The Average FCR in Sareni pen was 1.08 while in Majihar pen's it was 1.17. Overall survival in Sareni jheel was 69.52 % in Labeo rohita and 77.74% in Catla catla while in Majihar it was found to be 76.8% for Rohu and 72.1% for Catla respectively. Benefit cost Ratios (BCR) of pen culture for raising advanced fry to advanced fingerlings of Labeo rohita and Catla catla were calculated as 1.64 and 1.69 respectively. Return on investment was more for Sareni Jheel (0.69) than Majihar Jheel (0.64). The values indicate that culture is beneficial in these wetlands and Sareni Jheel is more profitable than Majihar.

Pen culture in Majihar *jheel*, Uttar Pradesh

Impact of fisheries management practices on socio-economics of riparian population

Through the survey of three beels namely namely, Sukdol-Sarubari, Udari and Barmanoha of Morigaon district, Assam under three management situations such as shallow un-stocked (Sukdol-Sarubari), shallow stocked (Udari) and deep stocked (Barmanoha) were selected for analyzing the livelihood of fishermen families. The highest engagement in fishery was 2 persons/ family in the household of deep stocked beel followed by one each in shallow stocked beel and shallow un-stocked beel. Intermediate assets consisted of crafts, gear and livestock. Craft formed the highest 14.79% of total value of intermediate asset for the deep stocked beel. The highest percentage of income from fishery (41.67% of total annual income) was received by the sample fisher of shallow-un-stocked Sukdol-Sarubari followed by 39.39% and 22.04% by the fishers of deep stocked Barmanoha and shallow stocked Udari. The highest annual employment from fishery by a single fisherman (102 man days) was generated by the fisher of shallow-un-stocked Sukdol- Sarubari followed by deep stocked (88 man days) and shallow stocked (84 man days). Estimation of impact of management on fisher's livelihood revealed that, the maximum increase in annual income from fishery was 47.11% in shallow un-stocked beel as compared to shallow stocked beel. The highest decline in fishery income to the tune of 78.21% was calculated for the fisher of shallow stocked beel as compared to deep stocked beel.

Impact of management on fishers livelihood (+ = % increase / - = % decrease)

Parameters	Between beel variations		
	Shallow unstocked & stocked	Shallow, unstocked & deep, stocked	Shallow & deep stocked
Fishery Income	+47.11	+5.47	-78.72
Fishery Employment	+17.65	+13.72	-4.76
Season wise Fishery Employment			
Lean season	+3.98	-3.80	-8.10
Mid Season	-4.08	+10.58	+14.09
Peak Season	+1.19	-8.67	-7.39

Project : Habitat characteristics, fish assemblage, stock dynamics and impact of stocking in selected reservoirs

Investigators : D. S. Krishna Rao, M. Karthikeyan, (Mrs) R. Palanisamy, Preetha Panikkar, D. Panda, K. M. Sandhya and D. Bhakta

Habitat character of selected reservoirs

Habitat characteristics of Krishnarajasagar reservoir of Karnataka and Walayar reservoir of Kerala were assessed. Krishnarajasagar reservoir (13000 ha) on river Cauvery in Karnataka recorded annual mean water temperature of 25.6 $^{\circ}$C ± 1.9. Based on limnological parameters (transparency: 122.7 ± 64.9 cm; pH 7.2; alkalinity: 62.9 mg/l ± 48.8) coupled with features like inorganic turbidity for greater part of the year, the reservoir was characterized as moderately productive. Walayar (259 ha), a seasonal reservoir in

Kerala was fed by both south-west and north-east monsoon. The Carlsson trophic state index (TSI) for Seechi disc (54.16) and chlorophyll a (60.69 mg/m^3) indicated that the reservoir is eutrophic. The fish production potential of this reservoir was estimated at 130 kg/ha while the present exploitation was observed to be 70 kg/ha.

Fish assemblage and stock dynamics

Krishnarajasagar reservoir

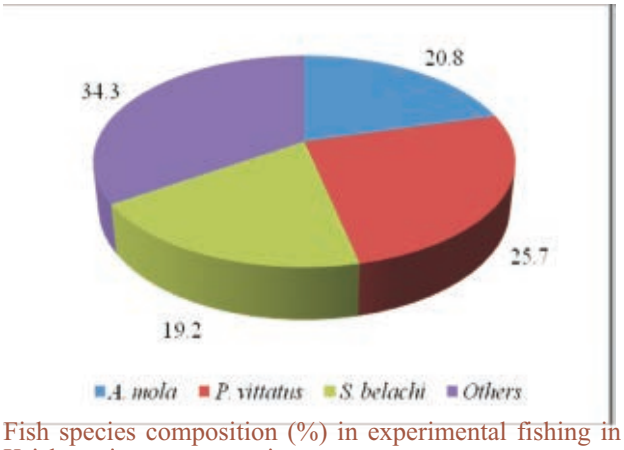
Experimental fishing in Krishnarajasagar reservoir using monofilament multi-mesh gillnets of 20, 35, 45, 65, 90 and 120 mm (each panel of 30 m length) in lotic, intermediate and lentic zones recorded 6819 individuals belonging to 13 families and 38 species. Family-wise, cyprinids were most abundant (78.9%) followed by bagrids (9.2%). Abundant species were *Puntius vittatus*, *Amblypharyngodon mola* and *Salmostoma belachi* together contributing 65% to the numerical density. Native carps of commercial importance, *Puntius sarana, Labeo calbasu* and *Labeo fimbriatus* were recorded in low numbers. The α diversity (Shanon-Weiner), calculated on pooled data was, $H^{/}$=2.26 which increased from lotic (1.78) to lentic zone (2.49). The Pielou's index, a measure of evenness, was 0.62 indicated similar trends as $H^{/}$ increased from lotic (0.53) to lentic sector (0.71). Ichthyofaunal diversity indicated that, the fish community in the lentic zone was more diverse.

In the riverine sector, 30 species belonging to 10 families were recorded and was 21% less than the reservoir. *Puntius ticto* was the most abundant (37.6%) followed by *Puntius conchonius* (11.9%), *Cirrhinus reba* (9.9%) and others (40.6%). $H^{/}$ (2.35) and J (0.69) values suggested that, the α diversity of the community of river was similar to that of the reservoir.

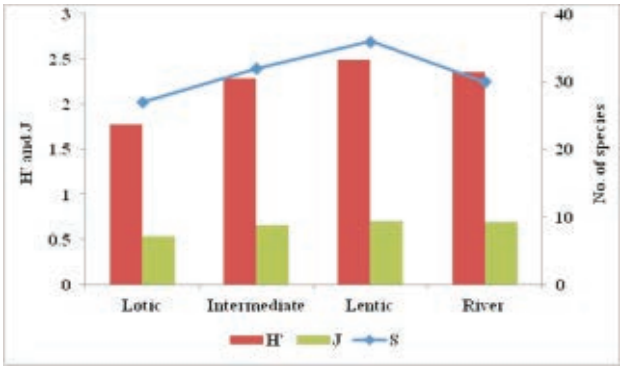
Fourteen species were recorded in the experimental fishing in Walayar reservoir with multi-meshed gillnets with the native species represented by *Puntius filamaentosus, Puntius. sophore, Mystus armatus* and *Mystus. cavasius*. The fish diversity increased from lentic to lotic zone.

The catch composition of Panchet reservoir

Panchet (7511 ha) reservoir across river Damodar in Jharkhand represented by 11 families, 19 genera and 27 fish species. Cyprinidae was the most diverse family comprising of 12 species followed by Bagridae with 3 species. The dominant carp species were *Cirrhinus mrigala* followed by *Labeo rohita,*

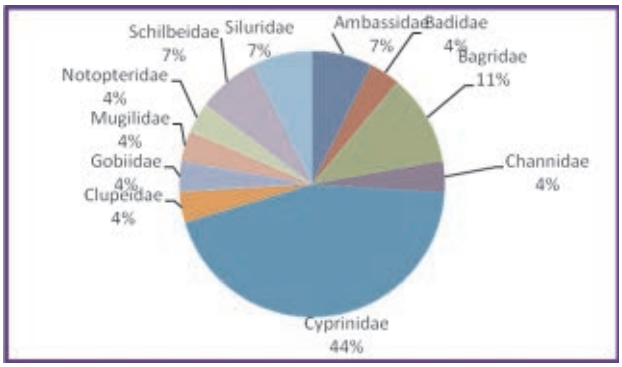


Fish species composition (%) in experimental fishing in Krishnarajasagar reservoir



α Diversity indices along the longitudinal axis of Krishnarajasagar reservoir

Labeo calbasu and *Catla catla.* Dominat catfish species were *Sperata seenghala, Sperata aor, Ailia coila, Wallago attu, Mystus tengara* and *Ompok bimaculatus.* Clupid, *Gudusia chapra* contributed significantly to the commercial catch. Boats operated in two major landing centres were recorded to be 42 and 30 in Panchet landing centre in Dhanbad district of Jharkhand and Mahesh *nadi* landing center in Purulia district of West Bengal respectively. The CPUE ranged from 0.256 kg/boat/day during October to 9.72 kg/ha/day during March, with an average of 2.88 kg/boat/day during 2014. Despite regular stocking with Indian Major Carps, the contribution of *C. catla* and *L.rohita* was very less compared to *C. mrigala.*



Fish diversity in Panchet Reservoir

Development of Electronic Data Acquisition System *(e-DAS)*

A user-friendly Android Application developed for the Electronic Data Acquisition System (*e-DAS*) was installed in the smart phone and the same was used to capture the sample data. The *e-DAS* designed to capture two parameters initially was modified to include up to ten parameters (*i.e.* Names of fishes). A pre-determined number of parameters (with their respective names) could be assigned to each fish landing centre where from the data is to be obtained through mobile phone. The database – mySQL Server – has been used at the backend to collect the data. The bugs encountered while interfacing the hardware with software are being fixed. Suitable softwares are being developed for the management of the database and for the report generation. Implementation of *e-DAS* for data capturing would be indeed a positive step towards building an authentic database for inland fishery resources and production of India. This, in turn, would immensely strengthen the Decision Support System in Inland Fishery Research.

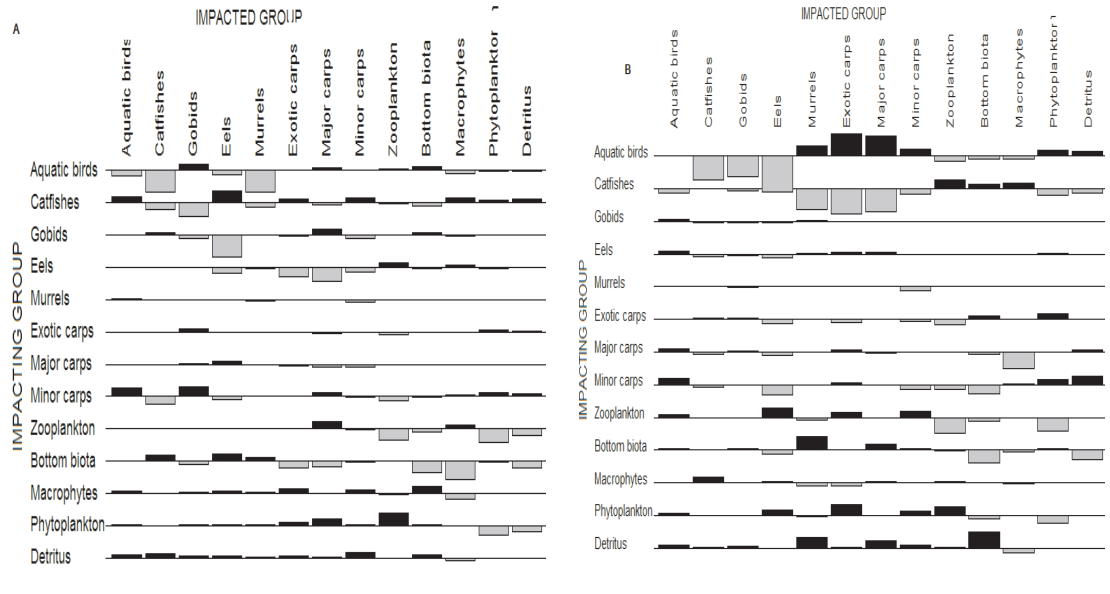
Hardwares in development of *e-DAS*

Project : Application of acoustics and trophic models for ecosystem-based fisheries management in reservoirs

Investigators: M. Feroz Khan, Preetha Panikkar and Thankam Theresa Paul

Application of trophic modelling in reservoirs for ecosystem-based management of fisheries

Comparative estimates of trophic status and energy flow were carried out to assess the impact of fish stock supplementation in Hemavathy reservoir ecosystem, Karnataka. Mass-balanced models of



(A) **(B)**

The mixed trophic impact in Hemavathy reservoir. (A) before and (B) after fish stock supplementation. The bars pointing upwards indicated positive impacts, while the bars pointing downwards showed negative impacts.

reservoir ecosystem were constructed for two periods, for 1982-83 and 2002–2003 using Ecopath software showing the impacts on different groups before and after introduction of fishes. There was an increase in almost all aggregated flows in the trophic network from 1985 to 2003.The stocked fishes, major carps and exotic carps showed positive flows (4.56 and 1. 95 t km^{-2} per year). These changes were proportional in value to those estimated in the biomass of the trophic groups in 1985 and 2003. The mixed trophic impacts (MTI), could be read as the total (direct and indirect) effect on the impacted group in Hemavathy reservoir ecosystem showing negative impact of catfishes on all other fish species except gobids in post-stocking phase and a positive impact on eels, exotic carp and minor carp in pre-stocking phase. MTI also showed the positive impact of macrophytes on all biotic communities in pre-stocking phase and on most of the fishes in post-stocking phase, except murrels and exotic carps. Phytoplankton and detritus also had a positive impact on most of the consumer groups in both phases.

Total system throughput value indicated that greater amount of material was processed by the members of the aquatic community in post-stocking phase than that in pre-stock phase in each square kilometer in each year. The higher order indices of ecosystem functioning showed that the pre-stock phase food web was less developed compared to post-stock food web. A slight increase in relative overhead (0.30%) and higher number of pathways was found in the post stock phase indicating the post-stock food web was more resistant to perturbations compared to pre-stock food web. The findings revealed that changes in the ecosystem stability can be caused by trophic interactions due to the supplementation of major carps. Very negligible (0.2%) increase in total system throughput was observed in the post stock phase revealing decreased detritus accumulation, reducing the tendency for eutrophication and a positive impact on the environmental management activity of the reservoir. The total number of pathways and mean path length increased by 0.35 and 14%, respectively in the post stocking phase, reflecting more mature and more complex system after the fish stocking in the reservoir.

Determining the target strength with relation to fish size using acoustics

Experiments were conducted in Kelaverapalli reservoir in Hosur, Tamil Nadu using commercially important fishes of various species to compare the target strength and actual size of the fish. The species used in the experiments were *Catla catla, Labeo rohita, Cirrhinus mrigala, Cyprinus carpio,*

Pangasianodon hypophthalamus, Oreochromis mossambicus and Oreochromis niloticus. The intensity of an echo from a fish depends on the size, the aspect angle, and the actual species. These experiments estimated the target strength from tracking the fish-echoes, and combined the estimates with data from fish measurements. The target strength was calculated by averaging the echoes' acoustic size determined from the individual echoes. These experiments yielded valuable data on target strength of different fish species of various sizes. The experiments were specifically designed in such a way that the received echo in vertical applications has low reverberation level, without a problem. Calibration based on reference target was done to improve the accuracy in the TS estimates.

Project : Refinement of enclosure fish culture (pens and cages) in reservoirs and wetlands for production of stocking materials and table fish

Investigators: A. K. Das, D. Panda, P. Das and S. S. Das

Technical support: B. K. Biswas, Subhra Saha and S. Das

Raising of stocking materials in cages in small reservoirs of Jharkhand

One battery of 16 floating cages (4m x 4m x 3 m) supported by G.I. make frame with iron drums as float was installed in Maithon resorvoir, Jharkhand. Seeds of *Labeo bata* (22-29 mm and 0.48-0.52 g size) were stocked and fed @ 5% of body weight due to low productivity of the reservoir. Overall survivability was observed to be 82%. The fish growth in terms of length and weight increased to 94-121 mm and 5.6-7.9 g in a four months cultivation period.

Monitoring of environment inside and outside of cage

The limno-chemical profile inside and outside of the cages revealed no phenomenal changes with little reduction in water pH and alkalinity during mid October, 2013 which got changed to 7.8 & 48 inside cages with outside values (8.0 & 50) at the end of March, 2014. Some increments in dissolved nutrients were also encountered inside cages.

System statistics estimated for pre-stock and post-stock phases for comparing the status of Hemavathy reservoir ecosystem

Parameter	Pre-stock	Post-stock	Percent difference (post-pre)/pre (%)
Total system throughput (TST) (tonnes/km^2/yr)	24306.000	29284.000	0.205
Sum of all exports (tonnes/km^2/yr)	11873.69	9227.870	-22.28
Sum of all flows into detritus (tonnes/km^2/yr)	12795.46	12221.070	-4.49
Total biomass/TST	0.009	0.005	-44.44
Total primary production/total respiration	6.200	5.330	-14.03
Primary production/biomass	34.12	72.580	112.72
Connectance index	0.368	0.264	-28.26
System Omnivory Index	0.136	0.112	-17.65
Total Number of Pathways	62.000	84.000	0.35
Mean Length of Pathways	3.290	3.750	0.14
Ascendancy (%)	52.400	38.200	-0.27
Overhead (%)	47.600	61.800	0.29

Water quality changes during cage culture

Parameters	October 2013		December 2013		February 2014	
	Inside cage	Outside cage	Inside cage	Outside cage	Inside cage	Outside cage
pH	7.3	7.4	7.7	7.9	7.8	8.0
Alkalinity (ppm)	46	48	52	54	48	50
Nitrate-N (ppb)	685	680	265	250	85	40
Phosphate-P (ppb)	490	480	100	80	170	130

Project : Assessment of Exotic Fishes in Inland Open Waters

Investigators: V. R. Suresh, K. D. Joshi, M.F. Khan, P. Panikkar, Sona Yengkokpam and A. Ekka

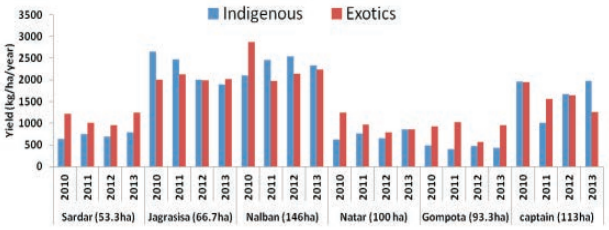
Technical support: D. K. Biswas, Subra Saha, Subrata Das, Y. Ali and M. E. Vijayakumar

A survey was carried out in six wetlands of East Kolkata to assess the time series changes in catch and proportion of exotic fishes. The data did not show any definite trend of changes in catch and proportion of exotics. About 48% of the total catch constituted indigenous species (*Catla catla, Labeo rohita* and *Cirrhinus mrigala*, besides other local fish species and the rest (52%) were exotic fish species (*Cyprinus carpio*, *Oreochromis niloticus*, *Hypophthalmichthys molitrix, Pterygoplichthys* spp.). In these wetlands, exotics contribute equally or higher than the IMC to the total yield.

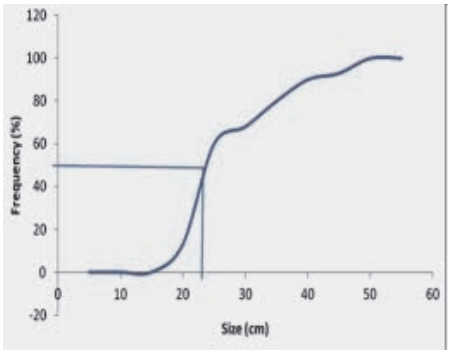
Targeted studies on the invasive exotic fish species *Pterygoplichthys disjunctivus* in the wetlands, with regard to reproductive biology, showed an overall sex ratio (Male: Female) of 1: 2.1 and relative fecundity of 14.62/ g body weight. The females matured at 23 cm TL and breed during November-January.

Monitoring of fish landing along 50 km stretch of Ganga at Allahabad showed continued presence of exotic fish species, especially *Cyprinus carpio* and *Oreochromis niloticus*. The monthly catch from the stretch ranged from 4.92 to 38.1 t, of which exotics formed 8.2 to 44.7% during 2013-14. There has been increase up to 2010 and marginal decline thereafter.

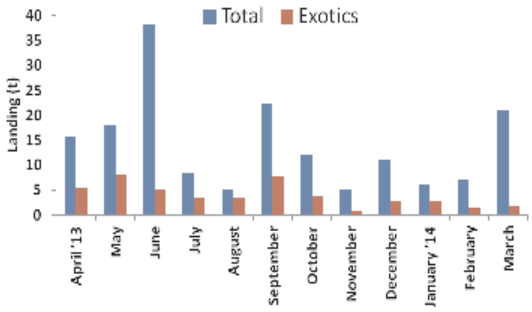
Sukdol-Sarubori (Sukdol-Sarubori) beel, a seasonally open beel situated in Morigaon District, Assam (17.05 ha) connected with the river Sonai is fully managed under capture fisheries norms with reported total catch of 6891 kg during the period April 2013 to March 2014. *Ctenopharyngodon idella* and *Cyprinus carpio* are the two exotic fish caught from the beel and contribute only 6% of the total catch which indicated the low occurrence of exotic fishes in the connecting river Sonai. The catch is dominated by indigenous fish such as *Puntius* spp. (30%), *Wallago attu* (20%), *Cirrhinus reba* (15%) and *Clupisoma* sp. (10%). The Indian Major Carps (Rohu and Mrigal) contributed only a meager 5% of the catch.



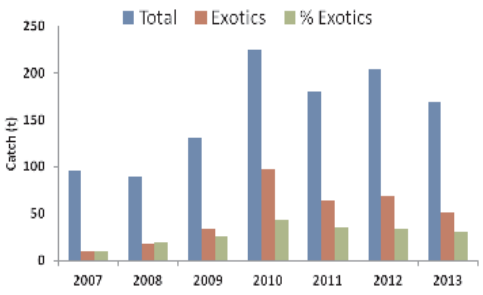
Trend in fish yield from selected East Kolkata wetlands



Size at first maturity of *Pterygoplichthys disjunctivus*



Monthly trend in total fish catch and that of exotic fishes at Allahabad stretch of Ganga



Trend in total annual fish catch from Ganga at Allahabad

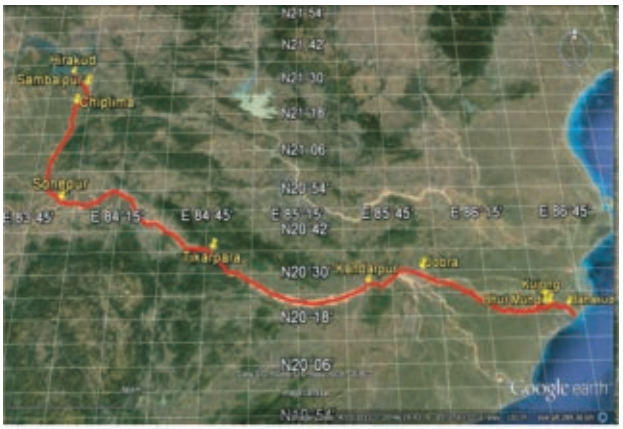
Programme: Environment and health monitoring of Inland open waters for ecosystem amelioration

Project : Monitoring and benchmarking of ecosystem health of major river systems in India

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

Technical support : S. Bhowmick, Mrs. K. Saha, L. R. Mahavar, S. K. Paul, S. Bandyopadhyay and A. Ghosh

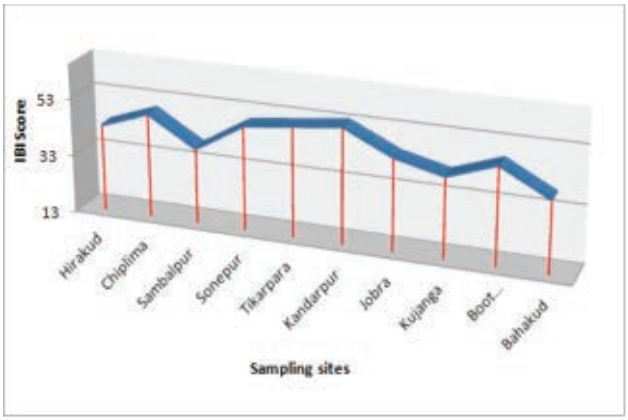
The study was conducted to monitor the stressors and assessing the ecological health and integrity of river systems through habitat profiling, physico-chemical analysis of water and soil, heavy metal and pesticides, and investigation on biota with emphasis on ichthyofauna. 400 kms stretch of river Mahanadi, between Hirakud dam and Bahakuda ghat (near the confluence of the river), were studied. Sampling was carried out in pre-monsoon, monsoon, post-monsoon and winter months.



Studied stretch of River Mahanadi with sampling sites

Biotic Integrity

Fish-based Index of Biotic Integrity (IBI) was applied to assess ecological integrity as an indicator of relative levels of environmental quality in the river. A total of 13 metrics were included for calculating the IBI scores. One of the major environmental stressors on River Mahanadi was the impaired river flow due to dam and numerous barrages constructed along the river. To know the impact of impaired flow on the biotic integrity, ethological traits like migration and rheophilic nature of fishes as well as population doubling time as a measure of species resilience were incorporated as IBI metrics. The score for the studied zone varied from 38 (Bahakuda) to 53 (Kandarpur) and sites did not qualify for the acceptable integrity class. 40% of the stretch showed slight impairment and 60% showed moderate impairment. At sites of hydrological alterations such as Hirakud and Jobra, the IBI score were low indicating impacts on biotic integrity, whereas the IBI score at Tikarpara located inside the Satkosia sanctuary, was relatively higher.



IBI scores along the sampling stretch of River Mahanadi

Water Quality

The water quality attributes were within normal limits: dissolved oxygen was always above 6 ppm, alkaline pH (7.15 to 8.97), low levels of oxidizable

organic matter, measured by BOD (up to 3.5 ppm) and COD (up to 8.8 ppm) and low to moderate nutrient contents (nitrate up to 0.3 ppm, phosphate up to 0.06 ppm except at downstream of Kujong (with p level up to 0.39 ppm) which is influenced by the effluents of Paradwip Phosphate Limited.

Sediment Quality

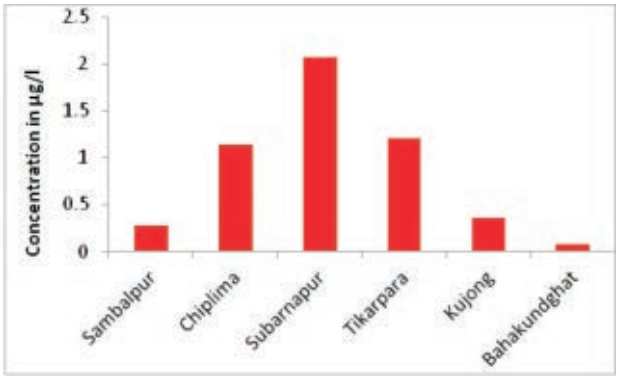
The sediment quality indicated neutral to alkaline pH (up to 8.3) with mild acidic condition in the upper stretch of Hirakud dam to Chiplima (up to 5.6). In majority of the sites the river bed is grossly sandy, and has low contents of organic matter (traces to 0.5%) and nutrients.
Comparison of the water and sediment quality data with the observations made during 1995-96 indicated almost similar quality with slight increase in water phosphate, and soil organic carbon content in the lentic areas.

Heavy Metals

The water was found free from heavy metal contaminations, viz., Cd, Cu, Mn, Pb, and Zn; only Mn was detected in trace levels in some cases. In sediment phase Cd and Pb were not detected, zinc was detected below its pollution levels of 90 ppm, copper was detected in 50% of the study sites to cross the mild pollution level of 25 ppm in some cases. In fish flesh only Zn was recorded. In samples from Hirakud, Zn level was 0.0-10.3 ppm in *Cirrhinus reba,* 14.9-16.9 ppm in *Labeo calbasu,* 0.0-8.5 ppm in *Silonia silondia* and 0.0 – 5.7 ppm in *Rita chrysea* at Chiplima; 2.5 - 4.3 ppm in *L. calbasu*, 15.3-16.0 ppm in *Salmophasia bacaila* at Sonepur*;* 9.2 ppm in *Johnius coitor,* 5.4 ppm in *L. calbasu and* 4.6 ppm in *S. silondia. It was traced in Wallago attu* at Jobra, *Sperata aor*; *Cirrhinus reba* and *Eutropiichthys vacha.* As a whole, fish fleshes could be considered as safe for human consumption.

Pesticide residues in water and fish

Analysis of water in GC-ECD for organochlorinated pesticide (OCP) residues revealed that about 33% samples were contaminated with residue of one or more OCPs, albeit in very minute concentrations. Among the HCH isomers (α, β, and) α-HCH in one and -HCH in three samples were recorded with total HCH concentration in positive samples ranging between 0.283 and 2.05 µg/l. DDT isomers and metabolites were detected in three samples in



Organochlorin pesticide residues in water of river Mahanadi

concentration varying from 0.021–0.07 µg/l. Endosulfan sulfate was detected in one sample, while α and β-endosulfan could not be detected. Heptachlor was also recorded in two samples. OCP residues was detected in water samples collected from different points. Residues of OCPs were detected in 22.22% of fish samples. Flesh of *Wallago attu*, *Sperata seenghala* and *Glossogobius* sp. from Zero point and Jobra was found to contain pp-DDE at concentration of 0.004, 0.02 and 0.22 µg/g respectively. Flesh of *Sperata seenghala* was also found to be contaminated with β-HCH (0.006 µg/g), -HCH (0.005 µg/g) and op-DDE (0.04 µg/g). The concentrations of different OCPs found in fish samples were much below the MRL (maximum residue level) prescribed by Govt. of India or other agencies.

Project : Developing microbiological protocols for bioremediation of polluted aquatic environment

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

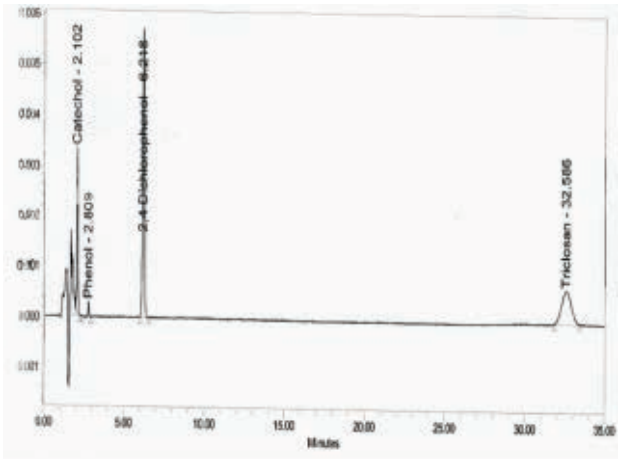
Technical support : K. Saha, S. K. Paul, S. Bandopadhyay and S. Chakraborty

Harvesting pollution degrading microorganisms from degraded ecosystems and their re-application would provide effective means for pollution bioremediation. In view of above, the project focuses on harnessing microbial diversity for amelioration of organic pollutants.

Harnessing bacteria for triclosan degradation: A total of nine bacteria have been isolated from city sewage for degradation of triclosan, a widely used antimicrobial preservative, on agar medium. Further study indicated only five strans as effective in degrading the pollutant. The strains have been identified as *Pseudomonas aeruginosa*, *Citrobacter freundi*, and *Enterobacter* sp. by 16S rDNA sequencing method. An HPLC method has been developed for quantitative estimation of triclosan and its metabolites viz. Phenol, Catechol and 2,4-dichlorophenol (2,4-DCP) in the biodegradation process.

Resorcinol degradation study: Twenty five bacterial strains, isolated earlier, were examined for resorcinol degradation and only two strains were effective in degradation of 600-700 ppm resorcinol in sewage proving their pollutant degradation capability.

Triclosan degradation on mineral agar medium



HPLC chromatogram of Triclosan and its possible metabolites

Protein characterization of selected microbes: Twenty four bacteria showing pollutant degradation activities were analysed for enzyme characterization by discontinuous gel electrophoresis. The results obtained were the complete protein profile of these bacteria showing difference in the enzyme expression. The zymography assay were done for each bacteria, proteases were identified with high expression in few bacteria.

Projecet : Assessment of microbial pollution status and its impact on fish in different riverine ecosystems

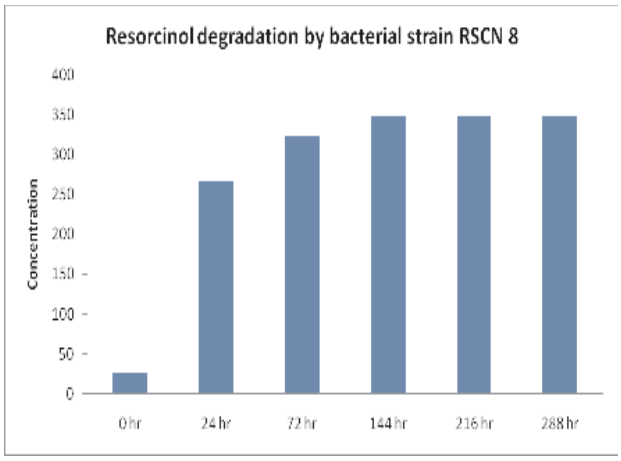
Investigators : S. S. Mishra, B.K. Singh and D. N. Jha

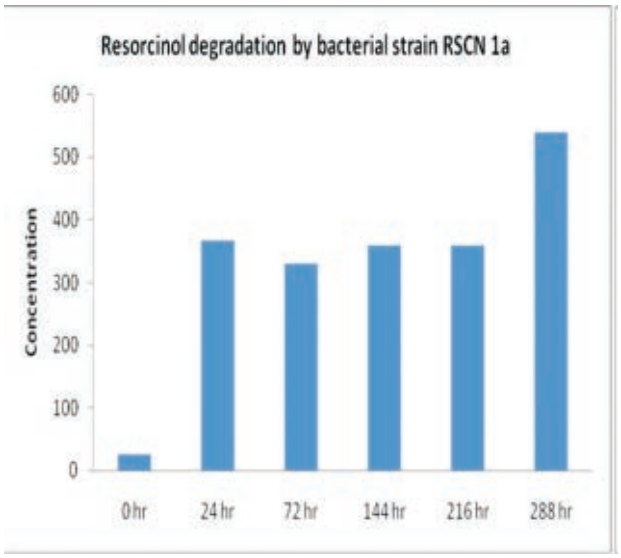
Technical Support : K. Srivastava and V. Kumar

Microbiological quality of River Ganga: Higher microbial load (CFU/ml) indicative of poor water quality was observed in the river Ganga during winter at Kanpur ($3.6x10^8$), Bithur ($2.8x10^8$) and Allahabad ($2.1x10^7$). In terms of *E. coli* counts (CFU/100 ml) were estimated at Kanpur ($4.7x10^4$), Bithur ($2.65x10^4$) and Allahabad ($1.01 X10^4$) indicated sewage contamination. *E. coli* was observed at all stations except Tehri.

Water quality of river Yamuna: The water quality between Delhi (Wazaribadh) to Auraiya (near Agra) was significantly poor in terms of physicochemical parameters (DO, 1.64 ppm; CO_2, 8.0 ppm; Chloride, 65 ppm) and microbial load. Improved water quality in terms of higher DO (10-12 ppm), Low turbidity and lower microbial load were observed in Auraiya to Allahabad zone except at Gaughat at Allahabad.

Antibiotic sensitivity of river bacteria of human health significance: The pure culture isolates of *E. coli, Vibrio* and *Aeromonas* isolated from water and fish samples were tested for their resistance to 12 different commonly used antibiotics viz. Ampicillin, Streptomycin, Tetracycline, Chloramphenicol, Ciprofloxacin, Erythromycin, Gentamycin, Ofloxacin, Norfloxacin, Cephalothin, Penicilin G and Kanamycin 30. Most of the isolates were highly resistant to Penicilin G and ampicillin and moderately resistant to cephalothin, erythromycin, gentamycin, and kanamycin indicating widespread antibiotic resistance, saving against fluoroquinolone antibiotics.





Project : Development of biotechnological tools for inland ecosystem health assessment

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

Technical support : Sanjay Bhaumik and Sk. Rabiul

Proteogenomic information on IMC *Catla catla*

Catla catla contributes a major share to the freshwater aquaculture production. However, little genomic information is available on this species to make it amenable for biomarker studies. After identifying 70 protein spots on the muscle proteome of Catla representing 22 proteins, partial coding sequence information on the genes have been generated and deposited at GenBank. This information would be useful for pollution biomarker discovery.

Transcriptomic information of freshwater catfish *Rita rita* and bivalve mollusc *Lamellidens marginalis*

The freshwater catfish *Rita rita* has been reported to be a suitable model for the riverine biomonitoring programs. Transcript information on liver HSPs and lens crystallins havebeen generated and deposited at GenBank. Similarly, coding sequence information on *hsp* genes from gill tissues of bivalve mollusc *Lamellidens marginalis* has been generated and submitted to GenBank.

GC-MS fingerprinting of fatty acids of freshwater bivalve *Lamellidens marginalis* in search of biomarkers of pollution

GC-MS fingerprinting of fatty acids in different tissues viz. foot, gill, mantle of bivalve *Lamellidens marginalis* was carried out. The major fatty acids identified include palmitic acid, margaric acid, stearic acid, oleic acid, linoleic acid, and eicosenoic acid. Interestingly, several non-fatty acid peaks like dibutyl phthalate, butylated hydroxyl toluene in FAME preparation were identified using NIST Library 2.0. This information on non-fatty acid peaks is important from QC point of view as these could not have been identified without the help of NIST Library and could possibly have led to ambiguity in the lipid biomarker identification.

Modulation in cytokine gene expression in *Labeo rohita* exposed to arsenic

Target gene sequences information of different test species

Target Genes	GenBank Accession No.
Catla catla	
Pyruvate kinase	KC707842
Creatine Kinase	KC788423
Beta actin	KC788424
Phosphorylase kinase	KC788754
Adenylate Kinase	KC816537
Enolase	KC816538
Phosphohistidine phosphatase	KC816539
PDZ and LIM	KC816540
CapZB	KC816541
Aspartate aminotransferase	KC816542
Glyceraldehyde 3 phosphate dehydrogenase	KC887542
Apolipoprotein	KC887543
Fructose 1,6 bisphosphate	KC887540
Lactate dehydrogenase	KC887544
Phosphoglycerate kinase	KC887545
hsp47	KC915024
hsp70	KC599207
hsc71	KC800800
hsp60	KC599205
hsp90	KC800801
18s RNA	KC915025
Rita rita	
αA Crystallin	KC787043
β B1Crystallin	KC787044
γ M Crystallin	KC787045
β actin	KC788424
hsp 70	KJ522810
hsp 90	KJ522811
hsc 70	KJ522812
L. marginalis	
hsp 70	1739387
hsp 110	1739518

Gene expression changes due to arsenic

Target genes of *Labeo rohita*	Changes in gene expression in rohu exposed to arsenic
IFNγ	↓
IL4	↓
IL10	↓
IL12	↓
hsp 47	↑
hsp 60	↑
hsp 70	↑
hsp 71	↑
hsp78	↑
hsp 90	↑

Fattyacid identified in *Lamellidens marginalis*

Sl. No.	Compounds identified through GC-MS fingerprinting : Fatty acid /fatty acid derivative (F)/ Non- fatty acid peaks (Nf)	% of total area *Lamellidens marginalis*			M/Z Value	GC-MS fingerprint Peak code No. *
		Foot	Gill	Mantle		
A. Fatty acid / fatty acid derivative (F)						
Saturated fatty acids						
1.	C 16 : 0 (Palmitic acid)	5.62	1.94	4.37	143,74	F1
2.	C 17 : 0 (Margaric acid)	1.41	----	1.95	199,255	F2
3.	C 18 : 0 (Stearic acid)	1.45	0.68	1.88	87,298	F3
Unsaturated fatty acids						
4.	C 18 : 1 (Oleic acid)	----	0.92	----	55,222	F4
5.	C 20 : 1 (Eicosenoic acid)	----	1.82	3.61	292,324	F5
6.	C 18 : 2 (Linoleic acid)	----	----	0.71	67,262	F6
B. Non-fatty acid (Nf) peaks (Compounds identified through NIST library search)						
7.	Butylated hydroxyl toluene (BHT)	39.76	73.57	11.47	205,220	Nf1
8.	Methyl-9-cis-11-trans-octadecadienoate	0.38	----	----	81,95	Nf2
9.	3,5-di-tert Butyl-4-hydroxy benzaldehyde	0.3	----	----	191,219	Nf3
10.	Dibutyl phthalate	3.25	----	16.52	149,150	Nf4
	Dibutyl phthalate	28.56	4.73	----	149,223	Nf5
11.	Phenol 4,4'-thiobis (methylene) bis (2,6-bis) (1,1-dimethylethyl)	6.25	----	----	203,219	Nf6
12.	Furan 2,5 dihydro 2,2 dimethyl 5-(1-methyl ethyl) -3-(1-methy ethyl)	----	1.09	----	137,165	Nf7
13.	Phlorobutyrophenone	----	0.46	----	153,196	Nf8
14.	Phenol-2,6-bis(1,1-dimethyl propyl)-4-methyl	----	7.74	----	219,258	Nf9

Cytokines are low molecular weight protein mediators produced by immune cells that contribute to cell growth, differentiation and defence mechanisms of the host. Knowledge of cytokine response is important in understanding the immunological basis of host resistance against foreign invaders or following exposure to environmental toxicants. Inorganic arsenic (iAs) is a toxic environmental contaminant that modulates the immune response. Besides, heat shock proteins (hsps) have cytoprotective function as many hsps function as molecular chaperones. Expression analysis of selected cytokine genes viz. IFNγ, IL4, IL10, IL12 in the head-kidney and hsp genes viz. hsp47, hsp60, hsp70, hsc71, hsp78, and hsp90 in the liver of *Labeo rohita* fingerlings was carried out by semi-quantitative PCR following arsenic exposure. The results showed that arsenic exposure led to a generalized immune suppression and most of the hsp genes showed upregulation in the liver.

Plasma biomarkers for arsenic induced hepatotoxicity

Arsenic is a major environmental contaminant and inorganic arsenic is a potential human carcinogen. To study the effects of acute and chronic exposure to arsenic changes in plasma protein profile in *Labeo rohita following experimental arsenic exposure was investigated.* Multi-fold up regulation of liver-specific proteins Apo A-1, A2ML and WAP65 clearly indicated liver damage following arsenic exposure at higher concentrations. These novel biomarkers could be utilized as biomarkers of chronic liver disease and hepatotoxicity.

Project : Development of eco-restoration protocols for eutrophic inland aquatic systems

Investigators : M. K. Bandyopadhyay, M. A. Hassan and D. Das

Technical support : K. Saha and S. Bandyopadhyay

Majority of urban and peri-urban lake are polluted and in eutrotrophic condition. The project aims at algal bloom control in nutrient rich lakes through biomanipulation, with immediate objective of efficiency assessment of selected fishes to control algal bloom. Through field survey, 4 No. Bheri of East Kolkata Wetlands located at Bidhannagar, Kolkata, West Bengal has been selected as experimental site which receives Kolkata city sewage through network of canals.

Experimental enclosure fabrication and installation

A new enclosure system was designed and fabricated, consisting of outer flexible HDPE made chamber of 5.0 m x 2.5 m x 3.0 m for in situ experiment. The inner HDPE netted (5.0 mm mesh) enclosure is 3.0 m x 1.5 m x 1.0 m in dimension with top open. The whole set up is immersed three fourth portions in lake water.

Fish growth and plankton abundance in enclosures

Four carp species namely *Labeo rohita*, *Labeo calbasu*, *Labeo bata* and *Hypophthalmicthys molitrix* were stocked @1.0 kg m^{-3}, 1.5 kg m^{-3} and 2.0 kg m^{-3} with stocking ratio i.e. 1:1:1:1 without any supplementary feeding. During growth period, dissolved oxygen level fluctuated between nil and 10.4 mg l^{-1}). A decreasing trend in cholorophyll-a from 50.15mg m^{-3} to 29.8 mg m^{-3} were recorded suggestive of intake of algal species by the stocked fishes inside enclosure. A total of twenty four phytoplankton species with dominance of blue green and green algae has been recorded from the enclosures. *Microcystis aeruginosa* has dominated (20.1%) over all species with a mean value of 2690 ul^{-1} and may be one of the causative factors for mortality of fishes in the enclosures observed with onset of summer. The overall length increment of reared fishes varied from 39 mm to 154 mm among the four species. Weight increment is found lowest in *Labeo bata* (29.2 gm) and highest in *H. molitrix* (570.2 gm). The survival percentage of reared fish species is in the order of *Labeo calbasu* (70%), *Labeo bata* (70%), *Labeo rohita* (65%) and *H. molitrix* (60%) respectively.

Project : Acquisition of fish catch data and resource mapping of inland open-waters on GIS platform, using modern tools

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

Technical support : S. Mazumder, S. Mondal and B. Bose

Monthly variation of surface water area in different water bodies in Jhansi district, Uttar Pradesh

Twelve RS imageries (LE8) of different dates of pass during May 2013 to March 2014 were procured to determine seasonal water area variation in eight water bodies (two medium size reservoirs viz. Kamala Sagar Dam and Barwar DAM, four small reservoirs viz. Barwa Sagar, Pahuj, Pachawara, Dongari and Magarpur, and two small water bodies). Initially NDWI, NDBI and NDVI were calculated using band 3,4,5,6 and surface water area was delineated on the basis HIS (Hue Intensity and Saturation).

Kamala Sagar and Barwar DAM (Medium Size Reservoir)

The surface water area of Kamala Sagar (Saprar), the only dam on the Shukahani River, attained the maximum of 1667 ha in October, 2013, which subsequently reduced to the minimum area of 973 ha

in March, 2014. In the previous year, the minimum area of 276 ha was observed in the month of May 2013. For the Barwar Dam, the maximum area of 1132 ha was delineated in October, 2013. The water area dwindled down to the minimum of 655 ha in March, 2014.

Pahuj, Barwa Sagar lake, Magarpur, Dongari, and Pachawara (Small Reservoier)

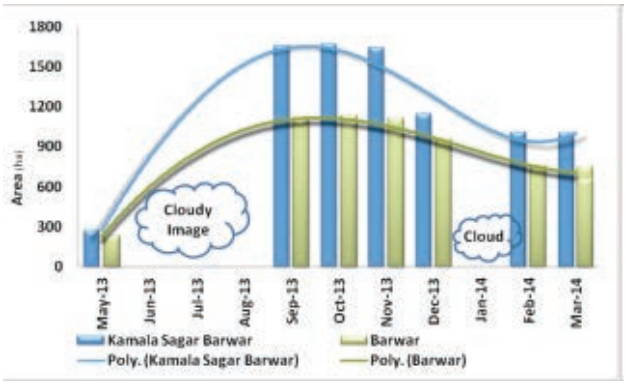
Pahuj Dam was constructed in 1969 on the Pahuj River. The maximum surface water area (388 ha) was computed in the month of September 2013. Decreasing of water area was noticed in December, 2013 and the same dwindled down to the minimum of 203 ha in March, 2014. Last year the reservoir attained the minimum area at 201 ha in May. Barwa Sagar Lake was constructed in 1694 on Barwa Nala. The maximum area was observed in month of December (401 ha) in year 13-14 and it decreased to a minimum area of 299 ha in March, 2014. Last year the minimum area (96 ha) was observed in the month of May. Magarpur bundh is an earthen dam constructed in 1920 on a local river. The maximum surface water area (301 ha) was observed in September, 2013. Water area started decreasing from December 2013 and shrankto 223 ha in March 2014. Pachwara Bundh is an earthen constructed in long back on a local river. The surface water area achieved a maximum of 233 ha in December, 2013 and thereafter it dwindled down to the minimum area of 114 ha in March, 2014.

Smaller water bodies

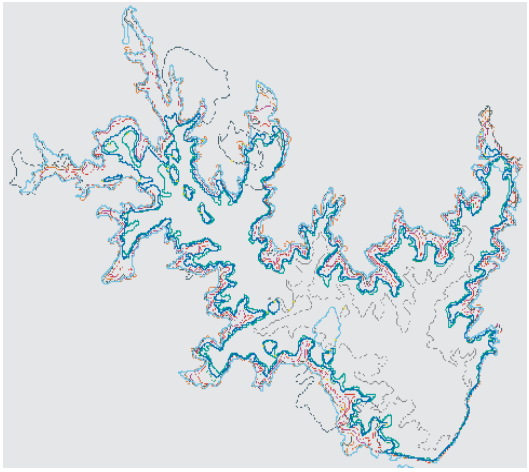
Two smaller water bodies of less than 50 ha were also examined for water area variation. The surface areas of those water bodies shrank to 36%, and 87 % of the corresponding maximum areas.

Change detection analysis of Hooghly estuaries using remote sensing imageries

Estuarine environment constitutes a highly dynamic fluvio-morphological setting where processes of accretion and deposition are active. Coastal zones are undergoing changes in shape and environment due to natural processes and human development activities. Natural processes such as waves, erosion, changes in river courses etc, cause long time effect at slower rate; but manmade activities, such as settlement, industrial activities, recreational activities, waste disposal etc., affect the coastal environment at comparatively much faster rate. Besides increasing vulnerabilities to storm



Water area variation of Medium reservoir over the year



Seasonal variation of water area of Barwar reservoir

Table : Maximum, Minimum and average area of water bodies of Jhansi district (during May'13 to March 14)

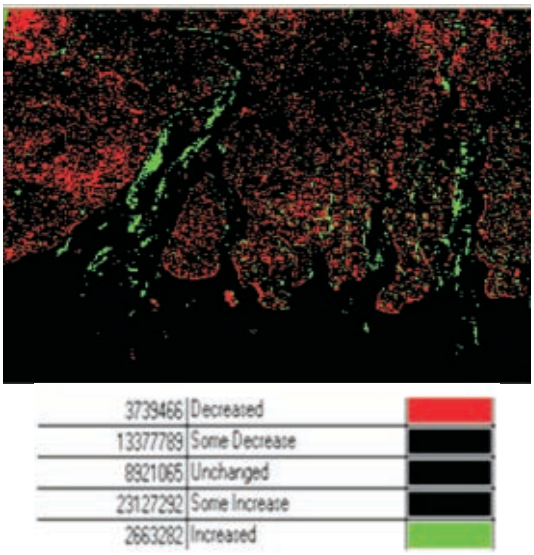
Water bodies	Maximum Area	Minimum Area	Average area	Standard deviation	Coefficient of variation
Kamala Sagar	1666.4	973.08	1371.08	302.27	0.220
Barwar Reservoir	1131.57	655.02	967.66	178.79	0.185
Barwa Sagar Lake	400.95	202.95	283.21	75.08	0.265
Magrpur	301.86	223.38	261.72	24.04	0.092
Pahuj Dam	387.36	203.76	303.57	65.37	0.215
Dongari Bundh	335.23	212.94	274.08	38.47	0.140
Pachwara	235.53	114.93	188.78	50.64	0.268
Railway Bundh	48.42	21.69	34.28	10.09	0.294
Pond In Ranipur	33.03	12.78	23.45	6.56	0.280

and coastal erosion, it changes tidal forcing and influencing estuarine sedimentation. Land cover and land use (LCLU) change detection is an important process in monitoring and managing natural resources to identify, describe and quantity differences between images of the some scene at different times and provides a fundamental input for planning, management and environmental studies.

The study was undertaken in part of Hooghly estuary, spanning between latitude 20°41'55.36"N to 22°16'25.19"N and longitude 87°16'32.32"E to 89° 0'41.38"E, to determine areas of land cover change between 2004 and 2012. IRS-P6 LISS III high resolution satellite sensor data (path/row – 108/56 & 108/57) of 11-Feb-2004 and 24-Jan-2012 has been used for this purpose. Image differencing is performed by subtracting the DN (digital number) value of 2012 image from the DN value of the same pixel for the same band of 2004 image using digital image-processing software ERDAS Imagine (v. 9.3). Initial results indicate that 12.35% of total study area has been changed completely, 70.43 % of area was changed slightly and only 17.2% area has remained unchanged. The change includes land use pattern in the catchment area and estuarine sedimentation. A "highlight" image was created indicating amount of changes took place during the study period. The study also revealed that Island loss occurred due to coastal erosion. The four islands viz. Gharamara, Nayachar, Gangasagar and Jambu situated in Hooghly see mouth lost 13.63%, 5.88%, 2.94% and 28.31% of their land areas respectively during 2004 to 2012.

Loss of Islands in Sundarbans during 2004 to 2012

Island	Area 2004 (sq km)	Area 2012 (sq km)
Nayachar Dwip	48.814	45.943
Gharamara	5.0296	4.344
Gangasagar	242.679	235.549
Jambu Island	5.941	4.259



Highlight image indicating observed changes during 2004-2012

Project : Inference on some selected inland open water through data mining and generalized linear models

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

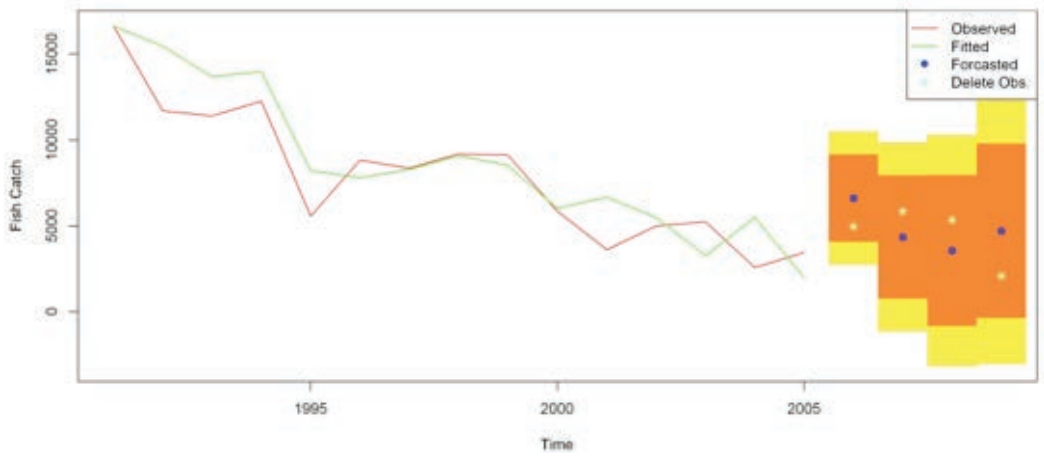
Technical support: S. Mazumder

Decreasing fish catch is a concern in Indian rivers and estuaries. Hilsa catch in Narmada estuary reflected a sharp decreasing trend during the period from 1992 to 2009. Study was conducted for searching evidences of such decreasing trend with the hypotheses (i) How the river hydrological factors interacting with each other, (ii) Whether hydrological regime is influencing Hilsa catch, and (iii) Whether forecasting of Hilsa catch in the presence of present river hydrology can help to formulate management options. The Narmada river downstream of the Sardar Sarovar dam stretching from 73^{0}36'09" E, 21^0 54' 22"N (Rangan) to sea mouth, encompassing estuarine and freshwater zone was covered in this study. The analyses were carried out for the variables: Hilsa catch, maximum flood level, sediment load, discharge, monsoon river flow at different river gauge station of the study area. Hilsa catch was our response variable and the remaining variable were collectively defined here as hydrological factors.

Time series factor analysis was carried out on the hydrological factors and thereafter factor scores of newly derived synthesized factors were plugged-in as explanatory variable in time series regression analysis with ARIMA errors. It was

Hilsa fishery prediction under different future scenario of hydrological regime in Narmada Estuary

Simulated Scenario		Prediction on percentage increase over last 5 year average
Factor 1	Factor 2	
No change	5 % increase	7.50 %
5 % increase	No change	13.13 %
5 % increase	5 % increase	14.00 %



Observed and forecasted Hilsa Catch (in Tonnes) in the Narmada Estuary.

observed that the maximum observable flood at Gurudeshwar, Bhauruch and discharge at Grurudeshwar are highly associated. The monsoon sediment load and monsoon flow at different river gauge stations are correlated. Out of seven hydrological factors, two main factors were derived to explain total hydrological variability. Factor1 is combined effects of maximum observable flood and concurrent discharge at Gurudeshwar. Since fishing for Hilsa fishing is done during spawning migration, we named Factor1 as the "spawning habitat availability potential". Factor2 is composed of sediment load and water flow, which are some of the main contributors to the habitat quality. We define this factor 2 as the "Spawning habitat quality potential".

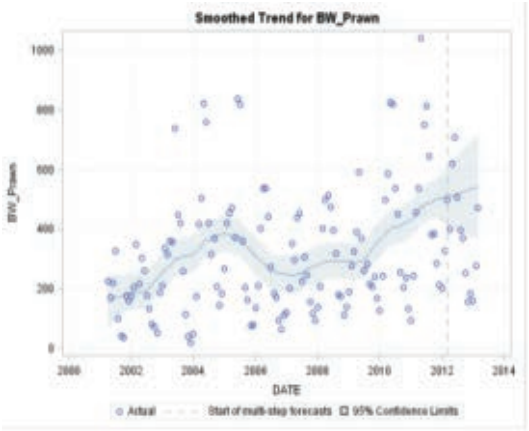
Time series regression with ARIMA errors was carried out to address the hypothesis (b). It revealed that both spawning habitat availability and quality were statistically significant (p-value <0.05, R^2 = 0.830) influencing factors. Spawning habitat availability (Maximum observable flood) appears to be the most influential factor which exhibits positive correlation with Hilsa catch. Time series forecasts show that if present hydrological regime prevails hilsa fisheries may further decline in future. However, increase in river level through water release from dam during spawning migration may improve the Hilsa fisheries. Based on the derived model hypotheses (c) is addressed. The forecast on Hilsa catch under following simulated scenario has been generated for management options (Table) which indicates that increased flood pulse during migration may improve Hilsa catch. One option could be to release more water from the dams for improving Hilsa fisheries in Narmada estuary.

Project : Development of time series models for the analysis and forecasting of fisheries data

Investigator: K. K. Goswami

Time series analysis of historical data of Chilka Lagoon

Structural time series models: Twenty monthly time series data sets of Fish, Prawn and Crab from Chilika Lagoon were analysed using Dual cyclic models and modelling with trend and seasonality to identify Pattern of time series data and filtering out noise in order to make the pattern more salient. Dual cyclic models decompose the response series into components such as trend, cycles.



Trend of brackishwater prawn catch

A stochastic generalization of the cycle ψI can be obtained by adding random noise to this recursion and by introducing a damping factor, ρ, for additional modeling flexibility. This model can be described as follows:

$$\begin{bmatrix} \psi_t \\ \psi_t^* \end{bmatrix} = \rho \begin{bmatrix} \cos\lambda & \sin\lambda \\ -\sin\lambda & \cos\lambda \end{bmatrix} \begin{bmatrix} \psi_{t-1} \\ \psi_{t-1}^* \end{bmatrix} + \begin{bmatrix} \nu_t \\ \nu_t^* \end{bmatrix}$$

where,$0 \leq \rho \leq 1$ and the disturbances ν_r and ν_i are independent $N(0, \sigma^2_\nu)$ variables.

Detection of Level Shift

A comparison of locally linear trend (LLT) between two regimes i.e., before and after opening of mouth was made. If the slope component is present, signified by the presence of slope, a locally linear trend (LLT) is obtained.

Development of ARIMAX Forecasting Models

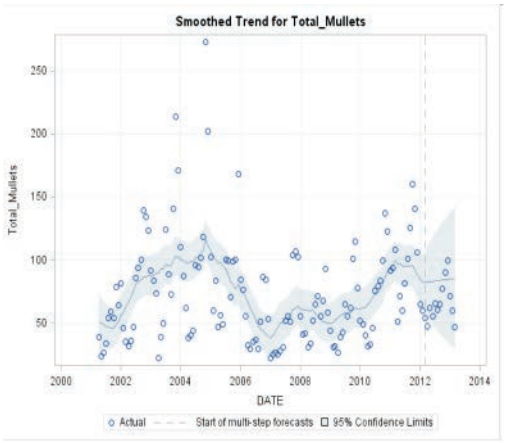
Unobserved component models were developed as forecasting models for monthly data sets (after opening of new mouth) available with Chilika Development Authority. The models were found to be suitable for describing the dynamics of the fishery and for forecasting up to 12 months ahead:

Parameter Estimates
B_W_PRAWN
MODEL: B_W_Pra wn: Alkalinity(Outer_Channel)0
$+p^H$ (Central_Sector) +Salinity (Southern_Sector)
+Water Trempature(Outer_Channel) + AR(1) INT
R^2= 0.69, MAPE= 43.11

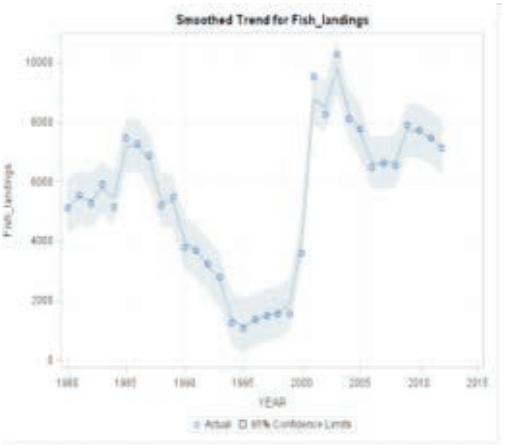
Time series analysis of Hooghly estuary

The development of forecasting models was undertaken for Fish Seed collection from Survey data generated under intensive study conducted in 6 estuaries of sunderbans during the period 1993 to 1998. Two stage sampling techniques were applied. In 1st stage, 10 villages of each estuary were randomly selected and in next stage, 30 seed collectors from each village were selected at random.
State-Space Models: Two-Way Random-Effects Model
The State Space Model is appropriate for jointly forecasting several related time series that have

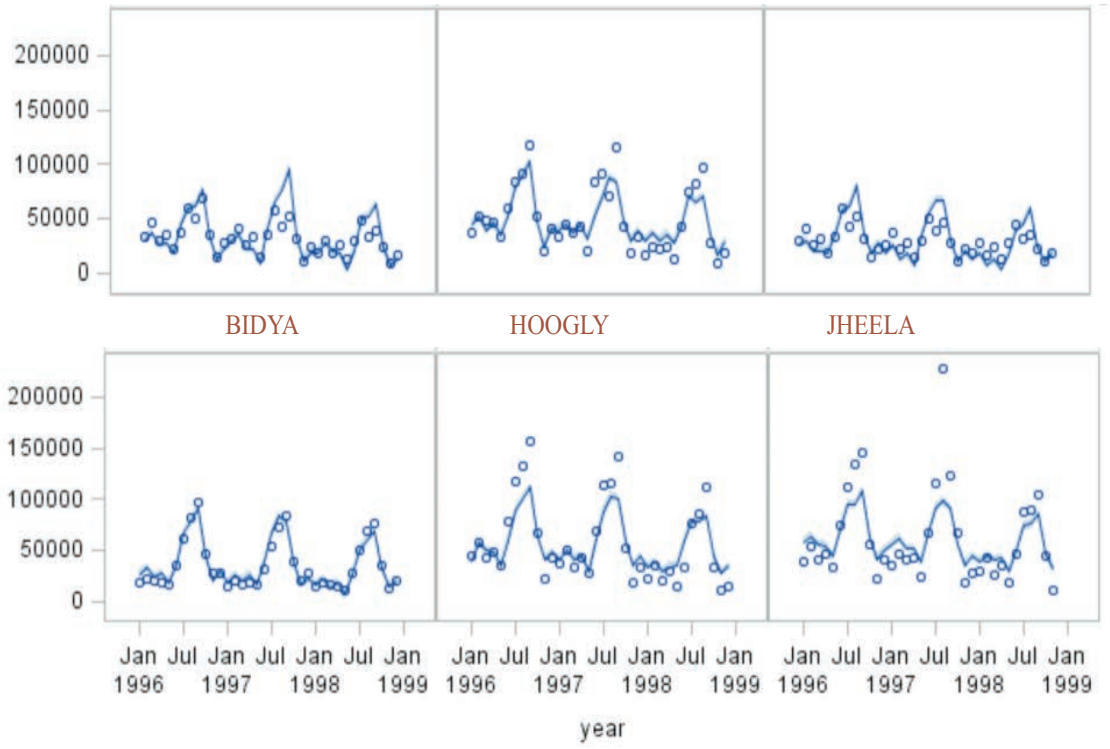
After opening of the mouth slope gradient is higher in case of Prawn and Crab with respect to fish.



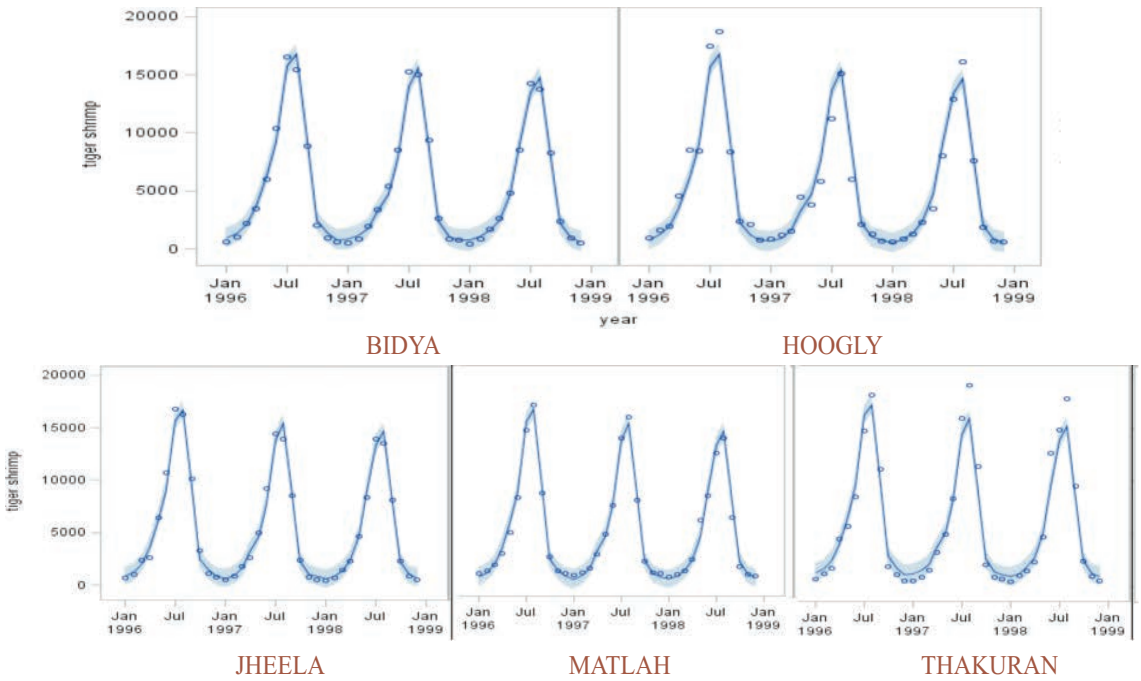
Trend of total mullets catch



Trends of fish and prawn landing in Chilika lake



River specific trends for fish with 95% confidence bands



Specific trends for tiger shrimp with 95% confidence bands

Sl. No	River	Model	R^2 Value	Mean Percent Error
1	BIDYA	Linear Trend + Water_Temp + ARIMA(1,0,0)(1,1,0)s	0.99	3.32
2	HOOGHLY	Linear Trend +Salinity +Water_Temp + ARIMA(1,1,0)s	0.89	23.96
3	MATLA	Water_Temp + ARIMA(1,0,0)(1,1,0)s	0.98	9.92
4	JHILA	Salinity + ARIMA(1,0,0)(1,1,0)s	0.99	9.73
5	THAKURAN	Linear Trend + Salinity + ARIMA(1,1,0)s	0.97	-0.05

dynamic interactions.
This SSM models allow us to develop random effect models for panel data.

$$y_t = X_t \beta + \gamma + \varepsilon_t I + \in_t$$

The two-way random-effect model can be described as follows: the (q xk) X_t contains the regression variables that are associated with the k dimension regression vector β, γ is a q–dimensional latent vector called cross sectional effect (Rivers), ε_t is a one-dimensional latent effects called time effect, I is a q-dimensional vector with all of its entries equal to one, and ϵ_t is called observational noise.

MODEL : Fish/Tiger Shrimp = intercept + sal+ wt + panel + teffect + wn.

TrendPlusReg = intercept + sal + wt + panel + teffect.

Sal= salinity, wt = water Trempature

Trend in Fish is decreasing with time while there is no any clear trend pattern is found in Tiger shrimp.

Forecasting Models of Tiger Shrimp for Hoogly Estuary

Forecasting models were developed for different rivers of Hoogly estuary for fish and Tiger shrimp data sets of seed collection generated from survey. the following forecasting models were found best fitted model for Tiger shrimp .R^2 values ranged from 0.89 to0.99 and MPE ranged from 3.32 to 23.96.

Programme: Valuation, institutional mechanisms and livelihoods in inland open waters

Project : Inventorization of inland open-waters based on institutional arrangements and governance and mapping of fisher livelihood assets in inland open-waters

Investigators: Ganesh Chandra, Malay Naskar, S.K. Sahu, Mrs. A. Roy and Anjana Ekka

Technical support: Sucheta Majumdar and D. K. Biswas

Institutional arrangements and fisheries governance in the state of Uttar Pradesh

Institutional arrangement and governance of fisheries resources were investigated in the state of Uttar Pradesh. Ownership of water bodies were vested under various departments of state govt. Revenue department has ownership over rivers, lakes and a large number of ponds. Whereas Irrigation department have ownership rights of 45 reservoirs and fisheries department had ownership of 40 reservoirs. Fisheries management rights on these reservoirs are with Deptt of fisheries (75%), UP Fisheries Development Corporation (14%) and UP fisheries Cooperative federation (11%). Reservoirs were selected for study of institutional arrangement.

Stakeholders

A large number of stakeholders involved in fisheries

management in reservoirs of Uttar Pradesh. These are State departments like Revenue, Irrigation, Fisheries, and Environment and forest. Others include UP Fisheries Development Corporation, UP Fisheries Cooperative Federation, Fisheries Cooperative societies, and Local bodies. Fishers, end users and water users of the reservoirs are other stakeholders.

Reservoirs for fisheries activities in Uttar Pradesh are classified in four classes as per the government order in 1981.

Class 1 & 2

In these two classes fisheries management rights were given to the highest bidder through bidding system. Lease of water body is for three years only. The fishing year starts from 1 July and end on 30 June of next financial year. Fishermen cooperative society and contractors both can bid for the fishing rights in this water bodies. Stocking of fingerlings is the responsibility of the department but lessee has to pay the full price. Fishing holiday was observed from July 1 to August 31, every year.

Class 3 & 4

In these types of water bodies, lease for fisheries management was given for five years. In the first cycle of bidding only those fishermen cooperative society or SHG can participate, who were registered with the gram-sabhas or blocks falls within the geographical boundary of the water bodies. In the second cycle, with all those of first round, sub-divisional or district level cooperative society can participate in bidding process. In the third cycle, apart from the first two, fishermen cooperative society registered at the commissionerate level can participate. In the fourth cycle of bidding, any fishermen cooperative society of state can participate. If the minimum bid amount not received, then, and in fifth cycle apart from fishermen cooperative society, contractors shall also be involved in bidding. There will be an increment of ten percent of the lease amount for subsequent years. Revenue system of fisheries governance model operates in the distribution of fisheries management rights in the state of Uttar Pradesh.

Institutional arrangement in Indira Sagar Reservoir: a case of people public private partnership (P4) in fisheries

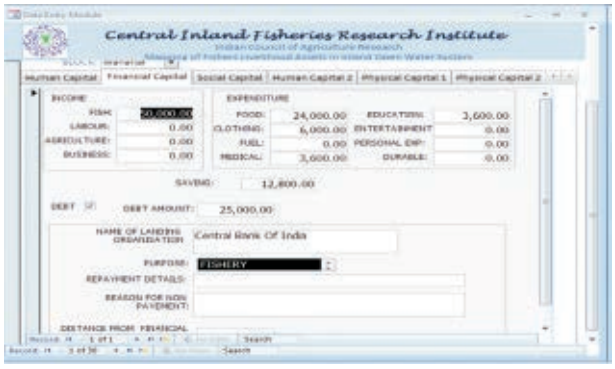
A case study was undertaken in Indira Sagar reservoir to understand the institutional arrangement and governance. Indira sagar reservoir has a water area of 93000 ha. One interesting fact came from this study was the arrangement of fisheries institution as People or community, Public and Private Partnership. The fishing in the reservoir is sole right of members of cooperative societies (People or Community), who belongs to fishermen community only. sixty six fishermen cooperative societies with 2670 fishers are fishing in this reservoir. Each member fisher is provided photo identity Diary (daily catch is recorded in the diary for wage payment). Fisheries are governed by the rule and regulation made by the government time to time and monitored by regional Manager, MP Matsya Mahasangh (public). The private participation came in the form of lessee who collects the fish from the fishers on the rate fixed by the government and sells it to the distant market, with reasonable restriction. For selling of harvested produce lease is given to the highest bidder on the basis of open tender system. Fishermen cooperative society/ registered commercial firm/ individual can participate in the bidding process. The lessee will collect the fish catch from the members of fishermen cooperative society and sell it with the restriction that 10% of the catch must be sold in local market. The lessee has to pay the wage to the fishermen at the rate fixed by the Fisheries Federation. At present the rates are for Catla (>4 kg) other major carp and cat fish (>1kg) Rs. 25/kg; minor carps and other fishes (> 0.5 kg) Rs. 15/ kg. Lessee has to stock 300 fingerlings (>50mm) per hectare in average available water area (approximately 49000 ha) in the ratio of Catla 40%, Rohu 30% and Mrigal & others 30%. (1.47 lac fingerlings). Destructive fishing methods are banned by the authorities in this reservoir

Data collection on livelihood assets of fishers in Ganga Basin

Primary and secondary data on five livelihood assets of 100 fisher families were collected from three

Borti Beel, 24Pargans(N), West Bengal

Fish catch from Borti Beel, West Bengal



Database structure of livelihood asset mapping

districts of West Bengal. The following blocks and stretch covered under data collection in 2013-14: Sagardihi and Murshidabad blocks in Murshidabad district, Haringhata and Tribeni in Nadia District, Barrackpore and Barasat blocks in North 24 Parganas district, and Hooghly river stretch fom Tribeni to Banshberia, from Nababganj to Barrackpore, and from Jangipur to Lalabag, and 2 wetlands, Kolshi beel and Borti beel.

Livelihood assets data of 30 fishers of Murshidabad district and 60 fishers of Nadia district indicate that five livelihood assets of the fishers are not well balanced. In Murshidabad district the human capital and social capital of fishers is in poor position. About 38% of the fishers are illiterate and 54% of them have less access to Government Hospitals due to distance. Most of the fishers of Murshidabad district do not have membership in society/groups etc. On the other hand the fishers of Nadia district particularly the beel (wetland fishers) are in better condition in terms of social and human capital. Most of the fishers are member of Fishermen Cooperative societies (64%). About 83% of the fishers are educated. It was also analyzed from the data that the water and aquatic resources (Natural capital) which is the main source of livelihood of the fishers is shrinking in both the districts due to various reasons. It has been observed that the livelihoods of wetland fishers are well off than the fishers fishing in Hooghly river stretch.

Database on fishers livelihood asset mapping

A data structure has been created for developing database in Microsoft access platform on livelihood asset mapping. The database covers (i) Natural capital: annual rainfall, size of waterbody, water resource, (ii) Human capital: female literacy, immunization, work participation, male female ratio, population density, (iii) Physical capital: access road, access to waterbody, access to town, craft, gear, land, house type, toilet, (iv) Social capital: membership of panchayat, Cooperative, SHG; office bearer of panchayat, Cooperative, SHGs; participation in meeting, extension participating, and (v) Financial capital: annual income, expenditure, saving, banking facility, debt repayment.

Project Title: Valuation of goods and services in Inland open-waters

Investigators: Arun Pandit, A. Sinha, A. Ekka, Roshith C. M.

Technical support: D. K. Biswas and S. Mandal

Economic value of shrimp by-catch

Catching of shrimp post larvae contribute significantly to the livelihood of most of the fishers in Indian Sundarbans. Post larvae collectors remain socially, economically and educationally disadvantaged and lack their own financial resources. The activity of collecting shrimp post larvae used for

Shrimp seed collection in Sunderbans

aquaculture, destroy other aquatic lives and species. Many other juveniles of shell and fin fishes are destroyed in the process of collection of post larvae of *Penaeus monodon*. The destruction of the by-catch juveniles pose serious ecological threats including breaking of the ecological chain, disrupting natural breeding processes and extinction of many indigenous varieties of fishes. The present study is based on primary survey of Bakkhali and Gosaba regions in South 24 Parganas. This region possesses mangrove vegetation, cluster of deltas with interlinked channels and creeks providing a suitable environment for habitat of numerous fin and shell fishes. Tidal amplitude and its nature have influence over fish availability therefore sampling was done mainly during full moon and new moon.

The peak season for collecting shrimp post larvae is from March to June. Out of the destroyed species 28 fish species have been taken into account for estimating the economic value. The prawn seed collectors who use the country boats for catching the shrimp seed were the samples for the study. The benefit cost analysis of prawn seed collectors was estimated to be 1.185 per boat. The potential economic loss of juvenile fish by-catch was estimated to be Rs 13.45 lakh per boat per year assuming 50 % mortality of the by catch species.

Huge destruction of bye catch during shrimp seed collection

Value of the mangroves to shrimp fisheries

Shrimp farms were surveyed in Gosaba and Bakkhali regions of Sundarbans. It was found that almost 80 percent of shrimp seeds required for the aquaculture in the study area were met through wild stocks which are indirectly dependent on mangroves. The economic value of mangroves in shrimp fisheries was calculated by comparative analysis of hatchery seed and wild stock used for shrimp production. In shrimp farms where hatchery produced shrimp post larvae were used as seed, it cost around 65 % in total input cost of production whereas wild stocks used as seed cost 50 % of total input cost. But wild stock's mortality rate was much lower (10%) compared to hatchery seeds (40%) which ultimately increase the profit of shrimp farming. The economic value of mangroves in supporting the shrimp fisheries was estimated to be Rs. 33,542 per ha.

Valuation study of Deepor beel of Assam

Assam possesses more than 1000 (1,196) beels which covers an area of about 1 lakh ha. However, many of the wetlands have disappeared in recent years, many are shrinking and many have lost their required depth. For the valuation study the Deepor beel of Assam has

Fishing in Deepor beel

been selected during the year 2013-14. The wetland as a whole lies on 50-56.4 metres above MSL and the core area covers 414 hectares.

Primary data and secondary data were collected from different government departments like AFDC, Fisheries Department, Forest Department, Guwahati Municipality and Guwahati University. The administrative responsibility was with AFDC and recently it has been transferred to the Department of Forests. The beel harbours one of the largest concentrations of aquatic birds in Assam. The neighbouring hills and forests are the home of many endangered and rare species of animals and insects. The beel has also lot of tourism potential. However, the area of the beel is gradually shrinking due to encroachments. Many industries have come up in its surroundings. Municipal solid wastes are being dumped in the vicinity of the beel. Sewage water from the Guwahati city also flows into the beel. The newly constructed broad gauge railway line traverses along the southern fringe of the beel. All these are adversely affecting the natural environment of the beel and badly affecting the flora and fauna of the region. Primary data were collected from the households of fishermen. A total of 59 households were covered under the study. The study shows that the beel provides a means of livelihood to a number of local families. Nine villages in the vicinity of the beel and around 850 households are involved in fishing. The fishermen organized themselves as Deepor Beel Panchpara Cooperative Society Ltd. (1976-77).

The analysis of the sample reveals that the fishermen observed fishing holidays for 90 days in the year w.e.f. 15th April to 15th July. They fish in the core areas (deeper part) during January to March, and during rest of the period they fish in the fringe areas. The study showed that the average fish catch per household was estimated to be 3.03 kg/day. Around 200 households reported to do fishing daily. The value of the fish was estimated at Rs. 2.503 crores per year.

Fishers' village around Deepor beel

Socio-economic characteristics of the fishermen household

Average age of family head (Years)	44.69
Education of family head (years of schooling)	4.69
Family size (No. of heads)	4.75
Average number of family members engaged in fishing	1.51
Operation holding (Bigha)	4.45
Livestock possession (Nos.)	
Cattle	0.25
Goat	0.37
Pig	0.41
Poultry	2.71
Number of total income generating activities/household	1.66
Number of cash generating activities	1.15
Occupation (% of Household)	
Only fisheries	54.24
Fisheries + Livestock	22.03
Others	23.73

Outreach activities

Project : Carp culture in cages and pens using feed

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

Performance of feed in response to species and environmental temperature

Feed under the project containing 34% CP was used for feeding trial with the objective to evaluate the

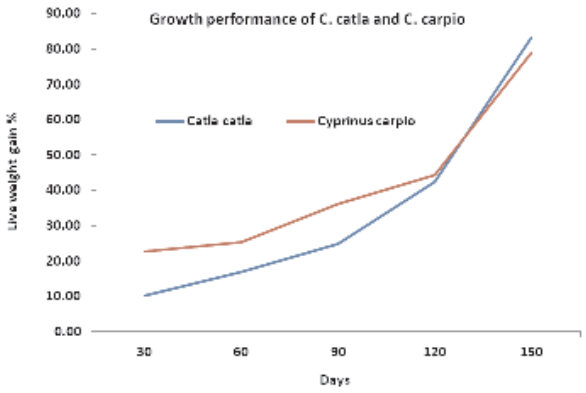
performance of the feed in fingerlings of two different species and under two temperature regimes. The feed performance trial using growth as indicator was conducted in cages in Maithon reservoir, Jharkhand on *Catla catla* (size: 17.0cm) and *Cyprinus carpio* (size: 11.8cm) during winter and summer with *ad libitum* feeding. Fishes were fed once at 2:00 p.m. during January-June with temperature variation of 19-36°C. Two species showed varied growth response to feed under two temperature regimes with slower growth (25-36% weight gain) during winter and faster growth rate (42.8-58.4% weight gain) during summer month. Differential growth pattern was observed between the two species in same temperature regimes with better performance of *C. carpio* (0.48% weight gain/day) than *C. catla* (0.33 % weight gain/day) during winter period of 75 days. However, the growth performance was better in *C. catla* (0.77% weight gain/day) than *C. carpio* (0.57% weight gain / day) during summer period of 75 days.

Optimization of cage environment for better performance of feed

In earlier experiments, it was observed that the growth performance of riverine fish, *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* reduced after attaining approximately 15 cm in cage confinement. It was therefore hypothesized that confining a riverine fish species in cages restrict their swimming space leading to stress, poor growth performance and accumulation of carcass fat. Therefore, in order to improve the performance of feed, attempt was made to optimize cage environment by providing optimum swimming space for *Calta catla*. Cage length was used as a variable having dimension of 6m, 12m and 18m. An experiment of 60 days was conducted in monsoon using *C. catla* (size: 22.75 cm) in respect of cage environment for improving performance of mustard and soybean oil cake based compact pellet (34% CP) which was fed twice daily @ 2.5% of live weight at 9 am and 2 pm on alternate days. Performance of feed in terms of live weight gain of *C. catla* was found to vary with cage environment. The best performance (61% live weight gain) of feed was recorded in 12 m long cage compared to 6 and 18 m long cages.

Use of brewery waste as alternate feed ingredient for developing floating feed

The demand of soybean meal as protein source for poultry and cattle farming coupled with increased awareness and consumption by human being has led



Growth performance of *C. catla* and *C. carpio* fed experimental diet

Comparative proximate composition of brewery waste and soybean meal

	Brewery waste	Soybean oilcake
Crude Protein (%)	49.2	44.41
Crude lipid (%)	3.12	1.75
Crude fibre (%)	12.83	9.14
Ash (%)	5.33	6.55
NFE (%)	24.14	32.22
Energy (KJ/g)	19.59	18.36

to soaring price of this commodity in the country. Therefore, to reduce dependency on soybean oil cake, an attempt was made to find an alternate protein source for use in fish feed. Brewery waste was identified as a cost effective alternative to soybean meal because of its high (49.2%) protein content.

Using brewery waste as principal source of protein, a diet composition was formulated (29.02% CP) to prepare floating feed using extruder pellet mill. The formulation was good in producing floating pellet. The pellet weretested for their physical stability and floatation time in both indoor and outdoor environment before testing its growth efficiency. In outdoor testing at Maithon reservoir revealed its floatation capability of 96 % for 3 hours and 68% for 24 hours. The pellet was found stable with little swelling in size was recorded after 8 hours of floatation and found physically intact for 18-24 hours.

Efficacy of Brewery waste based extruded pellets in cages for *Labeo bata* fingerlings.

Two iso-nitrogenous (% CP= 28.73±0.29) feed were formulated using brewery waste and soybean oilcake as protein source for comparing efficacy of brewery waste based feed. Extrusion pellet was prepared and fed twice daily at 9 am and 3 pm during November (water temp. 24 ˚C) and fed once at 11 am in alternate days during winter months (December- February; water temperature 19.5-24˚C) at subsistence level of 1% of the body weight. Twice daily feeding was resumed when water temperature reached above 24˚C during March.

Feed consumption and growth performance of fish fed with formulated extruded pellet was poor during winter months when water temperature was at the range of 19-24°C. With the improvement of water temperature better performance of feed was noticed in terms of percent live weight gain. The feed formulated with the brewery waste indicated better performance (75.8 % live weight gain) throughout the experimental period.

Project: **Fish genetic stock characterization and description**

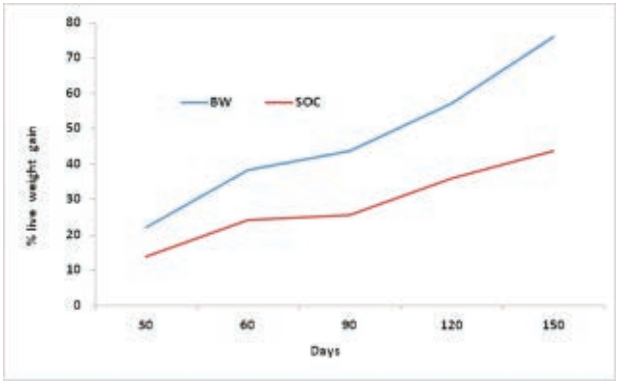
Investigators: B. K. Behera, A.K. Sahoo, D. Panda, D. K. Meena, P. Das, D. Bhakta and V. R. Suresh

Technical support: D. K. Biswas, Y. Ali, Pranab Gogoi, Asim Kumar Jana and A. Kakati

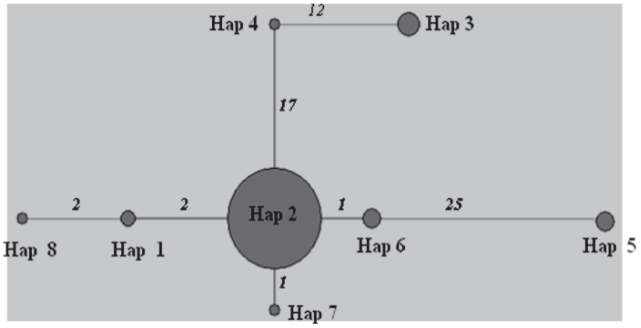
Genetic characterization of *Catla catla*

Ingredient composition of experimental diets

Ingredients	Inclusion (%)	
	D1	D2
Soybean meal	44.5	-
Brewery waste	-	40
Maize	44.5	49.5
Fish meal	5	5
Oil supplement	4	3.5
Vit-Min mix	2	2
Cost of feed(per Kg)	33.00	21.00



Growth performance of *L. bata* fed extruded pellet



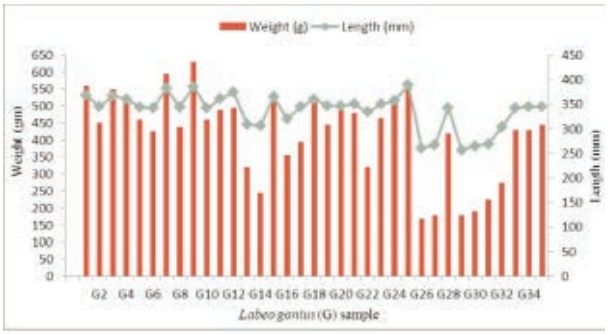
Median joining network of haplotypes of *Catla catla*. Each circle represents a haplotype and circle size is proportional to haplotype frequency. Numeral indicates number of mutations.

Number of haplotypes detected in *Catla catla* collected from six different sites

Haplotype	Allahabad (30)	Patna (06)	Farakka (18)	Nabadwip (20)	Guwahati (04)	Bharuch (09)
Hap-1	1	0	0	0	1	0
Hap-2	25	3	13	20	3	8
Hap-3	0	0	4	0	0	0
Hap-4	0	0	1	0	0	0
Hap-5	0	3	0	0	0	0
Hap-6	3	0	0	0	0	0
Hap-7	1 0		0	0	0	0
Hap-8	0 0		0	0	0	1

Out of a total of 367 bp of Cytochrome *b* mitochondrial gene amplified, 307 bp fragment of *Catla catla* was analyzed to determine genetic variation. Cytochrome *b* sequence data generated 8 haplotypes (Table); Total 46 variable sites were identified and 45 of them were parsimony informative.

Analysis of Molecular Variance (AMOVA) of cytochrome *b* gene sequences of *Catla catla* from Guwahati, Allahabad, Patna, Farakka, Nabadwip and Bharuch revealed that, out of total variation, 69.93% was attributed to variation within populations, while 30.07% was attributed to variation among populations and population structuring revealed by high and significant Fst value of 0.30074.



Gonadosometic index (GoSI) and Gastrosomatic index (GSI) of *Labeo gonius* species in respect to

Genetic diversity of *Labeo gonius*

Morphology (length, weight) and reproductive biology (gonad weight, gut length and weight, sex, maturity stages) of *Labeo gonius* from river Brahmaputra in Assam were studied. The length and weight of the specimens varied within the range of 257-415 mm and 170-630 g respectively. Similarly, Gonadosometic index (0.5-7.8 %) and Gastrosomatic index (2.6-4.7 %) showed wide range of indexes from individual to individual. Out of 35 specimens, 19 individuals were female and 16 were male. The gut length the collected specimen of the *L. gonius* showed longer in length and varied from 2130-4550 mm.

Project: Nutrient Profiling and Evaluation of Fish as a Dietary Component

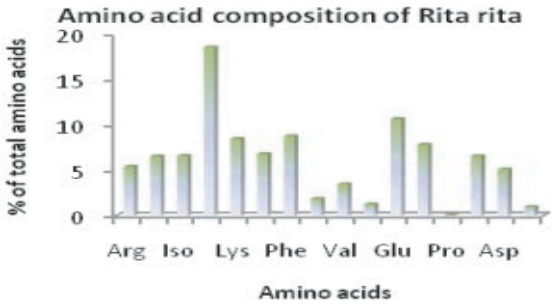
Investigators: B. P. Mohanty, D. Karunakaran, D. Debnath

Technical support: S. Bhowmick, Sk. Rabiul, A. Jana

Database on nutrient profile of food fishes from India

Screen-shot of home page of database

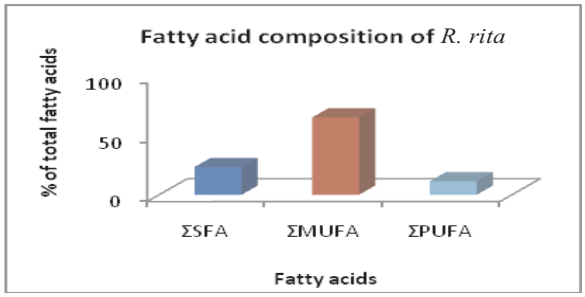
A database on 'Nutrient profile of food fishes from India' has been developed under the Outreach Activity # 3 incorporating nutrient profile in terms of proximate composition, amino acid, fatty acid and micronutrient profile composition of commercially important food fishes from India. The database can be accessed at http://www.cifri.ernet.in/outreach.



Nutrient information of freshwater catfish *Rita rita*

Proximate composition: Rita rita was found to be a good source of lean meat (19.4% protein and 1.65% fat).

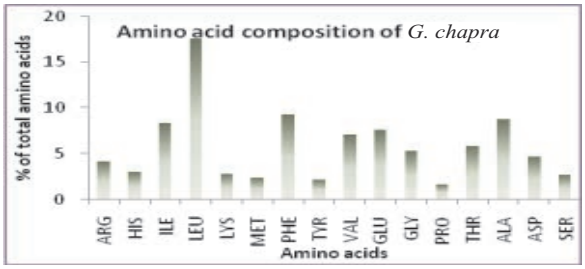
Amino acid profile: Amino acid analysis revealed that leucine, phenylalanine, glutamic acid and glycine were the predominant amino acids in *Rita rita*.



Fatty acid composition: Fatty acid analysis carried out by GC-MS (Thermo Trace GC Ultra-ITQ 900) showed that besides having low fat content, majority of fatty acids are unsaturated.

Nutrient information on *Ailia coila* and *Gudusia chapra*

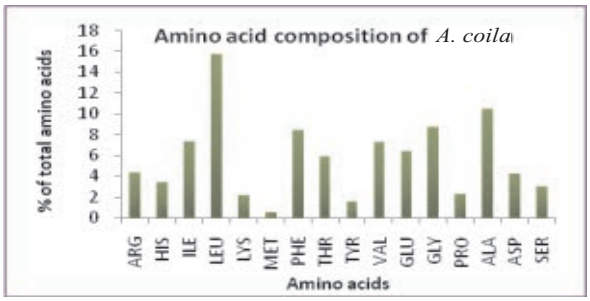
Proximate composition: A. coila and G. chapra both are rich in protein. *G. chapra* was also found to have a fair amount of fat/oil.



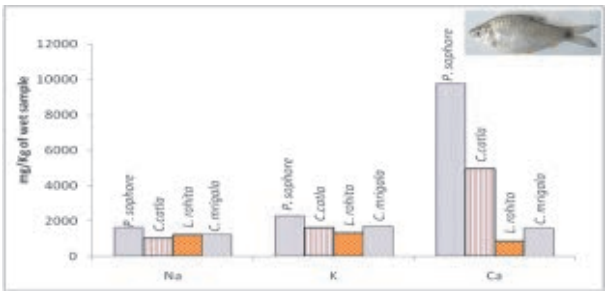
Amino acid profile: Amino acid composition revealed that leucine and phenylalanine were the predominant amino acid in *A. coila* and *G. chapra,* respectively.

Nutrient profile of small indigenous fish *Puntius sophore*

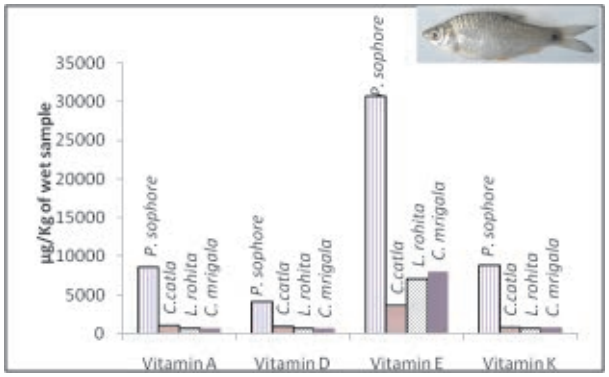
The genus *Puntius* comprises of about 134 species, of which *Puntius sophore* is important in terms of fisheries and food values. Although certain aspects of nutrient composition of some members of this genus are available in literature, comprehensive nutrient profile is not available. The proximate composition analysis showed that the fish is rich in proteins and minerals. The amino acid profiles showed that the level of essential amino acid histidine (22.94 ± 0.01 %) is very high among all the amino acids. Although this fish contains low amount of fat (5 %), the fatty acid profile showed that the fish is rich in unsaturated fatty acid out of which oleic acid (28.63 ± 0.02 %) is the most abundant one and a fair amount of eicosapentaenoic acid and docosahexaenoic acid are



also present. The mineral profiles showed that among the macro minerals, calcium is the most abundant one (9,748.2 ± 23.96 mg kg^{-1}), followed by potassium (2,283.7 ± 12.75 mg kg^{-1}) and sodium (1,610 ± 22.34 mg kg^{-1}). It was also found that P. sophore is a rich source of micro minerals Fe (115.0 ± 8.81 mg kg^{-1}), Zn (51.1 ± 10.15 mg kg^{-1}) and Mn (11.2 ± 2.09 mg kg^{-1}). Vitamin profiles showed that it is rich in all the fat soluble vitamins (A, D, E and K) and out of these vitamin E (30,685.8 lg kg-1) is the most abundant one.



Comparison of sodium, potassium and calcium contents of *P. sophore* with those of IMCs



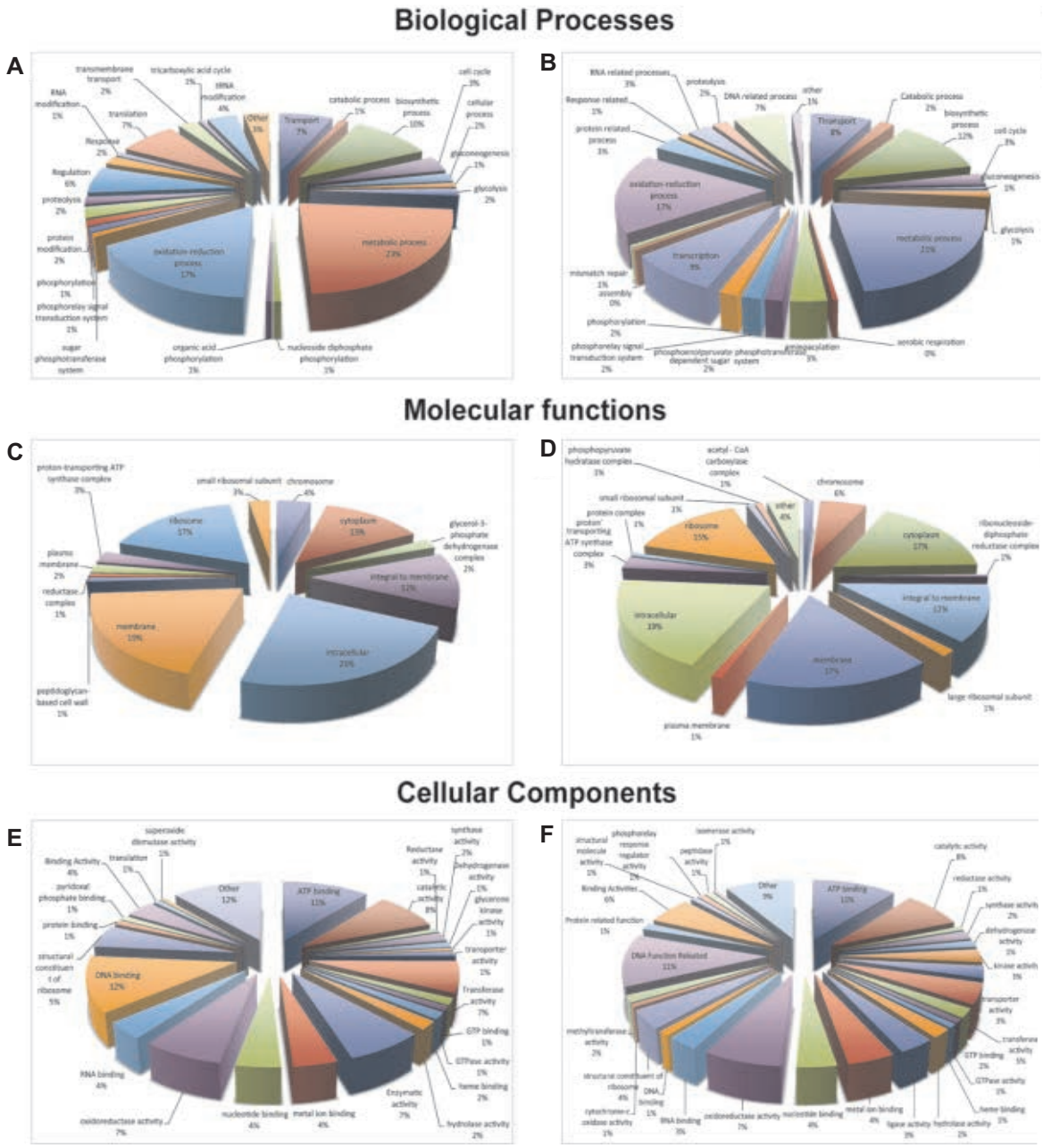
Comparison of fat soluble vitamin contents of *P. sophore* and IMCs

Externally funded projects

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

Investigators: B.K.Behera and D.K.Meena

Whole genome transcriptome profiling of one high salt stress tolerant Bacterium, *Staphylococcus epidermidis,* grown in 1.5% (control) and 20% (treated) NaCl concentration was carried out for characterization of salt stress tolerant genes. The generated transcriptome sequencing data has been annotated against the non-redundant database of NCBI. A total of 7891 ESTs of the control sample and 8706 ESTs from the treated sample were conformed to be candidate and rest ESTs were found to be novel. The Biological process, Molecular function and Cellular component annotation was carried out in InterProScan database search which were further mapped on Gene ontology (GO) database to assign the putative functions of each contig. GO distribution was used to annotate the contigs in specific ontology domains, where maximum contigs were allocated to cellular components and each contig may be categorized into



Pie chart showing Gene Ontology (GO) classification. The GO distribution of *S. epidermidis* unigenes in both control and treated samples. Control: (A) Biological Process, (C) Molecular Function, (E) Cellular Component; Treated: (B) Biological Process, (D) Molecular Function, (F) Cellular Component

more than one GO domain which signifies manifold functional characteristic of each contig. GO sequence distribution of both the bacterial samples showed ~85% contigs related to metabolic processes including carbohydrates and secondary metabolites metabolism, which may contribute to salt adaptation of *S. epidermidis*. This analysis found 152 salt responsive ESTs from control and 172 salt responsive ESTs from treated bacteria. Out of 22,000 ESTs (both control and treated) 290 and 655 SSRs were identified from control and treated *S. epidermidis,* respectively.

A haloterant bacterium was isolated from the sediment sample collected from Deuli Bunglow of

West Bengal and based on the salt physiology study, it was found to tolerate upto 25% NaCl concentration. Based on the biochemical and molecular characterization using 16S rRNA gene sequences of control (2% NaCl) and treated (5%, 10%, 15% and 25% NaCl stress) samples, the bacteria was identified as *Halomonas salina*. In addition to that, BLAST result showed >99% homology with *Halomonas salina.* This bacterium has been selected for whole genome transcriptome sequencing for identification of salt tolerant genes.

Project : Sustainable livelihood improvement through need based integrated farming system models in disadvantaged districts of Bihar

Investigators: M. A. Hassan and M. K. Bandyopadhyay

Participatory development, demonstration and validation of location specific integrated farming system models for livelihood improvement

Under this project, two farmer groups were selected, who adopted the technology of pen culture in a *chaur* in Bihar. Four HDPE circular pens measuring 1 ha for grow out, 0.1 ha for seed stocking and acclimation and two 0.5 ha for advanced fingering production was installed to validate the pen culture technique for table fish production without removing macrophytes and supplementary feeding. Considering the poor growth of *Cirrhinus mrigala* in this ecosystem zooplankton feeder *Catla catla* and periphyton feeder *Labeo rohita* were stocked. In order to utilize the load of detritus and biomass of macrophyte present in the *chaur*, emphasis was given to exotic fish species, *Cyprinus carpio* and *Ctenopharyngodon idella* for stocking for their efficiency in using the available food component and fast growth.

The fishers participated in producing stocking material in the nursery pond of hatchery complex created under the project, for learning by doing, for further rearing in pen to produce table fish. 5000 fingerlings produced in the nursery pond were stocked in the 0.1 ha pen for acclimation and growing to advance fingerling. A total of 3000 advanced fingerling thus produced were stocked in the open *chaur* along with outsourced seed. In another pen, 7000 advanced fingerling of grass carp were produced for stocking in open *chaur*. The total seed stocked in the *chaur* was 280 kg corresponding to 13,000 nos. The total seed required for the entire area of the *chaur* could not stocked presuming reduction in water level due to water abstraction for irrigation and natural loss.

Training on scientific Chaur management

The harvesting started after 10 months of first seed release in the open *chaur*. The highest growth was recorded with *C. catla* followed by *C. idella* and *C. carpio*. The harvesting trend indicated a targeted production of 2890 Kg fish from the chaur. The whole exercise of seed production in pen followed by stocking of *chaur* indicated a 10 fold increase in fish yield, which could create confidence among the stakeholders of this water body. The outcome of the project could be seen as formation of fish production groups, implementation of fisheries management practice and development of an entrepreneur who has learned the whole package of practice, developed confidence of fisheries management in such derelict aquatic resource available in the area. The agriculturist turned fishery entrepreneur had taken the chaur through open auctioning at a cost of Rs.2.05 lakh opening an opportunity of improving livelihood through fisheries.

Empowering resource poor farming community for enabling sustainable livelihood security

A 5 day training programme was organized for knowledge empowerment of 12 farmers from village Pirapur, Jandaha, Dist. Vaishali during September

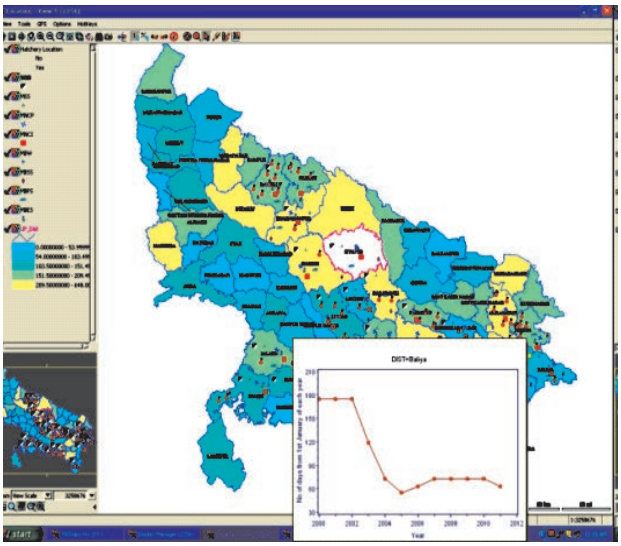
10-14 on "Livelihood improvement through scientific management of *chaur*" at CIFRI, Barrackpore. The programme included class room teaching, demonstration, exposure visit and interaction with progressive fishers. The participants were provided with a training manual on the subject prepared in Hindi.

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

Investigators: A. P. Sharma, Malay Naskar, B. K. Bhattacharyja, K. D. Joshi, D. S. K. Rao, S. K. Nag, Md. Aftabuddin, Arun Pandit, S. K. Sahu, D. Kanuranakaran, A. K. Yadav, S.C.S. Das, P. Panikkar, D. Sudheesan and S. Das

E-atlas of hatcheries of Uttar Pradesh

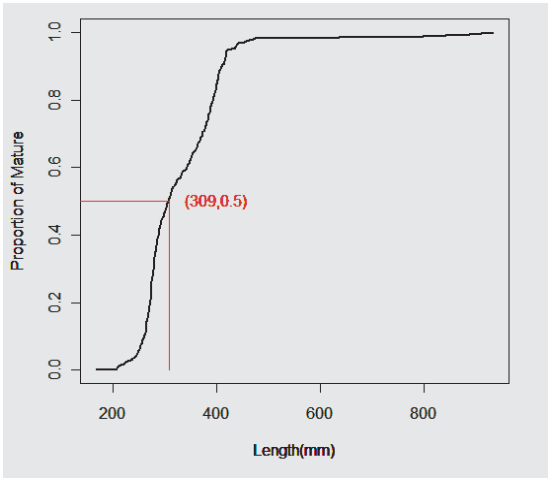
The E-atlas of fish hatcheries of Uttar Pradesh was developed containing primary information on the hatcheries, spcies cultivated, area, period of breeding, spawn output etc. that could be visualised in real time map. Some anlysed data are also presented in this GIS format and includes trends in onset of breeding period, trend in duration of breerding period, etc. As an add-on feature, the map of water bodies of below 10 ha was overlaid with the hatchery location. This will help in decision making for establishment of new hatchery in the changed scenario. The spatial differentiation could also be visualised which will be helpful for planning.



E-Atlas of fish hatcheries of Uttar Pradesh

Impact of monsoon on breeding period was studied for three states namely West Bengal, Bihar and Assam. An indicative positive relationship between breeding period and monsoon was observed in West Bengal. Bihar and Assam experienced a statistically significant effect of monsoon on breeding period. Strength of relationship between span of monsoon period with breeding period is stronger in Assam than that in Bihar.

Length at first maturity of Hilsa was determined on the basis of proportion of mature female at given size. A logistic regression was fitted to derive the curve of proportion of mature females with respect to length. Length at first maturity was found to be 309 mm for female. Earlier studies during 1980-86, the length at first maturity were recorded to be 341 mm suggesting a reduced size at first maturity. There was approximately 30 mm reduction of minimum length at maturity with respect to the base year 1980.



Size at first maturity of hilsa

However, more investigation is required to ensure whether such changes are attributable to climatic change or not.

Thermal tolerance of fish species

Experiment conducted in thermal aquarium revealed that conomically and nutritionally important minor carps *Labeo bata* (37.10 ±0.30 °C) were more tolerant ($p < 0.05$) compared to *Labeo rohita* (35.4 ±0.3 °C). In order to understand adaptation strategy for heat increment, change in pattern of energy molecules (glucose, triglycerides, protein), stress hormones (cortisol) and metabolic hormones (T4, T3) as well as hsp70 were observed for *Labeo rohita*. Serum glucose and triglycerides were increased while protein and cholesterol were decreased with faster rate of temperature increments. Faster rate of temperature increments was characterized by sharp increase in T4 and minute increase in T3, while the trend was opposite in slower rate. Cortisol increased sharply with slower increments in temperature.

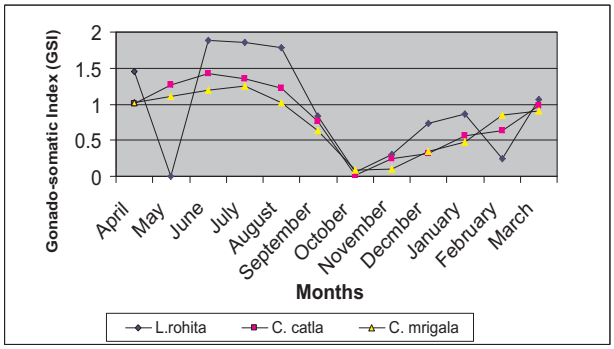
Gonadal maturity of fishes

Gonadal maturity stages of *Labeo rohita*, *Catla catla* and *Cirrhinus mrigala* of West Bengal, Odisha, Assam, Bihar, Uttar Pradesh, during April 2011-March 2014 were studied. Gonado somatic index (GSI) stages of maturity revealed that the reproductive maturity of Indian Major Carps has advanced by approximately month in Bihar and Assam.

Gonadal maturities of three coldwater fishes *Onchorhynchus mykiss, Schizothorax richardsonii*, and *Tor putitora* were studied in Uttarakhand. *Onchorhynchus mykiss experiences* full maturity during December 2013 to February 2014. Golden mahseer, *Tor putitora attains* full maturity during April to September 2013. In case of Snow-trout, *Schizothorax richardsonii* Gonado-Somatic Index (GSI) of in male showed highest (7.63) in August 2013 where as GSI in female showed minimum peak (14.65) in August 2013.

Fishers' vulnerability

A preliminary study based on 59 household involved on Deepor beel of Assam was carried out. It was found that majority of the fishermen household had low level of vulnerability. Only 10% households were vulnerable to a higher extent (0.50 and more). In general, the fishermen earned higher income than the state poverty line (Rs. 1008 per capita per month)



Trend of Gonado-somatic Index (GSI) in male *L. rohita, C. catla, C. mrigala*

which is one of the reasons behind low vulnerability. Further, it was found that, the income diversification is a negative factor for economic vulnerability, i.e. more source of income less the vulnerability.

Effect of extreme climate change events on fish seed production

Field studies covering 26 fish seed hatcheries of Kamrup, Nalbari and Barpeta Districts of Assam was carried out to study the impacts of raising atmospheric temperature and deficit rainfall on the hatchery fish seed production. The study showed that alteration in the seasonal rainfall resulting in flood and drought had adverse effects on fish seed production in the area. Delayed monsoon and deficit rainfall especially during March-April reportedly resulted in lower fertilization rates during induced breeding in IMC. To overcome this problem >40% of hatchery owners induce grass carp (*Ctenopharyngodon idella*) to breed which proved to be a suitable candidate species to breed in deficit precipitation. On the other hand, flood situation also bring great loss to the farmers, some of them reporting that flash flood destroyed their Chinese Eco-hatchery. On the positive side, a general rise in temperature reportedly led to increased growth rate of brood fish as well as reduced incubation period of eggs in the hatcheries.

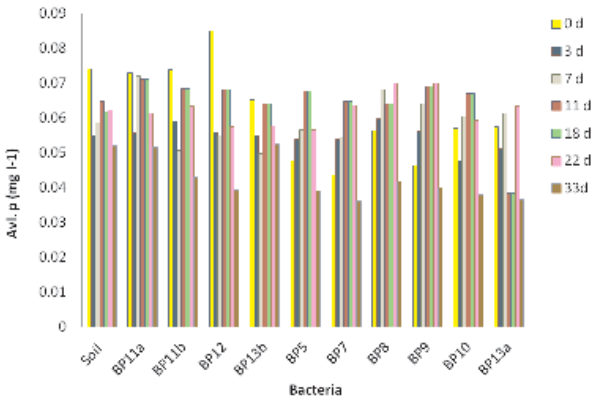
AMAAS Project : Microbial phosphorus transformations in inland open waters

Investigators : S. K. Manna and S. Samanta

To evaluate the role of pH, aeration and temperature on the phosphorus release a microcosm experiment was set up using sediment of Bhomra wetland.

Results showed no significant correlation between P release and change in Ca bound form or Al bound form. However, Fe bound P was almost absent elucidating the role of organically bound phosphorus in internal P loading of the organic reach floodplain wetlands of West Bengal. To evaluate the role of microbes in mediating aquatic P mineralization further microcosm study was performed using 10 bacterial strains, of which 2 strains were found to be most effective, and Sanger sequencing depicts the bacteria as *Brevibacillus borstelensis* and *Bacillus subtilis*.

Some other bacteria with proven P releasing activity were also identified: *Bacillus aryabhattai*, *Brevibacillus borstelensis, Bacillus megaterium*, *Klebsiella oxytoca*, *Pseudomonas aeruginosa*, *Acinetobacter ursingii*, *Methylobacterium gregans*, *Microbacterium* sp., *Arthrobacter* sp., *Bacillus* sp., *Curtobacterium luteum*, *Enterobacter* sp., *Agrobacterium fabrum*, *Acinetobacter radioresistens*, *Enterobacter asburiae*, *Acinetobacter soli*, *Microbacterium oxidans*, *Acinetobacter baumannii*, *Agrobacterium* sp., *Stenotrophomonas maltophilia*, *Novosphingobium* sp. Whole genome of two phosphorus releasing bacterium *Bacillus* sp. (ANNR00000000), *Bacillus* sp. (ANNS00000000) have been analyzed and found to have all known phosphorus releasing genes including phytase, nucleotidase etc. The sequences have been submitted to NCBI GenBank.

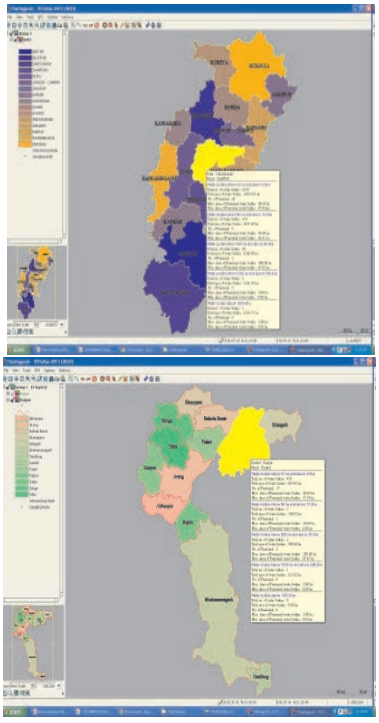


Effect of bacterial isolates on sediment phosphorus release

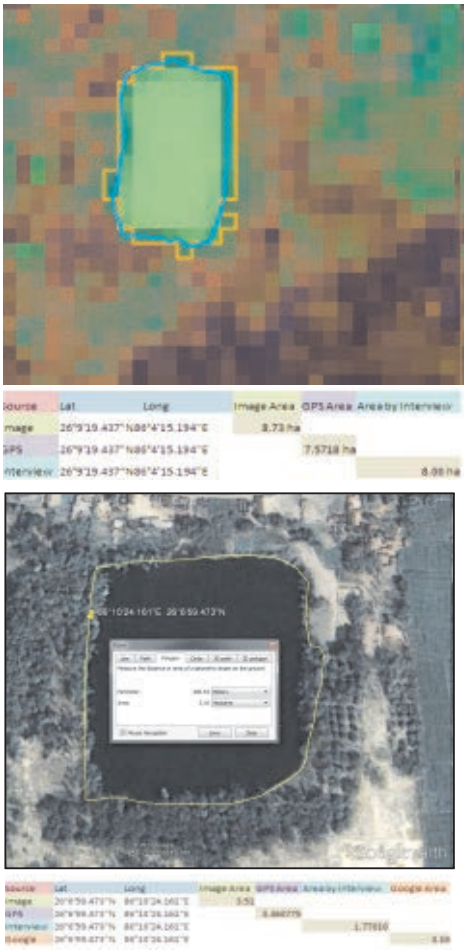
Central Sector Scheme : Strengthening of data base and Geographical information System of the fisheries sector.

Investigators: A.P. Sharma, K. D. Joshi, M. Naskar, M. Karthikeyan, S.K. Sahu, D. Karunakaran and D. N. Jha

The methodology of developing and maintaining GIS database was validated. Field visits were conducted in three states supported by simultaneous data analysis – for water bodies more than 0.5 ha - to re affirm the authenticity of quality work in progress. More than 300 water bodies were surveyed covering nearly 450 ha. Of the total water bodies surveyed, 116 were from Darbhanga (Bihar) with 100.62 hec water area, 108 were from Raipur (Chhattisgarh) with 262.36 hec water area and 111 were from Gorakhpur (Uttar Pradesh) with 116.49 ha water area. Image identification for Darbhanga district had an accuracy percentage of 98.28, for Gorakhpur district it was



E Atlas of water bodies of Chhattisgarh



Water area estimation by satellite image, Google image, interview and Ground truthing

98.20 and for Raipur district it was 100. Area estimation from image for Darbhanga district had an accuracy percentage of 85.86, for Gorakhpur district it was 71.13 and for Raipur district it was 86.07. Along with this, fishery resources (>0.5ha) estimation for the state of Maharashtra has been completed for the pre and post monsoon seasons leading to start of work in the state of Gujarat. A new methodology was worked upon by which an accurate identification and estimation of area for fishery resources is possible. The green, red, NIR and MIR bands were used to compute MNDWI, NDVI and NDBI in the new method. New images were composed from them, which refined the classification process by using threshold values derived from these advanced images. Electronic atlases of Chhattisgarh were completed.

NFBSFARA Project : Nature of impact of abiotic stresses on three diverse freshwater species of fish

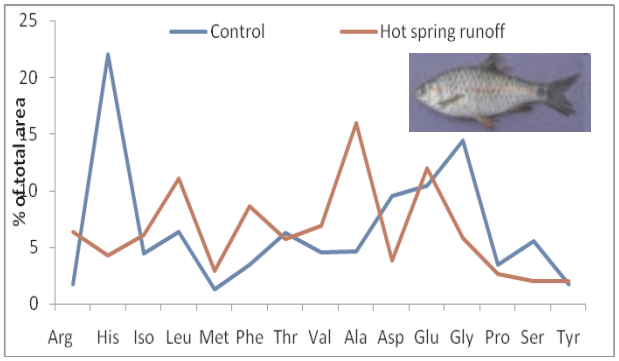
Investigator: B. P. Mohanty

Identification of perennially heat stressed ecosystem

In fishes inhabiting hot-spring runoffs and thermal discharge sites, specific adaptive mechanisms might be operating which could provide insights to high temperature stress tolerance mechanism in vertebrates. Therefore, we surveyed a number of such locations and found a hot spring located at Atri in Khurda district of Odisha (20°09'N, 85°18'E) in eastern India. The thermal spring at Atri has a circular tank the temperature of which has been recorded to be 56.1-54.95°C which is then channelized in to a nearby rivulet, a branch of river Rananadi. The temperature of the confluence and immediate periphery remains about 36-38°C.

Hsp gene expression

The changes in *hsp* gene expression in the *Channa striatus* experimentally exposed to temperature stress (36 °C) for varying durations (4, 15 and 30 days) was investigated and compared with two non-heat shocked groups; first, fish collected from aquaculture ponds (25-27 °C) and maintained at 25 °C in laboratory (control) and second, those collected from a hot spring runoff (36 °C). The findings suggest that Hsp60, Hsp70 and Hsp78 are involved in thermal acclimation and long term survival at high temperature. The most important observation made was that fish living in the hot spring runoff appears to



Changes in individual amino acids content in *P. sophore* collected from hot spring runoff.

continuously express *hsps* that can be approximated by long term induction of *hsps* in farmed fish (25 °C) if temperature of their environment is raised to 36 °C.

Dynamic changes in amino acids in *Puntius sophore* under high temperature stress

Whole body amino acid (AA) composition of the *Puntius sophore* collected from Atri hot spring runoff (36 - 38 °C) was studied and compared with fish from ponds (25 °C) to investigate the changes in amino acid composition in the fish in response to high temperature stress. The results showed significant increase in the concentration of essential AA arginine, phenyl alanine, leucine, methionine ($p < 0.01$) and decrease in the concentration of histidine, glycine and aspartic acid ($p < 0.01$) in the fish collected from hot spring runoff. The result shows that there is a clear metabolomic readjustment in the AAs, which could possibly be a biochemical adaptation for survival of these lower vertebrates.

Changes in fatty acid composition of *Puntius sophore* in response to thermal stress

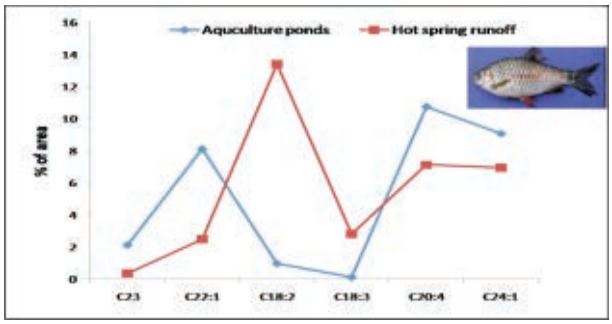
Whole body fatty acid composition of fish *Puntius sophore* collected from Atri hot spring runoff was compared with those collected from aquaculture ponds to investigate the changes in fatty acid composition of fish, *Puntius sophore* in response to high temperature stress. Significant increase in the unsaturated fatty acids linolenic acid (C18:3) and decrease in tetraeicosanoic (C20:4 erucic acid (C22:1) (3 fold) and nervonic acid (C24:1) content was observed in the hot spring runoff fish. The oleic acid content increased in the hot spring runoff fish but not to a significant extent.

Transcript information on *Channa striatus*

Transcript information of *Channa striatus* on the *hsps* and other genes involved in the thermal stress response has been generated, the sequence information has been submitted to NCBI data bank and the accession numbers has been obtained.

Gene sequences submitted to Gen Bank

Gene	Accession no.
hsp27	KC800797
hsp47	KC847092
hsp60	KC599206
hsp70	JQ945974
hsp78	KC800798
hsp90	KC599208
hsp110	KC915027
Superoxide dismutase	KC967218
Ferritin	KC710732
Hemoglobin subunit beta	KC915028
β-actin	KC967219
Glutathione-S-transferase	JX093902
Protein disulfide isomerase	KF044313
Enolase	KF044312
18s RNA	KC800799
Alfa tubulin	KC710731
ATP synthase subunit beta	JX644440

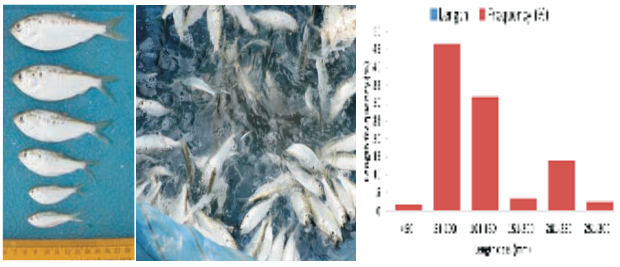


Changes in some fatty acid content in *P. sophore* collected from hot spring runoff.

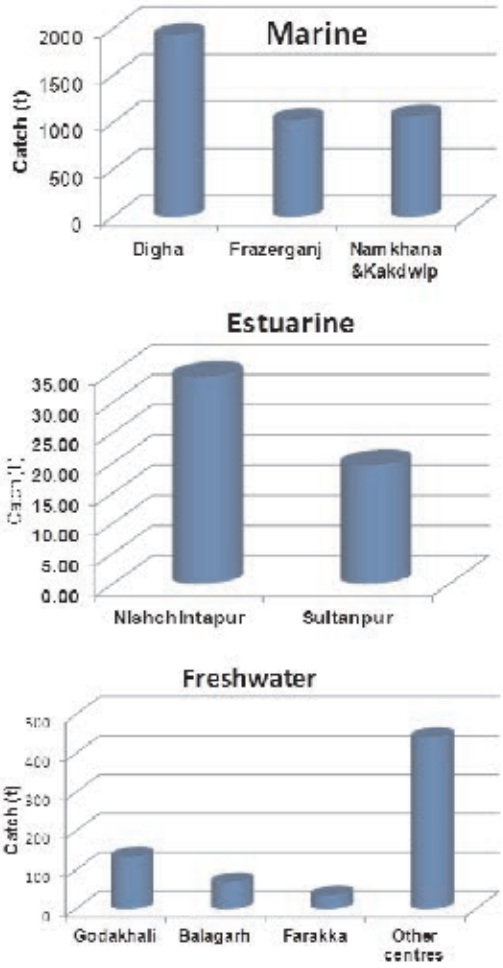
NFBSFARA Project : Stock characterization, captive breeding, seed production and culture of hilsa (*Tenualosa ilisha*)

Investigators: V. R. Suresh, B. K. Behera, R. K. Manna, Sajina A. M. and K. M. Sandhya

Hilsa catch from 16 stations along the Hooghly, including Digha, Frazergunj and Namkhana-Kakdwip for marine samples, Nischintapur and Diamond Harbour for brackish water samples, Godakali, Balagrah and Farakka for freshwater samples as major stations and other eight minor stations in between were monitored. The total catch estimated for the mainstream Hooghly, including the marine sector is 16318 t during 2013-14. Maximum catch comes from the marine sector. Average CPUE (per boat per day) was 150 kg in the marine sector (mechanized), while it was 0.5 to 2.5 kg along the freshwater sector (non-mechanized). Estimation of age at length of hilsa from Hooghly indicted that the fish attains 173 mm in six months and about 256 mm in one year in the natural environment. Surveys conducted in Ukai reservoir, Gujarat, showed presence of hilsa of all size groups in the reservoir, forming good fishery. Length frequency analysis of the specimens in catch showed capture of 50-150 mm size groups followed by 200-250 mm. The size range recorded from fishers' catch was 50-270 mm. Experimental fishing resulted in 5.8 kg of 50-150 mm TL live specimens in a single haul, indicating recruitment of the fish in the reservoir. Under pond culture trials, fingerlings (400 nos.) stocked in July in pond (0.3 ha) at Godakhali at a size of 50-70 mm/ 4.8-5.6 g av. size, grew to 136-178 mm/ 28-52 g av. size in five months, while medium sized specimens (170 individuals of 283 mm/ 236 g av. size) stocked in December grew to 295 mm/ 271 g av. size in four months.

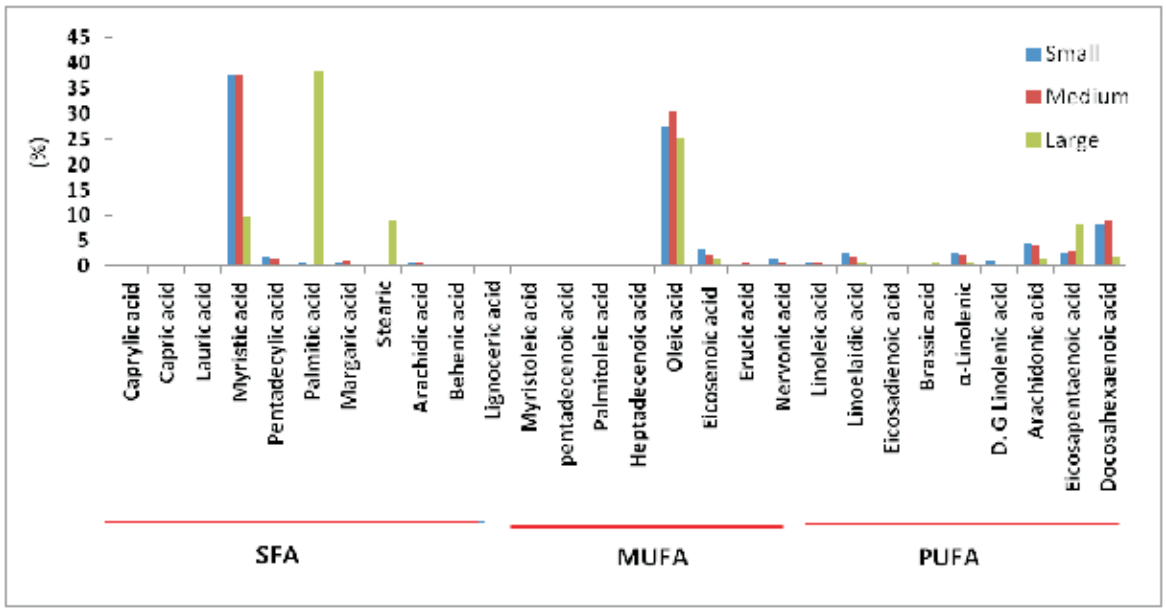


A haul of juvenile hilsa from Ukai and length frequency in fishers' catch



Zone wise catch of hilsa along Hooghly.

Hilsa stocked in freshwater pond sampled for growth and health assessment.



Fatty acid composition of hilsa of different size groups.

Analysis of biochemical composition of hilsa of different size, with regard to fatty acid profile, showed prevalence of Myristic acid, Palmitic acid, Oleic acid, besides a host of other fatty acids as shown below.

NFDB Project : National surveillance programme for aquatic animal diseases

Investigators : B. K. Behera, S. K. Manna, A. K. Sahoo and P. Das

Disease surveillance works have been initiated in three districts of Assam and four districts of West Bengal. The selection of districts was made on the basis of fish production potential and availability water resources. Ten fish farms from each district have been selected through interactive meeting/ consultation with the officials from Department of

Training Programmes

Sl. No.	Training course title	Period	Participants	Venue
1.	Inland fisheries production and resource management	21-27 June, 2013	30 fishers of Banka District, Bihar	CIFRI, Barrackpore
2.	Pen aquaculture in beels of Assam for fisheries enhancement (Under ICAR NEH Component of CIFRI)	24-26 June, 2013	24 beel lessees/ fishers' co-operative society members from 12 beels under AFDC	CIFRI, Guwahati Centre
3.	Orientation course on inland fisheries management	4-13 July, 2013	8 Students of CIFE, Mumbai	CIFRI, Barrackpore
4.	Inland fisheries production and resource management	11-17 July, 2013	30 fishers of Lakhisarai District, Bihar	CIFRI, Barrackpore
5.	Pen aquaculture in beels under AFDC and BTC for fisheries enhancement	23-25 July, 2013	49 beel lessees/fishers cooperative societies/ fishers	CIFRI, Guwahati Centre
6.	Inland fisheries production and resource management	24-30 July, 2013	30 fishers of Suphol District, Bihar	CIFRI, Barrackpore
7.	Inland fisheries production and resource management	6-12 August, 2013	30 fishers of Jamui District, Bihar	CIFRI, Barrackpore
8.	Ecology and fisheries assessment of Chilika lake	26 August to 7 September 2013,	Six postgraduate beneficiaries of Chilika Development Authority, Bhubaneswar	CIFRI, Barrackpore.
9.	Livelihood improvement through scientific management of wetlands (Chaur)	10-16 September, 2013	12 fish farmers of Jandaha, Vaisahali District, Bihar	CIFRI, Barrackpore
10.	Fish disease and ornamental fish breeding	19-23 November, 2013	35 students of S.K. Mahila College, Begusarai, Bihar	CIFRI, Barrackpore
11.	Inland fisheries production and resource management	25 Nov-02 December, 2013	30 fishers of Vaishali District, Bihar	CIFRI, Barrackpore
12.	Inland fisheries production and resource management	6-12 December, 2013	26 fishers of Saran District, Bihar	CIFRI, Barrackpore
13.	Inland fisheries production and resource management	17-23 December, 2013	30 fishers of Banka District, Bihar	CIFRI, Barrackpore
14.	Fisheries enhancement in floodplain wetlands	December, 23-29, 2013	15 students from Cachar College, Assam	CIFRI, Guwahati Centre
15.	Fishery enhancement in inland open waters.	3-7 January, 2014	10 AFO/FI of Department of Fisheries (Govt. of Chhattisgarh)	CIFRI, Barrackpore
16.	Ecology and fisheries assessment of Chilika lake	30 January to 8 February, 2014	Seven postgraduate beneficiaries of Chilika Development Authority, Bhubaneswar and CIFRI, Barrackpore	CIFRI, Barrackpore
17.	Inland fisheries production and resource management	17-23 January, 2014	30 fishers of Siwan District, Bihar	CIFRI, Barrackpore
18.	Inland fisheries production and resource management	28-3February, 2014	29 fishers of Saharsha District, Bihar	CIFRI, Barrackpore
19.	Inland fisheries production and resource management	6-12 February, 2014	26 fishers of Gopalganj District, Bihar	CIFRI, Barrackpore
20.	Inland fisheries production and resource management	14-20 February, 2014	30 fishers of Begusarai District, Bihar	CIFRI, Barrackpore
21.	Inland fisheries production and resource management	22-28 February, 2014	30 fishers of Lakhisarai District, Bihar	CIFRI, Barrackpore
22.	Inland fisheries production and resource management	4-10 March, 2014	27 fishers of Khagaria District, Bihar	CIFRI, Barrackpore
23.	Fisheries data collection and value chain assessment	13-14 March, 2014	13 CDA Personnel and five officials from Department of Fisheries, Odisha	WRTC, Barkul
24.	Inland fisheries production and resource management.	21-27 March, 2014	30 fishers of Nawada District, Bihar	CIFRI, Barrackpore

Mass Awareness Camps

Sr. No.	Name of the Camp	Date	Participants	Venue
1.	Recent advances in wetland management with integrated farming, fish health management and fish feeding management	12 April, 2013	200 people	Koklabari, Barma, Dist. Baksa, Assam
2.	Cage culture and demonstration of cage harvest	5 -7 July, 2013	Tribal fish farmers	Pookote lake, Wayanad, Kerala
3.	Utilization of low lying shallow open waters for fisheries development. (Organised in the Kishan Mela ground meeting pavilion)	6 September, 2013	50 fishermen and women	KVK, Nimpith, 24-Pgs(S),W.B.
4	Training and awareness on 'Ecosystem and fish diversity management for conservation and skill development of rural tribals'	10 -11 September, 2013.	20 tribal fishers	Sagar Island, Sundarban, 24-Pgs(S), W.B.
5.	Rally-cum-Awareness programme for surveillance period of Hilsa in Hooghly river (Fisheries Department, Govt. of West Bengal)	12 September, 2013	2 Scientists and 2 Technical Officer from CIFRI, Barrackpore participated in the rally of 150 personnel	Kakdwip, 24-Pgs (S), W.B. .
6.	Fish as nutritive food and therapeutic value (Organized in the seminar pavilion of 17th National Exhibition)	23 September 2013	60 B.Sc Zoology students from Howrah, Hooghly and 24-Parganas (N) district of West Bengal	Belur Math, Howrah, W.B
7.	Potentiality of inland fisheries development in the islands of Sundarban, West Bengal (Organized in the Sundarban Mangrove Festival ground)	7 December, 2013	70 fishermen and women	Bali Island, Sundarban, 24-Pgs(S), W.B.
8	Safety in fishing at Karapuzha reservoir	December 11, 2013	60 Fishermen	Wayanad district, Kerala

Krishi Mela/Exhibition participated

Name of Programme	Venue	Period	Participated By
International Symposium and Exhibition	CIFT, Kochi, Kerala	21-23 May, 2013	CIFRI Unit, Kochi
Expert consultation on fish genomics research in India	NBFGR, Lucknow, U.P.	02 August, 2013	CIFRI, Allahabad Centre
17th National Exhibition	Belur Math, Howrah, W.B.	23 - 25 September, 2013	CIFRI, Barrackpore
Kisan Mela	KVK, Nimpith, 24-Pgs(N), W.B.	06 September, 2013	CIFRI, Barrackpore
International Kisan Mela	Bangalore, Karnataka.	7-11 November, 2013	CIFRI, Bangalore Centre
Arunachal Meen Mahotsav	Itanagar, Arunachal Pradesh	21-22 Nov, 2013	CIFRI, Guwahati Centre
4th Agro Protech 2013	Milan Mela Ground, Kolkata	28-30 November, 2013	CIFRI, Barrackpore
Bajarpore Gramin Pradarshani –O-Mela	Alukaranbarh, Purba Medinipur, W.B	3-8 December, 2013	CIFRI, Barrackpore
Sundarban Mangrove Festival	Bali Island, 24-Pargans(S), W.B.	6-8 December, 2013	CIFRI, Barrackpore
Showcasing of Agricultural Technologies-2013	ICAR Research Complex, Patna, Bihar	6-7 December, 2013	NAIP (Component-III), Field Office (Jandaha, Bihar) of CIFRI
18th Sundarban Kristi Mela –O-Lokosanskriti Utsav.	Kultai, 24- Pgs(S), W.B.	24 – 29 December, 2013	CIFRI, Barrackpore
Sanhati Utsav-2014	Hazinagar 24-Pgs(N), W.B.	12-19 January, 2014	CIFRI, Barrackpore
Kishan Mela-cum-Exhibition	CPCRI Regional Centre, Kahikuchi, Guwahati	21 February, 2014	CIFRI Guwahati Centre
Technology Celebration Week – 2014	SBKVK,Kapgari, Pachim Medinipur, W.B.	21-25 January, 2014	CIFRI, Barrackpore
Sundarban Garmin Kutir Shilpo- O-Loko Sanskriti Utsav-2014	Joygopalpur, 24Pgs(S), W.B.	22- 28 January, 2014	CIFRI, Barrackpore
"Krishi Vasant" – National Agriculture Exhibition	Nagpur, Maharastra.	9-13 February, 2014	CIFRI, Barrackpore
Assam Matsya Mahotsav	Panjabani, Guwahati, Assam	26-27 February, 2014	CIFRI, Guwahati Centre
All India Krishi Vigyan Mela	IARI, New Delhi	26-28 February, 2014.	CIFRI, Allahabad Centre
Exhibition of Technology Celebration Week-2014	North 24-Parganas KVK, AshokNagar, W.B.	10-15 March, 2014	CIFRI, Barrackpore

Farmers' Meetings organized

Date	Particular(s) of Meeting
10.07.2013	Fishers - Scientist interaction meeting on 'Conservation of small indigenous fishes for nutritive and therapeutic value' at CIFRI, Barrackpore on the eve of National Fish Farmers Day celebration. 80 fishermen and women participated.
21.11.2013	Fishers-Scientist interaction meeting on "Potentiality of inland open waters fisheries development in Bali Island (Sunderban), West Bengal" at Bali Island, Gosaba , West Bengal. 60 fishermen and women participated.
13.03.2014	NFDB sponsored Researchers –Fish Farmers- Resource Managers meet on "Wetland fisheries development in North 24 -Parganas district of West Bengal' at North 24 -Parganas KVK, Ashokenagar, W.B. 150 fishermen and oxbow lake society members participated

Exposure visit of the Farmers and students

Sl. No	Particular(s) of visitors	Date of visit	Purpose
1.	28 B. F.Sc students, College of Fisheries, Mangalore, Karnataka	10.12.2013	Study tour
2.	21 fish farmers of Social Work and Research Centre, Naogaon District, Assam	13.01.2014	Exposure visit
3.	Visit of 12 B.F. Sc (4 th year) students and five PGDIF students from GADVASSU, Ludhiana, Punjab.	17 .01. 2014	Study tour
4.	10 Students of Halflong Govt. College , Assam	20.01.2014	Study tour
5.	25 trainees of Tripura Fisheries Training Institute,Udaypur, Tripura	20.01.2014	Exposure visit
6.	120 B.F.Sc. students of Assam Agricu lture University, Jorhat, Assam	29.01.2014	Study tour
7.	14 fish farmers of Akola, Maharashtra	05.02.2014	Exposure visit
8.	14 fish farmers of Washim, Maharastra	04 02.2014 – 05.02.2014.	Exposure visit
9.	13 fish farmers from Goa	07.02.2014	Exposure visit
10.	18 students of BSMV PG College, Lucknow, U.P.	17 .02. 2014	Study tour

Awards/Recognitions

	Recognition
Allahabad Regional Centre CIFRI	✓ Received 2nd prize in ***Rastriya Kisan Mela evam Sabji Pradarshani*** held at Indian Institute of Vegetable Research, Varanasi on 1 st February 2014.
Allahabad Regional Centre CIFRI	✓ ***Second Prize*** among the lawns of government offices in Allahabad in ***Mandaliya Phal Shak -Bhaji Evam Pushp Pradarshani*** held at Chandra Shekhar Azad Park, Allahabad. The award was presented in prize distribution ceremony held at the Park on 9th March 2014.
B. K. Bhattacharjya	✓ Director, Board of Directors of AFDC Ltd., Guwahati ✓ Member, State -level project expert committee of State Institute of Rural Development (under Dept. of Panchayat & Rural Development), Govt. of Assam, Guwahati. ✓ Resource person of the Krishi Darshan Programme of DDK, Guwahati
Preetha Panikkar	✓ **Best presentation award** at the International Conference on *Ecosystem Conservation, Climate Change and Sustainable Development* (ECOCASD 2013) during 3-5 October 2013 at Thiruvananthapuram ✓ **Best paper award** for the paper "Evaluation of the impact of stock supplementation on the food-web of a reservoir ecosystem in India" co-authored with M. Feroz Khan and A. P. Sharma
Pronob Das	✓ Expert in 'BUSINESS TIME' programme of News Time Assam on 'Aquaculture' ✓ Resource person of the Krishi Darshan Programme of DDK, Guwahati

Doctoral degree awarded

Ms Sandhya K.M. was conferred Ph.D. degree by CIFE, Mumbai on 10th May 2013 for her research work 'Biology and stock assessment of *Otolithes cuvieri* Trewavas, 1974 along Ratnagiri coast.'

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

- Department of Aquaculture Development, Cambodia
- Aquatic Ecosystem Health and Management Society, Canada
- The Ohio State University (OSU), Columbus, Ohio, USA
- NOFIMA, Norway
- Norwegian Research Council
- Ghent University, Belgium
- Network of Aquaculture Centres in Asia-Pacific (NACA)
- Wageningen University and Research Centre, The Netherlands
- South Asian Forum for Environment (SAFE)

National:

State:

- *Assam Fisheries Development Corporation, Guwahati*
- Directorate of Fisheries, Assam
- Directorate of Fisheries, Bihar
- Directorate of Fisheries, Madhya Pradesh
- Directorate of Fisheries, Maharashtra
- Directorate of Fisheries, Meghalaya
- Directorate of Fisheries, Chhatishgarh
- State Department of Fisheries, Gujarat
- State Department of Fisheries, Karnataka
- Assam Agricultural University, Jorhat, Assam
- Sundarban Development Board, West Bengal
- Bidhan Chandra 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
- All India Radio, Bangalore
- Burdwan University, Burdwan
- Vidyasagar University, Midnapore
- UAS, Bangalore
- Sardar Sarovar Narmada Nigam Limited, Gandhinagar

Central:

- NIRD, North-east Regional Centre, Khanapara, Guwahati
- College of Fisheries, CAU, Lembucherra, Agartala
- National Fisheries Development Board, Hyderabad
- 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
- Indian Statistical Institute, Kolkata

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 Umiyam, Meghalaya
- National Institute of Animal Nutrition & Physiology (ICAR), Bangalore
- National Research Centre on Yak, Dirang
- National Research Centre on Pig, Guwahati
- 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, Kanpur
- 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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NEH Activities

The Institute carried out extensive collaborative work programmes for pilot-scale validation of CIFRI technologies in collaboration with line departments and other stakeholders of open water fisheries in the Northeast under the NEH component.

Monitoring of collaborative pen aquaculture demonstrations in selected beels of Assam

The institute has collaborative demonstration of pen culture technology in 34 beels of Assam of which 30 are under the Assam Fisheries Development Corporation Ltd. (AFDC), Guwahati and 4 under Bodoland Territorial Council (BTC), Kokrajhar.

In various beels, rectangular pen (0.26-0.61 ha) was erected in marginal areas using cheap and locally available construction materials (e.g., split-bamboo screens and LDPE mosquito netting). Carp fry/ fingerlings (25-100 mm length) were stocked at density of 2-7 fish/ m^2. The common species of carp stocked were catla, rohu and mrigal at a ratio of 40:30:30. In some beels, common carp and grass carp were also stocked. The stocked fishes are being fed using locally available rice bran-mustard oil cake mixture (1:1 ratio) @ 2-5% body weight.

Preliminary analysis of data collected from collaborative pen culture demonstrations indicated that the technology is economically viable for carp fingerling rearing with B:C ratio ranging from 1.8-5.4. The collaborators felt that poaching as well as rising cost of bamboo and labour were the major constraints of the technology at present.

Collaborative development pig-cum-fish model

The Centre initiated a collaborative development of model Pig-fish farm with NRC on Pig, Rani, Guwahati under NEH component of CIFRI. Staff of the Centre visited and interacted with the Director and Scientists of NRC, Pig and made plans for development of model Pig-fish farm. Desiltation and liming of a fish pond (0.045 ha) was carried out as part of pond preparation for initiating pig-cum-fish culture trials (low-cost unit).

Gangabunh beel, BTC, Kokrajhar, Assam

46 Morakolong beel, Morigaon, Assam.

Tribal Sub Plan Activities

With the fast developing India, tribal population requires specific attention not only with monetary allocation, but technical and scientific inputs for their rapid socioeconomic development. CIFRI took the following initiatives under TSP for the socio-economic up-liftment of the tribal community:

- ✓ Mass awareness program and demonstration of cage culture was conducted at Pookote Lake, Wayanad District on 4 July 2013. Around 100 tribes attended this program.

- ✓ The Institute facilitated formation of a Reservoir Fisheries Cooperative Society, involving unemployed tribal youth in Wayanad district, Kerala and trained them on reservoir fishing and demonstrated making of fishing crafts and gear. The co-operative society is now managing the fisheries of the reservoir empowering them in employment and income generation. Life jackets were distributed and trainings were imparted to the members of the Tribal fisheries cooperative society at Karapuzha reservoir,Wayanad Kerala on safe fishing in reservoirs

- ✓ With intervention of the Institute the fish production has increased by about 50% in recent years in Suvarnavathy reservoir, Attugulipura, Chamarajanagr District, Karnataka. To help farmers in fish catch, fiber glass coracles were distributed among tribal fishers on 8 February 2014. A leaflet in English and vernacular Kannada on the ecology and fisheries of Suvarnavathy reservoir along with recommendations for enhancement of fish production was distributed. The programme was covered by All India Radio and Doordarshan.

- ✓ A two days skill development and awareness programme was organized during 10-11th September, 2013 at Sagar Island of Sunderbans for the rural tribes on 'Ecology and fish diversity conservation. Four ponds belonging to tribals in Khansaheb Abaad village were stocked with local fish species for nutritional and livelihood security of the tribal families.

Demonstration of Cage culture with locally available materials at Pookote lake, Wayanad, Kerala

Training on safe fishing in reservoirs using life jackets

Release of fish seed in freshwater ponds in Sunderbans

- ✓ A consultation workshop on "Development of Action Plan for Livelihood Options at Bali Island of Sundarban" was organized on the occasion of Gandhi Jayanti for planning strategy for development of remote and underdeveloped islands of Sunderbans. The programme was presided over by Dr. S. Ayyappan, Secretary, DARE (Govt. of India) & Director General, ICAR.

- ✓ The Institute has initiated canal fisheries development in the Bali Island to support the livelihood and nutritional security to the tribal inhabitants in collaboration with Bali Nature and Wild Life Conservation Society. A Fishers-Scientist-Local governing body interface meeting was organized at Bali on 2[1st] November 2013 to develop the fisheries development plan. In February 2014 the Institute has stocked advanced fingerlings of *Catla catla, Labeo rohita, Cirrhinus mrigala* and *Labeo bata* in Malsa Banga Canal and Adibasipara canal in Bali. The group of tribals is managing the stocked canal that would support their livelihood as well as sustainability of canal fisheries in the area and conservation of the fish germplasm.

Seed stocking in Canals of Bali

Consultancies

Sl. No	Title	Funding Agency
1.	Study of Minimum Environmental Flow Requir ement for Aquatic Life in river Dri and Tagon for Etalin Hydroelectric Power Project	Etalin Hydro Electric Company Limited, Haryana
2.	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
3.	Investigation and suggestive measures on fish migration in river Kameng for Londa (Talong) Hydroelectric Project, Arunachal Pradesh	GMR Londa Hydropower Private Limited
4.	Post restoration assessment of the ecology and fisheries diversity of Chilika Lake	Chilika Development Authority (CDA), Bhubaneswar
5.	Impact analysis on ecology, flora, and fauna including fish and fisheries, due to movement of barges carrying coal through National Waterways No. 1 (Sagar to Farakka)	Jindal ITF Ltd. Jindal ITF Centre, 28 Shivaji Marg, New Delhi – 110015

Meetings

RAC Meeting

The Institute Research Advisory Committee (RAC) Meeting was held at Barrackpore during April 05-06, 2013. Prof. Brij Gopal, Chairman, RAC, presided over the meeting. Other members Dr. N. Sarangi, Dr. C. Vasudevappa, Dr. V. V. Sugunan, Dr. M. R. Bhupendernath and Scientists of CIFRI were also present. The Heads of Division, H.Q., Head/SIC, Regional centre and Research stations presented the progress of institute research projects started during XII plan. The PI of externally funded projects and out-reach projects also detailed the progress. The Chairman expressed that urgent attention need to be given for ecological/environmental flow research focusing on cause – effect relationship between river obstruction (dams and barrages) and fisheries through capacity building in river ecological models in collaboration with other organizations including Ministry of Water Resources. Impact study on fisheries due to river obstruction and integrated water resource management with special focus on ecology and fisheries should also get priority.

Stakeholders' Meeting

The CIFRI Regional Centre, Guwahati conducted a 'Stakeholders meeting on R&D linkages in open water fisheries in NE Region' on April 11, 2013 on the occasion of the QRT's visit to the Centre. Officials from the Department of Fisheries, Assam including the Director of Fisheries, Assam and Project Director, Assam Fisheries Development Corporation Ltd; Bodoland Territorial Council, Kokrajhar; Fishery Scientists from Assam Agricultural University, Jorhat; representatives of NGOs and fish farmers participated in the meeting. The QRT of CIFRI comprising Dr. M.V. Gupta, Chairman and members Dr. Dilip Kumar, Prof. L. Kannan, Prof. U.C. Goswami and Dr. N. Sarangi visited the CIFRI Regional Centre, Guwahati during April 8-15, 2013. The team reviewed the activities of the Centre for the period from 2007-13 on April 11, 2013.

Institute Research Committee Meeting

The meeting of IRC was held during May 27-29,

2013 at Barrackpore. Prof. A. P. Sharma, Director presided over the meeting. All the Head of Divisions and scientists of all cadres participated in this important meeting. Scientists also presented their achievements made during previous year and also the future work plans in this meeting. The Chairman desired that scientists should strictly follow suggestions of Research Advisory Committee. He emphasized the need for timely submission of appropriate inputs from the regional centers for Monthly, Quarterly and Half yearly reports of the Institute. He explained that the Institute has identified some flagship programmes which are to be given proper focus during the XII Plan. In addition to the regular presentations Dr. S.K. Manna, Dr. S.K. Nag and Dr. Arun Pandit presented and discussed the reporting system including HYPM, Result Framework Documents (RFD) and Performance Indicator, respectively. A comprehensive database, FISHPROT, was launched and dedicated to the scientific community by the Director, CIFRI during the Institute Research Council Meeting. The database can be accessed at http:// www. cifri.ernet.in/fishprot.html

42nd IMC meeting

The 42nd Meeting of the Institute Management Committee of CIFRI was held at Barrackpore on July 31, 2013. The meeting was attended by the Chairman and all the 11 members. 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 on the recommendations of 42nd meeting, financial achievements, purchase of spillover equipments, status report of audit paras, progress of spillover works and research activities were also presented. The committee appreciated the efforts of CIFRI for construction and elegantly furnishing the ICAR common guest house at Salt Lake, Kolkata. Dr. B.P. Mohanty delivered a special lecture on 'Fish health and nutritional security: Nutrient information on 33 species of fishes from India and their importance in fighting malnutrition and micronutrient deficiencies'. Overall, the committee expressed satisfaction on the achievements on all fronts.

1st Coordination Committee Meeting of NFBSFARA

1st Coordination committee meeting of NFBSFARA project on 'Stock Characterization, captive breeding, seed production and culture of hilsa (*Tenualosa ilisha*)' was held in CIFRI, Barrackpore on August 16, 2013. Dr. B. Meenakumari, DDG (FS), Chairperson and other members of the coordination committee viz. Dr. Madan Mohan, ADG (M. Fy), Dr. A. G. Ponniah, Director CIBA, Dr. P. Jayasankar, Director, CIFA, Bhubaneswar were present in the meeting. Most of the investigators associated in the project were also present. Chairperson Dr. Meenakumari opined that in view of many partners in the project, Coordination Committee has a special role to play for the smooth functioning of the project. Dr. V. R. Suresh, PI presented the overall progress of the project, which was followed by detailed presentations of progress made and constraints by individual partners. The meeting discussed all the coordination issues.

CIFRI-NOFIMA Interaction Meeting

An interactive meeting of Scientists of CIFRI, Barrackpore and NOFIMA, Norway was organized at CIFRI on September 17, 2013. Prof. A. P. Sharma, Director, all the Head of the Divisions and Scientists of CIFRI and Dr. Atle Mortensen, Sr. Scientist, Dr. Velmurugu Puvanendran, Sr. Scientist and Dr. Rama Bangera, Scientist of NOFIMA participated in the meeting. During the meeting detailed discussions were held regarding Hilsa breeding/aquaculture in India and probable collaboration with NOFIMA. In addition to that the scientists of NOFIMA presented the ongoing research activities at NOFIMA.

Final QRT Meeting

Final meeting of the Quinquennial Review Team (QRT) for CIFRI for the period 2007-2013 was held during September 19-20, 2013 at CIFRI, Barrackpore. The meeting was attended by the Chairman and all the members. The Director, CIFRI and all the scientific staff were also present on the occasion. The observations and recommendations were discussed in the meeting.

3rd Advisory Committee Meeting of NFBSFARA

Third Advisory Committee Meeting of the NFBSFARA project on 'Stock Characterization, captive breeding, seed production and culture of hilsa (*Tenualosa ilisha*)' was held during October 22-23, 2013 at CIFRI, Barrackpore. The meeting was attended by Dr. K. K. Vass, Chairman, and other members including Dr. K. G. Padmakumar, Dr. A. Bandyopadhyay, National Coordinator, NFBSFARA and Prof. A. P. Sharma, Director CIFRI. The PI and all the CCPIs and CIs were also present on the occasion. Dr. V. R. Suresh, PI, presented the ATR on the recommendations of the second advisory committee meeting which was discussed at length. The PI and all the CCPIs and PIs then presented the achievements made by the respective centers.

Consultative Meeting on Fisheries Development in West Bengal

One day 'Consultative meeting on Fisheries Development in the State of West Bengal' was organized on November 23, 2013 at Kolkata Centre of CIFE to prepare a road map for fisheries development in the State of West Bengal. The meeting was chaired by Shri Chandra Nath Sinha, Minister In-Charge, Department of Fisheries, Aquaculture, Aquatic Resources and Fishing Harbour, Government of West Bengal. Dr. S. Ayyappan, Secretary, DARE and DG, ICAR, Directors of CIFE, Mumbai; CIFRI, Barrackpore; CIBA, Chennai; CIFA, Bhubaneswar; Director, NBFGR, Lucknow; CMFRI, Cochin; DCFR, Bhimtal; Additional Chief Secretary and Joint Secretary(Fisheries), Govenment of West Bengal and In-Charge, Regional Research Centres of ICAR, Vice Chancellor of WBUAFS, Prof. Samir Bhattachrya of Visva Bharati University & Former Director, IICB, Kolkata; Zonal Project Coordinator, ZPD, Eastern Region; Faculty Members from WBUAFS; Subject Matter Specialists from KVK including Neempeeth; Representatives from MPEDA, MD, BENFISH & WBFC were among the participants in the meeting.

Dr. S. Ayyappan, Secretary, DARE and DG, ICAR led the team of ICAR and coordinated the entire proceedings of the meeting. Shri Sinha called upon the ICAR Fisheries Research Institutes to assist and provide research, development and extension support to the State Department in a collaborative

approach for fisheries development in the state. Dr. Ayyappan appreciated the initiative taken by the State Government and asked ICAR scientists to take up the challenge and develop action plan for achieving a target of 18.00 lakh tonne fish by the end of 2017 to bridge the demand-supply gap in the State. Dr. Ayyappan while summarising the proceedings of day long deliberations assured the department to extend all possible support and cooperation and directed all ICAR institutes to achieve the targeted production during the plan period. Dr. B. Meenakumari, DDG (Fisheries), ICAR discussed the specific technological interventions to be made in fisheries and aquaculture sectors of West Bengal for sustainable increase in fish production. The major focus areas included fish conservation, development of feed and health sectors in aquaculture, brackish water aquaculture, cold water fisheries, stock enhancement in inland open waters, quality fish seed production, cage farming in sea and developing a robust harvest and post harvest sector in the state.

Workshop on 'Integrated and Digital Library Management System'

Workshop cum Training on 'Integrated and Digital Library Management System' was organized by Library and Informatics Section, CIFRI, Barrackpore under NAIP Sub-Project on e-Granth on December 21, 2013. Dr. A.K Jain CCPI of NAIP e-GRANT and Dr. H. Chandrasekharan, CCPI, NAIP CeRA was present in the workshop. Dr. A. K Jain presented the overview of e-GRANTH. Dr. H. Chandrasekharan, also discussed about CeRA and how we can use it in a better way. A session was also arranged to discuss about the Digital Library Management System. Initiatives taken by CIFRI under the NAIP e-GRANTH project were also shown to the delegates of the workshop. Various Institutions of ICAR and SAUs namely NIRJAFT, CRIJAF, CIFE Kolkata, CIFA Rahara, NDRI Kalyani, IVRI Kolkata, BCKV and WBUA&FS participated in the workshop. The workshop was ended with a discussion on effective use of digital library and it's benefits.

Mid-term RAC

A two days mid-term RAC meeting was held at CIFRI, Barrackpore during January 09-10, 2014. The meeting was chaired by Prof. Brij Gopal and other members were Dr. V. V. Sugunan, ; Dr. C. Vasudevappa, ; Dr. N. Sarangi, ; Dr. S. D. Singh. All HoD's, PIs, Regional Heads, and scientists from the headquarters attended the meeting. The log frame of divisions were appreciated by the members as it helped RAC to look at the background of programmes, their objectives, interventions, and expected outputs. It was also suggested by RAC that logframes need to be updated in the light of the findings of the current meeting. It was further suggested that the projects should be linked with the 'interventions' and 'outputs' listed in the log frame so that gaps can be easily identified. It was recommended by RAC that CIFRI's flagship programmes should include e-flows, valuation of resources, development of policy advices for establishing suitable governance regimes for sustainable management of aquatic resources, sustainable management of floodplain wetlands and reservoir, fish passes, ecosystem approach and responsible fisheries.

Mid-term Review Meeting of ICAR Regional Committee-II

The midterm review meeting of ICAR Regional Committee-II was conducted on January 24, 2014 at CIFRI, Barrackpore, Kolkata. Dr. (Mrs.) Meena Kumari, DDG (FS) and ICAR Nodal Officer of RCM II presided over the meeting. Prof. A. P. Sharma, Director, CIFRI and Member Secretary, RCM II described the importance of RC zone II in the context of Indian agriculture. He also described the State of West Bengal as a hub of fish production and a land of culture having glorious history and landmark achievements in science and technology. This meeting was a follow up meeting of the last meeting which was held at NAARM Hyderabad during 19-20 July, 2012. A total of 42 representatives from member states West Bengal, Orissa, Andra Pradesh and Andaman and Nicobar (UT) participated in the meeting.

National Workshop on Modelling

One day workshop on "Application of modelling approaches for management of Indian Open Water Fisheries" was held at CIFRI, Barrackpore on February 20, 2014. Thirty scientists from CIFRI, Barrackpore and five scientists from regional centers, participated in the workshop. Three national level experts Dr. E. Vivekanandan, Emeritus Scientist, CMFRI, Chennai, Dr. Sunil Kumar Mohammad, Principal Scientist and HOD of the Molluscan Fisheries Division, CMFRI and Dr. A. K. Roy , retired Principal Scientist, CIFA, Bhubaneshwar participated in the workshop.

National Conference on Mitigation and Adaptation Strategies in Wetlands: A Leadership Perspective

National Conference on Mitigation and Adaptation Strategies in Wetlands: A Leadership Perspective was jointly organized by South Asian Forum for Environment (SAFE), and CIFRI under the aegis of Indian Council of Agricultural Research at Barrackpore to provide an effective platform to review the advances in ecological, biological, chemical and social sciences as they relate to wetlands, especially in the context of climate change during 1-2 March, 2014. The conference was inaugurated by Dr. S. Ayyappan, Secretary DARE and Director General ICAR. A large number of scientists, researchers, planners, extension personnel who are working on varied aspects of wetlands including fish and fisheries participated in the conference. Dr. V.S. Vijayan, Dr. S. Deshmukh, Dr. V. V. Sadamate and Dr. Dilip Kumar were the lead speakers in the conference. The conference provides an opportunity to exchange ideas between vast array of scientists, researchers and development agencies.

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

S.No.	Name of the Meeting, Training, Workshop, Symposium	Organizer, Venue and Date	Participants
1	Brainstorming session on Improving research in agricultural extension: Issues and way frward	Zonal Project Directorate; NBSS&LUP Regional Station, Kolkata. April 26, 2013	Ganesh Chandra
2	IITK-ICRISAT Workshop	Kochi, Kerala April 29-30, 2013	D. Karunakaran
3	NNRMS Standing Committee Meeting	Mahalanobis National Crop forecast Center. Pusa campus NewDelhi, April 30, 2013	S. K. Sahu
4	Training on "Taxonomy of freshwater algae - methods, material and mode of reporting"	Krisnamurthy Institute of Algology, Chennai. May 5-11, 2013	Soma Das, Sajina A. M Abhijita Sengupta
5	SFC meeting of Central Sector Scheme	DAHDF, MOA, Krishi Bhawan, New Delhi, May 16, 2013	S. K. Sahu
6	National Seminar on "Sustainability of fisheries with new technology"	Department of Fisheries; Mahatma Gandhi Labour Institute, Ahmedabad, May 24, 2013	S. N. Singh
7	Training on recent advances in statistical modeling techniques	IASRI, New Delhi May 31- June 20, 2013	D.K. Meena D. Panda
8	National seminar on 'Wetland ecosystem: conservation and management with a reference to Northeast India	Guwahati June 21, 2013	B.K. Bhattacharjya, Sona Y and A. K. Yadav
9	Agribusiness Camp	Zonal Technology Management-Business Planning and Development Unit (ZTM-BPD), NIRJAFT, Kolkata in association with NRC for Orchids, Pakyong, Sikkim ; Chintan Bhawan, Gangtok, Sikkim, June 24, 2013	A.K.Das
10	Meeting of Quality Management System as per 9001: 2008	AQL systems consultants; CIFRI, Barrackpore; June 26, 2013,	M. K. Das, A. K. Sahoo, Anjana Ekka, Aparna Roy, D. Karunakaran, D. Panda, K. K. Goswami, M.A. Hassan, Md. Aftabuddin, M. Naskar, P. Maurye, S. K. Manna, S. K. Nag, S.K. Sahu, Soma Das, Arun Pandit, Technical Officers and Administrative Officers

S. No.	Name of the Meeting, Training, Workshop, Symposium	Organizer, Venue and date	Participants
11	3rd Annual Conference of Society of Applied Biotechnology	Tirupati; June 28-29, 2013	B.P. Mohanty
12	Meeting on "Mapping of smaller water bodies"	Department of fisheries, Raipur; July 01, 2013	S. K. Sahu
13	TOLIC meeting	NAL, Bangalore; July 04, 2013	Preetha Panikkar
14	Fish farmers day	University of Agricultural Sciences, Bangalore; Fisheries Research Station, Hessarghatta; July 10, 2013	M Feroz Khan and Preetha Panikkar
15	Workshop on "Development of brood bank on Amur Common carp"	University of Agricultural Sciences, Bangalore; Fisheries Research Station, Hebbal; July 17, 2013	M Feroz Khan and Preetha Panikkar
16	Workshop on performance indicator of ICAR institutes	NCAP, New Delhi; July 17, 2013.	Arun Pandit
17	Project Review Meeting of NFBSFARA Project No. AS: 2001	University of Delhi, Delhi; July 21, 2013	B.P. Mohanty
18	Management Development programme on "Consultancy Project Management"	NAARM, Hyderabad ; August 1-7, 2013	S.K Sahu
19	Meeting on Cage Culture under NMPS at Krishna Rajasagar Reservoir	Directorate of Fisheries, Karnataka; Bangalore; August 14, 2013.	D.S. Krishna Rao
20	Coordination Committee Meeting of the NFBSFARA project Stock characterization, captive breeding, seed production and culture of hilsa (*Tenualosa ilisha*)	CIFRI Barrackpore; August 16, 2013	Sandhya K.M.
21	National Workshop on Climate Change & Management of Water Bodies	Deptt. of Environmental Sciences & Limnology (DESL), Barkatullah University; Bhopal; August 16-17, 2013	A.K. Das
22	Meeting with Secretary, Govt. of Gujarat, Gandhinagar along with Director CIFA, regarding provision of land for CIFRI/CIFA office	Gandhi Nagar; August 17, 2013	S. N. Singh
23	Training on Management Development Programme (MDP)	NAARM, Hyderabad ; August 26 - September 06, 2013	M.A Hassan, B.K Bhattacharya
24	Workshop on 'Assessment of post harvest losses of major horticultural crops, animal and fishery products'	New Delhi; August 29, 2013	V.R. Suresh
25	Outreach Activity (#3) Review Meeting	NASC Complex, ICAR; August 29 - September 01, 2013	B.P. Mohanty

S. No.	Name of the Meeting, Training, Workshop, Symposium	Organizer, Venue and Date	Participants
26	11th Meeting of the Technical Monitoring Committee (TMC) for Central Sector Scheme on *Strengthening of Database and GIS for Fisheries Sector*	Goa; August 30, 2013	M. Karthikeyan, S. K. Sahu
27	Training on internal auditing of Quality Management System (QMS)	CIFRI, Barrackpore; September 2-3, 2013	A. K. Das, A. K. Sahoo Anjana Ekka, Archana Sinha Aparna Roy, B. K.Behera B.P. Mohanty, D. Das D.K. Meena, D. Karunakaran D. Panda, Deepa Sudheesan G. Chandra, K.K. Goswami M.A. Hassan, Md. Aftabuddin M.K. Bandopadhyay, M. Naskar, P. Maurye R.K. Manna, Roshith C.M. S.K. Manna, S.K. Nag S.K. Sahu, S. Samanta Sajina A.M., Sandhya K.M. Soma Das, V.R. Suresh
28	NFDB meeting on the project "Development and demonstration of cage culture technology in reservoirs for production of table fish"	Hyderabad; September 2-3, 2013	A.K. Das
29	Meeting on Cage Culture under NMPS at Krishnarajasagar Reservoir	Directorate of Fisheries, Karnataka; Bangalore, September 18, 2013	D.S. Krishna Rao
30	Orientation training workshop on National surveillance program on aquatic animal diseases	NBFGR, Lucknow September 20, 2013	B.K.Behera
31	Annual Workshop of Zonal Technology Management Committee	Zonal Technology Management-Business Planning and Development, NIRJAFT; Kolkata; September 26, 2013	Ganesh Chandra
32	Agri Investors Meet	Zonal Technology Management-Business, NIRJAFT, Kolkata; September 26-27, 2013	Ganesh Chandra and Praveen Maurye
33	Seminar on Leading Bengal in Agriculture-Green to Evergreen Revolution	BCKV; Kalyani; September 28, 2013	Srikanta Samanta
34	Board of Directors meeting	AFDC Ltd., Guwahati 30 September, 2013 30 January, 2014	B.K.Bhattacharya

S.No.	Name of the Meeting, Training, Workshop, Symposium	Organizer, Venue and Date	Participants
35	Review meeting of NFBSFARA Project on Hilsa.	Godakhali, South 24 Parganas; October 3, 2013	A.P. Sharma, Sandhya K.M., Sajina Ali, V.R. Suresh, R.K. Maana and B.K. Behera
36	International Conference on Ecosystem Conservation, Climate Change and Sustainable Development (ECOCASD 2013)	Thiruvananthapuram; October 3-5, 2013	Preetha Panikkar
37	Foundation Day of AgrinnovateIndia Ltd	NASC Complex, New Delhi; October 10, 2013	A.K. Das
38	Training program on Next Generation Sequencing	College of Veterinary Sciences, Anand Agriculture University, Anand; October15-25, 2013	B.K. Behera
39	The Advisory Committee Meeting of the NFBSFARA project 'Stock characterization, captive breeding, seed production and culture of hilsa'	CIFRI Barrackpore; October 22-23, 2013	A.P. Sharma, Sandhya K.M., Sajina Ali, V.R. Suresh, R.K. Maana and B.K. Behera
40	Meeting with state fisheries officials of Karnataka	Mysore; October 26, 2013	M. Feroz Khan, M. Karthikeyan and Preetha Panikkar
41	Meeting under the NICRA Project, "Assessment of spawning behaviour of major fish species in inland environment with a view to harness the beneficial effects of temperature"	CIFRI, Barrackpore October 30 -31, 2013	A.P. Sharma, Malay Naskar, Arun Pandit, Md. Aftabuddin, Preetha Panikkar, Soma Das
42	Sensitization workshop on Management Information System (MIS) including Financial Management System (FMS) of ICAR (NAIP)	IINRG, Ranchi; October 31, 2013	Arun Pandit
43	ICT oriented strategic extension for responsible fisheries management	CMFRI, Kochi; November 05-25, 2013	Deepa Sudheesan, Sandhya K.M.
44	International Krishi Mela	GKVK, Bangalore; 7-11 November, 2013	M. Feroz Khan, M.Karthikeyan, Preetha Panikkar, D.S.K. Rao
45	Training-cum- Workshop on Biodiversity conservation for women scientist	Wild Life Institute of India, Dehradun; November 09-17, 2013	Anjana Ekka
46	Training on advances in molecular and serological tools in fish disease diagnostics.	CIFA, Bhubaneswar ; November 09-29, 2013	A.K. Sahoo
47	Training on application of remote sensing and GIS in natural resource management.	NBSS &LUP, Nagpur; November 12- 02 December, 2013	D. N. Jha

S.No.	Name of the Meeting, Training, Workshop, Symposium	Organizer, Venue and Date	Participants
48	Seminar on "Chemical Engineering Education and career prospects"	Calcutta Institute of Technology, Howrah November 13, 2013	B.K. Behera
49	Professional attachment training	CMFRI, Kochi; November 13, 2013 - February 12, 2014.	Rohan Kumar Raman
50	Consultative meeting organized by Department of Fisheries, West Bengal.	CIFE, Kolkata centre; November 23, 2013	A. K. Das, Anjana Ekka
51	Meeting with Dr. M. Munawar, President, Aquatic Ecosystem Health Management Society, Canada	CIFRI Barrackpore; November 28, 2013	All Scientists of CIFRI Barrackpore Headquarters
52	Agro-Protech 2013	Indian Chamber of commerce, Kolkata November 30, 2013	Ganesh Chandra
53	Short term Training Programme on Aus AID Ecotoxicology Training Workshop under the CSIRO-IITR-NBFGR project on 'Safe Water for the future'	NBFGR, Lucknow; December 2-6, 2013	Praveen Maurye
54	Hands on Training on advanced instruments of water quality testing	NIH, Roorkee; December 2-6, 2013	Keya Saha
55	National workshop on "Biomolecular Parasitology and Resource sustenance"	Allahabad University, Allahabad; December 3 -5, 2013	B.K.Behera
56	INSEE-SANDEE Pre-conference young scholars workshop on "Experimental Economics and its applications to the study of the human behaviour and its interface with the environment"	Tezpur University, Tezpur Assam; December 4, 2013	Anjana Ekka
57	7th Biannual conference of Indian Society of Ecological Economics 'Global change, ecosystems and sustainability'	Tezpur University, Tezpur Assam; December 5-7, 2013	Arun Pandit and Anjana Ekka
58	Professional Development Program (PDP) under training module "Capture and enhanced fisheries"	CIFE, Salt Lake City; December 6, 2013	A.K. Das
59	Project Review Meeting of NFBSFARA Project No. AS: 2001	University of Delhi, Delhi, December 10-11, 2013	B.P. Mohanty
60	Agri-Business Meet	NRC on Yak; Dirang; December 17, 2013.	Ganesh Chandra
61	Scientist-Fisheries Department Official-Industry Representatives meeting for Fisheries Development	Kolkata	B.K. Behera

S.No.	Name of the Meeting, Training, Workshop, Symposium	Organizer, Venue and Date	Participants
62	Workshop cum training programme in "Integrated and Digital Library Management System" under NAIP e-Granth project	CIFRI; Barrackpore; December 21, 2013	A.K. Das , A. Sinha, A.K. Sahoo, Aparna Roy, Arun Pandit, B. K. Behera, B.P. Mohanty, D. Karunakaran, G. Chandra, K.K. Goswami, M.A. Hassan, Md. Aftabuddin, Malay Naskar, P. Maurye, R.K. Manna, S.K. Sahu, S. Samanta, Sajina A.M., Soma Das,V.R. Suresh
63	Agriculture and Fisheries Exhibition cum Technical Guidance Camp	Gondiya District Fisheries Cooperative Societies Ltd, Saundad, Gondiya, Nagpur; December 27, 2013	A.K. Das, M. A. Hassan, M. Karthikeyan
64	Fish Festival	Gondiya Zilla Matsyavyavasai Sahakari Sangh; Gondiya; 27 December, 2013	M. Karthikeyan
65	Empowerment Committee Meeting of NFBSFARA	NASC Complex, ICAR, New Delhi; January 7, 2014	B.P. Mohanty
66	Interactive meeting for NSPAAD Project with Fisheries Departmental Officials of Government of West Bengal	Directorate of Fisheries, West Bengal; Kolkata; January 7, 2014	B. K. Behera
67	National Conference on Biodiversity, 2014 - Issues, concern and future strategies	Jadavpur University, Kolkata, WB; January 16-18, 2014	D. Panda, Soma Das
68	Block level Krishi Mela	Silinda, Nadia; January 17, 2014	A.K.Das
69	Launching workshop on 'National Surveillance Programme for Aquatic Animal Diseases'	Guwahati; January 29, 2014	B.K. Bhattacharjya, S. N. Goswami, SonaYengkokpam A.K. Yadav , P. Das
70	Meeting with Hon'bleMinister of Agricultue, Govt. of India on "Cage culture in Indian open waters (sea & reservoirs)"	Krishi Bhavan; January 29, 2014	A.K. Das
71	Consultation workshop on 'Self-sufficient and sustainable aquaculture in North-Eastern region'	Agartala February 5, 2014	B.K.Bhattacharjya, A. K. Yadav , P. Das
72	Krishi Vasant 2014	Ministry of Agriculture, Government of India; Nagpur, February 9-13, 2014	A. K. Das and Ganesh Chandra

S.No.	Name of the Meeting, Training, Workshop, Symposium	Organizer, Venue and Date	Participants
73	Project formulation training program	National Coordinator, NFBSFARA; NIRJAFT, Kolkata; February 10, 2014	B.K. Behera and S. K. Manna
74	Workshop on 'Integrated water management for Ganga basin: an international workshop on collaboration avenues'	National Mission for Clean Ganga; New Delhi; February 10-12, 2014	V.R.Suresh
75	Short course on "DNA barcoding of aquatic organisms: a tool for molecular taxonomy"	NBFGR; Lucknow	Md. Absar Alam
76	Review meeting of Central Sector Scheme on "Strengthening of database GIS for fisheries Sector"	DAHD & F, MOA, Krishi Bhawan , New Delhi; February 20, 2014	S. K. Sahu
77	Launch workshop of NFDB project on National Surveillance Programme for Aquatic Animal Disease	CIFRI; Barrackpore; February 21, 2014	A.K. Das, A.K. Sahoo, Anjana Ekka, Archana Sinha, Aparna Roy, B. K.Behera, B.P. Mohanty, D. Das, D.K. Meena, D. Karunakaran D. Panda, Deepa Sudheesan, G. Chandra, K.K. Goswami, M.A. Hassan, Md. Aftabuddin, M.K. Bandopadhyay, Arun Pandit, M. Naskar, P. Maurye, R.K. Manna, Roshith C.M., S.K. Manna, S.K. Nag, S.K. Sahu, S. Samanta, Sajina A.M., Sandhya K.M., Soma Das, V.R. Suresh
78	National Conference on Inference for Stochastic process- Recent Trends and Ideas (NCISPRTI 2014)	Vishva Bharati; Shantiniketan; February 21-22, 2014	Anjana Ekka
79	Review Meeting with Dr. Mangala Rai, Chairman of Empowered Committee of NFBSFARA for reviewing the progress of NFBSFARA Project on Hilsa.	NIRJAFT, Kolkata; February 22, 2014	Sandhya K.M., V.R. Suresh B.K. Behera, Sajina A.M.
80	Workshop on "Application of Modelling Approaches for Management of Inland Open Water Fisheries"	CIFRI, Barrackpore; February 24, 2014	Deepa Sudheesan, Soma Das, M. Feroz Khan, Preetha Panikkar, Md. Aftabuddin, Rohan K. Raman, Sandhya K.M., A.K.Yadav, Sajina A.M.

S.No.	Name of the Meeting, Training, Workshop, Symposium	Organizer, Venue and Date	Participants
81	Training on 'Introduction to analysis of community ecology data by using R and CANOCO'	CIFRI; Barrackpore February 25-27, 2014.	A.K.Yadav, Arun Pandit, Md. Aftabuddin, Anjana Ekka, Sandhya K.M., D.Panda, Soma Das, Sajina A.M., Deepa Sudheesan, Rohan K. Raman
82	*Rajbhasa Sammelan*	Guwahati; February 28, 2014	S.N. Goswami
83	National conference on 'Mitigation and adaptation strategies in wetlands: a community leadership perspective'	ICAR, SAFE, CIFRI and IFSI, CIFRI, Barrackpore; March 01-02, 2014.	A.K. Das, A.K. Sahoo Anjana Ekka, Archana Sinha Aparna Roy, B.K.Bhattacharya, B. K. Behera, B.P. Mohanty, D. Das, D.K. Meena, D. Karunakaran , D. Panda, Deepa Sudheesan , G. Chandra, K.K. Goswami, M.A. Hassan, Md. Aftabuddin, M.K. Bandopadhyay, M. Naskar, P. Maurye, R.K.Manna, Roshith C.M., S.K. Manna, S.K. Nag, S.K. Sahu, S. Samanta, Sajina A.M., Sandhya K.M., Soma Das, S.C.S. Das, V.R. Suresh
84	Joint working group meeting for Agriculture development of Jharkhand	New Delhi; March 10, 2014	V.R.Suresh
85	Scientific committee Meeting	CDA; WRTC, Barkul, Odisha; March 15, 2014	V.R.Suresh
86	Theme-wise expert committee meeting for NICRA projects	CMFRI; Kochi; March 18, 2014	B.K. Bhattacharya
87	Meeting on 'Operationalization of Dolphin action Plan	WWF-India, New Delhi; March 19-21, 2014	V.R. Suresh
88	Annual Technical meeting of Karnataka Veterinary, Animal and Fisheri es Sciences University (KVAFSU)	KVAFSU, Bidar, Karnataka; March 21, 2014	M. Feroz Khan and Preetha Panikkar
89	National Conference on 'Aquatic ecosystems and their management: recent trends and future perspectives	Centre for Environmental Sciences, Central university of Bihar; Patna; March 21-23, 2014	Ganesh Chandra, Rohan K. Raman
90	National Conference on "Advances in Statistical Theory, Modeling and Applications"	Bharathiar University, Coimbatore; March 27-28, 2014	M. Karthikeyan

Events

National Fish Farmers' Day

The Institute celebrated "National Fish Farmers' Day" to commemorate the first successful induced breeding technique of the Indian major and minor carps developed by Dr. Hiralal Choudhury at Angul fish farm, Orissa on 10 July, 1957. Sri Subesh Das, IAS, Additional Chief Secretary, Department of Fisheries, Aquaculture, Aquatic Resources and Fishing Harbour, Government of West Bengal was the Chief Guest. More than 100 fish farmers and fisher women from West Bengal, Bihar, Jharkhand and Chattishgarh participated in the programme. The Chief Guest emphasized on sustainability in fish production. He also highlighted various problems like ownership, market linkage etc. and suggested that development of unutilized water bodies should be given priority through culture based fisheries. Prof. A.P. Sharma, Director CIFRI mentioned that the country's total fish production is 8.29 million tonne, which is about 11 fold higher than that in 1950-51 owing to production of quality fish seed through induced breeding technology. Prof. Sharma also called the farming community to pay attention to the conservation of natural resources and assured to extend all possible scientific support for inland open water fisheries management from CIFRI. Three farmers were awarded NFFD Award, 2013 on this occasion.

ICAR Foundation Day

The National Agricultural Research System (NARS) of India is the largest national agricultural research systems in the world. The Indian Council of Agricultural Research (ICAR) plays a pivotal role in the NARS system. Its pioneering role in ushering Green Revolution and subsequent developments in agriculture in India making the nation food and nutritionally secured has been lauded everywhere. 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, 2013. Dr. P. Das, former Director, NBFGR, Lucknow was the chief Guest of this function and Prof G.N. Chattopadhyay, Viswabharati University was the guest of honour. All the staff of CIFRI including Head of Divisions, Scientists and CIFRI retired Scientists

attended the programme. In his foundation day lecture, Dr. Chattopadhyay gave a motivating speech and remembered the rich contribution of CIFRI. On the occasion the dignitaries distributed prizes to the winners of various competitions. Dr. P. Das also addressed the audience on this occasion.

DG visited CIFRI

The Secretary, DARE and DG, ICAR visited CIFRI on July 27, 2013. He held a meeting with all the investigators involved in NFBSFARA project on 'Stock Characterization, captive breeding, seed production and culture of hilsa (*Tenualosa ilisha*)'. He assessed the progress of the project and encouraged the project staff to meet the challenging objectives. After the meeting he sat with all the scientists and technical staff of the institute and assessed the achievements of CIFRI during the past one year. He urged the staff to make sincere efforts to re-invent CIFRI. He motivated the staff to bring laurel for the institute.

Independence Day

Like every year CIFRI celebrated the Independence Day with great zeal and enthusiasm on Aug 15, 2013. Prof. A. P. Sharma, Director of the institute hoisted the tri-colour and paid tribute to the nation. He remembered the achievements of CIFRI. He urged the staff to work hard with total honesty to keep the CIFRI flag high. He emphasized for teamwork and cohesiveness. All the CIFRI staff and members of the family were present on the occasion.

Hindi *Saptah/Divas*

Hindi *Saptah* was celebrated at Barrackpore headquarters and Bangalore and Guwahati centres through various activities. At Barrackpore it was observed during September, 13-19 and at Bangalore it was observed from September 07 to 13, 2013. Various competitions were organized during the week long celebrations. The *Saptah* celebrations culminated with a valedictory function on September 13 and 19, respectively at Bangalore and Barrackpore. Dignitaries from Department of Official Language graced the function. Prizes were distributed to the winners by the Chief Guest.

CIFRI Research Centre Vadodara organized "Hindi Divas" on September 18, 2013 to promote Hindi Language as Rajbhasha. The event was chaired by Dr. S.N. Singh Rtd. Principal Scientist & Officer in-charge with the presence of Dr. N.S. Parmar, Professor, Hindi Department, M.S. University, Vadodara & Mr. Dibakar Vikarm Singh, Assistant Director, (OL) Heavy Water Plant, Vadodara. All the staff of the Centre participated in the event. To encourage the staffs' competition like Hindi Nibandh Pratiyogita, Hindi quiz pratiyogita and Hindi sulekh pratiyogita, were conducted and prizes were distributed among the winners.

Vigilance Awareness Week

CIFRI observed 'Vigilance Awareness Week' during the period Oct 28-Nov 02, 2013. 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 curbing 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 'Promoting good governance-Positive contribution of vigilance' is extremely important as the vigilance has greater role to play in good governence. His lecture was very inspiring and thought provoking where he emphasized that public officials should work with sincerity and integrity in their public actions without fear or favour.

ASRB NET and Preliminary ARS Examinations

CIFRI conducted two important national level examinations under the leadership of Prof. A. P. Sharma, Director, CIFRI, and Dr. S. Samanta, Centre Supervisor, at Kolkata Centre. The National Eligibility Test, 2013 was conducted on October 27, 2013 and Preliminary Agricultural Research Service Examination, 2013 was conducted on December 29, 2013. The venue of both the examinations was Sri Aurobindo Institute of Education, CL 9-12, Sector-2, Salt Lake, Kolkata – 700091. Nearly 700 candidates appeared in the examinations. Both the examinations were conducted successfully and the representatives from ASRB appreciated the efforts of CIFRI.

World Fisheries Day

Central Inland Fisheries Research Institute (CIFRI), Kolkata celebrated 'The World Fisheries Day-2013' at Bali Island in collaboration with Bali Nature & Wildlife Conservation Society on November 21, 2013.

On the occasion, an interaction meeting of fishers with scientists was organized on 'Potentiality of inland openwater fisheries development in the island'. Dr. M.K. Bandyopadhyay; Dr. A.K. Das; Dr. R.K. Manna; Dr. (Mrs.) Aparna Roy interacted with the local people. More than sixty fishers, CIFRI personnel and Shri Anil Mistri, Secretary participated in the programme. The discussion were directed towards utilization of available canals in the island for inland fisheries development with restoration of small indigenous fish species lost from the system due to Aila strom and flooding effect. CIFRI in collaboration with other ICAR institutes will take up programme on fisheries development in freshwater wetlands/canals in Bali island under Tribal Sub plan.

Allahabad Regional Centre conducted a workshop on "*Matsyikee Kshetra Main Rojgar Ke Avasar*" in Hindi on the occasion of World Fisheries Day. The objective of the programme was to sensitise the fish farmers, fishers and fish traders of Allahabad, about the available options of employment in the fishery sector and also to bring together the stakeholders. More than 120 participants including fish farmers, fishers, fish traders, officials of state fisheries department, serving and retired scientists of CIFRI, researchers, representatives of local institutions and students participated in the programme. An exhibition was also organised on the occasion displaying various activities of the institute as well as of the Regional Centre.

Republic Day

CIFRI celebrated the Republic Day with great enthusiasm on January 26th, 2014. Prof. A. P. Sharma, Director of the institute hoisted the tri-colour and paid tribute to the nation. Prof. Sharma delivered a motivational speech on this particular occasion. All the CIFRI staff and members of the family were present on the occasion.

Launch Workshop of National Surveillance Programme for Aquatic Animal Diseases Project

The Launch workshop of "National Surveillance Programme for Aquatic Animal Diseases Project" was organized with Assam Fisheries Departmental officials and faculties of Assam Fisheries College, Raha at College of Veterinary Science, Assam Agricultural University, Guwahati on 29th January, 2014 which was chaired by Sri Basant Das, Minister of Fisheries, Government of Assam, Another Launch workshop of the same Project was organized with West Bengal Fisheries Departmental officials and faculties of West Bengal Fisheries College, Kolkata at CIFRI, Barrackpore on 21st February, 2014 which was chaired by Smt. Malabika Jha, the Director of Fisheries, Government of West Bengal .

National Science Day

CIFRI observed science day on 28th February, 2014 at CIFRI, Headquarters. 'Fostering Scientific Temper' was the theme chosen for this year's National Science Day by the Department of Science and Technology (DST). On this occasion, drawing competition was organized. An elocution competition for Research Scholars of CIFRI was also organized on the theme "fostering scientific temper". Dr. M. K. Das, Retd HoD, FREM division delivered special lecture on various facets of scientific temper. Dr. A.P. Sharma urged all scientific team to develop scientific temper which involves the application of logic in our day to day life so that the spirit of scientific enquiry may motivate us to excel in research.

DG inaugurated the aquarium and multispecialty training complex

Dr. S.Ayappan, Director General ICAR laid the foundation Stone on March 1, 2014, at CIFRI Headquarters for the proposed Aquarium and Multispecialty Training Complex. On the occasion a number of dignitaries like Dr. VS Vijayan, Dr. Deshmukh, Dr. Sadamate, Dr. Dilip Kumar were also present. The institute scientists, researchers, planners, extension personnel participated in the ceremony.

International Women's Day

International Women day was celebrated in CIFRI on 8 March, 2014. Institute's staunches like Dr. S. K. Nag, Dr. M. A. Hassan; Dr. V. R. Suresh congratulated all the ladies of CIFRI for their efforts in accomplishing institutional responsibility and at the same time taking care of their families. On this occasion, Dr.A.P. Sharma appreciated the dedication of women scientific and technical staff of the institute and said that we have to demonstrate our preparedness to be involved in all activities which can bring a change.

CIFRI's 68th Foundation Day

The Institute celebrated its 68th Foundation Day on 17 - 18 March, 2014 at its headquarter in Barrackpore, Kolkata. On the occasion a day long interactive meeting was held among the Director, scientists and technical officers to discuss about achievements and shortcomings of the previous year and the various measures to be taken towards the goal of achieving excellence in terms of output and outcome of the institute. Brig. J.C. Talukdar, Station Commander, Barrackpore Cantonment graced the occasion as Chief Guest. Brigadier Talukdar in his speech hailed the Director and the staff of the institute for its glorious past and wished all success in its present endeavor to find solutions to some of the challenging situations like reduction in production and productivity, loss in biodiversity, degraded environment, captive breeding of Hilsa, effect of climate change on fish and fisheries etc. Dr. S. Satpathy, Actg. Director, Central Research Institute on Jute and Allied Fiber, Barrackpore was the Guest of Honour. The meritorious children belonging to CIFRI staff were felicitated on this occasion.

Online NET Examination, 2014

CIFRI successfully conducted online NET Examination, 2014 (I) at Barrackpore during 26th March to 6th May, 2014. This is the first time ICAR conducted online examination for NET. Out of 24 centres in India CIFRI is the one and only centre in whole West Bengal with capacity to conduct online examination for 100 students at a time.

Distinguished Visitors

- Shri Manish Gupta, Hon'ble Minister of Power, Govt. of West Bengal.
- Dr. S. Ayyappan, Secretary, DARE & DG, ICAR
- Dr. B. Meena Kumari, DDG(Fs),ICAR
- Dr. Brij Gopal, Coordinator, Centre for Inland Waters in South Asia and Former Professor, Jawaharlal Nehru University, New Delhi
- Dr. A.E Eknath, DG, NACA
- Dr. M.V Gupta, Former ADG, World Fish Centre
- Prof. L. Kannan, Former Vice-Chancellor, Thiruvalluvar University, Tamil Nadu.
- Dr. V. V. Sadamate, Former Adviser Agriculture, Planning Commission and Principal Consultant, FAO
- Dr. V. S. Vijayan, Eminent Ecologist and Chairman, Salim Ali Foundation
- Dr. Dipayan Dey, Chair, South Asian Forum for Environment and Member, UNEP Environment Assembly
- Prof. Amlesh Choudhury, Biodiversity Expert and Eminent Researcher, Sunderban Biosphere
- Dr. S. D. Singh, ADG(In Fy),ICAR, New Delhi
- Dr. Madan Mohan, ADG (M. Fy)
- Dr. A. G. Ponniah, Director, CIBA, Chennai
- Dr. P. Jayasankar, Director, CIFA, Bhubaneswar
- Dr. J. K. Jena, Director, NBFGR, Lucknow
- Dr. A. K. Singh, Zonal Coordinator, ZPD-II, Kolkata
- Dr. M. Munawar, President, Aquatic Ecosystem Health and Management Society, Canada
- Dr. Velmurugu Puvanendran, Sr. Scientist, NOFIMA
- Dr. Rama Bangera, Scientist, NOFIMA
- Dr. A.K Jain, CCPI, NAIP e-GRANTH
- Dr. H. Chandrasekharan, CCPI, NAIP CeRA
- Sri Subesh Das, IAS, Additional Chief Secretary, Department of Fisheries, Aquaculture, Aquatic Resources and Fishing Harbour, Government of W. B.
- Prof. B.B. Jana, Kalyani University
- Dr. P. Das, Former Director, NBFGR, Lucknow

- Prof. G.N. Chattopadhyay, Viswabharati University
- Shri Shankar Kumar Dutta Gupta, Ex-DAG, CAG
- Dr. S. Deshmukh, Chairman Board of Studies in Life Sciences, University of Mumbai and Fellow Swaminatahn Foundation
- Dr. A. K. Singh, IAS, Principal Secretary, Fisheries Department, Govt. of Assam
- Dr. A. K. Roy, IAS, Secretary (Fishery), Govt. of Assam
- Dr. N. Sarangi, Former Director, CIFA, Bhubaneswar
- Prof. U. C. Goswami, Dept. of Zoology, Guwahati University
- Shri Kuldeep Dhaliwal, Member, ICAR General Body, ICAR, New Delhi
- Dr. S.C. Pathak, Former C.G.M. NABARD, Guwahati
- Dr. M. Sinha Former Director, CIFRI, Barrackpore,
- Dr. R.S. Chauhan, Head, Fisheries College, GBPUA&T, Pantnagar
- Dr. S.A.H.Abidi, Former Member, ASRB, New Delhi
- Dr. P. C. Mahanta, Former Director, DCFR, Bhimtal
- Prof. U. C. Srivastava, Department of Zoology, Allahabad University
- Prof. Anita Gopesh, Department of Zoology, Allahabad University
- Dr. S. L. Gupta, Joint Director, Botanical Survey of India, Allahabad
- Dr. K.W. Warsi, Deputy Director of Fisheries, Govt. of U. P.
- Mr. Rajeev Jaitley, AGM, NABARD, Allahabad
- Mr. M. K. Deka, ACS, Director of Fisheries, Assam, Guwahati
- Mr. K. C. Sarma, ACS, Managing Director, AFDC Ltd., Guwahati
- Dr. R. N. Goswami, Dean, Faculty of Veterinary Science (AAU), Khanapara, Guwahati
- Dr. A. K. Gogoi, Zonal Project Director, ICAR Zone III, Umiam, Meghalaya
- Dr. P. Hazarika, Assoc. Director of Extn. Edn. (Vety.), AAU, Khanapara
- Mr. M. Ahmed, Joint Director of Fisheries, Govt. of Assam
- Dr. B. Lahon, Project Director, AFDC Ltd., Guwahati
- Sri S.D. Bora, Additional Principal Chief Conservator of Forest, Sardar Sarovar Narmada Nigam Ltd. Gandhinagar
- Sri S.M. Saiyad, Dy. Conservator of Forest , Sardar Sarovar Narmada Nigam Ltd, Vadodara
- Dr. Dilip Kumar, Former Director, CIFE
- Dr. R.S. Biradar, Former Joint Director, CIFE
- Prof. U.C. Goswami, Guwahati University
- Prof. E. Kannan, Annamalai University
- Dr. C. Vasudevappa, NFDB, Hyderabad
- Dr. S. N. Biswas, Deputy Director, Dept. of Fisheries, Govt. of W.B.
- Dr. V. V. Sugunan, Former ADG (In. Fy), ICAR
- Dr. Indranil Mukhopadhyay, Associate Professor, Indian Statistical Institute, Kolkata
- Dr. Sabyasachi Bhattacharya, Associate Professor, Indian Statistical Institute, Kolkata
- Dr. Gaurangadeb Cahttopadhyay, Associate Professor, University of Calcutta,

Foreign Visit by CIFRI Scientists

- Prof. A.P. Sharma visited Lao PDR and Cambodia on an exposure visit to the Mekong river basin during August 20-24, 2013.

- Dr. Sajina A. M. attended a short course on 'Fisheries Governance' by Centre for Development Innovation (CDI) of Wageningen University and Research Centre, The Netherlands, under Netherlands Fellowship Programme. The short course was for 19 days from October 21to November 8, 2013. The short course on fisheries governance aimed at providing the participants insights on challenges that fisheries governance face and to explore ways to strengthen fisheries governance.

- Dr. Subir Kumar Nag visited Carbon Management & Sequestration Center (C-MASC), School of Environment and Natural Resources, College of Food, Agricultural, and Environmental Sciences, The Ohio State University (OSU), Columbus, Ohio, USA w.e.f. 17 October, 2013 to 16 January, 2014 to attend International training in frontier areas of agricultural sciences approved under HRD program of NAIP in the subject area of Carbon Trading/Carbon Sequestration/Climate Change (Fisheries). During the training he worked on carbon sequestration potential and GHG emission from wetlands under the supervision of Prof. Rattan Lal, Distinguished Professor, C-MASC, OSU.

- Prof. A. P. Sharma, attended the first meeting of the Joint Working Group (JWC) on "*Cooperation in the field of fisheries"* between India and Bangladesh at Dhaka, Bangladesh during 12 to 13 March, 2014.

- Dr. Dipesh Debnath, Scientist attended the DBT Overseas Associateship for NE Scientists at Ghent University, Belgium during May 23, 2013 to May 24, 2014.

Promotions

Sl. No.	Name	Designation	Promoted to	with effect from
1	Md. Quasim	STO	ACTO	29.06.2011
2	Shri S. Choudhury	TO	STO	22.07.2011
3	Mr. S.R. Meena	TO	STO	22.07.2011
4	Ms. Rina Naiya	TO	STO	01.01.2010
5	Ms. U. Unnithan	STA	TO	24.06.2012
6	Mr. P. Gogoi	TA	STA	13.09.2011
7	Dr. S. Bhoumick	ACTO	CTO	03.02.2012
8	Mr. S. Monoharan	STO	ACTO	04.06.2013
9	Mr. J. Balmiki	Technician	Sr. Technician	29.07.2013
10	Mr. Biswanath Bose	Technician	Sr. Technician	29.07.2013
11	Shri A. K. Goswami	TA	STA	29.07.2013
12	Mr. A. Chakraborty	TA	STA	18.02.2013
13	Mr. D. Sanfui	TO	STO	01.01.2011
14	Mrs. A. Sengupta	TO	STO	27.08.2011
15	Mr. Vijaykumar M.E.	TA	STA	01.11.2012
16	Mr. James Murmu	TO	STO	29.06.2011
17	Ms. Sunita Prasad	TO	STO	04.10.2011
18	Mr. N. K. Saha	STA(Retd.)	TO (Retd)	01.07.2013
19	Mr. Arijit Ghosh	ST	TA	02.01.2013
20	Sk. Rabiul	ST	TA	12.06.2013
21	Mr. Soumitra Roy	TO	STO	31.01.2010
22	Mr. Sanjay Das	ST	TA	11.09.2013
23	Mr. J. K. Singh	ST	TA	15.01.2013
24	Mr. Sukumar Saha	ACTO (Retd.)	CTO (Retd)	03.02.2012
25	Ms. Keya Saha	STO	ACTO	01.01.2010
26	Mr. S. Gupta	Assistant	AAO	06.06.2013 (AN)
27	Mr. S. Karmakar	Sr. Clerk	Assistant	07.06.2013
28	Mr. U. B. Bhattacharjya	Sr. Clerk	Assistant	07.06.2013
29	Ms. J. Pal	Sr. Clerk	Assistant	07.06.2013
30	Mr. P . K. Ghosh	Sr. Clerk	Assistant	10.06.2013
31	Ms. Jolly Saha	P.A.	Privte Secretary	12.07.2014
32	Mr. C. Chakraborty	Sr. Clerk	Assistant	10.02.2014
33	Mr. G. C. Barman	Sr. Clerk	Assistant	10.02.2014
34	Mr. Kishore Shaw	Sr. Clerk	Assistant	10.02.2014
35	Mr. A. C. Biswas	Sr. Clerk	Assistant	10.02.2014

Transfers

Sl. No.	Name & Designation	Place of posting	Transferred to
1	P. K. Katiha, Pr. Scientist	Barrackpore	NAIP, ICAR, New Delhi
2	S. Monalisa Devi, Scientist	Vadodara Centre	CIARI, Andaman
3	S. S. Mishra, Pr. Scientist	Allahabad Centre	CIFA, Bhubaneswar
4	P. K. Nayak, AFAO	Barrackpore	NRC on Pig, Guwahati
5.	Dibakar Bhakta	Barrackpore	Vadodara

New Appointments

Sl. No.	Name & Designation	Place of posting	Date of joining
1	Shri Dibakar Bhakta, Scientist	Barrackpore	10.04.2013
2	Shri K. P. Nath, SFAO	Barrackpore	18.04.2013
3	Shri R. K. Raman, Scientist	Barrackpore	10.10.2013
4	Ms. Suman Kumari, Scientist	Barrackpore	10.10.2013
5	Ms. Lokenath Chakraborty, Sr. Technical Assistant	Barrackpore	07.03.2014

Superannuations

Sl. No.	Name	Designation	Date of Retirement	Place of posting
1	Dr. U. Bhaumik	Head	30.04.2013	Barrackpore
2	Mr. B.N. Das	T-5	30.04.2013	Barrackpore
3	Mr. Karam Raj	T-1	30.04.2013	Allahabad
4	Mr. Gour Gharami	SSS	30.04.2013	Barrackpore
5	Mr. J. Mukhia	SSS	31.05.2013	Barrackpore
6	Mr. K. Ninge Gowda	SSS	31.05.2013	Bangalore
7	Mr. Prasidhh Sahani	SSS	06.06.2013	Barrackpore
8	Dr. B. B. Satpathy	Pr. Scientist	31.07.2013	Barrackpore
9	Dr. B. K. Singh	Pr. Scientist	31.08.2013	Allahabad
10	Mr. S. L. Das	SSS	31.08.2013	Barrackpore
11	Dr. S. N. Singh	Pr. Scientist	30.09.2013	Vadodara
12	Dr. M. K. Das	Head	31.10.2013	Barrackpore
13	Mr. N. Rajak	LDC	30.11.2013	Barrackpore
14	Ms. Sikha Majumder	AAO	31.12.2013	Barrackpore
15	Mr. P. C. Kachari	SSS	31.12.2013	Guwahati
16	Mr. Munni Lal Mallah	SSS	31.01.2014	Allahabad
17	Mr. Ram Pada Halder	SSS	28.02.2014	Barrackpore
18	Mr. N. Subramoni	SSS	31.03.2014	Bangalore

हिन्दी सारांश

केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान
(भारतीय कृषि अनुसंधान परिषद्)
बैरकपुर, कोलकाता–700120, पश्चिम बंगाल

प्रस्तावना

केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान ने रिपोर्ट अवधि के दौरान 12वीं योजना के प्रारंभ में संस्थान की अनुसंधान परियोजनाओं को संघटित किया। संस्थान ने अपनी अनुसंधान परियोजनाओं में मत्स्य आवास परिवर्तन, क्षेत्र विखंडन व संकुचन, विदेशी प्रजातियों का आक्रमण एवं प्रदूषण से होने वाले आवास अपकर्ष से नदियों की पारिस्थितिकी पर प्रतिकूल प्रभाव को सम्मिलित किया है। इसके साथ नदीय धारा का आंकलन एवं इसके पुनरूत्थान हेतु योजना कार्यान्वित की गई है। इस दिशा में गंगा और महानदी के जलीय गुणवत्ता संबंधी आंकड़ों को एकत्र किया गया जिससे प्रबंधन योजनाओं को कार्यान्वित किया जा सके। ज्वारनदमुख जैवविविधता से सम्पन्न होते हैं अतः संस्थान की अनुसंधान परियोजनाओं में पूर्वी एवं पश्चिमी तटवर्ती क्षेत्रों के कुछ ज्वारनदमुखों का पर्यावरण आंकलन, जैवविविधता, मत्स्य स्टॉक डायनामिक्स पर बल दिया गया हैं। देश के जलाशय मत्स्य उत्पादन का एक महत्वपूर्ण संभावित संसाधन क्षेत्र हैं। अतः संस्थान का वर्तमान फोकस इन जलाशयों में प्रोटोकोल का विकास करना है। इस दिशा में संस्थान द्वारा प्रस्तावित तकनीकी निर्देशों का पालन कर बहुत सी जलाशयों में उत्पादन वृद्धि हुई है और जलाशयों में पिंजरा पालन से बड़ी मछलियों का उत्पादन भी बढ़ा है। संस्थान का यह प्रयास राष्ट्रीय स्तर पर प्रसार माध्यमों द्वारा देश के प्रत्येक क्षेत्र में पहुंचाया जायेगा। संस्थान के उत्तर–पूर्वी क्षेत्रीय केन्द्र, गुवाहाटी द्वारा पेन एवं पिंजरा पालन कार्यक्रम का आरंभ किया गया है।

बाढ़कृत आर्द्रक्षेत्र के पर्यावरण का पुनरूत्थान एवं मत्स्य उत्पादन वृद्धि में महत्वपूर्ण भूमिका होती है। इसके लिये प्रतिपालित प्रबंधन मार्गदर्शी नियम संबंधी आंकडों का संग्रहण किया गया जिससे मात्स्यिकी एवं मछुआरों के लिये आजीविका के साधन उपलब्ध किया सके। पश्चिम बंगाल, ओडिसा, बिहार, छत्तीसगढ़, उत्तराखण्ड और आन्ध्र प्रदेश के प्रमुख मत्स्य प्रजातियों पर जलवायु परिवर्तन के प्रभाव का आंकलन किया गया तथा ओडिसा के चिलिका लैगून पर फालिन चक्रवात के दुष्प्रभाव का मूल्यांकन किया गया है।

बी ओ बी एल एम ई (BOBLME) नेटवर्क परियोजना के अंतर्गत हिल्सा मछली के स्टॉक का आंकलन किया गया तथा एक बड़ी अनुसंधान कार्यक्रम को आरंभ किया गया जिससे स्टॉक कैरेक्टराइजेशन, कैपटिव ब्रिडिंग, हिल्सा का मत्स्य बीज उत्पादन एवं इसके पालन को परिषद के अन्य मात्स्यिकी संस्थानों एवं विश्व भारती विश्वविद्यालय, पश्चिम बंगाल के सहयोग से कार्यान्वित किया जा सके। आउटरीच परियोजना के अंतर्गत मछलियों के आहार पर न्युट्रियेन्ट प्रोफाइल पर एक डेटाबेस का विकास किया गया।

रिपोर्ट अवधि के दौरान संस्थान में अनुसंधान कार्यक्रमों के अलावा अन्य कई प्रायेजित परियोजनाओं एवं परामर्शी सेवाओं को संचालन किया गया। गंगा नदी बेसिन की प्रबंधन योजना में संस्थान ने आई आई टी, कानपुर के सहयोग से कार्य किया है। इसके लिये गंगा नदी की मत्स्य विविधता पर आंकड़ों को संग्रहित कर पर्यावरण एवं वन मंत्रालय के लिये प्रबंधन परियोजना तैयार की गयी है। इसी प्रकार संस्थान ने नोफिमा, नार्वे के साथ दक्षिण एशिया क्षेत्र में हिल्सा पालन कार्यक्रम को और भी सुदृढ़ बनाया है।

वर्ष 2013–14 के दौरान संस्थान ने विभिन्न राज्यों में पिंजरा पालन तकनीक का प्रसार किया है तथा हिमाचल प्रदेश में इस तकनीक को प्रदर्शित भी किया है। इस वर्ष संस्थान में कई प्रमुख विकास क्षेत्रों जैसे, मानव संसाधन विकास, मूलभूत सुविधाओं का विकास तथा मानव क्षमता विकास की दिशा में कार्य किया गया है जिससे संस्थान के समस्त कार्य सुचारू रूप से कार्यान्वित हो सकें।

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 समस्त सदस्यों को 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
दिनांक 8 जुलाई 2014

विशिष्ट सारांश

केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान को अंतर्स्थलीय मात्स्यिकी एवं जलीय परितंत्र के क्षेत्र में राष्ट्रीय एवं अंतर्राष्ट्रीय स्तर पर एक प्रमुख संस्थान के रूप में माना जाता है। वर्तमान में इस संस्थान में 51 वैज्ञानिक, 60 तकनीकी अधिकारी व कर्मचारी, 50 प्रशासनिक अधिकारी व कर्मचारी तथा 83 कुशल सहायक कर्मचारी संस्थान मुख्यालय एवं इसके क्षेत्रीय केन्द्रों (इलाहाबाद, गुवाहाटी, वडोडरा, बैंगलुरू, कोलकाता एवं कोची) में कार्यरत हैं।

वर्ष 2013–14 के दौरान संस्थान द्वारा पांच अनुसंधान कार्यक्रमों का परिचालन किया गया है। इन अनुसंधान कार्यक्रमों का परिचालन संस्थान के चार मुख्य प्रभागों, नदीय पारिस्थितिकी एवं मात्स्यिकी प्रभाग, मत्स्य संसाधन एवं पर्यावरणीय प्रबंधन प्रभाग, जलाशय एवं आर्द्र क्षेत्र मात्स्यिकी प्रभाग तथा कृषि आर्थिकी अनुभाग द्वारा किया गया। इसके अलावा, संस्थान में इस वर्ष विभिन्न बाहरी संस्थाओं द्वारा प्रायोजित परियोजनाओं, प्रशिक्षण व प्रसार कार्यक्रमों तथा जन जागरूक कार्यक्रमों का सफलतम संचालन किया गया।

वर्ष 2013–14 के दौरान संस्थान की उपलब्धियाँ निम्नलिखित हैं–

नदीय पारिस्थितिकी एवं मात्स्यिकी प्रभाग

- नर्मदा ब्लॉक में किये गये सर्वेक्षण यह बताते हैं कि सुन्दरवन क्षेत्र में छोटी देशी प्रजातियों की उपलब्धता में कमी आई है जिसका कारण है, प्राकृतिक आपदा, गहन कार्प पालन एवं मानवजनित कार्यकलाप। इसके लिये स्थानीय तौर पर उपलब्ध छोटी देशी प्रजातियों के संरक्षण एवं पालन पर मदनगंज, नामखाना में जन जागरूक कार्यक्रम का आयोजन किया गया। यह देखा गया कि ए मोला प्रजाति वर्ष में तीन बार, मार्च, जुलाई–अगस्त और अक्टूबर में प्रजनन करती है।
- सुन्दरवन मैंग्रोव क्षेत्र में *Avicennia alba* के पत्ते लगभग 414.37 ग्रा. प्रति वर्ग मी. की दर से तथा *Bruguiera gymnorrhiza* के पत्ते 410.43 ग्रा. प्रति वर्ग मी. की दर से झड़ जाते हैं। *Avicennia alba* के अवशिष्ट में फास्फोरस 2 प्रतिशत से अधिक एवं *A. alba, S. apetala* और *E. agallocha* के अवशिष्ट में फास्फोरस 1 प्रतिशत से अधिक पाया गया हैं। इन पत्तों के अवशिष्ट से पता चला है कि *Excoecaria agallocha* के पत्तें एक महीने बाद करीबन 80 प्रतिशत तक नष्ट हो जाते हैं जो परितंत्र के पोषक तत्वों के पुनर्चक्रण के लिये अत्यन्त ही प्रभावी हैं। अगस्त–सितम्बर के महीनों में नदी के जल में पोषक तत्वों की प्रचुरता होती है। मिट्टी में जैव कार्बनिक तत्व दिसम्बर में सबसे अधिक (औसतन 1.49 प्रतिशत) एवं ग्रीष्म ऋतु में सबसे कम (औसतन 0.43 प्रतिशत) पाया गया।
- झारखाली में मानसून पूर्व झींगा प्रजातियों की उपलब्धता मछलियों से अधिक (लगभग 90 प्रतिशत) देखा गया। झींगा प्रजातियों में सबसे अधिक *Fenneropenaeus indicus* पाये गये। बैगनेट से पकड़ी गईं बाम्बे डक प्रजाति का आकार 35–234 मि.मी. के बीच था पर इनमें अंगुलिकाओं की संख्या सबसे अधिक थी।
- मानसून के तुरंत बाद महानदी के ऊपरी, मध्य एवं निचली स्तर में 50 जेनेरा एवं 21 वर्ग की 70 मत्स्य प्रजातियों की उपस्थिति दर्ज की गई। इसी प्रकार, इन 70 स्थानीय मत्स्य प्रजातियों में से 8 निचली स्तर में, 6 मध्य में एवं 36 ऊपरी स्तर में दर्ज की गईं। कुल 20 प्रजातियां लगभग सभी क्षेत्रों में पाई गईं।
- महानदी से जल धारा के प्रवाह में तीव्रता एवं साधारण गति दोनो ही देखी गई। जून महीने के अंत से नवम्बर तक जल प्रवाह में तीव्रता देखी गई। अगस्त के महीने में बाढ़ की स्थिति के कारण मछलियों का अभिगमन मेन चैनल से अनसूपा आर्द्रक्षेत्र में हुआ है।
- रिडन्डेन्सी एनालिसिस (आर डी ए) यह बताते हैं कि बायोटिक प्राचल (मछली, बेंथोस एवं प्लवक विविधता) प्रत्यक्ष रूप से जल गुणवत्ता प्राचलों (आवेग, घुलित ऑक्सीजन, सिलिकेअ एवं टी डी एस) से संबद्ध हैं। मत्स्य समुदाय टी डी एस, पेरिफायटन, उच्च सिलिकेट स्तर एवं बेंथिक समुदाय जल के वेग द्वारा संचालित होती है। यह देखा गया है कि जल का आवेग (0.8 मी प्रति सेकेन्ड से अधिक) अधिक होने से *Thiara lineate* प्रजाति का घनत्व कम होने लगता है।
- गत् 34 वर्ष से हरिद्वार के निकट गंगा नदी की धारा का अध्ययन यह बताते हैं कि मानसून के समय प्राप्त एवं प्रवाहित जल का घनत्व क्रमशः 1886.86 एवं 1618.76 क्युमेक्स तथा शेष महीनों में 376.75 एवं 176.62 क्युमेक्स था। गंगा नदी क्षेत्र के टेहरी बांध और कानपुर बराज के ऊपरी एवं निचले क्षेत्रों के जल गुणवत्ता प्राचलों में नदीय जल धारा एवं संबंधित परिवर्तन होने के कारण भिन्नता देखी गई है।
- गंगा नदी से 77 जेनेरा, 30 वर्ग एवं 10 आर्डर वाली 123 मत्स्य प्रजातियों को दर्ज किया गया। गंगा नदी से प्रथम बार कुल 13 मत्स्य प्रजातियों को दर्ज किया गया – *Setipinna brevifilis, Aspidoparia jaya, Garra mullya, G. annandalei, G. gotyla, Salmophasia scinaces, Barilius vagra, B. tileo, B. shachra, B. barna, Nemachelius corica, Badis badis* और *Megarasbora elanga*।

- वर्ष 2013 में गंगा नदी के इलाहाबाद क्षेत्र में मत्स्य लैंडिंग 169.72 टन दर्ज किया गया। इनमें विविध प्रजातियां 33 प्रतिशत, विदेशी 30 प्रतिशत, भारतीय मेजर कार्प 25 प्रतिशत एवं कैटफिश 12 प्रतिशत थे।

जलाशय एवं आर्द्रक्षेत्र मात्स्यिकी संसाधन

- असम के विभिन्न बीलों, धीर, सुकदोल–सारूबरी, तरियाचरा, मेर एवं दमाल में मात्स्यिकी एवं पारिस्थितिकी पर मत्स्य स्टॉक संवर्धन के प्रभाव का आंकलन किया गया। असंचयित बील में छोटी साइप्रिडिनस प्रजातियां जैसे, *Puntius* spp., *Labeo gonius, Cirrhinus reba* और *Psilorhynchus* spp. की प्रधानता थी। *Wallago attu, Colisa* spp. और *Mystus* spp 10 प्रतिशत तथा भारतीय मेजर कार्प, ग्रास कार्प एवं कॉमन कार्प 11 प्रतिशत पाये गये। संचयित क्षेत्रों में भारतीय मेजर कार्प एवं विदेशी कार्प 55–70 प्रतिशत पाये गये।

- छिछले और असंचयित बीलों में छिछले और संचयित बीलों की तुलना में मात्स्यिकी से आय 47 प्रतिशत अधिक और गहरे व संचयित बीलों से 5 प्रतिशत अधिक प्राप्त किया गया। इस वर्ष मात्स्यिकी से जुड़ी आजीविका के साधन छिछले और असंचयित बीलों में छिछले और संचयित बीलों की तुलना में 18 प्रतिशत और गहरे व संचयित बीलों से 14 प्रतिशत अधिक था।

- उत्तर प्रदेश में पेन पालन तकनीक का प्रदर्शन राय बरेली जिले के दो बंद आर्द्रक्षेत्रों, मजिहार झील (48 हे.) और सरेनी झील (18 हे.) में किया गया। दोनों आर्द्रक्षेत्रों में जलमग्न और तैरते हुये एवं इनके किनारों पर मेक्रोफाइट ग्रसन पाये गये। मेक्रोफाइट ग्रसन मजिहार झील में 53 प्रतिशत एवं सरेनी झील में 42 प्रतिशत था।

- वर्ष 2013 के दौरान मजिहार झील और सरेनी झील में पेन पालन में भारतीय मेजर कार्प की बड़ी अंगुलिकाओं का संचयन (25 अंगुलिकायें प्रति वर्ग मी. की दर से) किया गया। इन प्रजातियों में 2.88 ग्रा. वाली लेबियो रोहिता और 2.1 ग्रा. वाली कतला कतला का विकास सरेनी झील में 57.2 ग्रा. एवं 67.38 ग्रा. क्रमशः हुआ। इसी प्रकार मजिहार झील में इन दोनों प्रजातियों का विकास क्रमशः 54.38 ग्रा. और 65.96 ग्रा. हुआ। सरेनी के पेन का औसत एफ सी आर 1.08 तथा मजिहार पेन का औसत एफ सी आर 1.17 था। इसी प्रकार दोनों झीलों का लाभ–लागत अनुपात (Benefit cost Ratio) क्रमशः 1.64 तथा 1.69 था। दोनों झीलों के उत्पादन से होने वाले लाभ यह बताते हैं कि इन आर्द्रक्षेत्रों में पेन पालन लाभकारी है।

- कावेरी नदी का कृष्णाराजसागर जलाशय से होने वाला लाभ सामान्य रहा। 13 वर्ग की कुल 38 मत्स्य प्रजातियों का प्रयोगात्मक कृषि की गई। शैनोन–वेनर प्रणाली द्वारा मत्स्य विविधता को मापा गया और यह विविधता 2.26 थी। जलाशयों में प्रजातियों में साम्यता का स्तर 0.62 था जो यह बताते हैं कि स्थिर जल में प्रजाति भिन्नता अधिक होती है। नदी एवं जलाशय दोनों क्षेत्रों में प्रजाति भिन्नता समान देखे गये।

- केरल की एक छोटी मौसमी जलाशय, वयालार (259 हे.) में Carlsson trophic state index प्रणाली द्वारा इसकी इयुट्रोफिकेशन को मापा गया जिससे जल की सेकी डिस्क पारदर्शिता और क्लोरोफिल के स्तर को जाना जा सके। इस जलाशय की संभावित मत्स्य उत्पादन 130 कि.ग्रा प्रति हे. है तथा यहां अधिकतम उत्पादन 70 कि.ग्रा प्रति हे. प्राप्त किया गया। प्रयोगात्मक मत्स्ययन द्वारा बहु–छिद्र गिल जाल के प्रयोग से 14 मत्स्य प्रजातियों की उपलब्धता को दर्ज किया गया। इन प्रजातियों में स्थानीय प्रजातियां *Puntius filamaentosus, P. sophore, Mystus armatus* और *M. cavasius* को देखा गया। स्थिर जल में प्रजाति भिन्नता अधिक देखी गयी।

- दामोदर नदी के पानचेट जलाशय में केवल 27 मत्स्य प्रजातियों की उपलब्धता को दर्ज किया गया। इस जलाशय में भारतीय मेजर कार्प प्रजातियों के नियमित संग्रहण के बावजूद सी मृगला की तुलना में कतला कतला और लेबियो रोहिता का उत्पादन कम था।

- इलेक्ट्रोनिक आंकड़ों को प्राप्त करने की प्रणाली (*e-DAS*) का विकास अंतर्स्थलीय जल निकायों से मछलियों के संग्रहण संबंधी आंकड़ों को प्राप्त करने के लिये किया गया है। इस प्रणाली को और भी उन्नत बनाने के लिये प्रयास किये जा रहे हैं।

- कर्नाटक के हेमावती जलाशय में मास–बैलेन्स मॉडल का विकास 1982–83 और 2002–03 के ट्रोफिक स्थिति एवं ऊर्जा प्रवाह के आंकलन द्वारा किया गया। प्राप्त इकोपाथ संचयित मत्स्य प्रजातियो, मेजर कार्प प्रजातियों एवं विदेशी कार्प प्रजातियों पर हुये प्रभाव को दिखाता है। कैटफिश के संचयन से, केवल गोबिड प्रजाति को छोड़कर, अन्य सभी प्रजातियों पर प्रतिकूल प्रभाव पड़ा था। पर ईल, विदेशी कार्प प्रजातियों और माइनर कार्प पर संचयन पूर्व सकारात्मक प्रभाव पड़ा था। पारिस्थितिकी तंत्र का विश्लेषण यह बताते हैं कि संचयन पश्चात् वाले फूड वेब, संयचन पूर्व वाले फूड वेब से अधिक विकसित थे।

- असम के मारीगांव जिले के सुकदोल–सारूबरी बील से प्राप्त आंकड़ें यह बताते हैं कि इस बील में देशी प्रजातियों की अधिक प्रधानता थी। *Puntius* spp. 30 प्रतिशत, *Wallago attu* 20 प्रतिशत, *Cirrhinus reba* 15 प्रतिशत और *Psilorhynchus* spp. 10 प्रतिशत थे। भारतीय मेजर कार्प प्रजातियां, रोहू और मृगल कुल उत्पादन का 5 प्रतिशत और

विदेशी प्रजातियां, *Ctenopharyngodon idella* और *Cyprinus carpio* 6 प्रतिशत प्राप्त हुये।

मत्स्य संसाधन एवं पर्यावरणीय प्रबंधन प्रभाग

- पर्यावरण संबंधी आंकलन यह बताते हैं कि हिराकुड बांध के निचले क्षेत्र में महानदी नदी का 400 कि.मी. के विस्तार क्षेत्र में इंटरगिटि क्लास प्राचल निर्धारित स्तर से कम पाया गया है। नदी विस्तार क्षेत्र का अध्ययन यह बताते हैं कि इस क्षेत्र का 40 प्रतिशत भाग को कम हानि हुई है पर इसका 60 प्रतिशत भाग सामान्य रूप से क्षतिग्रस्त है। जल धारा परिवर्तन हुये क्षेत्रों में आई बी आई स्कोर कम है जो पारिस्थितिकी एवं बायोटिक इंटिग्रिटी पर धारा के क्षतिग्रस्त प्रभाव को दिखाते हैं। वर्ष 1995–96 के जलीय प्राचलों के तुलनात्मक अध्ययन यह बताते हैं कि शेष जलीय प्राचलों को छोड़कर केवल फॉस्फेट का स्तर थोड़ी अधिक है। इसी प्रकार, वर्ष 1995–96 के तलछट का तुलनात्मक अध्ययन यह बताता है कि स्थिर जल क्षेत्रों के तलछट में जैव कार्बनिक तत्व का स्तर बढ़ा है।
- महानदी का जलक्षेत्र धातु (कैडमियम, कॉपर, मैंगनीज, लेड एवं जिंक) प्रदूषण से मुक्त पाया गया है। इसके तलछट में कहीं–कहीं केवल कॉपर का स्तर 25 पी पी एम पाया गया जो प्रदूषण की ओर इंगित करता है। पर मछली में किसी प्रकार का धातु और ऑरगेनोक्लोरिन प्रदूषण नहीं पाया गया।
- प्रदूषण के प्रभाव को कम करने वाली दो बैक्टीरियल स्टेन, *Pseudomonas* sp. की पहचान की गई है जो केवल 2–4 दिनों में अवशिष्ट तत्वों में उपस्थित 600–700 पी पी एम रिसोरसिनोल के प्रभाव को कम करता है। व्यापक तौर पर व्यवहृत पांच प्रकार के ट्राइक्लोसन के प्रभाव को कम करने वाली बैक्टीरिया, *Pseudomonas aeruginosa*, *Citrobacter freundi* और *Enterobacter* sp. की पहचान की गई है।
- मीठाजल कैटफिश प्रजाति, रीता रीता पर हीट शॉक प्रोटीन के प्रभाव पर सूचना प्राप्त की गई है। वाइवैल्व मोलस्क, *Lamellidens marginalis* के पैर, गिल एवं बाहरी भाग के उत्तकों का जी सी– एम एस फिंगरप्रिंटिंग को प्राप्त किया गया जो प्रदूषण अनुमापन में लिपिड जैवसूचक के रूप में कार्य करेगा।
- आर्सेनिक प्रदूषण के कारण हुई हेपाटॉक्सिसिटी एवं यकृत संबंधी गंभीर बिमारियों के लिये प्रोटियोमिक जैवसूचकों की पहचान कर ली गई। ये जैवसूचक हैं – Apo-A1 (Apolipoprotein-A1), A2ML (α-2 macroglobulin-like protein), Wap65 (warm-temperature acclimation related 65kDa protein).
- हुगली ज्वारनदमुख में IRS - P6 LISS III अधिक रिजोलुशन वाले सैटेलाइट सेंसर डेटा यह बताते हैं कि वर्ष 2004 से वर्ष 2012 तक 12.35 प्रतिशत क्षेत्र संपूर्ण रूप से परिवर्तित हो गये हैं, 70.43 प्रतिशत क्षेत्र में आंशिक परिवर्तन एवं 12.35 प्रतिशत क्षेत्र में कोई परिवर्तन नहीं हुआ है। यह परिवर्तन भूमि उपयोग एवं ज्वारनदमुखीय तलछट द्वारा परिलक्षित होता है। हुगली ज्वारनदमुखीय में स्थित चार द्वीप, घरामारा, नयाचार, गंगासागर और जम्मू के मुहाने क्षेत्र में 13.63%, 5.88%, 2.94% और 28.31% तक परिवर्तन हुआ है।
- नर्मदा ज्वारनदमुख की हिल्सा मात्स्यिकी संबंधी पूर्वानुमान हेतु ए आर आई एम ए मॉडल का विकास किया गया है। कुल सात जलीय कारकों में से दो प्रमुख कारक, ''अंडजनन हेतु संभावित वासस्थल'' एवं ''अंडजनन हेतु संभावित उत्तम वासस्थल'' को चुना गया। अंडजनन के लिये वासस्थल की उपलब्धता हिल्सा प्रग्रहण में सबसे अधिक महत्वपूर्ण है क्योंकि इसके घटने से हिल्सा प्रग्रहण कम हो जाता है। अगर वर्तमान जलीय कारक इसी प्रकार से रहे तो नर्मदा ज्वारनदमुख में हिल्सा मात्स्यिकी खतम हो जायेगी। पर यदि 5 प्रतिशत जल का बहाव बढ़ा दिया जाय तो नर्मदा ज्वारनदमुख में हिल्सा मात्स्यिकी में 13 प्रतिशत की वृद्धि हो जायेगी।
- प्रमुख मत्स्य प्रजातियों एवं चिलिका लैगून के फिनफिश और शेलफिश पर नये मुहाने के प्रभाव के आंकलन हेतु Dual cycle, ARIMAX और Level Shift मॉडल का विकास किया गया।
- उत्तर प्रदेश में जलाशय मात्स्यिकी पर संस्थागत सहयोग का मूल्यांकन यह बताते हैं कि जलाशयों का मालिकत्व सिचाई विभाग (45 जलाशयों से अधिक) एवं मात्स्यिकी विभागों (40 जलाशयों से अधिक) के बीच बांट दिया गया है। मात्स्यिकी प्रबंधन अधिकार मात्स्यिकी विकास के पास 75 प्रतिशत, उत्तर प्रदेश मात्स्यिकी विकास निगम के पास 14 प्रतिशत तथा उत्तर प्रदेश मात्स्यिकी सहकारी फेडरेसन के पास 11 प्रतिशत है। जल निकायों के वर्गानुसार पट्टे की अवधि तीन से पांच वर्ष तक होता है। मात्स्यिकी प्रबंधन का अधिकार खुला संविदा प्रणाली द्वारा प्रदान किया जाता है।
- इंदिरा सागर जलाशय में मात्स्यिकी समुदाय–लोक–निजी सहभागिता (P4) माडल पर आधारित है। मत्स्ययन अधिकार केवल मछुआरा समुदाय को ही प्राप्त है। यहां मात्स्यिकी सरकारी नियमानुसार किया जाता है तथा इसका अनुवीक्षण मध्य प्रदेश मत्स्य महासंघ के क्षेत्रीय प्रबंधक द्वारा होता है। निजी सहभागिता में पट्टेदार सरकारी दर पर मछलियों को बेचता है।

- पश्चिम बंगाल के सुन्दरवन मैंग्रोव से प्राप्त शिंगटी मछलियों को आर्थिक मूल्यांकन प्रति हेक्टर रू.33541 आंका गया। इस क्षेत्र के बक्खाली के 2 कि.मी. के विस्तार क्षेत्र में शिंगछी मछलियों के बीज संग्रहण में 20 मत्स्य प्रजातियां नष्ट हो गईं। यह हानि प्रति वर्ष 6.72 करोड़ रू. आंका गया है।

आउटरीच परियोजना

कतला कतला और साइप्रिनस कार्पियो के लिये शीत एवं ग्रीष्म ऋतु में आहार तैयार किया गया जिसमें सी पी 34 प्रतिशत था। शीत ऋतु में सी कार्पियो का शारीरिक भाग अन्य प्रजातियों से अधिक था जबकि ग्रीष्म ऋतु में सी कतला का विकास दर अन्य प्रजातियों की तुलना में सबसे अधिक था।

- एक ऐसी मत्स्य आहार को तैयार किया गया है जो जल में तीन घण्टे तक लगभग 96 प्रतिशत तक सुरक्षित और 24 घण्टों तक 68 प्रतिशत तक सुरक्षित रह सकता है। इस आहार को ब्रिवरी के अवशिष्ट तत्वों से तैयार किया गया है। इसकी लागत मूल्य बहुत ही कम होती है। इसके फिश पैलेट लगभग 8 घंटों तक जल में तैरते रहते हैं एवं 18–24 घंटों तक नष्ट नहीं होते हैं। इस आहार से पिंजरों में दी जाने वाली सोयाबीन से तैयार आहार की तुलना में लेबियो बाटा में अधिक विकास हुआ है।
- देशी मछलियों को दी जाने वाली आहार की न्युट्रियेन्ट प्रोफाइलिंग पर एक डेटाबेस को विकास किया गया है।
- गुवाहाटी, इलाहाबाद, पटना, फरक्का, नवद्वीप एवं भरूच क्षेत्रों से प्राप्त कतला कतला साइटोक्रोम बी जीन सिक्वेंस के मोलेकुलर वेरियेन्स के विश्लेषण यह बताते हैं कि कुल वेरियेशन में से 69.93% वेरियेशन प्रजातियों के भीतर और 30.07% वेरियेशन विभिन्न प्रजातियों के बीच दर्ज किया गया।
- असम के ब्रह्मपुत्र नदी के लेबियो गोनियस को गोनाडो–सोमेटिक इंडेक्स 0.512-7.8 % के बीच तथा गैस्ट्रो–सोमेटिक इंडेक्स 2.6-4.7 % के बीच रहा।

परिषद् की नेटवर्क परियोजना

- उत्तर प्रदेश के विभिन्न जिलों के हैचरी पालन संबंधी विभिन्न पहलुओं जैसे मछलियों के प्रजनन, पालन, अंडजनन आदि पर सूचनाओं को एकत्र कर ई–एटलस बनाया गया है।
- वर्ष 1980 की तुलना में परपक्व मादा मछलियों के न्युनतम लंबाई 30 मि.मी कम हो गई है। पर इस परिवर्तन के वास्तविक कारणों को जानने के लिये और भी अध्ययन किया जाना चाहिये।
- बिहार एवं असम में भारतीय मेजर कार्प प्रजातियों, लेबियो रोहिता, कतला कतला और सिरहिनस मृगला के गोनाडो–सोमेटिक इंडेक्स एवं परिपक्वता समय पूर्व हुआ है।
- लेबियों बाटा (37.10 ± 0.30 डिग्री से.ग्रे.) में लेबियो रोहिता (35.4 ± 0.3 डिग्री से.ग्रे.) की तुलना में ताप सहने की अधिक क्षमता होती है।
- असम के कामरूप, नलबारी और बारपेटा जिलों का अध्ययन यह बताते हैं कि मौसमी वर्षापात में परिवर्तन के कारण होने वाली बाढ़ एवं सूखे के कारण इन क्षेत्रों में मत्स्य बीज उत्पादन बुरी तरह से प्रभावित हुआ है। मानसून के देरी से आने एवं कम वर्षा के कारण विशेषका मार्च–अप्रैल के महीनों में मेजर कार्प प्रजातियों के प्रेरित प्रजनन को निषेचन दर कम रहा। इसके लिये 40 प्रतिशत से अधिक हैचरियों में ग्रास कार्प, *Ctenopharyngodon idella* का प्रजनन किया गया।
- पी स्रावित करने वाली बैक्टीरिया की पहचान की गई – *Bacillus aryabhattai*, *Brevibacillus borstelensis*, *Bacillus megaterium*, *Klebsiella oxytoca*, *Pseudomonas aeruginosa*, *Microbacterium* sp., *Arthrobacter* sp., *Curtobacterium luteum*, *Agrobacterium fabrum*, *Enterobacter asburiae*, *Microbacterium oxidans*, *Acinetobacter* spp., *Stenotrophomonas maltophilia* और *Novosphingobium* sp

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

- अधिक लवणीय जल को सहन करने वाली एक बैक्टीरिया, *Staphylococcus epidermidis* का जीनोम ट्रान्सक्रिपटोम प्रोफाइलिंग किया गया।
- पश्चिम बंगाल के दिवली बंगला से प्राप्त तलछट से अधिक इबाव सहन करने वाली बैक्टीरिया, *Halomonas salina* की पहचान की गई।
- चन्ना स्ट्रिएटस की नीन का विश्लेषण किया गया जो यह बताता है कि *hsp* 60, *hsp* 70 और *hsp* 78 संभवतः इनके दीर्घायुपन एवं सहनशीलता का कारण हैं। ग्रीष्म ऋतु में एक्सप्रेशन का स्तर बहुत अधिक अर्थात् Hsp27, Hsp70, β, γ-crystallin, triosephosphate isomerase होता है।
- अधिक तापमान पर पुन्टियस सोफोर के अमीनो एसिड संरचना में बहुत अधिक परिवर्तन हुआ। कुल हिल्या प्रगहण सबसे अधिक हुगली ज्वारनदमुख में हुआ है। वर्ष 2013–14 में समुद्री क्षेत्र से मत्स्य उत्पादन 16318 टन रहा। समुद्री क्षेत्र से औसत सी पी यु ई (प्रति बोट प्रति दिन) 200 कि.ग्रा. था जबकि मीठाजल पालन में

उत्पादन 0.5 से 2त्र5 कि.ग्रा था। पोखर पालन में गोदाखली में 50–70 मि.मी. वाली अंगुलिकाओं का संचयन जुलाई में किया गया। केवल 5 महीनों में इनका आकार 136–178 मि.मी हो गया। मध्यम आकार (283 मि.मी.) वाली अंगुलिकाओं का संचयन दिसम्बर में हुआ तथा 4 महीनों में बढ़कर इनका आकार 295 मि.मी. तक हो गया।

- बिहार चौर के मत्स्य किसानों के दो वर्गों द्वारा पेन पालन किया गया। एच डी पी ई वृत्ताकार पेन लगाये गये तथा बड़ी मछलियों का संचयन किया गया। 10 महीनों के बाद कुल उत्पादन 2890 कि.ग्रा. हुआ।

केन्द्रीय सेक्टर योजना जी आई एस डेटाबेस के विकास में प्रणाली उपयोग के कारण चित्र लगभग 98.20 प्रतिशत तक सही प्राप्त हुये। इस दिशा में और भी कार्य किये जा रहे हैं।

संस्थान का एन ई एच भाग

असम के 30 बीलों में ए एफ डी सी, गुवाहाटी और बोडोलैण्ड टेरिटोरियल परिषद् असम के सहयोग से पेन पालन को प्रदर्शित किया गया। प्रारंभ में कार्प के अंगुलिकाओं का रियरिंग बी : सी 1.8–5.4 बहुत ही लाभदायी रहा। पेन संरचना हेतु बांस का मूल्य वृद्धि तथा मानव श्रम प्रमुख कठिनाइयां हैं।

भूमिका

संक्षिप्त इतिहास

केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान की स्थापना सर्वप्रथम एक अनुसंधान केन्द्र के रूप में 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 कलकत्ता में हुई। एक छोटे पैमाने पर प्रारंभ इस केन्द्र, केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान केन्द्र को अपने कार्यकलापों के बल पर वर्ष 1959 में एक पूर्ण संस्थान का दर्जा प्राप्त हुआ तथा यह बैरकपुर, पश्चिम बंगाल के नवनिर्मित भवन 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। वर्तमान में संस्थान की कार्यप्रणाली का मुख्य उद्देश्य प्राकृतिक संसाधन प्रबंधन करना है और तदनुसार 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 प्रभाग एवं एक अनुभाग के अंतर्गत संचालन होती हैं। तीनों प्रभागों के प्रभागाध्यक्ष संस्थान के अनुसंधान कार्यक्रमों के समन्वयक हैं।

इलाहाबाद एवं गुवाहाटी प्रादेशिक केन्द्र में नियुक्त प्रभारी इन प्रादेशिक केन्द्रों में अनुसंधान कार्यक्रमों का संचालन करते हैं। इन प्रभागों को विभिन्न अनुसंधान कार्यों में अन्य अनुभाग भी सहायता प्रदान करते हैं। इलाहाबाद एवं गुवाहाटी प्रादेशिक केन्द्रों के प्रभारी उनके केन्द्रों में चल रही अनुसंधान परियोजनाओं के कार्यान्वयन में प्रशासनिक दायित्व संभालते है तथा इन परियोजनओं की तकनीकी देख–रेख तीनों प्रभागाध्यक्षों द्वारा की जाती हैं।

नदीय पारिस्थितिकी एवं मात्स्यिकी प्रभाग

बैरकपुर स्थित यह प्रभाग देश की नदीय तथा ज्वारनदमुख की पारिस्थितिकी तथा मात्स्यिकी के प्रबंधन हेतु प्रभावकारी योजनाओं के विकास तथा उनमें मत्स्य संरक्षण पर अनुसंधान करता है। इस प्रभाग की अनुसंधान परियोजनाएं

बैरकपुर, कोलकाता, वडोदरा तथा इलाहाबाद प्रादेशिक केन्द्र से कार्यान्वित होती हैं।

मत्स्य संसाधन एवं पर्यावरणीय प्रबंधन प्रभाग

बैरकपुर स्थित यह प्रभाग निम्नलिखित विषयों पर अनुसंधान करता है–

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

जलाशय एवं आर्द्र क्षेत्र मात्स्यिकी प्रभाग

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

कृषि आर्थिकी अनुभाग

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 कक्ष बैरकपुर में स्थित है पर 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 कक्ष (PME) – 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। साथ ही, संस्थान के विभिन्न रिपोर्ट जैसे मासिक, तिमाही एवं अर्द्ध–वार्षिक रिपोर्ट को परिषद् के समक्ष प्रस्तुति संबंधी कार्य करना है। यह कक्ष विभिन्न प्रकार की तकनीकी रिपोर्ट, छमाही न्यूजलेटर, पैम्फलेट, ब्रोसर, लिफलेट और वार्षिक प्रतिवेदन को प्रकाशित करने का कार्य करता है साथ ही यह आर. पी. एफ. 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 कक्ष – इस कक्ष से प्रशिक्षण, प्रदर्शनियां, निरूपण कार्यक्रम, मत्स्य पालक दिवस आदि का आयोजन होता है और अंतर्स्थलीय मात्स्यिकी से संबंधित विविध तकनीकी प्रणालियों को मत्स्य पालकों, मछुआरों, उद्यमियों, विस्तार 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।

कृषि सूचना प्रबंधन इकाई – यह इकाई संस्थान में सूचना प्रौद्योगिकी सेवाओं को प्रोत्साहित करता है। संस्थान में कम्प्युटर संबंधी तकनीकी सेवाओं के साथ–साथ इनका प्रबंधन, ई–गवर्नेन्स, ई–प्रोक्युरमेन्ट, संस्थान में वेब होस्टिंग तथा सर्वर/कम्प्युटर सिक्युरिटी हेतु कार्य करता है। यह इकाई समस्त आधुनिक सुविधाओं जैसे, लाइनक्स सर्वर, स्विच, राउटर, पी आई एक्स फायरवाल तथा वाई–फाई आदि से भरपूर है। संस्थान में लगाये गये 100 एम बी पी एस बैंडविथ इंटरनेट कनेक्टिविटी की देखरेख इस इकाई के द्वारा होती है। यह इकाई परिषद् द्वारा संचालित ए आर एस/ए एस आर बी नेट परीक्षाओं को ऑन लाइन माध्यम से आयोजित करता है और इसके लिये संस्थान में 100 कम्प्युटर, 2 सर्वर एवं 2 एम बी पी एस इंटरनेट कनेक्टिविटी प्रदान की गई है।

पुस्तकालय व सूचना अनुभाग – संस्थान का पुस्तकालय मुख्यालय व अनुसंधान केन्द्रों में कार्यरत वैज्ञानिकों की आवश्यकताओं के अलावा अन्य संगठनों के शोधकर्ताओं, अध्यापकों, विद्यार्थियों तथा अधिकारियों को भी अपनी सेवायें उपलब्ध कराता है। वर्ष 2013–2014 के दौरान संस्थान के पुस्तकालय में 251 पुस्तकें, 13 विदेशी जरनल और 28 भारतीय जरनल की वृद्धि हुई है। इस समय पुस्तकालय में कुल 12729 पुस्तकें, 1800 हिन्दी पुस्तकें और अन्य प्रकाशन जैसे पुनर्मुद्रित लेख, मानचित्र और विविध प्रकाशनों का संग्रह है। वर्तमान में पुस्तकालय में आधुनिक साफ्टवेयर लगाये गये हैं और उपलब्ध पुस्तकों एवं अन्य सामग्री का पूर्ण डिजिटाइजेशन किया गया है। एन ए आई पी परियोजना के अंतर्गत KOHA साफ्टवेयर में अन्य पुस्तकालयों से संचार व्यवस्था तथा लाइब्रेरी प्रबंधन हेतु सभी पुस्तकों को आंकड़ाबद्ध किया गया है।

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

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

हिन्दी कक्ष – यह कक्ष 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।

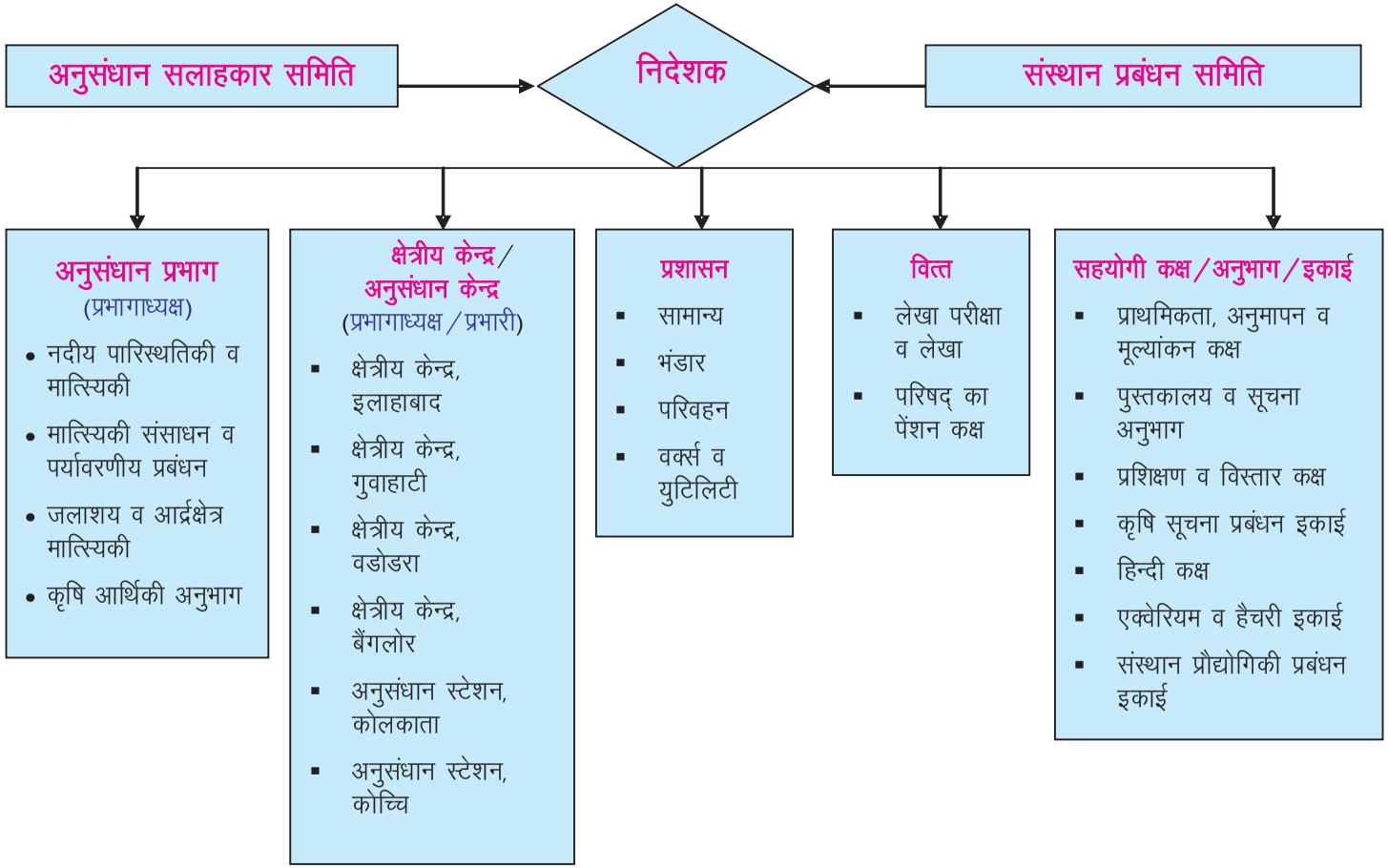
प्रशासनिक अनुभाग – यह अनुभाग संस्थान मुख्यालय और इसके विभिन्न केन्द्रों के संपूर्ण प्रशासनिक कार्यकलापों को नियंत्रित करता है। इस अनुभाग

के अंतर्गत कार्यरत अन्य भाग संस्थान के निदेशक, अनुसंधान और समस्त अधिकारियों एवं कर्मचारियों के प्रशासनिक कार्यों की देखभाल 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 –

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



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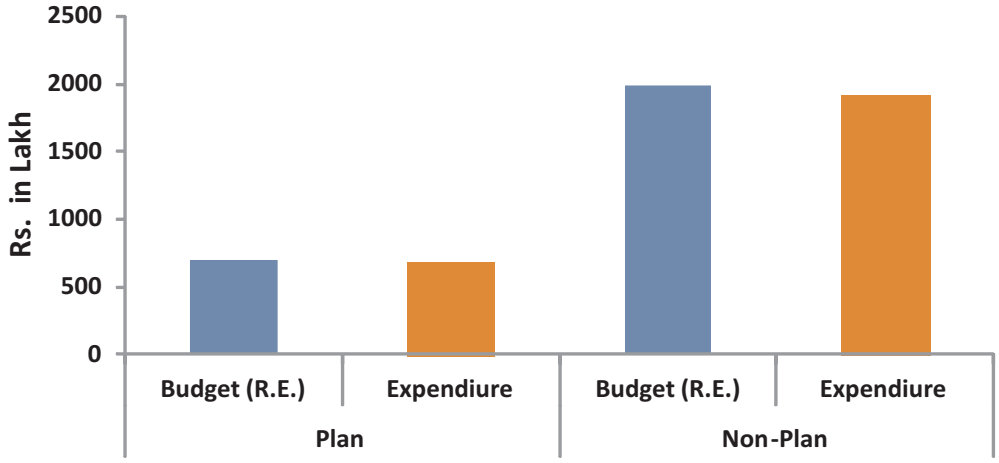
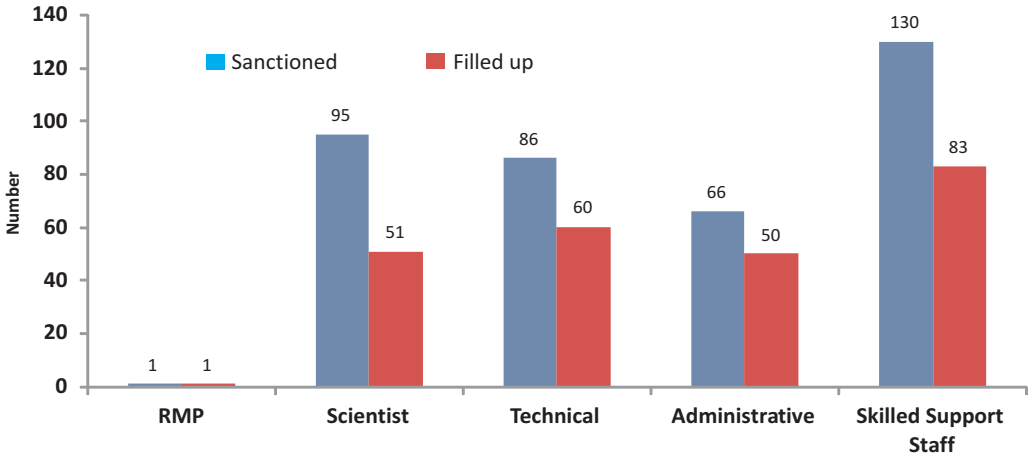


संस्थान के अधिकारी व कर्मचारी (31. 03. 2014 में)



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