वार्षिक प्रतिवेदन
Annual Report
2024



भाकृअनुप –केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान
बैरकपुर, कोलकाता- 700 120, पश्चिम बंगाल
ICAR- Central Inland Fisheries Research Institute
Barrackpore, Kolkata-700120, West Bengal



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Preface

India has become the top fish producer in inland capture fisheries sector which is a key driver of food security, rural employment, and overall socio-economic development in the country. The inland fisheries and aquaculture have emerged as a cornerstone of the nation's Blue Economy, aligning closely with the objectives of the Blue Revolution and the Government's broader vision of sustainable and inclusive development. The remarkable growth witnessed in this sector over the past few decades is a testament to the evolving role of inland fisheries in supporting sustainable development and biodiversity conservation. With the abundance of inland aquatic resources including rivers, estuaries, lakes, reservoirs, floodplain wetlands, backwaters and lagoons, ICAR-CIFRI is forging ahead to harness their potential for long-term socio-economic growth, food security, and livelihood generation to support millions of fishers and fish farmers, primarily from rural and economically marginalized communities.

Through decades of research, the Institute has generated a vast knowledge base and strides out to newer heights to achieve the national goals. To develop sustainable feed for inland enclosure culture systems, three feeds, maintaining isonitrogenous protein level (CP-30 %), have been formulated that would significantly reduce waste generation and minimize the environmental impact of cage culture on the water bodies. As a part of species diversification for the next generation inland open water cage culture, the growth performance of high value Pabda in cages was evaluated. A comparative bio-conversion of *Salvinia molesta* had shown a higher yield of stable vermicompost manure (38.94%) than the garden wastes (25%) which offers an eco-friendly viable solution to the aquatic weed management in the drinking water unit, proving the concept of "Waste to Wealth". To achieve Sustainable Development Goals (SDGs) through inland fisheries, 446 beneficiaries were covered and farmers' income was increased through production enhancement strategies, *viz*., penculture, cage culture and culture-based fisheries (CBF) under the SDGs 8,13 and 14.

Several new research projects have been initiated this year for incorporating the interdisciplinary research perspectives in inland fisheries and to sustain the blue economy. Research focus has been laid on River Ganga and Yamuna; catch estimation and socio-economics of fishers in rivers and estuaries like Narmada, Cauvery, Gomati, Sutlej, Pampa, Pulicat lake, Kayamkulam estuary, and Mahi estuary for sustainable management. The Indian Sundarbans is being studied to evaluate its ecosystem health, fish catch structure and mangrove landscape changes. A new concept of Fish Parasite-Based Health Assessment Index (HAI) for selected fish species in reservoirs of eastern India has also been initiated. Assessment of greenhouse gas emissions and carbon sequestration potential of selected wetlands and river stretches for developing mitigation strategies to reduce adverse impacts of climate change was also attempted. Development of natural farming protocol for culture-based fisheries in wetlands is also in action to enhance fisheries enhancement and livelihood security. To further strengthen reservoir fisheries, an initiative was taken to foster the fisheries for blue growth and achieving SDGs amid climate change and the anthropocene. A great attempt was made to harness the data science for optimizing spatial assessment of riverine and wetland fisheries resources. The ecosystem health evaluation based on the assessment of petroleum hydrocarbons, PFAS, and phenolic micro-pollutants in surface water and their effect was studied. The research on resilience of native fish communities in different hydro-climatic zones was initiated for documenting biodiversity and to formulate conservation guidelines. The recent biotechnological interventions for aquatic environment and fisheries management of wetlands by connecting with SDGs was also given emphasis to widen the research scope.

To provide significant attention to the North-east region, three institute projects were initiated focusing fisheries and habitat characteristics of River Brahmaputra and Rivers of Sikkim in response to natural and anthropogenic changes.

The Institute co-organized a mega conference: 13th Indian Fisheries and Aquaculture Forum: "Fostering Growth of Fisheries and Aquaculture for Sustainable Development" at Kolkata which was an overwhelming success. The institute also organized workshop on Fish Proteomics, 'Mahila Matsyajibi Sammelan 2.0' at Kultali, Workshop on "Better Health Management Practices in Cage Culture and Aquaculture Farms", Interactive Meeting on 'Exploring Fish Diversity and Catch Estimation of Major Rivers in Sikkim'. Thirty capacity development programmes were organized for 847 fishers/fish farmers. Similarly, 100 officials were trained through 4 training programmes and 16 training programmes were organized for 337 students.

The scientists brought many awards and recognitions for the Institute. Best Scientist award, Young Scientist Award, Best Senior Scientist Award, Reviewer Excellence Award were some of the highlights. Besides, 15 scientists got the Best oral presentation awards in different fora.

During the year under report, two patents and 4 trademarks were granted/registered. The Institute has also received grants of 11 copyrights registration from copyright registry. I am confident that constant endeavors and persistent efforts of researchers will lead to wider adoption of existing technologies, development of newer technologies, and protocols for sustainable production enhancement and ecosystem health conservation that would push the inland open water fisheries sector to a new height.

I would like to acknowledge the profound support received from Dr. Himanshu Pathak, Secretary, DARE and DG, ICAR. I am also grateful to Dr. J. K. Jena, Deputy Director General (Fisheries Science); Dr. Devika Pillai, Assistant Director General (Inland Fisheries); Dr. Subhadeep Ghosh, Assistant Director General (Marine Fisheries); as well as to the team of scientists and other members of the ICAR-CIFRI fraternity for their unstinted support. The guidelines and recommendations given by IRC, learned RAC, IMC, QRT for Institute's development, and streamlining the Institute's research and activities are also humbly acknowledged. The efforts of the Editorial team in the preparation of this document are commendable.



Dated : 01 March, 2025
Barrackpore

B. K. Das
(Director)

प्रस्तावना

वर्तमान में भारत को अन्तर्स्थलीय प्रग्रहण मात्स्यिकी क्षेत्र में एक शीर्ष मछली उत्पादक देश माना जा रहा है। यह एक महत्वपूर्ण संसाधन है जो देश में खाद्य सुरक्षा, ग्रामीण रोजगार और समग्र सामाजिक –आर्थिक विकास को प्रमुख तौर पर संचालित करता है। अन्तर्स्थलीय मत्स्यपालन और जलकृषि देश की ब्लूइकॉनॉमी (नीली अर्थव्यवस्था) का एक आधारस्तंभ है, जो ब्लू रिवोल्यूशन (नीली क्रांति) के उद्देश्यों और सरकार की समावेशी व सतत विकास से व्यापक एवं प्रत्यक्ष तौर पर जुड़े हुए हैं। पिछले कुछ दशकों में इस क्षेत्र के सतत विकास और जैव विविधता संरक्षण में अन्तर्स्थलीय मत्स्य पालन की भूमिका अभिन्न है। हमारे देश में नदियों, मुहाना, झीलों, जलाशयों, बाढ़कृत मैदानी झील, बैकवाटर और लैगून सहित अन्तर्स्थलीय जलीय संसाधनों की प्रचुरता है। इन समस्त बातों को ध्यान में रखते हुए भाकृअनुप–केन्द्रीय अन्तर्स्थलीय मात्स्यिकी अनुसंधान संस्थान, बैरकपुर, कोलकाता (ICAR-CIFRI) इन जलीय क्षेत्रों से दीर्घ कालिक सामाजिक–आर्थिक विकास, खाद्य सुरक्षा और आजीविका सृजन की संभावनाओं को साकार करने की दिशा में आगे बढ़ रहा है, जिससे लाखों मछुआरों और मछली पालकों, विशेषकर ग्रामीण और आर्थिक रूप से कमजोर समुदायों को सहायता मिल सके।

संस्थान ने दशकों से मात्स्यिकी अनुसंधान में एक विशाल ज्ञान भंडार विकसित किया है और राष्ट्रीय लक्ष्यों की प्राप्ति हेतु यह निरंतर नई ऊँचाइयों की ओर अग्रसर है। अन्तर्स्थलीय जलों में घेरे में पालन हेतु टिकाऊ फ़ीड जिनमें समान नाइट्रोजन युक्त प्रोटीन स्तर (CP-30%) हो, तैयार किए गए हैं। ऐसे फ़ीड जल में अपशिष्ट के स्तर में उल्लेखनीय कमी करने के साथ जल निकायों पर पिंजरे में मछली पालन से होने वाले पर्यावरणीय प्रभाव को भी कम कर सकते हैं। आने वाले दिनों में अन्तर्स्थलीय खुलाजल में पिंजरे में मछली पालन हेतु उपर्युक्त और संभावित प्रजातियों के विविधीकरण की दिशा में पिंजरों में उच्च मूल्य वाले पाबदा मछली के विकास का मूल्यांकन किया गया। *सल्विनिया मोलेस्टा* की तुलनात्मक जैव रूपांतरण यह दिखाता है कि इससे टिकाऊ वर्मीकंपोस्ट खाद का उत्पादन 38.94% हुआ, जो कि बागवानी अपशिष्ट (25%) की तुलना में अधिक है। यह पेय जल स्रोत में पाई जाने वाली जलीय खरपतवार के प्रबंधन के लिए एक पर्यावरण–अनुकूल और व्यवहारिक समाधान प्रदान करता है। इससे "कचरे से कंचन" (Waste to Wealth) मुहिम की दिशा में उपलब्धि प्राप्त हो सकती है।

अन्तर्स्थलीय मत्स्य पालन के माध्यम से सतत विकास लक्ष्यों (SDGs) को प्राप्त करने के लिए 446 लाभार्थियों को आदान तथा जन–जागरूकता द्वारा उनकी आय में वृद्धि की गई। यह आय वृद्धि उत्पादन संवर्धन रणनीतियों जैसे पेन और पिंजरे में मछली पालन तथा पालन–आधारित मात्स्यिकी द्वारा अर्जित हुई है जो सतत विकास लक्ष्यों 8 (सार्थक कार्य व आर्थिक वृद्धि), 13 (जलवायु परिवर्तन) और 14 (जलीय क्षेत्र) से संबंधित हैं।

इस वर्ष अन्तर्स्थलीय मत्स्य पालन में अंतर्विषयक अनुसंधान को शामिल करने और सतत ब्लू इकोनॉमी हेतु कई नई शोध परियोजनाएं प्रारंभ की गई हैं। शोध का मुख्य फोकस गंगा और यमुना, नर्मदा, कावेरी, गोमती, सतलुज, पंपा नदियो , पुलिकट झील, कायमकुलम मुहाना और माही मुहाना क्षेत्र में मछली पकड़ और मछुआरों की सामाजिक–आर्थिक स्थिति का आकलन पर रहा है, ताकि उनका सतत प्रबंधन और विकास किया जा सके। भारतीय सुंदरबन का अध्ययन इसके पारिस्थितिकी तंत्र के स्वास्थ्य, मछली पकड़ संरचना और मैंग्रोव परिदृश्य में हुए परिवर्तनों के मूल्यांकन के लिए किया जा रहा है। पूर्वी भारत के जलाशयों में चयनित मछली प्रजातियों के लिए मछली परजीवी–आधारित स्वास्थ्य आकलन सूचकांक (HAI) की एक नई संकल्पना भी शुरू की गई है। जलवायु परिवर्तन के प्रतिकूल प्रभावों को कम करने के लिए निदान उपायों को विकसित करने की दिशा में चयनित आर्द्रभूमि और नदीय खंडों के ग्रीनहाउस गैस उत्सर्जन और कार्बन पृथक्करण क्षमता का आकलन भी किया गया है। मत्स्य पालन और आजीविका सुरक्षा संवर्धन के लिए आर्द्रभूमि में पालन आधारित मात्स्यिकी के लिए प्राकृतिक खेती प्रोटोकॉल का विकास किया जा रहा है। जलाशय मत्स्य पालन को और भी सुदृढ़ करने के लिए, जलवायु परिवर्तन और मानवजनित परिस्थितियों के बीच जलीय कृषि में वृद्धि और सतत विकास लक्ष्यों को प्राप्त करने के लिए जलाशय मत्स्य पालन द्वारा एक पहल की गई। नदी और आर्द्रभूमि मत्स्य संसाधनों के स्थानिक मूल्यांकन को अनुकूलित करने के लिए डेटा विज्ञान का उपयोग करने का एक बड़ा प्रयास किया गया। जलवायु परिवर्तन और मानव जीवन पर इसके प्रभावों के बीच जलाशय मत्स्य पालन को बढ़ावा देने की पहल की गई है ताकि ब्लूग्रोथ और सतत विकास लक्ष्यों की प्राप्ति हो सके। डेटा विज्ञान द्वारा नदी और आर्द्रभूमि मत्स्य संसाधनों का स्थानिक मूल्यांकन भी अनुकूलित किया गया है। सतही जल में पेट्रोलियम हाइड्रोकार्बन, PFAS और फिनोलिक जैसे सूक्ष्म प्रदूषकों का आकलन कर पारिस्थितिकी तंत्र के स्वास्थ्य का मूल्यांकन किया गया। विभिन्न जलवायु क्षेत्रों (hydroclimatic zones) में स्वदेशी मछली समुदायों की अनुकूलन क्षमता (resilience) पर शोध प्रारंभ किया गया है, जिससे जैव विविधता के संरक्षण के लिए दिशा–निर्देश तैयार किए जा सकें। साथ ही, सतत विकास लक्ष्यों के साथ आर्द्रभूमि के जलीय पर्यावरण और मत्स्य प्रबंधन के लिए जैव प्रौद्योगिकी हस्तक्षेप पर भी जोर दिया गया। पूर्वोत्तर क्षेत्र को विशेष ध्यान देने हेतु तीन संस्थान परियोजनाएं शुरू की गईं, जो ब्रह्मपुत्र नदी और सिक्किम की नदियों की मत्स्य और आवासीय विशेषताओं पर केंद्रित हैं।

संस्थान ने कोलकाता में 13वें भारतीय मत्स्य पालन और जलीय कृषि मंच "सतत विकास के लिए मत्स्य और जलकृषि का संवर्धन" नामक एक विशाल सम्मेलन का सह–आयोजन एवं सफल आयोजन किया। इसके अतिरिक्त संस्थान ने मछली प्रोटिओमिक्स, पिंजरा पालन और जलीय कृषि फार्मों में बेहतर स्वास्थ्य प्रबंधन प्रणाली" पर कार्यशाला और सुंदरबन के कुलतोली गाँव में 'महिला मत्स्यजीवी सम्मेलन 2.0, 'सिक्किम में प्रमुख नदियों की मछली विविधता और पकड़ अनुमान की खोज' पर इंटरैक्टिव बैठक का आयोजन किया। इन कार्यक्रमों में लगभग 847 मछुआरों/मछली पालकों के लिए 30 क्षमता विकास कार्यक्रम

आयोजित किए गए। इसी तरह, 4 प्रशिक्षण कार्यक्रमों के माध्यम से 100 अधिकारियों को प्रशिक्षित किया गया और मात्स्यिकी विज्ञान के 337 छात्रों के लिए 16 प्रशिक्षण कार्यक्रम आयोजित किए गए।

संस्थान के वैज्ञानिकों ने कई पुरस्कार और सम्मान प्राप्त किए। इनमें सर्वश्रेष्ठ वैज्ञानिक पुरस्कार, यंग साइंटिस्ट अवार्ड, वरिष्ठ वैज्ञानिक पुरस्कार, समीक्षक उत्कृष्टता पुरस्कार शामिल हैं। इसके अलावा, 15 वैज्ञानिकों को विभिन्न मंचों पर सर्वश्रेष्ठ मौखिक प्रस्तुति हेतु पुरस्कार भी प्राप्त हुए हैं।

रिपोर्ट वर्ष के दौरान, दो पेटेंट और 4 ट्रेडमार्क प्रदान/पंजीकृत किए गए। संस्थान को कॉपीराइट रजिस्ट्री से 11 कॉपीराइट पंजीकरण के अनुदान भी प्राप्त हुए हैं। मुझे विश्वास है कि शोधकर्ताओं के निरंतर और सतत प्रयासों से वर्तमान प्रौद्योगिकियों को व्यापक रूप से अपनाया जाएगा। साथ ही, नई प्रौद्योगिकियों का विकास होगा और टिकाऊ उत्पादन वृद्धि और पारिस्थितिकी तंत्र स्वास्थ्य संरक्षण के लिए प्रोटोकॉल तैयार किए जाएंगे, जिससे अन्तर्स्थलीय खुलाजल मत्स्य पालन क्षेत्र को एक नई ऊंचाई प्राप्त होगी।

मैं डॉ. हिमांशु पाठक, सचिव, डेयर और महानिदेशक, भारतीय कृषि अनुसंधान परिषद द्वारा प्रदत्त अपार सहयोग के लिए आभार व्यक्त करता हूँ। मैं डा. जे. के. जेना, उप महानिदेशक (मत्स्य विज्ञान); डा. देविका पिल्लई, सहायक महानिदेशक (अन्तर्स्थलीय मात्स्यिकी); डा. शुभदीप घोष, सहायक महानिदेशक (समुद्री मात्स्यिकी) तथा सिफ़री वैज्ञानिकों की टीम और अन्य सदस्यों को उनके भरपूर सहयोग के लिए धन्यवाद देता हूँ। संस्थान के विकास तथा अनुसंधान और गतिविधियों को सुव्यवस्थित करने हेतु संस्थान अनुसंधान समिति (IRC), अनुसंधान सलाहकार समिति (RAC), संस्थान प्रबंधन समिति (IMC) और पंचवर्षीय समीक्षा टीम (QRT) द्वारा दिए गए दिशा निर्देशों और सिफारिशों को भी विनम्रता पूर्वक स्वीकार करता हूँ। इस प्रलेख के संकलन एवं सम्पादन में संपादकीय टीम के प्रयासों की सराहना की जाती है।

बि. के. दास

दिनांक : 01 मार्च, 2025
बैरकपुर

बि. के. दास
(निदेशक)

From the Director's Desk



The inland fisheries sector serves as a significant contributor towards livelihood and nutritional security to a large chunk of masses and is also helpful for achieving Sustainable Development Goals (SDGs) in many ways. As our nation is marching towards Viksit Bharat and going through the Amrit Kal era, wherein self-sufficiency and self-reliance are paramount, the fisheries sector has also to gear up for this challenges.

The growth in fish production in India has experienced a remarkable achievement. In the last couple of years, around 9% annual growth rate has been achieved in this sector. The total fish production has reached 175 lakh tonnes from a mere 7.5 lakh tonnes in 1950-51. The science-based fisheries practices, training and capacity building, demonstration and awareness made the country number one in inland capture fisheries in the world. Comprehensive approach adopted under the PMMSY, optimal utilization of fisheries, infusion of technology, and capacity building also contributed to this coveted success.

In 2024, the Institute successfully patented two technologies namely "Vertical slab gel electrophoresis" and "A Portable Split Beam Transducer Assembly on Water Craft for Measuring Exact Transducer Position below the Water". The Institute has received grants for four trademark registration, namely "CIFRI Fish Tanavhari", "RESHMEEN", "CIFRI NutriFishIn" and "CIFRI-ALGA S+". One trademark application was also filed in this period. We have also received grants of 11 copyrights registration from the copyright registry of India, namely "Mapping of Inland Water Bodies of Telangana", "Inland water bodies of Bihar", "Success stories from wetlands", "Catch Assessment Software for the Chhattisgarh state, India", "Catch Estimation Methodology for Inland Water Bodies", "GIS Mapping of Inland Water Bodies of Odisha", "*Sundarbaner Khudra Matsya Chasider Daridrota Durikarner Mahat Prayas*", "Sarana - A Lucrative Species in Pen Based Model in Wetland for Auto Recruitment", "Success Stories Wetlands of Bihar Series-II", "Inland Fisheries Development in Mayurbhanj" and "Indian Major Carps Conservation Plans and Fish spawn prospecting in River Ganga".

I am happy to share the news of many awards and recognitions brought by the staff for the Institute. Best Scientist award, Young Scientist Award, Best Senior Scientist Award, Reviewer Excellence Award are to name a few. Besides, 15 scientists got the Best oral presentation awards in different fora. Fellowships of professional societies, Keynote speaker, Chief Guest in prestigious programmes were few of the notable recognitions received by the scientists.

On the research front, assessment of the annual fish catch and fishing effort in major rivers have been continued in this period, namely Narmada, Cauvery, Sutlej, Gomati, Pampa, Brahmaputra for this purpose. For conservation of native fish stock and to enhance fish production, we continued river ranching prog-rammes. A total of 54.44 lakh fingerlings of Indian Major Carps (IMC) and Mahseer were ranched into the river Ganga. A total of 47,755 adult Hilsa (*Tenualosa ilisha*) fishes along with 30,000 spawn and 5.6 lakh fertilized eggs were released in the river Ganga, upstream of the Farakka Barrage. Fishery resource assess-ment and ecological monitoring are being done for Pulicat Lake, Kayamkulam estuary, Mahi estuary and Sundarbans.

In reservoir fisheries research, ecosystem dynamics and fisheries of Kanva (Karnataka), Sathanur (Tamil Nadu), Banasurasagar (Kerala), Gandhisagar (MP), Getalsud (Jharkhand), Maithon (Jharkhand), Malampuzha (Kerala), Meenkara (Kerala) were assessed. Ectoparasitism and their effects on fish populations of eastern Indian reservoirs was also investigated. A new initiative has been taken to use the potential of abandoned open coal pits (OCPs) and quarries into productive fisheries using Culture-Based Fisheries (CBF) and cage culture technologies. The initiative provides economic opportunities for local fishermen, supporting both subsistence fishing and organized fishing groups, contributing to food security and livelihood enhancement in Jharkhand. The study confirmed that fish produced in these environments are comparable in quality to those farmed in traditional reservoirs. A natural farming-based pen culture trial of *Systomus sarana* has been initiated in Kholsi beel to explore its viability in wetland fisheries. Growth trials in cages incorporating high-value indigenous species such as *Ompok bimaculatus, Heteropneustes fossilis, Labeo rohita* (Jayanti), *L. bata, L. gonius, Systomus sarana, Osteobrama belangeri* and *Etroplus suratensis* are being continued.

Captive-reared *Macrognathus aral* (One-stripe spiny eel) was successfully matured under controlled conditions, leading to the breeding of the F2 generation with

improved survival rates compared to the F1 generation. Another ornamental fish species *Badis blosyrus* was bred successfully in captivity for the second consecutive year, confirming sustainability.

A fish disease surveillance and health management program were conducted in West Bengal in which a total of 66 fish farms have been surveyed and awareness programmes were conducted. A total of 120 *E. coli*, 116 *Aeromonas* sp., and 68 *Staphylococcus* sp. were identified from nine districts of West Bengal, including North 24 Parganas, South 24 Parganas, Hoogly, Howrah, Malda, Murshidabad, Kolkata, Burdwan, and East and West Medinipur. *E. coli* exhibited over 75% resistance to Amoxyclave (AMC), while *Aeromonas* demonstrated a higher resistance of nearly 46% to Ampicillin/Sulbactam (SAM) and 24% resistance to Cephalexin (CEP). Additionally, *Staphylococcus* sp. showed more than 42% resistance to Penicillin.

Impact of petroleum hydrocarbon, PFAS and phenolic micropollutants on ecosystem health of surface water was investigated. Pharmacokinetics study in *P. hypophthalmus* and biosafety of antibiotic enrofloxacin acid was evaluated in *P. hypophthalmus.* A method has been developed for As(V) detection using feroxyhyte (FeOOH) nanoparticles as a sensor probe with limit of detection of 0.006 mg L-1. Detection of plastic-degrading enzymes at the Dakshineswar and Bagbazar locations underscores the potential of microbial communities in mitigating plastic pollution. Colorimetric sensing mechanism developed for detection of Tetracycline antibiotic in fish muscle using specific aptamer.

Primers are developed for QPCR-based diagnostic for detection of *Aermonas hydrophila.* To control snail and helminthic parasites in aquaculture system, a suitable formulation is developed. Under the NEH programme, we conducted ecological investigations on Deepor beel, Brahmaputra river and few rivers of Sikkim. Under climate change research, ecological assessment of wetland using GIS tools in changing climate, assessment of carbon sequestration and greenhouse gas emission from wetlands were attempted.

The institute implemented the SCSP and STC programmes, with a focus on empowering rural women through various fisheries technologies such as ornamental fish culture, backyard pond fish-culture, culture-based fisheries (CBF), and pen culture. The programme, which was implemented in a participatory manner in rural and difficult areas such as Sunderban, benefited over 3000 people through fisheries input distribution, technology demonstrations, capacity building, sensitization, interactive workshop and technical assistance.

We have organized capacity-building programmes in specialized areas for developing and strengthening the skills, attitudes, and abilities of the 1284 stakeholders, including fishers/fish farmers, officials and students. The institute has also organized workshops, interfaces and interactive meetings with officials of Jharkhand and Chhattisgarh. The Institute took a lead role in organizing the mega conference, 13th Indian Fisheries and Aquaculture Forum: "Fostering Growth of Fisheries and Aquaculture for Sustainable Development" at Kolkata which was an overwhelming success. 'Mahila Matsyajibi Sammelan 2.0' at Kultali, Sundarbans received great applause from the ICAR.

The institute staff, including research scholars have published 127 research papers, with a total NAAS rating of 1142. In addition, we have published 11 popular articles,19 books, 48 book chapters, 11 technical bulletins and training manuals. I extend my appreciation to all staff members for their dedicated efforts in advancing the Institute to new heights. I express gratitude to the Heads of Divisions, PME, Heads of Centres, Administration and Finance for their tireless efforts and valuable contributions for the timely publications of the annual report.

Dated : 01 March, 2025
Barrackpore

B. K. Das
(Director)

निदेशक की कलम से

देश में आजीविका और पोषण सुरक्षा सुनिश्चित करने में अन्तर्स्थलीय मत्स्य पालन क्षेत्र की एक प्रमुख भूमिका रही है। साथ ही, इससे विभिन्न प्रकार से सतत विकास लक्ष्यों (SDGs) की प्राप्ति भी हो रही है। वर्तमान में हमारा राष्ट्र "विकसित भारत" की दिशा में अग्रसर है और "अमृतकाल" के दौर से गुजर रहा है, जहां आत्मनिर्भरता और आत्म–स्वावलंबन सर्वोपरि हैं। अतः मत्स्य पालन क्षेत्र को भी इन चुनौतियों का सामना करने के लिए सचेष्ट रहना आवश्यक है।

भारत में मत्स्य उत्पादन की वृद्धि में उल्लेखनीय सफलता देखी गई है। बीते कुछ वर्षों में इस क्षेत्र में वार्षिक 9% की वृद्धि दर्ज की गई है। भारत का कुल मत्स्य उत्पादन 1950–51 में मात्र 7.5 लाख टन था जो बढ़ कर अब 175 लाख टन तक पहुँच चुका है। मत्स्य पालन की वैज्ञानिक पद्धतियों, प्रशिक्षण और क्षमता निर्माण, प्रदर्शन और जनजागरूकता ने भारत को विश्व में अन्तर्स्थलीय पकड़ मत्स्य पालन में शीर्षस्थान दिलाने में महत्त्वपूर्ण भूमिका निभाई है। प्रधानमंत्री मत्स्य संपदा योजना (PMMSY) के अंतर्गत अपनाए गए समग्र दृष्टिकोण, प्रौद्योगिकी का समावेश और क्षमता निर्माण ने भी इस विशिष्ट सफलता में योगदान दिया है।

वर्ष 2024 में, संस्थान ने दो प्रौद्योगिकियों अर्थात् "वर्टिकल स्लैब जेल वैद्युतकण संचलन" और " वर्टिकल स्लैब जेल इलेक्ट्रोफोरेसिस", और "एक पोर्टेबल स्प्लिट बीम ट्रांसड्यूसर असेंबली (जलयान पर ट्रांसड्यूसर की सटीक स्थिति मापने हेतु) के सफलता पूर्वक पेटेंट प्राप्त किए है। साथ ही, संस्थान को चार ट्रेडमार्क पंजीकरण के अनुदान प्राप्त हुए हैं, अर्थात् "सीआईएफआरआई फिश तनावरी", "रेशमीन", "सीआईएफआरआई न्यूट्रीफिशइन" और "सीआईएफआरआई–एल्गा एस+"। इस अवधि में एक ट्रेडमार्क आवेदन भी दायर किया गया था। हमें भारत की कॉपीराइट रजिस्ट्री से 11 कॉपीराइट पंजीकरण अनुदान भी प्राप्त हुए हैं, जेसे "तेलंगाना के अन्तर्स्थलीय जल निकायों का मानचित्रण", "बिहार के अन्तर्स्थलीय जलनिकाय", "आर्द्रभूमि से सफलता की कहानियां", "भारत के छत्तीसगढ़ राज्य के लिए कैच अनुमान पद्धति", "ओडिशा के अन्तर्स्थलीय जल निकायों का जीआईएस मानचित्रण", "सुंदरबनेर खुद्र मत्स्य चासी देर दारिद्रता दुरिकरनेर महत प्रयास"(Bengali), "सराना - प्राकृतिक प्रजनन के लिए वेटलैंड में पेन आधारित मॉडल के लिए एक उपयुक्त प्रजाति", "बिहार के आर्द्रक्षेत्रों की सफलता की कहानियां – सीरीज–II", "मयूरभंज में अन्तर्स्थलीय मत्स्य विकास" और "भारतीय प्रमुख कार्प संरक्षण योजनाएं और गंगा नदी में मछली स्पॉन उत्पादन"।

मुझे यह साझा करते हुए अति प्रसन्नता हो रही है कि संस्थान के वैज्ञानिकों को कई पुरस्कार एवं सम्मान प्राप्त हुए हैं - जैसे बेस्ट साइंटिस्ट अवॉर्ड, यंग साइंटिस्ट अवॉर्ड, बेस्ट सीनियर साइंटिस्ट अवॉर्ड, रिव्यु अर एक्सीलेंस अवॉर्ड, आदि। इस के अतिरिक्त, 15 वैज्ञानिकों को विभिन्न मंचों पर सर्वश्रेष्ठ मौखिक प्रस्तुति हेतु पुरस्कार प्राप्त हुए हैं।

अनुसंधान क्षेत्र में इस वर्ष भी प्रमुख नदियों में वार्षिक मत्स्य पकड़ और प्रयास का आकलन किया गया, जिसमें नर्मदा, कावेरी, सतलुज, गोमती, पंपा और ब्रह्मपुत्र नदीयों को शामिल किया गया। देशी मत्स्य प्रजातियों के संरक्षण और उत्पादन वृद्धि हेतु नदी रैंचिंग कार्यक्रम के अंतर्गत 54.44 लाख अंगुलिकाओं (इंडियन मेजर कार्प और महासीर) को गंगा नदी में छोड़ा गया। इसके साथ ही 47,755 वयस्क हिल्सा, 30,000 स्पॉन, और 5.6 लाख निषेचित अंडे फरक्का बैराज के अपस्ट्रीम में गंगा नदी में छोड़े गए।

जलाशय मात्स्यिकी अनुसंधान में कर्नाटक के कण्वा, तमिलनाडु के सतनूर, केरल के बनासुर सागर, मध्यप्रदेश के गांधीसागर, झारखंड के गेतलसूद और मैथन, केरल के मलमपुझा और मीनकरा जलाशयों की पारिस्थितिकीय गतिशीलता और मात्स्यिकी का अध्ययन किया गया। पूर्वी भारत के जलाशयों में मछलियों में होने वाले बाह्य परजीवितावाद (एक्ओ पैरासिटिज़्म) और उनके प्रभावों की भी जांच की गई। एक नई पहल के तहत निष्क्रिय कोयला खदानों (ओसीपी) में मछली उत्पादन वृद्धि के लिए "पालन आधारित मात्स्यिकी" (सीबीएफ) और पिंजरों में मछली पालन तकनीकों का उपयोग किया जा रहा है। यह पहल झारखंड में स्थानीय मछुआरों के लिए आर्थिक स्वनिर्भरता के अवसर प्रदान करती है, जिससे आजीविका और खाद्य सुरक्षा सुनिश्चित होती है – चाहे वह आत्मनिर्भर मछली पकड़ गतिविधियाँ हों या संगठित मछुआरा समूह। अध्ययन में यह भी पुष्टि की गई है कि इन नए जलाशयों में उत्पादित मछलियों की गुणवत्ता पारंपरिक जलाशयों में पालन की गई मछलियों के समान है। खोलसे बील में प्राकृतिक खेती आधारित पेन पालन प्रणाली के अंतर्गत *सिस्टोमस सराना* प्रजाति की संभाव्यता (viability) का परीक्षण शुरू किया गया है, जिससे आर्द्रभूमि मत्स्यिकी में इसके उपयोग की संभावना को परखा जा सके। पिंजरे (केज) में उच्च मूल्यवाली देशी मछली प्रजातियों जैसे *ओम्पोक बाइमैकुलेटस, हेटरोप्नेयूस्टेस फॉसिलिस, लेबिओ रोहिता* (जयन्ती), *एल. बाटा, एल. गोनियस, सिस्टोमस सराना, ऑस्टियोब्रामा बेलांगेरी*, और *एट्रोप्लस सुराटेंसिस* के विकास परीक्षण भी जारी हैं।

घेरे में पालित *मैक्रोनेथस एराल* (वन–स्ट्राइप स्पाइनी ईल) का नियंत्रित परिस्थितियों में सफलतापूर्वक परिपक्वता देखी गई, जिससे दूसरी संतति (F2 जनरेशन) का प्रजनन संभव हुआ। F2 संतति (generation) की जीवित रहने का दर F1 संतति की तुलना में बेहतर रही। एक अन्य अलंकारी मछली प्रजाति, *बैडिस ब्लोसाइरस* (*Badis blosyrus*) ने लगातार दूसरे वर्ष घेरे में सफलतापूर्वक प्रजनन किया जिससे सतत उत्पादन की पुष्टि होती है।

पश्चिम बंगाल में एक मछली रोग निगरानी और स्वास्थ्य प्रबंधन कार्यक्रम संचालित किया गया, जिसके अंतर्गत कुल 66 मछली पालन केंद्रों का सर्वेक्षण किया गया और जागरूकता कार्यक्रम आयोजित किए गए। पश्चिम बंगाल के नौ जिलों - उत्तर 24 परगना, दक्षिण 24 परगना, हुगली, हावड़ा, मालदा, मुर्शिदाबाद, कोलकाता, बर्धमान, और पूर्व तथा पश्चिम मेदिनीपुर से कुल 120 *ई. कोलाई* (*E- coli*), 116 *एरोमोनास* प्रजाति (*Aeromonas* sp.), और 68 *स्टैफिलोकोकस* प्रजाति (*Staphylo-coccus* sp.) की पहचान की गई। *ई. कोलाई* (*E-coli*) ने *एमोक्सिक्लेव* (AMC) के प्रति 75% से अधिक प्रतिरोधकता दिखाई, जबकि *एरोमोनास* (*Aeromonas*) ने एम्पिसिलिन/सलबैक्टम (SAM) के प्रति लगभग 46% और

सेफालेक्सिन (CEP) के प्रति 24% प्रतिरोध दर्शाया। इसके अतिरिक्त, *स्टैफिलोकोकस* प्रजाति (*Staphylococcus* sp.) में पेनिसिलिन के प्रति 42% से अधिक प्रतिरोध क्षमता देखी गई।

पेट्रोलियम हाइड्रोकार्बन, पीएफएएस (PFAS) और फिनोलिक माइक्रोपॉल्युटेंट्स का सतही जल की पारिस्थितिकी स्वास्थ्य पर प्रभाव की जांच की गई। *पैंगासियस हाइपोफथालमस* (*P. hypophthalmus*) में इस औषधि से शरीर पर प्रभाव (Pharmaco-kinetics) का अध्ययन और एंटीबायोटिक एनरोफ्लॉक्सासिन एसिड (Enrofloxacin acid) की जैव–सुरक्षा (Biosafety) का मूल्यांकन किया गया। आर्सेनिक (As V) का पता लगाने के लिए फेरॉक्सिहाइट (FeOOH) नैनो कणों का उपयोग करते हुए एक विधि विकसित की गई, जिसकी पहचान सीमा 0.006 मिलीग्राम प्रति लीटर है। दक्षिणेश्वर और बागबाज़ार स्थानों में प्लास्टिक–नाशक एंजाइमों की पहचान ने यह दर्शाया कि सूक्ष्म जीव समुदाय प्लास्टिक प्रदूषण को कम करने की दिशा में महत्वपूर्ण भूमिका निभा सकते हैं। मछली की मांसपेशियों में टेट्रासाइक्लिन (Tetracycline) एंटीबायोटिक का पता लगाने के लिए विशिष्ट एप्टामर (Aptamer) का उपयोग करते हुए रंगात्मक संवेदनतंत्र (colorimetric sensing mechanism) विकसित किया गया।

एरोमोनास हाइड्रोफिला (*Aeromonas hydrophila*) की पहचान हेतु QPCR आधारित डायग्नोस्टिक प्राइमर विकसित किए गए हैं। जलीय कृषि प्रणाली (Aquaculture System) में घोंघा और हेल्मिथ परजीवियों को नियंत्रित करने के लिए एक उपयुक्त फॉर्मूलेशन विकसित किया गया है। पूर्वोत्तर क्षेत्र कार्यक्रम (NEH Programme) के अंतर्गत दीपोर बील, ब्रह्मपुत्र नदी और सिक्किम की कुछ नदियों पर पारिस्थितिकीय अध्ययन किए गए। जलवायु परिवर्तन अनुसंधान के अंतर्गत, बदलती जलवायु में आर्द्रभूमि (wetland) का पारिस्थितिक मूल्यांकन, कार्बन अवशोषण (carbon sequestration) तथा आर्द्रभूमियों से ग्रीनहाउस गैसों के उत्सर्जन का आकलन किया गया।

संस्थान ने अनुसूचित जाति उपयोजना (SCSP) और जनजाति उपयोजना (STC) कार्यक्रमों को लागू किया, जिनका उद्देश्य इन समुदायों के ग्रामीण महिलाओं को आर्थिक तौर पर सशक्त बनाना था। इसके तहत अलंकारी मछली पालन, बैकयार्ड तालाबों में मछली पालन, पालन आधारित मत्स्य पालन (CBF) और पेन पालन जैसी विभिन्न मत्स्य प्रौद्योगिकियों को बढ़ावा दिया गया। यह कार्यक्रम सहभागितापूर्ण तरीके से ग्रामीण और दुर्गम क्षेत्रों जैसे सुंदरबन में लागू किया गया, जिससे 3000 से अधिक लोग लाभान्वित हुए। कार्यक्रम के अंतर्गत मत्स्य आदान का वितरण, प्रौद्योगिकी का प्रदर्शन, क्षमता निर्माण, जागरूकता कार्यक्रम, इंटरएक्टिव कार्यशालाएं, और तकनीकी सहायता प्रदान की गई।

हमने विशेषीकृत क्षेत्रों में क्षमता निर्माण कार्यक्रमों का आयोजन किया, जिनका उद्देश्य 1284 हितधारकों - जिनमें मछुआरे/मछली किसान, अधिकारी और छात्र शामिल थे - के कौशल, दृष्टिकोण और क्षमताओं का विकास और सुदृढ़ीकरण करना था। संस्थान ने झारखंड और छत्तीसगढ़ के अधिकारियों के साथ कार्यशालाएं, इंटरफेस और इंटर एक्टिव बैठकों का भी आयोजन किया। संस्थान ने कोलकाता में आयोजित "13वां इंडियन फिशरीज एंड एक्वाकल्चर फोरमः सतत विकास के लिए मत्स्य और जलीय कृषि संवर्धन" पर अंतर्राष्ट्रीय सम्मेलन के आयोजन में अग्रणी भूमिका निभाई है जो अत्यंत सफल रहा। सुंदरबन के कुलतोली में 'महिला मत्स्यजीवी सम्मेलन 2.0' आयोजित किया गया, जिसे भारतीय कृषि अनुसंधान परिषद ने भी बहुत सराहा।

संस्थान कर्मीदल, जिनमें शोध छात्र भी शामिल हैं, ने 127 शोध पत्र प्रकाशित किए, जिन की कुल एनएएएस (NAAS) रेटिंग 1142 रही। इसके अतिरिक्त, हमने 11 लोकप्रिय लेख, 19 पुस्तकें, 48 पुस्तक अध्याय, और 11 तकनीकी बुलेटिन एवं प्रशिक्षण पुस्तिकाएं प्रकाशित की हैं।

मैं संस्थान को नई ऊंचाइयों तक पहुंचाने में उनके समर्पित प्रयासों के लिए सभी कर्मचारियों के प्रति अपनी सराहना व्यक्त करता हूं। मैं विभागाध्यक्षों, केंद्राध्यक्षों, प्रशासन और वित्त विभाग के प्रति भी कृतज्ञता प्रकट करता हूं, जिन्होंने वार्षिक प्रतिवेदन के समय पर प्रकाशन हेतु अथक परिश्रम और मूल्यवान योगदान दिया है।

दिनांक : 01 मार्च, 2025
बैरकपुर

बि. के. दास
(निदेशक)

Executive Summary

In the year 2024, the Institute operated 31 Institute-funded, 2 network research projects, 25 externally funded and consultancy projects, besides execution of SCSP, STC and NEH programmes. Salient achievements emanated from these activities are summarized below:

Riverine and Estuarine Fisheries

- A study covering 161 villages along the upper, middle, and lower reaches of the Narmada River estimated an annual fish landing of 8308 tonnes, with the highest yields recorded in Bharuch (2,521.21 tonnes/year) district. Catch Per Unit Effort (CPUE) exhibited significant variability, with maximum CPUE recorded at Bharuch (6.33) in the lower stretch, and the lowest at Annupur district (2.93 kg/fisher/day) in the upper stretch.
- In river Cauvery, daily average fish landings ranged from 22 kg at Kollidam in the estuarine stretch to 376 kg at Hogenakkal in the middle stretch. The catch per unit effort (CPUE) in the middle stretch at Hogenakkal ranged from 4.8 – 14.8 kg/boat/day, with an average of 7.6 kg/boat/day. The highest average CPUE was recorded from the lower stretch of Cauvery at Bhavani (13.35 kg/boat/day). Minor carp *Bangana dero* constituted 33% of the fish landings in the upper stretch of the river. In the lower stretch at Mayannur, exotic fishes accounted for 71.35% of the total fish landings.
- The estimated annual fish catch from the Sutlej River was 445 tonnes. The highest fish catch was recorded at Firozpur (158.0 tonnes), followed by Rupnagar (133.0 tonnes) and Harike (93.0 tonnes). CPUE (kg/fisher/day) along the stretches of Himachal Pradesh and Punjab varied from 2 - 6 and 3 - 25, respectively. In Himachal Pradesh stretch of the river, snow trouts (*Schizothorax plagiostomus, S. richardsonii*, and *S. esocinus)* dominated the catch, followed by mahseer (*Tor putitora*). Fish catch in the Punjab stretch was dominated by Indian Major Carps (2-71%), followed by minor carps (8-44%).
- In river Gomti, the water quality parameters complied with the prescribed limits for fisheries, except for dissolved oxygen (DO) at downstream and upstream of Lucknow. The middle and lower stretches are subjected to anthropogenic stresses. The miscellaneous group of fishes dominated the catch throughout the river stretches, followed by the exotics (majorly, *Cyprinus carpio* and *Oreochromis niloticus*). Catch of Indian Major Carps has drastically declined from the river.
- Organized fishing is prevalent in the middle and lower stretches while part time hook and line fishing is being practiced in the upper stretch of River Pamba. The major fishery resources of the river Pamba include *Labeo dussumieri*, *Systomus sarana*, *Etroplus suratensis* and *Amblypharyngodon microlepis*. The *Crassostrea* fishery with an average CPUE of 1.5 to 2.0 kg/hr/person and income of Rs. 375–500/hr, provides significant livelihood to woman fishers of the Kayamkulam estuary.
- Ecological study establishes Pulicat as a hypersaline (salinity 31.6-43.4 ppt) lake with low water depth, and high water transparency. The Lake water is predominantly alkaline (pH 8.2-9.4). A total of 50 finfish species were recorded from the fish landings of the Lake, with dominance of mullets (28.16%), followed by carangids (16.50%), *Terapon* spp. (14.56%), and siganids (11.65%).
- The exotic Nile tilapia (*O. niloticus*) dominated fish landings from the Mahi estuary. During the pre-monsoon season, the estimated catch per unit effort (CPUE) was 2 kg/boat/day, and during the monsoon season, it was 4.5 kg/boat/day, with the total annual fish catch ranging from 1200 to 1400 tonnes.
- Geospatial mapping has identified increasing water area and human settlement area and shrinking tree cover and area under crop in Indian Sundarbans. In Sundarbans, the bagnet catches were dominated by marine migrant species in areas with higher salinities, whereas the lowered salinity conditions have favoured the dominance of estuarine species. The CPUE was lowest at Sandeskhali (14.2 kg/net/day) mainly due to the lowered salinity and high turbidity in monsoon.

Reservoir and Wetland Fisheries

- A steady-state food web model of the Kanva Reservoir ecosystem in Karnataka was developed, revealing a total system throughput of 14,084.89 t/km²/year.
- The production potential was estimated at 2360 kg/ha/year for Sathanur reservoir, Tamil Nadu and 780 kg/ha/year for Kanva reservoir.
- A survey confirmed that all previously recorded submerged macrophytes in Kholsi *beel* went extinct due to algal europhication along with the application of weedicides. This loss has significantly impacted the availability of Small Indigenous Fish (SIF). Eight SIF species, including Kholsi fish (*Trichogaster fasciata, T. lalia* and *T. sota*), which accounted for 19.5% of indigenous fish production in 2014-15, have disappeared from the wetland.
- Raising small indigenous fishes (*Trichogaster fasciata, Lepidocephalichthys guntea,* and *Nandus nandus*) in cages with submerged macrophytes in

wetlands showed good growth of the fishes which might be useful in restoration of SIFs in wetlands.

- An initial trial on utilizing jute-retting slurry in micro-pond-based fish culture showed promising results, particularly for growth of Tilapia and *Anabas*. This approach holds promise of reduction of jute retting pollution impacts in inland water bodies and presents a model for waste-to-wealth conversion, supporting a circular economy while promoting micro-pond-based jute retting technology.
- Exploratory study conducted across various zones of the Maithon Reservoir indicated that the lotic zone, linked to the Barakar River, functions as a crucial breeding ground for several commercially significant fish species, including Indian major carps, large catfishes, and murrels.
- A socio-economic survey conducted among fishers of the Getalsud Reservoir to assess their vulnerability to climate change and anthropogenic factors, revealed concerns about the potential impact of Floating Solar Photovoltaic (FSPV) system installations on their livelihoods, particularly fishing and tourism-related boating.
- Small indigenous fishes (SIF) contributed more than 80% of the fish catch in Nesa Dam, a small reservoir of Mayurbhanj, Odisha highlighting the role of auto-recruitment of small fishes in small reservoir fisheries.
- The estimated primary productivity, production potential, and harvestable potential of the Malampuzha reservoir were much lower than those reported in previous studies, which may be attributed to the decline in the reservoir's morphological and water quality attributes.
- The transformation of abandoned open coal pits (OCPs) into productive fisheries using Culture-Based Fisheries (CBF) and cage culture techniques demonstrates a sustainable approach to utilize unused resources for fish production. Experimental study confirmed that fish cultured in OCPs holds good nutritional values, with protein content of 17-19% and low-fat levels. This indicates that fish raised in such environments are comparable in quality to those farmed in natural reservoirs.

Open-water Aquaculture Production and Management

- Circular cage farming of IMCs has been initiated in the Hirakud Reservoir. IMCs with average weight of 61.20 ± 4.12 g for Catla, 59.83 ± 3.55 g for Rohu, and 58.00 ± 4.10 g for Mrigal were recorded post overwintering period of 120 days.
- An effective therapeutic has been developed to reduce post stocking morbidity and mortality in fish in cage culture.
- Study has identified a significant ($p<0.05$) correlation between nitrogen and phosphorus leaching, retention, and fecal excretion, suggesting that optimized feed formulations contain black soldier fly larvae meal, algal meal, and earthworm meal.
- Three different feed formulations, *viz*., Feed 1 (black soldier fly larvae meal, algal meal, rice bran, and soybean meal), Feed 2 (corn gluten meal, pea protein concentrate, duckweed meal, and soybean meal), and Feed 3 (broken rice, earthworm meal, duckweed, and soybean meal) have been developed to minimize nitrogen and phosphorus loading in culture environments.
- Ectoparasites such as *Argulus* spp., *Posthodiplostomum* spp. and isopod parasites have been recorded from fishes from Hirakud and Panchet reservoirs during summer season.
- Identified ectoparasite, *Posthodiplostomum* spp. as causative agent for blackspot disease in *Puntius terio* from the Hirakud reservoir during summer season. This ectoparasite has also been identified from *Pethia conchonius* captured in drag net at Panchet reservoir during winter season.
- Cage culture protocols for *Ompok bimaculatus* and *Systomus sarana* were successfully validated through multilocation trials, confirming their suitability for enclosure-based aquaculture.
- The optimal stocking density for Silver carp fry was standardized at 20 individuals/m³ for the initial 4 months, followed by thinning to 10 individuals/m³ to attain marketable size within an 8–9 months culture period.

Fishery Resource Assessment and Informatics

- A semi-automated data science pipeline has updated 1239 Native Indian Freshwater Fish (NIFF) taxa, with minimal human intervention. New discovery analytics show peak discovery rates: 18.86 from 1999-2024 and 8.30 in north-eastern India.
- Machine learning approach predicted freshwater fish species threat risk with 88% validation accuracy, prioritizing habitat degradation as the most potential risk factors.
- The estuarine stretch of river Hooghly was explored for pollution with petroleum hydrocarbon (PHC), phenolic micropollutants like Bisphenol-A, Nonyl phenol. Accumulation of Per- and polyfluoroalkyl substances (PFAS), the newly emerging pollutants was noticed in commercially important fishes of the Hooghly estuary.

- The resilience of native fish communities has been studied by analyzing populations of *Systomus sarana* and *Cirrhinus reba* across five hydroclimatic zones. The length-weight relationship (LWR) analysis revealed positive allometric growth (b > 3) for *S. sarana* in the Cauvery, Bhima, and Ganga rivers, while *C. reba* exhibited varied growth patterns in different rivers.
- Fish pathogenic and multidrug-resistant *Kytococcus sedentarius* has been characterized through genome sequencing.
- Disease investigation in Blood parrot fish revealed combined infection of *Citrobacter freundii* and *Candida* sp.

Aquatic Environmental Biotechnology

- Seven species of gastropods were morphologically confirmed and further identified through *Cytochrome oxidase* subunit I gene sequencing.
- Mining of proteins for selection of suitable biomarkers against selected emerging contaminants was done.
- To investigate effect of anthopogenic stresses on selected fish species, DNA was isolated from the collected samples of two species (*Heteropneustes fossilis* and *Glossogobius giuris)*, and the mitochondrial markers gene cyt b and D-loop region were amplified. The amplified gene sequences were submitted to NCBI. Later, Primers were designed for expression analysis of genes of Heat shock proteins (hsp70, hsp90, hsc70), caspase 3, myeloid differentiation factor 88 (MyD88), interleukin-8, Toll-like receptor (TLR 20), hypoxia-induced factor 2a, glutathione peroxidase 4 (gpx4), superoxide dismutase (sod2), catalase, mitogen-activated protein kinase (mapk12) Cytochrome P450 (CYP P450), DNA Damage (DD), Histone H3.
- From polluted and non-polluted wetland fish were collected and information on amino acid profiles of *G. giuris* and *H. fossilis* from Shantipur have been generated.

Fisheries Socio-Economics

- Seven SDGs, *viz*., SDGs 1: End poverty, 2: Zero hunger, 5: Gender equity and women empowerment, 8: Economic Growth, 12: Sustainable Consumption and Production, 13: Climate Action, and 14: Life below water were addressed through the inland fisheries resources such as wetlands, reservoirs and small rainfed water bodies. Production enhancement in Baguha reservoir of Odisha through *in-situ* fish seed raising in pens was attempted. Production of SIFs were also encouraged to supplement nutrition requirement and family income.
- Climate-resilient species like *Systomus sarana* were cultured and popularized in CIFRI HDPE-pen systems in Garapota *beel* of West Bengal as part of the sustainable fishery enhancement initiative.
- Ginni Coefficient of the income inequality among the members of SHGs of Birbhum district of West Bengal was estimated to be 0.08. Income is more homogenous and equitable in fishery than the other sources of income. In the Beledanga, Chamta, Sindrani and Kholshi wetlands of West Bengal, fishing contributed 100% livelihood to 47-69% households. Fishing generated around 12,850 mandays of labour in the wetlands in a year.
- In Roopnagar to Ferozpur stretches of Sutlej River, 85% of the fishers were migrant and 15% were local. Index of income diversification (Simpson's index) was found to be 0.216 which was lower than those of Mahanadi and Hooghly-Matlah fishers.
- In Gomati rive of UP, the fishing in the river contributed 62% of the monthly income of Rs. 9168. The yearly total catch per family was found to be 652 kg.
- Economic feasibility of cage culture for various fish species in reservoirs of Chhattisgarh was examined. *Ompok bimaculatus* and *Labeo bata*, in GI cages provided higher benefit-cost ratio of 1.63 and 1.57, respectively.
- The study of 38 FPO farmers of Assam, Tripura and West Bengal suggested that the Pure technical inefficiency was primarily responsible for overall technical inefficiency in crop and vegetable production. All the fish farmers have efficiency score of above 0.70 (1 is most efficient). On an average, the FPO farmers in WB suffer from scale inefficiency at a level of 11%, 11% and 10%, respectively for paddy, vegetable and fish production. Whereas, the FPO farmers in Tripura suffer from scale inefficiency at a level of 13%, 0.05% and 30%.
- Attempted conservation of the fish diversity in floodplain wetlands and small reservoirs with special focus to SIFs.

Network Projects

- Captive-reared *Macrognathus aral* (One-stripe spiny eel) was successfully matured under controlled conditions, leading to the breeding of the F2 generation with improved survival rates, as compared to the F1 generation.
- A tank setup with submerged plants significantly improved growth, feed acceptance, and reduced cannibalism in *Nandus nandus*.
- During 2024, a total 66 fish species and 66 water samples from 66 farms were studied for

understanding the AMR pattern in *Escherichia coli*, *Aeromonas* sp., and *Staphylococcus*. Seventy-five per cent of *E. coli* strains were resistant to Amoxyclav (AMC), while *Aeromonas* demonstrated a higher resistance of nearly 46% to Ampicillin/Sulbactam (SAM) and 24% resistance to Cephalexin (CEP). Additionally, *Staphylococcus* sp. showed more than 42% resistance to Penicillin.

- A series of awareness programs on AMR have been conducted throughout different regions, engaging over 1000 fishermen, students, and research faculty from different organizations.

Externally Funded Projects

- Superficial mycosis causes significant morbidity and mortality loss in *Pangasianodon hypophthalmus* culture, especially in winter. The causative agent of saprolegniasis in cage reared Pangasius has been identified as *Saprolegnia parasitica*.
- A method has been developed for As(V) detection using feroxyhyte (FeOOH) nanoparticles as a sensor probe with limit of detection of 0.006 mg L^{-1}.
- Based on the calculated values of WAWQI, the Hirakud reservoir water has been classified as "good to excellent" during pre-monsoon and post-monsoon seasons. Based on the calculated CTSI (Carlsons Trophic State Index), the reservoir was found to be '*mesotrophic*' across the seasons.
- Identification of antibiotic resistance genes (ARGs) in the sediments of River Ganga at the Dakshineswar and Bagbazar locations underscores alarming prevalence of multidrug-resistant bacteria in aquatic ecosystems.
- Several microbial fish pathogens were screened and identified from the East Kolkata Wetlands. An investigation of fish's immune response and nutrient profiling was done to evaluate the effect of wastewater on cultured fish.
- Emergence of Multidrug-Resistant *Proteus vulgaris* infection in *Pangasianodon hypophthalmus* cultured in cages at Maithon reservoir, Jharkhand.
- First report of Tilapia Parvovirus (Tipv) outbreak in cage and wetland tilapia farms at Hiarakud reservoir and East Kolkata Wetlands.
- Analysis of the performances of 38 FPOs in West Bengal, Assam and Tripura revealed that the market facilities, inputs for farming, and extension advisory services created the most supportive environments, while credit or financial assistance from banks had the least support to the FPOs.
- Thirty ranching activities were conducted by releasing 54.44 lakhs fingerlings to conserve and restore Indian Major Carps (IMC) and Mahseer in the Ganga river.
- A total of 47,755 adult Hilsa (*Tenualosa ilisha*) fishes along with 30,000 spawn and 5.6 lakh fertilized eggs were released in the river Ganga upstream of the Farakka Barrage. Four successful artificial breeding of Hilsa involving controlled spawning techniques were conducted to enhance its production for both commercial and ecological benefits.
- A colorimetric sensing mechanism using specific aptamer has been developed for detection of tetracycline antibiotic in fish muscle.
- Microplastics abundance was estimated in water, sediment and fish of river Brahmaputra at eleven sites. Microplastics in water ranged from 140 to 420 particles/m^3, while sediment samples contained 13.63 to 53.33 particles/kg.

NEH Programme

- The invasive exotic vermiculated sailfin catfish *Pterygoplichthys disjunctivus* has been recorded for the first time from Deepor *beel* and in a tributary of Barak River. Highly carnivorous exotic catfish *Clarias gariepinus* was recorded from Umiam reservoir of Meghalaya, which is a major threat to ichthyofaunal diversity of the reservoir.
- An energy efficient and cost-effective traditional fishing trap locally known as "*Dori*" has been documented from fishers of Sone *beel*, Assam.
- Assessed feasibility for sustainable fisheries in Sareswar *beel*, Shilai-Nalia *beel*, Diplai *beel* (Kokrajhar District) and Champamati Irrigation Project (Bijni District) of Bodoland Territorial Council (BTC), Kokrajhar, Assam.
- Cavernicole fish diversity in East Jaintia Hills, Meghalaya has been documented. Occurrence of *Channa aristonei* and *Channa gachua* were recorded.
- A total of 70 finfish species belonging to 52 genera under 23 families and 9 orders were recorded from the River Brahmaputra in Assam.
- Fish catch from different landing sites on Brahmaputra ranged from 6 to 237 kg/day during the monsoon season, which increased to 10 to 326 kg/day during the post-monsoon season. Total estimated fish catch from the river was 72.7 and 122.1 tonnes during the monsoon and post-monsoon seasons respectively.
- Population characteristics of *Cabdio morar* (single-most dominant fish species of river Brahmaputra in Assam) were assessed. The estimated von Bertalanffy growth parameters for *C. morar* were $L\infty$=147.53 mm and K=1 $year^{-1}$.
- Habitat ecology of major rivers (Teesta, Rangeet and eight

tributaries) of Sikkim were studied in post-monsoon and winter seasons. The most dominant species in the rivers of Sikkim were chocolate mahseer (*Neolissochilus hexagonolepis*) contributing 42.0-78.5% and snow trout (*Schizothorax richardsonii*) contributing 33.87-90% to catch in both the seasons. Brown trout (*Salmo trutta*) dominates in the upper stretches of the Teesta River during the winter season. The average CPUEs of Teesta River and Rangeet river were 2-3 kg/fisher/day and 3-4 kg/fisher/day, respectively.

Awards

- Many awards and recognitions were brought by the staff of the Institute. In 13th Indian Fisheries and Aquaculture Forum (13 IFAF) 2024, 13 scientists received different awards in categories like Best Oral Presentation, Best Poster Presentation, Best Speaker, Dr. J. K. Jena Young Scientist Award and Best Young Scientist Award.
- Similarly, in the workshop on 'Inland fisheries towards the SDG' at the institute Hqs, three scientists got Best Poster presentation awards. Another two scientists got best presentation awards in other fora.
- Dr. B. K. Das, Director was awarded with the Fellowship of the Academy for Advancement of Agricultural Sciences, Kalyani, West Bengal. Dr. Archana Sinha was awarded with the BASA Fellowship for the year 2024. Dr. Sullip Kumar Majhi was awarded with Prof. D. K. Belsare Medal of Zoological Society of India.
- Reviewer Excellence Award, 2024; Scientist of the Year Award; Excellence in Research Award were some of the other awards bagged by the scientists. Keynote speaker, memorial lectures, lead lecture and chair/cochair in national/international seminars/conferences are some of the recognitions showered on the institute staff.

Intellectual Property Rights

- During the year under report, two patents namely "Vertical slab gel electrophoresis" and "A Portable Split Beam Transducer Assembly on Water Craft for Measuring Exact Transducer Position below the Water" were granted. Similarly, four trademarks, "CIFRI Fish Tanavhari", "RESHMEEN", "CIFRI NutriFishIn", "CIFRI-ALGA S+" were registered. The Institute has also received grants of 11 copyrights registration from copyright registry. Three technologies were commercialized namely "CIFRI Fish Tanavhari", "CIFRI Pen HDPE" and "CIFRI Argcure" on non-exclusive license for a period of five years.
- Three technology certificates, namely "Methodology to quantify the determinants of willingness to-participate and willingness-to-pay", "CIFRI Fish Tanavhari: a unique herbal fish sedative/anaesthetic" and "Fish-based multi-metric Index of Biotic Integrity for assessing the ecological health of Indian rivers" were granted by the ICAR.
- Ten MoUs were signed, four with central government department/public institution and one with state government department. Two MoU were signed for technical guidance to Non-government organizations and three MoU were signed with private companies for technology commercialization.

STC and SCSP Programmes

- The institute implemented SCSP and STC programmes, with a focus on empowering rural masses, especially women, with various fisheries technologies such as ornamental fish culture, backyard pond fishculture, culture-based fisheries (CBF), pen culture, etc. These activities, which were implemented in participatory manner in difficult areas such as Sunderbans and Purulia benefited over 3000 people through fisheries input distribution, technology demonstrations, capacity building, sensitization, interactive workshop and technical assistance.
- *Mahila Matsayajibi Sammelan* 2.0 was organized at Sundarbans in the august presence of Dr. J. K. Jena, DDG (Inland Fisheries, ICAR) which saw participation of around 3500 fishers including 1500 women fishers.
- Inputs were distributed for aquaculture, capture fisheries, ornamental fish culture and pen culture benefitting more than 3700 fishers and fish farmers in the remote and vulnerable regions of West Bengal, Gujarat, Kerala, Karnataka, Uttar Pradesh, Tamil Nadu , Assam, Odisha.
- Two training programmes have been conducted on inland fisheries management under the STC programme. The institute declared 26 December as Women Fish Farmers' Day or *Mahila Matsyajibi Diwas* commemorating the vital contributions of women in fisheries and aquaculture, particularly in the Sundarbans.

HRD and Other Activities

- The Institute took a lead role in organizing the mega conference 13th Indian Fisheries and Aquaculture Forum: "Fostering Growth of Fisheries and Aquaculture for Sustainable Development" at Kolkata with overwhelming success. The institute also organized workshop on Fish Proteomics, Workshop on "Better Health Management Practices in Cage Culture and

Aquaculture Farms", Interactive Meeting on 'Exploring Fish Diversity and Catch Estimation of Major Rivers in Sikkim.'

- Thirty capacity development programmes were organized benefitting 847 fishers/fish farmers. Similarly, 100 officials and 337 students were trained in 20 training programmes.The institute conducted 144 awareness programmes under the NMCG on dolphin, hilsa and fish biodiversity conservation sensitizing 7,916 fisher folks and local communities along different rivers across the Gangetic basin.
- The institute has published 127 research papers, with a total NAAS rating of 1142, besides publication of 19 books, 48 book chapters, 11 technical bulletin and training manuals and 11 popular articles.



Floating pens in operation at Kelaghagh Reservoir, Simdega, Jharkhand

विशिष्ट सारांश

वर्ष 2024 में संस्थान ने 31 संस्थान–प्रायोजित, 2 नेटवर्क अनुसंधान परियोजनाओं के साथ 25 बाह्य–वित्त पोषित और परामर्श परियोजनाओं का संचालन किया है। इसके अतिरिक्त अनुसूचित जाति उपयोजना (SCSP), आदिवासी उपयोजना (STC) और पूर्वोत्तर क्षेत्र (NEH) कार्यक्रमों का क्रियान्वयन भी किया गया। रिपोर्ट अवधि के दौरान संस्थान की प्रमुख उपलब्धियों का सारांश निम्नलिखित है:

नदीय और ज्वारनदमुख मात्स्यिकी अनुसंधान (Riverine and Estuarine Fisheries)

- नर्मदा नदी के ऊपरी, मध्य और निचले क्षेत्रों में स्थित 161 गांवों में किए गए अध्ययन में वार्षिक मत्स्य उत्पादन 8308 टन आंका गया है। सबसे अधिक उत्पादन भरूच जिले (2,521.21 टन/वर्ष) में दर्ज किया गया। कैच प्रति इकाई प्रयास (CPUE) में महत्वपूर्ण भिन्नता पाई गई, जैसे भरूच में अधिकतम(6.33 किग्रा/मछुआरा/दिन) और अनुपुर जिले में न्यूनतम (2.93 किग्रा/मछुआरा/दिन) दर्ज किया गया ।
- कावेरी नदी में दैनिक औसत मछली पकड़ 22 किग्रा (कोल्लिडम, ज्वारनदमुख क्षेत्र) से 376 किग्रा (होगेनेक्कल, मध्य क्षेत्र) के बीच रही। कैच प्रति इकाई प्रयास (CPUE) होगेनेक्कल में 4.8–14.8 किग्रा/नाव/दिन के बीच रही (औसतन 7.6 किग्रा/नाव/दिन)। सबसे अधिक औसत कैच प्रति इकाई प्रयास (CPUE) भवानी (निचला क्षेत्र) में 13.35 किग्रा/नाव/दिन दर्ज की गई। ऊपरी क्षेत्र में माइनर कार्प प्रजाति, *बांगाना डेरो* 33%, जबकि मयनूर (निचला क्षेत्र) में विदेशी मछलियों की भागीदारी 71.35% दर्ज की गई।
- सतलुज नदी का अनुमानित वार्षिक मत्स्य उत्पादन 445 टन था। सबसे अधिक मछली पकड़ फिरोजपुर (158.0 टन), रूपनगर (133.0 टन) और हरिके (93.0 टन) में दर्ज की गई। हिमाचल प्रदेश में CPUE 2–6 किग्रा/मछुआरा/दिन और पंजाब में 3–25 किग्रा/मछुआरा/दिन के बीच रही। हिमाचल में स्नोट्राउट, *साइजोथोरेक्स* एसपीपी और महासीर, *टोर पुटीटोरा* प्रमुख थे, जबकि पंजाब में इंडियन मेजर कार्प (2–71%) और माइनर कार्प (8–44%) की प्रमुखता देखी गई।
- गोमती नदी में अधिकांशतः जल गुणवत्ता मापदंड मत्स्य पालन के लिए उपयुक्त पाई गई, परंतु लखनऊ के ऊपरी और निचले भागों में घुलित ऑक्सीजन का प्रतिशत मानक स्तर से कम रहा क्योंकि ये दोनों क्षेत्र मानवजनित कार्यकलापों के कारण पर्यावरणीय दबाव में हैं। नदी के समस्त क्षेत्रों में विविध मत्स्य प्रजातियाँ की प्रमुखता रहीं। इसके बाद विदेशी प्रजातियाँ (मुख्यतः *साइप्रिनस कार्पियो* और *ओरियोक्रोमिस लोटिकस*) रहीं पर इंडियन मेजर कार्प के पकड़ में भारी गिरावट देखी गई।
- पंबा नदी के मध्य और निचले क्षेत्रों में में संगठित मत्स्ययन किया जाता है, जबकि ऊपरी क्षेत्र में आंशिक रूप से हुक और लाइन जाल से मछली पकड़ी जाती है। इस नदी के प्रमुख मत्स्य प्रजातियों में *लेबिओ डस्सुमियेरी, सिस्टोमस सराना, एट्रोप्लस सुराटेंसिस* और *एंब्लीफैरिंगोडोन माइक्रोलेपिस* हैं। कायकुलम मुहाना क्षेत्र में क्रैसॉस्ट्रिया मत्स्यन (सीपी) का औसत प्रति इकाई मत्स्ययन प्रयास (CPUE) 1.5 से 2.0 किग्रा/घंटा /व्यक्ति है, जिससे महिलाओं को 375-500 रुपये/घंटे की आय होती है।
- पुलिकट झील की पारिस्थितिकीय अध्ययन में यह देखा गया कि यह एक अतिलवणीय (लवणता 31.6–43.4 पीपीटी), कम गहरी और उच्च पारदर्शिता वाली झील है। झील का जल मुख्यतः क्षारीय (पीएच 8.2–9.4) है। मछली पकड़ में कुल 50 प्रजातियाँ दर्ज की गईं, जिनमें मुलेट (28.16%) कैरैंगिड्स (16.50%), टेरापॉन प्रजातियाँ (14.56%) और सिगानिड्स (11.65%) की प्रमुखता रही।
- माही मुहाना क्षेत्र के मछली पकड़ में विदेशी प्रजाति, नाइल तिलपिया, *ओ. नाइलोटिकस* की प्रमुखता दर्ज की गई। मानसून पूर्व मौसम में प्रति इकाई मत्स्ययन प्रयास (CPUE) 2 किग्रा/नाव/दिन और मानसून में 4.5 किग्रा/नाव/दिन रही। वार्षिक कुल मछली उत्पादन 1200 से 1400 टन के बीच रहा।
- भारतीय सुंदरबन में भू–स्थानिक मानचित्रण से जलक्षेत्र और मानव बस्तियों में वृद्धि और पेड़ों से आच्छादित तथा कृषि क्षेत्र में कमी दर्ज की गई। अधिक लवणीय क्षेत्रों में बगनेट पकड़ में समुद्री प्रवासी प्रजातियों की प्रमुखता रहीं, जबकि कम लवणता वाले क्षेत्रों में ज्वारनदमुख प्रजातियाँ प्रमुख रहीं। मानसून में अधिक गाद और कम लवणता के कारण संदेसखाली में कैच प्रति इकाई प्रयास (CPUE) सबसे कम (14.2 किग्रा/जाल/ दिन) रही।

जलाशय और आर्द्रभूमि मात्स्यिकी अनुसंधान (Reservoir and Wetland Fisheries)

- कर्नाटक के कन्वा जलाशय की पारिस्थितिक प्रणाली पर एक राज्य–विशिष्ट खाद्य जाल मॉडल विकसित किया गया, जिससे कुल प्रणाली प्रवाह (Total System Throughout) 14,084.89 टन/किमी^{2}/वर्ष आंका गया।
- सथानूर जलाशय (तमिलनाडु) की उत्पादन क्षमता 2360 किग्रा/हेक्टेयर/वर्ष तथा कन्वा जलाशय की उत्पादन क्षमता 780 किग्रा/हेक्टेयर/वर्ष आंकी गई।
- खोलसी बील में एक सर्वेक्षण से पुष्टि हुई कि पहले से दर्ज सभी जलमग्न मैक्रोफाइट्स शैवाल यूट्रोफिकेशन और खर–पतवार ग्रसन के कारण विलुप्त हो गए हैं। इससे छोटी स्वदेशी मछलियों की उपलब्धता पर गंभीर और हानिकारक प्रभाव पड़ा है। छोटी स्वदेशी

मछलियों की आठ प्रजातियाँ, जिनमें खोलसी मछली (*ट्राइकोगैस्टर फासिआटा, टी. ललिया* और *टी सोटा*) शामिल हैं। इसमें 2014–15 में स्वदेशी मछली उत्पादन का 19.5% होता था जो अब इस आर्द्रभूमि से लुप्त हो चुकी हैं।

- जलमग्न मैक्रोफाइट के साथ पिंजरों (Cages) में प्रयोगात्मक तौर पर छोटी स्वदेशी मछलियों जैसे *ट्राइकोगैस्टर फेसीएटा, लेपिडोसेफलिक्थिस गूनटिया* और *नेंदस नेंदस* पालन से इन मछलियों में उल्लेखनीय वृद्धि देखी गई। यह विधि आर्द्रभूमि में छोटी स्वदेशी मछलियों की पुनर्स्थापना में सहायक हो सकती है।
- छोटे तालाबों में मछली पालन के प्रारंभिक परीक्षण में जूट को गलाने के लिए बने घोल का उपयोग करने से मछलियों, विशेषकर *तिलापिया* और *अनाबास* मछलियों के विकास में उत्साहवर्धक परिणाम देखने को मिले हैं। यह पद्धति अन्तर्स्थलीय जल निकायों में जूट रेटिंग प्रदूषण को कम करने, अपशिष्ट से संपदा में परिवर्तन (waste to wealth) और चक्रीय अर्थव्यवस्था (circular economy) को बढ़ावा देने की दिशा में एक मॉडल प्रस्तुत करती है।
- मैथन जलाशय के विभिन्न क्षेत्रों में किए गए अध्ययन से पता चला कि लोटिक क्षेत्र, जो बराकर नदी से जुड़ा है, आर्थिक रूप से महत्वपूर्ण कई मछलियों जैसे इंडियन मेजर कार्प, बड़े कैटफिश और मरेल की प्रजनन क्षेत्र हेतु कार्य करता है।
- गेटलसूद जलाशय के मछुआरों पर जलवायु परिवर्तन और मानव कार्यकलापों से होने वाले प्रभाव के आंकलन पर सामाजिक–आर्थिक सर्वेक्षण में पाया गया कि तैरते हुए सौर फोटोवोल्टिक (FSPV) सिस्टम तथा पर्यटन–आधारित नौकायन उनकी आजीविका और उनके मत्स्यन पर नकारात्मक प्रभाव डाल सकती है।
- नेसा डैम (मयूरभंज, ओडिशा) में छोटी स्वदेशी मछलियों (SIF) का प्रतिशत कुल मछली पकड़ का 80% से अधिक है जो छोटे जलाशयों में इन छोटी स्वदेशी मछलियों की प्राकृतिक प्रजनन क्षमता (auto – recruitment) के महत्त्व को दर्शाता है।
- मालमपुरा जलाशय की प्राथमिक उत्पादकता, उत्पादन क्षमता और संभावित दोहन क्षमता पिछले अध्ययनों की तुलना में काफी कम पाई गई, जिसका कारण जलाशय की संरचनात्मक और जल गुणवत्ता में गिरावट हो सकती है।
- परित्यक्त और निष्क्रिय कोयले की खुले खदानों में पालन आधारित मात्स्यिकी और पिंजरे में मछली पालन तकनीकों के माध्यम से मछली उत्पादन को बढ़ाया जा सकता है। इससे अप्रयुक्त संसाधन क्षेत्रों में सतत तौर पर मछली उत्पादन में सहायता होगी। प्रयोगात्मक अध्ययन से यह पुष्टि होती है कि इन खुली खदानों में पालित मछलियों में पोषक तत्व सही मात्रा में पाए जाते हैं, जैसे प्रोटीन 17–19% और वसा का स्तर कम पाई जाती है। इनमें उपलब्ध पोषक गुण लगभग प्राकृतिक जलाशयों में पालित मछलियों के समान ही देखी गई है।

खुलाजल मत्स्य उत्पादन एवं प्रबंधन (Open Water Aquaculture Production and Management)

- हिराकुद जलाशय में इंडियन मेजर कार्प (IMCs) मछलियों को वृत्ताकार पिंजरे में पालन की शुरुआत की गई। लगभग 120 दिनों के बाद कतला का औसत वजन 61.20 ± 4.12 ग्राम, रोहू का 59. 83± 3.55 ग्राम और मृगल का 58.00± 4.10 ग्राम दर्ज किया गया।
- पिंजरे में मछली पालन में मछली संग्रहण के बाद होने वाली बीमारी और मृत्यु दर को कम करने हेतु एक प्रभावी निवारक चिकित्सा (preventive therapeutic) प्रणाली विकसित की गई है।
- एक अध्ययन में पाया गया कि नाइट्रोजन और फास्फोरस के रिसाव, अवशोषण और मल उत्सर्जन के बीच महत्वपूर्ण संबंध ($p<0.05$) है, जिससे यह निष्कर्ष निकाला गया कि मछलियों के संतुलित आहार को बनाने के लिए ब्लैक सोल्जर मक्खी के लार्वा, शैवाल और केंचुआ की आवश्यकता है।
- जलीय कृषि में नाइट्रोजन और फास्फोरस की मात्रा को कम करने में तीन विभिन्न आहार संयोजन तैयार किए गए हैं: आहार 1: ब्लैक सोल्जर मक्खी के लार्वा, शैवाल, चावल की भूसी और सोया भोजन; आहार 2: मक्का, ग्लूटन, मटर प्रोटीन, डकवीड , और सोया भोजन; और आहार 3: चावल के टुकड़े, केंचुआ, डकवीड और सोया।
- ग्रीष्म काल में हिराकुद और पंचेत जलाशयों से पकड़ी गई मछलियों में बाह्य परजीवी जैसे *आर्गूलस* एसपीपी, *पोसथोड़ीपलोसोमम* एसपीपी और आइसोपोड परजीवी पाए गए।
- ग्रीष्म काल में हिराकुंड जलाशय में *टियस टेरियो* में पाए जाने वाले ब्लैक स्पॉट रोग का कारण *पोसथोड़ीप - लोसोमम* एसपीपी का संक्रमण बताया गया। यही परजीवी पंचेत जलाशय में सर्दियों में ड्रैग नेट से पकड़े गए पेथिआ कॉन्कोनीयस में भी दर्ज किया गया।
- पिंजरा पालन में *ओम्पक बाईमूलटस* और *सिस्टोमस सराना* को बहु–स्थान परीक्षणों के माध्यम से सफलतापूर्वक सत्यापित किया गया, जिससे पुष्टि होती है कि ये प्रजातियाँ घेरे में मत्स्य पालन के लिए उपयुक्त हैं।
- सिल्वर कार्प के लिए आदर्श संग्रहण घनत्व पहले 4 महीनों के लिए 20 मछली/घन मीटर और इसके बाद विपणन योग्य आकार तक पहुँचने के लिए 10 मछली/घन मीटर का सुझाव दिया गया है, जिससे 8–9 महीनों की पालन अवधि में वांछित वृद्धि प्राप्त हो सके।

मत्स्य संसाधन मूल्यांकन और सूचना विज्ञान (Fishery Resource Assessment and Informatics)

- एक अर्ध–स्वचालित डेटा साइंस पाइपलाइन के माध्यम से भारतीय मीठे पानी के 1239 स्वदेशी मछली प्रजातियों को अपडेट किया गया, जिसमें मानव हस्तक्षेप न्यूनतम रहा। नई खोज विश्लेषण से यह दर्शाया गया कि वर्ष 1999–2024 के दौरान पूर्वोत्तर भारत में सर्वेक्षण दर 18.86 और 8.30 रही।
- मशीन लर्निंग दृष्टिकोण से मीठे पानी की मछलियों के संकट जोखिम की 88% सटीक पूर्वानुमान किया गया, जिसमें आवासीय क्षरण (habitat degradation) को सबसे प्रमुख कारक के रूप में चिह्नित किया गया।
- हुगली नदी के ज्वारीय क्षेत्र में पेट्रोलियम हाइड्रोकार्बन (PHC), बिसफेनॉल–ए, नॉनिल फिनॉल जैसे फिनोलिक माइक्रोपॉल्यूटेंट्स तथा उभरते प्रदूषक (*फ्लुओरो एल्किल* सब्स्टेंस) की उपस्थिति पाई गई, जो व्यावसायिक रूप से महत्वपूर्ण मछलियों में संचित हो रहे हैं।
- पाँच जलीय–जलवायु क्षेत्र में *सिस्टोमस सराना* और *सीरहीनस रेबा* की जनसंख्या विश्लेषण द्वारा मूल मछली समुदायों की पुनर्प्राप्ति क्षमता (resilience) का अध्ययन किया गया। कावेरी, भीमा और गंगा नदियों में एस सराना में सकारात्मक ऑलॉमेट्रिक वृद्धि (b>3) दर्ज की गई, जबकि विभिन्न नदियों में *सी रेबा* के वृद्धि में भिन्नता पाई गई।
- मछलियों में रोग उत्पन्न करने वाले और मल्टीड्रग–प्रतिरोधी, *कैटोकॉकस सेडेन्टेरियस* बैक्टीरिया के जीनोम अनुक्रमण (genome sequencing) के माध्यम से विशेष रूप से पहचान की गई।
- ब्लड पैरेट फिश में एक रोग जांच में साइट्रोबैक्टर फरेंडी और कैन्डिडा प्रजातियों के संयुक्त संक्रमण की पहचान की गई।

जल–जैव पर्यावरणीय जैव प्रौद्योगिकी (Aquatic Environ-mental Biotechnology)

- सात गैस्ट्रोपोड प्रजातियों की पहचान पारंपरिक संरचना विज्ञान (morphology) और साइटोक्रोम ऑक्सीडेज उप–इकाई I जीन अनुक्रमण (gene sequencing) के माध्यम से की गई।
- उभरते प्रदूषकों के विरुद्ध उपयुक्त बायोमार्कर्स (जैविक संकेतक) चयन हेतु प्रोटीन माइनिंग पद्धति अपनाया गया।
- मानव गतिविधियों के कारण उत्पन्न तनाव (anthropogenic stresses) के प्रभाव को जांचने के लिए दो मछली प्रजातियों, *हेटरोनिस्टस फोसिलिस* और *ग्लॉसोगोबीयस गुरिस* से DNA निकाला गया और mitochondrial markers के जीन (cyt b और D-loop क्षेत्र) को प्रवर्धित (amplified) किया गया। इन जीन अनुक्रमों को NCBI में जमा किया गया। इसके बाद निम्नलिखित जीनों की अभिव्यक्ति विश्लेषण (expression analysis) हेतु प्राइमर डिजाइन किए गए: हीट शॉक प्रोटीन (hsp70, hsp90, hsc70); कैस्पेस 3, माइलॉयड विभेदन कारक 88 (MyD88); इंटरल्यूकिन–8, टोल–लाइक रिसेप्टर (TLR 20); हाइपोक्सिया–प्रेरित कारक 2, ग्लूटाथिऑन पेरोक्सीडेस 4 (gpx4); सुपरऑक्साइड डिसम्यूटेस (sod2), कैटालेज; MAPK12, साइटोक्रोम P450 (CYP P450); डीएनए ह्रास (DD), हिस्टोन H3।
- शांतिपुर क्षेत्र से प्रदूषित और अप्रदूषित जल स्रोतों से मछलियाँ एकत्र की गईं तथा *जी. गुरिस* और *एच फोसिलिस* की अमीनो एसिड प्रोफाइल तैयार की गई।

मत्स्य पालन का सामाजिक – आर्थिक पहलू (Fisheries Socio-Economics)

- सात सतत विकास लक्ष्यों (SDGs) - SDG 1: गरीबी उन्मूलन, 2: भूखमरी उन्मूलन, 5: लैंगिक समानता, 8: आर्थिक वृद्धि, 12: सतत उपभोग और उत्पादन, 13: जलवायु परिवर्तन, और 14: जलीय जीव विज्ञान - को अन्तर्स्थलीय मत्स्य संसाधनों जैसे आर्द्रझील क्षेत्र, जलाशय और वर्षा - आधारित जल निकायों के माध्यम से संबोधित किया गया। ओडिशा के बगुहा जलाशय में पेन में इन–सिटू मत्स्य बीज पालन के माध्यम से उत्पादन वृद्धि का प्रयास किया गया। छोटी स्वदेशी मछलियों (SIFs) के उत्पादन को पोषण आवश्यकताओं और पारिवारिक आय के पूरक के रूप में प्रोत्साहित किया गया।
- जलवायु परिवर्तन के प्रभावों के प्रति सहनशील प्रजातियाँ जैसे *सिस्टोमस सराना* को सिफ़री एचडीपीई पेन पद्धति के तहत पश्चिम बंगाल के गारापोटा बील में पालन कर लोकप्रिय बनाया गया।
- पश्चिम बंगाल के बीरभूम जिले के स्वयं–सहायता समूहों के सदस्यों के बीच आय असमानता का आनुमानिक गिन्नी गुणांक 0.08 था। मत्स्य पालन से होने वाले आय को अन्य आय स्रोतों की तुलना में अधिक समरूप और न्यायसंगत देखा गया। पश्चिम बंगाल के बेलडांगा, चामता, सिंद्रानी और खोलशे आर्द्रभूमि में, मछली पकड़ने से 47–69% परिवारों की 100% आजीविका जुड़ी हुई है। मछली पकड़ने से आर्द्रभूमि में एक वर्ष में लगभग 12,850 मानव दिवस का श्रम उत्पन्न होता है।
- रूपनगर से फिरोजपुर तक सतलुज नदी की धाराओं में 85% मछुआरे प्रवासी और 15% स्थानीय थे। आय विविधीकरण का सूचकांक (सिम्पसन सूचकांक) 0.216 पाया गया, जो महानदी और हुगली–मातला क्षेत्र के मछुआरों की तुलना में कम था।
- उत्तर प्रदेश की गोमती नदी में मछली पकड़ से मासिक आय ₹9168 का 62% आँकलित किया गया है। प्रति परिवार वार्षिक कुल पकड़ 652 किलोग्राम पाई गई।

- छत्तीसगढ़ के जलाशयों में विभिन्न मछली प्रजातियों के लिए पिंजरे में मछली पालन की आर्थिक व्यवहार्यता की जांच की गई। जीआई केज में *ओमपोक बाइमेकुलेटस* और *लेबियो बाटा* में उच्च लाभ–लागत अनुपात क्रमशः 1.63 और 1.57 दर्ज किया गया।
- असम, त्रिपुरा और पश्चिम बंगाल के 38 एफपीओ किसानों के अध्ययन में पाया गया कि कुल तकनीकी अक्षमता ही प्रमुख कारण है। सभी मत्स्यपालकों की प्रभावशीलता स्कोर 0.70 से ऊपर थी।पश्चिम बंगाल में एफपीओ किसानों को औसतन 11% धान, 11% सब्जी और 10% मछली उत्पादन में स्केल अक्षमता का सामना करना पड़ा। त्रिपुरा में यह क्रमशः 13%, 0.05%, और 30% रहा।
- बाढ़कृत आर्द्रभूमि और छोटे जलाशयों में मत्स्य जैव विविधता संरक्षण का प्रयास किया गया। इसके अंतर्गत छोटी स्वदेशी मछलियों (SIFs) पर विशेष ध्यान दिया गया।

नेटवर्क परियोजनाएं (Network Projects)

- नियंत्रित परिस्थितियों में घेरे में पालित *मैक्रोनेथस अराल* (वन–स्ट्राइप स्पाइनी ईल) को सफलतापूर्वक परिपक्व किया गया, जिससे F2 जनरेशन का प्रजनन हुआ। इसकी अतिजीविता दर F1 जनरेशन की तुलना में बेहतर देखी गई।
- एक टैंक में जलमग्न पौधों के कारण *नेंदस नेंदस* जैसे परभक्षी प्रजातियों की वृद्धि, भोजन ग्रहण क्षमता में वृद्धि और परभक्षण में कमी देखी गई है।
- वर्ष 2024 में 66 मत्स्य प्रजातियों और 66 मत्स्य पालन स्थलों से जल के नमूनों का अध्ययन किया गया। यह अध्ययन *एसरीकिया कोलाई, एरोमोनास* और *स्टेफ़ाईलोकोकस* में एंटीमाइक्रोबियल प्रतिरोध (AMR) पैटर्न को समझने के लिए किया गया। *ई कोलाई* के 75% स्ट्रेन Amoxyclav (AMC) के प्रतिरोधी पाए गए। एरोमोनास में एम्पिसिलीन/ सलबैक्टम (SAM) के प्रति 46% और सेफलेक्सीन (CEP) के प्रति 24% प्रतिरोध देखा गया। *स्टेफ़ाईलोकोकस* प्रजाति में पेनिसिलिन के प्रति 42% से अधिक प्रतिरोध देखा गया।
- विभिन्न क्षेत्रों में 1000 से अधिक मछुआरों, छात्रों और शोध संस्थानों के साथ AMR पर जागरूकता कार्यक्रम आयोजित किए गए।

बाह्य वित्तपोषित परियोजनाएं (Externally Funded Projects)

- सर्दियों में *पंगेसिओनोडोन हाइपोथलमस* पालन में सतही फंगल संक्रमण (Superficial Mycosis) से प्रचुर हानि होती है। इस क्रम में पिंजरों में सैप्रोलग्नियासिस के कारक एजेंट को *साइप्रोलेनिआ पैरासीटिका* के रूप में पहचान की गई।
- फेरॉक्सीहाईट (FeOOH) नैनोकणों का उपयोग करके As (V) की पहचान हेतु एक विधि विकसित की गई, जिसकी समय सीमा 0.006 mg/L है।
- WAWQI के आधार पर हीराकुंड जलाशय का जल गुणवत्ता स्तर "अच्छा से उत्कृष्ट" पाया गया। Carlson's Trophic State Index (CTSI) के अनुसार जलाशय को mesotrophic के रूप में वर्गीकृत किया गया।
- गंगा नदी के दक्षिणेश्वर और बागबाजार क्षेत्रों से तलछट में एंटीबायोटिक रेजिस्टेंस जीन (ARGs) की पहचान की गई, जिससे जलीय पारिस्थितिकी तंत्र में बहु–औषधि प्रतिरोधी बैक्टीरिया की चिंताजनक उपस्थिति का संकेत मिलता है।
- पूर्व कोलकाता वेटलैंड से कई सूक्ष्मजीवीय मत्स्य रोगजनकों की पहचान की गई। मछलियों की प्रतिरक्षा प्रतिक्रिया और पोषण प्रोफाइलिंग के माध्यम से अपशिष्ट जल के प्रभाव का मूल्यांकन किया गया।
- मैथन जलाशय, झारखंड में पिंजरे में पालित *पंगेसिओनोडोन हाइपोथलमस* में Multidrug - Resistant *Proteus vulgaris* संक्रमण का पहली बार प्रकोप देखा गया।
- तिलपिया पारवोवाईरस (TiPV) के प्रकोप की पहली रिपोर्ट हीराकुंड जलाशय और ईस्ट कोलकाता वेटलैंड के तिलापिया फार्मों से दर्ज की गई।
- पश्चिम बंगाल, असम और त्रिपुरा के 38 एफपीओ के विश्लेषण में पाया गया कि बाजार सुविधा, इनपुट और विस्तार सेवाएं सबसे अधिक सहायक थीं, जबकि बैंक ऋण सुविधा और वित्तीय सहायता सबसे कमजोर थीं।
- गंगा नदी में 30 रैंचिंग कार्यक्रमों के तहत 54.44 लाख अंगुलिकाएँ छोड़ी गयीं, जिससे इंडियन मेजर कार्प और महासीर की संरक्षण और पुनर्स्थापन को बढ़ावा मिला है।
- गंगा नदी के फरक्का बैराज के ऊपरी क्षेत्र में 47,755 वयस्क हिल्सा, 30,000 स्पॉन और 5.6 लाख निषेचित अंडे छोड़े गए। नियंत्रित स्पॉनिंग तकनीकों का उपयोग करते हुए हिल्सा की चार सफल कृत्रिम प्रजनन किया गया।
- मछली मांसपेशी में टेट्रासाइक्लिन एंटीबायोटिक की पहचान के लिए एक विशिष्ट एप्टामर आधारित कलोरीमेट्रिक सेंसिंग तंत्र विकसित किया गया।
- ब्रह्मपुत्र नदी के 11 स्थानों पर जल, तलछट और मछली में माइक्रोप्लास्टिक्स की मात्रा का अनुमान लगाया गया। जल में माइक्रोप्लास्टिक्स की मात्रा 140 से 420 कण प्रति घन मीटर और तलछट में 13.63 से 53.33 कण प्रति किग्रा पाई गई।

पूर्वोत्तर क्षेत्र कार्यक्रम (NEH Programme)

- परभक्षी विदेशी प्रजाति, वर्मीकुलेटेड सेलफिन कैटफिश (*Pterygoplichthys disjunctivus*) को पहली बार दीपोर बील और बराक नदी की सहायक नदी से दर्ज किया गया। *क्लेरियस गैरीपिनस*, एक मांसाहारी

विदेशी कैटफ़िश को मेघालय के उमियम जलाशय में पाया गया, जिसे जैव विविधता के लिए खतरा माना जा रहा है।

- "डोरी" नामक पारंपरिक मछली पकड़ने के जाल को सोन बील, असम के मछुआरों से प्रलेखित किया गया। यह विधि ऊर्जा कुशल और किफायती है।
- बोडोलैंड आंचलिक काउंसिल (BTC), कोकराझार, असम के सरेश्वर बील, सिलाई–नालिया बील, डिपलाई बील और चंपामाटी सिंचाई परियोजना में सतत मत्स्य पालन की संभावनाओं का आकलन किया गया।
- पूर्व जयंतिया पहाड़ी क्षेत्र, मेघालय की गुफा में वास करने वाली मछली विविधता दर्ज की गई। *चानना एरोस्टेनी* और *चानना गछुआ* की उपस्थिति दर्ज की गई।
- ब्रह्मपुत्र नदी, असम से 52 जीनस, 23 परिवार और 9 ऑर्डर की 70 फिनफिश प्रजातियों को दर्ज किया गया।
- मानसून के दौरान ब्रह्मपुत्र के विभिन्न लैंडिंग केंद्रों से मछली पकड़ 6 से 237 किग्रा/दिन और मानसून के बाद 10 से 326 किग्रा/दिन दर्ज की गई। मानसून में कुल अनुमानित मछली पकड़ 72.7 टन और पोस्ट मानसून में 122.1 टन थी।
- कैबडिओ मोरार (ब्रह्मपुत्र की प्रमुख प्रजाति) की जनसंख्या विशेषताओं का आकलन किया गया। Von Bertalanffy वृद्धि पैरामीटरः $L\infty$ = 147.53 mm और $K = 1$ वर्ष$^{-1}$ था।
- सिक्किम की तीस्ता, रंगीत और 8 सहायक नदियों की आवास पारिस्थितिकी का मानसून बाद और सर्दियों में अध्ययन किया गया। चॉकलेट महासीर (*Neolissochilus hexagonolepis*) का योगदान 42.0–78.5% और स्नोट्राउट (*Schizothorax richardsonii*) का योगदान 33.87-90% तक रहा। सर्दियों में तीस्ता नदी के ऊपरी क्षेत्रों में ब्राउन ट्राउट (*Salmo trutta*) की प्रमुखता देखी गई। तीस्ता और रंगीत नदियों की औसत पकड़ प्रति इकाई प्रयास (CPUE) क्रमशः 2–3 किग्रा/मछुआरा/दिन और 3–4 किग्रा/मछुआरा/दिन रही।

पुरस्कार (Awards)

- वर्ष 2024 में संस्थान के अधिकारियों/कर्मचारियों ने कई पुरस्कार और सम्मान प्राप्त किए। 13वें इंडियन फिशरीज एंड एक्वाकल्चर फोरम (13 IFAF) में 13 वैज्ञानिकों को विभिन्न श्रेणियों में जैसे - सर्वश्रेष्ठ मौखिक प्रस्तुति, सर्वश्रेष्ठ पोस्टर प्रस्तुति, सर्वश्रेष्ठ वक्ता, डॉ. जे. के. जेना यंग साइंटिस्ट अवार्ड, तथा बेस्ट यंग साइंटिस्ट अवार्ड से सम्मानित किया गया। इसी प्रकार, संस्थान मुख्यालय में आयोजित 'इनलैंड फिशरीज टुवर्ड्स द एस डी जी कार्यशाला में तीन वैज्ञानिकों को सर्वश्रेष्ठ पोस्टर प्रस्तुति के लिए पुरस्कार प्राप्त हुआ। अन्य मंचों में दो वैज्ञानिकों को सर्वश्रेष्ठ प्रस्तुति हेतु पुरस्कार प्राप्त हुआ।
- डा.. बि. के. दास, निदेशक को एकेडमी फॉर एडवांसमेंट ऑफ एग्रीकल्चरल साइंसेज, कल्याणी, पश्चिम बंगाल की फैलोशिप तथा डा. अर्चना सिन्हा को वर्ष 2024 के लिए BASA फैलोशिप से सम्मानित किया गया। डा. सुलीप कुमार माझी को जूलॉजिकल सोसाइटी ऑफ इंडिया द्वारा प्रो. डी. के. बेलसारे मेडल प्रदान किया गया।
- वैज्ञानिकों को अन्य कई सम्मान जैसे रिव्यूअर एक्सीलेंस अवार्ड 2024, साइंटिस्ट ऑफ द ईयर अवार्ड, एक्सीलेंस इन रिसर्च अवार्ड भी प्राप्त हुए। इसके अतिरिक्त, कीनोट स्पीकर, स्मृति व्याख्यान, लीड लेक्चर तथा नेशनल/इंटरनेशनल सेमिनार/कॉन्फ्रेंस में चेयर/को–चेयर के रूप में आमंत्रित किया गया।

बौद्धिक संपदा (Intellectual Property)

- रिपोर्ट अवधि में दो पेटेंट – "वर्टिकल स्लैब जेल इलेक्ट्रोफोरेसिस" "पोर्टेबल स्प्लिट बीम ट्रांसड्यूसर असेंबली ऑन वॉटर क्राफ्ट फॉर मेज़रिंग एक्जैक्ट ट्रांसड्यूसर पोजीशन बिलो द वॉटर" स्वीकृत हुए और चार ट्रेडमार्क, "सिफ़री फिश तनावहारी", "रेशमीन", "सिफ़री न्यूट्रीफिशइन", "सिफरी–एल्गा एस+" पंजीकृत हुए। संस्थान को 11 कॉपीराइट का पंजीकरण मिला तथा तीन तकनीकों (सिफ़री फिश तनावहारी, सिफ़री पेन एचडीपीई और सिफ़री आर्गकयुर) का पाँच वर्षों के लिए नॉन–एक्सक्लूसिव लाइसेंस पर व्यावसायीकरण हुआ।
- भारतीय कृषि अनुसंधान परिषद द्वारा संस्थान के तीन तकनीकों, "सहभागिता और भुगतान हेतु निर्धारकों की स्वीकृति को मापने की कार्यप्रणाली" (Methodology to quantify the determinants of willingness to participate and willingness to pay), फिश तनावहारी – एक अनोखा हर्बल मछली निश्चेतक और "भारतीय नदियों की पारिस्थितिकीय स्वास्थ्य के आकलन हेतु फिश–आधारित मल्टी–मेट्रिक इंडेक्स ऑफ बायोटिक इंटीग्रिटी" को प्रमाणपत्र प्रदान किए गए।
- वर्ष 2024 में 10 समझौता ज्ञापन (एमओयू) पर हस्ताक्षर किए गए जो 4 केंद्र सरकार के चार विभागों/सार्वजनिक संस्थानों के साथ, 1 राज्य सरकार, 2 गैर–सरकारी संगठनों को तकनीकी मार्गदर्शन के लिए तथा 3 निजी कंपनियों के साथ प्रौद्योगिकी व्यावसायीकरण हेतु किया गया।

एसटीसी और एससीएसपी कार्यक्रम (STC and SCSP Programmes)

- संस्थान ने अनुसूचित जाति उप–योजना (SCSP) और STC (जनजाति उप–योजना) कार्यक्रमों के तहत ग्रामीण

समुदायों, विशेष रूप से महिलाओं को सशक्त बनाने हेतु विविध मत्स्य तकनीकों जैसे,: सजावटी मछली पालन, घर के पीछे स्थित तालाब में मछली पालन, पालन आधारित मात्स्यिकी (CBF), पेन में मछली पालन आदि को बढ़ावा दिया है। इन गतिविधियों को सुंदरबन और पुरुलिया जैसे दुर्गम क्षेत्रों में सहभागी तौर पर लागू किया गया और 3000 से अधिक लोगों को मछली बीज, तकनीकी प्रदर्शन, क्षमता निर्माण, कार्यशाला एवं तकनीकी सहायता के माध्यम से लाभ पहुंचाया गया है।

- सुंदरबन में डॉ. जे. के. जेना, उपमहानिदेशक (मत्स्य विज्ञान) की अध्यक्षता में "महिला मत्स्यजीवी सम्मेलन 2.0" का आयोजन, किया गया, जिसमें करीब 3500 मछुआरों (जिनमें 1500 महिलाएं थीं) ने भाग लिया।
- पश्चिम बंगाल, गुजरात, केरल, कर्नाटक, उत्तर प्रदेश, तमिलनाडु, असम और ओडिशा के सुदूर और संवेदनशील क्षेत्रों में 3700 से अधिक मछुआरों और मत्स्य पालकों को मत्स्य पालन, प्रग्रहण मात्स्यिकी, सजावटी मछली पालन और पेन में मछली पालन हेतु आदान वितरित किए गए।
- जनजाति उप–योजना कार्यक्रम के तहत अन्तर्स्थलीय मात्स्यिकी प्रबंधन पर दो प्रशिक्षण कार्यक्रम आयोजित किए गए। सुंदरबन की महिलाओं के योगदान को सम्मानित करने देने 26 दिसंबर को "महिला मत्स्य किसान दिवस" के रूप में घोषित किया गया है।

मानव संसाधन विकास और अन्य गतिविधियां (HRD and Other Activities)

- संस्थान ने 13वां इंडियन फिशरीज एंड एक्वाकल्चर फोरम : Fostering Growth of Fisheries and Aquaculture for Sustainable Development का कोलकाता में सफल आयोजन किया। अन्य कार्यक्रमों में "फिश प्रोटीओमिक्स पर कार्यशाला", "पिंजरों में मछली पालन एवं मत्स्य फार्म में बेहतर स्वास्थ्य प्रबंधन पद्धतियाँ", "सिक्किम की प्रमुख नदियों में मत्स्य विविधता एवं अनुमानित मछली पकड़" पर संवादात्मक बैठक प्रमुख हैं।
- संस्थान में 30 क्षमता विकास कार्यक्रमों के माध्यम से 847 मछुआरों/मत्स्य पालकों को लाभ मिला है तथा 20 प्रशिक्षण कार्यक्रमों में 100 अधिकारी एवं 337 छात्र प्रशिक्षित हुए। राष्ट्रीय स्वच्छ गंगा मिशन (NMCG) के तहत डॉल्फिन, हिल्सा एवं मत्स्य जैव विविधता संरक्षण पर 144 जागरूकता कार्यक्रम आयोजित किए गए, जिससे 7,916 मछुआरों एवं स्थानीय समुदायों को जागरूक किया गया।
- संस्थान ने 127 शोध पत्र प्रकाशित किए (कुल NAAS रेटिंगः 1142) हैं। इसके अलावा 19 पुस्तकें, 48 बुक चैप्टर, 11 तकनीकी बुलेटिन एवं प्रशिक्षण पुस्तिका और 11 लोकप्रिय लेख प्रकाशित किए गए हैं।

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

Mandate

- Basic and strategic research for sustainable management of inland open water resources
- Develop protocols for productivity enhancement in reservoirs and wetlands and aquatic ecosystems health management
- Act as repository of information on inland open water fisheries resources
- Human resource development through training, education and extension

वार्षिक प्रतिवेदन

Annual Report

2024

Introduction

History

Established as Central Inland Fisheries Research Station at Calcutta under the Ministry of Food and Agriculture, Government of India on 17 March 1947 following the recommendation of the sub-committee of Central Government on Agriculture, Forestry and Fisheries, the institute reaches the land mark of 78 years of its existence. The Station was promoted to Central Inland Fisheries Research Institute in 1959 shifting its location to Barrackpore, West Bengal. The Institute was brought under the umbrella of Indian Council of Agricultural Research (ICAR), New Delhi in 1967. During the last seven and half decades, the Institute has established itself as a pioneer research institute in the field of inland fisheries research in India and abroad. The major responsibilities of the Institute were to assess inland fishery resources, develop strategies to optimize fish production in sustainable manner and human resource development in the field of inland fisheries.

The blue revolution in the country has been possible largely due to ICAR-CIFRI's contribution. The founders of this great institution had a vision of service to the mankind through quality research for food and nutritional security. Subsequently many stalwarts led this institute and with the help of quality staff, this institute becomes a doyen in the field of fisheries in the world. This institution not only did world class research but also produces highly competent and qualified scientists.

The Government of India put much emphasis on aquaculture research and development during the late sixties and seventies. 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 Brackishwater Fish Farming during 1971-1973. The Institute, besides several other technologies, developed induced breeding and composite fish culture technologies that ushered blue revolution in the country and laid down a solid foundation for development of freshwater aquaculture.

During the late 1980s, the institute's focus has been shifted to research on inland open water fisheries of rivers, reservoirs, floodplain wetlands, estuaries, lagoons and backwaters since late. This resulted in development of fisheries management/development protocols for large, medium and small reservoir and for wetlands, progressive production enhancement from these large resources. IoT, drone application, application of remote sensing and GIS, riverine catch estimation, exploring the unconventional resources, automation of cages are some of the areas added tom the research arena of the institute. A vast amount of information was generated on ecology and fisheries status of nearly all the major river systems, reservoirs, wetlands and lagoons with technologies, protocols and policy recommendations for fisheries management and development in inland open water resources of the country. In recent past, to address the national need, focus of the Institute has been inclined towards natural resource management, sustainable production enhancement and ecosystem health with revision in mandate and for the fulfillment of these objectives, the institute has prioritized adaptation of the latest available technologies and also development of new technologies.

Organizational Structure

The Institute is ISO 9001: 2015 certified. To address the mandate throughout the country, the institute established Regional Research Centers at Prayagraj, Guwahati, Bengaluru, and Vadodara and Research station at Kochi. The Headquarters of the Institute is located at Barrackpore, West Bengal. The research activities are now taken up through five Research Divisions, *viz*.,

- Riverine and Estuarine Fisheries Division
- Reservoir and Wetland Fisheries Division
- Open Water Aquaculture Production and Management Division
- Fisheries Resources Assessment and Informatics Division
- Aquatic Environmental Biotechnology Division

Besides these, Socio-economic research, Extension and Training activities are carried out through the 'Economics and Policy Unit' and 'Extension and Training Cell', respectively. The research activities of each division are led by Head of Division appointed by ICAR. The Regional Research Centers at Prayagraj, Guwahati and Bengaluru are administered by Heads of Regional Centers appointed by ICAR, other research centres and stations are administered by Officers-in-Charges. The Institute has sanctioned cadre strength of 88 Scientists, 86 Technical Officers, 66 Administrative and 65 Supporting personnel.

The head-quarters of the Institute has a number of support services, *viz.* Administration Section, Audit and Accounts Section, PME Cell, Hindi Cell, AKM Unit, Library and Informatics Section, Institute Technology Management Unit, Stores Section, Vehicle Section, and Nodal Officers for MGMG programme, STC programme, SCSP programme, ICAR Regional Committee meetings, and HRD executing different functions of the Institute.

The overall research, administrative and financial management was the responsibility of the Director. He carried out his duties as per the guidelines and recommendations of the Institute Management Committee, Institute Research Committee, Research Advisory Committee and Quinquennial Review Team.



Prayagraj RRC



Barrackpore HQ



Vadodara RRC



Bengaluru RRC

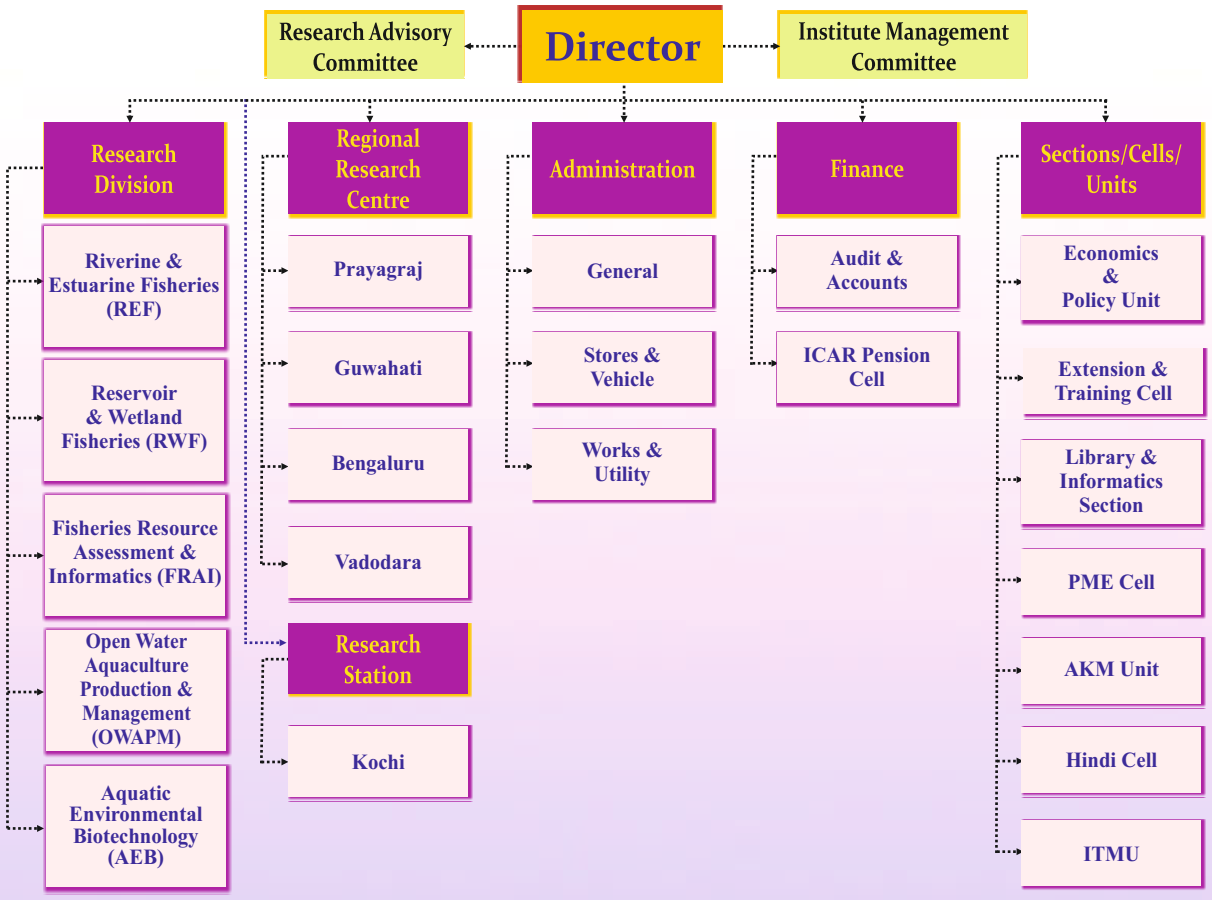


Guwahati RRC



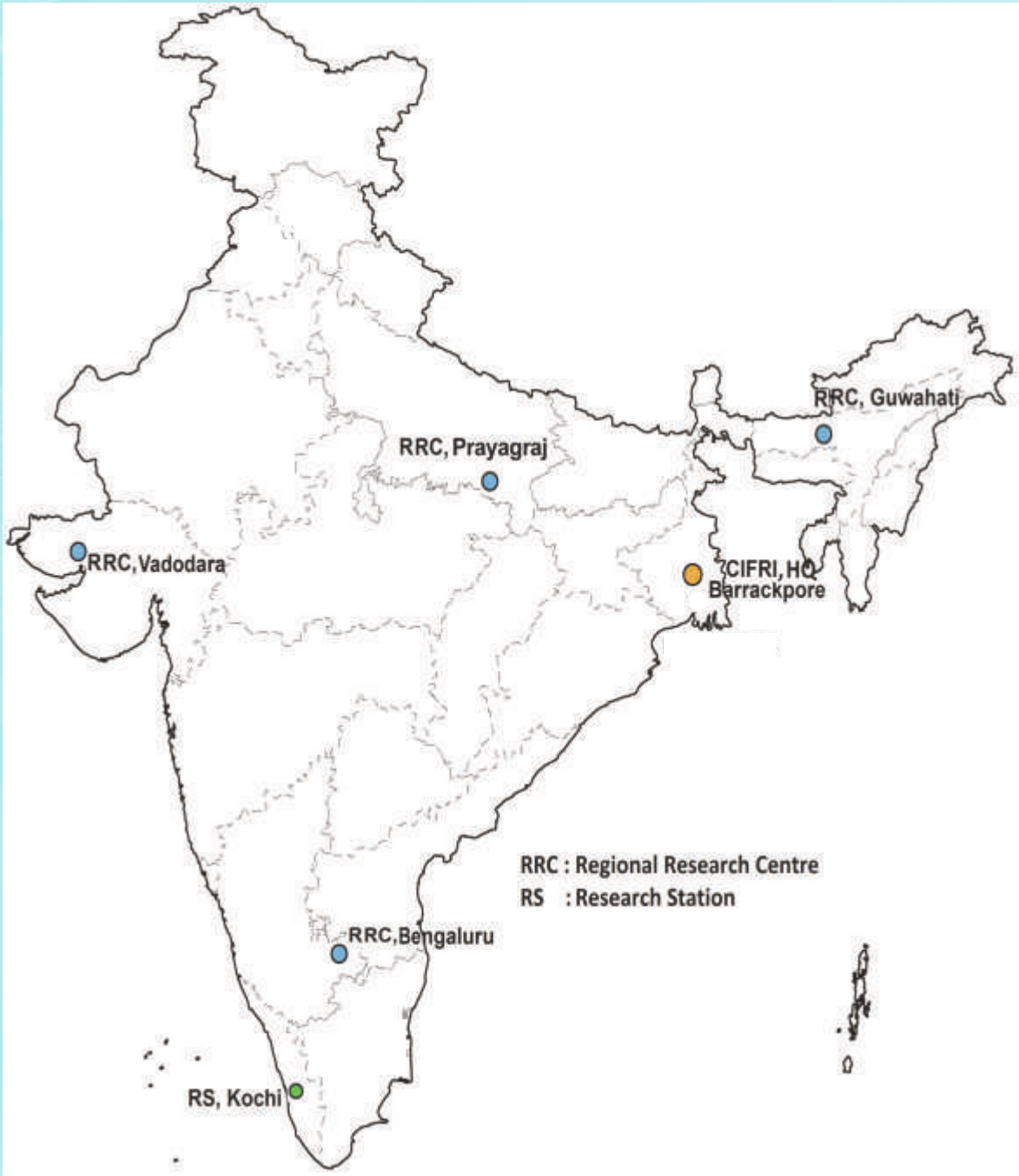
Kochi RS

Organogram of ICAR-CIFRI





Location of ICAR-CIFRI Headquarter, Regional Research Centres and Research Station



Budget Details

Budget Details for the Year 2024-25 (upto 31.12.2024) (₹ in Lakh)

Head of Accounts	Budget (RE)	Expenditure
Pay and Allowance including OTA*	13008.03	10854.00
TA	42.07	35.28
Other charge including Equipment, Library Books, IT and HRD	1473.17	1114.02
Works	175.76	6.45
Grand Total	**14699.03**	**12009.75**
*includes Pension also		

Budget & Expenditure under The Institute for the Financial Year 2024-25 (upto 31.12.2024) (₹ in Lakh)

Budget Head	Budget	Expenditure
Revenue		
Estt. Charges	3359.08	2776.61
OTA	0.00	0.00
TA	42.07	35.28
Other charges	632.76	572.44
Office Building	3.87	3.87
Residential Building	1.87	1.38
Minor Works	5.70	3.26
Misc. Expenses including HRD	2.75	1.74
TSP General	70.00	50.15
NEH General	205.00	86.48
Capital		
Equipment	205.58	133.10
Information Technology	57.08	47.69
Library Books	2.44	1.72
Vessels / Vehicles	0.00	0.00
Furniture & Fixture	26.12	26.12
Works	160.50	0.00
Minor Works	15.26	6.45
TSP Capital	30.00	19.53
NEH Capital	75.00	63.10
SCSP Capital	30.00	15.41
SCSP General	125.00	88.04
Total	**5050.08**	**3932.37**
Pension	9648.95	8077.38
Total	**14699.03**	**12009.75**
Loans & Advances	**0.00**	**0.00**

Projects 2024-25 (upto 31.12.2024) (₹ in Lakh)

Budget Head	Budget			
	Receipts		Expenditure	Refund
Ornamental Fish	42.00	32.20	7.41	0.00
CABIN	19.00	15.00	11.70	0.00
AMR	17.72	12.94	6.65	0.00
NASF Nano Biosensor	29.70	29.67	23.72	0.00
NASF Labour migration	1.67	0.84	0.00	0.00
Fish Health	15.52	9.52	8.44	0.00
ITMU	3.73	3.73	3.19	0.00
NePPA	50.00	20.05	10.07	0.00
Deposit Schemes (Externally funded)	1125.57	1125.57	402.07	0.00
Consultancies	105.04	105.04	47.60	0.00

Revenue Receipts 2024-25 (upto 31.12.2024) (₹ in Lakh)

Head	ICAR	Institute	Target	Achievement
Income from Sales / Services	68.59		50.00	68.59
Fee / Subscription	0.00			
Income from Royalty, Publication etc.	0.00			
Other income	18.62	48.74		
STD Interest	0.00			
Sale of Assets	0.00			
Recoveries on Loans and Advances	31.99			
CPWD / Grants Refund	0.00			
Total	**119.20**	**48.74**	**50.00**	**68.59**



A. Institute Funded Projects Completed in March 2024

Sr. No.	Project Code	Project Title	P. I.	CoPIs
1.	REF/20-23/11	Temporal assessment of estuarine fisheries resources for sustainable management (Hooghly-Matla, Rushikulya, Mandovi-Zuari, Netravathi-Gurupur and Vembanad Lake)	S. Samanta	
1.1	*Sub-project 1*: REF/20-23/11/01	Temporal assessment of Hooghly-Matla estuarine fisheries resources for sustainable management	D. Bhakta	S. Samanta, R. K. Manna, Sangeetha M. Nair, Arun Pandit (w.e.f. 01.04.22), Chayna Jana (w.e.f. 01.04.22), Prajna R. Behera (w.e.f. 01.04.23 to 11.12.2023), Rosith C. M. (w.e.f. 04.08.23)
1.2	*Sub-project 2*: REF/20-23/11/02	Assessment of ecohydrological dynamics in relation to fish fauna and their recruitment towards development of sustainable management strategies in Rushikulya Estuary	S. K. Das	Roshith C. M. (study leave 07.04.22-09.11.22), P. Gogoi (w.e.f. 01.04.22), Chayna Jana (w.e.f. 01.04.22)
1.3	*Sub-project 5*: REF/20-23/11/05	Temporal assessment of Vembanad estuarine fisheries resources for sustainable management	T. T. Paul	Deepa Sudheesan
2.	REF/20-23/12	Assessment of ecological impacts of dams and barrages in selected rivers with special references to fisheries	A. K. Sahoo	S. K. Das, Sangeetha M. Nair (w.e.f. 01.04.2021)
3.	REF/20-23/15	Eco-variability and impact study of River Yamuna on River Ganga with special emphasis on fisheries	D. N. Jha	A. Alam, J. Kumar, V. R. Thakur, Vikas Kumar (w.e.f. 01.04.23)
4.	RWF/20-23/10	Understanding spatio-temporal variations of reservoir ecosystem and developing improved fisheries management strategies for different eco-regions: A new perspective	A. K. Das	
4.1	*Sub-project 1*: RWF/20-23/10/01	Understanding spatio-temporal variations of large reservoir ecosystems (Hirakud, Panam & Idukki) anddeveloping improved fisheries management strategies	A. K. Das	Deepa Sudheesan, T. T. Paul, Satish Koushlesh Sajina A.M. (w.e.f. 01.04.23)
5.	RWF/20-23/11	Eco-orientation approach for fisheries enhancement of floodplain wetlands in diverse eco-regions of India	A. K. Das	
5.1	*Sub-project 1*: RWF/20-23/11/01	Eco-orientation approach for fisheries enhancement of floodplain wetlands in NE States of India	S. K. Majhi / D. Debnath (upto 28.04.24)	Simanku Borah, S. Yengkokpam (up to 15.03.24), S.C.S. Das, Pranob Das, A. K. Yadav, B. K. Bhattacharjya, Niti Sharma (w.e.f. 01.04.2021)
5.2	*Sub-project 2*: RWF/20-23/11/02	Eco-orientation approach for fisheries enhancement of floodplain wetlands in West Bengal	A. K. Das	Asit K Bera, Md. Aftabuddin, Lianthuamluaia, P. J. Majhi (w.e.f. 01.04.22)
5.3	*Sub-project 3*: RWF/20-23/11/03	Eco-orientation approach for fisheries enhancement in floodplain wetlands in Bihar	A. Sinha	Ganesh Chandra, P. R. Behera (01.04.22 to 11.12.2023)
6.	RWF/21-24/12	Sustainable production enhancement and livelihood improvement through technological intervention (pen culture) in selected reservoirs and wetlands of India	M. A. Hassan	S. K. Manna, D. K. Meena, Raju Baitha, Rahul Das, SuhasKamble
7.	FREM/20-23/17	Evaluation and management of environmental health through omics technologies	Vikash Kumar	

Contd.....

Sr. No.	Project Code	Project Title	P. I.	CoPIs
7.1	*Sub-project 1*: FREM/20-23/17/01	Metagenomic profiling of floodplain wetlands for ecosystem health monitoring	Vikash Kumar	Tanushree Bera (upto 28.12.23), Niti Sharma (w.e.f. 01.04.21), Suvra Roy (w.e.f. 01.04.22)
7.2	*Sub-project 3*: FREM/20-23/17/03	Stock characterization of two bagrid species (*Mystus cavasius* and *M. gulio*) for fisheries management	S. Roy	D. Bhakta, V. L. Ramya, Suvra Roy (w.e.f. 01.04.22)
8.	FREM/20-23/18	Fisheries resource assessment and prediction in inland open water under AI and Big Data platform	M. Naskar	B. K. Das, S. K. Sahu, Chayna Jana, T. N. Chanu, Arun Pandit, A. K. Das, D. Das
9.	FREM/21-24/19	Development of ammonium and phosphate remediation techniques using nanostructured materials for refurbishment of polluted wetlands	D. J. Sarkar	Santhana Kumar V., Tanushree Bera (upto 28.12.23), Suvra Roy
10.	FSE/23-24/05	Socio-economic profile of inland fisheries: A rapid assessment	Arun Pandit	A. Roy, Ganesh Chandra, Anjana Ekka and P. Debroy
11.	FSE/23-24/06	Investigating the feasibility of the Food-Energy-Water nexus in the Cauvery River Basin	Anjana Ekka	Arun Pandit and D. Bhakta
12.	NEH/20-23/03	Refinement of management strategies for open-water fisheries of Northeastern Region through location and ecosystem-based approaches	B. K. Bhattacharjya	
12.1	*Sub-project 1*: NEH/20-23/03/01	Sustainable utilization of openwater fisheries in Assam and Nagaland through community participation.	S. Borah	Pronob Das, Anil Kumar Yadav, Shyamal Chandra Sukla Das, Raju Baitha, Aparna Roy (w.e.f. 01.04.22)
12.2	*Sub-project 2*: NEH/20-23/03/02	Enclosure culture in openwaters of Manipur incorporating locally important fish species for stock replenishment and table fish production	S. Yengkokpam	Dipesh Debnath (upto 28.02.24), N. Nirupada Chanu, Niti Sharma (w.e.f. 01.04.2021)
12.3	*Sub-project 3*: NEH/20-23/03/03	Refinement of cage culture and species enhancement in Dumbur reservoir of Tripura	S.C.S. Das	Dipesh Debnath (upto 28.02.24), Anil Kumar Yadav, M Shaya Devi (on leave 10.10.22-26.07.23), P. Deb Roy (w.e.f. 01.04.22)
12.4	*Sub-project 4*: NEH/20-23/03/04	Refinement of cage aquaculture technology in reservoirs of Mizoram	D. Debnath	Shyamal Chandra Sukla Das, Lianthuamluaia
12.5	*Sub-project 5*: NEH/20-23/03/05	Sustainable utilization of reservoir fisheries of Meghalaya through community participation	P. Das	Sona Yengkokpam (upto15.03.24), Simanku Borah, and D. K. Meena
12.6	*Sub-project 6*: NEH/20-23/03/06	Refinement of enclosure culture technologies for stock enhancement and table fish production in openwaters of Arunachal Pradesh	A. K. Yadav	Sona Yengkokpam (upto15.03.24), Simanku Borah, Tasso Tayyung (upto 05.10.21)

B. Institute Funded Projects Operated during 01.04.2024 - 31.03.2025

Sr. No.	Project Code and Title	P. I.	CoPIs	Duration
	REF Division Projects			
1.	**REF/24-26/17:** Estimation of fish catch, diversity, and socio-economics of fishers of selected rivers towards fisheries and livelihood sustainability (Narmada, Cauvery, Sutlej, Gomoti and Pamba)	S. K. Manna		2024-2026
1.1	*Sub-project 1:* **REF/24-26/17/1:** Estimation of fish catch, diversity and socio-economics of fishers of Narmada River towards fisheries and livelihood sustainability	S. K. Manna	D. Bhakta, P. Gogoi, M. Ramteke, C. Johnson, P. Debroy, S. P. Kamble	2024-2026
1.2	*Sub-project 2:* **REF/24-26/17/2:** Estimation of fish catch, diversity and socio-economics of fishers of Cauvery River towards fisheries and livelihood sustainability, livelihood sustainability	C. M. Roshith	S. K. Das, S. M. Nair, A. Ekka, V. L. Ramya, Sibina Mol S.	2024-2026
1.3	*Sub-project 3:* **REF/24-26/17/3**: Estimation of fish catch, diversity, ecological variability and socio-economics of fishers of Sutlej River towards fisheries and livelihood sustainability	A. Alam	D.N. Jha, V. R. Thakur, J. Kumar, V. Kumar, Arun Pandit	2024-2026
1.4	*Sub-project 4:* **REF/24-26/17/4**: Estimation of fish catch, diversity, ecological variability and socio-economics of fishers of Gomoti River towards fisheries and livelihood sustainability	D. N. Jha	A. Alam, V. R. Thakur, J. Kumar, V. Kumar, Arun Pandit	2024-2026
1.5	*Sub-project 5:* **REF/24-26/17/5:** Estimation of fish catch, diversity, ecological variability and socio-economics of fishers of Pamba River towards fisheries and livelihood sustainability	D. Sudheesan	T. T. Paul, T. Abdulla, Ganesh Chandra	2024-2026
2.	**REF/24-27/18:**Assessing changes in estuarine fisheries resources for sustainable management (Pulicat Lake, Kayamkulam estuary, and Mahi estuary)	D. Bhakta		2024-2027
2.1	*Sub-project 1:* **REF/24-27/18/1:** Assessing changes in fisheries resources for sustainable management of Pulicat Lake	D. Bhakta	S. K. Manna, S. K. Das, A. K. Sahoo, Sangeetha M. Nair, Aparna Roy, C. Johnson	2024-2027
2.2	*Sub-project 2:* **REF/24-27/18/2:** Assessing changes in fisheries resources for sustainable management of Kayamkulam estuary	P. Panikkar	Jesna P. K., Sonalika Sahoo, Deepa Sudheeshan, T. T. Paul, Tanuja Abdulla, Ganesh Chandra	2024-2027
2.3	*Sub-project 3:* **REF/24-27/18/3:** Assessing changes in fisheries resources for sustainable management of Mahi estuary	S. P. Kamble	Roshith C. M.	2024-2027
3.	**REF/24-27/19:** Evaluation of ecosystem health, fish catch structure, mangrove landscape patterns aiming to Sustainable Development Goals (SDGs) with changing climate scenario in Indian Sundarbans	A. Saha	B. K. Das, Roshith C. M., Pranab Gogoi, Sangeetha M. Nair, Sonalika Sahoo	2024-2027
	OWAPM Division Projects			
4.	**RWF/22-25/13:** Development of environmentally sustainable feed for enclosure culture	D. K. Meena	A. U. Muzaddadi, Rahul Das	2022-2025

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Sr. No.	Project Code and Title	P. I.	CoPIs	Duration
5.	**RWF/23-26/14:**Next generation inland open water cage culture in India with special reference to system and species diversification	B. K. Das	M. A. Hassan, Gunjan Karnatak, Mishal P., Suman Kumari, Raju Baitha, Mitesh Ramteke, D. K. Meena, Rahul Das, Venkatesh Thakur, Suhas P. Kamble, Sona Yengkokpam, Dipesh Debnath (upto 28.02.24), P. Das, A.U. Muzaddadi (since 01.04.24)	2023-2026
6.	**OWAPM/24-27/01:**Investigation of ectoparasitism and their effects on fish populations of Eastern Indian reservoirs	R. Baitha	B. K. Das, A. K. Das, Arman U Mozaddadi, Rahul Das	2024-2027
	RWF Division Projects			
7.	**RWF/23-26/15:**Exploration of ecosystem dynamics and fisheries of Kanva (Karnataka), Sathanur (Tamil Nadu) and Banasurasagar (Kerala) reservoirs for sustainability and conservation	P. Panikkar	Ramya V. L., Jesna P. K., Sonalika Sahoo, Sibina Mol S. (from 01.04. 2024)	2023-2026
8.	**RWF/24-27/16:**Development of natural farming protocol for culture-based fisheries in wetland	R. K. Manna	H. Chowdhury, Md. Aftabuddin, Lianthuamluaia, Suman Kumari, P. Majhi	2024-2027
9.	**RWF/24-27/17:**Fostering reservoir fisheries for blue growth and achieving SDGs amid climate change and anthropocene	Sajina A. M.	A. K. Das, R. K. Manna, Suman Kumari, Lianthuamluaia, Satish K. Koushlesh, Pritijyoti Majhi, Chayna Jana, T. T. Paul, D Sudheesan and T. Abdulla	2024-2027
10.	**RWF/24-27/18:**Exploration and feasibility study of pits and quarries for fish production	Suman Kumari	A. K. Das, R. K. Manna, Sajina A.M., S. Kaushlesh, and Pritijyoti Majhi	2024-2027
	FRAI Division Projects			
11.	**FRAI/24-27/01:** Harnessing data science for optimizing spatial assessment of riverine and wetland fisheries resources	M. Naskar	S. K. Sahu, Chayna Jana and Soma Das Sarkar	2024-2027
12.	**FRAI/24-27/02:**Assessment of Greenhouse Gas Emission and carbon sequestration potential of selected wetlands for developing mitigation strategies to reduce the adverse impacts of climate change	B. K. Das	S. Samanata, S. K. Nag, Vikas Kumar, N. Chanu	2024-2027
13.	**FRAI/24-27/03:** Assessment of petroleum hydrocarbon, PFAS and phenolic micropollutants in surface water and their effect on ecosystem health	S. K. Nag	Soma Das Sarkar, Ajoy Saha, Md. Aftabuddin	2024-2027
14.	**FRAI/24-27/04:** Assessing the resilience of native fish communities in different hydroclimatic zones	V. L. Ramya	Jesna P. K., Sibina Mol, Sonalika Sahoo, Niti Sharma, Absar Alam	2024-2027

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Sr. No.	Project Code and Title	P. I.	CoPIs	Duration
	AEB Division Projects			
15.	**FREM/23-26/20:** Aquatic environment health assessment and novel formulations development for fish health management	B. K. Das	Asit K. Bera, H. Chowdhuri, D. J. Sarkar, P. Maurye, Soma Das Sarkar, Santhana Kumar, Kavita Kumari, Vikash Kumar, Suvra Roy, M. Shaya Devi	2023-2026
16.	**AEB/24-27/01:**Biotechnological interventions for aquatic environment and fisheries management of wetlands	A. Sinha	Dhruba Jyoti Sarkar, Praveen Maurye, Kavita Kumari, Vikash Kumar, Suvra Roy, M. Shaya Devi and Santhana Kumar V.	2024-2027
	Social Science Projects			
17.	**FSE/20-23/04:** Sustainable inland fisheries development pathways to ensure Sustainable Development Goals (SDGs)	B. K. Das	A. Roy, P. Debroy, Lianthuamluaia, Mitesh Ramteke, Satish Koushlesh, T. Nirupada Chanu, M. A. Hassan (upto 31.12.23), Arun Pandit, S. P. Kamble, A. K. Das, Ganesh Chandra, Raju Baitha (w.e.f. 01.04.22), Prajna R. Behera (01.12.2021 to 11.12.2023), Suman Kumari (w.e.f. 01.04.22), Anjana Ekka (w.e.f. 01.10.2022), Gunjan Karnatak (w.e.f. 01.04.2023)	2020-2025
	NEH Projects			
18.	**NEH/24-27/04:** Sustainable management of inland open water fisheries of Northeastern India	S. K. Majhi	B. K. Bhattacharjya, P. Das, S.C.S. Das, S. Borah, A. K. Yadav, Niti Sharma, Rakesh Kumar	2024-2027
19.	**NEH/24-27/05:** Assessing fisheries and habitat characteristics of River Brahmaputra and rivers of Sikkim in response to natural and anthropogenic changes	B. K. Bhattacharjya		2024-2027
19.1	*Sub project 1*: Revitalizing River Brahmaputra for assessing fisheries and habitat characteristics in response to natural and anthropogenic changes	B. K. Bhattacharjya	S. K. Manna, S. K. Majhi, A. K. Yadav, S.C.S. Das, S. Borah, P. Gogoi, Rakesh Kumar	2024-2027
19.2	*Sub-project 2*: Assessment of fish diversity, distribution and fish catch structure in rivers of Sikkim	Niti Sharma	S. K. Majhi, A. K. Sahoo, S.C.S. Das, D. Bhakta	2024-2027
	Network Projects			
20.	Breeding of indigenous fish species of ornamental value from West Bengal and Assam	Suman Kumari	Sona Yengkokpam (upto 15.03.24), A Sinha, Niti Sharma (w.e.f. 01.09.2021)	Continuing
21.	Anti-microbial resistance in fisheries and aquaculture	A. K. Sahoo	A. K. Bera	Continuing

Externally Funded Research Projects

Sr. No.	Project Title	Funded by	P. I.	CoPIs	Duration
1.	All India network project on fish health	ICAR-CIBA	S. K. Manna (CCPI)	S. K. Nag, A. K. Bera, R. Baitha, P. Panikkar	2015-2026
2.	Development of biosensors for detection of fish pathogenic bacteria and hazardous metalloids in selected water bodies	NASF, ICAR	D. J. Sarkar	B. K. Das	2020-2024
3.	Captive breeding of Hilsa, *Tenualosa ilisha*: Phase II	NASF, ICAR	S. Samanta (Consortium P.I.)	S. Samanta R. K. Manna, A. K. Sahoo, Suvra Roy	2021-2024
4.	IoT based precision enclosure culture and fisheries management in inland open waters	NePPA	B. K. Das	S. Samanta, D. K. Meena, Chayna Jana, A. U. Muzaddadi	2021-2026
5.	Environmental and aquaculture animal health monitoring in Hirakund Reservoir under cage culture programme	DOF, Govt. of Odisha	B. K. Das	S. K. Koushlesh, C. Johnson	2021-2026
6.	Microbiome meta transcriptomics assessment of Indian river basins for ecosystem health monitoring	CABin, ICAR, New Delhi	B. K. Das	D. J. Sarkar, Suvra Roy, Vikash Kumar	2021-2025
7.	National Surveillance Programme for Aquatic Animal Diseases: Phase II	Pradhan Mantri Matsya Sampada Yojana (PMMSY)	B. K. Das	Vikash Kumar	2022-2025
8.	Addressing skill gap in the FPO ecosystem in eastern and north eastern parts of India - project led by WBUAFS, Kolkata	ICSSR	Arun Pandit (Project Co-Director)	Nil from ICAR-CIFRI	2022-2024
9.	Imparting state of art knowledge on fish breeding to the local fishermen for livelihood improvement and enhancing the native fish population through ranching programme in river Ganga	NTPC, Farakka	B. K. Das	A. K. Sahoo, D. K. Meena	2022-2025
10.	Production systems, agribusiness and institutions - Component I: Impact of agricultural technology' - network project led by ICAR-NIAP	ICAR, NIAP	Arun Pandit	Anjana Ekka	2022-2025
11.	Cage culture in Kangsabati reservoir	DOF, West Bengal	B. K. Das	M. A. Hassan, D. K. Meena, Rahul Das, Gunjan Karnatak	2023-2024
12.	The changing dynamics of labour migration on employment, livelihoods and resource productivity patterns in Indian marine fisheries sector- project led by ICAR-CMFRI	NASF, ICAR	A. Roy (CCPI)	Nil from ICAR-CIFRI	2023-2026
13.	Improving livelihood of tribal communities through Scampi fisheries enhancement technologies in under-utilized reservoir resources of Jharkhand	Govt. of Jharkhand	A. K. Das (PI), B. K. Das (Coordinator)	Mishal P., Raju Baitha	2023-2026
14.	Identification and comparative expression analysis of novel immune related genes against prevalent bacterial infection and development of remedial measures in Asian Seabass, *Lates calcarifer*	DBT	A. K. Sahoo	D. K. Meena	2023-2026

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Externally Funded Research Projects

Sr. No.	Project Title	Funded by	P. I.	CoPIs	Duration
15.	Fish conservation and stock enhancement of fishery of Ganga river basin (Phase-III) under NamamiGange Mission	NMCG	B. K. Das	A. K. Sahoo, Raju Baitha, Dibakar Bhakta, D. K. Meena, Ajoy Saha, Mitesh H. Ramteke, Arun Pandit, Aparna Roy, Canciyal Johnson, Gunjan Karnatak, Suman Kumari, Lianthuamluaia, Santhana Kumar V., T. N. Chanu, D. N. Jha, Md. Absar Alam, Vikas Kumar, V. R. Thakur	2023-2026
16.	(A) Assessment of production of fish, fish disease and feasibility study of certification for fish produced in East Kolkata Wetland *Sub-project 1*: Multiple value assessment (B) Assessment of agriculture (paddy), horticulture, medicinal plants, floriculture and uses *Sub-project 2*: Culture of indigenous fish species *Sub-project 3*: Assessment of invasive fish species with special emphasis on *Pterygoplichthys* spp. for control/eradication in East Kolkata Wetland	East Kolkata Wetland Management Authority	B. K. Das	S. Samanta, A.K. Das, G. Karnatak, L. Lianthuamluaia, V. Kumar, P. Mishal	2024-2027
17.	Point of care nanobiosensors for antibiotic residue detection in fish	NASF, ICAR	D. J. Sarkar	Santhana Kumar V. (upto 11.03.2025)	2024-2027
18.	Benchmarking microplastic pollution in the river Ganga and Brahmputra in relation to native edible fish fauna	DBT	B. K. Das	Dhruba Jyoti Sarkar, Soma Das Sarkar, Ajoy Saha, Rakesh Kumar, Santhana Kumar V. (upto 11.03.2025)	2024-2026
19.	Nutraceutical solutions for sustainable aquaculture : Extraction and utilization on tasar pupae oil and meal in feed formulation	Central Silk Board	B. K. Das	D. K. Meena, Rahul Das	2024-2026
20.	ICAR-WorldFish collaborative research project (Window -3): Small scale fisheries in wetlands for livelihood and nutritional security	ICAR-World Fish	B. K. Das	B. K. Bhattacharjya, A. K. Das, Arun Pandit, B. K. Behera, A. K. Sahoo, A. Roy, P. K. Parida, G. Karnatak, S. Borah, Pronob Das	2024-2029
21.	National Agricultural Innovation Fund (NAIF) Component-1 ITMU	ICAR	G. Chandra	ITMC Chairman – B. K. Das	2013 - continuing

Consultancy Projects

Sr. No.	Project Title	Funded by	P. I.	CoPIs	Duration
1.	Planning and design of fish hatchery at Bichom dam site along with studies on reproductive biology of snow trout, *Schizothorax richardsonii* for conservation and artificial propagation in river Bichom, Arunachal Pradesh, funded by NEEPCO, Ministry of Power, Govt. of India	NEEPCO	B. K. Das	B. K. Bhattacharjya, A. K. Sahoo, D. K. Meena, Simanku Borah	2022-2024
2.	Assessment of fisheries and ecology in Kameng basin of Arunachal Pradesh in relation to proposed hydropower projects at Gongri and Dinchang (Phase I & II)	Scatec ASA, Norway	B. K. Das	Mishal P., Simanku Bora	2023-2024
3.	Watershed development plan for micro-watershed within 10 km radius of the 1440 MW Malshejghat Bhorande Pumped storage project in Thane District (Maharashtra) funded by Adani Green Energy Limited	Adani Green Energy Limited, Ahmedabad	D. K. Meena (PI); B. K. Das (Coordinator)	Arun Pandit, S. P. Kamble, M.S. Behera (Consultant)	2023-2024
4.	Watershed development plan for micro-watershed within 10 km radius of the 1200 MW Warsgaon Warangi Pumped storage project village Teckpole and Warangi, Tehsil Velhe and Mahad, District Pune & Raigad (Maharashtra) funded by Adani Green Energy Limited	Adani Green Energy Limited, Ahmedabad	D. K. Meena (PI); B. K. Das (Coordinator)	Arun Pandit, S. P. Kamble	2023-2024
5.	Study on impact of water intake due to Gadarwara STPP on ecology of Narmada River funded by National Thermal Power Corporation Limited	NTPC Farakka	B. K. Das	S. Samanta, S. K. Das, A. K. Sahoo, S. P. Kamble, Vaisakh G.	2023-2025



Circular floating pen in operation at Masaria reservoir, Gumla, Jharkhand

Project Code: REF/20-23/11

Project Title: Temporal Assessment of Estuarine Fisheries Resources for Sustainable Management (Hooghly-Matla, Rushikulya, Mandovi-Zuari, Netravathi-Gurupur and Vembanad Lake)

Sub-project 1: Temporal Assessment of Hooghly-Matla Estuarine Fisheries Resources for Sustainable Management

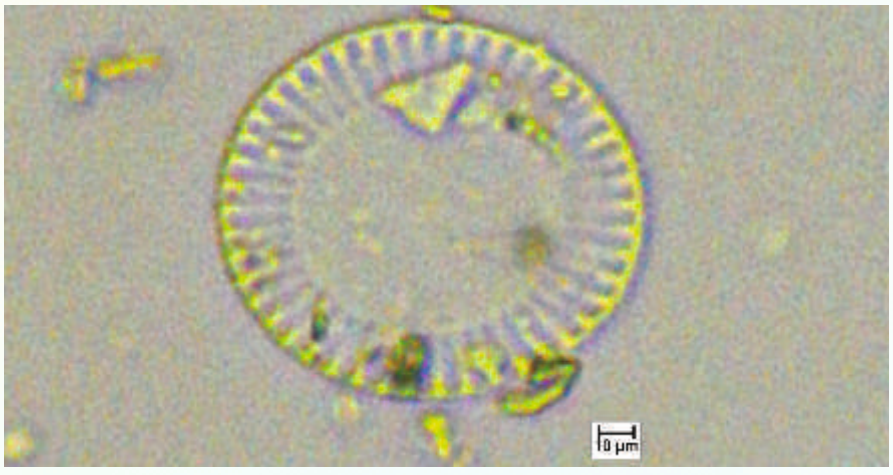
Duration: 01.04.2020 – 31.03.2024

Plankton Assemblage Pattern

The geographical and temporal fluctuations of phytoplankton communities and their responses to fluctuating salt levels were examined in the Hooghly Matlah estuary. A thorough examination carried out at ten sampling points revealed 132 phytoplankton species belonging to 95 genera. The study revealed 12 principal algae groupings, with highest prevalence of the class Bacillariophyceae having 43 species. Analysis of indicator species indicated that the tidal freshwater zone was primarily characterised by *Aulacoseira granulata*, *Scenedesmus quadricauda*, *Eudorina* sp., and *Protococcus* sp., whereas the intermediate zone exhibited a greater prevalence of *Pleurosigma* sp., *Synedra* sp.; *Coscinodiscus* sp. *Cyclotella* sp. and *Closterium* sp. predominated in the middle and lower estuaries of the upper Sundarbans, whilst *Entomoneis* sp. and *Chaetoceros* sp. were more prevalent in the lower Sundarbans.



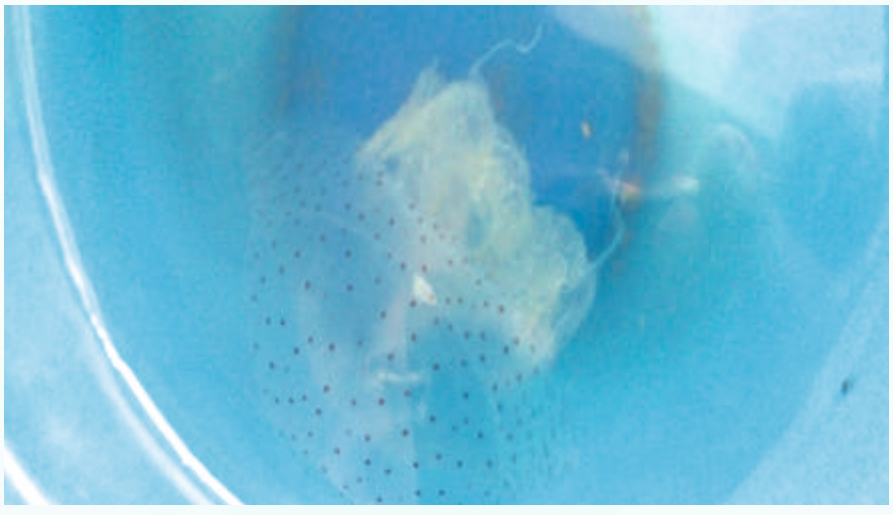
Aulacosiera granulata



Cyclotella sp.

Jellyfish Swarming in Indian Sundarbans

A significant discovery was made during the survey of the Hooghly-Matlah estuary in the winter of 2024, showing many ctenophores and jellyfish at seven locations: Sandeshkhali, Gosaba, Jharkhali, and Pathar Pratima in the Matlah estuary, and Nischintapur, Kakdwip, and Fraserganj in the Hooghly estuary. Their abundance may be categorised



Jellyfish *Acromitus flagellatus* (Maas, 1903) collected from Sundarbans

as a swarm or bloom, as these phenomena are observable with great density in surface water. The principal species found comprised three ctenophores, viz. *Pleurobrachia globosa*, *P. pileus*, and *Beroe ovata* and two jellyfish species, viz. *Chrysaora caliparea* and *Acromitus flagellatus*. Earlier study reported *P. globosa* as the sole occupant of the entire niche. The changes in the types of species and the rise in jellyfish numbers in the Indian Sundarbans appear to be caused by long-lasting changes in the water quality - increasing salt levels and temperatures in winter, along with calm and clear waters full of plankton help jellyfish grow. Additionally, higher levels of nutrients in the upper Sundarbans, shown by water data from Sandeshkhali, appear to have encouraged the growth of jellyfish. Estuarine zones are significant breeding habitats for various fish species and an abrupt increase in jellyfish density has prompted worries regarding the overall ecological health of the estuaries.

Sub-project 2: Assessment of Ecohydrological Dynamics in Relation to Fish Fauna and their Recruitment Towards Development of Sustainable Management Strategies in Rushikulya Estuary

Duration: 01.04.2020 – 31.03.2024

Turtle Congregation and Changes in Biotic Communities

Mass nesting (*arribada*) of the olive ridley sea turtle (*Lepidochelys olivacea*) occurs annually in the Rushikulya rookery, located at the sea mouth of the Rushikulya river in Coastal Odisha, between April and October. A study aimed to clarify the influence of turtle congregation on biotic components, specifically phytoplankton and benthos, revealed that phytoplankton species richness was significantly higher (108 species) following turtle congregation compared to pre (98) and during (92) the mass nesting phenomenon.

No significant differences were observed in phytoplankton species richness ($F=1.1367$; $p=0.347$) and density ($F=2.730$; $p=0.093$) across the periods before, during, and after turtle congregation in the estuary. Phytoplankton biomass (Chl a) exhibited significant variation ($p<0.05$) before and after the assembly. The evaluation of Ecological Quality Status (EcoQS) through the Index of Phytoplankton Integrity (IPI) and the Multimeric Phytoplankton Index (MMPI) indicated a consistent classification of 'moderate' ecological health ($0.72>IPI\geq0.53$; $0.6>MMPI\geq0.4$), with a marginally elevated index value observed during and after the assembly period. The diversity of benthic taxa, categorised into four functional groups (Scrappers/Shredders, Filter Collectors, Collector Gatherers, and Detrital Shredders), increased following mass nesting (44 taxa) compared to the congregation period (36 taxa).

There was no significant variation ($p>0.05$) in benthic species abundance between the during and post-assembly periods. The polychaete species *Cirrulatus cirratus* and *Prionospio cirrifera* served as indicator taxa following congregation (IndV > 30%); however, their presence was notably low during aggregation. Post-congregation observations indicated markedly elevated levels of NO_3^- and PO_4^{3-} in the estuarine water. Pearson's correlation analysis revealed a strong relationship between phytoplankton abundance and nutrients (NO_3^- and PO_4^{3-}) during the post-assembly period, suggesting that additional nutrients significantly influence phytoplankton succession in the estuary following mass nesting. The consistently moderate EcoQS over time and the statistically insignificant ($p>0.05$) changes in the abundance and diversity of plankton and benthos communities indicate that mass nesting does not significantly influence estuarine biocoenosis.

Sub-project 5: Temporal Assessment of Vembanad Estuarine Fisheries Resources for Sustainable Management

Duration: 01.04.2020 – 31.03.2024

Ecological Status

Trophic state estimates of the lake indicated a shift from 49.53 (meso-trophic) to 66.7 (hyper-eutrophic) during the study period of April, 2020 to March, 2024. An increase in TSI in high salinity zone from 48.37 (meso-trophic) to 56.75 (hyper-eutrophic). [(TSI range between 35 (high saline) -62 (low saline): Asha et al., 2016)]. Average BOD levels (2.14) indicates moderate pollution levels. Average GPP ($mgC/m^3/hr$) increased from 93.75 to 141.9 $mgC/m^3/hr$ during the study period. (Earlier reports : 150-550 gC/m^3/year by Nair *et al*., 1975). The primary productivity decreased towards high saline zone. This is unlike other open estuaries wherein primary production is high in high saline zone or estuarine mouth.

Plankton and Benthos Diversity

33 species of phytoplanktons belonging to 33 genera and 6 classes were recorded. Abundance ranged from 20 to 280 nos./L. A shift in plankton composition during the study period: from dominance of Baccilariophyceae (50% of total phytoplankton) in 2021-22 to Chlorophyceae (34%) in 2022-23 was noticed. Earlier reports (Nandan and Sajeevan, 2018) mentioned dominance of Baccilariophyceae (83.55%). Bivalves (41.7%) dominated in 2021-22, whereas amphipod dominated (34.3%) in

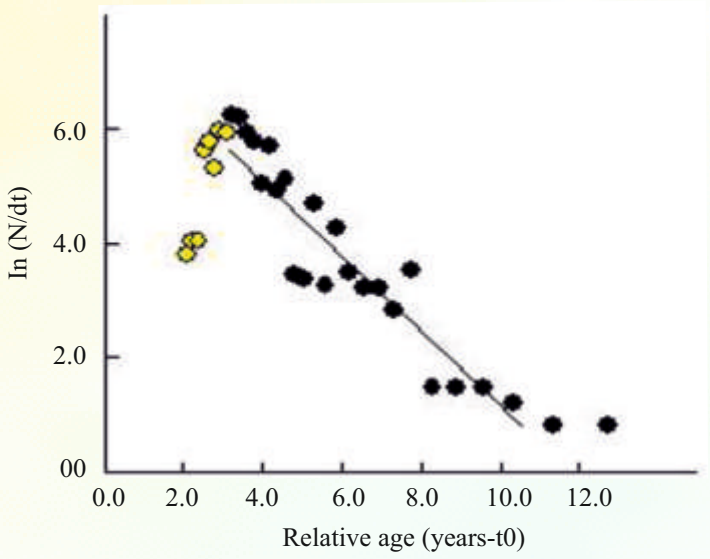
2022-23. Benthic diversity is more in medium saline zone. Bivalves dominated in low (53.2%) and medium (45.5%) saline zones. High saline zone was dominated by crustaceans in 2021-22.

Fish Diversity

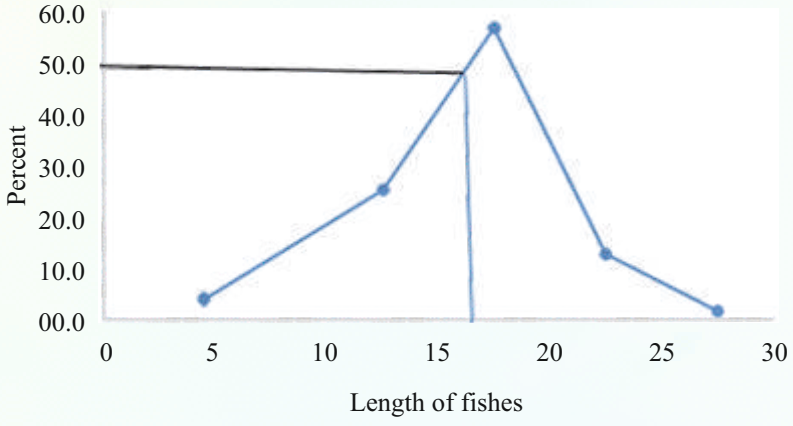
76 finfish species belonging to 44 families & 17 orders. 05 species of penaeid prawns, 2 species of palaemonid prawns, 2 species of crab and 1 species of clam were recorded. Total number of species decreased from of 150 species (56 families) (Kurup, 1982) to 90 species (48 families), after the construction of the barrage (Roshni et al., 2021). Shift from the carnivore dominant fishery (3.36) in 1993 to omnivore dominant fishery in 2023 was noticed which shortened the food chains, leaving ecosystems less able to cope with natural or human-induced change. Nearly 80 fish species were found unavailable in the ecosystem as compared to 1993. The diversity index of the lake decreased from 2.46 (Kurup et al.,1990a) to 1.35 (2022-23). *Etroplus suratensis* (20-25%) is the major contributor to catch followed by A*mbassis* sp. (18%), *Oreochromis mossambicus* (18%). Among shrimps, *Metapenaeus dobsoni* forms 64.1% of the catch, followed by *Fenneropenaeus indicus* (21.5%) and *M. monoceros* (12.4%). During 2012-13 (Asha *et al*. 2014), finfishes contributed 26.7% and crustaceans 73.3% to the total fishery. *Etroplus suratensis* (35.8%), Mullets (29.9%), Tachysuridae (19.1%), Sciaenid sp. (6.2%) and Ambassid sp. (5.6%) contributed to maximum to fishery. Among shellfishes, *Metapenaeus dobsoni* contributed 64.82% to the fishery followed by *Fenneropenaeus indicus* (14.84%), *Metapenaeus monoceros* (10.29%) .

Population parameters and Biology of *Etroplus suratensis*

L-infinity at 27.83 cm and K at 0.24 cm/yr indicated slow growth rate.



Length-Converted Catch Curve



Length at first maturity

Studies by Kannan *et al*. (2014) reported growth rate of 0.4 cm/year and L∞ at 40 cm.

Natural mortality and total mortality were estimated at 0.4911/yr and 1.64/yr.

Biology

Sex ratio of *Etroplus suratensis* was estimated at 1:0.88. Studies by Bindu and Padmakumar (2014) reported sex ratio at 1:0.8.

Length at first maturity was recorded at 17.5 cm. But, studies by Bindu and Padmakumar (2014) was reported at 20 cm.

GSI of *Etroplus suratensis* was estimated at 0.02 to 0.93 (males) and 0.06 to 2.822 (females). Studies by Bindu and Padmakumar (2014) reported a GSI of 0.01 to 1.363 in males and 0.04 to 2.69 in females.

Impact Assessment of Water Hyacinth Iinfestation

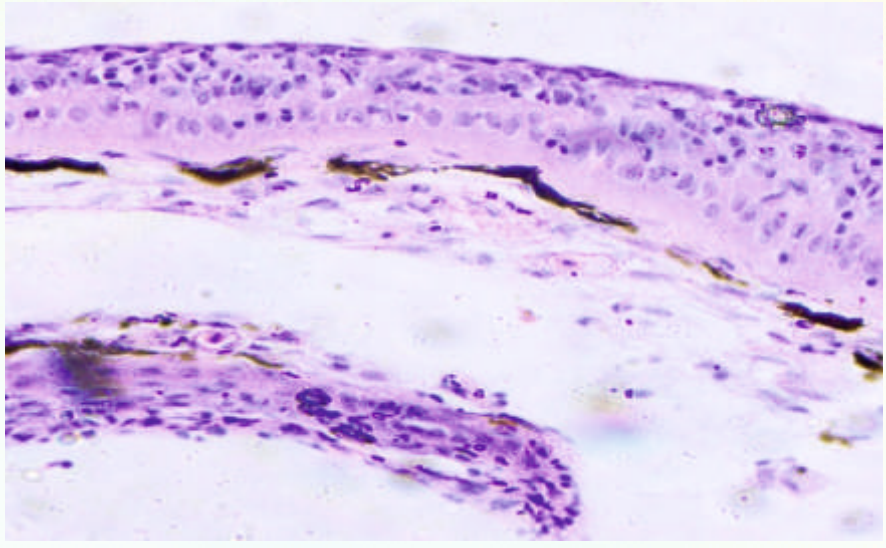
The fishing days/month has come down from 18 to 10; the scouting time

has increased from 4 to 6 hours/day and the catch per day decreased from 10 kg/day to 7 kg/day. The maintenance cost of gear during infestation has increased from Rs. 10,000 to Rs. 30,000, total income decreased from Rs. 45,000/ month to Rs. 20,000/month.

Project Code: REF/20-23/12

Assessment of Ecological Impacts of Dams and Barrages in Selected Rivers with Special References to Fisheries

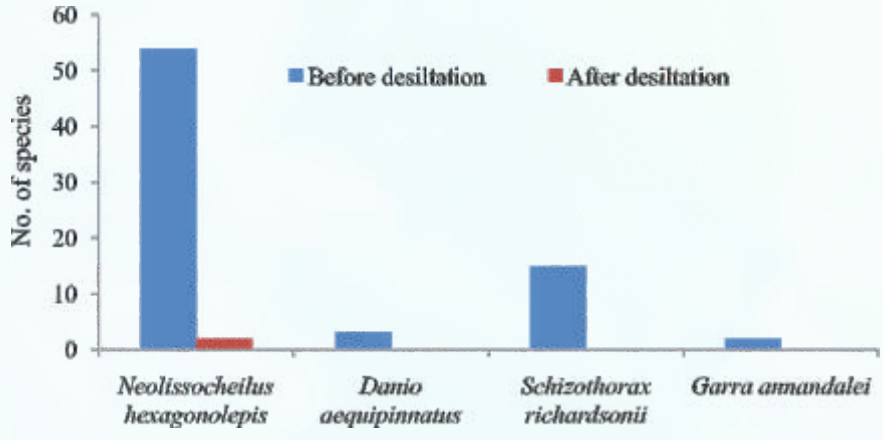
Duration: 01.04.2020 – 31.03.2024



Histology of fish skin exposed to high load of silt indicating hyperplasia

Impact on Fish Diversity and Health

The specific impact of reservoir de-siltation from the Dam on the fish and ecology at the downstream (Manpur) was accessed. The study indicated the reduction of 96.27% of chocolate mahseer *Neolissocheilus hexagonolepis*, 100% in *Schizothorax* sp. and *Garra* sp. in the main river channel. The abundance of juveniles as well as adult fishes were considerably reduced after de-siltation. Histology of the fish skin showed severe hyperplasia, an indication of host responses to the highly turbid water carrying heavy silts. In addition, gill lamellae showed necrosis, mucus cell proliferation and gill fusion. The results showed reservoir flush not only impact the fish diversity but also the fish health.



Impact of reservoir de-siltation on fish diversity

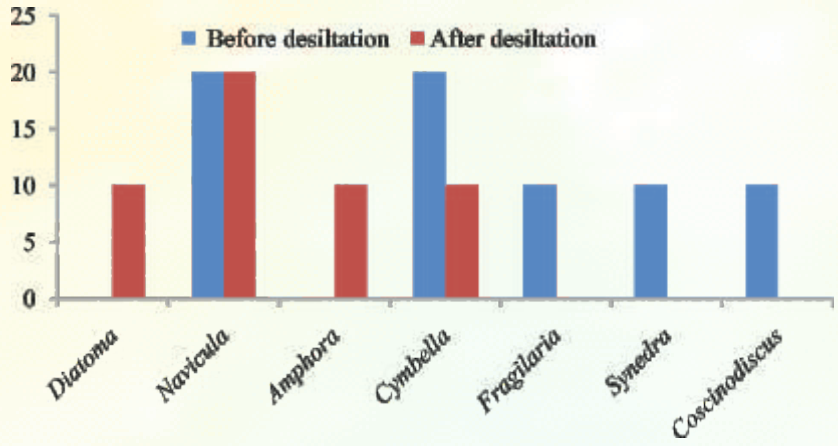
Impact on Algal Diversity

Reservoir flushing showed a significant impact on the algal diversity. Algal genera *Fragilaria, Synedra* and *Coscinodiscus* were present before reservoir flush. While these species were completely absent, presence of genera diatom and amphora after de-siltation was observed.

Water Quality Parameters

Impact of reservoir de-siltation on the water quality parameters were analysed. The study showed increased value in pH, specific

conductivity, total alkalinity, TDS. Total hardness and Ca, Mg were also high. Increased Ca, Mg was responsible for increased total alkalinity. The turbidity has increased to 62 % indicating the extremely high load of silt carrying. Correlating the water quality and fish abundance, the study conclude that turbidity and specific conductivity have more impacts on the fish abundance and fish health.



Phytoplankton distribution before and after de-siltation

Project Code: REF/20-23/15

Eco-Variability and Impact Study of River Yamuna on River Ganga with Special Emphasis on Fisheries

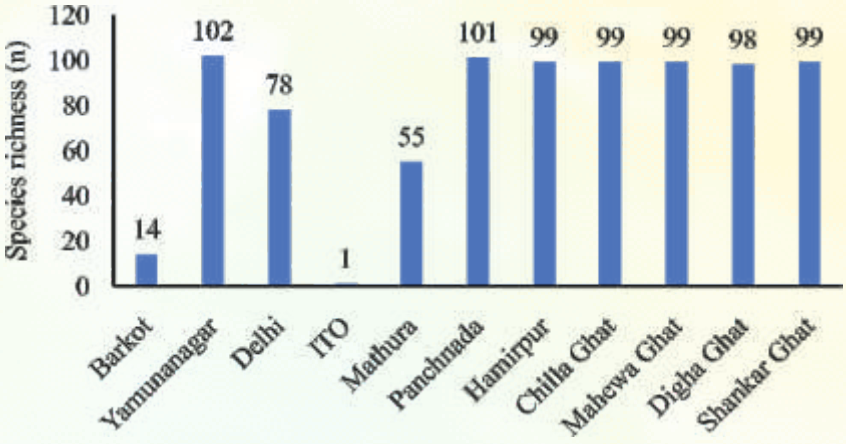
Duration: 01.04.2020 – 31.03.2024

Physico-chemical Characteristics of Water

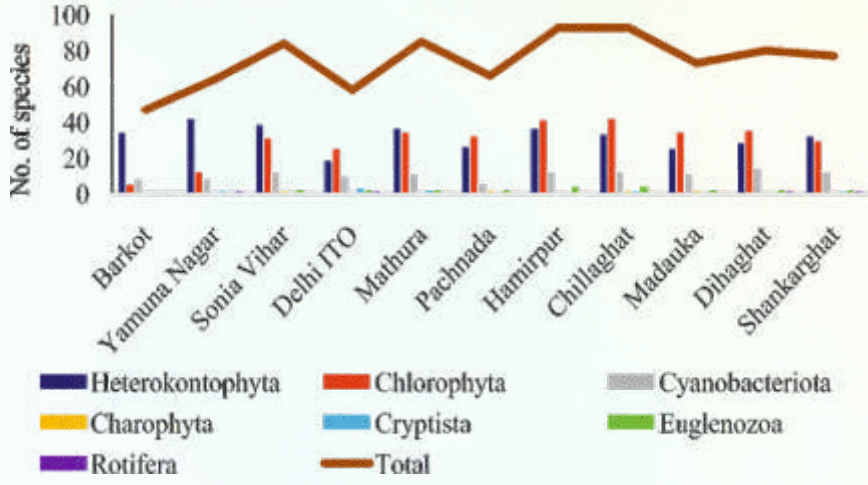
The study in River Yamuna recorded water temperature (WT) ranging from 8.4 to 35.60 °C with a mean value of 24.60±7.28 °C. Based on the temperature and climatic conditions, Barkot comes under a cold hilly region while the rest of the sampling station comes under a sub-tropical region. The lowest values of WT, turbidity, TDS, EC, chlorinity, alkalinity, hardness, Ca-H, Mg-H, available phosphate, total phosphate, nitrate - N, total – N, DOM, and COD were recorded at an upper hilly stretch (Barkot). The highest values of pollution indicator parameters like TDS, EC, hardness, Ca-H, available phosphate, total phosphate, DOM and COD and the lowest value of DO were recorded at ITO, Delhi stretch. Similarly, at Mathura, the highest values of alkalinity, chlorinity, hardness, nitrate - N and total -N, and the second highest values of EC, TDS, Ca-H, available and total phosphate, DOM and COD were reported. The higher values of these parameters at ITO, Delhi and Mathura might be associated with the

Table: Physicochemical characteristics of water of River Yamuna

Parameters	Minimum	Maximum	Average
WT (°C)	8.40	35.60	24.60
Flow (m/sec)	BDL	1.60	0.39
Turbidity (NTU)	1.26	382.00	51.11
Transparency (cm)	8.00	105.00	32.59
pH	7.40	8.99	8.26
Total Alkalinity (mg/l)	28.00	336.00	149.22
DO (mg/l)	BDL	12.14	7.13
EC (µS/cm)	46.00	1582.00	445.51
TDS (mg/l)	22.00	1500.00	277.57
Total Hardness (mg/l)	32.00	388.00	173.39
Ca-Hardness (mg/l)	6.41	80.16	35.87
Mg-Hardness (mg/l)	1.46	64.09	20.44
Available phosphate (mg/l)	0.01	3.60	0.85
Total phosphate (mg/l)	0.03	5.29	1.28
Nitrate-N (mg/l)	0.02	5.56	0.68
Total-N (mg/l)	0.13	11.90	2.23
DOM (mg/l)	0.19	10.88	2.17
COD (mg/l)	8.32	344.96	82.43



Fish species richness along the river Yamuna



Species richness of plankton in river Yamuna

discharge of domestic wastewater and industrial wastewater into the Yamuna River system.

Heavy Metals in Water and Sediment

The metal concentrations in the water matrix followed the order Mn > Cr ≃ Zn > Pb > Cu and Cd. Cu, Cd, Pb, Zn, Mn and Cr content in water ranged from 2.00 - 42 mg/l, 0.50 - 8.00 mg/l, 1.00 – 106.00 mg/l, 3.00 – 108.00 mg/l, 11.00 – 281.00 mg/l and 3.00 – 60 mg/l with mean values of 9.88±6.66 mg/l, 3.20±1.63 mg/l, 29.95±19.65 mg/l, 36.05±23.87 mg/l, 105.52±59.52 mg/l and 24.85±13.38 mg/l, respectively.

The metal concentration in sediment followed the order Mn > Cr ≃ Zn > Pb> Cu and Cd. Cu, Cd, Pb, Zn, Mn and Cr content in sediment ranged from 0.07-65.12 mg/kg, 0.17-3.08 mg/kg, 0.32 – 50.84 mg/kg, 5.08 – 102.09 mg/kg, 56.50 – 516.23 mg/kg, and 9.46 – 108.42 mg/kg with mean values of 15.65±10.51 mg/kg, 1.28±0.68 mg/kg, 21.55±11.62 mg/kg, 37.66±17.04 mg/kg, 202.00±110.95 mg/kg, and 39.03±22.14 mg/kg, respectively. ITO, Delhi and Mathura reported the highest levels of Cd, Pb, and Zn.

Fish Diversity

A total of 126 fish species belonging to 13 orders, 34 families and 82 genera were recorded from the nine sampling sites of river Yamuna. Fish species richness at Barkot, Yamuna Nagar, ITO Delhi, Wazirabad, Mathura, Pachnada, Hamirpur, Chilla, and Prayagraj were 13, 102, 79, 1, 54, 101, 99, 99 and 99, respectively. The highest values of species richness were found in the Yamuna Nagar stretch of the river. This was due to the recording of migrant species like *Tor putitora*, *Neolissochilus hexagonolepis* that move upstream to spawn and feed at higher altitudes and then back down to the lower feeding grounds, and presence of hill stream fishes like *Garra annandalei, Garra lamta, Pseudecheneis sulcata, Pseudolaguvia ribeiroi, Nemacheilus corica,* etc.

Plankton

A total of 193 plankton species were recorded under seven phyla, viz. Heterokontophyta (diatoms), Charophyta (desmids), Chlorophyta (green algae), Cryptista (cryptomonads), Cyanobacteria (blue-green algae), Euglenophyta (euglenoids), and Rotifera (zooplankton). The diatoms were the most dominant phylum followed by green algae and blue-green algae. The upper stretches, namely, Barkot, Yamuna Nagar, and Sonia Vihar exhibited a noteworthy increasing trend of species richness with the highest percentage of diatoms with occurrence rates exceeding 72%, 65% and 45% respectively. In contrast, the intermediate to lower strata were primarily distinguished by prevalence of green algae. The species richness suddenly decreased at Delhi ITO due to increasing pollution.

The most frequently occurring phytoplankton species such as *Cyclotella* sp., *Navicula* sp., *Ulnaria ulna* and *Pseudoanabaena* sp. were documented at each sampling location. Other species such as *Cyclotella meneghiniana*, *Nitzschia* sp., *Nitzschia palea*, *Ulnaria acus*, *Monoraphidium contortum* and *Phormidium* sp. were the second most frequently occurring species

recorded at ten sampling locations. Likewise, *Aulacoseira granulata*, *Melosira* sp., *Pinnularia viridis*, *Stephanodiscus* sp., *Eudorina* sp., *Kirchneriella lunaris*, *Tetradesmus obliquus*, *Tetraedron* sp., *Geitlerinema* sp., and *Trachelomonas* sp. were frequently recorded at the different sampling locations.

Phytoplankton Biomass

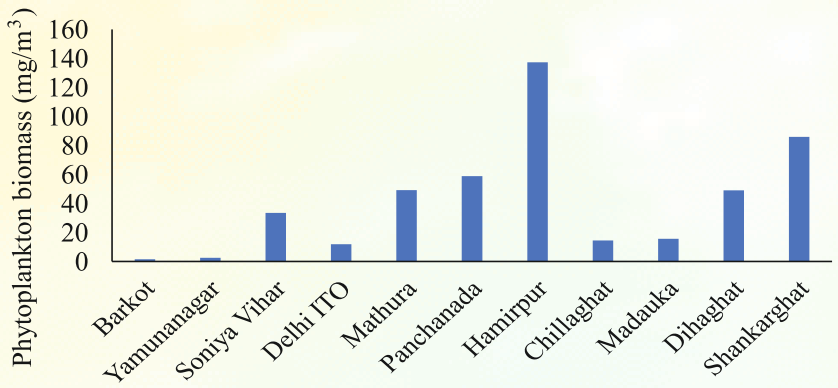
The phytoplankton biomass (chl-*a*) ranged from 1.424 to 137.24 mg/ m^3 with a minimum value recorded at Barkot and a maximum value recorded at Hamirpur. The upstream sampling site Barkot had the lowest recorded value of chlorophyll-*a*, indicating that the combination of low water temperature and strong water velocity had a suppressive effect on phytoplankton biomass.

Periphyton

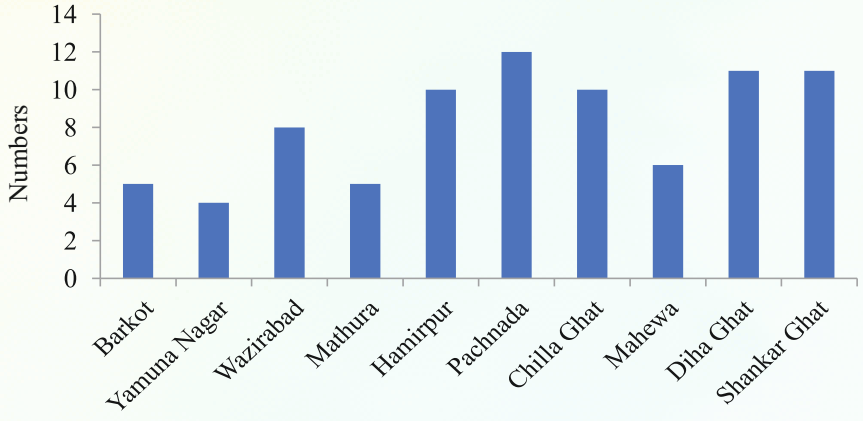
A total of 181 species of periphyton belonging to diatoms, green algae, blue-green algae, euglenoids, desmids and cryptomonads were recorded in the river Yamuna. Diatoms were the dominant group (102 species), followed by green algae (54 species) and blue-green algae (17 species).

Diversity and Abundance of Macrobenthos

A total of 28 species of macrobenthos species (Molluscs - 13, Bivalves - 06, Insects - 08 and Annelids - 01) belonging to ten orders and 16 families were documented from whole stretch of river. The higher abundance of the benthos was observed in pre monsoon season (70-980 N/m^2), followed by post-monsoon (20-720 N/m^2) and monsoon season (10-650 N/m^2). This study identified substantial abundance of pollution-tolerant species from the Chironomidae (Diptera) family at all downstream sites, particularly Wazirabad, Mathura and Hamirpur in all seasons indicating organic pollution. Only freshwater sinistral gastropods *Physella acuata* were recorded in Wazirabad, Yamuna Nagar, Hamirpur and Pachnada site which prefer polluted water.



Phytoplankton biomass (chlorophyll a) of river Yamuna



Macrobenthos richness at different sites of river Yamuna

The insects were dominant in upstream of river Yamuna at Barkot (*Rhyacophila* sp., *Polycentropus* sp., *etc*) which favour cold, fast running and well oxygenated water of streams and were found associated with bottom sediments in pre-monsoon season. The species richness was higher at Pachnada (12) followed by Diha ghat (11), Shankar ghat (11), Hamirpur (10), Chilla ghat (10) and most polluted sites such as Wazirabad (8) and Mathura (5) showed less species as compared to others.

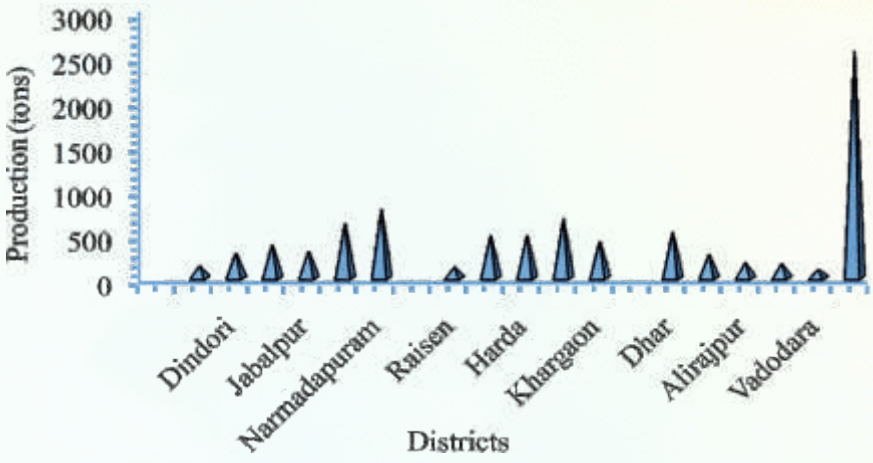
Project Code: REF/24-26/17

Project Title: Estimation of Fish Catch, Diversity and Socio-Economics of Fishers of Selected Rivers Towards Fisheries and Livelihood Sustainability (Narmada, Cauvery, Sutlej, Gomati and Pamba)

Sub-project 1: Estimation of Fish Catch, Diversity and Socio-Economics of Fishers of Narmada River towards Fisheries and Livelihood Sustainability

Duration: 01.04.2024 – 31.03.2026

The river Narmada, flowing through the states of Madhya Pradesh, Maharashtra and Gujarat, has high fish diversity providing round-the-year livelihood to the riparian fishers and quality nutrition to the population. The present status of fish catch and fisheries socio-economics have been investigated here. Survey covering 161 villages on both sides of the river, from its origin in Annupur district to Bharuch, estimated an annual fish catch of 8308 tonnes.



Fish catch in different districts along the course of river Narmada



A glimpse of commercial catches from river Narmada

Fish Catch Estimation

There were wide variations in fish catch at different stretches of the river. The upper stretch of the river from Annupur to Narmadapuram district, recorded the highest total fish catch in Narmadapuram (764.5 tons). Other major fish landings were recorded from Narsinghpur (611.89. tons) and Mandla (370.35 tons) districts. Seasonal variations in catch was most marked in this stretch with most catch recorded in the monsoon season, with districts like Narmadapuram recording peak catches during this period (456.31 tons).

Although fish availability was highest during monsoon, seasonal variations in fish catch were less marked in the middle stretch extending from Raisen to Khargaon district. Higher catches were recorded in Dewas (655.22 tons), followed by Sehore (473.01 tons) and Harda (473.93 tons). In the lower stretch, from Dhar to Bharuch, maximum catch was recorded in Bharuch (2,521.21 tons) which far exceeded other districts in the region. Fish availability was highest during monsoon season, contributing 854.31 tons at Bharuch district only. Other important fish landing centres in the region were Dhar (511.98 tons) and Barwani (261.36 tons).

Fishing Crafts and Gears

Fishermen along the Narmada River use a variety of traditional gears for subsistence fishing. Majority of the fishing crafts operating in the river are non-motorized wooden boats (plank-built and dug-out) locally called *Donga*/*Naav*, tin/aluminium made boats locally called *Kisti*, and inflated tire tubes. The middle stretch of the Narmada in Madhya Pradesh is the main location for tube fishing.



Dugout canoe



Wooden plank boat



Tin/Aluminum boat (Kisti)



Gill net with the harvest



Inflated tube



Hook and line



Cast net operation

The fishing gears include gillnet, trammel net, cast net, dragnet, scoop net, hook and line. Gill nets and cast nets have proven to be the most effective among various fishing gears for fish exploitation. Fishermen in the region continue to depend on traditional fishing techniques for their economic livelihood and nutritional security.

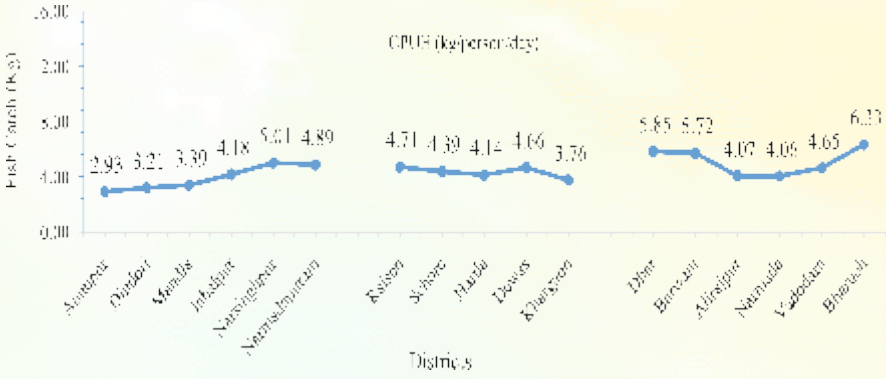
Catch Per Unit Effort (CPUE)

The surveys revealed significant variations in CPUE in different river stretches with relatively higher values in the lower stretch, particularly in Bharuch, Dhar and Barwani reflecting high fish availability and fishing efficiency in the region. The stretch also had high CPUE (expressed as Kg/person/day), in all the districts indicating favorable ecological conditions for fishing.

In the upper stretch, Narsinghpur recorded the highest CPUE (5.01 kg/person/day) indicating exceptional productivity and fishing efficiency. Other districts, such as Narmada puram (4.89) and Jabalpur (4.18) also had relatively high CPUE values, while Annupur had the lowest CPUE (2.93). The Middle stretch of Narmada region showed balanced CPUE values, with no extreme highs or lows, suggesting consistent fishing practices across its districts. Raisen district had the highest (4.71), followed closely by Dewas (4.66) and Sehore (4.39) and Khargaon (3.76). In the lower stretch, Bharuch had the highest CPUE (6.33), followed by Dhar (5.85) and Barwani (5.72). Other districts like Vadodara (4.65) and Alirajpur (4.07) showed moderate productivity. Overall, both the fishing effort and return were moderate.

Socio-Economic Status of Fishermen

The riverine fisheries is governed by the Madhya Pradesh Riverine Fisheries Rules, 1972 and Madhya Pradesh Fisheries (Amendment) Act,



CPUE (kg/person/day) of fishing at different districts on river Narmada



Fishers interacting with the survey team



Fisher women sorting and processing fishes for value addition

1981. Fishing in the river is free and there is no fishermen licensing system at present. The fishers belonged to fishing communities Kewat and Kahar. Fishing was the primary occupation for 33.33% fishers in upper stretch and for 60% fishers in middle stretch. The average age of fishers in the upper stretch was 40.67 years and in the middle stretch was 33.56 years. The average family size in the upper stretch was 5.78 and in middle stretch was 9. Secondary level of education was attained by 50% fishers in upper stretch and 8% fishers had higher education in middle stretch. Average experience in fishing in upper stretch was 26.17 years and in middle stretch was 17.5 years showing continuation of fishing as a livelihood. Income from fisheries in the upper stretch ranged from ₹ 2,500 - 4,500; ₹ 4,000 - 7,500 in the middle stretch; and ₹ 5,000 to 10,000 in the lower stretch indicating sustaining livelihood support from river fishing to the fishers. Own agricultural land was possessed by 0.42% fishers in the upper stretch with an average area of 0.57 ha. The other forms of occupation are agriculture, horticulture, daily wage labourer, boat operation and sand mining.

Sub-project 2: Estimation of Fish Catch, Diversity and Socio-Economics of Fishers of Cauvery River towards Fisheries and Livelihood Sustainability

Duration: 01.04.2024 – 31.03.2026

Comprehensive fisheries resource assessment surveys were conducted during August-September to estimate fish landings, catch structure, and the socio-economic status of fishers along the River Cauvery. Data pertaining to fish catch, fishing effort, dominant fish species, and the socio-economic profile of fishers was collected from the upper, middle, lower, and estuarine stretches of the River Cauvery in Karnataka and Tamil Nadu, extending from Sirangala (Kodagu District, Karnataka) to the estuarine region at Kollidam (Nagapattinam District, Tamil Nadu).



Fish landing data collection at Karnataka stretch of Cauvery River

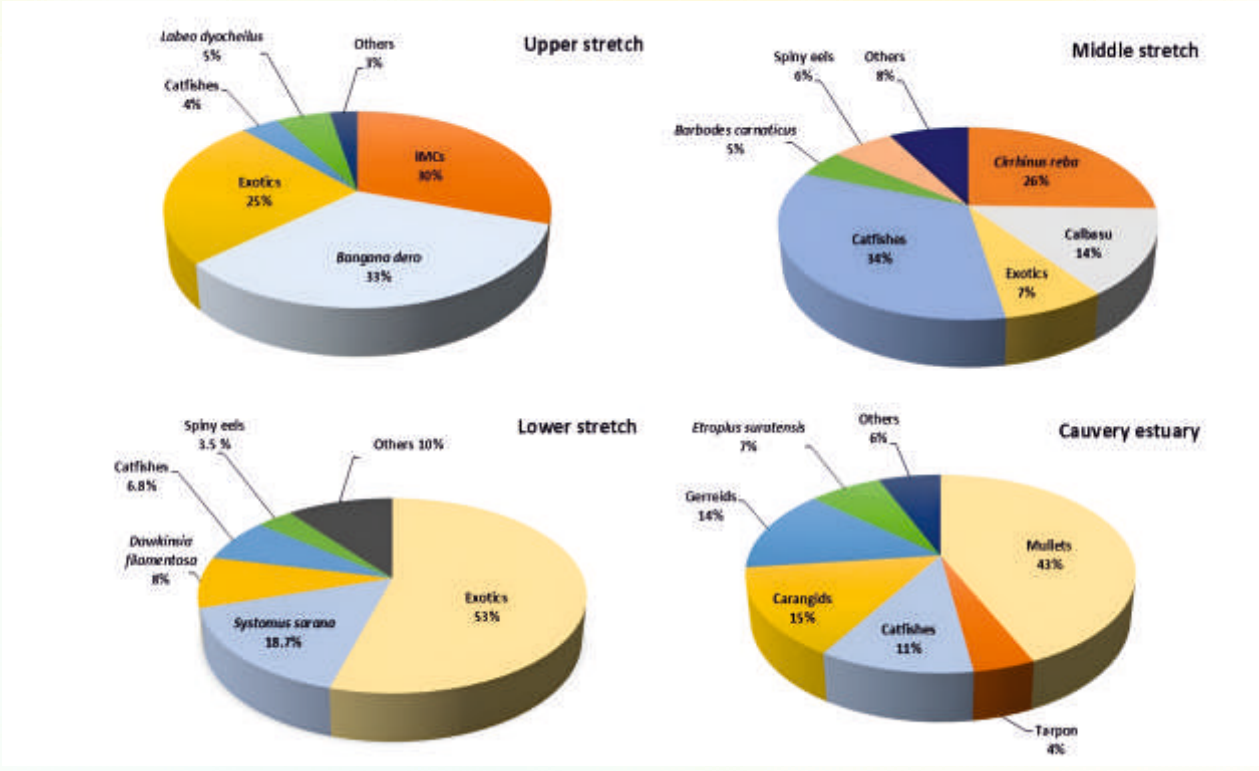
Fish Landings and Catch Structure

The fish landing data was collected through semi-structured interviews with fishers at fishing villages, members of fishermen's cooperative societies, and officials from the respective State Fisheries Departments, combined with direct observations on riverine fish landings carried out by the project team members. The survey encompassed 62 fishing villages and 14 major riverine fish landing centres that were situated within the districts of Kodagu, Mysore, Chamarajanagara, Krishnagiri, Dharmapuri, Salem, Erode, Karur, Tiruchirappalli, Thanjavur, and Nagapattinam.

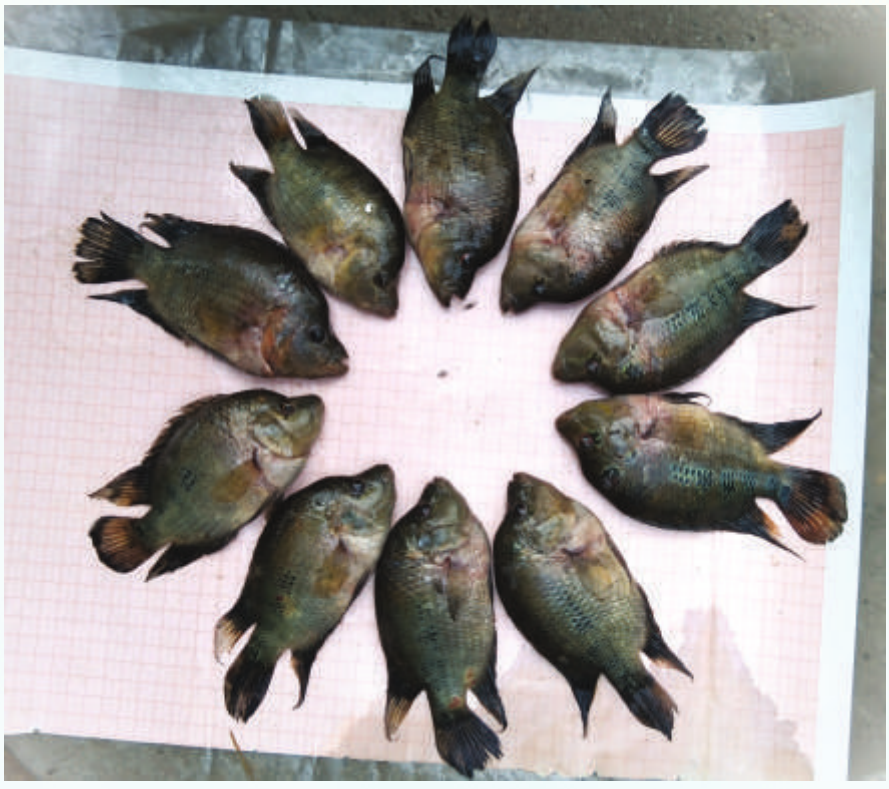
In general, the monsoon period from June – September is the lean fishing season in Cauvery River as the flooded river channels with heavy freshwater influx makes it difficult to operate the gill nets, the major fishing gear in Cauvery. The only gear that has been regularly used during the monsoon period is the cast net which has low fishing efficiency and the catches from cast nets could not make a significant contribution to overall fish landings. The low fishing intensity during the survey period was reflected in the lower fish diversity which comprised of 65 species of fishes, one species of prawn (*Macrobrachium malcolmsonii*) and two species of freshwater crabs. The fish diversity was highest in the lower stretch at Bhavani (30 species) and lowest along the estuarine part at Kollidam (12 species). The average fish landings per day ranged from 22 kg at Kollidam to 376 kg in the middle stretch at Hogenakkal.

Carps formed the major catch component in the riverine fish landings along the upper stretch of Cauvery, with the minor carp *Bangana dero* (Dero carp) contributing to 33 % of the total catch, followed by Indian Major Carps (IMCs) with 30% contribution. The fish catch along the middle stretch was dominated by catfishes (34 % of the total landings), among which the butter catfish *Ompok bimaculatus* was the major species (contributed 46.8 % of total catfish landings). The catch per unit effort (CPUE) for gill nets at Hogenakkal ranged from 4.8 – 14.8 kg/boat/day, with an average of 7.6 kg/boat/day. Along the lower stretch, fish landings at Bhavani was dominated by the exotic *Oreochromis niloticus*, which constituted 41.35 % of the total landings, followed by the olive barb *Systomus sarana* (18.7 %), *O. mossambicus* (11.03 %), the filament barb *Dawkinsia filamentosa* (8%) and the pearlspot *Etroplus suratensis* (3.79 %). The exotic fish species contributed to 53 % of the total fish landings at Bhavani. Although the CPUE at Bhavani ranged from 3.2 – 23 Kg/boat/day, the average CPUE recorded at this centre (13.35 kg/boat/day) was highest among all the landing centres studied. The exotic trimac cichlid (*Amphilophus trimaculatus*) which was first recorded from a lotic environment outside its native range by CIFRI at Bhavani during 2020, has presently become one of the main components of fish catch (1.52 % of total fish catch) at Bhavani.

At Mayannur, there was sheer domination of exotic fish species, with three species, *viz*., *O. niloticus*, *O. mossambicus* and the African



Dominant species/species groups recorded in the fish landings across different stretches of river Cauvery



Specimens of the exotic cichlid *A. trimaculatus* caught at Bhavani

catfish (*Clarias gariepinus*) contributing to 71.35 % of the total fish landings. The average fish landings per day was lowest at the estuarine stretch at Kollidam (18 kg) as the heavy influx of freshwater released from the upstream dams and barrages made it difficult to operate trammel net (triple walled gill net), the main fishing gear used in the area. Majority of the fishers at Kollidam have not ventured into fishing during the survey period and the only estuarine fish catch observed at the Kollidam landing centre was from cast nets operated by a few fishers. The landing at Kollidam was dominated by the flathead grey mullet *Mugil cephalus* which contributed to 43 % of total catch, followed by juveniles of giant trevally *Caranx ignobilis* (15 %), and *Gerres filamentosus* (14 %). Predominance of exotic fish species in the upper, middle and estuarine stretches and forming one of the main catch components is alarming and requires immediate attention.

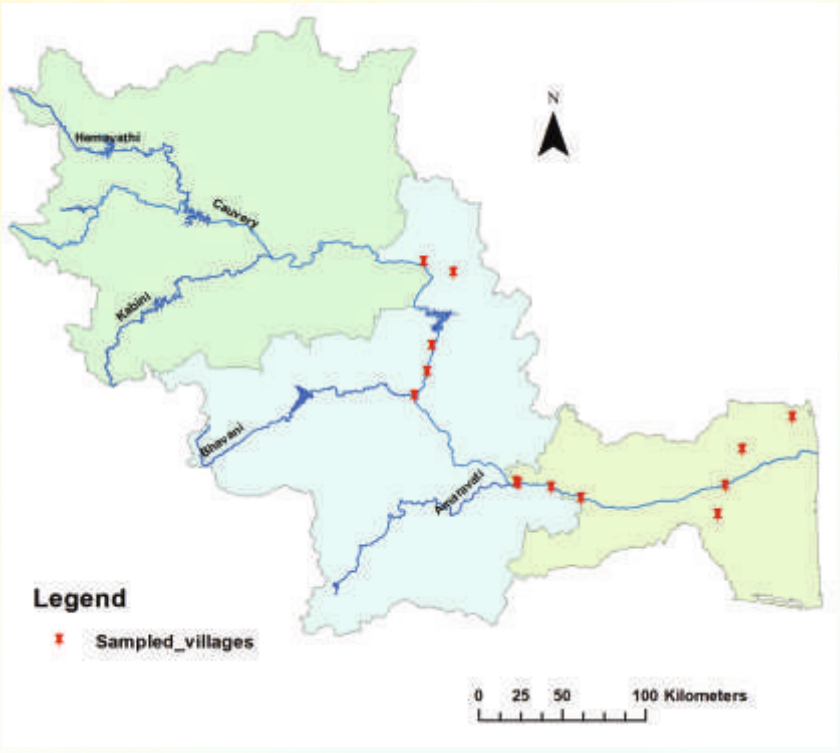
Socio-Economic Status of Fishers along the River Cauvery

The socio-economic survey was carried out in fifteen villages in the middle and lower stretch of the Cauvery River in Tamil Nadu. Fishers had diverse educational backgrounds, ranging from illiterate individuals to those with Master's degrees and diplomas: this variation significantly influences their livelihood opportunities, decision-making capacity, and socio-economic mobility.

The following table provides information on the average monthly income earned by Cauvery fishers from various occupations. Fisheries serve as the primary income source, contributing ₹14,360 per month. No income is reported from aquaculture, indicating either a lack of practice or unavailability of aquaculture infrastructure and training in the region. Crop farming contributes ₹9,536.12 per month, reflecting a diversified livelihood strategy, especially during periods when fishing is less productive. Other income sources contribute ₹4,120 per month, which may include temporary jobs such as working in factories and other seasonal activities.

The migration patterns among fishing households reveal distinct types of migration driven by economic and environmental factors. Seasonal migration is observed in 12.20% of households, primarily motivated by employment opportunities in aquaculture farms. These migrations to nearby districts or states typically last for 3 to 5 months. Permanent migration was less common (1.63%).

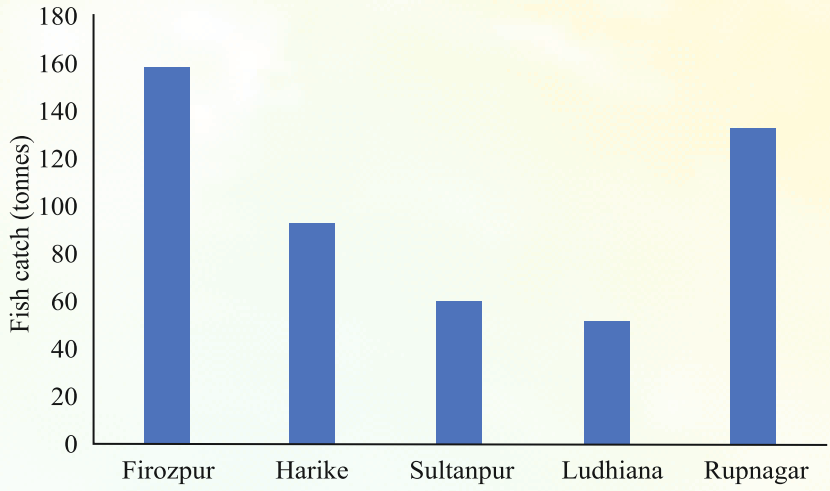
The data reflects a strong dependence on fisheries and crop farming for a livelihood, with fish vending and casual labour as supplementary income sources. In summary, Cauvery fishers rely heavily on traditional fishing and crop farming for livelihoods, with limited income diversification and formal employment opportunities. Enhancing livelihood options, promoting aquaculture, and building capacity through targeted interventions can strengthen their income security and resilience against environmental and economic challenges.



Map depicting fishing villages surveyed for socio-economic data collection

Table: Incidence of migration among Cauvery riverine fishers

Migration type	Number of Households (%)	Reason for migration	Duration	Destination
Seasonal	12.20	To work in aquaculture farms	3-5 months	Nearby districts/states
Permanent	1.63	Better job opportunities	Indefinite	Urban areas
Distress Migration	0.00	Drought, reduced fish catch, reduced fishing opportunities	1-3 months	Urban areas
No migration	86.18	Not applicable	Not applicable	Not applicable



Fish catch at different stretches of the Sutlej River





Fish landing at various landing centers along the Sutlej River

Sub-project 3: Estimation of Fish Catch, Diversity, Ecological Variability and Socio-Economics of Fishers of Sutlej River towards Fisheries and Livelihood Sustainability

Duration: 01.04.2024 – 31.03.2026

The Sutlej, a transboundary river, flows 320 km and 440 km through Himachal Pradesh and Punjab in India. The current status of fish catch and catch composition, the socio-economic status of fishers, and ecology of Indian part of the river were studied at 8 sampling stations spanning from Rupnagar to Firozpur, during the summer and monsoon seasons.

Fish Catch and Composition

The fish catch data was collected through semi-structured interviews with fishermen, and fishery officials of the State Fisheries Departments, and direct observations of the fish landings by the project team members. The survey included the six landing centres, viz Firozpur, Harike, Sultanpur, Ludhiana, and two in Rupnagar districts of Punjab. Fishing in river is done mainly by migrant fishers from Uttar Pradesh and Bihar. There were wide variations in fish catch at different stretches of the river. The annual fish catch from the river was estimated at 445 tonnes with wide variations in catch at different stretches. The highest catch was recorded at Firozpur (158.0 tonnes) followed by Rupnagar (133.0 tonnes), Harike (93.0 tonnes), Sultanpur (60 tonnes) and Ludhiana (51.0 tonnes). The catch per unit effort CPUE (kg fish/ fisher/day) in the Himachal stretch and the Punjab stretches ranged between 2 - 6 and 3 - 25.

Indian Major Carps contributed significant part to the catch in the lower stretch at Firozpur (71%), and Harike (40%), and least at Rupnagar (2%). Among the IMCs, *Cirrhinus*

mrigala contributed most, followed by *Labeo rohita, L. calbasu*, while *L. catla* was scarce at all the landing centres. Minor carps (8-44%) were the next important group in the landings and was comprised mostly by *Bangano dero,* followed by *Labeo gonius, Cirrhinus reba, L. bata* and *L. dyocheillus*. The catfishes constituted between 2 and 18% to total catch and was mainly comprised of *Spereta seenghala* and *Wallago attu*. Among the exotic fish species, *Cyprinus carpio* contributed the most at Rupnagar (63%).

Fishing Crafts and Gears

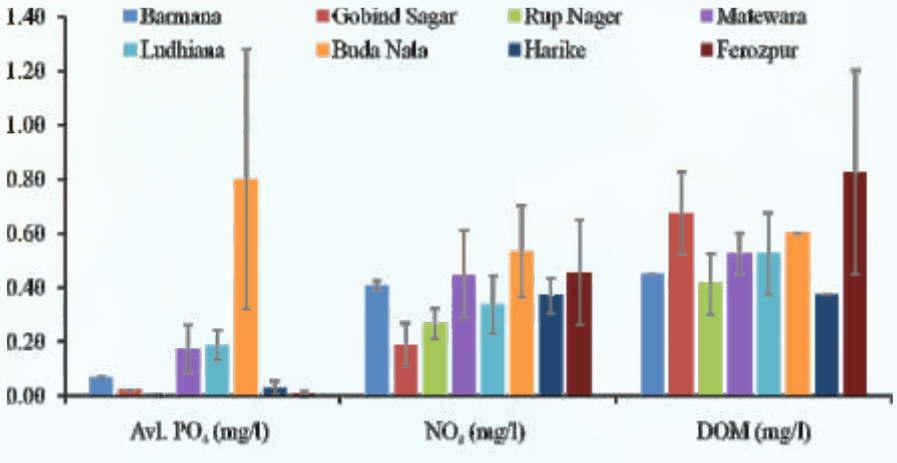
Along the Sutlej River, fishermen use a variety of gears for fishing. The fishing gears employed in Himachal Pradesh are cast net, followed rod and lines, and handlines. The fishing gears employed in Punjab stretch are predominantly gill nets with mesh size ranging between 25-150 mm, followed by caste nets (locally called *Jhingurjal*, 50 mm mesh size), drag net with pockets (called *chathajal*, 50 mm mesh size), longlines and pole and line. The fishing crafts operated in the river are non-motorised wooden boats (plank-built boat) and in some places inflated truck tire tubes are also used.



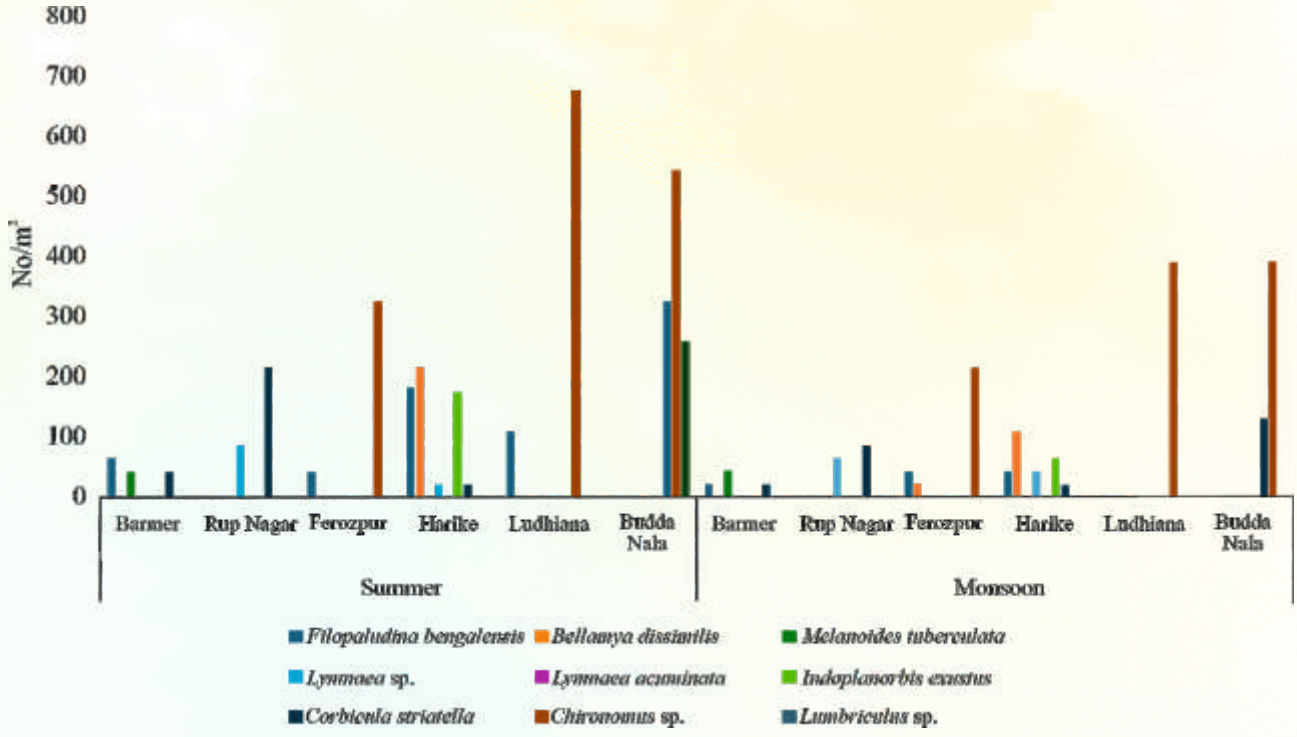
Dominant crafts and gears employed for fishing in the Sutlej River

Water Quality

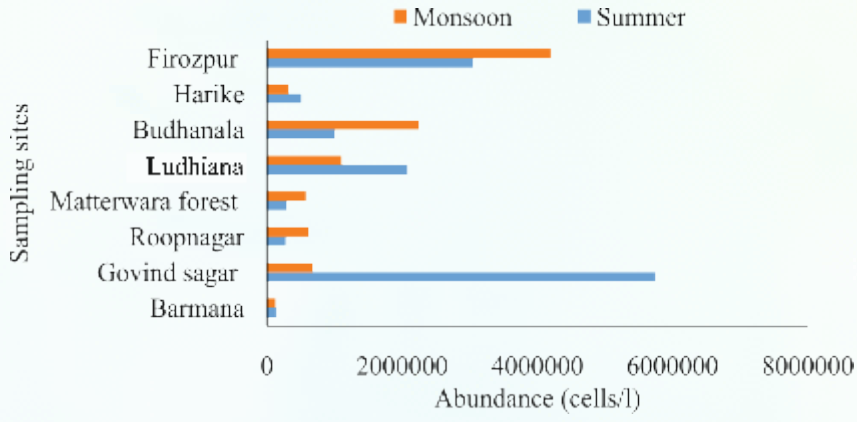
The water quality of the Sutlej River varies significantly at different locations, indicating varying degrees of pollution. Places such as Buda Nala exhibits severe pollution with extremely high turbidity (80.85 NTU), electrical conductivity (545 µS/cm), total dissolved solids (387.50 mg/l), and biochemical oxygen demand (BOD, 12.60 mg/l). Similarly, Ludhiana and Matewara show high turbidity during monsoon, suggesting poor water quality. On the other hand, the river water at Gobind Sagar and Barmana have relatively less turbidity (3.99 NTU), BOD (1.20 mg/l), and phosphate levels (0.02 mg/l) indicating better water quality.



Water quality parameters of Sutlej River



Seasonal macrobenthos diversity at different sites



Spatial variation of phytoplankton abundance

Harike and Ferozpur exhibit moderate level of pollution with acceptable dissolved oxygen, but higher BOD levels. The low DO, high BOD, high phosphate and nitrate concentrations in certain areas, especially Buda Nala, were due to industrial and sewage effluent discharge. Overall, the data suggests that the River is facing significant water quality issues, especially near urban and industrial areas.

Macrobenthic Diversity of River Sutlej

A total of nine macrobenthos species (Mollusc 06, Bivalves 01, Insects-01 and Clitellata 1) belonging to 5 orders and 7 Families were documented. The benthos density varied from 151-1126 N/m^2 and 87-649 N/m^2 during summer and monsoon, respectively. *Chironomous* was observed at three sites in the middle stretch indicating organic pollution. The Harike site was dominated by five species and most species-abundant site among all. At downstream, gastropods such as *Filopaludina bengalensis* and bivalve *Corbicula striatella* dominated during summer and monsoon, respectively.

Phytoplankton Species Richness and Abundance

A total of 49 phytoplankton species belonging to the phyla - Heterokontophyta, Euglenophyta, Cyanobacteria, Chlorophyta, and

Charophyta were recorded. Species richness ranged from 4 to 13 during summer and 5 to 21 during monsoon with lowest richness recorded at Barmana while highest species richness recorded at Ludhiana in summer and at Firozpur in monsoon seasons. Lowest diversity was recorded at Matterwara in summer and Budhanala in monsoon.

Abundance of phytoplankton ranged from 1.3 x 10^5 - 5.7 x 10^6 cells/l during summer while 1.2 x 10^5 to 4.1 x 10^6 cells/l during monsoon seasons, respectively. Minimum abundance was recorded at Barmana whereas maximum abundance was recorded at Govind Sagar during summer and at Firozpur during monsoon season, respectively.

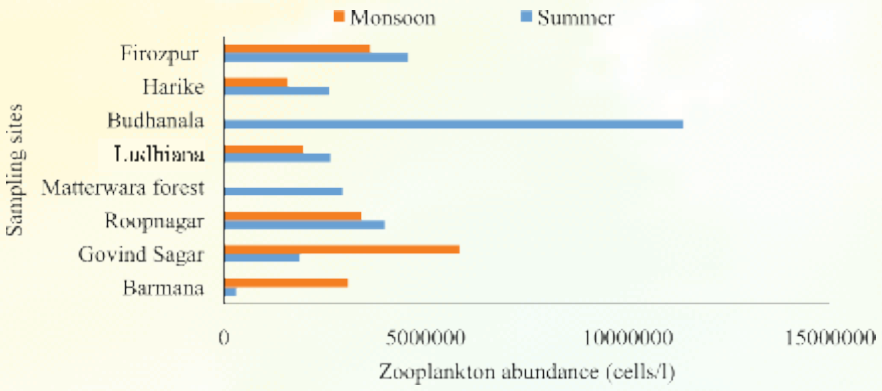
Zooplankton Species Richness and Abundance

A total of 24 zooplankton species belonging to phyla Arthropods, Protozoa, and Rotifera were recorded. Species richness ranged from 1 to 14 in summer with the least richness recorded at Harike and Ludhiana and highest richness at Firozpur. In monsoon season, the species richness ranged from 1 to 6, with minimum value at Mathewara and maximum at Harike.

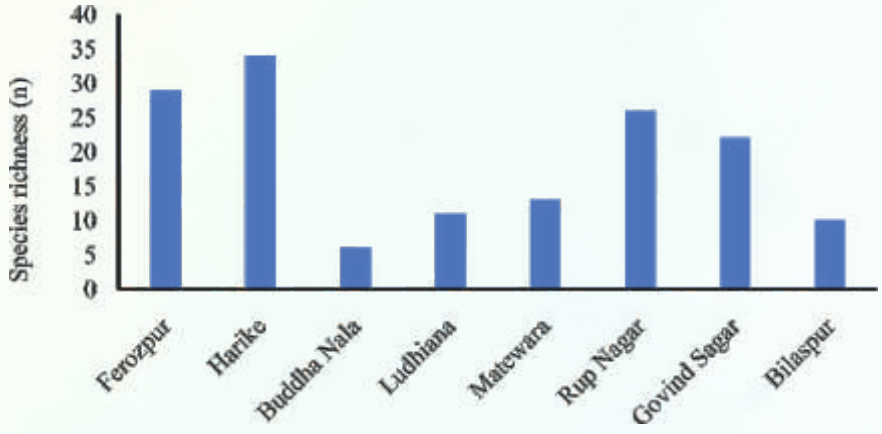
The zooplankton abundance ranged from 1 - 52 cells/l in summer and 1 - 8 cells/l in monsoon. Minimum and maximum abundances were recorded at Harike and Ferozpur, respectively.

Fish Diversity

A total of 42 fish species belonging to 26 genera, 14 families and 6 orders



Spatial variation in abundance (cells/cm^2) of zooplankton



Fish species richness in the Sutlej River

were recorded and among them 6 were exotics. Cypriniformes (27) was the most species-rich order, followed by Sluriformes (8), and Anabantiformes (6). Cyprinidaewas the most species-rich family (19), followed by Danionidae (3), Ambassidae (3), and Xenocyprinidae (3). As per IUCN (2022), 3 (*Chitala chitala, Ompok bimaculatus*, and *Parambassis lala*) were near-threatened (NT), 5 were vulnerable (*Schizothorax richardsonii, S. plagiostomus, S. esocinus, Bagarius bagarius*, and *Wallago attu*), 27 were of least concern (LC).

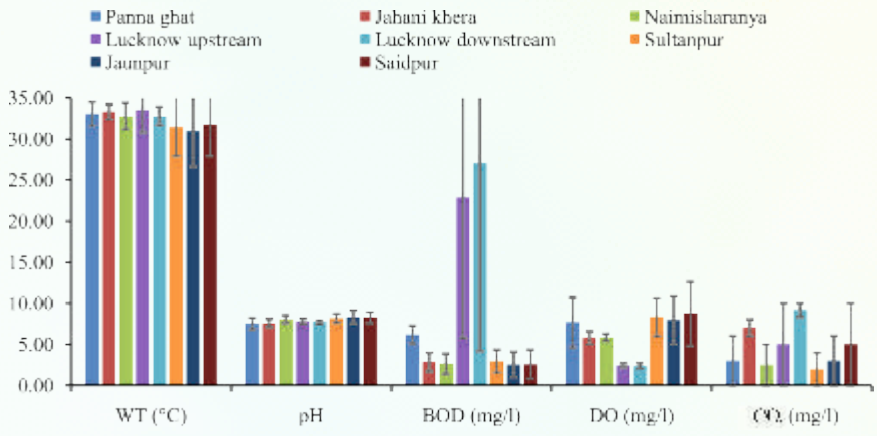
Sub-project 4: Estimation of Fish Catch, Diversity, Ecological Variability and Socio-Economics of Fishers of Gomati River towards Fisheries and Livelihood Sustainability

Duration: 01.04.2024 – 31.03.2026

Gomati River, a tributary of the Ganges, has a length of 960 km with a drainage area of 18,750 sq. km. The present study was undertaken to assess its fisheries, catch structure, ecology and socio-economic profile of the fishers through surveys on either bank of the river.

Physicochemical Characteristics of Water

The study was conducted at 8 sampling sites (Panna Ghat, Jahani Khera, Naimisharanya, Lucknow upstream, Lucknow downstream, Sultanpur, Jaunpur and Saidpur) of the river in summer and monsoon seasons. Water temperature, pH, transparency, DO, TDS, and electrical conductivity ranged from 26.60 – 36.20 °C, 6.80 – 9.10, 14 – 150 cm, 2.00 – 12.64 mg/l, 92 – 259 mg/l and 130 – 553 µS/cm, respectively. Alkalinity, hardness, nitrate-N and available-phosphate ranged from 80-420 mg/l, 64 -268 mg/l, BDL- 0.82 mg/l and 0.05 – 4.23 mg/l, respectively. The lowest dissolved oxygen of 2.36 mg/l was recorded at Lucknow.



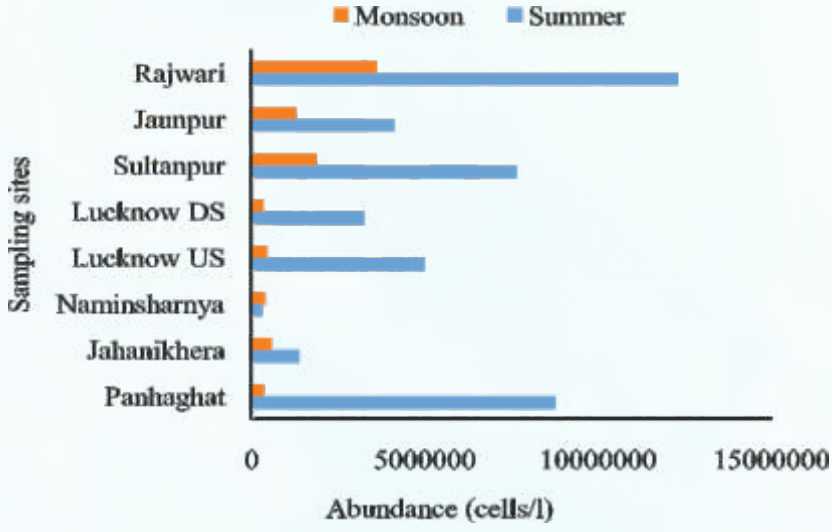
Salient water quality parameters of the Gomati River

Physicochemical Characteristics of Sediment

The Gomti River sediment was slightly alkaline (pH 7.75 – 8.80). Average specific conductivity ranged from 83 – 627.5 µS/cm with highest value recorded at Lucknow and lowest at Naimisharanya. The mean free $CaCO_3$, organic carbon (OC), available-P and available-N ranged from 1.75 – 7.00 %, 0.21 – 2.27%, 6.99- 66.64 mg P/100 g sediment and 13.86 – 37.72 mg N/100 g sediment, respectively. The highest organic carbon (OC), available-P and available-N were noted at Lucknow downstream suggestive of anthropogenic impacts. The sediment was dominated by sand (84.00 – 98.75%), followed by silt (0.50 - 15.00%).

Phytoplankton Species Diversity, Richness and Abundance

A total of 73 phytoplankton species belonging to phyla Heterokontophyta, Euglenophyta, Cyanobacteria, Chlorophyta, and Charophyta were found in the river. Species richness ranged from 2 - 26 during summer and 5 - 25 during monsoon with lowest richness at Namisharanya and Jaunpur and highest richness at Rajwari and Sultanpur. Shannon diversity and Simpson diversity indices of phytoplanktons ranged from 0.960 - 2.563, and 0.371 - 0.911, respectively. The minimum diversity was recorded at Banjarganj and the maximum at Haidergarh in summer. The minimum diversity was recorded at Jaunpur and the maximum at



Spatial variation in abundance (cells/l) of phytoplankton

Jahanokhera during monsoon season. The abundance of phytoplankton ranged from 2.6 x 10^5- 1.2 x 10^7 cells/l during summer and 3.3 x 105 - 3.5 x 106 cells/l during monsoon seasons. Minimum abundance was recorded at Gopamau and Panhaghar while maximum abundance was recorded at Rajwari.

Phytoplankton biomass ranged from 1.06 - 270.3 µg chl*a*/l during summer and 1.06 - 21.2 µg/l during monsoon seasons with maximum value was recorded at Ferozpur. Very low values were recorded at Jahanikhera, Gopaman and Namisharanya during summer and at Harike and Bermana during the monsoon.

Phytoplankton, Zooplankton and Periphyton Diversity and Abundance

Phytoplankton community was constituted of 73 species (59 spp. in summer, 43 spp. in monsoon) belonging to phyla Heterokontophyta, Euglenophyta, Cyanobacteria, Chlorophyta, and Charophyta. Zooplankton community was constituted of 40 species (40 spp. summer, 18 spp. in monsoon) belonging to phyla Amoebozoa, Arthropoda, Ciliophora, Protozoa, and Rotifera. There were 80 periphyton species (73 spp. in summer, 37 spp. in monsoon) belonging to Heterokontophyta, Cyanobacteria, Chlorophyta, Charophyta and Euglenophyta.

The abundance of phytoplankton ranged from 2.6 x 10^5 to 1.2 x 10^7 cells/l during summer (avg. 6.5 x 10^6 cells/l) and 3.3 x 105 to 3.5 x 106 cells/l during monsoon (avg. 1.1 x 106 cells/l) seasons Abundance of zooplanktons ranged from 2 to 634 cells/l during summer (av. 148 cells/l) and 2 to 33 cells/l during monsoon (av. 19 cells/l) seasons and that of periphyton ranged from 5.5 x 10^6 to 3.6 x 10^7 cells/cm^2 during summer (av. 1.4 x 10^7 cells/cm^2) while 3 x 10^5 to 4.6 x 10^6 cells/cm^2 during monsoon (av. 1.9 x 10^6 cells/cm^2) seasons, respectively.

The Shannon diversity index of phytoplankton ranged from 0.960 to 2.563 during summer and 2.215 during monsoon season. Simpson diversity index ranged from 0.371 to 0.911 during summer and 0.447 to 0.913 during monsoon season. The Simpson diversity of periphyton ranged from 0.601 to 0.911 during summer and 0.431 to 0.826 during monsoon seasons. Shannon diversity index of periphyton ranged from 1.331 to 2.588 during summer and 0.743 to 2.086 during monsoon season.

Phytoplankton Biomass (Chlorophyll-a)

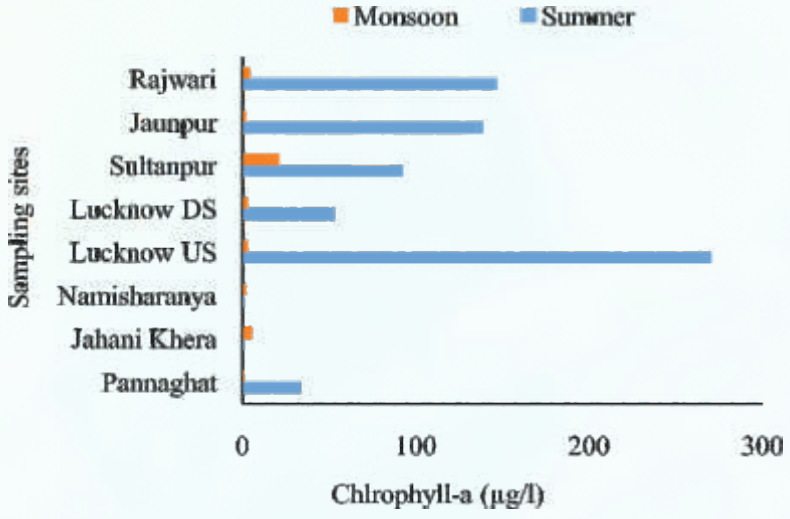
Phytoplankton biomass ranged from 1.06 to 270.3 µg/l during summer and 1.06 to 21.2 µg/l during monsoon seasons. The minimum value was recorded at Jahanikhera, Gopaman and Namisharanya during the summer season and at Harike and Bermana during the monsoon season. The maximum value was recorded at Ferozpur during both summer and monsoon seasons.

Macrobenthos Diversity

A total of 17 species of macrobenthos species (Mollusc 10, Bivalves 04, Insects-02 and clitellata-01) belonging to six orders and nine families were documented from studied sites of the river. The benthos density varied from 65-1840 N/m^2, 130-2619 N/m^2 during summer and monsoon, respectively. Presence of *Chironomous* was noted at almost all downstream sites indicating organic pollution, with very rich density noted at Lucknow (2619 N/m^2). Presence of *Lestes* sp. and *Lumberculus* sp.are also indicative of pollution in the river. Gastropod such as *Filopaludina bengalensis* and bivalve *Corbicula striatella* were dominant during the summer and monsoon periods, respectively.

Fish and Fisheries

A total of 47 fish species belonging to 33 genera, 14 families and 6 orders were recorded and among them 6 were exotics. The most species-rich order was Cypriniformes (22), followed by Sluriformes (11), and Anabantiformes (9), respectively. Cyprinidae (12) was the most species-



Spatial variation in chlorophyll-a (µg/l) of phytoplankton during summer and monsoon seasons

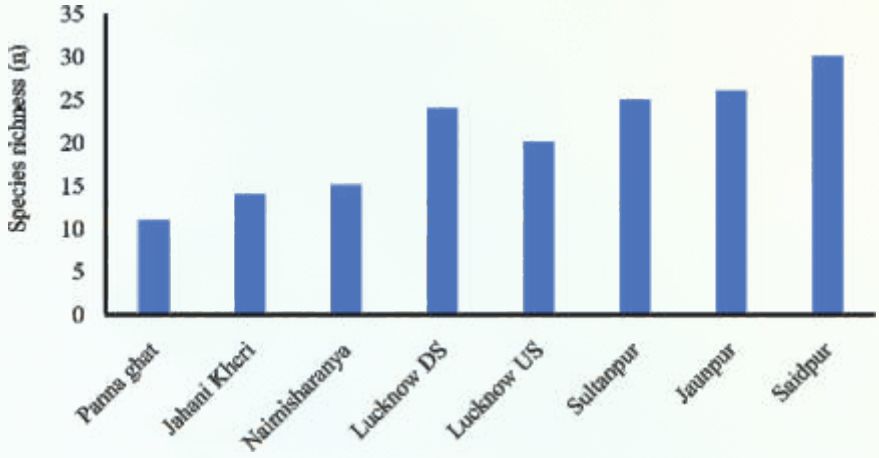


Filopaludina bengalensis *Parreysia corrugata* *Corbicula striatella*

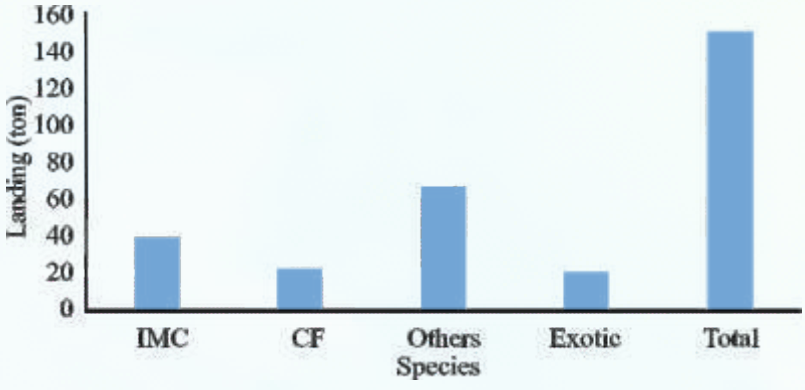


Chironomus sp. *Tarebia granifera* *Thiara scabra*

Dominant macrobenthos of river Gomti



Fish species richness along the Gomati River

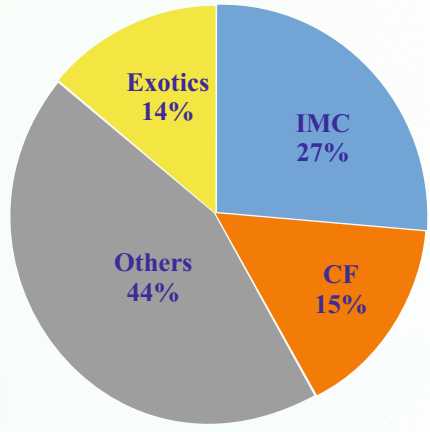


Fish Landing at Prayagraj during 2024

rich family, followed by Danionidae (7), and Bagridae (5), respectively. As per IUCN (2022), 3 species (*C. chitala, O. bimaculatus*, and *Parambassis lala*) were near-threatened (NT), 1 was vulnerable (*W. attu*) and 38 were of least concern (LC).

Fish Landing at Prayagraj

Fish landing from Allahabad stretch of the river Ganga was estimated to be 149.759 tonnes during 2024 with about 13.71 % share of exotic fishes. This catch is 6.10% higher over the fish landing in previous year. In the commercial catch, miscellaneous group of fishes (44.40%) dominated, followed by IMC, catfishes and exotics. Among IMC, catch of *C. mrigala* was highest. Among the exotic fishes, common carp dominated over tilapia. An increase in share of IMC in total landing also has been obsersed with respect to previous years and might be due to ranching effort by the institute in the river.

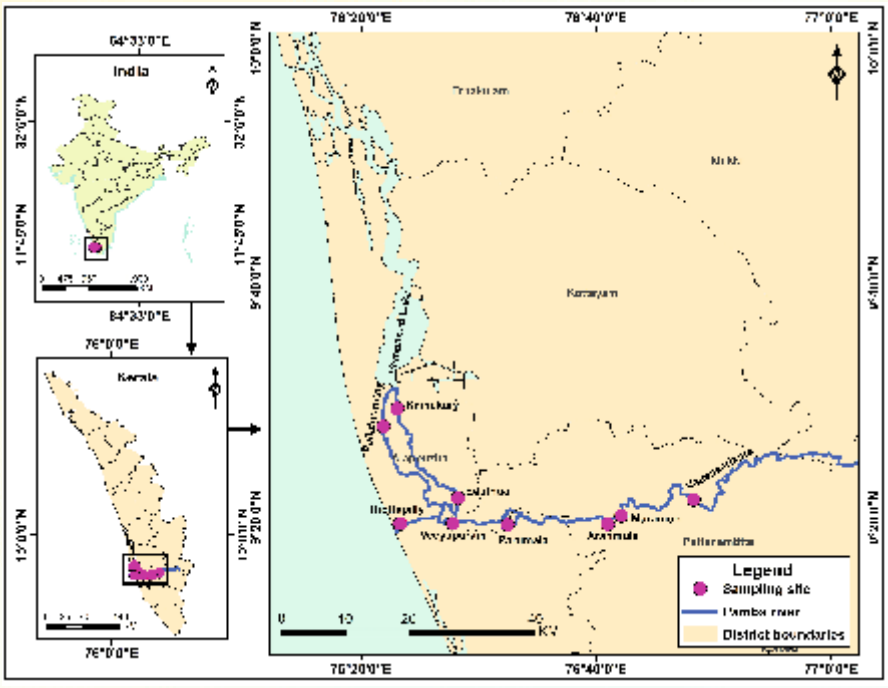


Share of different groups of fishes in landing

Sub-project 5: Estimation of Fish Catch, Diversity and Socio-Economics of Fishers of Pamba River towards Fisheries and Livelihood Sustainability

Duration: 01.04.2024 – 31.03.2026

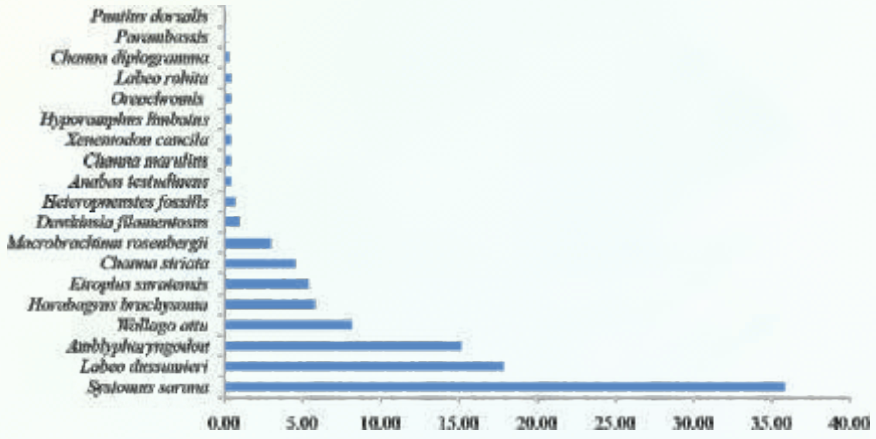
The Pamba is the third longest river in Kerala with 176 km length and 2,235 sq.km catchment area. After originating from the Western Ghats it flows through the districts of Pathanamthitta and Alappuzha, forms an arterial network in the Kuttanad area where one branch flows into Vembanad lake and the other flows into the Thottapally Spillway. Status of fisheries and fish catch from the river were surveyed at 9 stations.



Pamba river course and the sampling sites

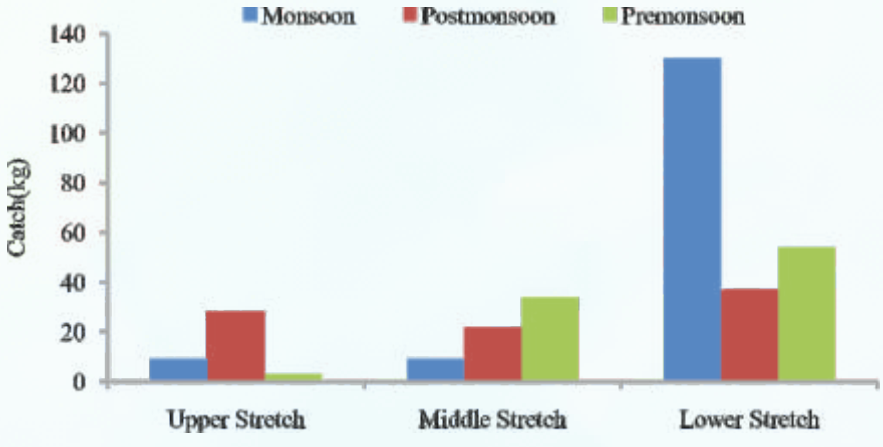
Estimation of Fish Landings and Catch Structure

Regular fishing is carried out in the middle and lower stretches, whereas in the upper stretch fishing is a part time activity. The highest fishing activities take place in the lower stretch. The survey revealed *Systomus sarana* as the dominant species (35.85%), followed by *Labeo dussumieri* (17.83%), *Amblypharyngodon microlepis* (15.14%) and *Wallago attu* (8.17%). *Macrobrachium rosenbergii* constitutes the only shellfish fishery, contributing 2.9% to the total catch. This high value shellfish is majorly exported.

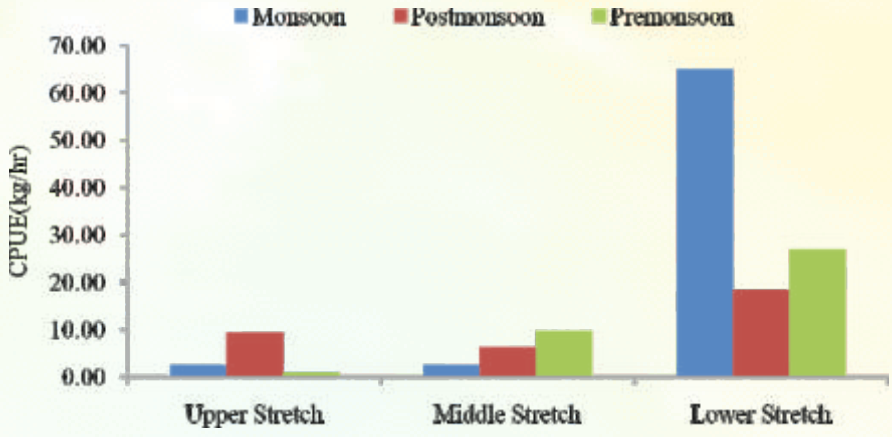


Species-wise contribution to fish catch from Pamba river

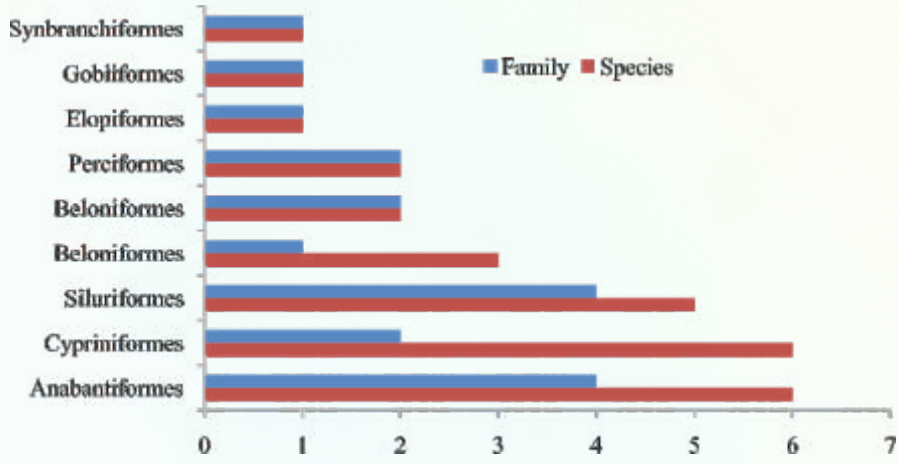
The highest catch per day per fisherman (130 kg) was recorded in monsoon season in the lower stretch and the lowest catch was 3 kg during pre-monsoon in the upper stretch. During the first showers of south-west monsoon, the matured fishes migrate for breeding and these are targeted by fishermen, a type of fishery known as '*oothapiditham*' in local language: this yields a significant catch of several fish species during the 4-5 days.



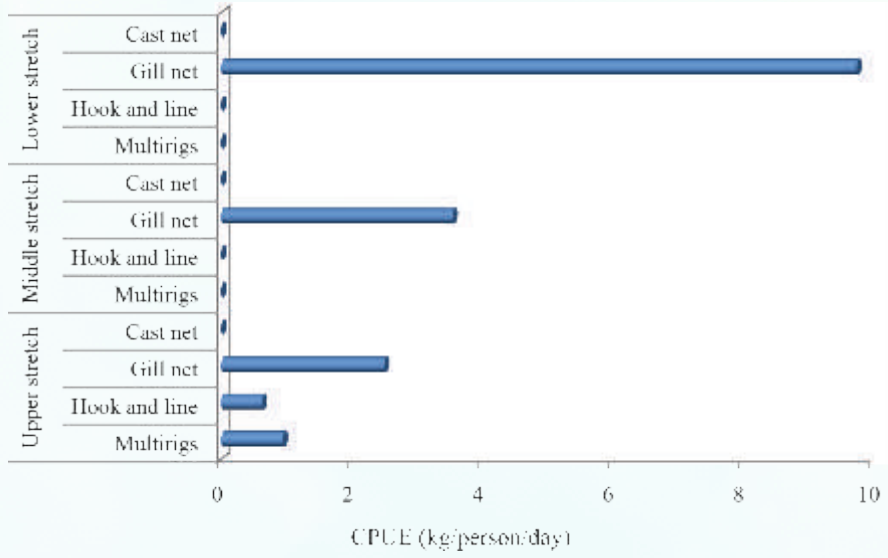
Average catch per day per fisherman in Pamba river



CPUE in different stretches of Pamba river



Finfish diversity in Pamba



CPUE of different fishing gears in Pampa river

Assessment of Spatial Variations of Ichthyofaunal Diversity and Time Scale Changes in Rivers

Twenty seven finfish species belonging to 24 genera, 18 families and 9 orders were recorded during the survey. *Labeo rohita* and *Oreochromis nilotius* were the non-native species recorded form the river. Commercially important species *viz*. *Horabagrus brachysoma*, *Channa diplogramma*, and *Wallago attu* were categorized as 'vulnerable' as per the IUCN Redlist.

The number of species remains relatively stable across seasons and the river stretch, ranging from 19 to 23. Shannon and Simpson indices indicate higher diversity in the lower stretch with 23 species. The dominance index values are high in the post monsoon season. This is may be due to the abundance of *Amblypharyngodon* (40-60%).

Fishing Craft and Gears and Fishing Effort

Gill nets of 35 -130 mm mesh sizes is the major fishing gear used in the river; nets of different mesh sizes target different fish species. Gears like seine nets, cast nets and hook and line are also used. FRP coated plank-built boat is the major crafts used for fishing. Upper stretch has dominant multi-rig fishery, and hook and line fishery with occasional use of gill nets. CPUE of gillnet fishery is 2.5 kg/fisher/day in the upper stretch, 3.55 kg/fisher/day in the middle stretch and 9.5 kg/fisher/day in the lower stretch of the river.

Project Code: REF/24-27/18

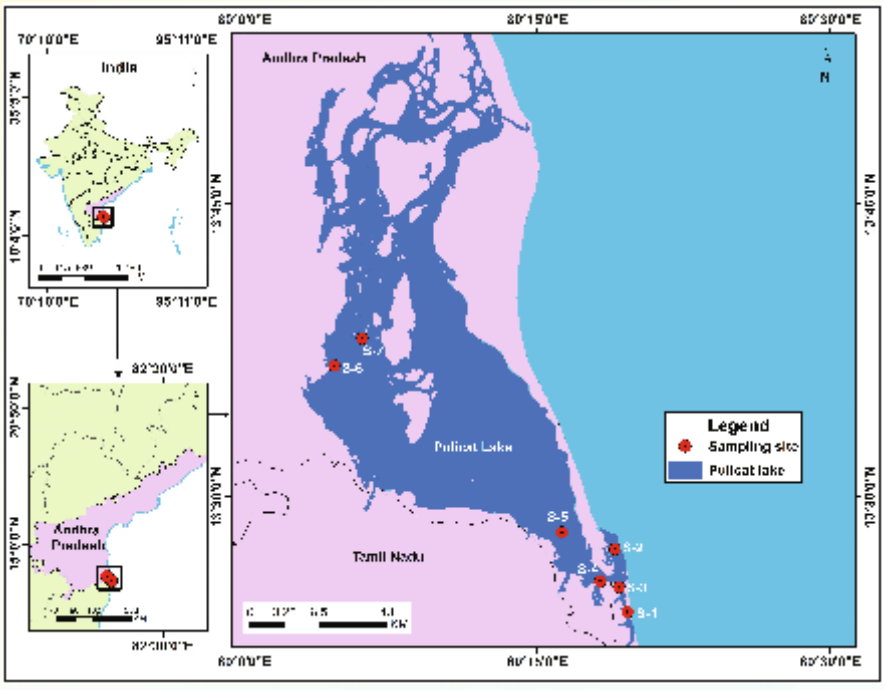
Project Title: Assessing Changes in Estuarine Fisheries Resources for Sustainable Management (Pulicat Lake, Kayamkulam Estuary, and Mahi Estuary)

Sub-project 1: Assessing Shifts in the Fish Diversity, Environment and Fish Species Stocks with Respect to the Climate Change Scenario of Pulicat Lake

Duration: 01.04.2024 – 31.03.2027

Pulicat Lake Fishery

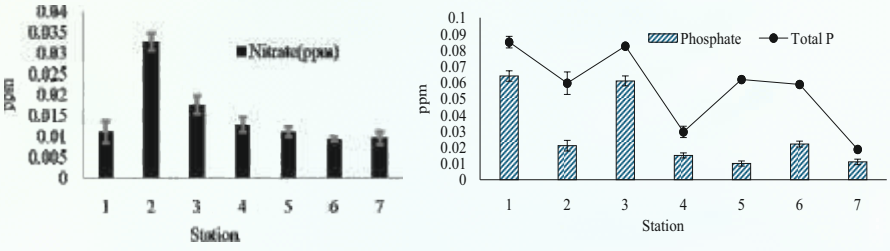
The Pulicat Lake is the second largest saltwater lagoon on the east coast of India. Its unique hydrology makes it a highly productive ecosystem providing diverse habitats for a variety of plants and animals, including fish and shellfish. However, the lake is under serious pressure. The habitat characteristics and fisheries of the lake were studied during July-August at seven sampling sites in Tamil Nadu and Andhra Pradesh parts of the lake.



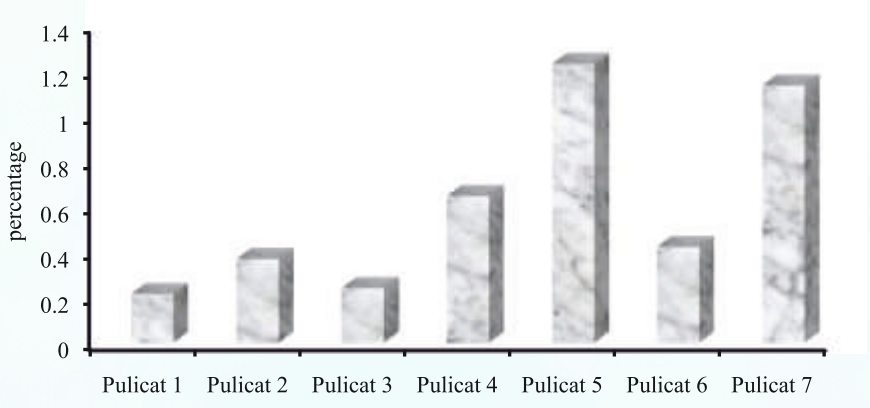
Map showing the study sites in Pulicat Lake

Water and Sediment Parameters

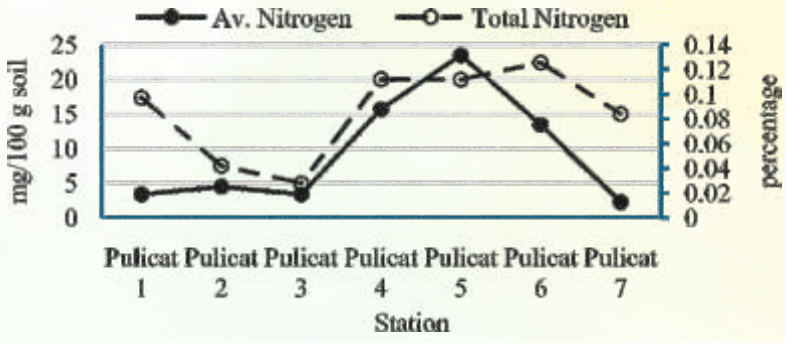
The water pH was predominantly alkaline (8.2-9.4), influenced by factors like flow and catchment geology. This was also reflected as elevated total alkalinity (120-272 ppm). The lake exhibited hypersalinity (salinity 31.6-43.4 ppt) at all sampling sites. The primary reason being the absence of rainfall resulting in minimal freshwater influx to the lake from associated rivers during the sampling period. The lake also had considerable shallow water depth (40 - 135 cm at various stations), coupled with elevated ambient temperature resulting in heightened evaporation. The sodium concentration in the lake water often exceeded 1000 mg/l. Water total hardness ranged between 5700 and 7500 mg/l. The lake in Tamil Nadu part had higher concentrations of nitrogen and



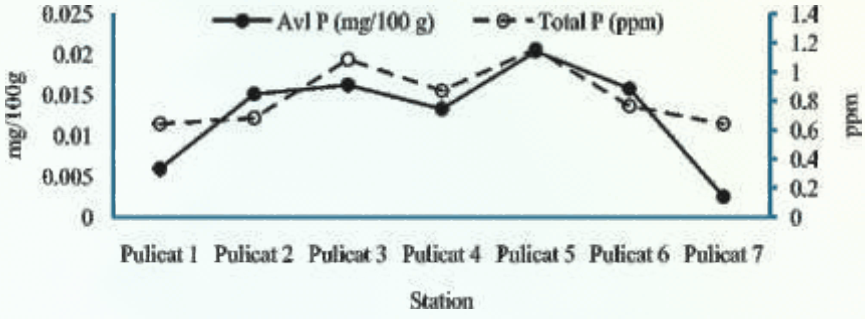
Nitrogen and phosphorus contents in Pulicat lake water



Organic carbon content in sediment of the Pulicat lake



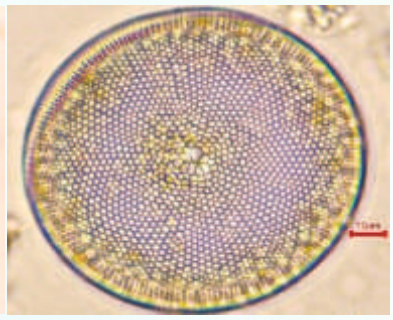
Total and available nitrogen contents in Pulicat lake sediment



Total and available phosphorus contents in Pulicat lake sediment



Cylindrotheca closterium



Coscinodiscus sp.

Dominant phytoplankton taxa in Pulicat lake







Pirenella cingulata *Meretrix casta* *Geloina bengalensis*

Dominant microbenthic species in Pulicat lake

phosphorus in water (NO_3^{-1} = 0.0005-0.0026 ppm; PO_4^{-3} = 0.01-0.06 mg/l). The silicate content ranged from 2.2 to 5.5 mg/l.

Sediment samples from the lake had near-neutral pH (range: 6.63 - 7.45). The soil is mostly sandy (80-92% sand) while samples from stations 4 and 5 showed significant proportions of silt (30-36%) and clay (8-10%). The organic carbon contents were low in Tamil Nadu parts than that in the Andhra part of the lake. The sediment at station 5 had higher levels of nutrients, including total and available nitrogen and phosphorus, compared to other sites.

Plankton Diversity

A total of 19 genera of phytoplankton were recorded, with dominance of Bacillariophyceae (13), Cyanophyceae (2), Dinophyceae (2), and Chlorophyceae (2) during the survey. Bacillariophyceae constituted 69.26% of the total plankton population, followed by Cyanophyceae (17.17%), Dinophyceae (6.30%), and Chlorophyceae (5.92%). Among Bacillariophyceae, abundance of *Cylindrotheca closterium* was observed from the sea mouth of Pulicat Lake at Tamil Nadu. The other dominant genera include *Cocconeis* sp., *Cymbella* sp., *Gyrosigma* sp., *Skeletonema* sp., and *Coscinodiscus* sp. The study could record only three genera of zooplankton, constituting 13.9% of the total plankton population, comprising of two copepod and one protozoan species. The highest plankton population was recorded near Pulicat Bridge (4233 units/L) and lowest from Venadu (692 units/L).

Macrobenthic Fauna Diversity

A total of 16 macrobenthic species belonging to nine families and represented by bivalves (11 species, 3 families), gastropods (4 species, 4

families), and crustaceans (1 species, 1 family) were recorded from the lake. The macrobenthic population was highest in the Pulicat Sanctuary area (1523 no./m²) with abundance of *Meretrix meretrix* (609 no./m²), and the lowest near the Pulicat Bridge (826 no./m²). The common species available in the study were *Pirenella cingulata, Meretrix casta,* and *Geloina bengalensis.*



Stake net fishery at Tamil Nadu part of Pulicat Lake

Fish and Fisheries

The monsoon survey recorded a total of 50 finfish species belonging to 13 orders and 29 families. Perciformes dominated the catch (12 species), followed by Acanthuriformes (9 species), Clupeiformes (6 species), Carangiformes, and Mugiliformes (5 species each). As per the IUCN Red List Status, 34 species fall under the Least Concern (LC), 12 under Not Evaluated (NE), 3 under Data Deficient (DD) category.



Drag net fishery at Tamil Nadu part of Pulicat Lake



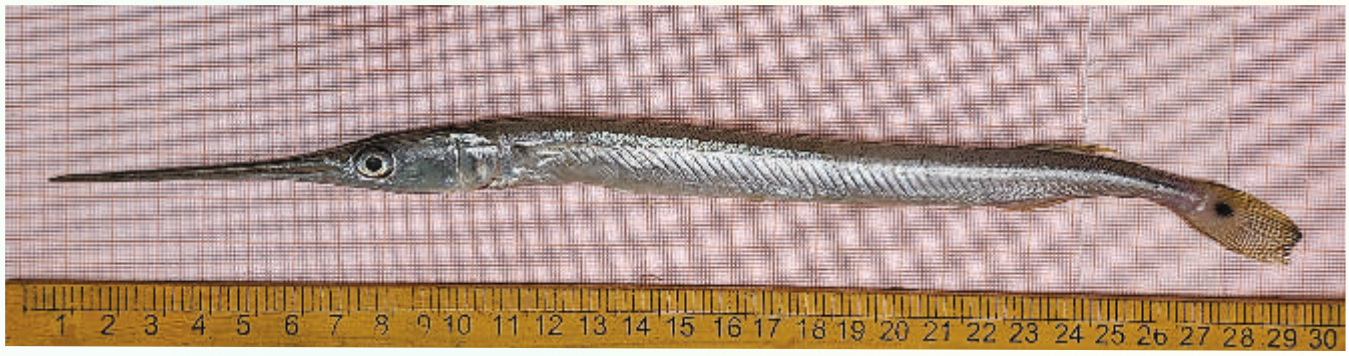
Pulicat Lake fish market in Tamil Nadu



Lutjanus russellii, a dominant species from TN part



Etroplus suratensis, a dominant species from TN part



Strongylura strongylura, a dominant species from AP part



Fish landing sites at Pulicat Lake, AP part

The most common fishing gears in Tamil Nadu part were stake nets (*suthu valai*) used to catch shrimp, and drag nets (*badi valai*), which are like shore seines used to catch all kinds of finfish. *Fenneropenaeus indicus* and *Penaeus monodon* are the most targeted shrimps. Among the finfishes, *Mugil cephalus*, *Crenimugil seheli*, *Leiognathus splendens*, *Pomadasys maculatus*, *Siganus javus*, *Terapon jarbua*, *Strongylura strongylura* majorly constituted the catch. In the Andhra Pradesh part of the lake, both stake nets and gill nets are dominant gears and majorly target fish like *Strongylura strongylura, Strongylura leiura, Mugil cephalus,* and *Terapon jarbua*. The catch per unit effort (CPUE) was estimated to be 1.5-3.5 kg/net/day for stake net, and 5.5-21.5 kg/net/day for drag net.

Sub-project 2: Fishery Resource Assessment and Ecological Monitoring of Kayamkulam Estuary, Kerala

Duration: 01.04.2024 – 31.03.2027

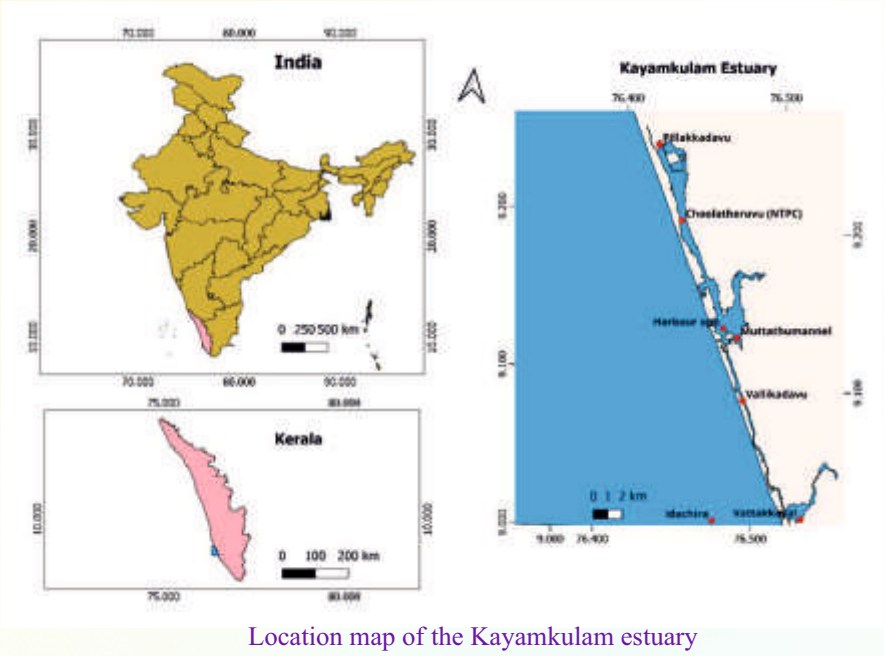
The Kayamkulam estuary is a typical estuary along the Kerala coast spread across two districts (Alappuzha and Kollam) and extending between latitudes 9°2' N and 9°16' N and longitudes 76°25' E and 76°32' E. It is connected to Vembanad in the north and Ashtamudi Lake in the south. The present study aims to assess the hydro-geochemistry, fish and fisheries, and ecosystem health of the estuary.

Water Quality Parameters

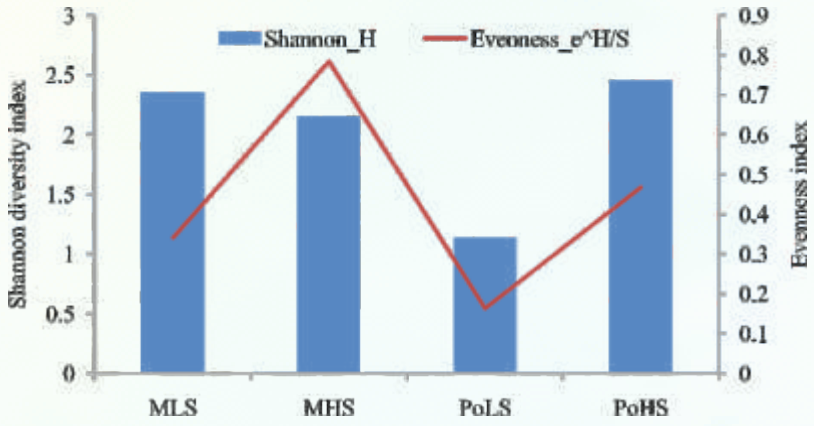
The pH of Kayamkulam estuary water ranged between 8 7.5 and 9.3. The salinity did not vary much between the two sampling periods, with an avg. salinity of 17.5 ppt. Lower salinity and total hardness were recorded at the Pillakkadavu, Vallikadavu, and Vattakkayal sampling stations, which are farther from the estuary-ocean confluence. High total hardness (>700 mg/l) in both sampling periods might be from saline sources. Biological oxygen demand (BOD) varied between 0.4 and 6 ppm. Water transparency was high (>80 cm) at all the sampling stations.

Fish Assemblage

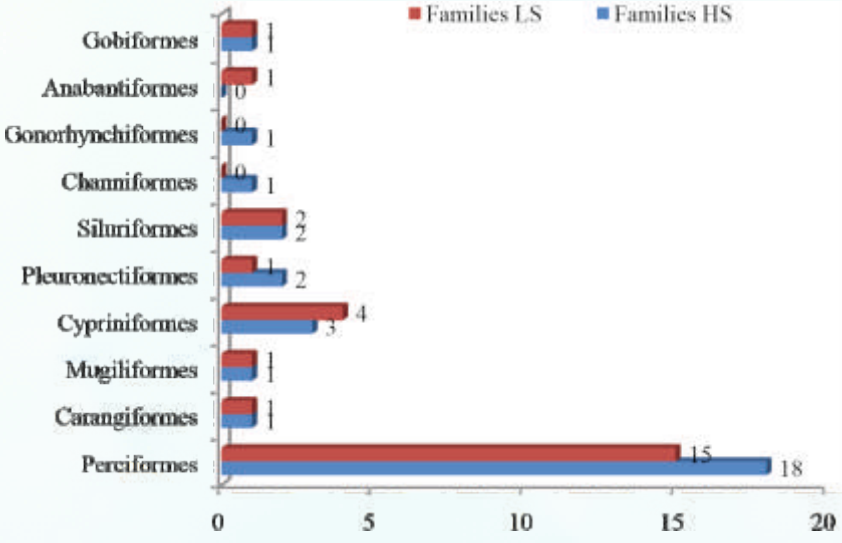
The fish assemblage in the Kayamkulam estuary consisted of 54 species belonging to 46 genera, 26 families, and 10 orders in the high saline zone of the estuary. *Ambassis thomassi* (41.1%), *Amplypharyngodon melettinus* (12.4%), and *Valamugil cunnesius* (10%) were the major species contributing to fish diversity. Order Cypriniformes had the maximum diversity (10 species). *Oxyurichthys* sp., an indigenous fishery of the estuary, recorded 11.1% of the diversity of total species



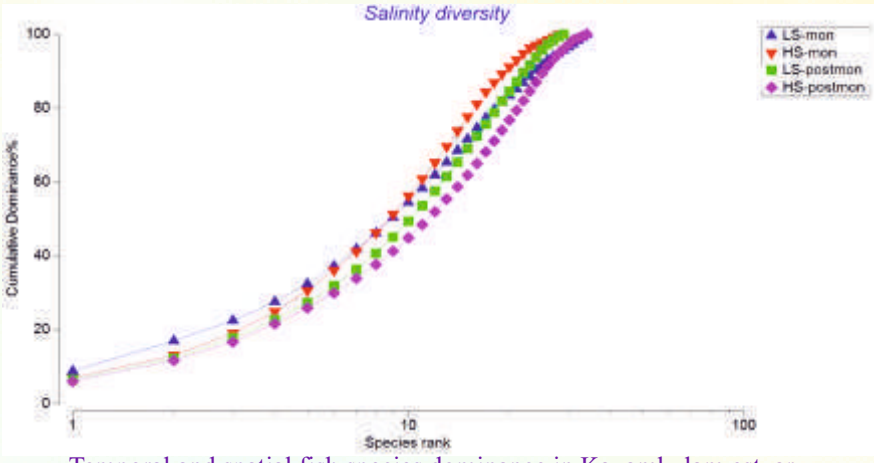
Location map of the Kayamkulam estuary



Temporal and spatial diversity indices in Kayamkulam estuary
MLS: monsoon low saline; MHS: monsoon high saline
PoLS: post-monsoon low saline; PoHS: post-monsoon high saline



Salinity-wise family level fish diversity of Kayamkulam estuary
LS: low saline; HS: high saline



Temporal and spatial fish species dominance in Kayamkulam estuary
LS: low saline; HS: high saline



Etroplus suratensis



Fenneropenaeus indicus



Scatophagus argus

Catch from Kayamkulam estuary



Crassostrea collection and processing by women fishers in Kayamkulam estuary

abundance. A total of 44 species belonging to 38 genera, 30 families, and 10 orders were documented in the low saline zone. *Leiognathus dussumieri* (18.0%) and *Etroplus suratensis* (14.72%) contributed most to the fish diversity (in abundance) in the Kayamkulam estuary in the low saline zone.

Shannon diversity index is highest in high saline zones (2.46) during post-monsoon; evenness index is also highest (0.47) during this time. The high saline zone may have experienced a nutrient influx contributing to this phenomenon. The highest number of families and species belong to the order Perciformes, followed by Cypriniformes. The dominance study indicated a stable and balanced ecosystem in the high saline zone, with 12 species representing 80% of the fish diversity during the post-monsoon period.

Fishing Gears

Gill nets and boat seines are the major gears used in the Kayamkulam estuary. Gill nets with mesh sizes of 40 mm, 50 mm, 70 mm, 80 mm, and 90 mm are widely used. Boat seines of mesh sizes 10-12 mm and trammel nets (inner mesh size of 50 mm and outer mesh sizes of 110 mm) are also used.

Women in Fisheries

The *Crassostrea* fishery is prominent at Mutathumannel (Latitude 9.128957, Longitude 76.481392) part of the estuary. Fisher women play an important role in collection and processing of *Crassostrea* and generate additional income for their families. Average CPUE estimated from oyster fishery by women is 1.5-2.0 kg/hr/person, generating an income of ₹375-500/hr/woman.

Sub-project 3: Assessment of Ichthyofaunal Diversity, Fish Catch, Water Characteristics and Socioeconomics of Mahi estuary

Duration: 01.04.2024 – 31.03.2027

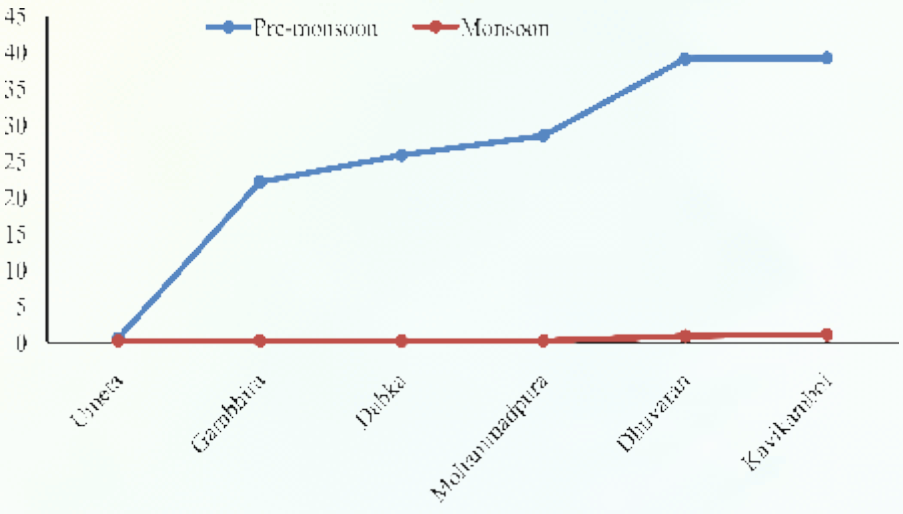
Mahi estuary is one of the most important estuarine fishery resources in Gujarat, and its estuarine stretch extends up to 50 km upstream. However, information on finfish and shellfish diversity, species assemblages, food and feeding habits, etc. of the estuary are lacking. The present work aims to assess ecology, fish diversity and catch of the Mahi estuary.



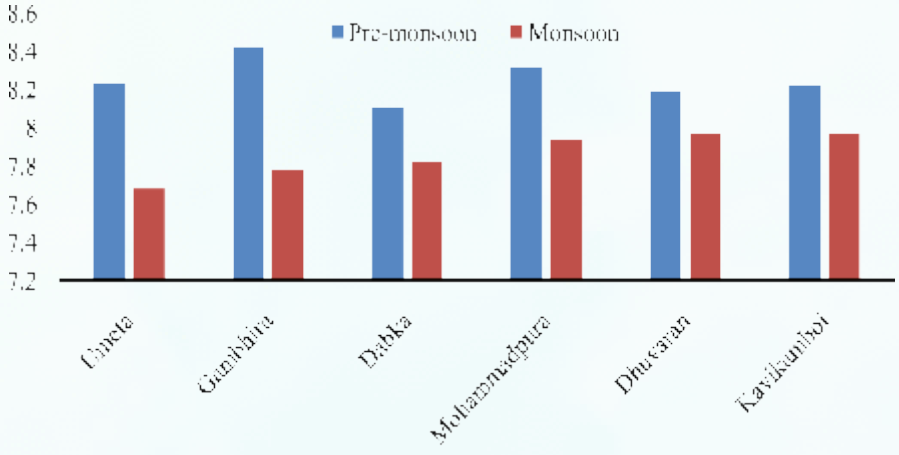
A view of the Mahi estuary

Water and Sediment Characteristics

The study revealed distinct zonation in Mahi estuary during pre-monsoon and monsoon seasons. During pre-monsoon, the estuary was clearly demarcated into two zones: the polyhaline zone and the euhaline zone. However, with increased freshwater inflow during monsoon, the entire estuary transitioned into an oligohaline zone. Water and sediment characteristics also exhibited seasonal variations, especially during monsoon. A notable decrease in salinity occurred during the monsoon, along with reductions in associated parameters including total dissolved solids, specific conductivity, and total hardness. The pH of water and total alkalinity were higher during pre-monsoon than in the monsoon season in all the sampling stations. The water pH is slightly alkaline with decreases significantly during monsoon. Total alkalinity also decreases significantly during the monsoon.

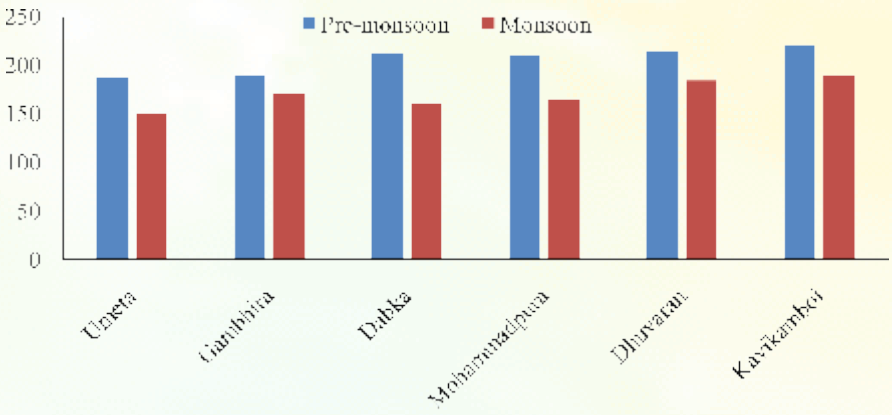


Water salinity (ppt) at different sampling stations of Mahi estuary



Water pH at different sampling stations of Mahi estuary

Soil properties exhibited spatial and seasonal variations at different locations, with alkaline pH at all locations and minor seasonal fluctuations. Specific conductance decreased during monsoon, attributed to dilution effects from



Total alkalinity (mg/l) at different sampling stations of Mahi estuary



Dominant prawn and fish species in the Mahi estuary

rainfall. The organic carbon content showed stability or a slight increase during the monsoon season, with highest value of 1.92% at Kavi Kamboi and lowest value of 1.26% at Gambhira in pre-monsoon season. Phosphorus levels increased during monsoon period, with highest level found at Kavi Kamboi (0.032 mg/100 g). During the pre-monsoon season, Kavi Kamboi recorded the highest total nitrogen content (0.1386%), while Mohammadpura recorded the lowest (0.1012%). Soil texture exhibited relative stability throughout the seasons, with Kavi Kamboi displaying the highest sand content (72%), and Mohammadpura recorded the highest silt content during the monsoon (34%).

Fisheries Status

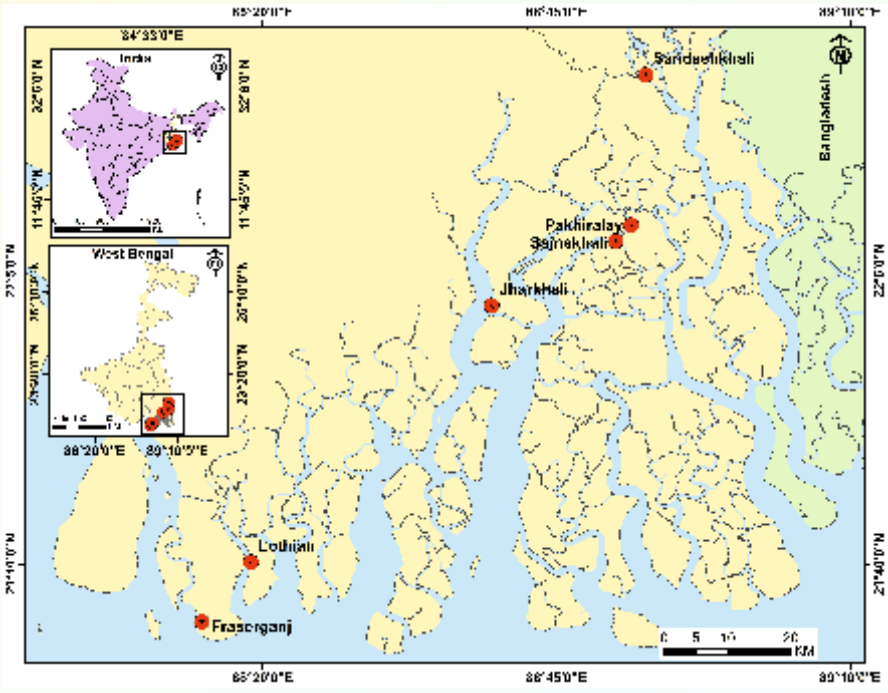
A total of 13 fish species and 1 shellfish species belonging to 12 families and 11 orders were recorded from the estuary. Notably, *Oreochromis niloticus* was found in significant quantities in both the seasons. The catch per unit effort (CPUE) was estimated at 2 kg/boat/day in pre-monsoon and 4.5 kg/boat/day in monsoon season. The total fish catch from the estuary ranged between 1200 and 1400 tonnes. The major fishing gears employed include gill nets, cast nets, and stake nets, with wooden non-motorised boats serving as the principal fishing craft.

Project Code: REF/24-27/19

Project Title: Evaluation of Ecosystem Health, Fish Catch Structure, Mangrove Landscape Patterns Aiming to Sustainable Development Goals (SDGs) with Changing Climate Scenario in Indian Sundarbans

Duration: 01.04.2024 – 31.03.2027

The Sundarban, being one of the most biodiverse mangrove forests and a world heritage site has attracted a lot of attention. Studies revealed the overall forest loss for Sundarban remained unchanged in-terms of aerial extent, but in more recent research pointed out a loss of overall mangrove forest area between 2006 and 2016. However, a complete understanding about the mangrove landscape pattern with the changes in land-use change is not available. To fills this scientific gap, sampling was conducted at Jharkhali, Sajnekhali, Pakhiralay, Sandeshkhali, Fraserganj and Lothian island of Indian Sundarbans eco-region on environmental parameters, mangroves and other biota during the monsoon season of the year 2024.



Location map of core sediment sampling points in Indian Sundarbans

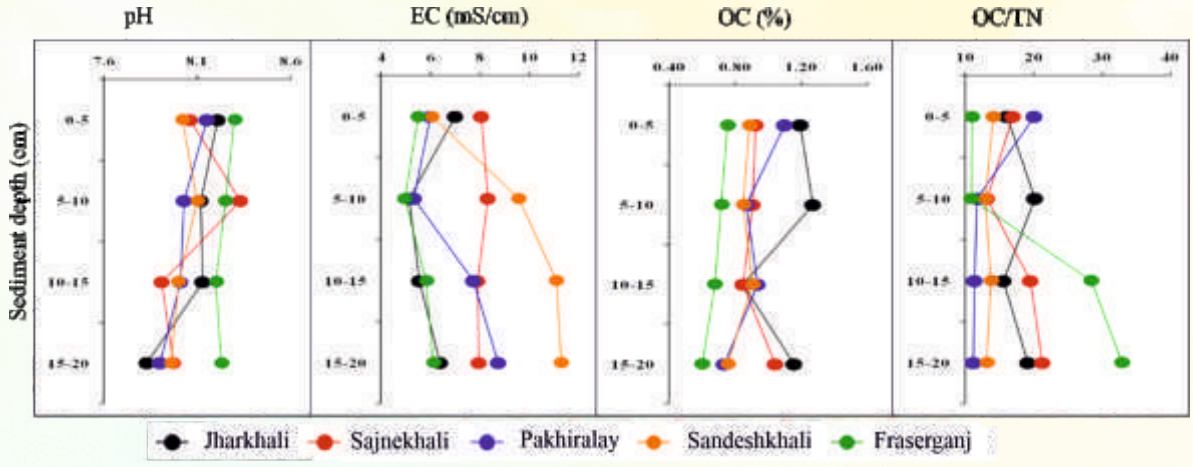
Basic physico-chemical water quality parameters revealed pH for the studied station showed neutral to sub-alkaline nature (8.11-8.55). High turbidity was recorded which might be due to riverine influx bearing excess suspended load coupled with high monsoon precipitations. Nutrients are sufficient to support primary productivity. Noticeable salinity in monsoon season indicates severing these inner estuaries completely from the freshwater source at their upstream heads. Metal concentration (µg/l) in water varied from 0.7-5.3, 1.6-273.4, 42.1-193.8, BDL-0.18, BDL-6.04, BDL-10.82, 1.87-21.07, 0.01-1.12, BDL-0.16 and 0.02-3.4 µg/l for Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Cd and Pb, respectively.

Vertical Distribution of Major Trace Elements

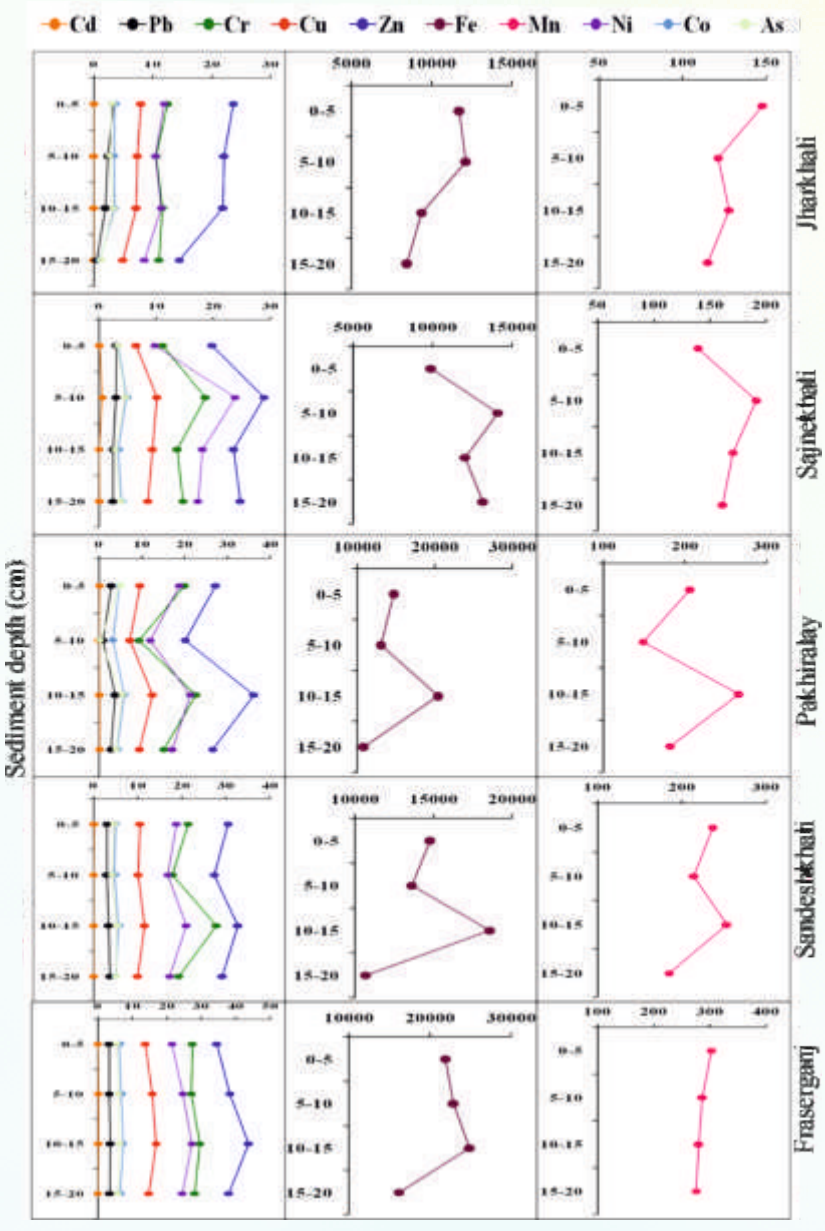
The study assessed the current status

Table: Changes in physiochemical and nutrient parameters in Indian Sundarban estuary

Parameters	Jharkhali	Sajnekhali	Pakhiralay	Sandeshkhali	Fraserganj	Lothian
Water(°C)	31.5	30.4	30.7	32.5	32.4	32.4
pH	8.545	8.26	8.12	8.105	8.32	8.54
Sp. conductivity (mS/cm)	25.5	25.4	23.7	7.1	24.7	25.3
Total hardness(mg/l)	4800	5000	3800	800	2350	3000
Turbidity (NTU)	34.35	199	236	90.65	120	133
Dissolved oxygen (mg/l)	7.115	5.4	5.2	2.6	5.6	5.3
NO_3^--N (mg/l)	0.02	0.00	0.01	0.01	0.01	0.01
PO_4^{3-}-P (mg/l)	0.02	0.02	0.02	0.09	0.06	0.05
TP (mg/l)	0.14	0.14	0.12	0.11	0.09	0.09
SiO_2 (mg/l)	8	8.33	8.12	16	9.75	8.25
Chl-a (µg/l)	6.81	6.35	5.41	0.67	2.20	1.89
Salinity (ppt)	14.6	14.9	14.4	3.2	12.2	14.2



Variation of general sedimentary parameters in the sediment core



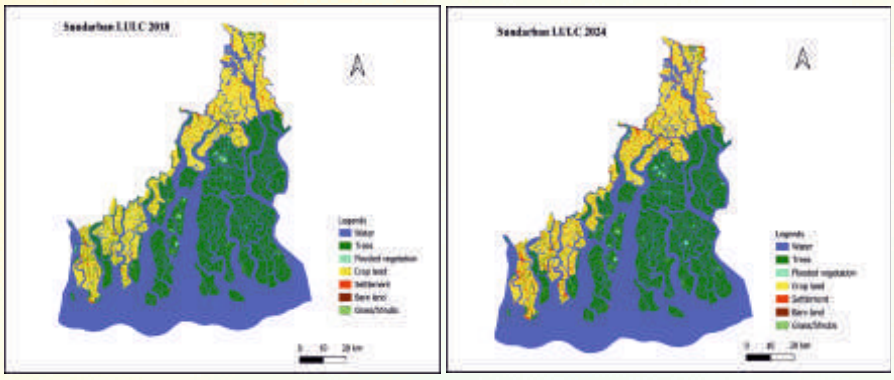
Depth profile of heavy metal concentrations (mg/kg) in core sediments from Indian Sundarban

of trace element concentrations in core sediments. The pH of the core sediments was slightly alkaline (7.83-8.33) in nature which inducing formation of different metal hydroxides and carbonates and thus, protecting the water and sediment systems if there is an excessive availability of heavy metals. The spatial variation of organic carbon (OC) concentration down the core varied in the range 0.60-1.27% and revealed that the top layer acted as a reservoir of OC and low OC in sub-surface sediment. Highly variable vertical profile in the OC/TN ratios clearly suggests anthropogenic N loadings altering the OC/TN stoichiometry.

The range of variations in concentration of Fe was in between 4645.6 mg/kg and 24807.56 mg/kg with an average value of 14237 ± 5209.7 mg/kg. The lowest and highest concentrations were observed in the Pakhiralay (5-10 cm) and Fraserganj (10-15 cm) sediment, respectively. Except Sajnekhali, all other stations exhibited a decreasing trend in Fe and Mn concentration towards the bottom layer. Amongst the minor element, Zinc concentration was highest and it varied between 14.58 mg/kg and 43.74 mg/kg with an average value of 28.20 ± 7.34 mg/kg. The Cd varied in between BDL and 0.63 mg/kg with an average value of 0.09 ± 0.14 mg/kg,

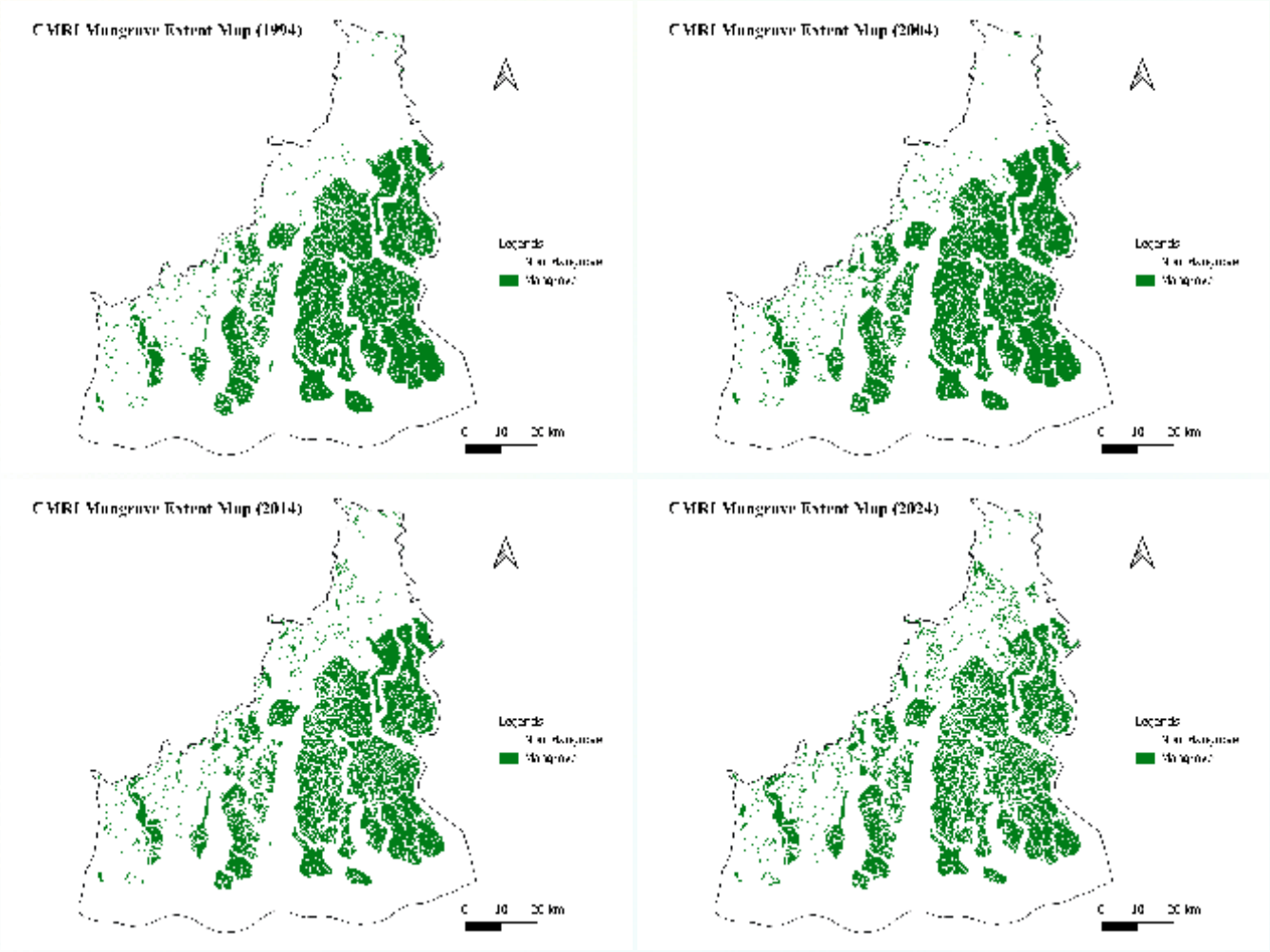
and the average concentration was the lowest among the studied elements. The pollution levels varied from unpolluted to moderately polluted, and in general, the patterns of metal concentrations reflect differential trace element loading due to human activities.

Land Use Land Cover Changes in Indian Sundarbans Area During 2018 to 2024

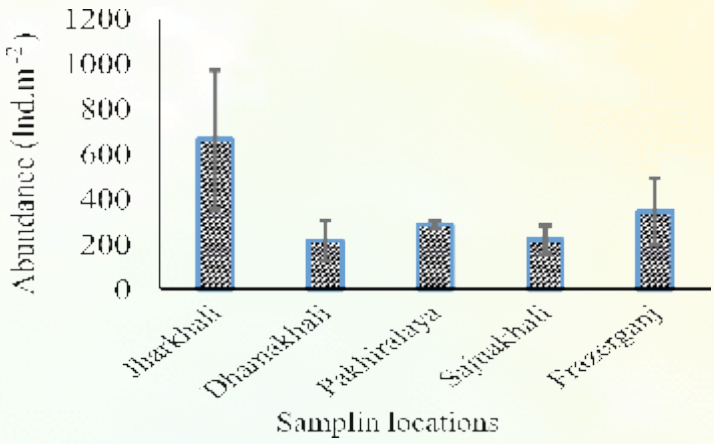


Land use land cover (LULC) maps over last six years

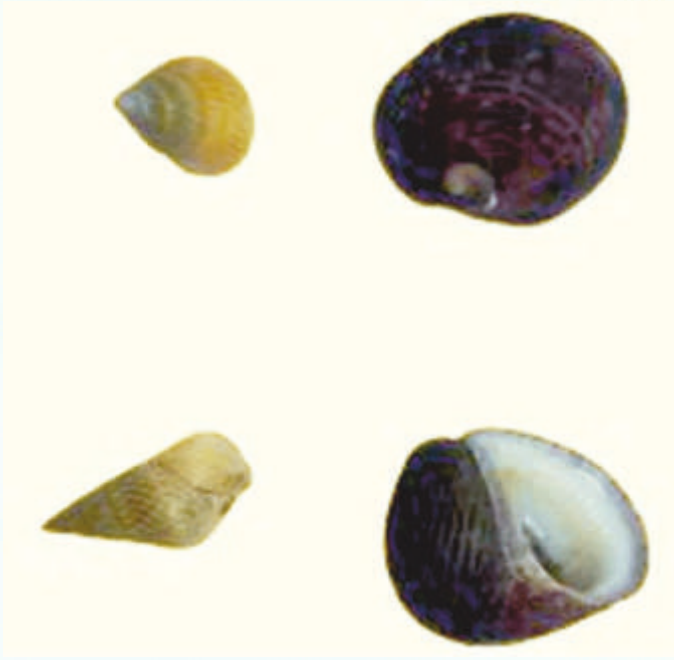
Land use land cover maps were prepared for the Sundarbans area for the year of 2018 and 2024 using Sentinel-2 data. The satellite images were processed for atmospheric and radiometric correction and DN values were converted to reflectance values at the top of the atmosphere and an NDVI map was prepared. Supervised maximum likelihood classification (MLC) was performed and 7 classes were assigned on the study area. The classifications assigned were: water, tree, flooded vegetation, crop land, settlement, bare land and grass/shrubs. High-resolution Google Earth images were used as a reference point to identify the actual LULC classes. The LULC maps of our study revealed that in 2018 the water area was 3359.08 km^2, which increased to 3424.39 km^2 in



Classification outputs of CMRI on Indian Sundarbans



Abundance of macrobenthos in different sampling locations



Species dominated in mangrove trunk
(*Littoraria melanostoma* and *Nerita articulata)*

2024. Tree cover has reduced from 2128.5 km^2 in 2018 to 2026.4km^2 in 2024. However, settlement area has been significantly increased by 96.3 km^2 over the studied years. This shows the increasing negative impact of human activities on the fragile ecosystem of Sundarbans.

Decadal Change in Mangrove Extent of Sundarbans

Mangrove extent maps were prepared using Combine Mangrove Recognition Index (CMRI) for the year of 1994, 2004, 2014 and 2024, to estimate the decadal change in mangrove area of Indian Sundarbans. Landsat 4-5, Landsat 7, Landsat 8 and Landsat 9 data were used for the map preparation. The mangrove area in 1994, 2004, 2014 and 2024 were 1798.8, 1850.4, 1624.6, and 1584.3 km^2 respectively. The mangrove area had increased by 51.6 km^2 in 2004 from 1994. From 2004 onwards there has been decrease in area under mangrove, and it has decreased by 266 km^2 in 2024.

Association of Algae and Macrobenthos in Mangrove Pneumatophores

Attached macroalgae samples were collected from the mangrove pneumatophores of *Avicenia marina* and *A. alba.* A total of 32 attached algae species were recorded belonging to 22 genera. Cyanophyceae dominated throughout the algal population followed by Chlorophyceae in terms of numerical abundance. The pneumatophores of *Avicenia marina* showed the dominance of filamentous cyanophyte species *Lyngbya majora, Oscillatoria tenue and Phormidium* spp. Among macrobenthos, species *Pyrinella cingulata* was the single dominant gastropods followed by *Nerita articulate* irrespective of mangrove species pneumatophores. However, in the trunks species *Littoraria melanostom* are presented maximum numbers followed by *N. articulate* primarily in *A. marina* and *A. alba.* The mean abundance of macrobenthos was maximum at Jharkahli (664±307 ind.m^{-2}) and lowest at Dhamakhali (215±88 Ind.m^{-2}) in the mangrove pneumatophores across the sampling locations. Density of mixed mangrove stands: 13 – 35 nos./3m^2 across sampling locations. The density and average diameter at breast height (DBH) of *A. alba/ A. marina* was maximum at Jharkhali as compared to other stations.

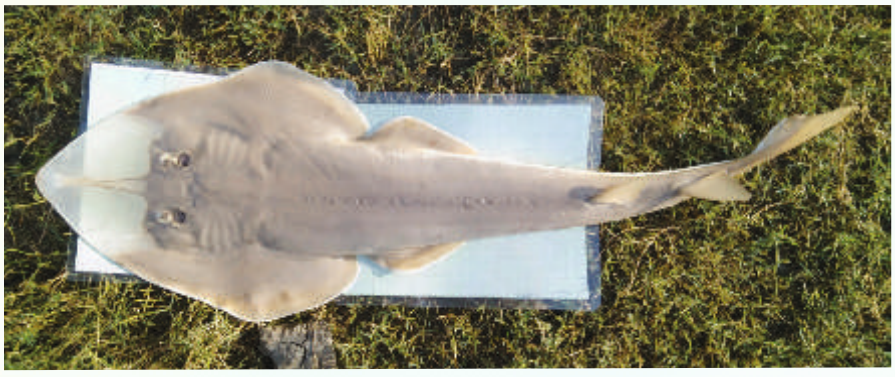
Fish Landings and Catch Structure

Detailed surveys on fish landings and catch structure were conducted at various sampling sites within the Indian Sundarbans during the monsoon season. Data were collected through semi-structured interviews. The information regarding total fish catch, catch per unit effort (CPUE) and catch structure was based on direct observations at the landing centres. A total of 112 fish species



Fisheries data collection from bagnet fishermen at Jharkhali

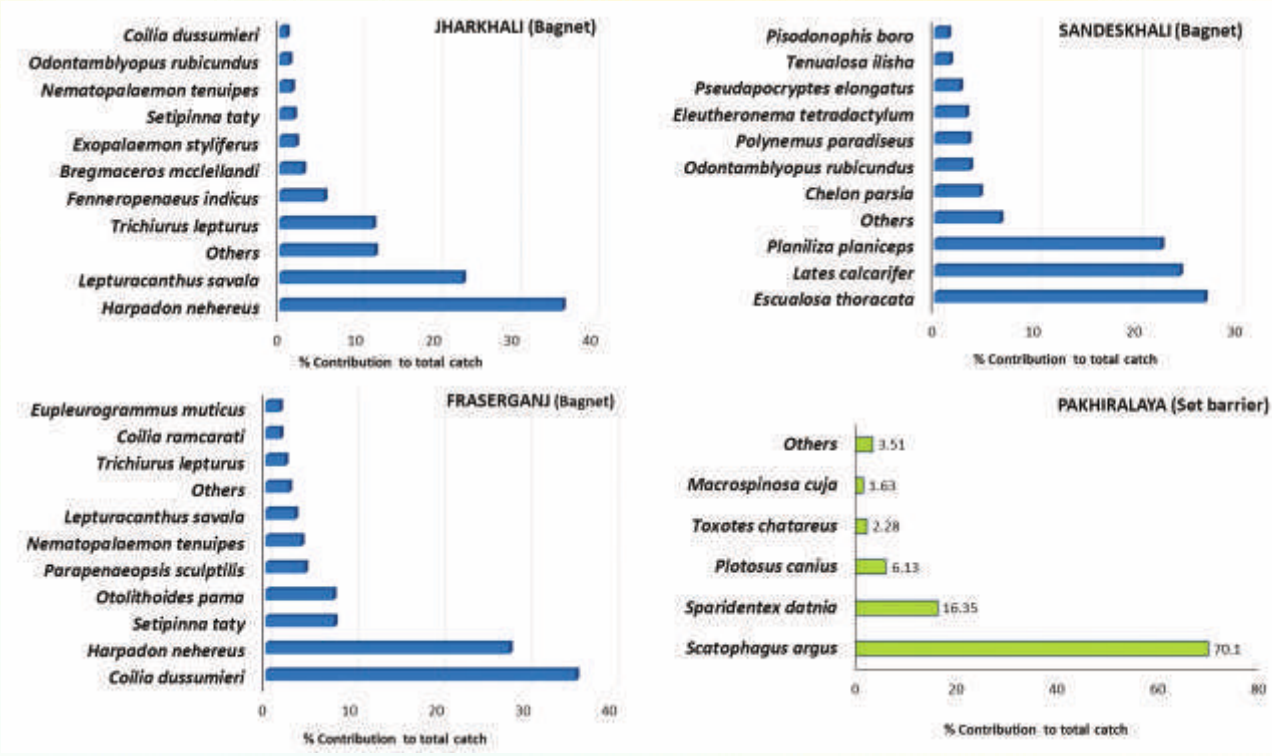
from the fishery landings of the Indian Sundarbans, of which, three species were elasmobranchs including the widenose guitarfish (*Glaucostegus obtusus*), a critically endangered elasmobranch as per the IUCN Red List of Threatened Species. Recorded the maximum size of *Scatophagus argus* (Linnaeus, 1766) with a total length of 32.3 cm (942 g) from Pakhiralay. The previous maximum length recorded for the species from Indian waters was 30 cm, collected at Mandapam, Tamil Nadu, India. The most diverse fish families were Gobiidae (13 species), Sciaenidae (12 species), and Engraulidae (10 species). Besides fin fishes, the fisheries catch of the Indian Sundarbans included 21 species of shellfish, comprising prawns (14 species), crabs (3 species), cephalopods (2 species) and stomatopods (2 species).



Critically endangered guitarfish *Glaucostegus obtusus* captured at Jharkhali

The common fishing gears employed in Sundarbans include cast nets (*khepla jal*), seine net (*ber jal*), gill nets, set barrier (*charpata / khalpata jal*), bagnets (*behundi jal/been jal*), and hook and line. The information regarding the fish catch structure collected during surveys pertains to the two widely employed fishing gears along the Indian Sundarbans, *viz*., bagnets and set barriers. The set barriers were operated mainly on the mangrove creeks within the Matla-Bidya estuarine region such as Pakhiralaya, Jharkhali, Bali Island, Jatirampore and Bagna. The CPUE of set barriers ranged from 9.6 to 32 kg/net/day with an average of 15.4 kg/net/day. The fish landings from set barriers were dominated by the estuarine scat *Scatophagus argus* which contributed to about 70% of the total landings, followed by the Bengal yellowfin seabream *Sparidentex datnia* (16.35%) and the eel-tailed catfish *Plotosus canius* (6.13%).

Wide variations were observed in the catch composition of bagnets at different sampling sites which can be attributed to the varied salinity regime in these areas. In areas with higher salinities such as Jharkhali (14.6 ppt) and Fraserganj (12.2 ppt), the bagnet catches were dominated by marine migrant species, whereas the lowered salinity conditions at Sandeshkhali (3.2 ppt) have favoured the dominance of estuarine species. The heavy freshwater riverine influx at Sandeshkhali have resulted in the introduction of primarily freshwater species such as the schilbeid catfish *Clupisoma garua* and the striped gourami *Trichogaster fasciata* into the estuarine waters. The CPUE was lowest at Sandeshkhali (14.2 kg/net/day) mainly due to the lowered salinity and high turbidity in monsoon which resulted in the migration of several marine fish species towards lower stretches of the estuary. More than half of the bagnet catch at Sandeshkhali was composed of white sardine *Escualosa thoracta* (26.74 % of the total bagnet catch) and juveniles of the Asian seabass *Lates calcarifer* (24.28 %).



Catch composition of bag nets and set barriers at different sampling stations along the Indian Sundarbans



Scatophagus argus (32.3 cm TL) recorded from Indian Sundarbans

Both penaeid and non-penaeid prawns formed one of the major components of the bagnet fish catch at Jharkhali and Fraserganj with percentage contributions of 9.36 % and 8.66 % respectively. The prawn catches were dominated by species, *viz*., *Fenneropenaeus indicus* (Indian white prawn), *Parapenaeopsiss culptilis*, *Exopalaemon styliferus* (Roshna prawn) and *Nematopalaemon styliferus* (Spider prawn). The Bombay duck (*Harpadon nehereus*) was the major component in the bagnet catch at Jharkhali contributing to 36.1 % of the total catch, with the ribbon fishes *Lepturacanthus savala* (Small-head hairtail) and *Trichiurus lepturus* (Largehead hairtail) with percentage contributions of 23.4 and 11.96 % respectively. The CPUE of bagnets recorded at Jharkhali during monsoon remained at31.86 kg/net/day. The CPUE was highest at Fraserganj (41.5 Kg/net/day). The dominant component of the bagnet catch at Fraserganj was the gold-spotted grenadier anchovy *Coilia dussumieri* (35.8 % of the total catch), followed by *H. nehereus* (28.11 %) and the scaly hairfin anchovy *Setipinna taty* (7.95 %).

New Maximum Size Record of the Spotted Scat *Scatophagus argus* (Linnaeus, 1766) from Indian Waters

The ichthyofaunal surveys conducted during monsoon on the mangrove-associated fisheries recorded the maximum size of *Scatophagus argus* (Linnaeus, 1766) with a total length of 32.3 cm (942 g) from Jatirampore area situated in the mangrove creeks of the Indian Sundarbans. The previous maximum length recorded for the species from Indian waters was 30 cm for a specimen collected at Mandapam, Tamil Nadu.

Project code: RWF/20-23/10

Project Title: Understanding Spatio-Temporal Variations of Reservoir Ecosystem and Developing Improved Fisheries Management Strategies for Different Eco-Regions: A New Perspective

Sub-project 1: Understanding Spatio-Temporal Variations of Large Reservoir Ecosystems (Hirakud, Panam & Idukki) and Developing Improved Fisheries Management Strategies

Duration: 01.04.2020-31.03.2024

Panam Reservoir, Gujarat

Enhancing Fisheries Productivity and Management

Panam Reservoir, a large reservoir located in Panch Mahal District of Gujarat, has significant potential for fisheries development. With 41 fish species, two prawn species, and a productive plankton community, the reservoir presents a conducive environment for fish production. However, the current fish yield (18.26 kg/ha) is substantially lower than the estimated potential (103.63 kg/ha), indicating a gap that can be addressed through strategic interventions. Discontinuation of fingerling stocking during 2020 to 2022 negatively impacted the reservoir production. To maximize productivity, regular and scientifically guided stocking of IMCs, along with improved habitat management, should be implemented.

The reservoir harbours a substantial population of Small Indigenous Fish Species (SIFs), which remain underutilized. Promoting their harvesting and local consumption can enhance food security and nutritional benefits for riparian communities. Developing community-based fisheries management models and integrating sustainable fishing techniques will ensure long-term ecological and economic benefits.



A glimpse of the Panam reservoir

Addressing Exotic Species Invasion

The establishment of Nile Tilapia (*Oreochromis niloticus*) in Panam Reservoir presents a challenge, as it has rapidly increased from negligible landings to more than 20% of the total catch within four years. The species' accidental introduction from cage culture operations emphasizes the need for stringent biosecurity measures and better regulation of enclosure-based aquaculture. To mitigate the impact of invasive species, periodic monitoring and stock assessments should be conducted. Additionally, cage culture systems should incorporate containment measures, such as secure netting and controlled harvesting, to prevent accidental escapes. Awareness programs for fishers regarding the ecological risks of exotic species and their potential competition with native species will further aid in controlling their spread.

Sustainable Fisheries and Policy Recommendations

Panam Reservoir holds immense potential to contribute to food and nutritional security, given its pristine catchment and self-recruiting native fish stocks. To ensure its sustainable utilization, a multi-pronged approach integrating ecological conservation, scientific fisheries management, and community-driven initiatives is essential. Key recommendations include:

1. Regular Stocking and Habitat Management: Establishing a scientific stocking schedule with quality fingerlings, supported by habitat conservation measures, to enhance fish productivity.
2. Exotic Species Monitoring and Control: Implementing strict regulations on cage culture, periodic fish population assessments, and awareness programs to mitigate the impact of invasive species.
3. Fisher Training and Community Participation: Conducting targeted skill development programs to improve local fishers' capacity and encourage participatory fisheries management.
4. Infrastructure Development: Enhancing storage, transportation, and processing facilities to strengthen market linkages and improve fisher incomes.
5. Revising Leasing Policies: Revisiting reservoir leasing policies to reduce financial burdens on cooperatives and ensure fair participation of local fishers in fisheries development initiatives.

Project code: RWF/20-23/11

Project title: Eco-Orientation Approach for Fisheries Enhancement of Floodplain Wetlands in Diverse Eco-Regions of India

Sub-Project 1: Eco-Orientation Approach for Fisheries Enhancement of Floodplain Wetlands in NE States of India

Duration: 01.04.2020 – 31.03.2024



A haul of Indian rRiver shad recorded from Tamranga beel, Assam



Fishers boat with harvest (Indian River Shad) from Tamranga beel, Assam

Gudusia chapra Dominated Fish Catch of Tamranga Beel, Assam

Tamranga beel, located in Abhyapuri, Bongaigaon district of Assam, is an open beel (400 ha) with connectivity with the river Brahmaputra. The beel is managed under capture fisheries norms under the administrative control of Assam Fisheries Development Corporation (AFDC), Guwahati. It is rich in fish diversity and so far, more than 90 fish species have been recorded. However, a single species, Indian River Shador *Gudusia chapra* belonging to the family Clupeidae, contributed more than 60% of the total catch from the beel. It fetches good price in the market and contribute significantly to the income, livelihood and nutrition of beel fishers.

Ichthyofaunal Diversity of Algapur *Anua* in Brarak Valley

Knowing fish diversity is critical for developing effective conservation plan as well as maintaining a healthy aquatic ecosystem. The present study was conducted in Algapur *Anua*, an oxbow wetland connected to the river

Barak, in Cachar district of Barak valley, Assam. A total 53 fish species belonging to 42 genera, 24 families and 10 orders were recorded. Majority of the species belonged to the Order Cypriniformes (20 species), followed by Perciformes (12 species), Siluriformes (11 species), Synbranchiformes (3 species) and Osteoglossiformes (2 species). Order Beloniformes, Tetradontiformes, Charciformes, Cyprinodontiformes, and Clupeiformes each had single fish species. In terms of economic importance, 33 fish species has food values, 14 species have ornamental value, and 6 species has both food and ornamental value. On the IUCN Red List, three species is listed as Near Threatened (NT), one species is listed as Endangered (EN), and one species are listed as being Vulnerable (VU). Water quality of the wetland is congenial for fish production. Six exotic fish species, *viz*., *Cyprinus carpio, Ctenopharyngodon idella, Hypophthalmichthys molitrix, H. nobilis*, *Oreochromis niloticus,* and *Piaractus brachypomus* were documented from the wetland and may pose threat to native fish fauna.



Fishing in Algapuranua, Assam



A view of Algapuranua, Assam



Pen aquaculture in Sone beel

Adoption of Pen Aquaculture Technology in Sone Beel, Assam

A successful model of adoption of pen aquaculture technology (PAT) in Sone beel of Assam was documented. A group of three fishers initiated pen culture in 2012-13 and presently owns three pens, constructed with mosquito netting material supported with bamboo poles. Ten different species (*Labeo catla*, *L. rohita*, *Cirrhinus mrigala*, *Hypophthalmichthys nobilis*, *H. molitrix*, *Cyprinus carpio*, *Barbonymus gonionotus*, *Oreochromis niloticus*, *L. calbasu* and *L. angra*) were stocked with an average size of 115.5 g in April 2022. Fishes were reared up to five months followed by periodic harvesting. The survival and growth rates of the cultured fishes ranged between 83.3 to 95% and 229.4 to 866.7%, respectively. Total fish production achieved after one cycle of pen culture was 5437.4 kg/ha. Total expenditure (capital plus operational) was worked out at ₹ 6,75,192.5 and total income at ₹ 10,43,262, hence the net income from one ha of pen culture was ₹ 3,68,069.5. The benefit-cost ratio was worked out at 1.55. Stakeholders' perception analysis revealed that productivity, cost efficiency, ease of management, control over production, technology complementarity, input complementarity, lesser complexity, trialability and observability favoured adoption of PAT. Availability of fish seed for pen culture was not recognized as an issue

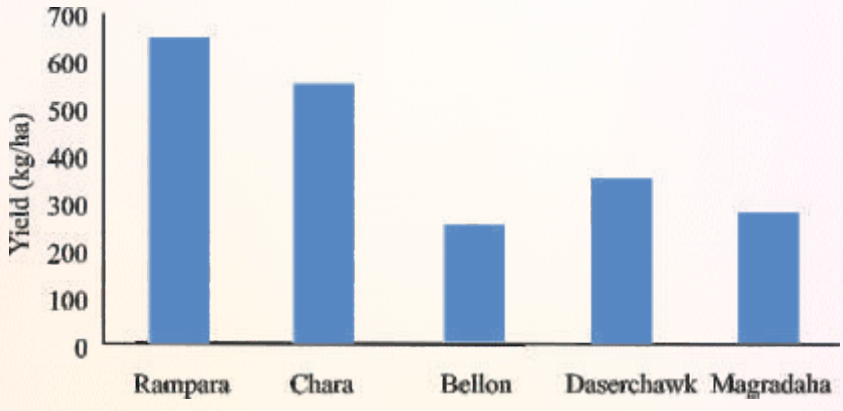
by the farmers (70%). About 63% of the respondents confirmed that investment for fish culture in ponds was higher than in pen culture. However, 1/3rd of the farmers thought that there was high financial risk in pen fish farming compared to pond fish farming, and 57% thought that there was limited risk in the former than the latter.

Sub-Project 2: Eco-Orientation Approach for Fisheries Enhancement of Floodplain Wetlands in West Bengal

Duration: 01.04.2020 – 31.03.2024

An assessment of the ecology and fisheries of four wetlands, *viz*. Rampara, Chhar, Beloon, and Daserchak in Murshidabad, West Bengal was conducted. Large-size stocking material is the main management practice in Rampara and Chhar wetlands. Silver carp (*Hypophthalmichthys molitrix*) dominates in Rampara, while Grass carp is the most common stocking material in Chhar. Stocking occurs in post-monsoon, with harvesting is done in late summer. Besides stocked fish, small indigenous fish (SIF) like *Salmophasia phulo*, *Parambassis lala*, *Puntius sophore*, and *Amblypharyngodon mola* contribute to the catch in Rampara; *Amblypharyngodon mola* and *Chanda nama* are prominent in Chhar. Beloon, the largest wetland (335 ha) studied, lacks proper stocking management and needs de-weeding, de-silting, and restoration of river connectivity to improve fisheries. Gill nets is the main fishing gear used by fishers.

Daserchak's fisheries is managed by a local cooperative, but rising lease amount has created management challenges. Bighead carp, Silver Carp, Catla, Rohu, Mrigal, and Bata dominated the fish catch. However, due to irregular stocking, major carp production has significantly declined, forcing fishers to rely on SIFs and other native species. The water quality parameters of the wetlands indicate suitability for fish production. Cluster analysis showed that Daserchak was distinct from the other wetlands. Daserchak exhibited the highest levels of specific conductivity (398.5 mg/l), total alkalinity (230.75 mg/l), dissolved oxygen (9.8 mg/l), total phosphorus (0.064 mg/l), and silicate (5.25 mg/l), highlighting its high productivity. Fish species richness was higher in Beloon wetland. Fish yield is higher in the stocked wetlands. Stocking density is estimated at 2100 fingerlings/ha/y to attain the estimated fish yield potential of 1800 kg/ha/yr.



Estimated fish yield of the studied wetlands of West Bengal

Sub-project 3: Eco-orientation Approach for Fisheries Enhancement in Floodplain Wetlands in Bihar

Duration: 01.04.2020 – 31.03.2024

Three important semi-open flood-plain wetlands (mauns) namely Manika, Simra and Bhusra of Muzaffarpur district of Bihar were studied. Except Bhusra, the other two are located along the bank of Budhi Gandak River, whereas the Bhusra is located along Baghmati River. The ecology of these wetlands was accessed. In case of the biotic components, among benthos, gastropods were the dominant species while among plankton cyanophycae and Chlorophyceae were the dominant groups. As far as different types of fish farming practices undergoing in the state is concerned, most of the farmers only stock the IMC fish seed in the seasonal pond and further after 6 months they harvest the fish without following any scientific fish culture practices. Ponds under FFDA are composite fish farming doing scientifically. The fish seed stocked in these ponds are IMC *viz*. *Catla catla*, *Labeo rohita, Cirrhinus mrigala* and Exotic carps *viz*. *Ctenopharyngodon idella*, *Hypopthalmichthiys molitrix* and *Cyprinous carpio*.

The stocking rates vary from 5000 8000 fingerlings per hectare and species ratio are 40% surface feeder, 20% column feeder, 30% bottom feeder and 10% micro-vegetation feeders. However, it has been found that the stocking densities and species ratio are sometimes altered depending upon the availability of fish seed. A fair population of small indigenous fish (SIF) from wetlands was documented. A mass awareness was conducted among local fishermen to protect the biodiversity of SIF which should not be thrown as trash fish but should be utilized for nutrition and livelihood security. Besides, the physico-chemical

parameters of these wetlands were accessed and it was adviced to promote culture based fisheries in Simra and Manika *mauns*. Bhusra *maun* is selected for cage culture and Manika *maun* for pen culture with the joint efforts with DFO Muzaffarpur. Moreover, pollution from point and non-point sources led to fish mortality in Manika *maun*. Monsoon runoffs from the adjoining agriculture fields and settlement areas caused large fish mortality (about 30% of stocked carp).

Conservation and proper application of these valuable resources, as well as awareness about the cleanliness of the water bodies to reduce the pollution load, are some essential key points for the sustainability of these water bodies. Manika *maun* in Muzaffarpur district will be developed on the lines of Delhi's famous *Dilli Haat*. This is a big project of the Tourism Development Corporation which will boost tourism in the region. It will also create employment opportunities for local people.



Status of Simra maun, Muzaffarpur



Weed infested Bhusra maun, Muzaffarpur



Water hyacinth cover in Manika maun, Muzaffarpur

Project Code: RWF/23-26/15

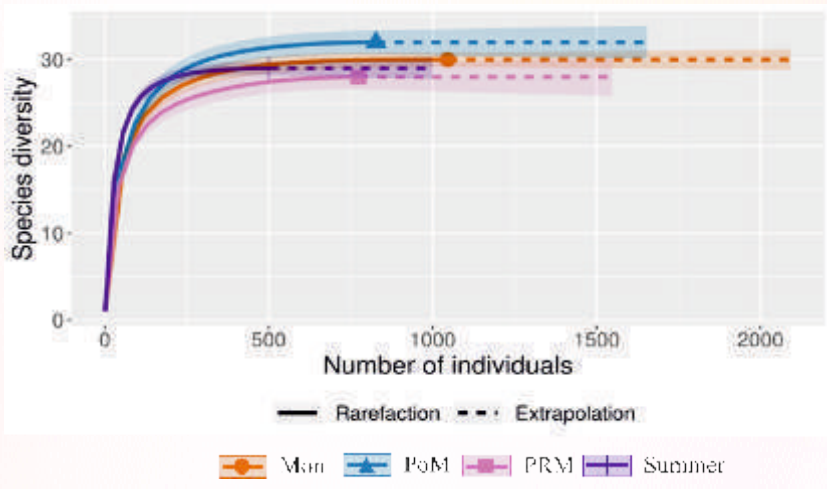
Project Title: Exploration of Ecosystem Dynamics and Fisheries of Kanva (Karnataka), Sathanur (Tamil Nadu) and Banasurasagar (Kerala) Reservoirs for Sustainability and Conservation

Duration: 01.04.2023 – 31.03.2026

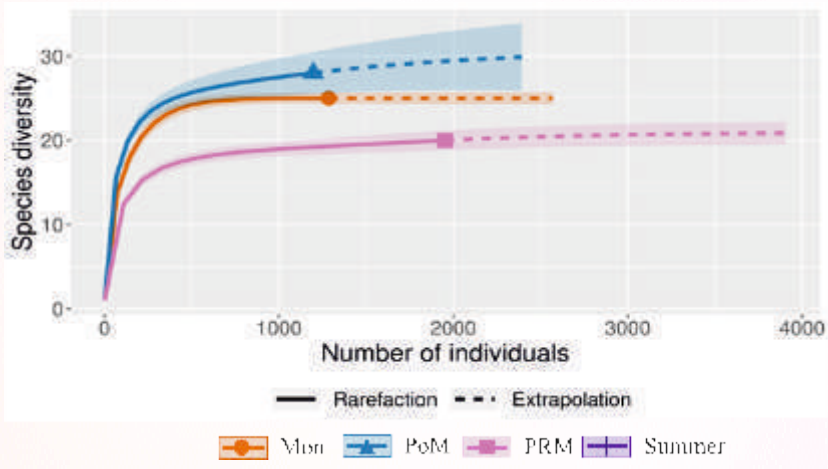
The three reservoirs being investigated are Sathanur in Tamil Nadu, Kanva in Karnataka, and Banasurasagar in Kerala, with the objectives of studying reservoir ecosystem dynamics and identifying region-specific species for conservation and fisheries enhancement.

Fish Composition and Productivity

The experimental fishing conducted using multi-size monofilament gill net revealed a total of 34 species belonging to 10 families and 7 orders in the Sathanur reservoir. Species richness and abundance was high in the Cyprinidae family followed by Cichlidae and Mugilidae. The commercial catch was dominated by



Seasonal variation in fish species distribution in Sathanur reservoir



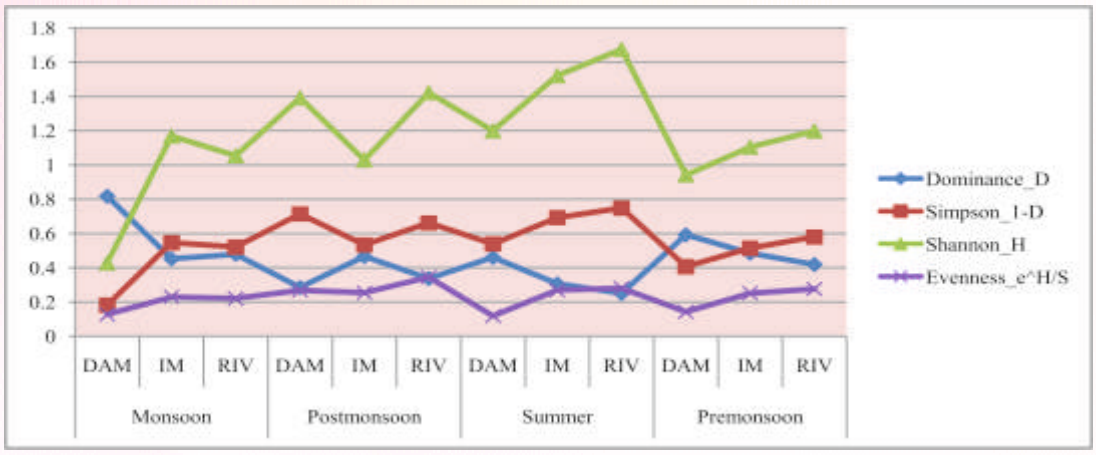
Seasonal variation in fish species distribution in Kanva reservoir

Indian Major Carps (IMCs). The experimental fishing showed higher abundance of *Rhinomugil corsula*, *Dawkinsia filamentosa*, and *Etroplus suratensis*. The mullet, *R. corsula* dominated this reservoir, accounting for 37.5% of the catch and the highest abundance was at the intermediate site. The average length of the species was 27.5±2.8 cm and weight 210.8 ±15.6 g. Species richness was maximum in riverine zone (29) of the reservoir followed by transitional (25) and lacustrine (21) zones in spatial scale, whereas highest fish richness was recorded during post-monsoon season. The socio-economic survey showed that the fishermen struggle with low fish catch during the monsoon season, when the average catch is around 8-10 kg/day/fisherman. The increased water level in the monsoon season and the targeted fishery practices for carps could be the main factors for low catch. Though the mullet *R. corsula* is abundant in this reservoir, there is no targeted fishery for this species. A targeted mullet fishery would contribute to a higher catch providing additional income to fisher folk for a better living. The average net primary productivity of Sathanur reservoir was 156 mgC/m^3/hr. The production potential of the reservoir was 2360/kg/ha/yr.

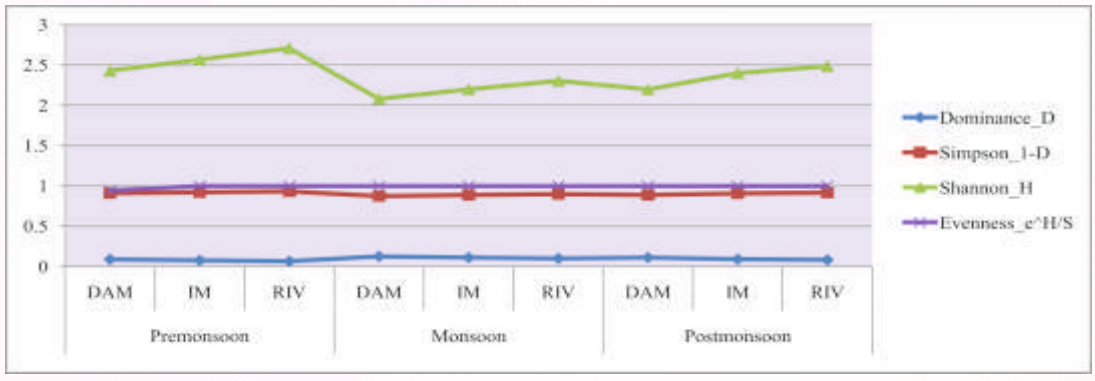
In Kanva reservoir, the commercial catch was dominated by IMCs. The experimental fishing showed the occurrence of 22 species belonging to seven orders and 10 families. The fish abundance and species richness were maximum in Cyprinidae family. Species richness was high in riverine zone (22) followed by lacustrine (18) and transitional (17) zones. On a seasonal scale, maximum fish species richness was recorded during post-monsoon season. The species belonging to the family Heteropneustidae and Mastacembelidae were present only in the riverine zone of the reservoir. The razor belly minnow, *Salmostoma belachi*, dominated throughout the reservoir with a relative abundance of more than 85%. The average net primary productivity of Kanva reservoir was estimated to be 62 mgC/m^3/hr. The production potential of the reservoir was 780/kg/ha/yr.

Plankton Dynamics

The present study recorded 42 phytoplankton genera belonging to 11 classes in Sathanur reservoir. The phytoplankton diversity indices showed significant variations on spatial and temporal scales. Highest species diversity (1.68) and lowest dominance value (0.25) were observed at the riverine site during the summer season. The lowest diversity (0.43) and higher dominance (0.82) were observed at the dam site during the monsoon season. The algal genus pollution index (AGPI) was estimated to be around 15-20 during the pre-monsoon and summer seasons indicating high organic pollution. The AGPI was estimated to be 29 at the dam site during summer season indicating severe organic pollution. The monsoon season can be categorized as less organic pollution based on this index. There were 37 zooplankton species belonging to four functional groups copepods (44.1%) dominated the population followed by cladocerans (30.7%), rotifers (24.9) and ciliates (0.2%).



Spatio-temporal variations in diversity indices of phytoplankton in Sathanur reservoir
(DAM = dam site, IM = intermediate site, RIV = river site)



Spatio-temporal variations in diversity indices of phytoplankton in Kanva reservoir
DAM = dam site, IM = intermediate site, RIV = river site.

In Kanva reservoir, 28 phytoplankton genera belonging to nine algal classes were observed. The highest phytoplankton diversity (2.71) and lowest dominance value (0.06) were observed at the riverine site during the pre-monsoon season. The lowest species diversity (2.08) and highest dominance (0.13) were observed at the dam site during the monsoon season. The AGPI (10-15) suggests moderate organic pollution in Kanva reservoir. The dam site can be categorised as of no organic pollution (AGPI <10) during the monsoon and post-monsoon seasons. There were 23 zooplankton species belonging to four functional groups. Copepods (46.5%) dominated the population, followed by cladocerans (45.4%), rotifers (7.5) and ostracods (0.5%).



Sampling at Sathanur reservoir



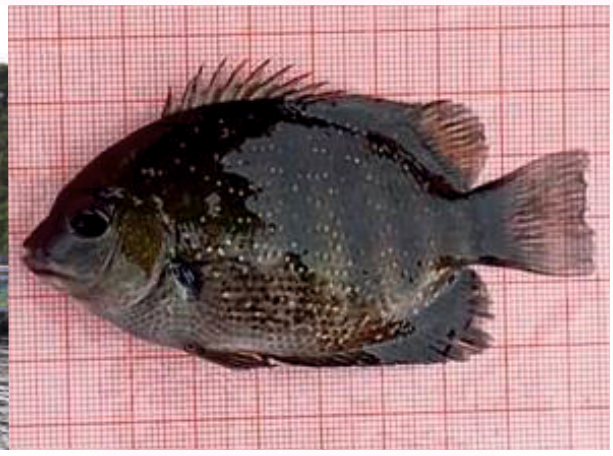
Sampling at Banasurasagar reservoir



Mullet catch during experimental fishing at Sathanur reservoir



HDPE cages installed at Banasurasagar reservoir



Etroplus suratensis grown in cages at Banasurasagar reservoir

In Banasurasagar reservoir, 15 algal genera belonging to five algal classes were recorded during the monsoon season. The zooplankton community was dominated by copepod (74.8%), followed by cladocerans and rotifers. The AGPI values indicate no organic pollution in this reservoir.

Cage Culture of *Etroplus suratensis* in Banasurasagar

Around 12,000 fingerlings of *Etroplus suratensis* were stocked in the cages in Banasurasagar reservoir at the rate of 4000 fingerlings per cage (4x3x3 m). The average length and weight of the fishes were 5.22 ± 0.5 cm and 3.43 ± 1.02 g respectively. The fishes were fed with 38% crude protein feed (08 mm pellet) at 5% of the body weight per day. The mean weigh gain after four months of culture period is 28.3 ± 7.6 g.

Habitat Parameters of Sathanur Reservoir

Water Quality

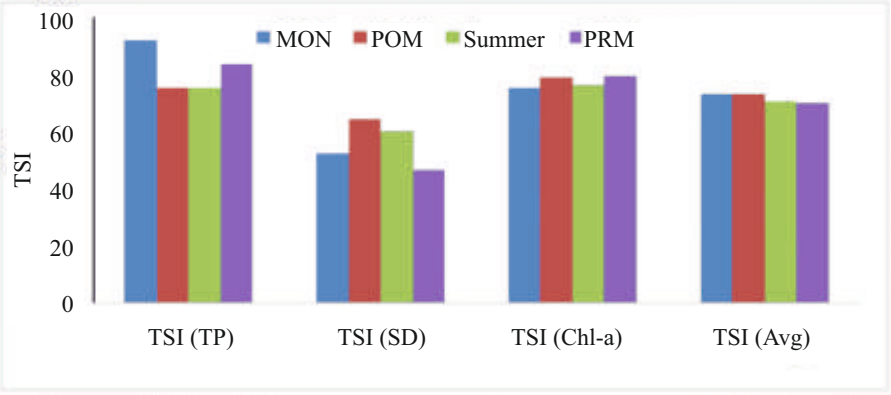
The nutrients and physicochemical parameters were assessed in Sathanur reservoir at 6 sampling stations over four seasons *viz*. monsoon, post-monsoon, summer and pre-monsoon. The pH of the water was alkaline throughout all the seasons (average pH> 8.33) with lower pH during monsoon season. Higher value of EC was observed across the sampling stations and seasons (average 1135µS/cm). Highest and lowest TDS were observed in the pre-monsoon (781 ±62 ppm) and monsoon (572±55 ppm) season respectively. Total alkalinity was lowest during monsoon season and highest during pre-monsoon season. Chlorophyll-a content varied from 36 to 54 µg/l. The higher pH, EC, alkalinity and Chl-a contents indicate anthropogenic pollution of Sathanur reservoir.

Trophic State Index

The site-wise average values for TSI (TP), TSI (Chl-a) and TSI (SD) were 81.7, 55.95 and 77.64, respectively. All the TSI (avg) values were in the range of eutrophic values (>54). Overall, TSI (avg) value for the Sathanur reservoir was 71.77. These TSI values, based on the modified version of Lamparelli (2004) classification criteria, clearly indicate that the reservoir was eutrophic during the entire study period.

Hydro-geochemistry of Surface Water

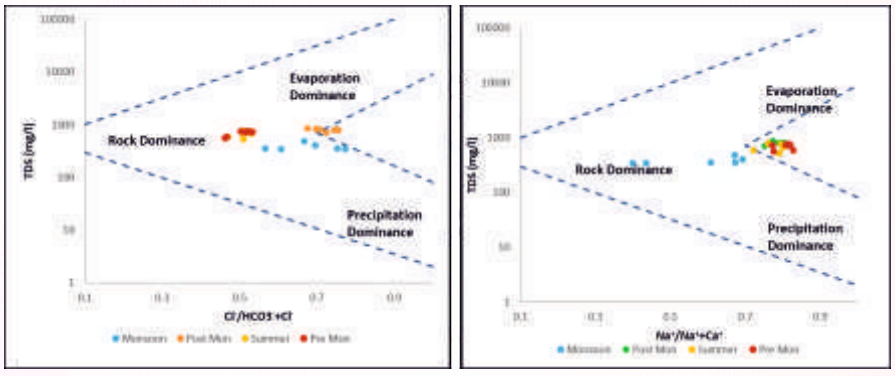
The cation ratio and anion ratio varied across the seasons and medium TDS concentration were found in the Gibbs plot. Distributions of reservoir water samples in cation and anion plots were located in the rock dominance area. It indicated that reservoir water chemistry was mainly controlled by the interaction of reservoir water with sediment/rock. Few samples were outside the plot area, indicating anthropogenic effects.



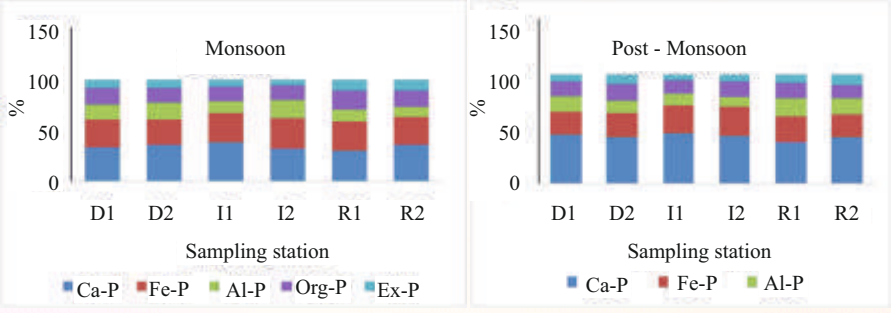
Seasonal variations in trophic state index of the Sathanur reservoir (MON = monsoon; POM = postmonsoon; PRM = pre-monsoon).

Sediment Characteristics and Spatio-temporal Variations of Phosphorous in Sediment

The pH of the sediment varied from 7.8 to 8.5 and the organic carbon concentration varied from 1.29-2.85 %. The available P and N concentration varied from 0.5 to 3.1 mg/100 g and 25.2 to 32.1mg/100g respectively. To understand the source and availability of sediment P different fractions of P was estimated for Monsoon and post-monsoon samples. The average Total P concentration in monsoon and post-monsoon sediment were 6.83±0.76 g/kg and 6.61±0.65 g/kg respectively. Calcium bound phosphorous (Ca-P) was the dominant fraction in both the seasons. The overall trend was Ca-P> Fe-P>Al-P>Org-P>Ex-P. Nearly 50% of the sedimentary inorganic P was found to be bio-available and are prone to be released into the water.



Gibbs plot of major cations (a) and anions (b) in the Sathanur reservoir



Spatio-temporal variations of P fractions in Sathanur

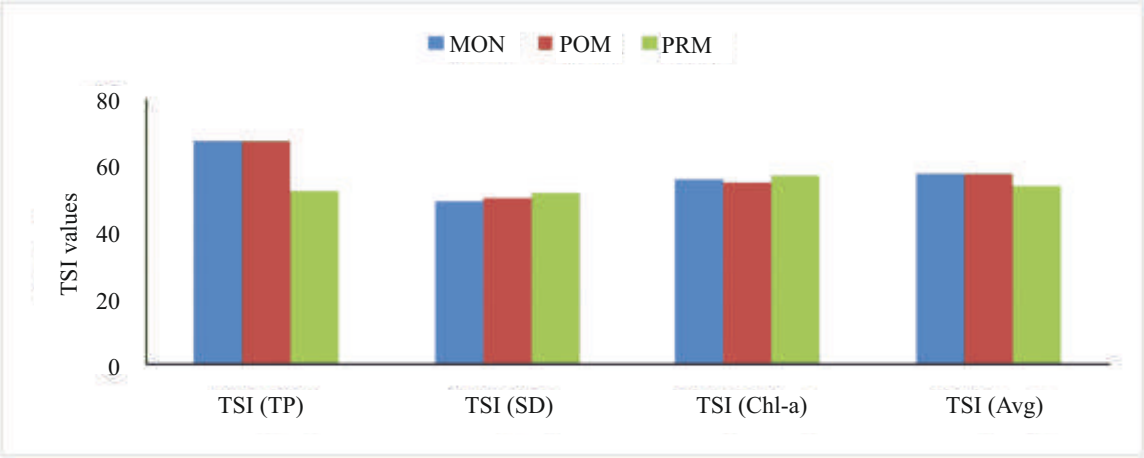
Habitat Parameters of Kanva reservoir

Water Quality

The nutrients and physicochemical parameters were assessed in Kanva reservoir at 6 sampling stations over three seasons, *viz.* monsoon, post-monsoon and pre-monsoon. The pH of the water was moderately alkaline throughout the three seasons (7.92 to 8.9) with lower pH during monsoon season. Transparency was high across the sites and seasons (>100cm). Highest value of EC was observed in pre-monsoon seasons (average 661 µS/cm) and lowest EC was found in monsoon season (average 587 µS/cm). The TDS values were nearly constant during the study period. BOD values were <5 mg/l during the sampling period. Chlorophyll-a content varies from 10 to 18 µg/l.

Trophic State Index

The site-wise average values for TSI

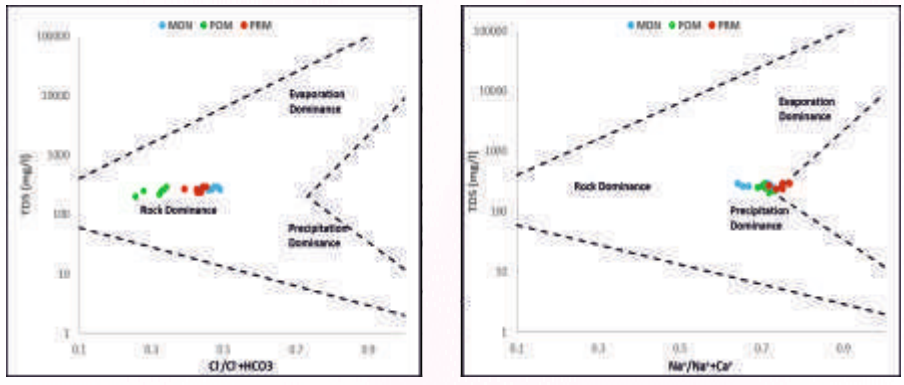


Seasonal variation in trophic state index of Kanva reservoir
(MON = monsoon; POM = post-monsoon; PRM = pre-monsoon)

(TP), TSI (Chl-a) and TSI (SD) were 62.5, 50.4 and 55.8 respectively. All the TSI (avg) values were in the range of threshold eutrophic values (54-57). Overall, TSI (avg) value for the Kanva reservoir was 56.2.

Hydro-geochemistry of Surface Water

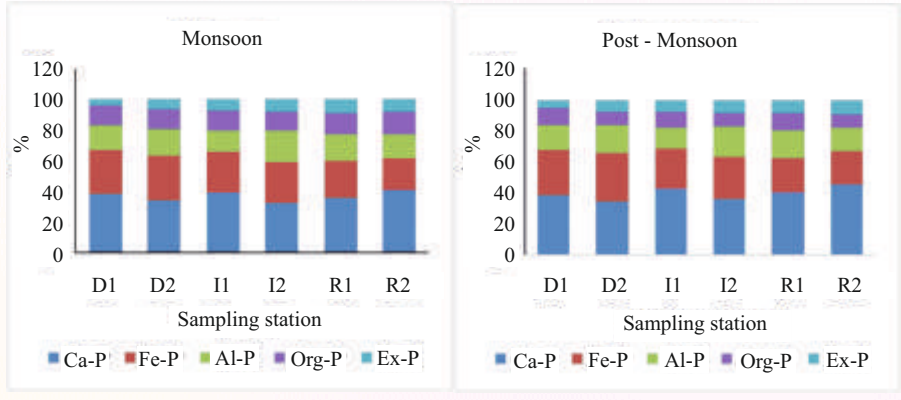
The high cation ratio, low anion ratio varied across the seasons and medium TDS concentration were found in the Gibbs plot. Distributions of reservoir water samples in cation and anion plots were located in the rock dominance area. It indicated that reservoir water chemistry was mainly controlled by the interaction of reservoir water with sediment/rock.



Gibbs plot of major cations (a) and anions (b) in the Kanva reservoir

Sediment Characteristics and Spatio-temporal Variations of Phosphorous in Sediment

The pH of the sediment varied from 7.5 to 8.35 and the organic carbon concentration varied from 1.05-2.32 %. The available P and N concentration varied from 0.9 to 2.5 mg/100 g and 16.2 to 20.1 mg/100g respectively. Different fractions of sediment P was estimated for monsoon and post-monsoon samples. There was no significant difference in P fraction content among the sampling sites. Calcium bound phosphorous (Ca-P) was the dominant fraction in both the seasons. The overall trend was Ca-P> Fe-P>Al-P>Org-P>Ex-P.



Spatio-temporal variation of P fractions in Kanva reservoir

Food Web Model of Kanva Reservoir

A steady state food web model of Kanva reservoir ecosystem in Karnataka was developed to study the trophic interactions and to estimate the carrying capacity of important functional groups in the ecosystem. The biological components were classified into 16 ecological groups which included the top predator (aquatic birds), 10 fish groups (catfishes, snake heads, Nile Tilapia, Indian Major carps, barbs, glass fishes, snake heads,

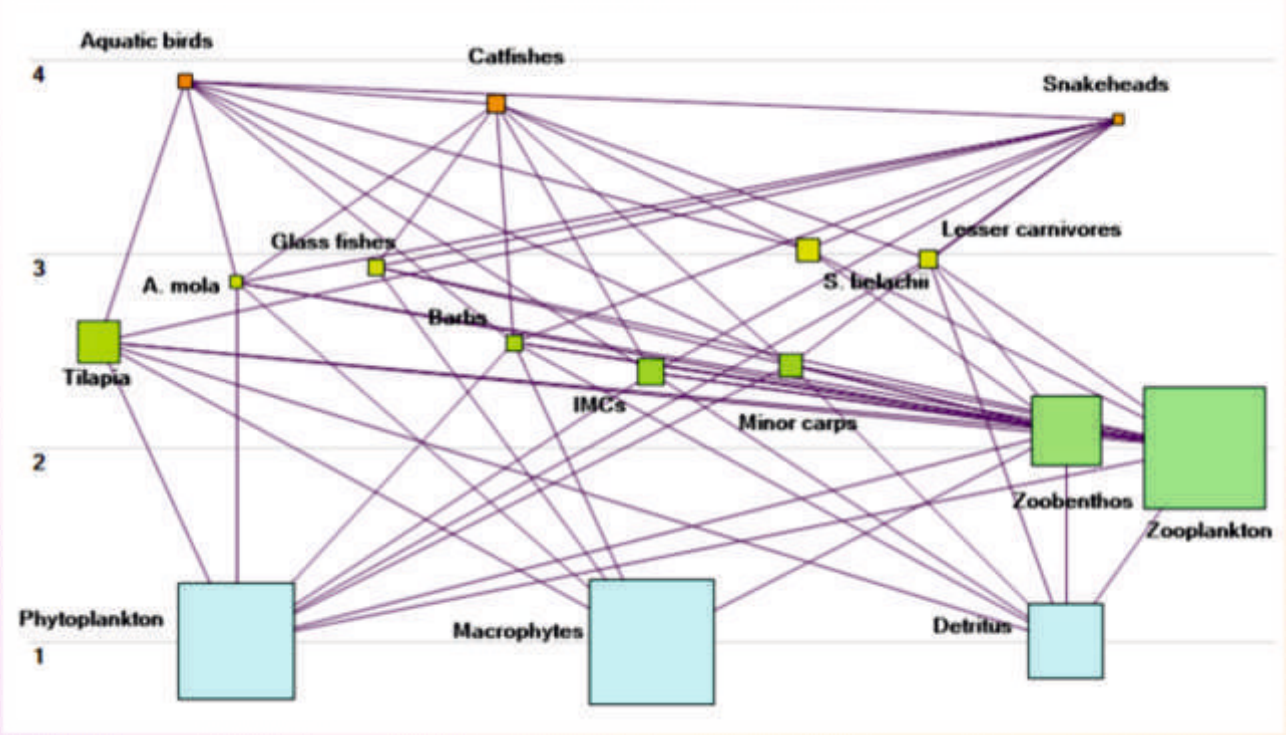
Amblypharyngodon mola, Salmostoma belachi and lesser carnivores), 2 invertebrates (zooplankton and benthos), 2 primary producers (macrophytes and phytoplankton and a non-living group (detritus) The model constructed and parametrized based on the data collected during the field sampling was used to describe the ecological attributes of the ecosystem and to estimate the ecological carrying capacity of different important functional groups. *A. mola* had the highest ecotrophic efficiency (0.944) indicating the highest exploitation, followed by barbs (0.780) IMCs (0.715) and *S. belachi* (0.623). Other fish groups had low EE values indicating low utilization in the system. Macrophytes (0.006) and zooplankton are the most under-utilised (EE= 0.90) groups in the ecosystem. The trophic level values ranged from 3.89 (aquatic birds to 1.0 (the primary producers). The total system throughput was 14084.89 t/km²/year, total primary production/total biomass estimated at 34.98 and total primary production/total respiration was 2.23. These parameters suggest that the ecosystem is in the developmental phase.

Table: System summary statistics estimated for Kanva reservoir ecoysystem

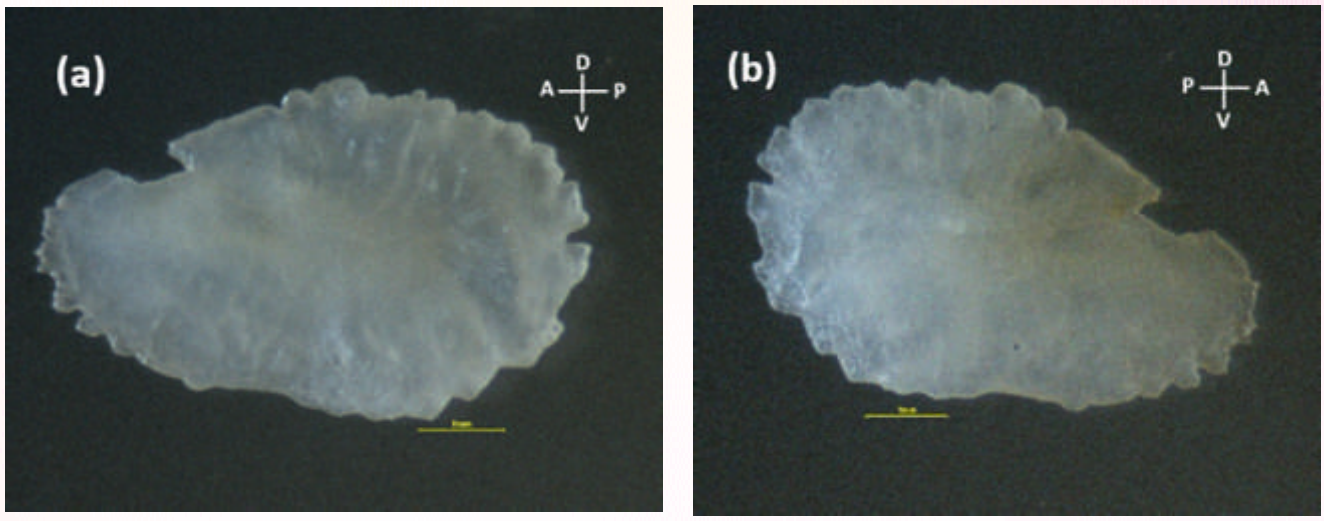
Parameters	Value	Units
Sum of all consumption	3727.71	t/km²/year
Sum of all exports	2977.86	t/km²/year
Sum of all respiratory flows	2428.14	t/km²/year
Sum of all flows into detritus	4951.18	t/km²/year
Total system throughput	14084.89	t/km²/year
Sum of all production	6639.43	t/km²/year
Calculated total net primary production	5406.00	t/km²/year
Total primary production/total respiration	2.23	-
Net system production	2977.87	t/km²/year
Total primary production/total biomass	34.98	-
Total biomass/total throughput	0.01	t/km²/year
Total biomass (excluding detritus)	154.53	t/km²
Connectance Index	0.27	-
System Omnivory Index	0.12	-
Ascendency	39.47	%
Overhead	59.80	%

Study of Otolith

There are three pairs of otoliths in teleosts; one each of sagitta, lapillus and asteriscus. They differ in location, size, shape, microstructure and function. Sacculartoliths (Sagitta) of *Oreochromis niloticus* from Kanva reservoir were extracted and viewed under a stereo zoom microscope (Neumann & Miller). Otolith images were captured and measured (length and width) using Image View software (10X). The *O. niloticus* samples (n=14) varied from 123.0 to 273.0 mm (164.21 ± 9.37) in length. The length and width of the



Flow chart of food web interactions in Kanva reservoir showing relative biomass of the functional groups



Sagitta (Left) of *Oreochromis niloticus* from Kanva reservoir (a) distal view (b) proximal view (10X)



Otolith of *Notopterus notopterus* from Kanva reservoir (10X)

sagittae (n = 25) varied from 4.93 to 6.66 mm (5.96 ± 0.08 mm) and 3.03 to 4.09 mm (3.77 ± 0.05 mm), respectively. Otoliths of *Notopterus notopterus* from Kanva reservoir were collected and the length of the otoliths (n=6) varied from 5.94 to 6.97 mm with a mean of 6.45 ± 0.15 mm while the width varied from 4.35 to 5.06 mm (4.67 ± 0.12 mm).

Project code: RWF/24-27/16

Project Title: Development of Natural Farming Protocol for Culture-Based Fisheries in Wetland

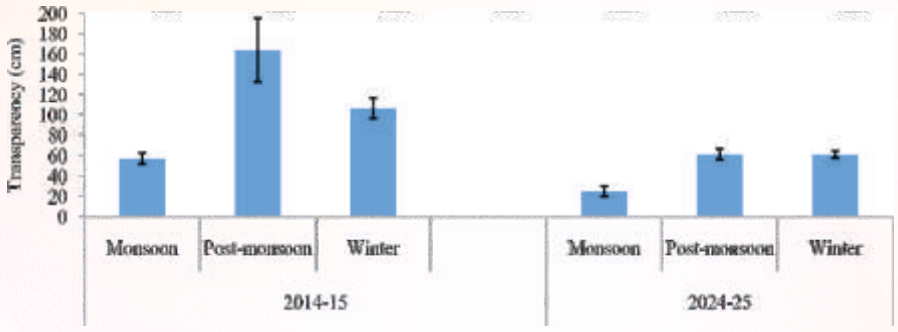
Duration: 01.04.2024 – 31.03.2027

Kholsi beel, a 65 ha seasonally connected floodplain wetland in Nadia district of West Bengal, was adopted for study to develop natural farming protocol for culture-based fisheries (CBF), to understand the impact of anthropogenic pollution like jute retting and to develop a nature-based solution for fish diversity conservation strategy. The wetland is shallow in nature and water depth varied from 64 cm (pre-monsoon) to 270 cm (monsoon).

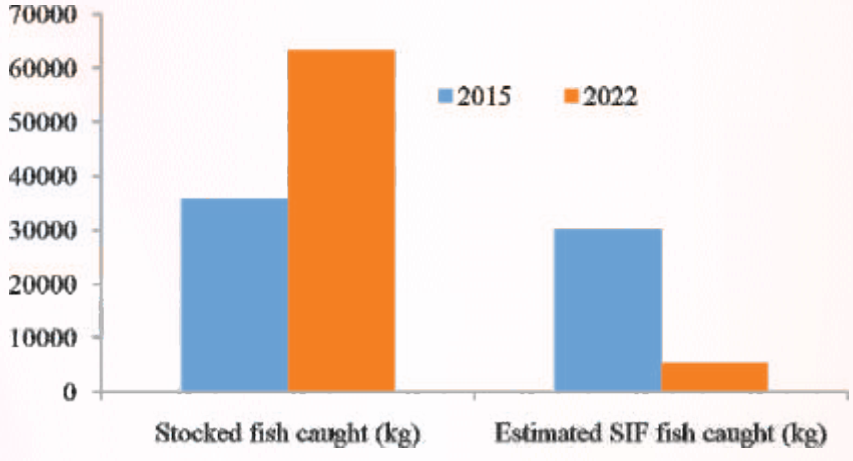
Macrophyte Management *vis-à-vis* Algal Eutrophication in Kholsi Beel

The wetland has undergone significant human interventions over the past few years aimed at boosting

fish production. One key management measure involved the intended removal of floating macrophytes by applying mixture of weedicides like 2,4-D and glyphosate to facilitate the drag net fishing operations targeting stocked carp fishes.This intervention had a noticeable impact on the wetland's overall trophic status when all the previously reported submerged macrophytes like *Hydrilla verticillata*, *Ceratophyllum demersum*, *Vallisneria spiralis*, etc. which had previously occupied a significant ecological niche in the wetland, have completely vanished from there. Nutrient cycling is now mostly operated through plankton chain creating periodic algal bloom. Increased plankton turbidity in the water column as evidenced by significantly lower transparency as compared to earlier studies (2014-15) is probably preventing the re-establishment of those key submerged macrophytes. Significant impact was noticed on fish diversity and its associated ecological parameters, including water quality, sediment composition, plankton populations, and benthic communities as a result of the absence of those submerged macrophytes.



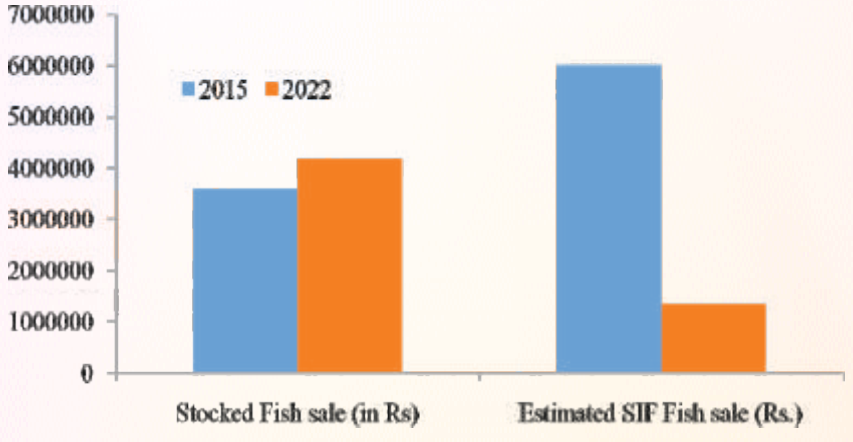
Reduction in transparency in Kholsi beel across time periods



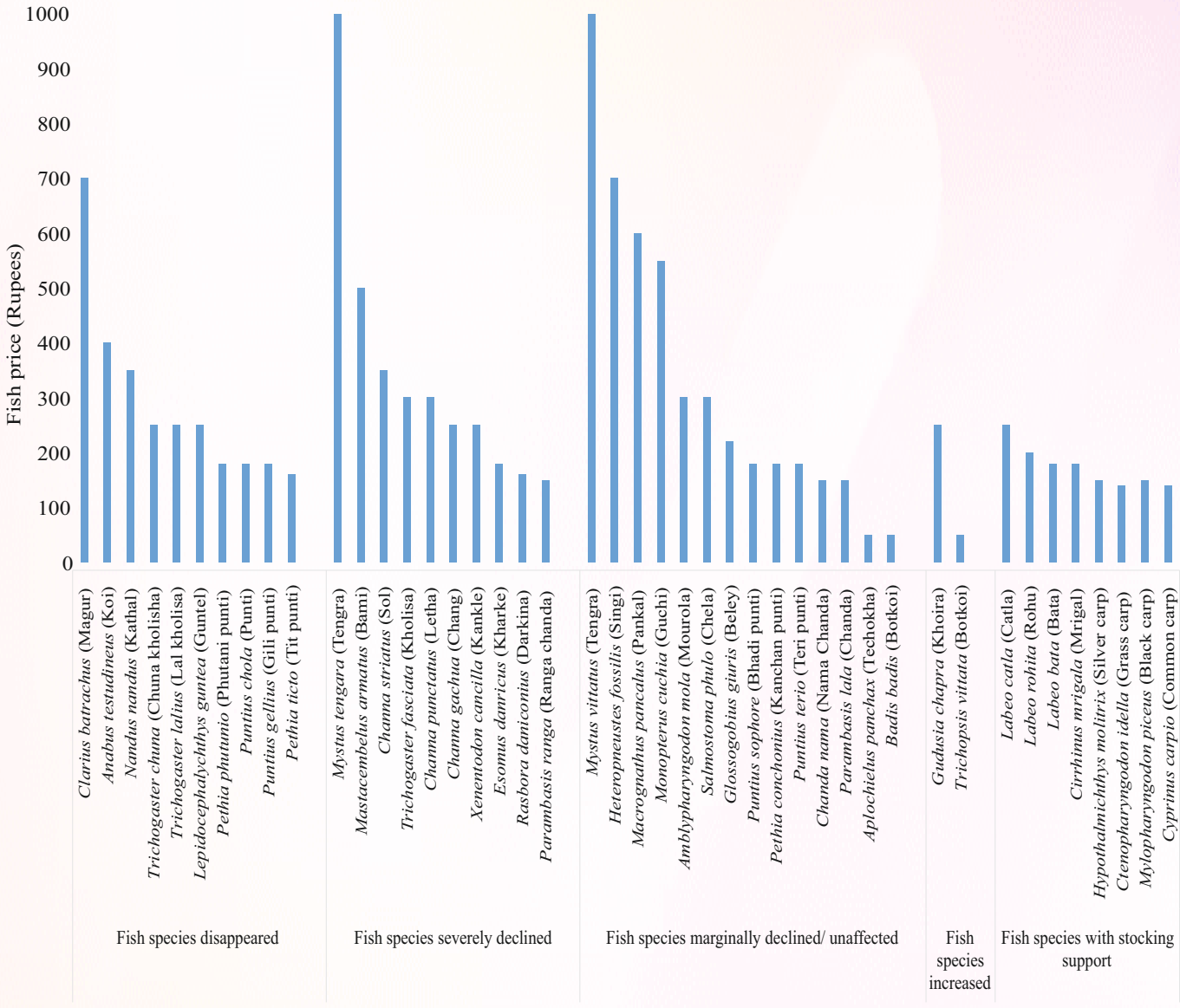
Impact of submerged macrophyte removal on fish production in Kholsi beel

Impact of Submerged Macrophytes Removal on Fish Diversity

An earlier study conducted by ICAR-CIFRI during 2014-15 documented the presence of 37 fish species in Kholsi beel, with small indigenous fishes (SIF) being a major component. The present survey revealed that as many as eight SIF species have disappeared from the wetland due to absence of submerged macrophytes, despite the presence of seasonal connection of the wetland to the river. The disappeared fish species include Kholisa fish (*Trichogaster fasciata*, *T. lalia*, *T. sota*), which accounted for 19.5% of



Impact of submerged macrophyte removal on fish sale (Rs.) in Kholsi beel



Impact of algal bloom on fishes of Khalsi beel and their price range

the total indigenous fish production in 2014. Other fish species that have disappeared from the wetland include *Nandus nandus*, *Lepidocephalichthys guntea*, *Rasbora daniconius, Channa gachua,* and *Anabas testudineus* suggesting crucial role of submerged macrophytes in their life cycle.

The fishery of *Puntius* sp. has also been significantly impacted, with its contribution to the total indigenous fish catch declined from 56.38% to mere 5-10%; however, seven different *Puntius* species as recorded earlier responded differently -*P. chola* and *P. gelius* being the most impacted. Analysis revealed that fishers significantly lost their income due to severely declined catch of prized SIF, which fetched up to ₹1000 per kg, whereas stocked indigenous and exotic carps were sold at much lower rates (₹ 140-250 per kg). A comparison of fish catch (kg) and sale price (₹) between 2015 and 2022 revealed that despite increase (about two-fold) of stocked carp fishes, drastic reduction (about 10 fold) of SIF ultimately resulted in significant loss of income for the poor fishers.

Invasion of Exotic Fishes in Kholsi Beel

Besides stocked exotic fishes like silver carp, grass carp, black carp, common carp, etc. two exotic fishes were encountered for the first time from Kholsi beel during the survey. These were *Pterygoplichthys pardalis* and *Trichopsis vittata*. Increasing abundance of such exotic fishes is a matter for concern, when all three indigenous gourami *i.e. Trichogaster* sp. vanished from the wetland, but exotic gourami like *T. vittata* is flourishing.



Present pattern of SIF catch in Kholsi beel

Impact of Submerged Macrophyte Removal on Macrobenthos

Large scale mortality of submerged macrophytes also led to the decline of attached molluscan population. Earlier studies conducted in 2014-15 reported the presence of as many as 15 varieties of mollusks. The present study revealed that the wetland sediment is filled with dead shells of those mollusks, while live molluskan population is mostly absent in bottom sediment.

Pen Culture Trial of *Systomus sarana* in Natural Farming Mode

A total of 1000 numbers of *Systomus sarana* seeds (avg. size 2.7 g) were stocked in two pens, each measuring 100 sq. m, installed in Kholsi beel. In one pen, supplementary feeding is being provided, while the fish in the other pen rely entirely on naturally available food, such as planktons. Fishes were performing well in both the pens. Experimental trial is ongoing.

Impact Study of Jute Retting on Wetland Ecology and Fish Health

Jute retting in wetland is known to degrade wetland ecology, affecting fish health. A study was conducted to generate data on chemical and biochemical data on wetland ecology with respect to jute retting. Water and sediment sample were collected from both areas under jute retting and sites



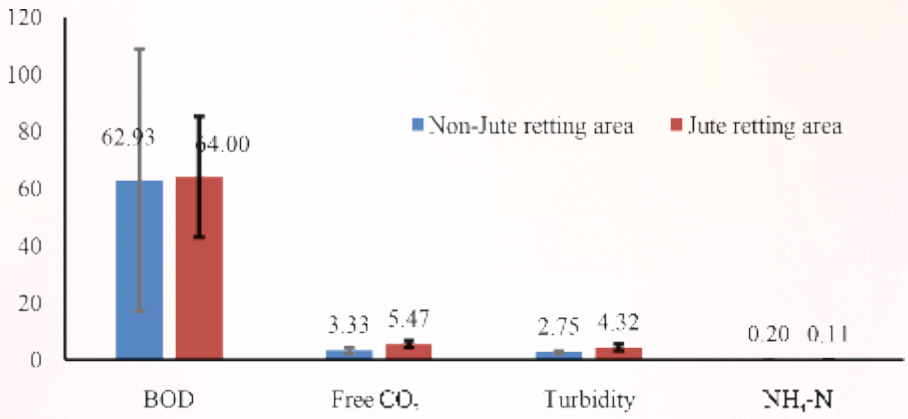
Large-size *Pterygoplichthys pardalis* caught from Kholsi beel



Trichopsis vittata, an exotic gourami recorded in Kholsi beel



Stocking of *Systomus sarana* seed in pen



Impact of jute retting on selected water parameters in Kholsi beel

Table: Indicator in water and sediment for assessment of jute retting in wetland

Water parameters				
	Particulate matter (mg/l)		Turbidity(NTU)	
Period	Jute area	Non jute area	Jute area	Non jute area
Pre-Jute retting	82.07	45.00	56.67	36.62
Jute retting	11.66	9.98	7.75	5.04
Post-jute retting	7.69	18.45	7.47	7.72
Average sediment microbial (Dehydrogenase) activities (µg TPF/h/g dry sediment)				
Time	Jute retting area		Non-jute retting area	
Pre-retting period	60.06		53.10	
Retting period	59.11		77.24	
Post-retting period	33.95		52.75	

far away from jute retting zone during July, August, October and November 2024 in Kholsi beel, Nadia, West Bengal.

Impact of Jute Retting on Selected Chemical Parameters of Water and Sediment

Kholsi beel established connectivity with the river during jute retting period in the monsoon (July-September). However, jute retting still impacts water quality parameters such as turbidity, with jute retting area exhibiting higher turbidity (4.32 ± 1.10 NTU) as compared to non-jute retting areas (2.75 ± 0.39 NTU) in the wetland. Additionally, higher free CO_2 and higher BOD were recorded in the jute retting areas.

Impact of Jute Retting on Biochemical and Microbiological Parameters of Water and Sediment

Particulate matter and turbidity were assessed in water column, while microbial activity (dehydrogenase activity) and organic matter were analysed in sediment. The assessment of particulate matter (mg/l) in water during the jute retting period and post jute retting period showed a higher density in retting area during the initial and peak retting period, followed by reverse trend with lower density during the post-retting period. Water turbidity, which is influenced by particulate matter in the water column followed a similar pattern, with higher turbidity in jute retting area during the retting period. The turbidity was higher during the initial phase than in the later phase, while the post-retting period showed only marginal variations.

In sediment, dehydrogenase activity was used as an indicator and showed significantly higher value in jute retting areas during the initial phase. However, this trend reversed in later phase of jute retting and post-jute retting period. Overall organic matter of sediment gradually decreased with time indicating less impact in wetland sediment phase as a whole.

Impact of Jute Retting on Plankton

The average phytoplankton density was the highest (2.01×10^5 cells/l) during post-jute retting month, followed by pre-jute retting (1.1×10^5 cells/l) and during jute retting (8.6×10^4 cells/l). Phytoplankton composition (RA%) showed that Chlorophyceae had the highest species richness, while Cyanophyceae dominated, accounting for 45% and 48% in the pre- and post-jute retting periods, respectively. In the pre-jute retting period, Cyanophyceae contributed 45%, followed by Chlorophyceae (32%) and Bacillariophyceae (15%). During jute retting, the relative abundance of Chlorophyceae increased to 49%, followed by Cyanophyceae (37%) and Bacillariophyceae (10%). Post-jute retting, Cyanophyceae dominated again with 48%, followed by Chlorophyceae (26%). The lowest percentages were observed in Euglenophyceae, Zygnemato-phyceae, and Dinophyceae. Indicative association phytoplankton species such as *Scenedesmus quadricauda*, *Oscilla toriatenuis*, *Cyclotella* sp., *Ankistrodesmus falcatus*, *Gomphonema gracile*, *Pediastrum* sp., *Pandorina* sp., *Microcystis aeruginosa*, *Anabaena* sp., were observed during the study period.



Diseased Silver carp in Kholsi beel during jute retting period

Zooplankton abundance was the highest during the post-jute retting period (1128.75 Ind./l) and lowest during the jute retting period (930.25 Ind./l). At the site near the jute retting area, the post-retting period showed the highest zooplankton density, with groups like Rotifera (388 Ind./l), egg masses (24.33 Ind./l), protozoa (31 Ind./l), and Cladocera (120 Ind./l) being most abundant. In contrast, the pre-jute retting period saw higher densities of Copepoda (317.33 ± 185.30 Ind./l) and crustacean nauplii (186 ± 77.74 Ind./l). Species of Rotifera, such as *Brachionus calyciflorus*, *B. fulcatus*, *B. diversicornis*, *B. caudatus*, and *Asplanchna* spp., were characteristic indicators in the pre-jute retting period. However, this shifted post-jute retting, where species like *B. fulcatus*, *B. quadridentus*, *B. forficula*, *Testudinella* spp., *Lecane* spp., and *Filinia opoliensis* emerged as indicator taxa with an IndVal (Indicator Value) of ≥40%.

Impact of Jute Retting on Fish Health

Mortality and fish disease occurrences were recorded during and just after the jute retting period in Kholsi beel. The most affected fish species was silver carp followed by *Labeo catla*, *Cirrhinus mrigala*, *L.bata* and *Puntius* species. Bacteriological investigation of the diseased fishes revealed *Aeromonas* species as the primary disease causing organism.

Development of Alternate Option of Jute Retting Pollution in Wetland

The nutrient-rich slurry and wastewater from jute retting were experimentally used for possible consumption as feed by fish, particularly detritivorous fish, through intensive aquaculture in a micro-pond (7 m diameter; 38.5 sq m surface area, 1 m water depth; suitable for jute retting of crop from 1 bigha i.e. ⅓ acre). This micro-pond, constructed at one corner of the field or wetland nearby places. Additionally, jute slurry was effectively mineralized to make nutrients available for plankton production, which could be utilized by stocked planktivorous fishes using appropriate application of liming. The BOD level of the micro-pond was also reduced significantly with liming.

The culture period started after completion of jute retting process during the month of September. Fish species, which can tolerate stressful environment of jute retting micro-pond and thrive in low winter temperature regime (October - March) were identified. A total of six indigenous and exotic fishes *viz. Oreochromis niloticus* (Tilapia), *Anabas testudineus* (Vitenam strain) (Koi), *Heteropneustes fossilis* (Singi), *Ctenopharyngodon idella* (grass carp), *Cyprinus carpio* (Common carp), *Clarias magur* (Magur) were selected for this experimental trial. Growth and survival studies revealed that Tilapia has the maximum potential to be adopted in jute slurry based fish culture followed by *Anabas* species (Vietnam strain) during a culture period of 8 months (October to May). The initial trial indicated a promising prospect, demonstrating utilization



Jute-slurry based micropond used for fish culture

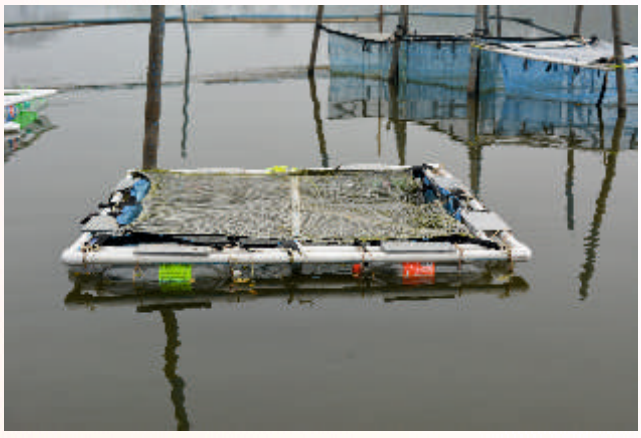


Harvested Tilapia grown in jute-slurry based micropond

of jute slurry for fish culture, which can be a model of waste to wealth conversion and contribute to a circular economy. The approach could encourage the jute farmers to adopt the micro-pond-based jute retting technology and saving the precious biodiversity of floodplain wetlands.

Experimental Trial towards Nature-Based Solution for Fish Diversity Conservation

Cages of 1 m^3 dimension were used to stock selected small indigenous fishes (SIF) such as *Trichogaster fasciata*, *Lepido-cephalichthys guntea* and *Nandus nandus* separately for an experimental trial of natural breeding and auto recruitment in wetland environment. These fish species were chosen as they disappeared from the Kholsi beel due to anthropogenic disturbances. To create a natural environment, selected rooted submerged macrophytes were placed inside the cages. No external feed was provided, the fish relied entirely on natural plankton available inside cages. After five months (October-February) of rearing, it was observed that the fishes are quite healthy inside the cages.



1 m^3 cage with submerged macrophytes in Kholsi beel



Stocked *Trichogaster fasciata* in cage



Stocked *Lepidocephalichthys guntea* in cage



Stocked *Nandus nandus* in cage

Project Code: RWF/24-27/17

Project Title: Fostering Reservoir Fisheries for Blue Growth and Achieving SDGs amid Climate Change and Anthropocene

Duration: 01.04.2024 – 31.03.2027

Seasonal sampling and stakeholder surveys were conducted in seven selected reservoirs for the study, *viz*. Gandhisagar (Madhya Pradesh), Maithon (Jharkhand and West Bengal), Getalsud (Jharkhand), Bhairavi (Jharkhand), Nesa (Odisha), Malampuzha (Kerala), and Meenkara (Kerala).

Gandhisagar Reservoir

The Gandhisagar Reservoir, impounded on the River Chambal by a masonry gravity dam constructed in 1960 and located in the Mandsaur and Neemuch districts of Madhya Pradesh, is part of the Integrated Chambal Development Programme playing a key role in water management in the region. The reservoir is one of the largest reservoirs in central India and plays a crucial role in supporting fisheries and livelihoods in the region.

The sampling was carried out along five sampling station representing three hydrological zones in Gandhisagar reservoir, viz lotic, intermediate and lentic zone during post-monsoon season.



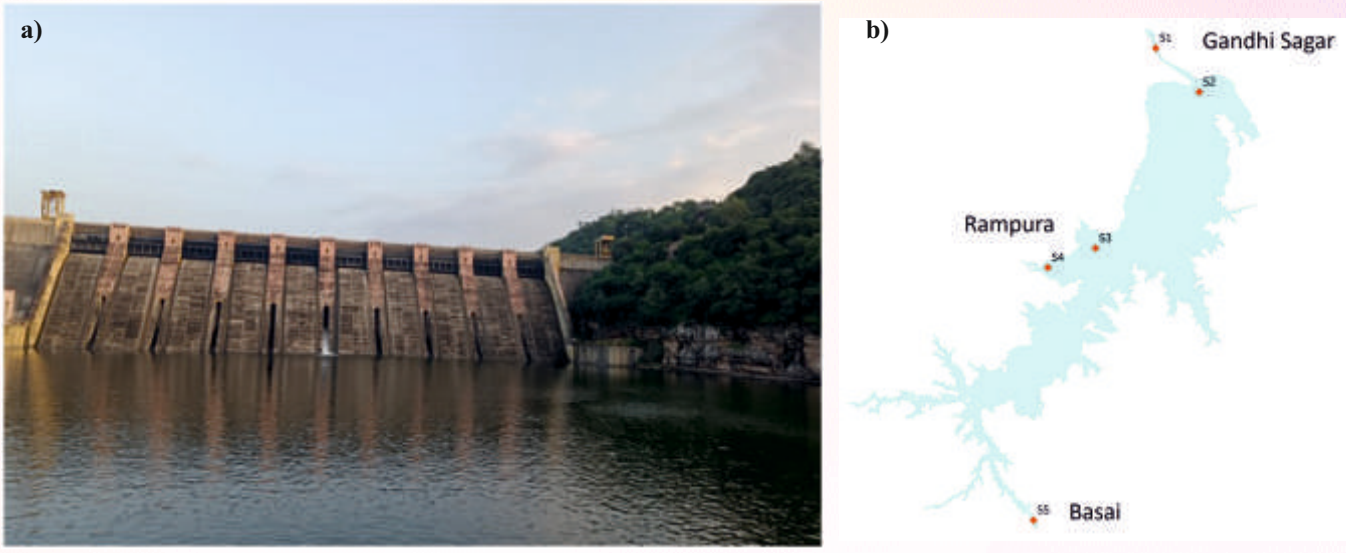
Map showing seven selected reservoirs under the project

Water Quality and Productivity

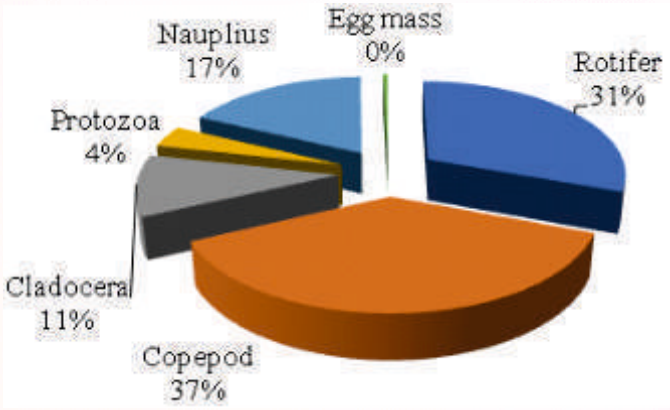
The transparency of reservoir water measured via Secchi depth ranged from 92.0 cm (lotic zone) to 334.5 cm (lentic zone), water depth along the mid channel section ranged from 12.5 (lotic zone) to 39.1 m (lentic zone), the pH ranged from 8.54 ± 0.5 (lentic zone) to 9.07 ± 0.1 (intermediate zone), which is moderately alkaline. The average DO value was ranged 5.5 ± 0.5 (lentic zone) to 7.9 ± 0.9 (lotic zone), average total alkalinity was between 109.3 ± 45.9 (intermediate zone) to 223.0 ± 1.4 mg/l, average specific conductivity ranged from 389.1 ± 3.6 (lentic zone) to 724.5 ± 27.6 µS/cm (lotic zone) and total dissolved solids (TDS) was 273.9 ± 27.9 (lentic zone) to 509.5 ± 19.1 mg/l (lotic zone). Among the nutrient contents nitrate-N ranged between 0.099 ± 0.016 (intermediate zone) and 0.566 ± 0.049 (lotic zone) while available phosphorus ranged from 0.0208 ± 0.0205 (intermediate zone) to 0.155 ± 0.0007 (lotic zone) indicating moderate to high productivity of the reservoir. The chlorophyll concentration of the reservoir water varied between 2.67 to 4.7 mg/m^3.

Planktonic and Benthic Diversity

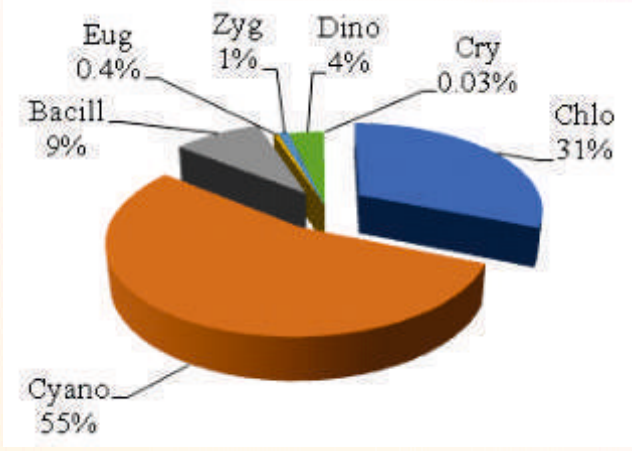
In total, 98 species of phytoplankton were recorded from Gandhi Sagar. Four algal groups, viz. Chlorophyceae, Cyanophyceae, Dinophyta and Bacillariophyceae, were the dominant quantitative components, remarkably influencing the total phytoplankton population in the reservoir, contributing about 87% of total phytoplankton. Although, the species richness was maximum under the group Chlorophyta (Chlo), Cyanophyta (Cyano) comprised 55% of the total phytoplankton population followed by Chlorophyta (31%),



a) Gandhisagar dam (b) Sampling locations in the Gandhisagar



Composition of major zooplankton groups in Gandhisagar reservoir



Relative abundance of major phytoplankton classes from Gandhisagar reservoir

Bacillariophyta (Bacilli) (9.2%), Dinophyta (Dino) (3.6%), Zygnematophyta (Zyg) (1%). The algae group Euglenophyta(Eug) and Cryptophyta (Cry)was the least which accounted for 0.48% and 0.04%, respectively to the phytoplankton population. The zooplankton community consisted of 45 taxa. Among the four primary zooplankton groups, Rotifera was the most significant in terms of species richness contributing 31% but in numerical abundance Copepoda represented most (37%) of the total zooplankton population, followed by, Crustacean nauplii (17%), Cladocera (11%) and Protozoa (4%).

The benthic population at the Gandhisagar dam site was primarily composed of gastropods, particularly *Bellamya bengalensis*, whereas the Rampura sample was dominated by Chironomid worms (bloodworms), specifically *Clinotanypus* sp. The presence of *Clinotanypus* sp. indicates a higher organic load in the sediment, suggesting organic matter accumulation in the transitional zone of the reservoir.

Reservoir Fisheries and Management

The reservoir fishery is primarily focused on Catla. Other major carps, such as Rohu, Grass Carp, Silver Carp, and *Labeo calbasu* also contribute significantly. Apart from carps, the reservoir supports a prominent catfish fishery, dominated by *Sperata seenghala*, *Silonia silondia*, and *Eutropiichthys vacha*. There is a massive abundance of Nile Tilapia in the reservoir and the pathway check of which indicated that the species proliferated in the system after a huge flood occurred in 2019 as farm-escaped Tilapia reached the reservoir system in large numbers.



Clinotanypus sp. (blood worm) is abundant in the Rampura zone of Gandhisagar Reservoir



A fishing boat heading to the fishing ground



The sorted catch is being transferred to tractors for transport to the packaging center

The reservoir is managed by the MP Fisheries Federation through a licensed contract system. Fishing operations in this reservoir are highly cost-efficient and involve multi-day gill-net fishing using non-motorized traditional wooden boats. Although non-motorized, these boats have been optimized for better efficiency and use sails to travel to and from the fishing grounds, depending on wind direction. The collected catch is then transported using mechanized boats, followed by fast ice-preservation, packaging, and proper marketing. This shows a highly cost- and fuel-efficient fishing mechanism, ensuring both the quality of the catch and its proper marketing. The landing and packaging operations of the catch are mainly centered in two sites, namely, Gandhisagar in Mandsaur district and Rampura in Neemuch district, where the MP Fisheries Federation has facilities for packaging and transport. The reservoir fisheries have proper Monitoring, Control, and Surveillance in place, as evidenced by the large collection of fishing nets and boats taken into custody for illegal fishing. The integration of sustainable fisheries management practices, including regulated fishing schedules and conservation efforts, have contributed to the productivity and long-term viability of the reservoir's fisheries.



Fishers at Magurdih fishing village, located upstream of Maithon Reservoir



Gill net haul from Maithon showing the predominance of SIFs in the catch

Maithon Reservoir

The Maithon Reservoir, situated in the Dhanbad District of Jharkhand and the Paschim Bardhaman District of West Bengal, is one of the biggest dams in Jharkhand. This dam is built on the Barakar River, a main tributary of the Damodar River in eastern India.

Fish Diversity and Reservoir Fisheries

The fish diversity at lotic, lentic and transitional sites were explored. Large fish are caught only in limited numbers, with the primary species being Indian Major Carps (IMCs), *Labeo calbasu*, *Sperata seenghala*, *Eutropiichthys vacha*, and the exotic Nile tilapia. The bulk of the catch from reservoir comprises smaller-sized species such as *Osteobrama cotio*, *Salmostoma bacaila*, *Cirrhinus reba*, *Gudusia chapra*, *Notopterus notopterus*, *Puntius* spp., *Chanda nama*, and *Gagata* sp., etc. The presence of juvenile major and medium carps, catfishes, murrels, and other species in the lotic zone of this reservoir, which is not regularly stocked, suggests that this area functions as a breeding ground for several commercially significant species, contributing significantly to the self-sustaining fish populations.

Fishing in the upstream areas of the dam is primarily on a small scale and of subsistence-nature, with no functional Primary Fisheries Cooperative Societies (PFCS) in these sections. Most fishers engage in fishing as a part-time activity, often combining it with farming or working as labourers at construction sites or in brick kilns. The team also interviewed fishers from the Magurdih and Goghna fishing villages to assess their vulnerability to climate change.

The dam area hosts cage culture units, and there are floating pen (RFF) culture units in some of the surrounding fishing villages. There is significant potential to boost fish production from the reservoir by boosting performance of PFCSs and implementing fisheries management strategies such as regular fingerling stocking and the installation and maintenance of RFF and cage farming units.

Getalsud Reservoir

Getalsud Reservoir, located in the Rukka Block, in Ramgarh district of Jharkhand, is a medium-sized reservoir. It is a multi-purpose reservoir that supplies water to Ranchi city and the surrounding industrial area. The reservoir was completed in 1971 and its main source of water is the Subarnarekha River, which originates in the Chhotanagpur plateau of South Bihar.

Physico-chemical Characteristics

The transparency of reservoir water measured via Secchi depth ranged from 90.0-141.0 cm, water depth along the mid channel section ranged from 6.6 - 7.3 m (lotic zone), 16.3 - 17.1 m (intermediate) and 15.6 -18.1 m (lentic zone), the pH ranged from 7.57± 0.08 (lentic zone) to 7.75 ± 0.02 (lotic zone). The average DO value ranged from 5.1±0.2 (lentic zone) to 6.5 ± 0.1(lotic zone), average total alkalinity was between 59.7 ± 2.9 (lentic zone) to 72.0 ± 1.6 mg/l, average specific conductivity ranged from 205.3 ± 41.0 (lentic zone) to



A scenic view of Maithon Dam, featuring islands within the reservoir and tourist boats in the vicinity

246.6 ± 3.84 µS/cm and total dissolved solids (TDS) was 133.0 ± 27.9 (lentic zone) to 160.2 ± 2.5 mg/l (lotic zone). Among the nutrient contents nitrate-N ranged between 0.039 ± 0.001(lentic zone) and 0.076 ± 0.005 (lotic zone) while available phosphorus ranged from 0.040 ± 0.007 (intermediate zone) to 0.058± 0.045 indicating moderate productivity of the reservoir. The depth-wise profile of water temperature, dissolved oxygen, pH and free CO_2 concentration of water did not indicate klinograde curves indicating lack of high productivity in Getalsud reservoir during post-monsoon season.

Reservoir Fisheries

The reservoir is being utilized for fisheries enhancement through culture-based fisheries and enclosure culture practices, such as cage culture and floating pen system known as the Riverine Fish Farming (RFF) model. At the Maheshpur site (a transitional zone of the reservoir) around 400 cages are dedicated primarily to farming Pangas and Tilapia. The RFF system is stocked with Indian Major Carps (IMCs) and grass carp, while CBF practices also focus mainly on these carps. Despite not being stocked, Tilapia have proliferated in the reservoir and constitute a significant portion of the RFF catch. Native fish species commonly caught include *Labeo calbasu*, *Notopterus notopterus*, and smaller species like *Puntius* spp., *Pethia* spp., *Glossogobius giuris*, and *Salmophasia bacaila*. The socio-economic survey conducted among fishers of the Getalsud Reservoir, Jharkhand, to assess their vulnerability to climate change and anthropogenic factors, revealed concerns about the potential impact of Floating Solar Photovoltaic (FSPV) system installations on their livelihoods, particularly fishing and tourism-related boating. A scientific assessment of the impacts of FSPV installations on reservoir fisheries is needed.

Bhairavi Reservoir

The Bhairavi Reservoir located in Ramgarh district of Jharkhand, a small reservoir of less than 500 ha, was constructed on the Bhairavi River (also known as the Bhera River) in the Damodar Basin.



Enclosure farming practices in Getalsud Reservoir: (a) Floating Pen (RFF), (b) Cage culture units



Cage culture and RFF units in the Bhairavi Reservoir, showcasing the intensive fisheries development infrastructure

Completed in 2016, the reservoir's construction began in 1990. Although designed for water storage, the irrigation network remains underdeveloped, with the right and left canals still incomplete. Despite not being fully utilized for irrigation, the reservoir is intensively used for fisheries development, incorporating cage culture, floating pen systems (RFF units), and the CBF model. The reservoir supports eight fishing villages and seven PFCSs, although the proliferation of submerged macrophytes hampers fishing operations. The reservoir serves the interests of 8 fishing villages (Hohad, Bonga Sauri, Bhalu, Potamdaga, Biyang, Nawadih, Bariatu, and Sothai) and 7 Fisheries Co-operative Societies (PFCSs), which have a significant stake in its resources. Socio-economic and climate vulnerability assessments were conducted through perception-based surveys in three villages.

Physico-chemical Characteristics

The transparency of reservoir water measured via Secchi depth ranged from 103-141 cm, with an average of 127 ± 17.8 cm, the average depth of the reservoir was found to be 7.0 ± 2.47 m, the pH ranged from 8.02 to 8.22 with mean value at 8.1 ± 0.1, which is slightly alkaline in nature. The DO value ranged from 6.4 to 6.8 with mean value at 6.5 ± 0.2 mg/l which is optimum for fish growth and survival. The average total alkalinity, specific conductivity and total dissolved solids (TDS) was 86.5 ± 3.8 mg/l, 283.8 ± 0.5 µS/cm and 201.8 ± 2.4 mg/l respectively indicating medium productivity dynamics in the reservoir during the study period. The study recorded mean NO_3-N concentration at 0.033 ± 0.01 mg/l while available phosphorus ranged 0.015 ± 0.006 mg/l indicating moderate productivity of the reservoir. The chlorophyll concentration of the reservoir water varied from 1.57 to 3.4 mg/m^3.with mean at 2.42 ± 0.91 mg/m^3. The sediment pH was near acidic (pH 4.81 ± 0.52); the mean organic carbon (%), specific conductivity and available phosphorus was 1.71± 0.14 %, 609.25 ± 232.21 µS/cm and 0.93 ± 0.27 mg/100g respectively.

Planktonic Diversity

The mean phytoplankton density was recorded during monsoon (1.9×10^4 cells/l) from Bhairavi reservoir. The highest abundance of phytoplankton was noticed in village side (3.11×10^4 cells/l) followed by river side (1.46×10^4 cells/l), and in dam site (1.32×10^4 cells/l). The mean quantitative density of zooplankton in the studied reservoir was 3514.50 Ind/l. The most common genera in the reservoir, encountered in majority of the samples were *Dolichospermum, Aulacoseira, Microcystis, Oedogonium, Oscillatoria, Lyngbya, Pediasturm, Mougeotia, Fragilaria, Nitzschia, Navicula,* and *Synedra.* Similarly, among zooplankton, the species such as *Bosmina* spp., *Diaphanosoma* spp., *Dunhevedia* spp., were conspicuous (Cladocera). Cyclopoid and calanoid copepods were represented by *Mesocyclops* spp., and *Diaptomus* spp., respectively. The protozoa included *Pleodorina* spp., *Difflugia* spp., and *Centrophyxis* spp.

Fisheries

The dominant native species caught from the reservoir were spiny eel (*Macrognathus armatus*), Singhi (*Heteropneustes fossilis*), and *Notopterus notopterus*. The exploratory survey carried out in Bhairavi reservoir showed a high infestation of exotics such as Nile tilapia, Mossambique tilapia, Pangas, grass carp, silver carp, bighead carp, and common carp which contributed more than 50% to the total catch. The exotics were introduced to the reservoir through stocking for CBF, and escapes from cage culture system and floating pen systems. The

indiscriminate placement of RFF units within the small reservoir has resulted in the reduction of essential breeding and feeding habitats for native species. Specifically, the marginal, macrophyte-dominated mesohabitats, which serve critical roles in supporting the breeding, feeding, and nursery functions for these fish, are now enclosed by the RFF units. This restriction prevents native fish from accessing the open reservoir, negatively affecting the recruitment of indigenous species to the reservoir fisheries. Additionally, this alteration in habitat structure creates opportunities for the invasion of exotic species that may be stocked or inadvertently enter the reservoir. The case study of Bhairavi Reservoir indicated that new reservoirs are highly vulnerable to invasions by non-native fish species, a process accelerated by fisheries enhancement activities that facilitate their spread.



Fisherfolk of Bhairavi Reservoir with the project team members during field interaction

Nesa Reservoir

In Odisha, the Nesa Reservoir is located in the Subarnarekha Basin, Mayurbhanj, with a catchment area of 24.61 km² and a submergence area of 169.17 ha.

Physico-chemical Characteristics

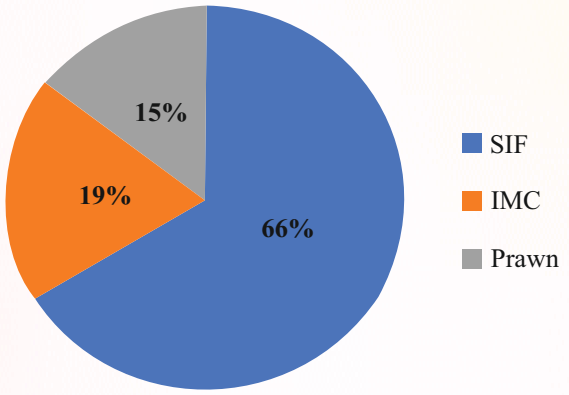
The transparency of reservoir water measured via Secchi depth ranged from 148-154 cm, with an average of 150.3 ± 3.2 cm, water temperature ranged from 30.4 to 31.2°C, the pH ranged from 8.3 to 8.8 with mean value at 8.5 ± 0.2, which is slightly alkaline in nature. The DO value ranged from 4.6 to 6.8 with mean value at 5.4 ± 1.5 mg/l. The average total alkalinity, specific conductivity and total dissolved solids (TDS) was 74.3 ± 2.5 mg/l, 170.1 ± 5.9 µS/cm and 119.7 ± 3.7 mg/l respectively indicating medium productivity dynamics in the reservoir during the study period. The study recorded mean NO_3-N concentration at 0.044 ± 0.01 mg/l while available phosphorus ranged 0.024 ± 0.013 mg/l indicating low to moderate productivity of the reservoir. The mean chlorophyll concentration recorded in the reservoir was 6.83 ± 2.62 mg/m^3.The sediment parameters pH (7.45), organic carbon (0.86%), available phosphorus (0.97 mg/100g) indicated medium productivity of the reservoir. The critical water and sediment quality parameters are in the optimal range for fish production indicating healthy environment.

Planktonic Diversity

The average quantitative abundance of phytoplankton in the Nesa reservoir was (3.11× 10^4 cells/l) recorded in monsoon. The species such as *Scenedesmus, Pediastrum, Tetraedron, Crucigenia, Schroederia* were conspicuous under the group Chlorophyta while Bacillariophyta represented by *Cyclotella, Aulacoseira, Nitzschia, Fragilaria, Synedra, Navicula*, etc. The most common genera encountered in the majority of the samples for the group Cyanophyta were *Phormidium, Chroococcus, Merismopedia, Microcystis, Cylindrospermum, Dolichospermum, Synechococcus, Lyngbya.* A total of 46 zooplankton species were observed from Nesa reservoir. Rotifera represented 47.28% of the total zooplankton population, followed by Copepoda (23.95%), Crustacean Nauplii (13.83%), Cladocera (10.34%) and Protozoa (2.53%). A total 12 congeneric species of rotifers were observed such as *Brachionus calyciflorus*, *B. falcatus*, *B. diversicornis*, *B. caudatus*, *B. forficula*, *B. angularis*, *B. quadridentatus*, *B. lyratus*, *B. sericus*, *Fillinia opoliensis*, *F. terminalis*, *F. longiseta.* The mean quantitative density of zooplankton in the studied reservoir was 4531.50 Ind/l.

Fisheries

The fish production of Nesa reservoir was manily contributed by the Small Indigenous Fish (SIF) contributing 66% of the total fish catch. Prawn (*Macrobrachium dayanum*) contributed 19% of the total catch. The stocked fish (Indian Major Carp) contributed only 15% of the catch indicating that the stocking was not sufficient for increasing fish production. During sampling 22 indigenous fish species were





Predominance of SIFs in the catch from Nesa Reservoir

observed. Among the SIF, *Amblyphryngodon mola* contributed the major portion followed by *Chanda nama, Salmophasia* spp. The prawn fisheries was maximum in the summer season but minimum in the winter season. The SIF was mainly caught by zero mesh size drag net, IMC was caught by gill net and prawn was mainly caught by local made trap.

The small reservoir is managed by a cooperative society comprising 45 members, with 20 being active, predominantly from Scheduled Tribes. Major challenges include illegal fishing by non-members, lack of proper stocking, and absence of fishing boats. Stakeholder perception indicates erratic rainfall as the primary climate-related concern, and Small Indigenous Fish (SIF) contribute more than 90% of the fish catch.

Malampuzha Reservoir

It is a medium reservoir of 23.13 sq. km located at 10.8388° N, 76.6904° E in Palakkad district of Kerala. It has a gross storage capacity of 226 million cu.m. The reservoir is stocked with Indian major carps. Nearly 108 fishermen are involved with reservoir fisheries. The fishing rights are distributed to eight (8) self help groups, the largest one being Jaladhara group.

Assessment of Ecosystem Vulnerability

Various indices have been used to assess the ecosystem vulnerability. The productivity status of the reservoir has been assessed with the help of primary productivity estimates. The gross and net primary productivity of Malampuzha was estimated as 250mgC/cu.m/day and 125mgC/cu.m/day respectively. The primary productivity was 141% lower than earlier CIFRI (603.6 mgC/cu.m/day) study (1997-98). This decrease in reservoir productivity refers to decline in the capacity of a reservoir to produce fishery resources.

Fish production potential of the reservoir was estimated at 109.5 kg/ha/yr, whereas the harvestable potential was estimated at 54.75 kg/ha/yr. This was very low compared to the earlier CIFRI studies which recorded 264.16 kg/ha/yr and 132.2 kg/ha/yr respectively. This may be attributed to decline in morphological and water quality parameters of reservoir (declining water levels, nutrient depletion and increased sediment accumulation), invasive species, and changes in water quality due to pollution or altered inflow patterns.

Table: Temporal changes in morphometric indices of Malampuzha reservoir

Morphometric variables	2024-25	1997-98	Indications
Allochthonous input	6.71	6.38	• Increase in organic load from allochthonous sources
Volume development Index	9.77	0.96	• Decrease in storage capacity of reservoir • Transition of reservoir bottom morphology from conical depressions to flat bottoms • Scope for more cage culture ventures
Shoreline development index	1.64	1.10	• Inundation of shoreline of reservoir • More accessible littoral zone and scope for increase in higher productivity
Morpho-edaphic index		3.82	• Decline in its potential for fish production

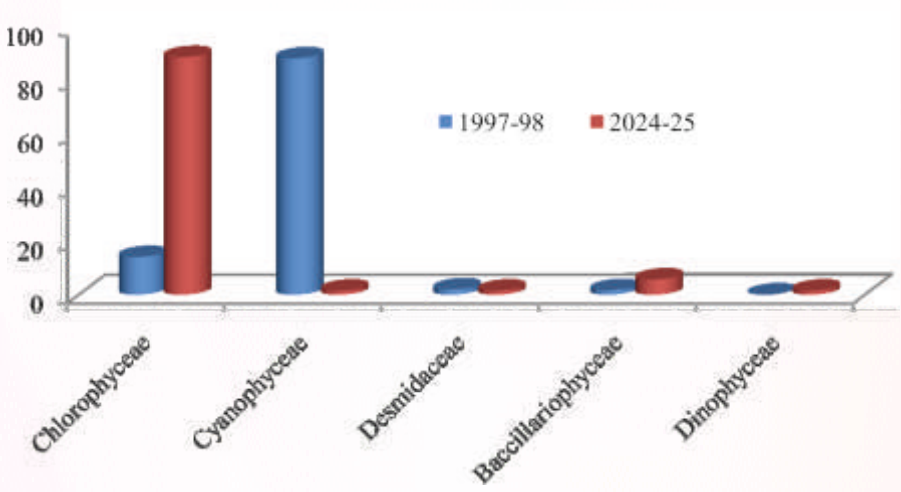
Table: Temporal changes in water quality indices of Malampuzha reservoir

Physical variables	2024-25 (Mean values)	1997-98 (Mean values)
Water temperature (^{0}C)	32	30.1
Transparency (cm)	108.3	110
DO (mg/l)	2.42	7.3
Carbon dioxide (mg/l)	0.8	1.0
T Alkalinity (mg/l)	20.0	26.4
TH (mg/l)	36	31.4
CaH (mg/l)	9.62	7.5
MgH (mg/l)	6.41	3.0

There is substantial reduction in water quality variables across the years. The increase in water temperature to the tune of 6.31% may be the prime reason for the predominant variation in basic chemical variables of the reservoir.

Plankton Assembleges

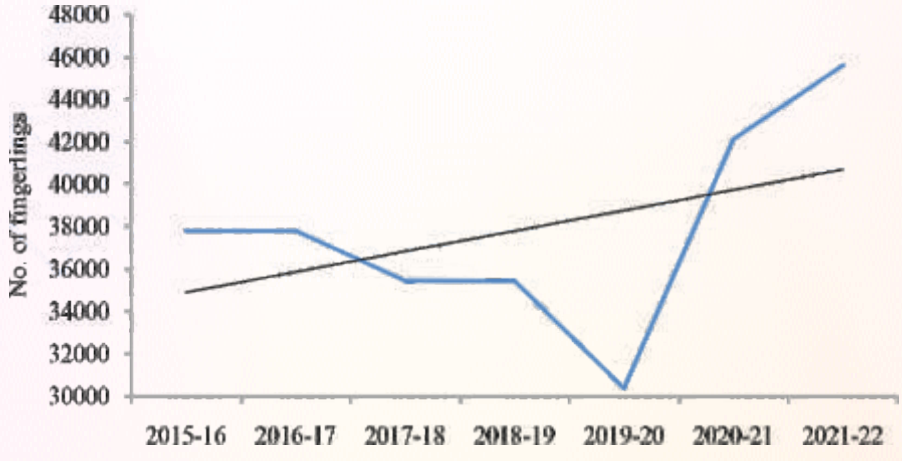
Plankton assemblage indicated a predominant shift in the plankton composition from 1997-1998 to 2024-25. The presence of chlorophyceae indicates scope for enhanced fishery activities including ranching.



Temporal changes in plankton assemblage in Malampuzha reservoir

Impact of Stocking on Reservoir Production

The annual stocking in Malampuzha reservoir ranged from 0.8 to 3.9 million fish seeds, mean value being 2.4±1.6 million. The production in this reservoir ranged from 37,972 to 57,008 kg, mean production being 47,246±7547 kg. The production in numbers in this reservoir ranged from 30,378 to 45,606 adult fishes, mean value being 37794±6038 fishes. The stock-production data of Malampuzha reservoir indicated that inadequate and non-continuous stocking of fish seeds has resulted in low production from this reservoir.



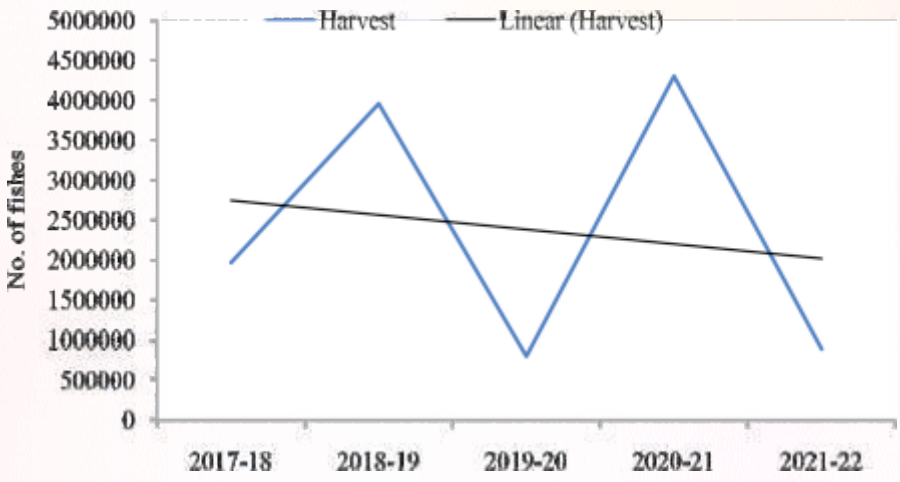
Fish seed stocking in Malampuzha reservoir

Meenkara Reservoir

It is a small reservoir of 2.59 sq.km located at10.6195° N, 76.7974° E in Palakkad district of Kerala. It has a gross storage capacity of 11.30 million cu.m. There are 27 fishers and 9 women fishers associated with Meenkara reservoir.

Assessment of ecosystem vulnerability

The productivity status of the reservoir has been assessed with the



Fish production from Malampuzha reservoir

help of primary productivity estimates. The gross and net primary productivity of Meenkara reservoir was estimated as 350 mgC/cu.m/day and 325 mgC/cu.m/day respectively.

Fish production potential of the reservoir was estimated at 153.3 kg/ha/yr, whereas the harvestable potential was estimated at 76.65 kg/ha/yr. The fish yield from reservoir (2000) was recorded at 107 kg/ha/yr against the current yield of 189 kg/ha/yr. This may be attributed to decline in morphological and water quality parameters of reservoir.

Table: Water quality indices of Meenkara reservoir

Physical variables	2024-25 (Mean values)
Water temperature (^{0}C)	32
Transparency (cm)	130
DO (mg/l)	2.96
Carbon dioxide (mg/l)	0.2
T Alkalinity (mg/l)	1.0
TH (mg/l)	90
CaH (mg/l)	16.02
MgH (mg/l)	15.55

Table: Morphometric indices of Meenkara reservoir

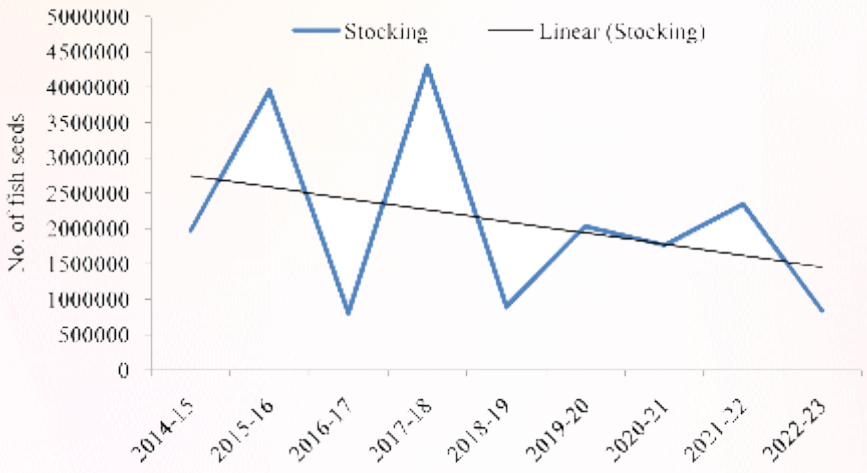
Morphometric variables	2024-25	Indication
Allochthonous input	0.36	Low organic input from catchment area
Volume development Index	0.44	Indicates more scope for cage culture activities
Shoreline development index	0.331	Indicates more accessible littoral zone and indicates scope for increase in higher productivity.

Impact of Stocking on Fish Production

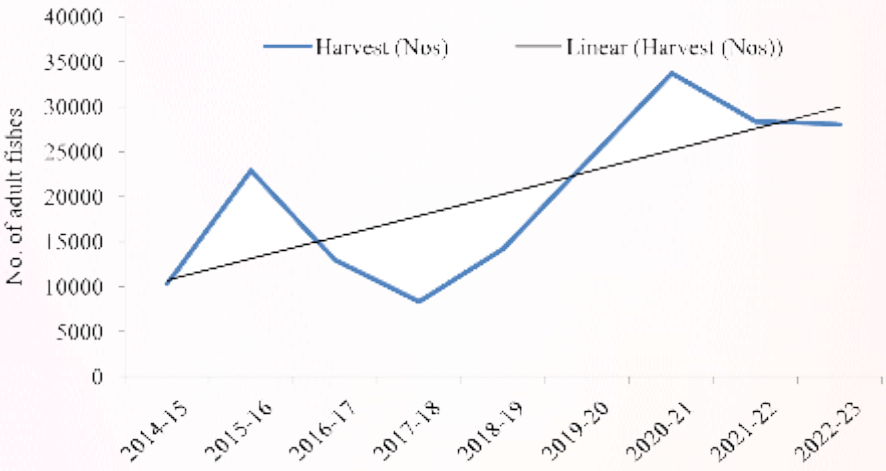
The annual stocking in this reservoir ranges from 0.8 to 4.3 million fish seeds, average being 2.0±1.28 million seeds. The production in this reservoir ranged from 10,367 kg to 42,185 kg, mean production being 25,390±11,347 kg. The production in numbers from this reservoir ranged from 10,367 to 42,185 fishes, mean value being 20312±9099 fishes. The stock- production trend of Meenkara reservoir indicated that despite negative trend in stocking, fish production from this reservoir exhibited a positive trend. The analysis indicated that this reservoir required consistently sustained levels of stocking for enhanced production and to attain its production potential.

Several challenges have been identified across the reservoirs, including climate variability and the invasion of exotic species, which are significantly impacting fish populations and productivity. Illegal and unregulated fishing activities remain a major concern in certain reservoirs, while the proliferation of invasive species continues to disrupt native fish diversity. Limited access to proper stocking and fishing equipment further exacerbates these issues, and socio-economic vulnerabilities pose additional challenges for fisher communities. Based on these findings, the project aims to provide insights and recommendations on climate-resilient fisheries management approaches, regulatory measures to address illegal fishing, and strategies

for conserving native fish through controlled stocking programs. Additionally, the project emphasizes the potential benefits of adopting advanced fishing techniques and equipment and highlights the importance of capacity-building initiatives to support fisher communities in sustainable practices.



Stocking in Meenkara reservoir



Fish production from Meenkara reservoir

Project Code: RWF/24-27/18

Project title: Exploration and Feasibility Study of Pits and Quarries for Fish Production

Duration: 01.04.2024 – 31.03.2027

Exploration of Utilization of OCPs in Jharkhand for Fisheries Development

Three abandoned coal pits (Open Coal Pits: OCPs) in two districts of Jharkhand have been chosen for this study: Ara-Khadan 8 in Ramgarh district, and Ara-Khadan 13 and Shondha in Patratu district. A total of 56 abandoned coal pits are located in Ramgarh district, while 48 are situated in Patratu district. These pits, with depths ranging from 15 to 50 meters, are being transformed for fisheries through Culture-Based Fisheries (CBF) and cage culture technology. Site-specific developments include the initiation of cage farming at Ara-Khadan 8 in 2021, Ara-Khadan 13 in 2022, and Shondha in 2023. Subsistence fishing is practiced by local fishermen, including both members and non-members of organized fishing groups, primarily for personal consumption. The primary species cultured in these coal pits include Tilapia and Pangas. Efforts are also being made to identify and monitor





Subsistence fishing by local fishers for own consumption



Experimental fishing for exploring fish diversity

the diversity of other species, which include stocked Indian Major Carps (IMCs) and native species such as *Mastacembelus armatus, Channa punctata, Puntius sophore, Pethia conchonius, P. ticto, Salmostoma phulo, Rasbora daniconius,* and *Garra* sp. alongside other aquatic fauna like crabs and prawns. The transformation of abandoned coal pits into productive aquaculture sites demonstrates a sustainable approach to utilizing unused resources. These initiatives not only support local livelihoods but also contribute to biodiversity conservation and sustainable fish production in the region.

Biotic Community Structure

The abundance of phytoplankton was assessed both at cage sites and away from cage sites. Phytoplankton density was low at both locations, ranging between 410-730 cells/l. The phytoplankton community consisted of a few colonies of *Microcystis* sp., *Nitzschia* sp., and *Synedra* sp. Zooplankton diversity included 11 species of rotifers, 2 groups of copepods, 2 genera of Cladocera, and 3 genera of protozoa. The highest zooplankton abundance was recorded at the Kuju cage site (84 ind/l) compared to the site away from the cage (66 ind/l). Common species observed at both sites included *Brachionus falcatus*, *B. diversicornis*, *Keratella tropica*, calanoid and cyclopoid copepods, *Diaphanosoma* spp., and crustacean

Table: Physico-chemical water quality parameters of OCPs during monsoon

Parameters	Ara Khadan 8			Ara Khadan 13	Shondha
	Inside cage	Depth-wise		Cage site	Cage site
Depth (mt)	17.0	5.0	15.0	35.3	15.3
Temp Water (°C)	30.4	28.4	25.6	31.2	31.9
pH	7.72	7.9	7.54	7.92	7.62
Sp.cond. (µS/cm)	820.0	816.0	850.0	808	855
Turbidity (NTU)	0.2	0.8	3.49	0.5	0.98
D.O. (mg/l)	3.6	3.2	0	5.2	4.6
TDS (mg/l)	577.0	580.0	596.0	586	604
Salinity (mg/l)	397.0	402.0	413.0	404	418



Cage farming site in Ara-Khadan 8, Kuju Block, Ramgadh

nauplii. The cage site was predominantly dominated by rotifer species, particularly *B. falcatus* and *K. tropica*. At Shondha-Khadan, benthic fauna was found to be abundant in the peripheral regions, indicating habitat-specific distribution patterns.

Proximate Composition of Fish Grown in OCPs

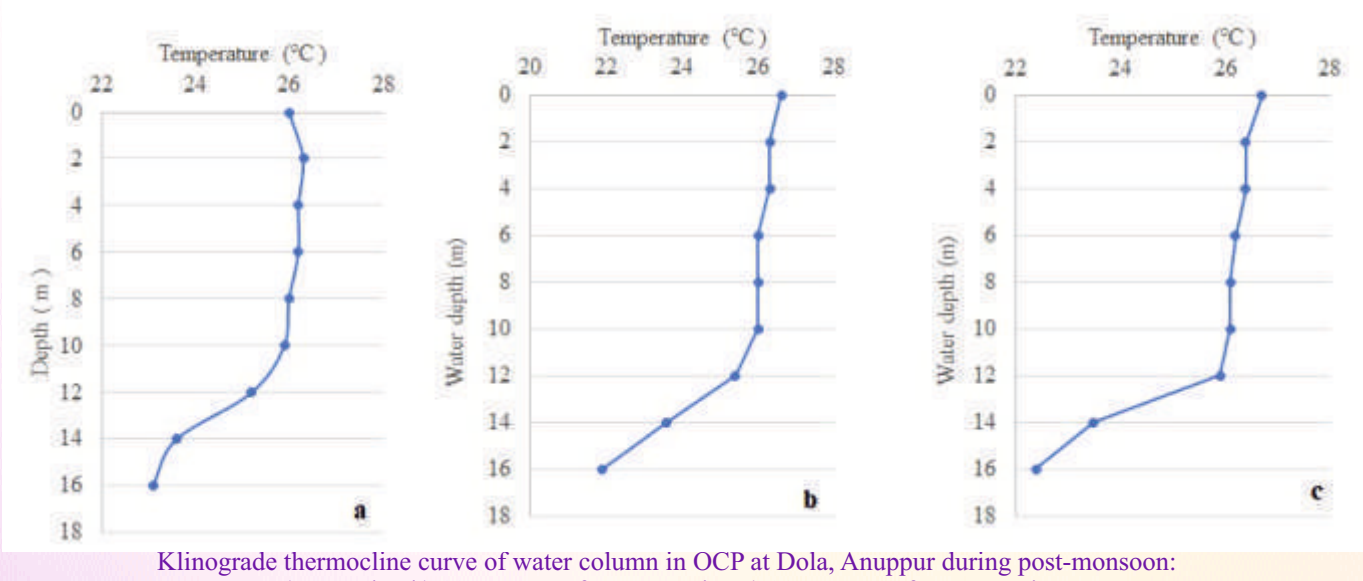
An analysis of fish muscle from *Labeo catla*, *Pangasianodon hypophthalmicthis*, and *Oreochromis niloticus* cultured in the abandoned open coal pits was conducted and compared with the same species cultured in cage farming systems in the Bhairavi reservoir in the same district. The moisture content ranged from 74-80%, crude protein levels were 17-19%, crude fat content ranged from 1-6%, and ash content was between 0.84-2%. The differences in proximate composition between fish species cultured in the OCPs and those cultured in the reservoir were found to be insignificant. These findings indicate that fish produced in the OCPs are nutritionally valuable, characterized by high protein and low-fat content. Variations in composition may occur due to factors such as species, size, environmental conditions, and culture practices.

Open Coal Pit (OCP) at Dola, Anuppur, Madhya Pradesh

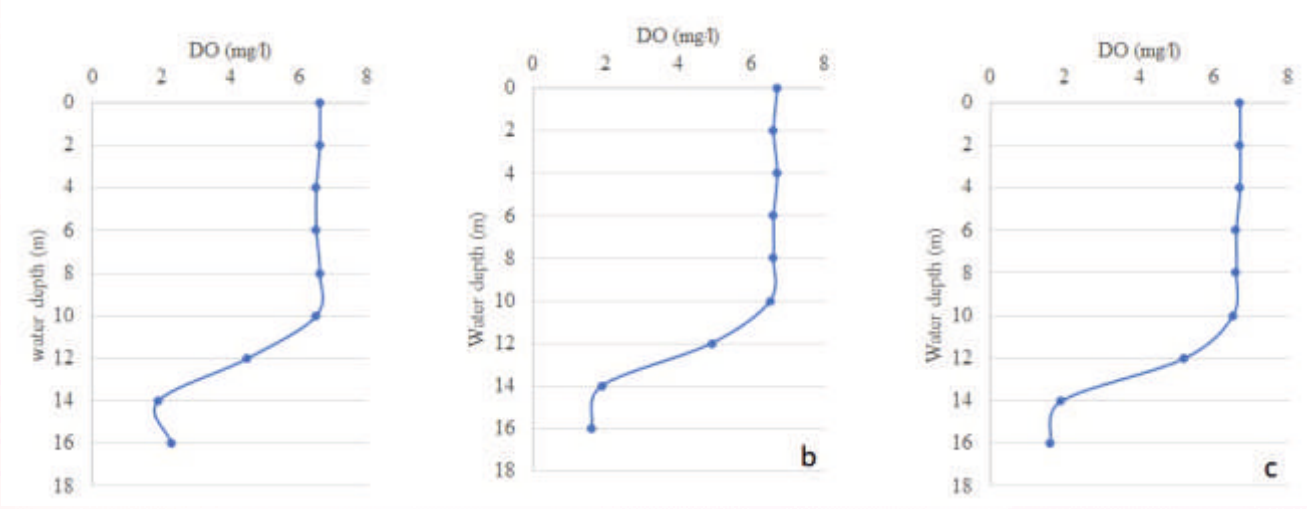
The sampling was carried in OCP at Dola village in Anuppur district (23° 2' 07.2240" N and 81° 12' 29.330" E) at three subsites, namely, Cage site (S1), 100 m from cage site (S2) and 200 m from cage site (S3). The OCP is utilized for fish production via floating cage battery consisting of 12 cages. Presently only 6 cages stocked with *Pangasianodon hypophthalamus* and *Oreochromis niloticus*. The average production of the farmed fish is low at 1.5-2 tonnes/cage.

Limnology and Fisheries of Dola OCP

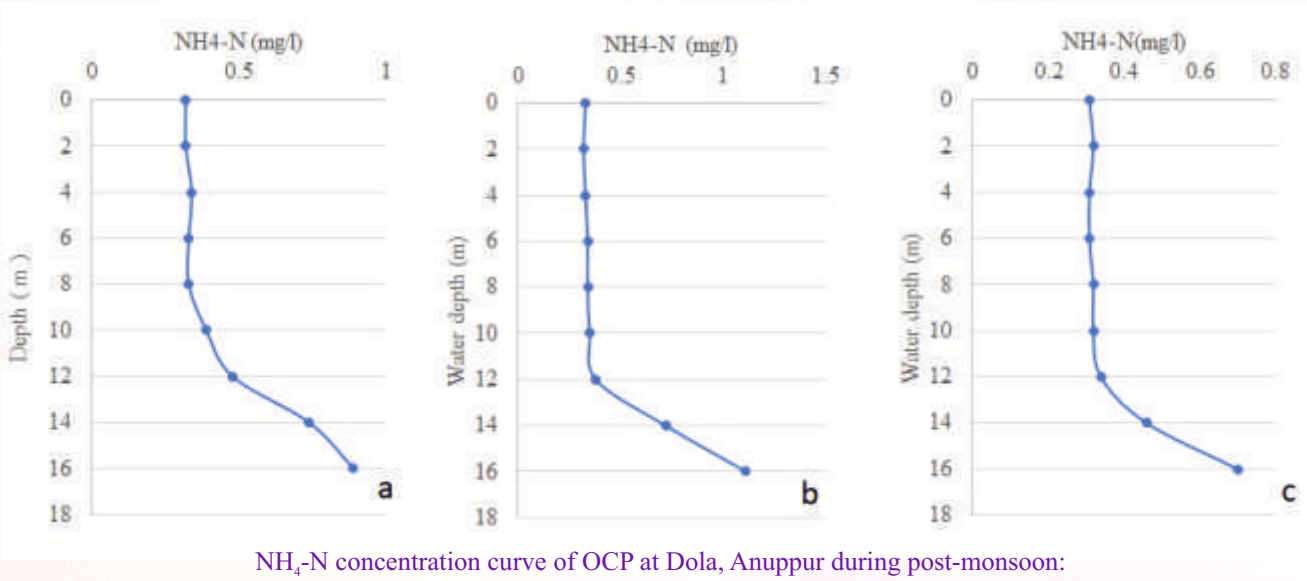
The water depth varied from 16.5 ± 0.25 m (S1) to 39.5 ± 1.1 m (S3). The transparency of reservoir water measured via Secchi depth ranged from 112.0-286.0 cm, the pH ranged from 7.9 ± 0.2 (S3) to 8.1 ± 0.3 (S1), which is slightly alkaline. The average DO value varied between 4.8 ± 2.4 (S3) to 5.1 ± 1.9 mg/l (S1),



Klinograde thermocline curve of water column in OCP at Dola, Anuppur during post-monsoon: a) cage site, b) 100 m away from cage site, c) 200 m away from cage site



Klinograde oxycline curve (DO in mg/l) of water column in OCP at Dola, Anuppur during post-monsoon:
a) cage site, b) 100 m away from cage site, c) 200 m away from cage site



NH_4-N concentration curve of OCP at Dola, Anuppur during post-monsoon:
a) cage site, b) 100m away from cage site, c) 200 m away from cage site

average specific conductivity varied from 341.4 ± 72.2 (S1) to 378.1 ± 11.3 µS/cm and total dissolved solids (TDS) was 221.9 ± 46.7 (S1) to 248.7 ± 15.1 mg/l (S2). The NH_4-N (mg/l) concentration gradually increased towards deeper layers, the site wise concentration was recorded lowest at S3 (0.43 ± 0.16 mg/l) and highest at S2 (0.53 ± 0.32 mg/l). The nitrite-N varied between 0.0006 mg/l (S3) and 0.0008 mg/l (S1) with an mean value at 0.0006 ± 0.0001 mg/l while the available phosphorus varied between 0.005 mg/l (S1) to 0.01 mg/l (S2) with a mean value at 0.007 ± 0.002 mg/l .The fish diversity was found to be very low (7 species). The species recorded among the fish catch in OCP were *Pangasianodon hypophthalmus*, *Oreochromis niloticus*, *Labeo catla*, *L. rohita*, *Cirrhinus mrigala*, *Cyprinus carpio* and *Esomus danricus*. All but *E. danricus* were attributable to stocking and culture practice employed at OCP. The catch per unit effort recorded was 0.93 kg/hr which is very low. The study on comparison of proximate composition of cage reared *O. niloticus* and *P. hypophthalmus* vis-o-vis fishes inhabiting outside cages in OCP showed that cage reared fishes have higher crude fat % and lower moisture content. The crude protein % in *O. niloticus* reared in cages were higher as compared to specimens inhabiting outside environment.

The study revealed presence of thermocline and oxycline in the studied OCP at Dola, Anuppur. The water column below 10 m recorded dissolve Oxygen concentration lesser than the optimum concentration of 5 mg/l required for fishery purpose while the NH_4-N concentrations rose substantially below 10 m at cage site thus showing presence of environmental stress for fish growth at water below 10 m depth. The study indicates water column below 10 m is not congenial for fishery purposes.

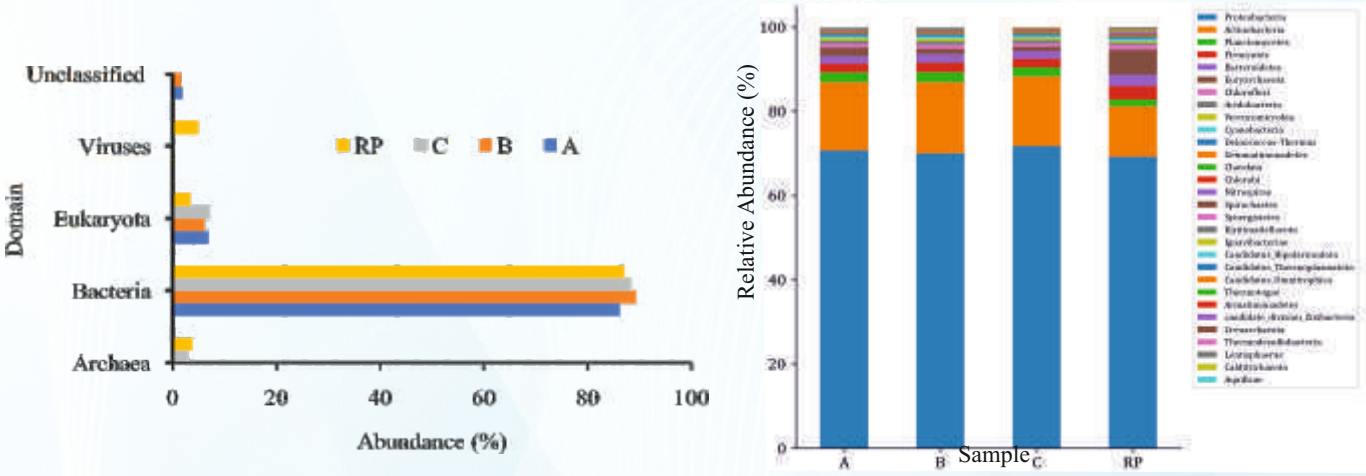
Project Code: FREM/20-23/17

Project Title: Evaluation and Management of Environmental Health through Omics Technologies

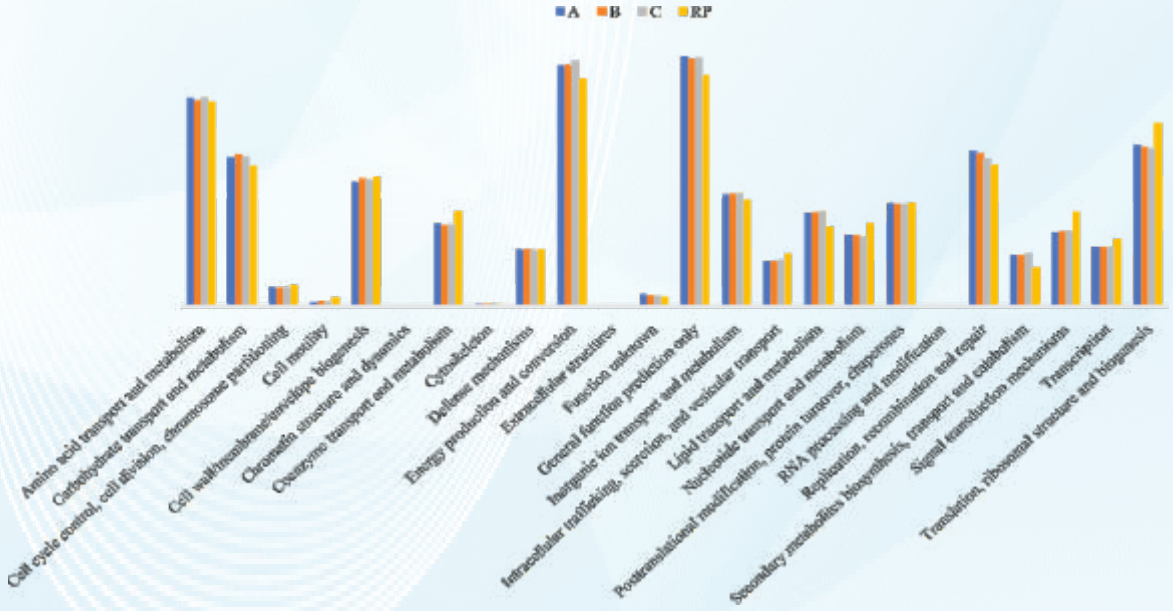
Sub-Project 1: Metagenomic Profiling of Floodplain Wetlands for Ecosystem Health Monitoring

Duration: 01.04.2020 – 31.03.2024

Metagenomic investigation of sediment microbiome community structure of Sardar Bherry, East Kolkata Wetland was conducted to examine for potential bio-indicator species and biomarker communities. Collected samples from the Sardar Bherry Wetland at four different locations: RP (reference point, which is the sewage intake site), A, B, and C (outlet site), respectively. Existence of large bacterial community was confirmed by taxonomic classification, followed by minor abundances of archaea and eukaryotes in all of the sampling sites, although the occurrence of viruses was only noted at RP site. *Proteobacteria* was the most prevalent bacterial phylum in all the points, followed by *Bacteroidetes, Firmicutes, Chloroflexi*, etc. The major genera found include *Bacillus, Candidatus, Coptotermes, Burkholderia, Acidithiobacillus, Dehalococcoides, Methanolinea, Methanosaeta Aminobacterium,* and



Taxonomic abundance of the microbial community of East-Kolkata Wetlands at (a) Domain and (b) Phylum levels



Functional annotation by COG level 2 subcategories of metagenome data of the East-Kolkata Wetlands

Coxiella etc. It is interesting to note that several bacteria and viruses have only been found at the RP sampling location, including *Arsenophonus, Bacteroides, Methanosaeta Aeromonas, Pseudomonas, Nitratiruptor, Desulfobulbus*, and *Flavobacterium*.

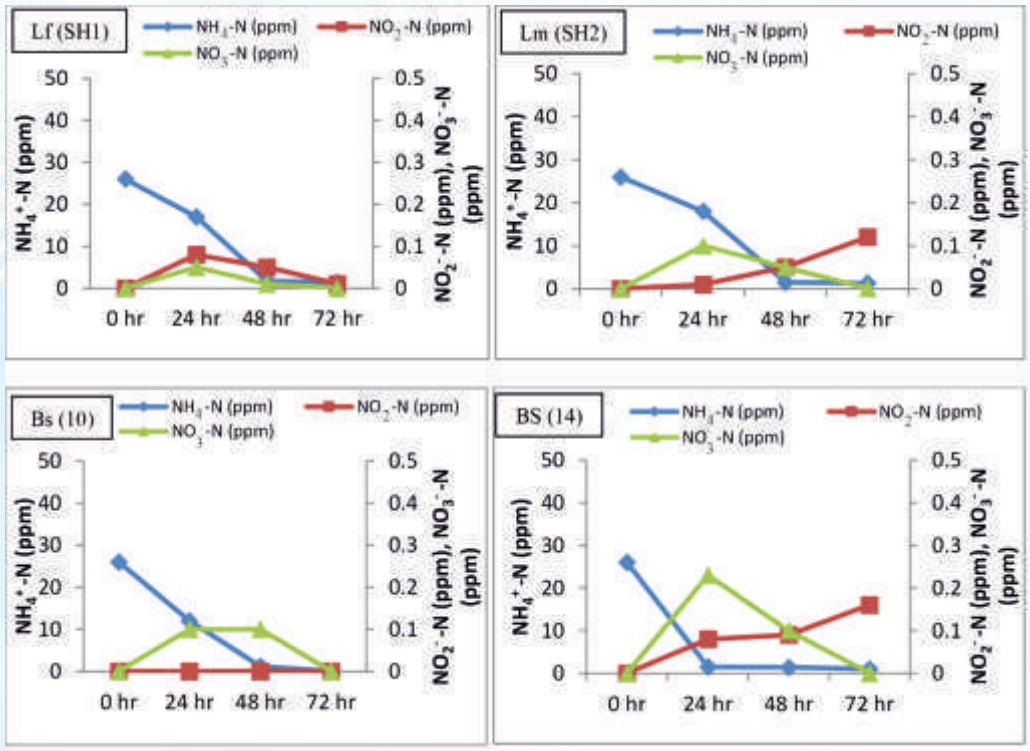
The functional profiling of COG revealed that nearly 50% of the genes were involved in metabolism (including carbohydrate, amino acid, lipid, nucleotide, and coenzyme transport & metabolism); nearly 20% of the genes are involved in cellular processes and signalling (including cell division, cell cycle control, cell wall/membrane biogenesis, intracellular trafficking, and signal transduction mechanisms, etc.), and 18% of the genes are involved in information storage and processing (replication, transcription, translation, RNA processing, chromatin structure and dynamics, etc.).

Development of Microbial Consortium for Ammonium Removal

Bio-remediation involving different microorganisms is very useful for degradation of pollutants from a physical resource. Our research was directed towards development of a microbial consortium and understanding the roles of individual members in removal of nitrogenous waste. Based on the survival and growth compatibility assay, a consortium involving 4 bacterial strains, out of 6 strains isolated from East Kolkata Wetlands, was developed to remove ammonia from the system. The consortium was non-pathogenic and have synergistic interaction on the removal of ammonia from the system.

Microbial Diversity and Pollution Status of Mirik Lake

Sumendu Lake, often called as Mirik Lake, in the lesser Himalayas is 1.25 km long, 110 ha in size, and has a maximum depth of 8 m. The water and sediment chemistry of the lake exhibits distinctive variability. The



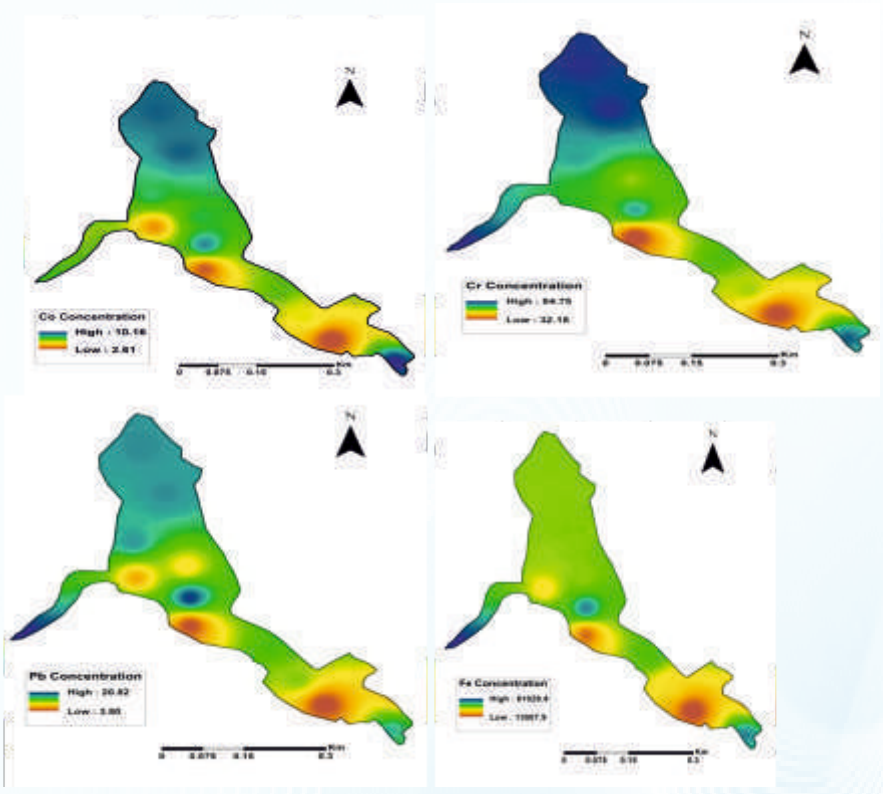
Ammonia removal by individual bacterial strains of the consortium. The initial concentration of NH_4^+-N is 26 ppm. *L. fusiformis* (SH1), *L. macroides* (SH2), *B. subtilis* (10) and *B. safensis* (14)

Table: Heavy metals (µg/g wet wt.) contents in fish muscle

	Cd	Co	Cr	Cu	Fe	Ni	Pb	Zn	Mn	As
Pethia conchonius	0.17	0.03	0.75	1.31	106.47	0.15	0.23	95.23	0.63	0.05
Cyprinus carpio	0.23	0.07	0.95	1.61	123.23	0.17	0.28	110.23	0.76	0.09
WHO (1989) safe limit	1		50	30	100	0.5-1	2	100	1	
FAO (1983) safe limit	0.05		-	30	-	-	0.5	30	-	

level of heavy metals in the water was found to be within acceptable bounds. Sediment samples were found to be low to moderately polluted according to several pollution assessment indices. The concentrations of heavy metals in fish were found to be within acceptable limits.

Spatial distribution pattern of heavy metals in sediment was also studied. Average concentrations of Cr, Co, Pb, Fe were 64.4 µg/g, 13.3 µg/g, 6.00 µg/g and 37823 µg/g, respectively. The highest concentration of Pb was found in the station outlet point (20.8 µg/g).



Geospatial distribution map of heavy metals in Mirik lake

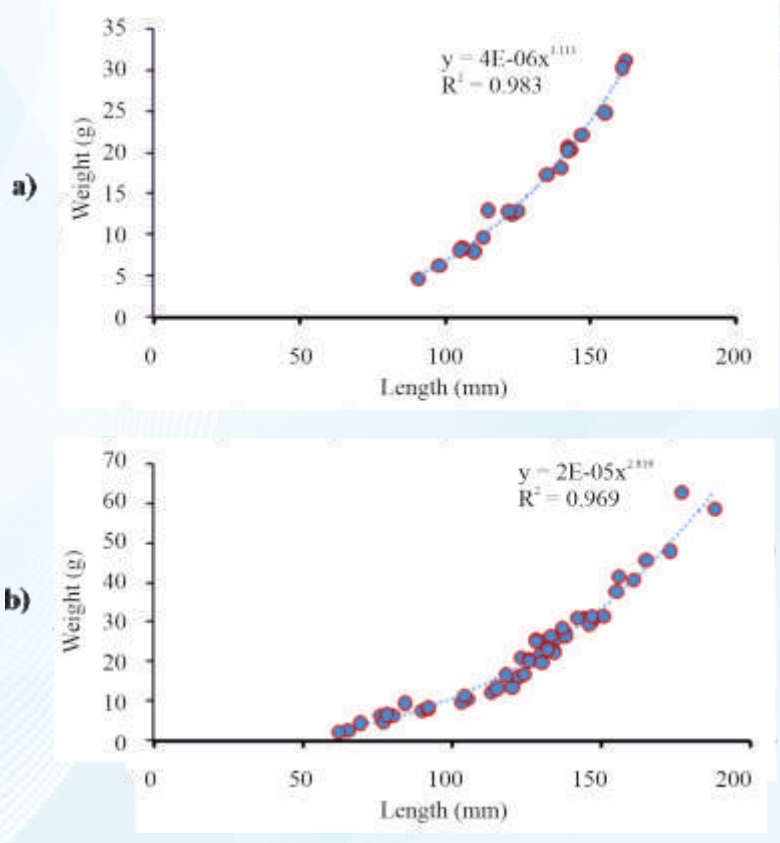
Sub-Project 3: Stock Characterization of Two Bagrid Species (*Mystus cavasius* and *M. gulio*) for Fisheries Management

Duration: 01.04.2020 – 31.03.2024

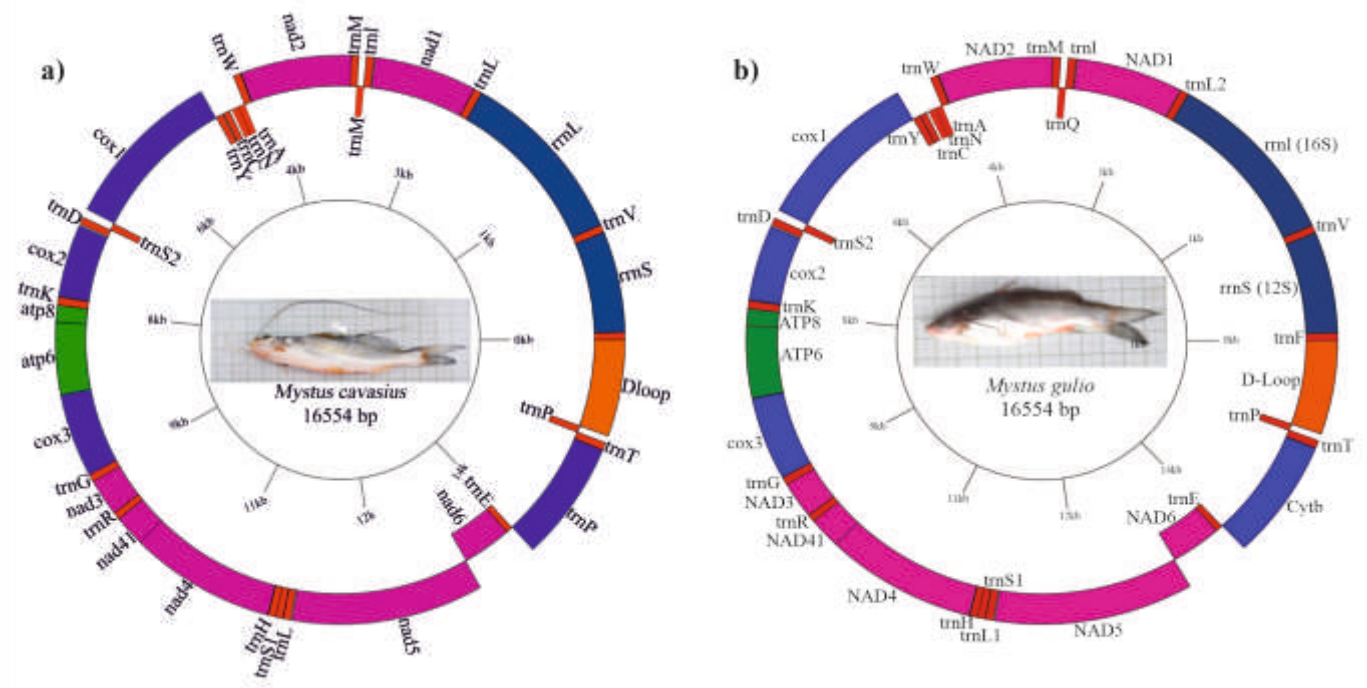
The management of fish wild genetic resources relies on an accurate assessment of genetic variability. Taken this into account, in present study two small indigenous catfish species of the bagridae family, *Mystus gulio* (long whiskers catfish/nona-tengra) and *Mystus cavasius* (Gangetic mystus/golsha-tengra) were considered for the stock characterization.

Length Weight Relationship (LWR) Study

A total of 19 *M. cavasius* specimens were collected from lower stretch of the Ganga River (Nabadwip, Kuntighat). The size of the specimens were 128.00±20.79 mm, and



Length-weight relationship of (a) *M. cavasius* and (b) *M. gulio*



Mitogenome of (a) *M. cavasius* and (b) *M. gulio*. Outer circle of circular map represents genes in heavy/positive strand and inner part represents genes in light/negative strand.

16.05±7.58 g. The established length-weight relationship study showed that exponent value 'b' was 3.113 with a correlation of determination (R^2) of 0.987 showing a positive allometric growth pattern for the species in the collected environments. A total of 52 samples of *M. gulio* was collected from Hooghly-Matlah estuarine zone (Sandeshkhali, Pathar Pratima, Bakkhali, etc.). The size of the specimen was 123.74±29.04 mm, and 22.56±13.51g. The established length-weight relationship study showed that exponent value 'b' was 2.819 with a correlation of determination (R^2) as 0.968 showing a negative allometric growth pattern for the species in the collected environments.

Genetic Stock Characterization

For genetic stock characterization *M. cavasius* samples (dorsal fin) were collected from the rivers Ganga, Krishna, Cauvery, Brahmaputra and Mahanadi, and samples of *M. gulio* were collected from the river Ganga, Mahanadi and a hatchery (Naihati). The mitochondrial Cytb gene was PCR amplified from each sample and a total of 213 sequences of Cytb gene of the fishes were submitted to NCBI.

Complete mitochondrial genome of two Bagrid Catfishes

The mitochondrial genome can reveal phylogenetic links and molecular evolution. In present study, Next-generation Illumina sequencing technology was used to characterize the mitochondrial genome of *M. gulio* and *M. cavasius*. The mitochondrial genomes of *Mystus cavasius* and *Mystus gulio* are circular DNA molecules of 16,554 bp in length. The complete mitochondrial genome sequences of *M. cavasius* and *M. gulio* have been submitted in GenBank with an accession number OP893799 and OP856487 respectively. The study showed that *Mystus* species mitogenomic organization consisted of 37 genes in total, including 13 protein-coding genes (PGCs), two ribosomal RNA (rRNA), 22 transfer RNAs (tRNAs), and a D-loop regulatory region which is comparable to that of typical vertebrate or other fish mitogenomes, indicating that mitogenomes may be highly conserved throughout the evolutionary process.

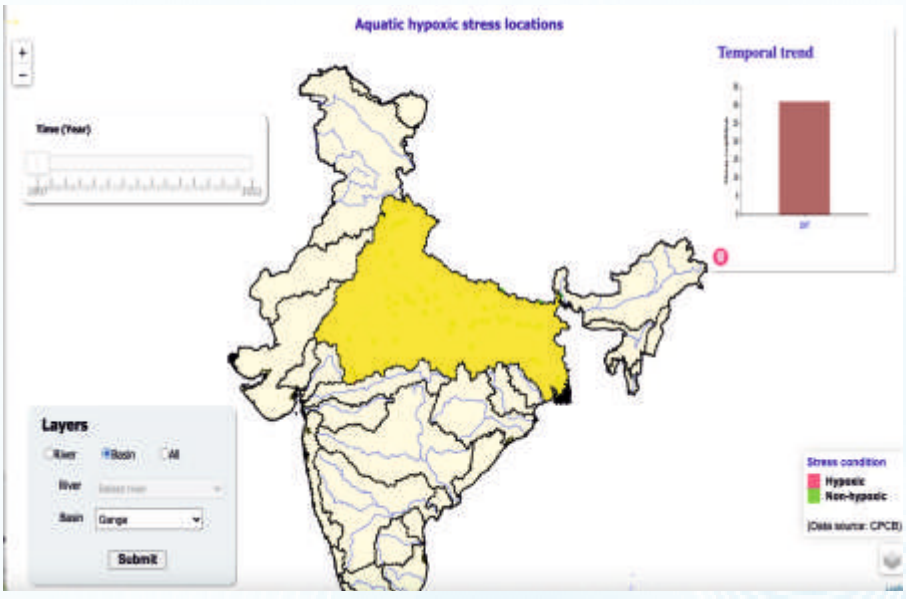
Project code: FREM/20-23/18

Project Title: Fisheries Resource Assessment and Prediction in Inland Open Water Under AI and Big Data Platform

Duration: 01.04.2020 – 31.03.2024

River and Basin Level Visualization and Decision Making

An interactive smart map depicting water dissolved oxygen levels in different rivers of India was developed for easy identification of the stressed river stretches by a user. The application highlights the basin or river with its spatio-temporal change dynamics.



Hypoxic stress locations of *Ganga* basin

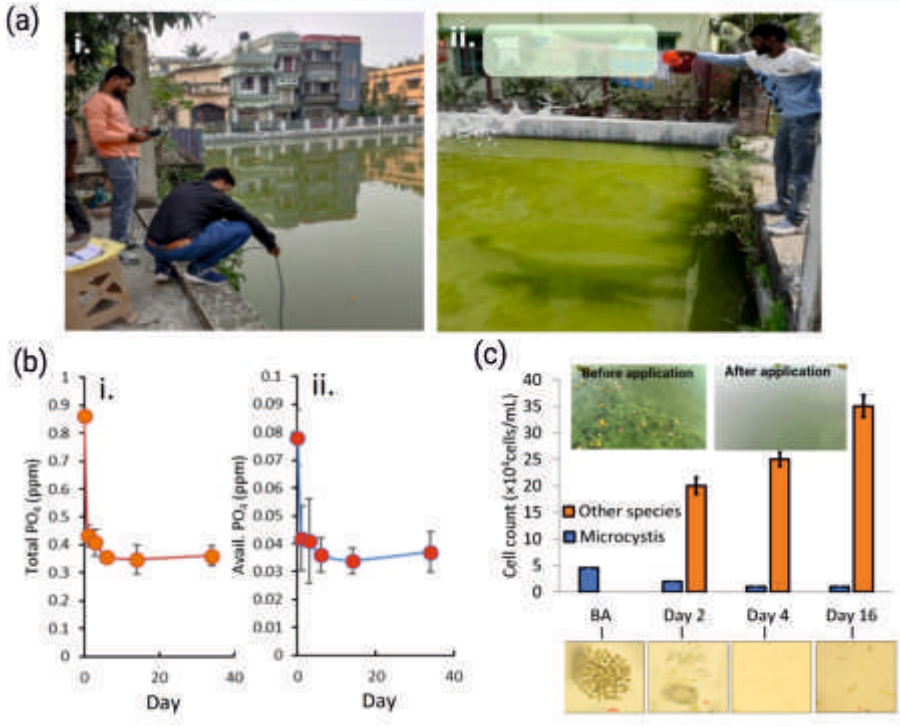
Project Code: FREM/21-24/19

Project Title: Development of Ammonium and Phosphate Remediation Techniques Using Nanostructured Materials for Refurbishment of Polluted Wetlands

Duration: 01.04.2021 – 31.03.2024

To test the efficacy of HCAL in field conditions, an hypertrophic pond was selected in West Bengal. The HCAL (1 kg) was first dispersed in the tap water, mixed thoroughly and applied at different corners of the pond after confirming the presence of *Microcystis* sp. The microalgal diversity and water quality parameters of the affected pond were analyzed before and after HCAL composite application. The bloom-affected pond exhibited a severe *Microcystis* sp. infestation, with an initial cell count of 5×10^4 cells/mL. By the third day post-application, the cell count had decreased by 78 %, and the presence of other microalgal species, such as *Scenedesmus* sp., *Nitzschia* sp., and *Chlorella* sp., was observed. The reduction in cyanobacterial blooms in this study is primarily attributed to the HCAL composite's ability to adsorb phosphate and sequester it at the pond bottom.

Before HCAL composite application, the total phosphate (TP) and available phosphate (AP) concentrations in the pond were recorded as 0.863 mg/l and 0.078 mg/l, respectively. One hour after application, phosphate levels had decreased by 50%. AP levels declined to 0.036 mg/l, while TP decreased to



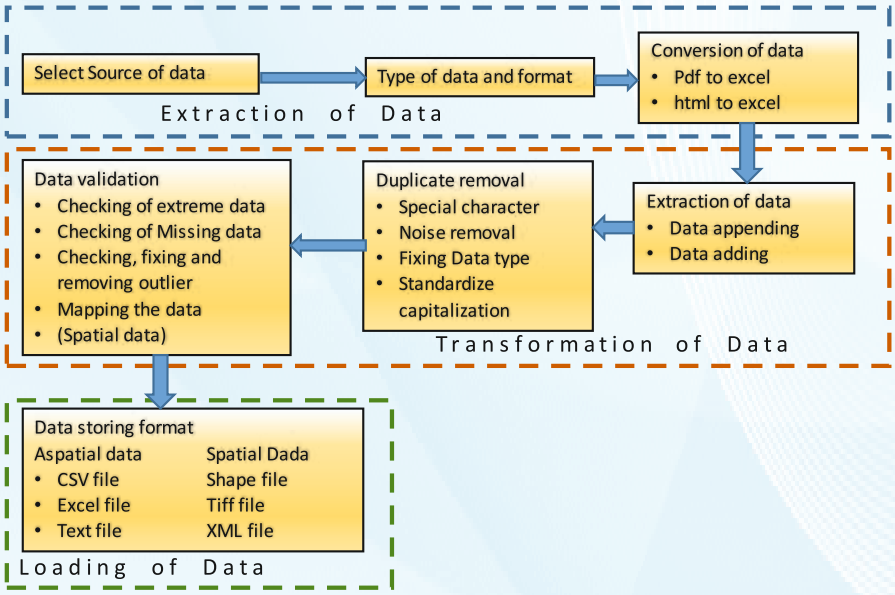
(a) Photographs showing water quality measurement (i) in the algal bloom affected pond and application of HCAL composite (ii); (b) Total (i) and available (ii) phosphate level in the bloom affected pond at different days; (c) Effect of HCAL addition on the cell count of *Microcystis* sp. in the infested pond and microscopic algae at different days.

0.357 mg/l within 3 to 6 day by HCAL application. After day 6, phosphate concentrations remained stable for approximately 34 days. Conductivity and total dissolved solids decreased from 390 to 381 µS/cm and 277 to 270 mg/l, respectively, by day 3, and further reduced to 359 µS/cm and 252 mg/l by day 6. No significant variations were recorded in water quality parameters beyond day 14. These findings suggest that HCAL composite effectively controls cyanobacterial blooms while exerting minimal impact on other microalgal species and overall water quality.

Project Code: FRAI/24-27/01

Project Title: Harnessing Data Science for Optimizing Spatial Assessment of Riverine and Wetland Fisheries Resources

Duration: 01.04.2024 – 31.03.2027



Schematic diagram for ETL

CPCB Data ETL Pipeline for Data Enrichment in the Existing Portal

An ETL (Extract-Transform-Load) pipeline is a process for extracting raw data, transforming it into a structured format, and loading it into a target destination, for instance, a CSV file or database. It is commonly used for processing data from semi-structured sources like PDFs to create structured data files like CSV or database. Essentially, it involves three main steps (a) extracting information from semi-structured data, (b) cleaning and structuring the data and (c) ensuring the desired formats (e.g., CSV) and saving the data in the target file or database. To add CPCB (Central Pollution Control Board) data to a Big Data platform, a

complete ETL pipeline was developed for yearly data ingestion into the database.

Step 1: The PDF data is downloaded from the CPCB site (https://cpcb.nic.in/nwmp-data/) for a specific year and converted into Excel format using specialized tools like Adobe Acrobat or Tabula software. Tables and numeric data within the PDF are located and extracted.

Step 2: Irrelevant information, such as headers and footers that are not part of the numerical data, is removed. Rows and columns are aligned correctly to avoid mismatches in the extracted data. Common issues such as merged cells, missing values, or unrecognized characters are carefully cleaned.

Step 3: All extracted data intended to be numeric is properly formatted and converted into CSV format using Excel and Python.

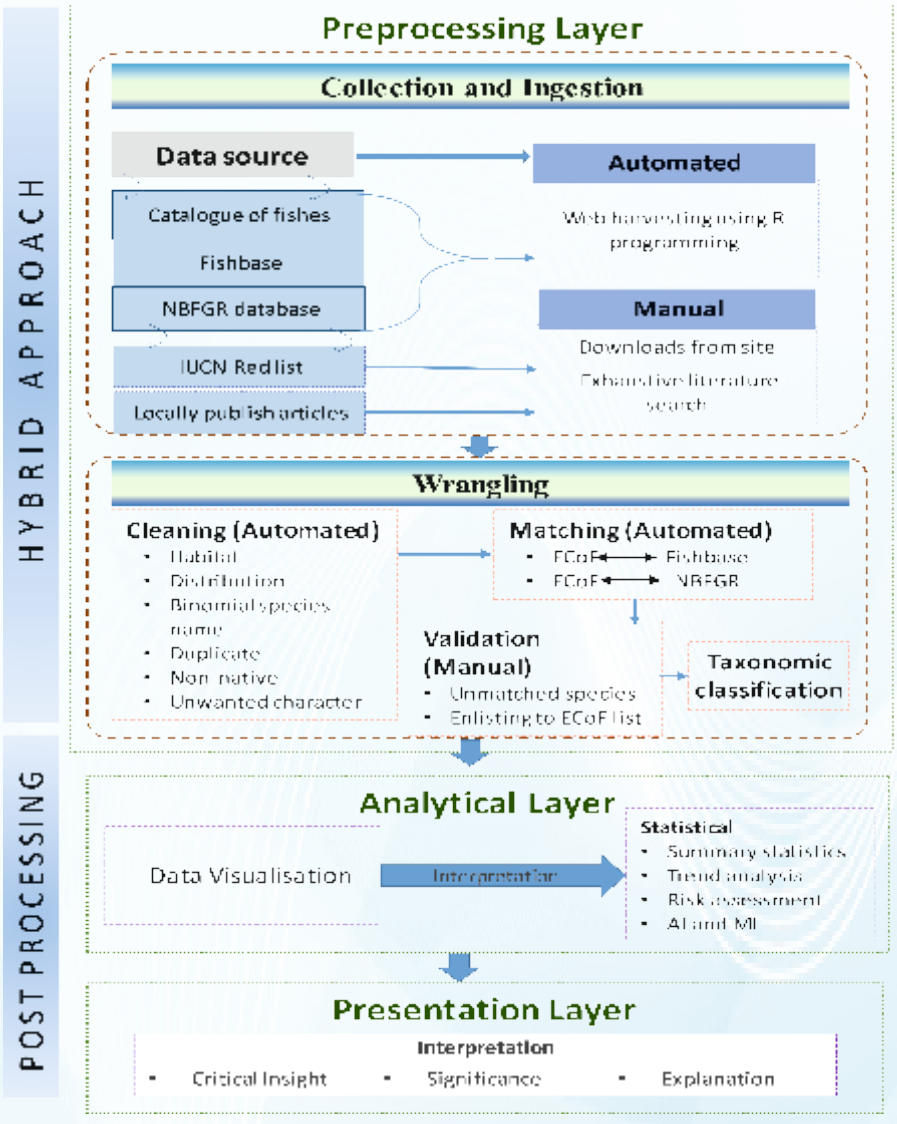
Step 4: The numeric data in the CSV file is manually compared against the original PDF to ensure accuracy and verify that no data was lost or corrupted during extraction and transformation.

Step 5: Location data, being spatial in nature, includes values such as X and Y coordinates or latitude and longitude. It is essential to verify whether the extracted location data corresponds accurately to the target locations.

The process involves projecting the location data onto a map and checking whether the data points or shapes fall within the specified Indian boundary. Open-source GIS software, QGIS is used for this purpose.

A Data Science Pipeline for the Informatics of Indian Native Freshwater Fishes (INFF)

The complete checklist of Indian freshwater fish species is the critical element for inland fisheries assessment. Looking beyond the typical printed document search, we embraced the latest data science tools to devise a complete methodological framework for INFF. The data science pipeline framework is presented in the schematic diagram as shown below.



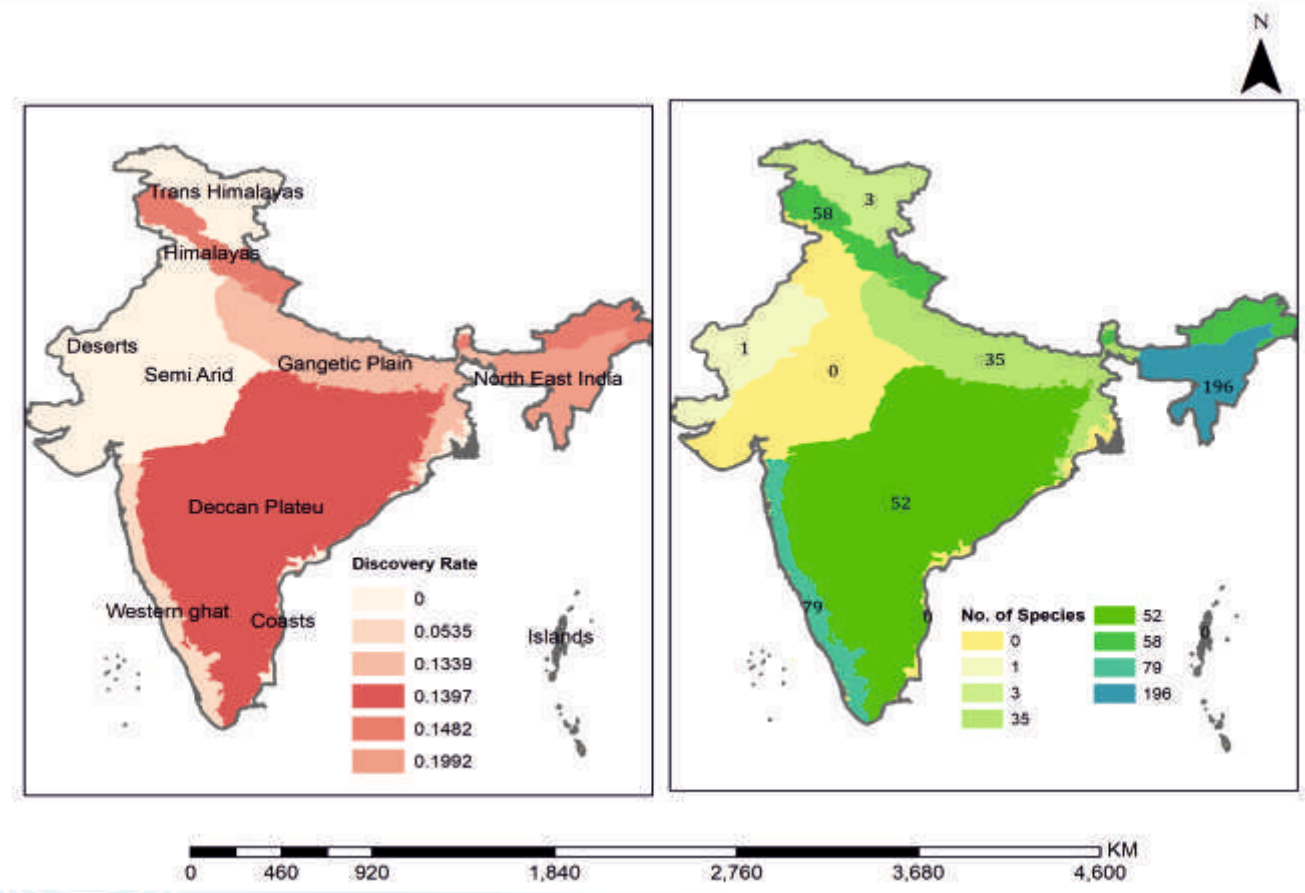
Schematic diagram of the proposed data science pipeline

Data Pre-processing

This layer consisted of two sub-layers: data collection and ingestion, and data wrangling.

Data collection and ingestion: The data sources for fish species included the Catalogue of Fishes, Fish-base, NBFGR website and various published articles. The conservation status of the species were obtained from the IUCN website. To compile species lists from these sources, R code was written utilizing two web harvesting libraries: 'httr' and 'rvest'.

Data wrangling: It is a crucial aspect in a data science pipeline, involving the transformation of raw data into a usable format for subsequent analysis. The data ingested from various sources such as COF, Fish-Base, NBFGR (AqGRISI), IUCN.



Bio-geographic distribution of new species discovered and associated discovery rate. left panel represents relative discovery rate and right panel represents total species discovered during 2000 to 2024

The data-wrangling process encompassed three main steps: cleaning, matching among the three sources, and validation. Cleaning and matching were automated using the R programming language, while validation was performed manually. Extensive literature review and online search were conducted to validate and include unmatched species in the final list.

Preparation of INFF Checklist

The automated process using R programming retrieved a total of 1,799 species from the COF, including 550 duplicate entries. Additionally, we fetched 1,044 unique species from FishBase and 1,270 unique species from NBFGR (AqGRISI). All species retrieved from Fish-Base were found to match those in COF; however, 100 species from NBFGR (AqGRISI) did not have matches in COF and were subsequently rechecked manually. After this manual review, we discarded 84 species -comprising 47 non-native species, 27 that had habitat mismatches, and 10 synonyms (comments and references can be found in the supplementary file). We also reconfirmed 16 species based on published literature. It is noteworthy that 32 species were from adjacent countries. After removing duplicate entries and incorporating the 16 reconfirmed species, the final checklist included 1,239 Indian native freshwater fish species, with full nomenclature according to the Catalogue of Fishes. The R code failed to detect only 5 species, resulting an error as low as below 1%.

Table: Taxon-level habitat distribution

Habitat	Species	Genus	Family	Order
freshwater	1015	175	49	14
freshwater, brackish	94	63	32	18
freshwater, brackish, marine	130	95	47	24

Taxon Level Summary

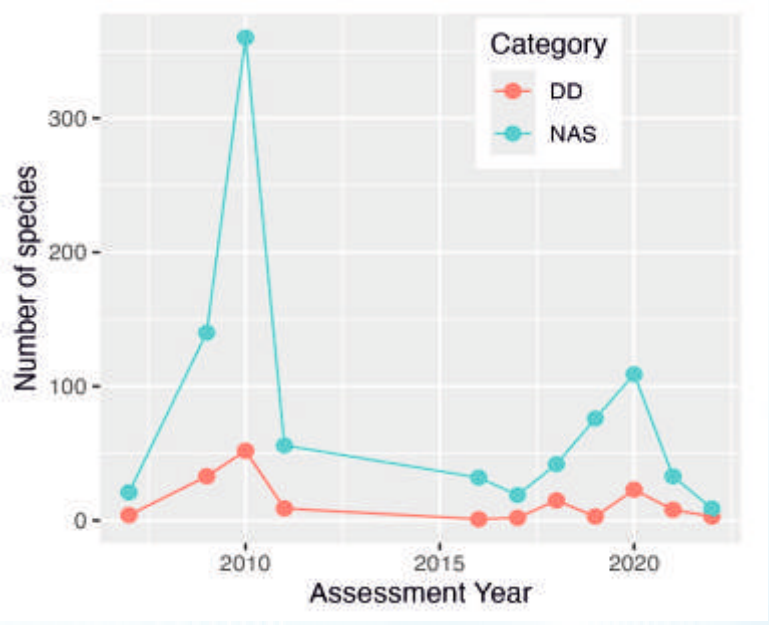
The present updated Indian Native Freshwater Fish (INFF) fish species checklist comprised 1239 species belonging to 299 genera, 92 families and 29 orders. Habitat distribution at various taxonomic levels were as follows: freshwater - 1015 species,

175 genera, 49 families and 14 orders; freshwater-brackish - 94 species, 63 genera, 32 families and 18 orders; freshwater, brackish and marine - 130 species, 95 genera, 47 families and 24 orders.

Biogeographic Trend of Species Discovery

The bio-geographic distribution of new species discovered or described between 2000 and 2024 shows that the northeastern region recorded the highest number of new species, totaling 196. This was followed by the Western Ghats with 79 new species, the Himalayas with 58, the Deccan Peninsula with 52, the Gangetic Plain with 35, the Trans Himalayas with 3, and both the Desert and Eastern Himalayas, each with 1 species.

Five bio-geographic regions registered increasing discovery rate. Regarding the relative comparison, the northeastern bio-geographic region led with a discovery rate of approximately 0.20.



Trend relationship between assessed and Data Deficient species.
DD: Data Deficient; NAS: Number of Assessed Species

Conservation Status

As of 2022, a total of nine hundred five (905) Indian native fish species was registered in the IUCN Red List, spanning 14 years from 2007 to 2022, with the missing years 2008 and 2014. Among the 905 species assessed, the largest proportion fell into the 'Least Concern' category, accounting for 57%. This was followed by 'Data Deficient' at 17%, 'Vulnerable' and 'Endangered' each at 10%, 'Near Threatened' at 4%, and 'Critically Endangered' at 2%.

However, intensities of 'Data Deficient' species during 2020, 2021 and 2022 were 21%, 24% and 33%. The individual trend pattern was quite similar. Notably, the number of assessed species in 2010 and 2020 was relatively high, which was also true for the number of 'Data Deficient' species during the same years.

Project code: FRAI/24-27/02

Project Title: Assessment of Greenhouse Gas (GHGs) Emission and Carbon Sequestration Potential of Selected Wetlands in West Bengal and Yamuna River for Developing Mitigation Strategies to Reduce the Adverse Impacts of Climate Change

Duration: 01.04.2024 – 31.03.2027

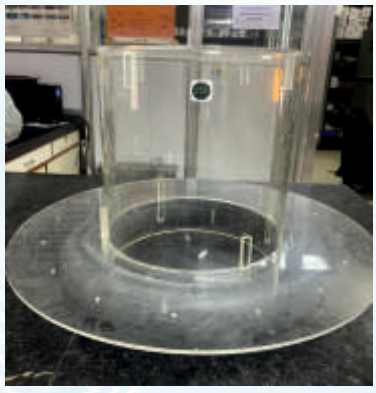
Assessment of greenhouse gases (GHGs) emissions was initiated in two selected wetlands of West Bengal *viz*. Kulia Beel (less polluted) and Noai Khal (highly polluted). Kulia Beel is a closed, oxbow lake situated adjacent to the Ganga River in the Nadia district of West Bengal whereas Noai Khal is a canal situated in the North 24 Parganas district of West Bengal passing through the sub-urban areas of Nilanganj, Khardah, Madhyamgram, etc. Noia Khal receives huge amounts of continuous domestic sewage and agricultural runoff from the nearby areas which made the wetland highly polluted.



A view of Noai Khal



A view of Kulia Beel



Floating chamber with digital thermometer



20 ml syringe with 3-way stop cock



Floating gas collection chamber onsite



GHG analyzer (Gas Chromatograph)

Fabrication of Floating Gas Collection Chamber

A floating gas chamber was designed and fabricated using acrylic material to collect the GHGs samples from the water-air interface of the selected water bodies. A free-floating cylindrical chamber made up of 0.5 cm thick acrylic sheet having a float made of inflated tyre tube was fabricated. The diameter and height of the chamber were 30 and 40 cm, respectively. The chamber was designed with an open-ended bottom that can penetrate water to a depth of 8 cm, thus forming a seal between the water surface and the air within the chamber and thereby proving a completely enclosed system to measure gaseous fluxes. The inlet and outlet of the floating chamber were positioned on the top surface of the chamber from where the gas samples can be collected using a 20 ml plastic syringe attached with a three way stop cock. A digital thermometer with LCD display was fitted inside the chamber to measure the inside temperature.

Quantification of GHGs Emission

GHGs samples were quantified using Gas Chromatograph (GHG Analyzer) (Model – Thermo Fisher Scientific Trace 1610) specially designed for simultaneous estimation of Carbon-dioxide, Methane and Nitrous Oxide. The GHG Analyzer has two detectors *viz*. Flame

Ionization Detector (FID) and Electron Capture Detector (ECD) and three valves. FID measures CO_2 and CH_4 whereas ECD measures N_2O.

GHGs emission from the water-air interface were estimated in a highly polluted (Noai Khal) and a less polluted wetland (Kulia Beel) of West Bengal during the monsoon and post-monsoon season 2024. Flux of all three GHGs (N_2O, CH_4 and Co_2) was observed to be much higher in the polluted wetland than the less polluted one. In the polluted wetland, estimated CO_2 flux ranged between 5.98 to 8.40 g $m^{-2}day^{-1}$ with the average flux of 6.85 g m^{-2} day^{-1}, CH_4 flux ranged from 395.76 to 692.88 mg m^{-2} day^{-1} with an average of 537.36 mg m^{-2} day^{-1} and N_2O flux ranged from 60 to 201 µg $m^{-2}day^{-1}$ with an average of 112.8 µg m^{-2} day^{-1}; while the CO_2 flux in the less polluted wetland ranged between 0.104 to 0.97 g m^{-2} day^{-1} (average – 0.40 g m^{-2} day^{-1}), CH_4 flux ranged between 2.64 to 168 mg m^{-2} day^{-1} (average – 60.96 mg m^{-2} day^{-1}) and N_2O flux was between 22.8 to 106 µg m^{-2} day^{-1} (average – 71.28 µg m^{-2} day^{-1}). Simultaneously, the GHGs flux from the reference upland site were also measured and the CO_2 and N_2O flux from the reference site in the less polluted wetland were observed much higher (about 6 times) than that of the wetland whereas flux of all the three GHGs in the reference upland site were found lower than that of the less polluted wetland. Average GHGs flux from the wetland and their corresponding reference site is tabulated.

Table: Average GHGs flux from the studied wetlands in West Bengal

Greenhouse Gas	KuliaBeel (Less polluted)		Noai Khal (Highly polluted)	
	Wetland	Reference Site	Wetland	Reference Site
N_2O (µg m^{-2} day^{-1})	71.28	438.72	112.8	46.03
CH_4 (mg m^{-2} day^{-1})	60.96	0.23	537.36	0.06
CO_2 (g m^{-2} day^{-1})	0.40	2.53	6.85	0.67

Project Code: FRAI/24-27/03

Project Title: Assessment of Petroleum Hydrocarbon, PFAS and Phenolic Micropollutants in Surface Water and Their Effect on Ecosystem Health

Duration: 01.04.2024 – 31.03.2027

The lower part of the Hooghly River, which is the major deltaic off-shoot of the River Ganga in its lower stretch and reaches the Bay of Bengal, forms the Hooghly River Estuary. The estuary flows through the densely populated and industrial towns and cities of 24 Parganas, Howrah, Hooghly district and Kolkata city in the state of West Bengal before merging with the Bay of Bengal at Ganga Sagar. The contamination in the estuary water arises from industrial wastes, sewage effluent, agricultural runoff, dumping of garbage, and domestic wastes through large and small drains. As a result it has become a receptor of diverse types of contaminants from several point and non-point sources of pollution. One of the objectives of the present project was to monitor the petroleum hydrocarbon, phenolic micro-pollutants in surface water, sediment and accumulation in biota (fish). Further, it was also targeted to investigate any accumulation of PFAS (Per- and polyfluoroalkyl substances), the newly emerging contaminant in fishes of the estuary.

As per the technical program, five sampling stations were chosen initially. The stations were as follows: Edward Creek, Frazerganj (21°35'03"N, 88°15'15"E); Diamond harbour (22°10'30"N, 88°11'39"E); Roychawk (22°12'26''N, 88°07'13''E); Godakhali (22°23'54''N, 88°08'24"E) and Birlapur (22°24'55"N, 88°08'49"E).

Water Chemistry

The pH of water at the studied station showed neutral to sub-alkaline nature (7.35 to 8.04±0.16) that was within the prescribed WHO and BIS guidelines of 6.5–8.5 (WHO, 2004; BIS, 1991). Average dissolved oxygen (DO) content was greater than 4.0 mg/l in all stations, indicating that the estuary is moderately oxygenated. Low DO content in tropical areas is due to release of organic matter rich waste and their subsequent degradations. For turbidity, a wide range of variations was pronounced from 30 to 158±79.20 NTU. The maximum turbidity was recorded in downstream stations. The sediment re-suspension from the wide mudflats along the river banks enhances the turbidity value. In general, Hooghly rivers estuary is relatively narrow in the upstream and have funnel-shaped wide mouth in the downstream show a steep salinity gradient across the station. The elevated alkalinity of the estuary indicates the prevalence of

Table: Physico-chemical parameters of water of Hooghly River

Parameter	Edward creek	Diamond harbour	Roychawk	Godakhali	Birlapur
pH	8.04	7.83	7.70	7.7	7.35
Temperature (°C)	25	26.6	26.5	26.5	26.5
Turbidity (NTU)	125.50	140.50	158	30	35
Salinity (mg/l)	8795	551.50	319.50	168	181
DO (mg/l)	7.50	6.10	5.80	5.8	5.40
Electric conductivity (µS/cm)	27850	1250.50	778.50	400	418
Total alkalinity (mg/l)	124	137	141	112	120.50
Total hardness (mg/l)	2225	310	270	140	147
Total Phosphate (mg/l)	0.15	0.16	0.16	0.144	0.29
Nitrate-N (mg/l)	0.09	0.08	0.04	0.064	0.11

Table: Sediment quality

Parameter	Edward creek	Diamond Harbour	Roychawk	Godakhali	Birlapur
pH	8.42	8.74	8.39	8.73	8.55
Specific Conductivity (µS/cm)	9360	439.00	615.00	232.00	272.00
Organic Carbon (%)	0.88	0.33	0.47	0.34	0.43
Total Nitrogen (%)	0.06	0.03	0.042	0.03	0.04
Total Phosphate (mg/100g)	82.14	50.51	210.71	57.14	41.83
Silt (%)	24.50	9.00	13.00	7.00	6.00
Clay (%)	7.50	7.00	12.00	7.00	8.00
Sand (%)	68	84.00	75.00	86.00	86.00

bicarbonates. Water of Hooghly river estuary is found to be very hard.

Sediment Quality

Different sediment quality parameters are presented in the table. Values of sediment pH are rather consistent and were found to be moderately alkaline, which is the characteristic of coastal sediments suffering from marine influence with values ranging from 8.39 to 8.74. The specific conductivity (EC) values in sediment samples ranged from 232.00 to 9360±113.14 µS/cm and the maximum EC value was observed at Edward creek. Estuary represents sediment constituting sand percentage between 86 and 68. Higher sand content indicates that a relatively high hydrodynamic energy state existed, allowing coarser fractions to deposit more quickly. A relatively lower percentage of organic carbon is attributed to the constant flushing activities by tides along with the impact of waves, which removes the finer particles from the sediments.

Assessment of Petroleum Hydrocarbon (PHC)

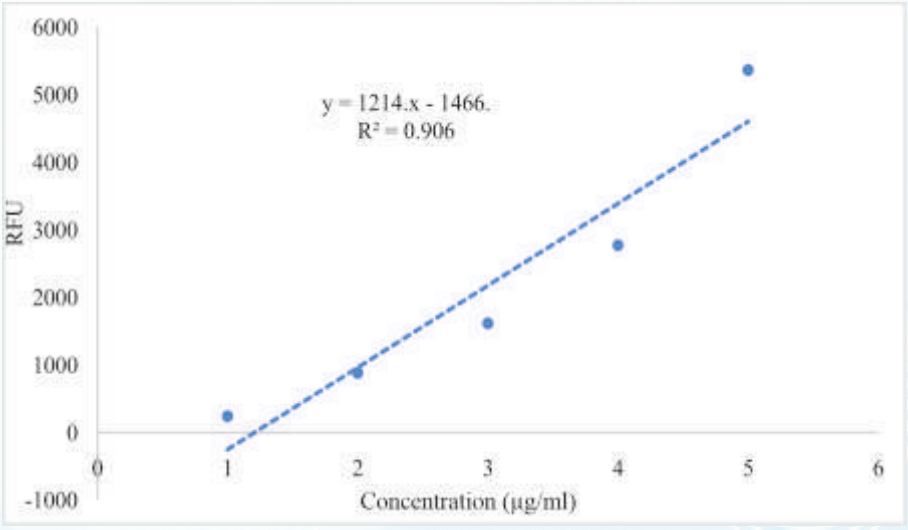
Total PHC including polyaromatic hydrocarbon (PAH) were analyzed in samples (water, sediment and fish muscle) collected from different locations like Edward Creek in Fraserganj, and lower stretch of Hooghly estuary, *i.e.* Diamond harbour, Roychawk, Godakhali and Birlapur. Surface water samples were collected in pre-cleaned amberglass bottles of 2 L capacity and extracted with n-hexane to transfer the PHC in the organic phase and dried over anhydrous Na_2SO_4. After collection, sediment and fishes were placed in ice box and brought to the laboratory and stored at -20° C in deep freezer until further analysis. The homogenized sediment and fish tissue samples were saponified using KOH and methanol by refluxing and then extracted with n-hexane. The organic layer was then dried with sodium sulfate and concentrated and subjected to column chromatography using alumina and silica. The separation of hydrocarbons was done by eluting alkane in n-hexane followed by aromatic fractions using dichloromethane: n-hexane (7:3) and dichloromethane. The intensity of fluorescence of the extracted samples was measured using microplate based fluorescence spectrophotometer at excitation wavelength 310 nm and emission wavelength of 360 nm against chrysene as standard. The calibration curve of chrysene is shown here.

PHC content in water phase varied from 10.13 to 27.03 µg/L with higher value in Diamond Harbour-Godakhali stretch than the other three locations. In sediment samples PHC varied from 0.356 to 1.483µg/g on dry matter basis with higher value in Edward Creek and Roychawk than rest of the locations. PHC is represented by only aromatic fractions in 50% of the sites while 4-5% aliphatic hydrocarbon was detected only in three sites. Aromatic hydrocarbon was detected the highest in Edward Creek mouth, Creek itself and Roychawk followed by Diamond harbour, Godakhali and Birlapur.

Table: Petroleum hydrocarbon (PHC) in water and sediment of Hooghly Estuary

Location	Station	Water(µg/L)	Soil (µg/g; DW)
Fraserganj	Edward Creek (North)	14.54	1.388
	Edward Creek (South)	17.94	1.483
Hooghly Estuary	Diamond Harbour	20.32	0.474
	Roychawk	20.08	1.077
	Godakhali	27.03	0.387
	Birlapur	10.13	0.356

PHCs in muscle samples of all the 18 fish species collected from six locations varied from 0.057 – 0.507 µg/g with an average concentration of 0.307 µg/g. The data revealed that the highest average PHC concentration was recorded in fishes of Godakhali followed by Fraserganj and Roychawk sample and dominated by aromatic (≈67-94%) than aliphatic fraction. The fractionation of PHCs revealed presence of mostly the aromatics and polyaromatic hydrocarbons (PAH). Some of the prominent PAH detected in sediment and also in fish flesh were Chrysene, Pyrene, Anthracene, Acenaphthylene, Acenaphthene, Benz[α]anthracene, Benzo[k] fluoranthene and few others.



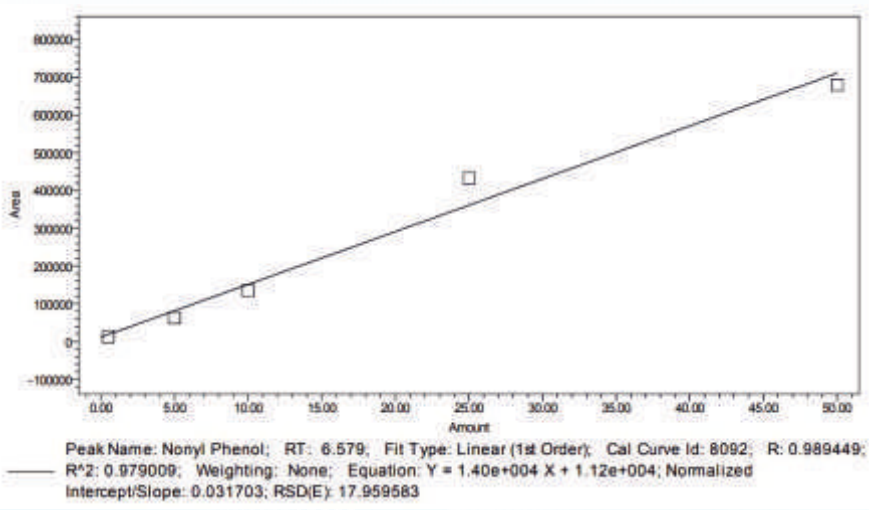
Standard curve for fluorescence intensity of Chrysene

Quantification of PFAS in Locally Caught Freshwater and Estuarine Fishes

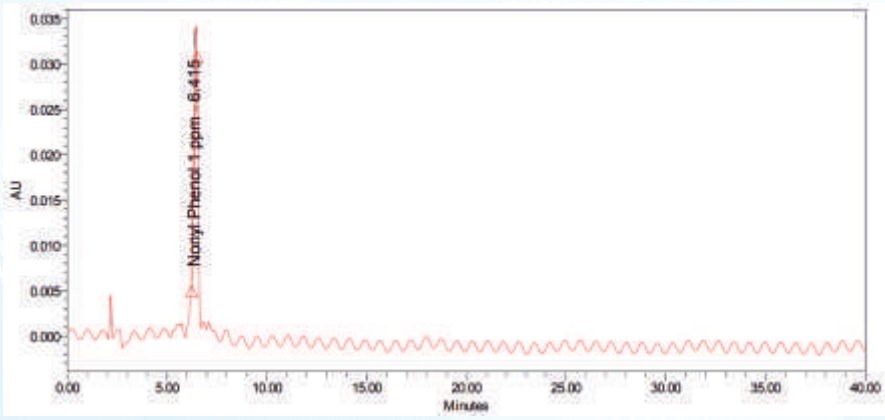
Per- and polyfluoroalkyl substances (PFAS) are a class of manufactured chemicals that is deliberately used in manufacturing facilities, municipal landfills and wastewater treatment plants, airports, and sites where PFAS-containing fire-fighting foams. These potential sources of PFAS discharge into surface water which get spread over soil, crops, wildlife including fishes and finally to human. Fresh muscle tissue of sampled fishes are used for quantification of compounds using LC-MSMS. The limit of quantification was 0.05 µg/kg (LOQ~0.05 µg/kg). PFAS was analyzed in the form of 4 sister compounds namely Perfluorohexane Sulfonic Acid (PFHxS), Perfluorononanoic Acid (PFNA), Perfluorooctane Sulfonic Acid (PFOS), and Perfluorooctanoic Acid (PFOA). A total of eight fishes namely, *Tenualosa ilisha* (Nawabganj), *Pampus argenteus* (Frazerganj), *Otolithoides pama* (Diamond harbour), *Arius maculatus*, *Polynemus paradiseus*, *Setipinna phasa* (Godakhali), *T. ilisha* and *Lates calcarifer* (Roychawk) were analysed for the presence of PFAS. Study revealed that PFOS was the largest contributor to total PFAS levels, averaging 16% of the total. The former compound is detected in five major commercial catch namely *O. pama*, *A. maculatus*, *P. paradiseus*, *S. phasa*, *Lates calcarifer* of Hooghly estuary with a range from 0.118 µg/kg to 2.958 µg/kg (average ~ 0.713 µg/kg).

Method Standardization and Detection of Nonylphenol in Surface Water and Fishes of Hooghly Estuary

4-Nonylphenol (4-NP) is the most relevant Alkylphenol ethoxylates (APEO) and is widely used in phenolic resins, plastics additives, detergents, emulsifiers, pesticides formulations etc. The compound is reported to contribute about 80% of the entire APEO production of which 60% get deposited in the environment causing serious disruption of natural hormones when interacting with estrogen receptors. The analytical method of the compound was standardized from aqueous phase and biological samples (fish tissue) using HPLC with PDA detector. The linearity was



Calibration curve of Nonylphenol

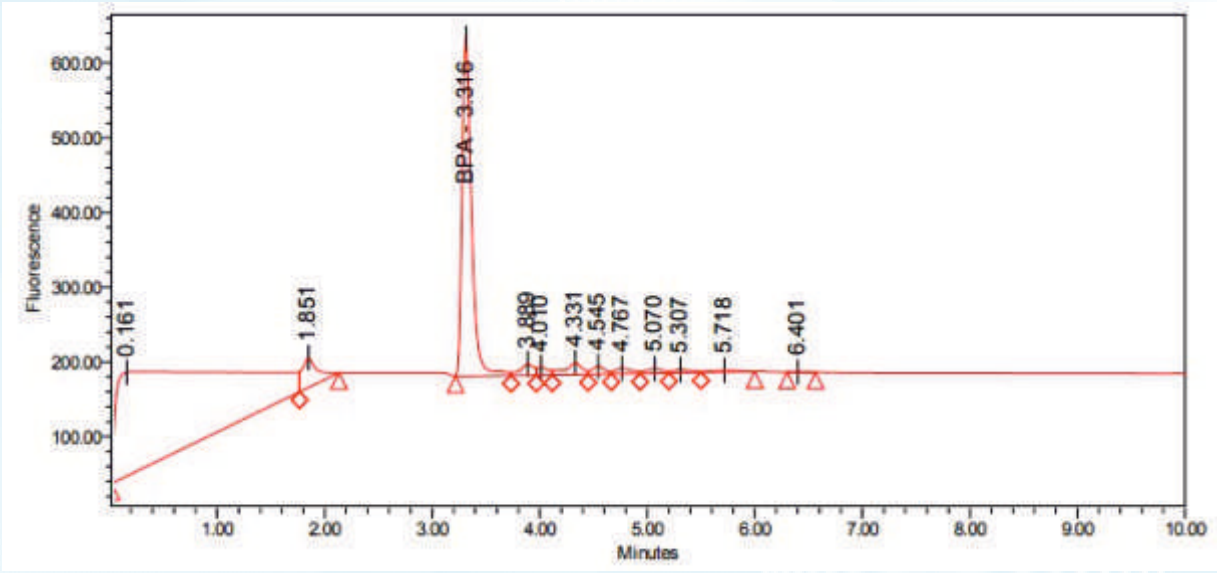


Standard curve of Nonylphenol

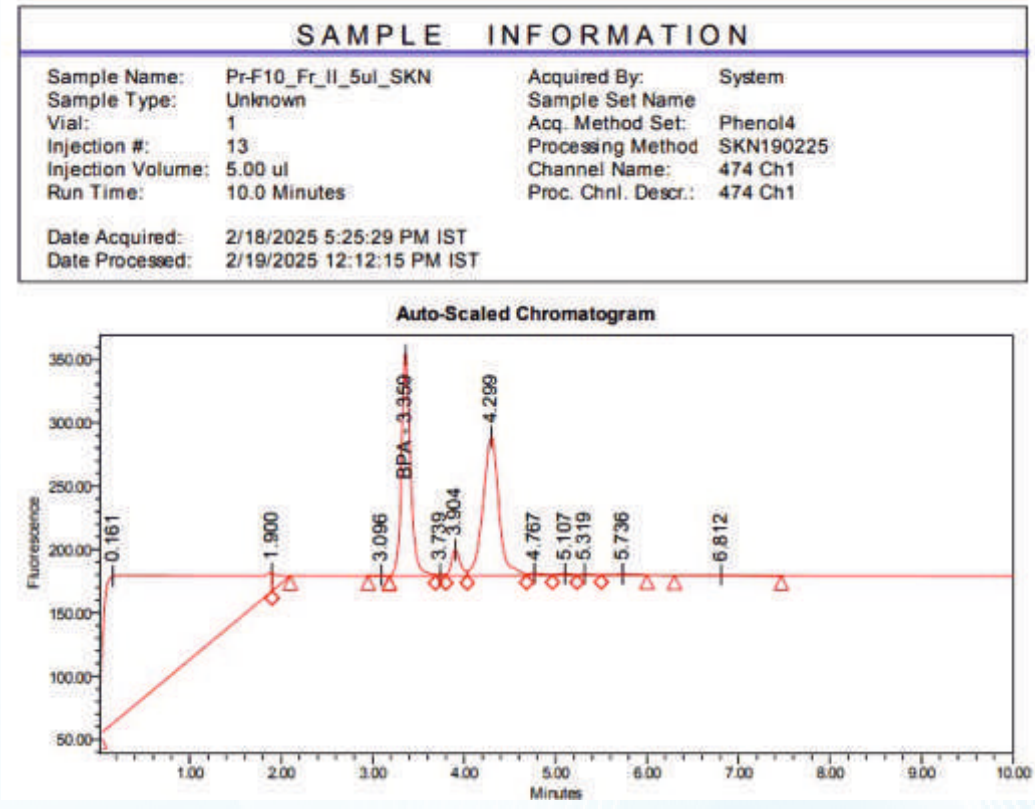
obtained by the analysis of five synthetic samples of concentrations 50, 25, 10, 5 and 0.5 µg/mL. The calibration curve is presented below (RSD=17.959; R^2=0.9790). Further, the standard curve for 1 µg/ml is also presented. A total of 6 fish samples and 9 water samples were analyzed for the presence of nonylphenol. However, samples did not show any traces of the compound.

Bisphenol A Estimation

Bisphenol A (BPA), a plasticizer compound and well-known endocrine disruptor, was targeted as one of the important phenolic micropollutant and environmental contaminant, was measured. In water, its concentration varied from 0.415 to 6.34 µg/l,the highest being recorded in Edward creek, followed by Godakhali and Diamond harbour. BPA was also found accumulated in fish flesh at concentration ranging from0.031-2.198 µg/g, with an average concentration of 0.31 µg/g. The highest concentration of BPA was recorded in flesh of fish *Arius* sp. obtained from Godakhali.



HPLC chromatogram of BPA standard



HPLC chromatogram of BPA in fish tissue

Assessment of Biochemical and Microbiological Aspects with Respect to Lower Stretch of Hooghly Estuary

The biological condition of the sediments collected from the selected sites was assessed. The study revealed higher microbial activities and organic matter in mouth and creek region followed by Birlapur area and Diamond Harbour, Roychawk, Godakhali and zone. Organic matter content in sediment and presence of mangrove might have positive effect in microbial activities of sediments.

Project Code: FRAI/24-27/04

Project Title: Assessing the Resilience of Native Fish Communities in Different Hydroclimatic Zones

Duration: 01.04.2024 – 31.03.2027

This study investigates the resilience of native fish communities by analyzing two species, *Systomus sarana* and *Cirrhinus reba*, across five distinct hydro-climatic zones. The research aims to assess how these species adapt to varying environmental conditions and the implications for ecosystem stability.

Length-weight relationship (LWR) studies help in biometric and morphological comparisons of different fish species from the same taxonomic group and fish stock assessments. Cyprinidae species (*S. sarana*, *C. reba*) were sampled in five different hydro-climatic zone. The captured specimens were identified in the field. The parameters of LWR were determined by linear regression and from the logarithmic form of weight–length relationship of Log W = log a + b log L, where W is the fresh weight in grams, L is the total length in cm, and a and b the equation parameters. The study summarized the sample size, descriptive statistics, and LWR parameters for each species. The exponent 'b' in the LWR equation determines the type of growth exhibited by the fish: isometric growth occurs when 'b'

Table: Descriptive statistics and estimated length-weight parameters for *Systomus sarana* and *Cirrhinus reba* from different rivers of India

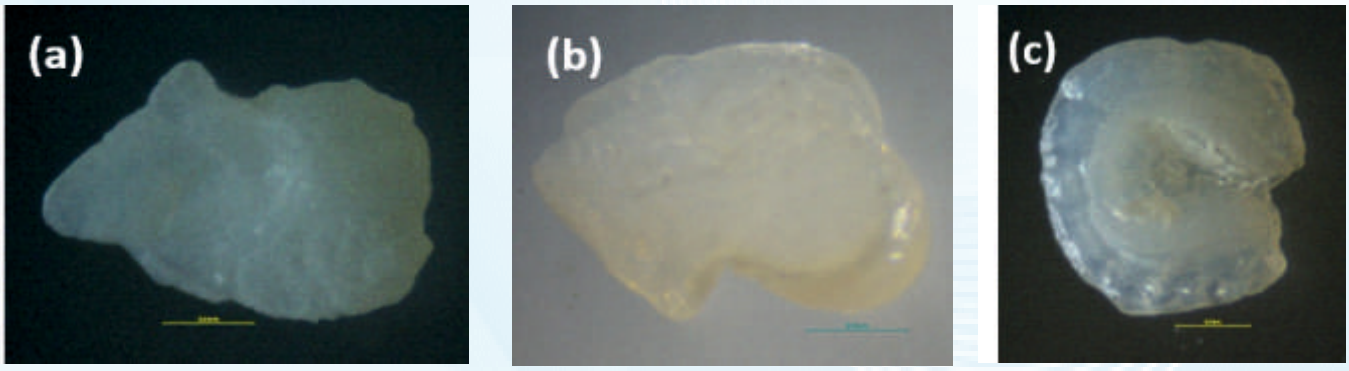
Species	River stock	n	Total length		Total weight		Regression parameters				r^2
			Min.	Max.	Min.	Max.	a	95% of CI of 'a'	b	95% of CI of 'b'	
Systomus sarana	Cauvery	23	14.4	26.5	20	280	0.0028	0.0007-0.011	3.54	2.07-3.99	0.85
	Bhima	40	17.1	29.4	50	400	0.0079	0.002 0.0029	3.15	2.73 3.58	0.92
	Thenpennai	59	12.5	26	8	633	0.0377	0.0037-0.387	2.64	1.816-3.458	0.86
	Ganga	18	17.3	20.3	66.4	123.04	0.002	0.0005-0.010	3.59	3.08-4.10	0.933
	Dawki	5	8.4	28.2	11.2	26.6	0.032	0.040-0.128	2.35	2.19-2.52	0.99
Cirrhinus reba	Cauvery	24	16	31.4	40	113.34	0.001	0.0009-0.003	3.57	3.34-3.81	0.98
	Bhima	12	22.1	25	80	150	0.00022	0.0000-0.17	3.6	2.45-3.86	0.81
	Thenpennai	12	20.8	32	100	340	0.099	0.0004-0.21	2.3	1.92-2.67	0.78
	Ganga	32	12.5	22.3	16.84	103	0.0126	0.007-0.0218	2.89	2.69-3.09	0.96
	Dawki	5	10.2	13.5	16.5	29.2	0.132	0.0039-0.191	2.1	1.7-2.4	0.72

equals 3, indicating proportional weight and length increase; positive allometric growth occurs when 'b' is greater than 3, suggesting the fish becomes relatively heavier as it grows longer; and negative allometric growth occurs when 'b' is less than 3, indicating the fish becomes relatively lighter as it increases in length. These growth patterns provide insights into the condition and health of fish populations, as well as their ecological adaptations.

In the study of *S. sarana* across various hydro-climatic zones, the LWR analysis revealed that the growth coefficient 'b' exceeded 3 in the Cauvery River (3.54), Bhima River (3.10), and Ganga River (3.59). This indicates positive allometric growth, where the fish's weight increases at a faster rate than its length. Such growth patterns suggest that *S. sarana* in these rivers benefits from favorable environmental conditions, abundant food resources, and suitable habitats. These factors likely contribute to the species' enhanced growth performance in these specific river systems. The LWR analysis for *C. reba* revealed variations in the growth exponent 'b' across different rivers. Specifically, 'b' values exceeded 3 in the Cauvery and Bhima rivers, indicating positive allometric growth, where the fish's weight increases at a faster rate than its length. Conversely, in the Ganga, Thenpennai, and Dawki rivers, 'b' values were less than 3, suggesting negative allometric growth, meaning the fish's length increases more rapidly than its weight. These differences in growth patterns may be attributed to varying environmental conditions, availability of food resources, and habitat characteristics in each river system. Understanding these variations is crucial for effective fisheries management and conservation strategies tailored to each specific habitat.

Preliminary Study on Hard Part (Otolith)

Otoliths of *C. reba*, *S. sarana* and *Ompok bimaculatus* from River Bhima were extracted and viewed under a stereo zoom microscope (Neumann & Miller). Otolith images were captured and its measurements (length and width) were obtained by employing Image View software at a magnification of 30X. *C. reba* fish specimens (n=6) varied from 216.0 to 325.0 mm (249.83 ± 15.57) in length. The length and width of the otolith (n = 6) varied from 2.21 to 2.93 mm (2.52 ± 0.15 mm) and 1.44 to 1.98 mm (1.68 ± 0.11 mm), respectively. The otoliths (n=4) of *P. sarana* (average length of 21.5 mm) varied from 1.98 to 2.77 mm (2.47 ± 0.17 mm) in length and 1.44 to 1.86 mm in width (1.64 ± 0.10 mm). The specimens of *O. bimaculatus* from River Bhima ranged from 235-278 mm in length and the length of otoliths (n=4) varied from 1.79 to



Otolith of (a) *Cirrhinus reba* (b) *Puntius sarana* and (c) *Ompok bimaculatus* from River Bhima

Table: Descriptive statistics and estimated length-weight parameters of *Oreochromis niloticus* from different reservoirs of Peninsular India

Reservoir stock	n	Total length		Total weight		Regression parameters				r^2
		Min.	Max.	Min.	Max.	a	95% of CI of 'a'	b	95% of CI of 'b'	
Manchanbele	41	25.3	50.7	350	2300	0.038	0.016-0.088	2.83	2.59-3.07	0.936
Krishnagiri	15	13	19.9	37	140	0.0155	0.0076-0.0318	3.07	2.81-3.32	0.98
Kanva	221	9	37	10	900	0.0827	0.0497 0.1377	2.4	2.288 2.632	0.79
Sathanur	23	14.4	49	60	2250	0.091	0.0145-0.108	1.67	1.28-2.42	0.54

1.97 mm (1.87 ± 0.03). The width of the otoliths ranged between 1.77 and 1.95 mm (1.88 ± 0.04 mm). Both left and right otoliths were utilized in the analysis.

Comparative Study on the Growth of Tilapia in Manchanbele Reservoir

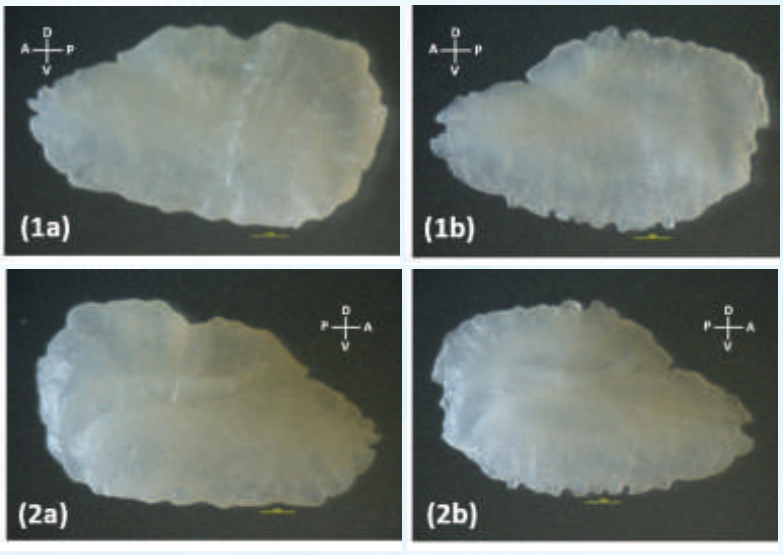
Manchanbele Reservoir, located approximately 51 kilometers west of Bangalore in Magadi Taluk, Ramanagara District, Karnataka, spans a water spread area of 365 hectares at full capacity. Constructed across the Arkavathi River, this reservoir has become a significant site for commercial fishing, with larger-sized tilapia (*Oreochromis niloticus*) dominating the catches. The current study focuses on understanding the habitat preferences and growth patterns of tilapia within this reservoir. A total of 22 genera of phytoplankton belonging to six classes were recorded from this reservoir. The average density of phytoplankton was estimated to be 5.29 x 10^5 cells/litre. Cyanophyceae dominated the phytoplankton community followed by Bacillariophyceae and Chlorophyceae. The zooplankton density in this reservoir was estimated to be 330 individuals/litre and the population was dominated by rotifers (78.9%) followed by copepods (20.5%) and cladocerans (0.5%). Algal genus pollution index (AGPI) value 11 indicates a moderate organic pollution in the reservoir. The *O. niloticus* population in Manchenbele reservoir was constituted of 44.4% male and 55.5% female of early maturing to mature stages of the gonad.

The study examines the dominance of the exotic fish species *O. niloticus* in natural water-bodies, highlighting its superior growth rate compared to native fish species. The LWR were analyzed across different reservoirs to assess the species' growth performance and ecological impact. Moreover, market preferences favor *O. niloticus* due to its rapid growth, availability, and consumer demand, further influencing its widespread cultivation and presence in natural water-bodies. However, the species' proliferation raises concerns about its impact on native biodiversity, necessitating further research and management strategies to maintain ecological balance in freshwater ecosystems.

The LWR analysis for the fish species in various reservoirs revealed distinct growth patterns. In the Krishnagiri reservoir, the exponent 'b' was calculated at 3.07, indicating positive allometric growth, where the fish's weight increases at a faster rate than its length. Conversely, in the Manchanbele Reservoir, the 'b' value was slightly less than 3, recorded at 2.83, suggesting negative allometric growth, meaning the fish's length increases more rapidly than its weight. More pronounced negative allometric growth was observed in the Kanva and Sathanur reservoirs, with 'b' values of 2.4 and 1.67, respectively. These variations in growth patterns across different reservoirs may be attributed to factors such as environmental conditions, availability of food resources, and habitat characteristics. Understanding these differences is essential for effective fisheries management and conservation strategies tailored to each specific reservoir.

Hard Part (Otolith) Study in Tilapia

Saccular otoliths of *O. mossambicus*



Distal (1) and proximal (2) view of Sagitta of (a) *Oreochromis mossambicus* and (b) *O. niloticus* from Manchanbele reservoir (10X)

(average length = 351.0 mm) and *O. niloticus* (average length = 331.92 mm) from Manchanbele reservoir were extracted during the study period. The length of sagitta varied from 10.1 to 10.43 mm (10.27 ± 0.08 mm) in *O. mossambicus* (n=4) and 8.48 to 13.24 mm in *O. niloticus* (n=12), while the width in former ranged from 5.88 to 6.15 mm (6.03 ± 0.06 mm) and in the latter, from 4.5 to 9.58 mm (6.19 ± 0.47 mm).



Catch of *S. sarana*



Sampling at Bhima river



Sampling at Cauvery river



Sampling at Manchanbele reservoir

Project Code: RWF/22-25/13

Project Title: Development of Environmentally Sustainable Feed for Enclosure Culture

Duration: 01.04.2022 – 31.03.2025

The development of environmentally sustainable fish feed is crucial for reducing the environmental impact of aquaculture. One of the key factors in achieving this goal is to minimize nitrogen and phosphorus losses through leaching and fecal excretion. This report presents an analysis of nitrogen and phosphorus leaching, retention, and fecal excretion percentages across three different feed formulations, namely Feed 1, Feed 2, and Feed 3, which were formulated to maintain an isonitrogenous protein level of 30% CP. The feeds were tested in *Pangasianodon hypophthalamus* juveniles.



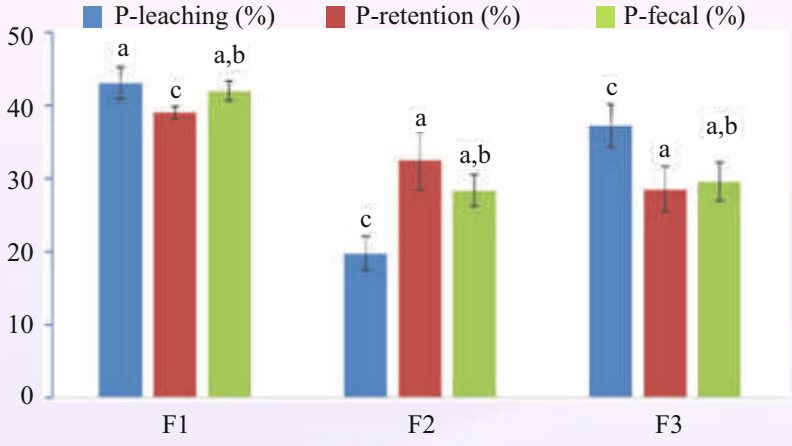
Feed 1 Feed 2 Feed 3

Formulated fish feeds

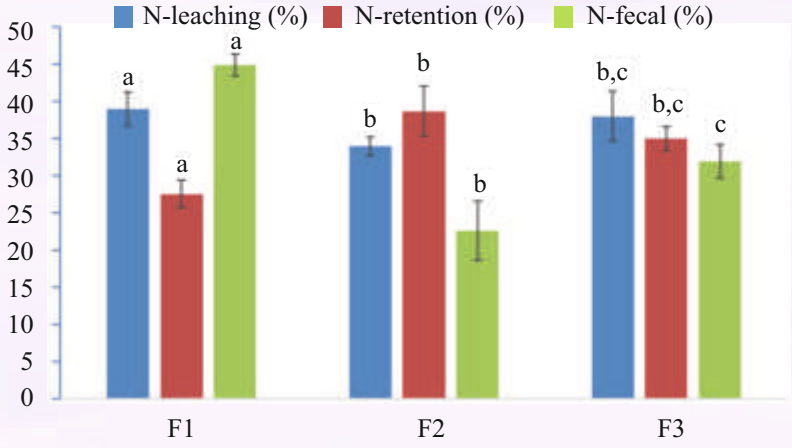
Feed Compositions

Three feeds were formulated with different ingredients to achieve the desired nutritional profile. Feed 1 consisted of black soldier fly larvae meal, algal meal, rice bran, wheat bran, soybean meal, enzymes (phytase), and probiotics, as well as other additives such as vitamins, minerals, and antioxidants. Feed 2 was composed of corn gluten meal, pea protein concentrate, duckweed meal, rice bran, soybean meal, vitamins, and minerals, antioxidants, and a growth promoter. Feed 3, on the other hand, was formulated with broken rice, earthworm meal, duckweed, maize bran, soybean meal, rice bran oil, mineral and vitamin premix, enzyme and probiotic blend, and a growth promoter.

Our analysis revealed that Feed 3 exhibited the lowest nitrogen leaching rate, approximately 30-32%, which was significantly lower than Feed 1 ($p < 0.01$) and Feed 2 ($p < 0.01$).



Phosphorus portioning formulated fish feeds



Nitrogen portioning formulated fish feeds

Additionally, Feed 3 had the highest nitrogen retention, approximately 38-40%, which was significantly higher than Feed 1 ($p < 0.05$) and Feed 2 ($p < 0.01$). Furthermore, Feed 3 had the lowest fecal nitrogen excretion, around 22-24%, which was significantly lower than Feed 1 ($p < 0.01$) and Feed 2 ($p < 0.01$).In terms of phosphorus, Feed 2 exhibited the lowest phosphorus leaching (28.50 ± 3.15%, $p < 0.05$), demonstrating the most efficient phosphorus conservation, while Feed 1 had the highest phosphorus leaching (43.04 ± 2.23%, $p < 0.05$), indicating significant phosphorus loss.

Feed 3 showed moderate phosphorus leaching, falling between Feed 1 and Feed 2. The highest phosphorus retention was observed in Feed 2 (32.48 ± 3.98%, $p < 0.05$), making it the most efficient in phosphorus utilization, whereas Feed 1 had the lowest phosphorus retention (19.77 ± 2.34%, $p < 0.05$), highlighting its inefficiency in phosphorus assimilation.

Correlation between Nitrogen and Phosphorus Leaching, Retention, and Fecal Excretion

Our analysis suggests that there is a significant ($p<0.05$) correlation between nitrogen and phosphorus leaching, retention, and fecal excretion. Feed 3, which had the lowest nitrogen leaching rate, also had the highest nitrogen retention and lowest fecal nitrogen excretion, while Feed 2, which had the lowest phosphorus leaching, also had the highest phosphorus retention. This suggests that the unique combination of ingredients in Feed 3, including earthworm meal and duckweed, may have contributed to its superior performance in terms of nitrogen utilization, while the combination of ingredients in Feed 2, including corn gluten meal and pea protein concentrate, may have contributed to its superior performance in terms of phosphorus utilization.

In conclusion, our analysis suggests that Feed 3 is the most environmentally sustainable option for nitrogen utilization, with the lowest nitrogen leaching rate, highest nitrogen retention, and lowest fecal nitrogen excretion, while Feed 2 is the most efficient in phosphorus utilization, with the lowest phosphorus leaching and highest phosphorus retention. However, considering both nitrogen and phosphorus parameters, Feed 3 can be considered as a balanced feed that performs well in both nitrogen and phosphorus utilization, although it may not be the best in either parameter individually. These findings have significant implications for the development of environmentally sustainable fish feed for enclosures. By minimizing nitrogen and phosphorus losses, we can reduce the environmental impact of aquaculture and promote sustainable aquaculture practices. However challenge study need to be done for the efficacy study.

Project code: RWF/23-26/14

Project Title: Next Generation Inland Open Water Cage Culture in India With Special Reference to System and Species Diversification

Duration: 01.04.2023 – 31.03.2026

Culture of Indian Major Carps in Circular Cages at Hirakud Reservoir

Circular cage farming has emerged as a promising method to enhance fish production in inland open waters. The ICAR-CIFRI installed four CIFRI-HDPE circular cages, each with a diameter of 16 meters, in the Hirakud Reservoir, Odisha. To assess feasibility and growth performance, Indian Major Carp fingerlings (*Labeo catla, L. rohita,* and *Cirrhinus mrigala*) with an average weight of 20.04 ± 3.41g were stocked in three CIFRI-HDPE circular cages at a stocking density of 10 fish per cubic meter (*Labeo catla*: 40%, *L. rohita:* 40% and *Cirrhinus mrigala:* 20%). Feeding commenced at the onset of winter in 2024 to support overwintering, facilitating faster and compensatory growth during the subsequent growing season. The fishes were fed with commercially available floating pellet feed containing 28% crude protein and 5% lipid, administered at a feeding rate of 5% to 3% of their body weight. After a 120-day culture period, the stocked fishes attained an average weight of 61.20 ± 4.12 g for Catla, 59.83 ± 3.55 g for Rohu, and 58.00 ± 4.10 g for Mrigal. This study is going on to determine the growth performance of carps in circular cages in large reservoirs.

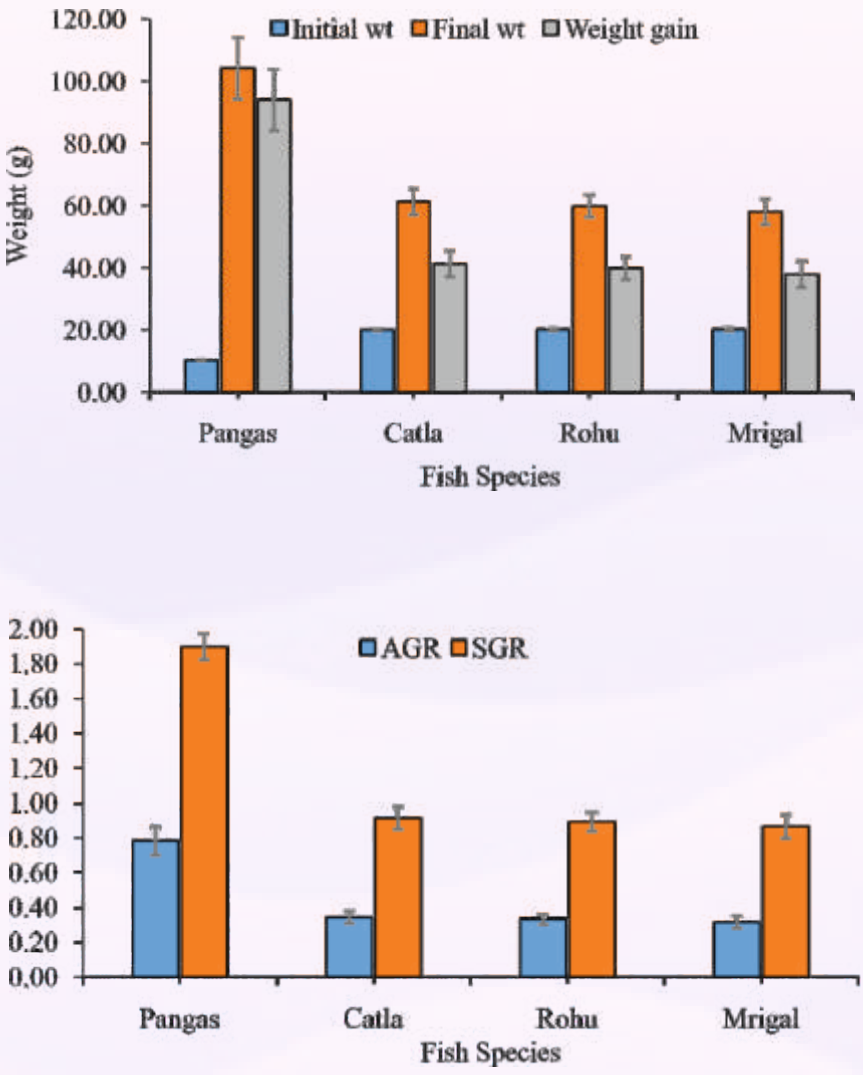


Culture of Indian Major Carps in circular cage

Additionally, the fingerlings of *Pangasianodon hypophthalmus* with an average weight of 10 g were stocked in one circular cage of 16 meters diameter. After 120 days, the Pangas attained a size of 104.18 ± 9.93 grams. The relatively modest growth observed in the stocked fish species during the study period may be attributed to the severe winter conditions experienced from November to February, which can adversely affect fish metabolism and growth rates.

Cage Culture of Silver Carp in Mapithel Reservoir in Participatory Mode

Mapithel is a medium reservoir located in the Kamjong district of Manipur. Cage culture of *Hypophthalmichthys molitrix* (Silver carp) was carried out with participation of local cage farmers. Fingerlings of silver carp having average weight 32.45 1.04 g and average length 15.3 0.86 cm were used for the study. Individual cage dimension of 6 x 6 x 4 m (144 m^3) with effective water volume of 126 m^3 was used for culture. Four stocking densities *viz*., 8,12, 16 and 20 fingerlings/m^3 were tested in triplicates. The trial finished when the fish weighed 1 kg. Fishes were fed with floating feed containing 28 % CP @ 2-3 % body weight. Fishes stocked at lower



Growth performance of stocked fishes in the CIFRI-HDPE circular cages at Hirakud reservoir




Cage culture in Mapithel reservoir

Table: Growth parameters of *Hypophthalmichthys molitrix* in cages

Growth parameters	Stocking density (no./ m^3)			
	8	12	16	20
Final weight (g)	1089 ± 123.23	1008 ± 100.08	1027 ± 89.56	1058 ± 80.73
Weight gain (g)	1056.55 ± 98.08	975.55 ± 80.06	994.55 ± 62.15	1025.55 ± 57.32
SGR (%/day)	1.46 ± 0.10	1.23 ± 0.08	0.96 ± 0.06	0.83 ± 0.0.05
Biomass (kg/cage)	1089 ± 123.23	1512 ± 125.27	2054 ± 154.48	2645 ± 128.08
Biomass (kg/m^3)	8.64 ± 0.03	12.00 ± 0.04	16.30 ± 0.09	20.99 ± 0.02
Days of culture	240	280	360	420

density had higher growth performance than those stocked at higher stocking density. Fishes stocked at 8 and 12 no./ m^3 reached harvesting size (1 kg) at shorter culture period although higher biomass was achieved at higher stocking densities. It can be recommended that initially silver carp fingerlings can be reared at 20 no./ m^3 for 4 months after which the stocking density can be reduced to 8 or 12 no./ m^3 to reduce the culture period.

Development of Preventive Mitigation Options to Reduce Post-Stocking Morbidity and Mortality of Fish Seeds

Cage farming of fish has several advantages, similar to any other animal production model, but risk and occurrence of fish diseases are one of the major constraints in the successful harvest. The chance of morbidity followed by mortality of fish seeds get escalated due to increase in unrecoverable stress generated by transport and change in culture environment. Therefore, the experiment was conducted with seeds of *Pangasianodon hypophthalmus* at cage facility in Kangsabati reservoir, Bankura, West Bengal in June 2023. The preliminary finding revealed that mortality cases reached its peak on 3rd day post-stocking and subsequently decreased irrespective of any control and treatment measures implemented. However, the mortality cases have been reduced to more than half as compared to control or untreated cages with therapeutics.

Project Code: OWAPM/24-27/01

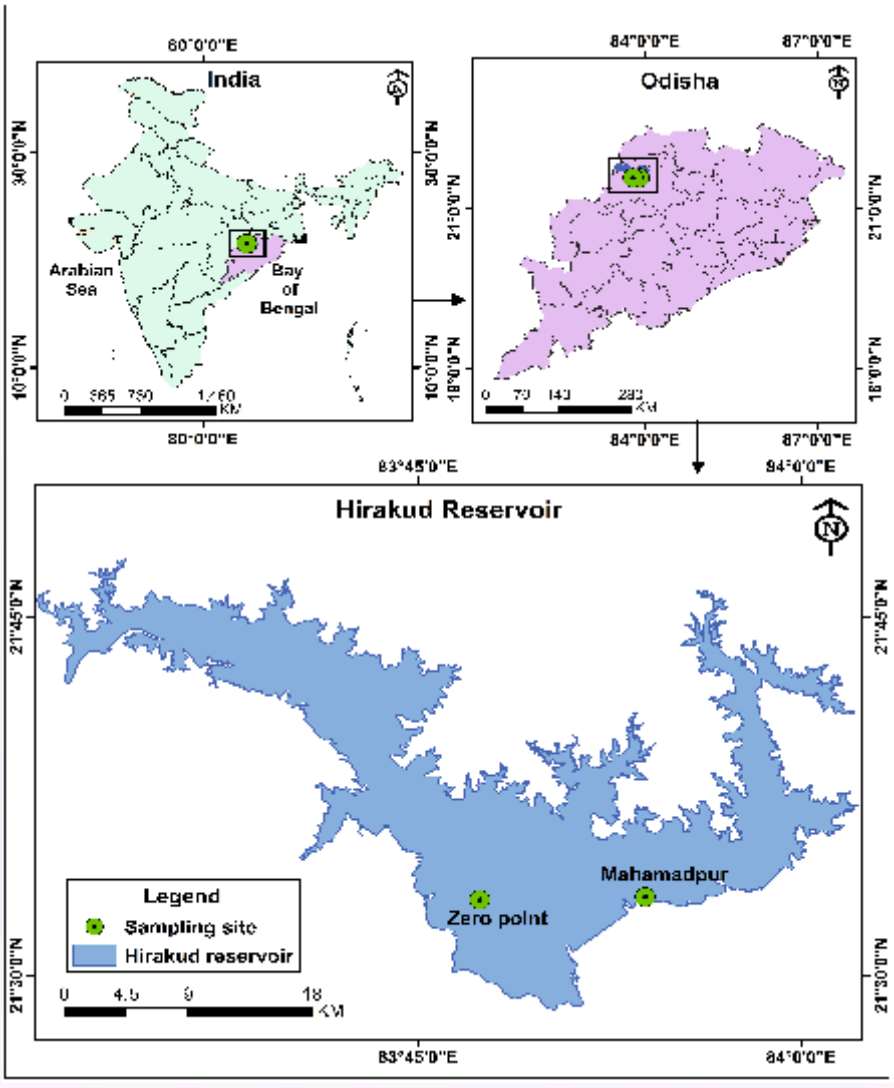
Project Title: Investigation of Ectoparasitism and Their Effects on Fish Populations of Eastern Indian Reservoirs

Duration : 01.04.2024 to 31.03.2027

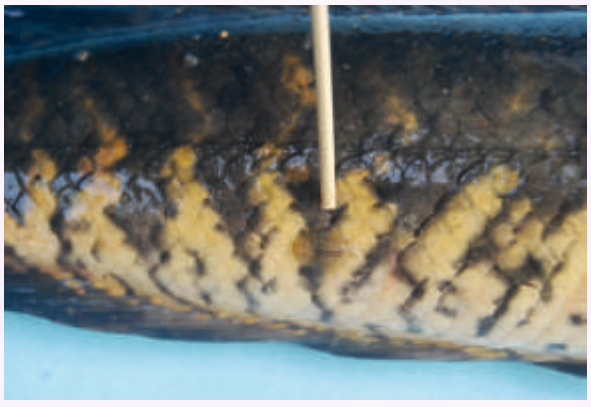
The eastern region of India is blessed with rich and diverse fisheries resources of which the reservoirs constitute a major fisheries resource. Hirakud and Panchet reservoirs have been built on two major river namely, Mahanadi and Damodar Rivers which support more than 60 fish species. But the information on fish parasite and species composition of both are limited and sporadic in nature. Therefore, both reservoirs were selected to catalogue ectoparasites of selected fish and relate with water quality parameters on parasite richness and abundance.

Fish Ectoparasites in Hirakud Reservoir

Mahmadpur and Zero point were two selected stations for collection of fish samples and water. Live fish caught with drag net, cast net and traps were included in the study. Fifteen fish species were examined for parasitological study and only *Argulus* spp. and *Posthodiplostomum* spp. recorded from *Channa striata* and *Puntius terio*, respectively. Further, *Posthodiplostomum* spp. caused massive changes in histo-architecture in the infected muscle tissues. Dissolved Oxygen (6.13



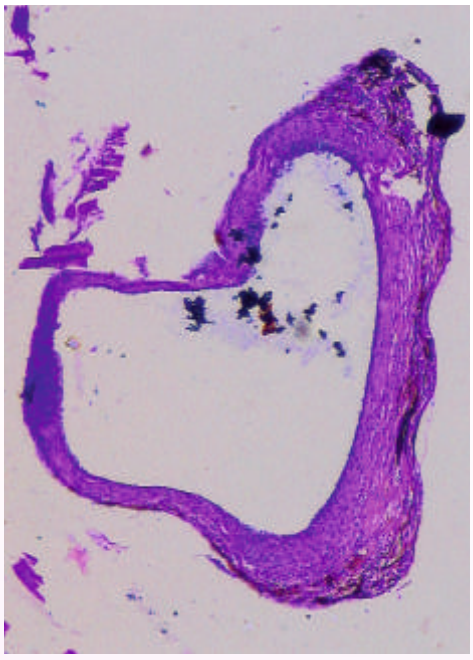
Sampling site in Hirakud Reservoir



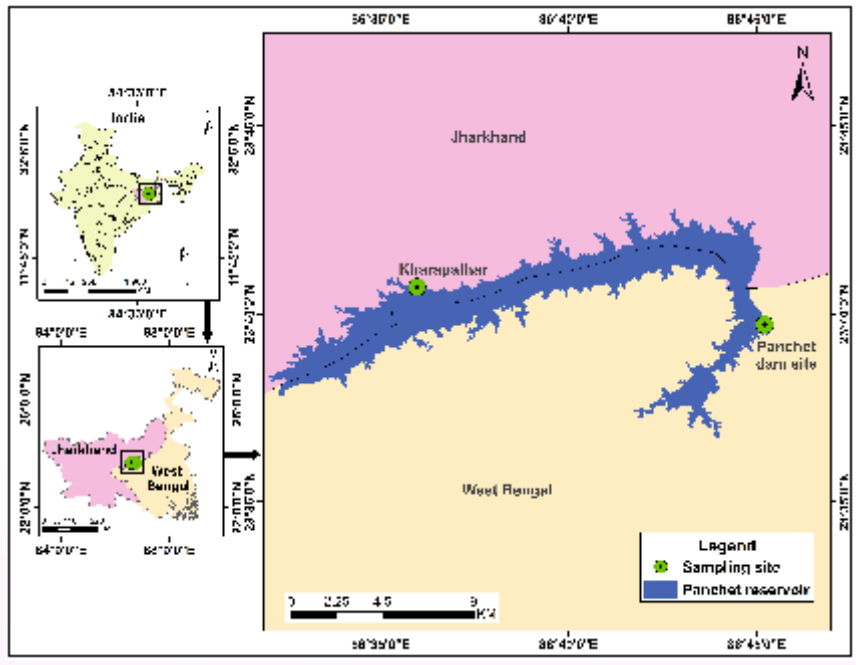
Argulus in *Channa striata*



Black spot in *Puntius terio*



Changes in histo-architechture in the infected muscle tissue



Sampling site of Panchet dam



Argulus species on the body of *Pethia conchonius*



Isopod on the body of *Puntius chola*



Black spot in *Pethia conchonius*

ppm), Water pH (8.1), total hardness (86.30) and total alkalinity (97.50 ppm) was in optimum range for sustaining aquatic life of the reservoir. However, the air and water temperature was slightly higher than the optimal thermal due to peak summer time.

Fish Ectoparasites in Panchet Reservoir

Dam site and Khadapathhar were the two selected stations for collecting fish and water sample. The study included only live fish captured with drag nets and traps. Twenty-two fish species were analyzed for the parasitological study. Two crustacean parasite, *Argulus* spp. and Isopod were recorded from *Puntius conchonius* and *Pethiachola*, respectively. Furher, Infection of *Posthodiplostomum* spp. was recorded from *P. conchonius*. Average Dissolved Oxygen (8.0 ppm), Water pH (7.2), total hardness (200) and total alkalinity (108 ppm) was in optimum range for sustaining aquatic life of the reservoir. However, the air and water temperature was lower than optimal thermal range due to peak winter season.

Project Code: FREM/23-26/20

Project Title: Aquatic Environmental Health Assessment and Novel Formulations Development for Fish Health Management

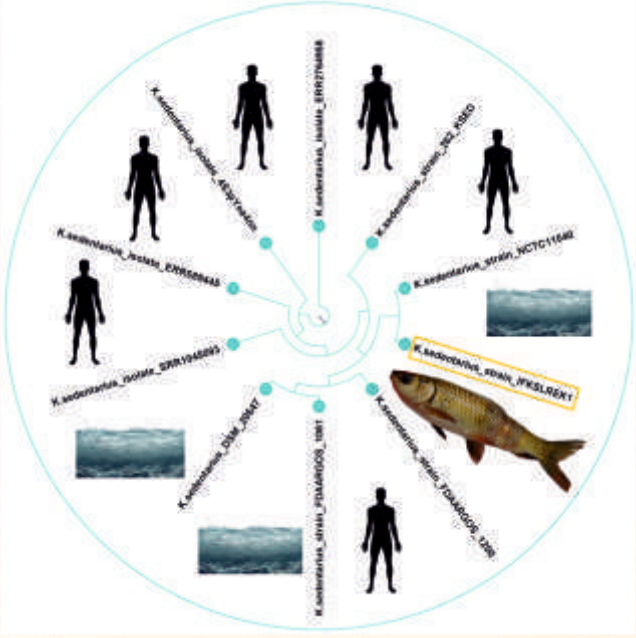
Duration: 01.04.2023 – 31.03.2026

Genome Sequencing of Novel pathogenic and Multidrug Resistant *Kytococcus sedentarius*

Kytococcus sedentarius (Family Kytococcaceae), ubiquitously found in aquatic and terrestrial environments, is characterized as a spherical/coccoid, Gram-positive, non-motile, non-encapsulated, and non-endospore-forming bacterium. We present a novel pathogenic and multidrug-resistant bacterium *Kytococcus sedentarius*. The *K. Sedentarius* Cp169391 was isolated from *Labeo rohita* cultured in Sardar bherry located in the East Kolkata Wetland, West Bengal, India. The symptomatic fish tissue samples were homogenized aseptically and transferred to a conical flask containing sterile tryptone soya broth (TSB). Afterward, based on uniqueness in morphology, size, and color, a single colony was picked from TSA plates and cultured overnight in TSB at 28°C. Biochemical assay and 16S rRNA gene sequencing determined by Sanger sequencing before genome sequencing confirmed the presence of the Enterococcaceae family. Based on *in vitro* and *in vivo* characterization and an antibiogram assay, the isolate was also confirmed for high virulence and multiple antibiotic resistance (MAR). The genomic assembly features of *K. sedentarius* CP169391 are presented in Table. The genome assembled in this study was 97.6% complete and 0.0% contaminated. It consisted of a closed, circular chromosome of 2598617 bp with a G+C content of 71.7%. We identified different antimicrobial resistance genes sta, novA, macB, tetA, vanS, adeF, and rphA. Our strains were closely related to each other, and they formed

Table : Genomic assembly features of *K. sedentarius*

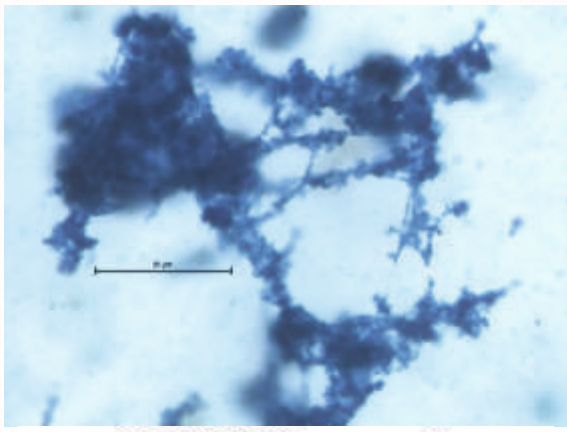
Bacterial isolate:	*Kytococcus sedentarius*
Sequencing method:	PacBio sequel II
HiFi reads:	311,737,818
Length of contig:	2598617
No. of contigs:	1
Total length (bp):	2598617
N50:	2598617
GC%:	71.7
Contamination:	-
Sequencing coverage:	119.96
Complete BUSCOs (C):	97.6
Complete and single-copy BUSCO (S):	94.4
Complete and duplicated BUSCOs (D):	0
Fragmented BUSCOs (F):	2.4
Missing BUSCOs (M):	0
No. of CDSs:	2393
No. of rRNAs:	6
No. of tRNAs:	51
No. of tmRNAs:	1
Antimicrobial Resistance Genes (total):	2173
BioProject number:	PRJNA1152948
Biosample accession no.:	SAMN43381806
Accession number:	CP169391

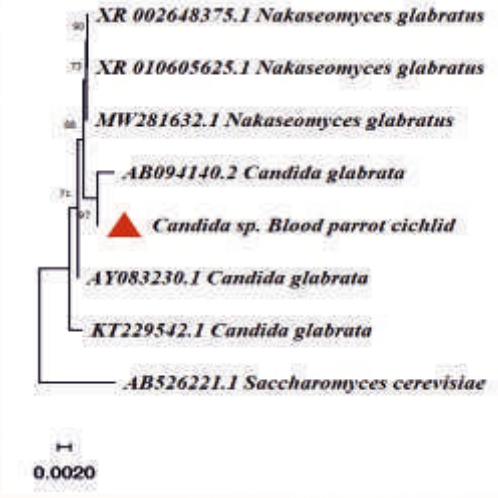


The phylogenetic tree comprises isolated *Kytococcus sedentarius* and strains from different sources and countries

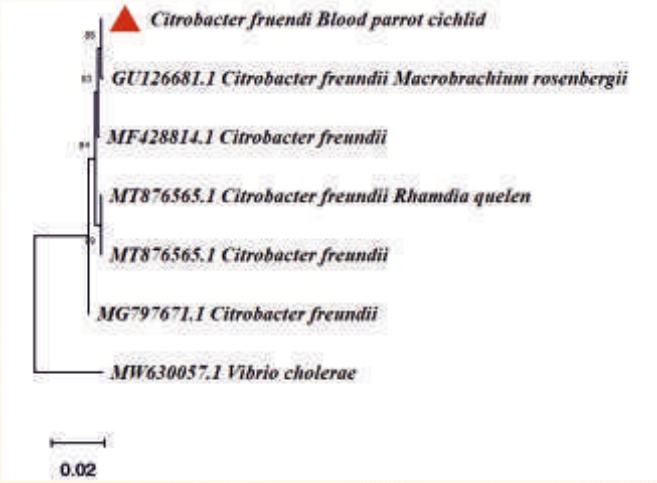


The moribund fish showed gill and fin rot with haemorrhagic patches





Isolation and identification of *Candida sp* using molecular techniques



Isolation and identification of *Citrobacter freundii* using molecular techniques

a clade with humans and seawater, isolates from Germany, the USA, China, and France.

Combined Infection by Opportunistic Bacteria and Fungus in Blood Parrot Cichlid

A total of 26 blood parrot cichlid died within 9 days. Moribund fishes exhibited symptoms like erratic swimming, hemorrhagic and whitish patches at body parts, rotten tail, gill and fin. On applying microbiological and molecular techniques, a common fish bacterial pathogen, *Citrobacter fruendi* and Yeast, *Candida* sp. was confirmed. First report of combined infection of *C. fruendi* and *Candida* sp. in blood parrot cichlid. The affected fish were studied for the hispathological changes in their liver, kidney and gills.

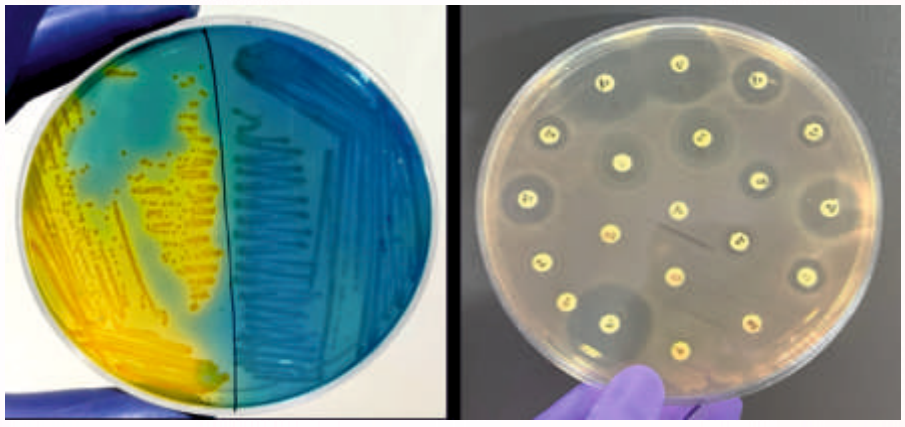
Heavy Metal-Tolerant Bacteria of Mussels in Sewage-Fed Aquatic Ecosystem Showed Multi-Drug Resistance Properties

Investigating phenotypic antibiotic resistance and β-lactamase-producing *Aeromonas* spp. in *Lamellidens marginalis*, a freshwater bivalve widely distributed across the Indian subcontinent, is crucial for assessing food safety and antimicrobial resistance. In this study, 92 *Aeromonas* isolates were recovered from 105 bivalves and screened for antimicrobial resistance. Out of 92 bacteria, 24 isolates exhibited resistance to copper (Cu), while none showed increased tolerance to cadmium (Cd), lead (Pb), chromium (Cr), or mercury (Hg) beyond their respective minimum inhibitory concentration (MIC) ranges. However, bacteria capable of tolerating Cd (11 isolates), Pb (53 isolates), and Hg (42 isolates) within their MIC ranges were identified, whereas no significant tolerance to Cr within the MIC range was observed. Among the Cu-resistant isolates, 12 carried the copA gene, indicating a genetic basis for Cu resistance. Antimicrobial resistance

profiling revealed a high Multiple Antibiotic Resistance (MAR) index of 0.8, with the highest resistance against ampicillin/sulbactam (82%), followed by cephalothin (58%), erythromycin (44%), cefoxitin (39%), and imipenem (38%). PCR analysis confirmed the presence of resistance genes, with blaTEM detected in 94% of isolates, blaCTX-M in 51%, and blaSHV in 45%, while 17% of the isolates harbored all three genes, indicating the presence of extended-spectrum β-lactamases (ESBLs). Notably, Cu-resistant isolates demonstrated a higher prevalence of multidrug resistance, suggesting a potential correlation between heavy metal tolerance and antibiotic resistance. This co-resistance may be attributed to the co-selection mechanism, where metal resistance genes and antibiotic resistance determinants are located on the same genetic elements, such as plasmids and transposons. This is the first study highlighting the emergence of multidrug-resistant *Aeromonas* spp. in *L. marginalis*, and the elevated level of antibiotic-resistant genes and Cu-resistant genes demonstrates the excessive use of antibiotics and massive heavy metal pollution.



L. marginalis from a sewage-fed wetland

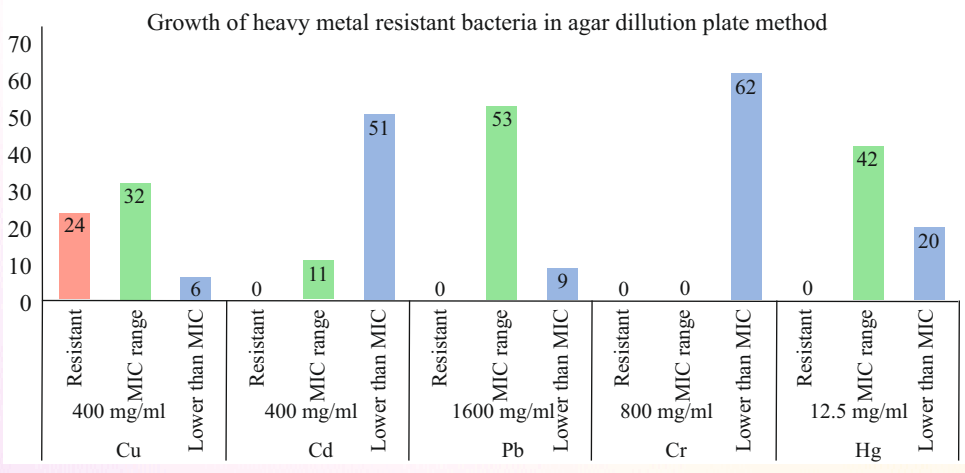


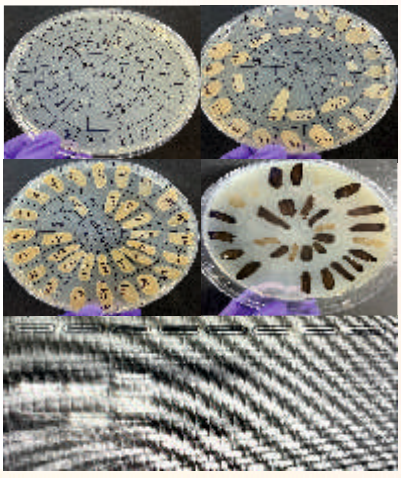
Isolation and antimicrobial susceptibility testing of *Aeromonas* spp. from *L. marginalis*

Development of qPCR-based Diagnostic for Detection of *Aermonas hydrophila*

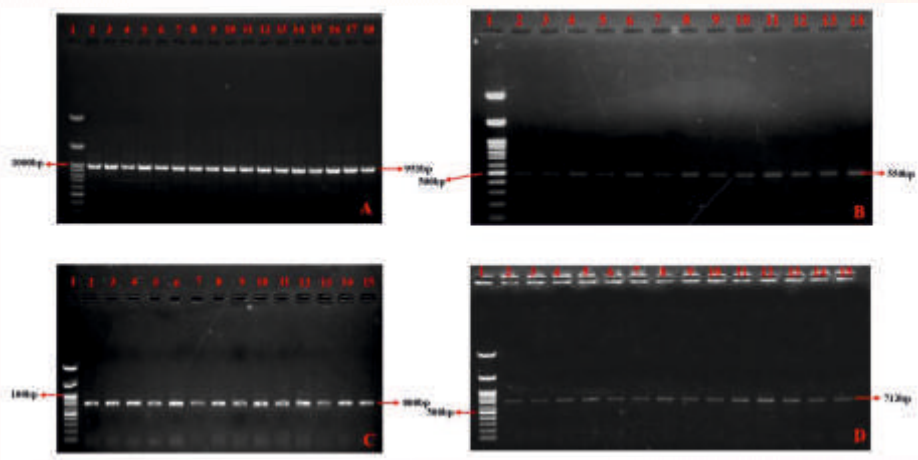
An in-situ diagnostic tool is being developed for fish health monitoring, specifically targeting the *Aeromonas hydrophila* pathogen. Microbial DNA was extracted from two different cultures: AKB5 and ATCC. These microbial cultures were first revived on nutrient media before DNA extraction. For PCR amplification, the universal primers AH−2968F/AH−2968R and NJ35−1F/NJ35−2R were selected.

Quantitative PCR (qPCR) was done to quantify specific *A. hydrophila* with AH−2968F/ AH−2968R and NJ35−1F/NJ35−2R primers. The *A. hydrophila* culture ATCC and AKB5 along-with other microbes' strains of the genus *Enterobacteria* sp., *Chrysobacterium* species, *Bacillus* species, *Staphylococcus* species and *Flavobacterium* species were selected to check specificity. The positive amplification was observed for ATCC and AKB5 culture with NJ35−1F/NJ35−2R primers whereas

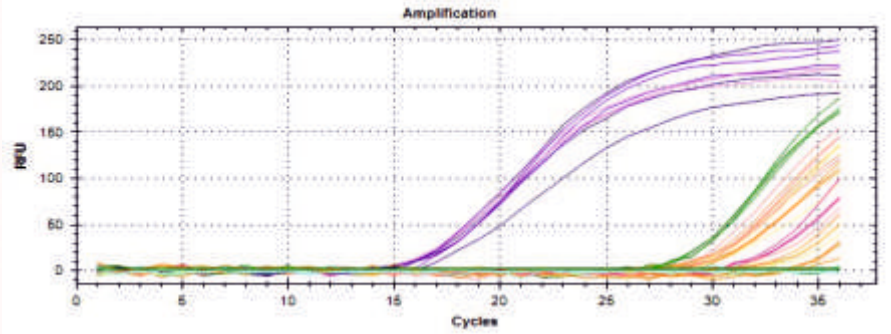




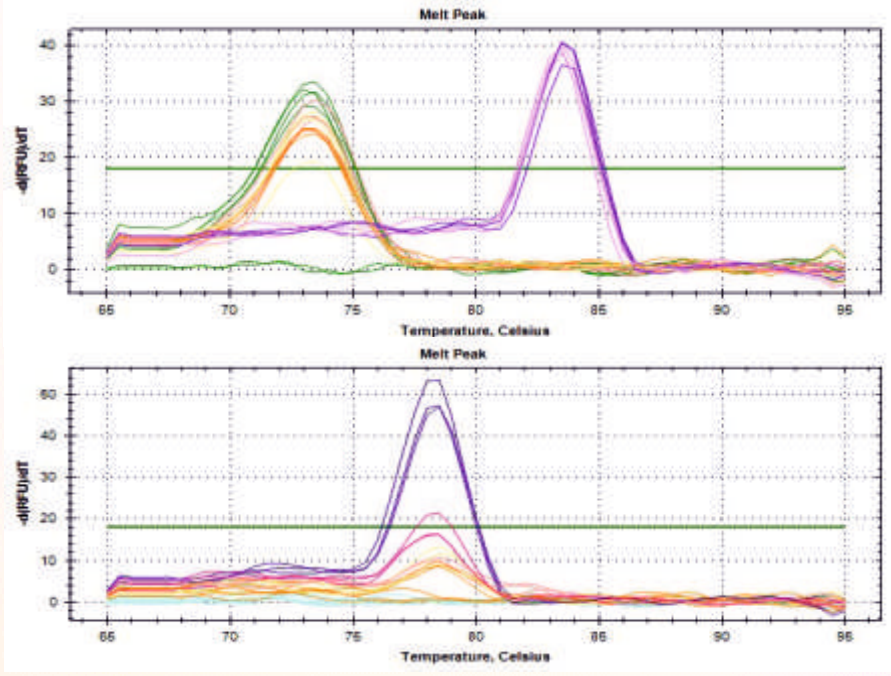
Heavy metal tolerance and *copA* gene screening in bacterial isolates. The bar graph represents the number of bacterial isolates exhibiting tolerance to different heavy metals (Cu, Cd, Pb, Cr, and Hg) within their respective MIC ranges.



Screening of different antibiotic resistance genes in bacterial isolates. The figure represents the presence of β-lactamase genes (blaTEM, blaCTX-M, and blaSHV) among the isolates, detected using PCR



qPCR amplification using AH−2968F/ AH−2968R and NJ35−1F/NJ35−2R primers of *A. hydrophila* culture ATCC and AKB5 and *Enterobacteria* sp., *Chrysobacterium* species, *Bacillus* species, *Staphylococcus* species and *Flavobacterium* species



Melt curve analysis of qPCR using NJ35−1F/NJ35−2R (left) and AH−2968F/ AH−2968R (right) primers for *A. hydrophila* culture ATCC and AKB5 and *Enterobacteria* sp., *Chrysobacterium* species, *Bacillus* species, *Staphylococcus* species and *Flavobacterium* species. The specific melt curve with NJ35−1F/NJ35−2R primers was observed at 83.5°C and with AH−2968F/ AH−2968R primers was observed at 78.5°C for ATCC and AKB5 culture whereas primer dimer was observed at 73.5°C for NJ35−1F/NJ35−2R primers

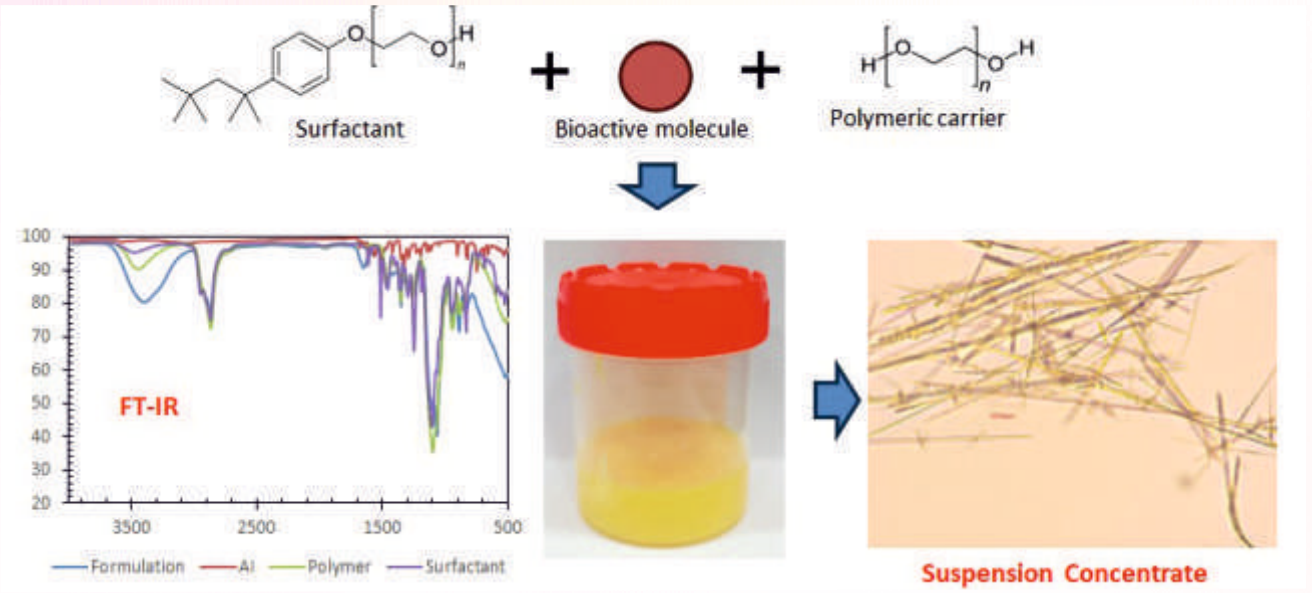
AH−2968F/ AH−2968R primers amplified only AKB5 culture and could not amplify ATCC culture. The primer dimer was observed for NJ35−1F/NJ35−2R whereas no primer dimer was observed for primer AH−2968F/ AH−2968R. No amplification for *Enterobacteria* sp., *Chrysobacterium* species, *Bacillus* species, *Staphylococcus* species and *Flavobacterium* species was observed for both the primers. This shows the primer is specific for *A. hydrophila*. The specific melting point of amplicon of AH−2968F/ AH−2968R primer was 78.5, whereas the melting temperature for NJ35−1F/NJ35−2R primers was 83.5. These primers could be used for specific identification of *Aeromonas hydrophila* in qPCR.

Formulation for Controlling Snail and Helminthic Parasites

Snails are reported as hosts of various types of parasitic worms and protozoan diseases in fish. Hence a formulation was developed for the control of snails and helminthic parasites in fisheries. The formulation was developed using an FDA-approved active ingredient along with a hydrophilic polymer and a surfactant for better dispersion in water. The particle size of the formulation dispersed in water was estimated using a DLS instrument and the size was found in the range of 2.01 µm. The zeta potential of the developed formulation was found in the range of - 53 mV. The acute toxicity of the developed formulation was tested on *Filopaludina bengalensis* which is prevalent in the Indo-Gangetic plain. The 96 hr LC_{50} of the developed formulation was 0.093 mg L.

Nutrient Recovery from Sewage Water Using Microalgae *Graesiella emersonii*

The East Kolkata Wetlands (EKW) is a renowned community-led, sewage-fed aquaculture system and is designated as a Ramsar site. In recent

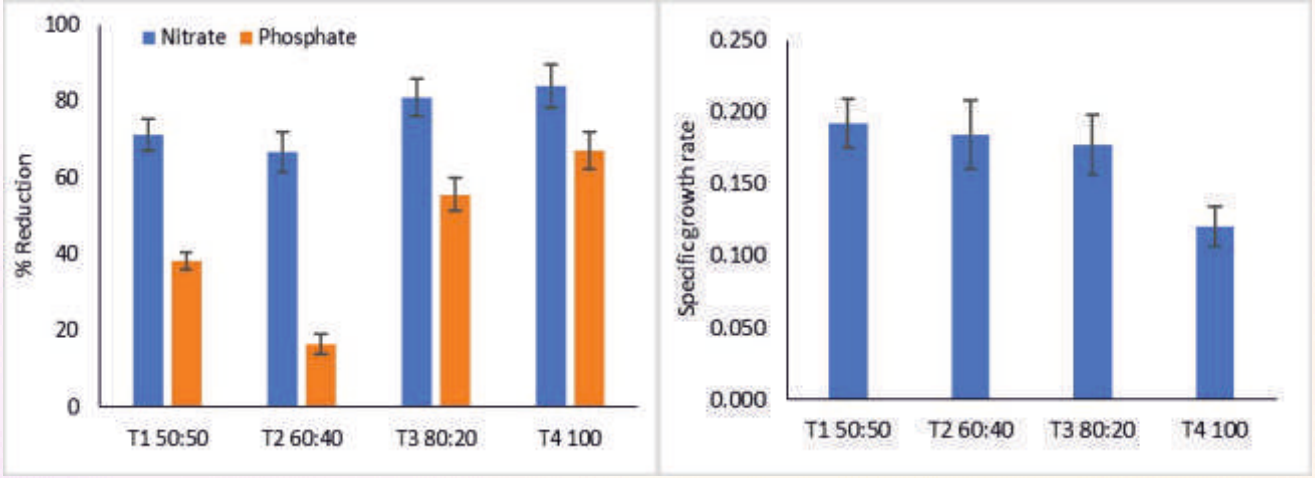


Scheme of formulation development along with FT-IR and microscopic view of the formulation

years, an increased nutrient load from industrial and domestic sewage has led to eutrophication and the gradual deterioration of EKW. This issue requires attention to meet the FAO Sustainable Development Goals (SDGs) on "Life Below Water," "Good Health and Wellbeing," and "Sustainable Cities and Communities." Microalgae have been identified as a potential solution for nutrient recovery from sewage water. In this context, we utilized the microalgae *Graesiella emersonii* to remove nutrients (total phosphorus and nitrate) from the system, and its tolerance level was assessed by measuring oxidative stress. Raw sewage was collected from EKW and diluted to different concentrations using laboratory-grade water (LW) (*i.e.*, sewage: LW~ 50:50; 60:40; 80:20; 100:0) in 250 mL conical flasks. One millilitre of pre-grown, exponential-phase microalgae (1.02 × 10^6 cells/mL) was inoculated into the treatments and observed for 12 days under laboratory conditions at 24 ± 2°C, with the light intensity of 1300 ± 400 lux and a photoperiod of 14 hours light and 10 hours dark. The results revealed nutrient removal efficiencies in the following order: 100 > 80:20 > 50:50 > 60:40. The addition of microalgae removed 84%

Table: Probit analysis of acute toxicity of the formulation against *Filopaludina bengalensis*

Time (Hr)	LC_{50} (ppm)	Lower F limit	Upper F limit	R^2	χ^2
24	0.667	0.324	1.374	0.96	0.48
48	0.362	0.222	0.590	0.99	0.58
72	0.191	0.106	0.343	0.95	0.95
96	0.093	0.051	0.168	0.95	0.96

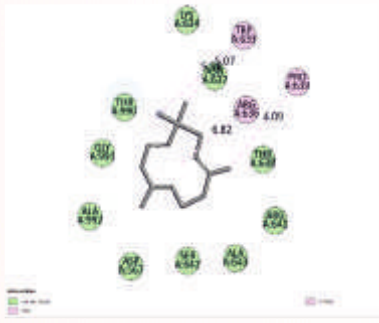


Left: Nitrate and phosphate removal efficiency of microalgae Right: Specific growth rate of microalgae in different sewage percentage

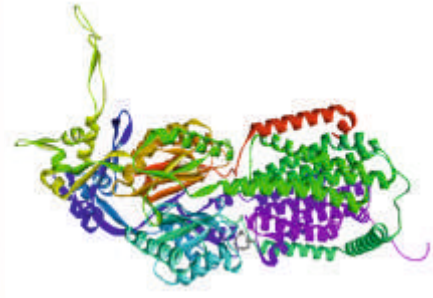
of nitrate and 67% of total phosphorus from the undiluted sewage. However, a lower growth rate (0.121) was observed. In contrast, the 80:20 treatment yielded a comparatively higher growth rate (0.177) while removing 81% of nitrate and 56% of total phosphorus. The oxidative stress developed in the microalgae during the sewage treatment was eliminated as estimated by enzymatic (SOD, CAT, GST) and non-enzymatic antioxidants (GSH). In conclusion, the test microalgae can effectively recover nutrients from wastewater used in sewage-fed aquaculture.

Approach to Breaking Antibiotic Resistance

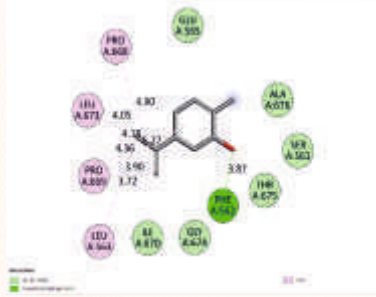
Tetracycline antibiotics, especially, oxytetracycline (OTC) is widely used to treat and prevent bacterial diseases of fish and other aquatic animals. Resistance to tetracycline antibiotics started emerging from the very start of their clinical use.Diseases caused by the Aeromonads with high antibiotic resistance are among the most common and troublesome diseases of fishes. Application of herbs is emerging as an important tool in managing antibiotic resistance. Plant-derived compounds can exhibit a direct antibacterial activity and/or an indirect activity as antibiotic resistance modifying compounds, which, combined with antibiotics, increase their effectiveness. In this study, a plant essential oil (EO) of Poaceae family was studied *in vitro* and *in silico* for its efficacy in managing oxytetracycline (OTC) resistance in *Aeromonas hydrophila* strains of fish origin. When the oil was combined with OTC at much lower MIC values (OTC/4-16 + EO/4-8), could synergistically (FICI ≤0.5) kill the sensitive strain of the bacteria, and the oil at its MIC/4 (EO/4) when combined with MIC/4-8 of the antibiotic (OTC/4-8) synergistically killed the resistant strains in *in vitro* studies.



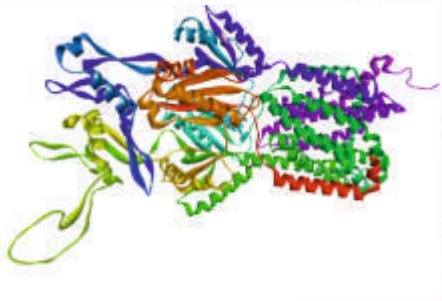
(a) α-Caryophyllene (2D)



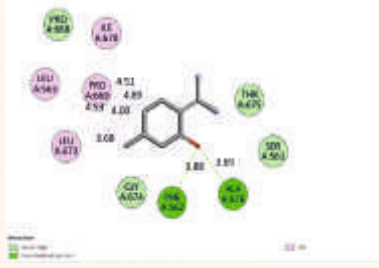
(b) α-Caryophyllene (3D)



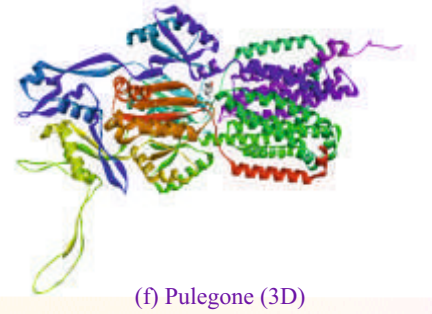
(c) Cis-Carveol (2D)



(d) Cis-Carveol (3D)



(e) Pulegone (2D)



(f) Pulegone (3D)

Molecular docking of AheB protein with essential oil components

The individual components of the oil (GC-MS) when computationally studied for their possible antibacterial efficacy applying PASS online software (Prediction of activity spectra for substances), many of the molecules having high Pa-Pi (>0.5; Pa=Probable active, Pi=Probable inactive) values exhibited strong inhibition on newly defined antibacterial target sites e.g., peptidoglycan glycosyltransferase (4-Nonanone, 1-tert-butyl-3,3-dimethylcyclopropene, 1-Adamantanol, 4,7,7-Trimethyl-bicyclo[4.1.0]heptan-3-one, cis-Geraniol, trans-Geraniol etc.) and CDP-glycerol glycerophospho-transferase (6-Methyl-5-hepten-2-one, β-trans-Ocimene, β-cis-Ocimene, Melonal, Rosefuran, *trans, trans*Photocitral-A, Citronellal, *cis*-Geraniol, Citral-b, trans-Geraniol, Neryl acetate, Geranyl acetate, α-Bergamotene etc.) indicating their probable bacterial cell wall disruptive efficacies. Peptidoglycan glycosyltransferase (GTase) is an enzyme that synthesizes peptido-glycan (PG), a macro-molecule that surrounds bacteria cell. CDP-glycerol glycerophosphotransferase catalyzes the teichoic acid synthesis, an essential bacterial cell wall component. More molecules exhibited probable inhibition on CDP-glycerol glycerophospho-transferasecatalyzes than peptido-glycan glycosyltransferase with higher Pa-Pi values. None of the molecules shown potential to inhibit four classical antibacterial targets corresponding to those reached by antibiotics actually used in the medicine (DNA gyrase inhibitor, DNA topoisomerase IV inhibitor, Protein ribosomal subunit inhibitor

or DNA directed RNA polymerase inhibitor) Thus, by disrupting the cell wall, the EO components might facilitate entry of the antibiotic inside the bacterial cell.

AheABC efflux pump a tripartite system consisting of the AheA, AheB, and AheC proteins, present in bacterial cell membrane which collectively pump-out the entered antibiotic from inside bacterial cell directly into the external medium reducing its concentration thus causing resistance. Among the three proteins, AheB being present at the inner membrane, act as main pump to drive out the antibiotic from inside the cell. Inhibition of this pump may be a tool in managing antibiotic resistance. Hence, *in silico* molecular docking study was conducted to explore the inhibition potential of the oil components to the AheB protein. Many of the components of the essential oil (6-Methyl-5-hepten-2-one, a-caryophyllene, b-caryophyllene, *cis*-carveol, cis-geraniol, *iso*-caryophyllene, Pullegone, *trans-trans*-photocitral-A) exhibited strong binding affinity towards the protein (strong inhibition) with low binding energy (<-0.5 Kcal/mol). The *in-silico* studies of the molecules on pharmacokinetics, drug-likeliness, bioavailability, environmental suitability etc. yielded results favouring a possible drug. The study, thus, indicates the plant essential oil as a potential synergistic co-component of tetracycline formulations to deal with antibacterial resistance in aquaculture.

Project code: AEB/24-27/01

Project Title: Biotechnological Interventions for Aquatic Environment and Fisheries Management of Wetlands

Duration: 01.04.2024 to 31.03.2027

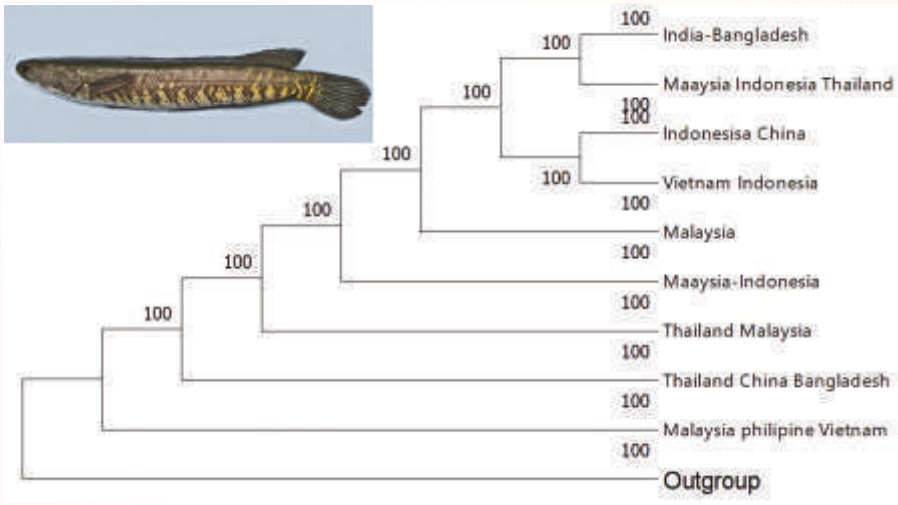
Phylogenetic Analysis of Fish from Manika Maun, Bihar, India

Recent survey of Manika *maun* revealed a total of 29 fish species having food and ornamental value. The 3-5 kg of Small IFs fishes were landed at Manika Maun, most of these fishes were juveniles. *Puntius* spp. dominated the total fish catch. The study also revealed first record of *Trichogaster labiosa* from Manika *maun*. A phylogenetic and phylogeographic study of *Channa striata* a widespread fish in South Asia and South East Asia was done.

The *C. striata* species is available in India, Malaysia, Vietnam, Bangladesh, Mayanmar, Indonesia, China, Philippines, and Thailand. The phylogenetic study revealed C. *striata* specimens from India is grouped along with specimens of Bangladesh and formed a distinct clade. The genetic distance study revealed 0.4 to 4.89% between country whereas it was observed to be 0.00 to 3.00% within country. The highest genetic divergence was observed between India and Thailand and lowest between Philippines and Malaysia.



Fish diversity of Manika *maun*, Bihar



Molecular Phylogeny of *Channa striata* population from different country

important species, *Heteropneustes fossilis* (Asian stinging catfish) and *Glossogobius giuris* (tank goby), after collecting individuals from Oxbow lake, Shantipur wetland. Genetic variation was assessed by analyzing two mtDNA markers: the D-loop and the ATPase 6/8 gene.

Sample collection-Two fish specimens, *H. fossilis* and *G. giuris*, were collected from the Oxbow lake, Shantipur. A specimen of *G. giuris* weighing 297 g and measuring 330 mm in length was the largest specimen found at Oxbow lake, Shantipur, WB.

Genetic Characterization, Gene Regulation, and Amino Acid Profiling of Fish Species

The information regarding genetic structure is essential for conserving natural stocks. Preserving allelic variation is crucial for maintaining genetic integrity and protecting the natural populations of freshwater fish. Fish populations are increasingly threatened by over exploitation, pollution, habitat destruction, and climate change. A decrease in genetic variation in the wild stocks of freshwater fish species may affect their ability to adapt to changing environments. Monitoring freshwater fish stocks is vital to tackle genetic decline. In this context, there is an urgent need to understand the genetic variation of freshwater fish species to conserve these genetic resources. Hence, this study concentrates on the genetic structure and regulation of two commercially



Glossogobius giuris from Shantipur wetland



Heteropneustes fossilis from Shantipur wetland

Table: Genetic distance between *Channa striata* population from different country

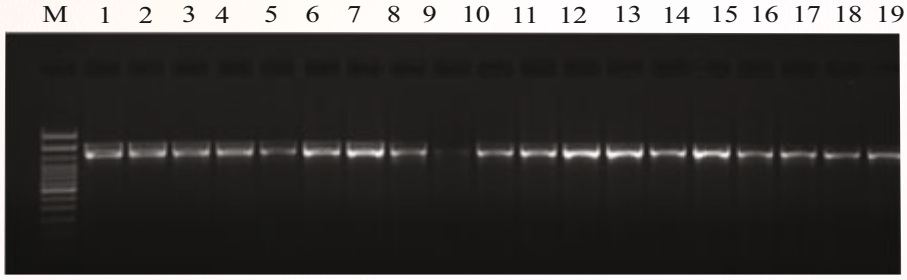
	Malaysia	China	Philippines	Bangladesh	Indonesia	Thailand	India	Vietnam
Malaysia	0.01							
China	0.0113	0.02						
Philippines	0.0048	0.0102	0.00					
Bangladesh	0.0234	0.0239	0.0235	0.02				
Indonesia	0.0233	0.0246	0.0249	0.0356	0.03			
Thailand	0.0246	0.0259	0.0223	0.0374	0.0386	0.03		
India	0.0336	0.0334	0.0374	0.0196	0.0420	0.0489	0.01	
Vietnam	0.0112	0.0136	0.0080	0.0264	0.0256	0.0276	0.0387	0.01

Gene regulation – Total RNA was extracted in triplicate from various tissues (gill, liver, and muscle) using the Trizol® reagent according to the manufacturer's instructions. The RNA concentration (ng/µL) was measured using NanoDrop, and quality was assessed by measuring absorbance at 260/280. RNA integrity was evaluated on a 1.2% agarose gel. RNA samples underwent treatment with DNAse I to eliminate any genomic DNA contamination. Subsequently, cDNA was synthesized with a Reverted H Minus First Strand cDNA synthesis kit. Primers were designed for selected immune and stress-related genes, including heat shock protein groups (hsp70, hsp90, hsc70), caspase 3, myeloid differentiation factor 88 (MyD88), interleukin-8, Toll-like receptor (TLR 20), hypoxia-induced factor 2a, glutathione peroxidase 4 (gpx4), superoxide dismutase (sod2), catalase, mitogen-activated protein kinase (mapk12), Cytochrome P450 (CYP P450), DNA Damage (DD), and histone H3.

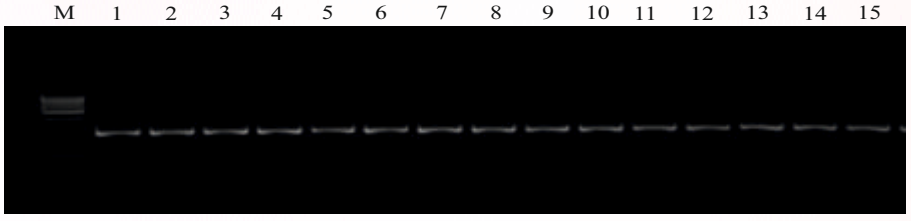
Amino Acid Analysis - Fish is a significant source of high-quality animal proteins and amino acids essential for human nutrition. The amino acid composition of *H. fossilis* and *G. guiris*, collected from Oxbow lake in Shantipur was analyzed using ultra-performance liquid chromatography (UPLC).

Molecular and Morphological Identification of Freshwater Gastropods from Wetland in West Bengal

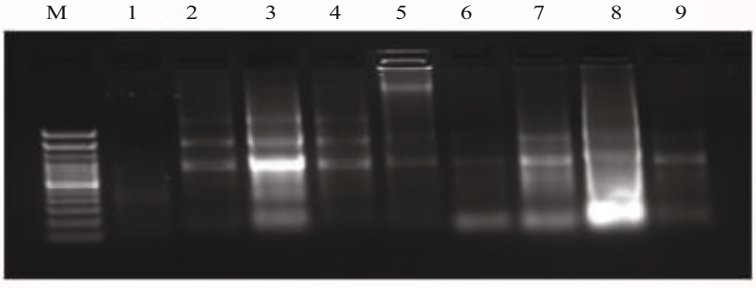
Freshwater gastropods play a crucial role in ecosystem functioning and serve as bioindicators of aquatic ecosystem health. Accurate identification through both conventional and molecular techniques is essential for understanding intraspecific variation. However, DNA barcode data for freshwater gastropods in West Bengal, India, remain unexplored. This study aims to



PCR amplification of mitochondrial ATPase 6/8 and D-loop gene of *H. fossilis* and *G. Giuris*.



Amplification of (a) D-loop region (900bp) from *H. fossilis* (Lane M- DNA Marker 100bp, Lane 1-19 are samples) and (b) ATPase6/8 (842bp) from *H. fossilis* (Lane M- DNA Marker 500bp, Lane 1-15 are samples)



RNA isolation from *H. fossilis* (Lane M- DNA Marker 100bp, Lane 1-9 are samples)

Table: Amino acid profile of *H. Fossilis* and *G. Giuris* collected from Shantipur wetland, West Bengal

AA	*H. fossilis* (g/100g of sample)	*G. giuris* (g/100g of sample)
HIS	0.012	0.011
SER	0.042	0.044
ARG	0.021	0.022
GLY	0.261	0.263
ASP	0.137	0.131
GLU	0.293	0.305
THR	0.045	0.042
ALA	0.009	0.010
PRO	0.006	0.005
CYS	0.006	0.005
LYS	0.180	0.160
TYR	0.022	0.005
MET	0.005	0.004
VAL	0.043	0.041
ISO	0.042	0.041
LEU	0.067	0.064
PHE	0.015	0.016

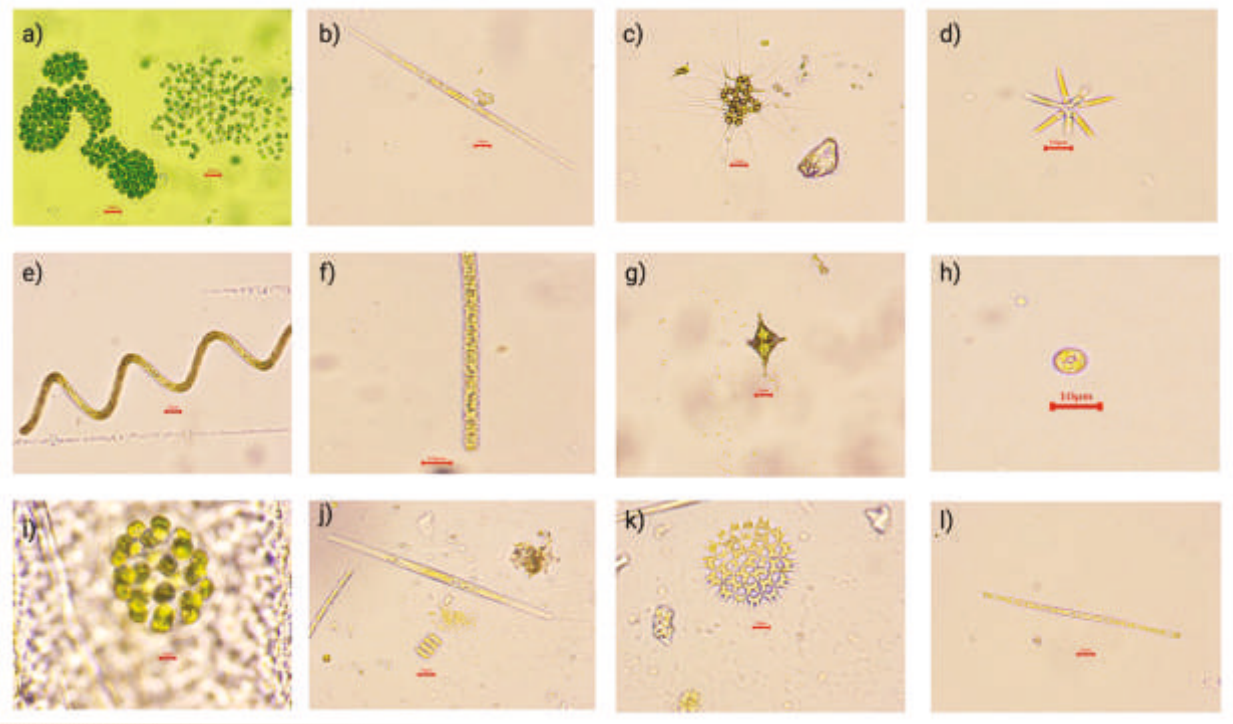
Table: Water and sediment quality parameters of Kulia and Shantipur wetlands

Water Parameters	Kulia wetland	Shantipur wetland
Water Temp. (ºC)	33.1	30.9
pH	9.51	7.58
DO ppm	5.33	5.22
Conductivity (µS/cm)	387.33	254.75
TDS (mg/L)	251.66	165.00
Chl-a (mg/m3)	11.11	20.61
Chl-b (mg/m3)	7.55	5.50
Chl-c (mg/m3)	2.70	8.74
NH4-N (mg/L)	0.09	0.17
Total P (mg/L)	0.25	0.48
Alkalinity (mg/L)	110.4	115.85

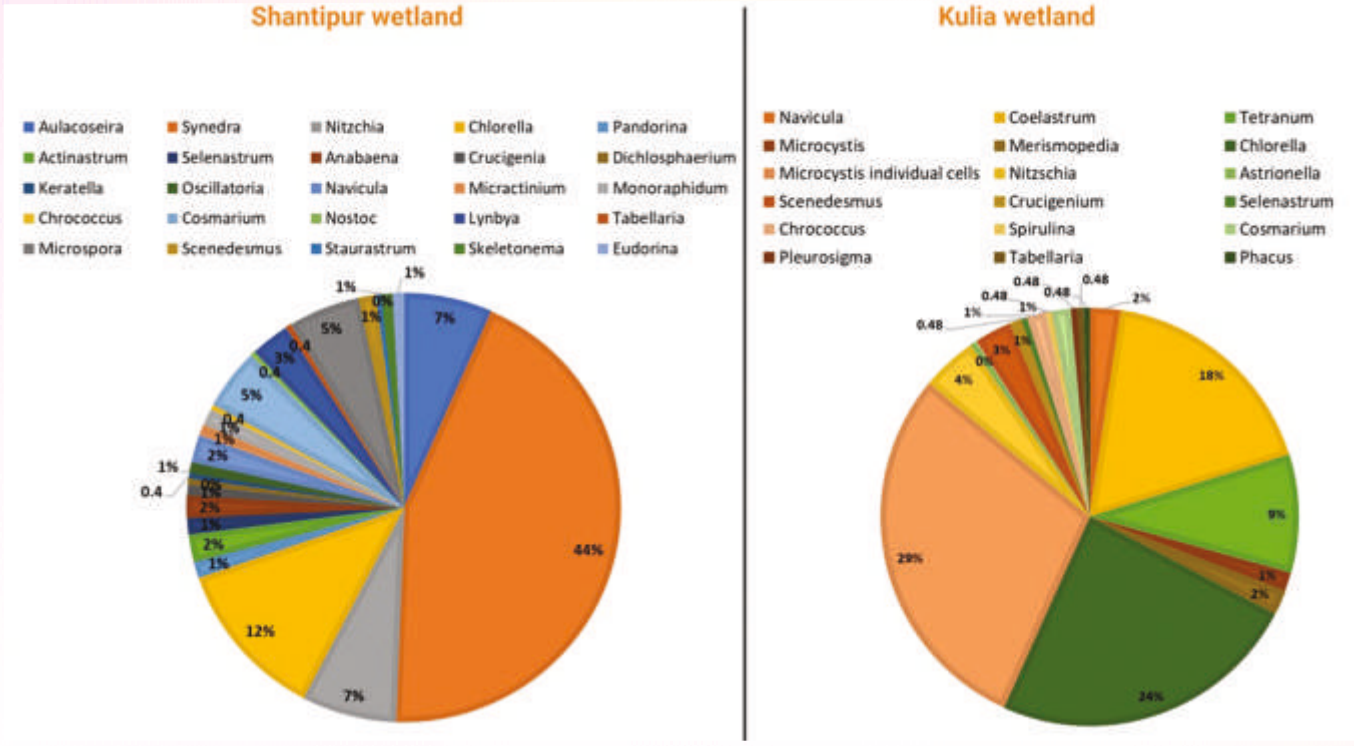
generate DNA barcodes for freshwater gastropods in the wetlands of West Bengal. A total of 76 specimens from eight species, belonging to the families Ampullariidae, Viviparidae, Thiaridae, Lymnaeidae, and Planorbidae, were identified based on morphological characteristics. Morphometric analysis revealed significant differences among species. Additionally, 48 COI barcode sequences were generated using a universal primer targeting the COI gene. The phylogenetic analysis revealed grouping of same species under a clade with bootstrap value of

Table: Level of PTEs in the water and sediment of Kulia and Shantipur wetlands

	Cr (ppm)	Mn (ppm)	Fe (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)	Cd (ppm)	Pb (ppm)
Kulia water	0.0008	0.1226	0.2792	0.0003	< BDL	0.0025	0.0402	0.0407	0.0001	0.0032
Kulia sediment	53.8527	388.3831	48967.4987	13.0731	31.7847	41.2891	140.3099	22.1081	0.3058	20.2559
Shantipur water	0.0019	0.3638	1.4565	0.0014	0.0045	0.0067	0.0638	0.0293	0.0001	0.0095
Shantipur sediment	35.4121	592.6705	42747.9407	10.4627	17.8703	26.1502	79.9106	28.2458	0.1495	8.3295



Microscopic images (40X) of microalgae species found in the water samples of both the wetlands (Kulia and Shantipur).
a) *Microcystis* sp., b) *Synedra* sp., c) *Micractium* sp., d) *Actinastrum* sp., e) *Spirulina* sp., f) *Oscillatoria* sp., g) *Staurastrum* sp., h) *Chlorella* sp., i) *Eudorina* sp., j) *Scenedesmus* sp., k) *Pediastrum* sp., l) *Aulacoseira* sp.



Pie charts show the microalgae diversity in the Shantipur and Kulia Wetlands of West Bengal, India

>60. Pair wise distance analysis indicated distinct variation among different taxa. Building a DNA barcode library is essential for species identification, confirmation and biodiversity conservation efforts as intraspecific variations in shell shape are common for some species.

Identification of Tolerant Microalgae Groups against Potentially Toxic Elements in the Wetlands of West Bengal

To identify microalgae with potential bioremediating properties against potentially toxic elements (PTEs), surveys were conducted in the Kulia and Shantipur wetlands of West Bengal, India. Water and sediment samples were collected and basic environmental parameters (APHA) and concentration of PTEs (ICP-MS) were assessed. Further, microalgae diversity in those wetlands was also analysed to find the dominant species. The recorded water quality parameters indicate that pH, dissolved oxygen, conductivity, and total dissolved solids were higher in the Kulia wetland as compared to the Shantipur wetland. However, chlorophyll-a concentration was found to be 46% higher in the Shantipur wetland which also exhibited higher phosphate and ammonia content in water. The concentration of As was found higherin the water of Kulia wetland. A microalgal diversity study revealed the presence of 18 species in the Kulia wetland, with *Microcystis* (30.7%), *Chlorella* (24.03%), *Coelastrum* (17.8%), *Tetranum* (9.1%), and *Nitzschia* (4.3%) being the dominant genera. In contrast, *Astrionella, Selenastrum, Spirulina, Pleurosigma, Tabellaria,* and *Phacus* were recorded as the least diverse species. The Shantipur wetland exhibited a greater diversity, with 25 microalgal species, dominated by *Aulacoseira* (6.6%), *Synedra* (44%), *Nitzschia* (7.1%), *Chlorella* (12%), and *Microspora* (5.4%). Species such as *Keratella, Chroococcus, Nostoc, Tabellaria,* and *Staurastrum* were found to be less diverse in this wetland.

वार्षिक प्रतिवेदन

Annual Report

2024

Project Code: FSE/20-23/05

Project Title: Socio-Economic Profile of Inland Fisheries: A Rapid Assessment

Duration: 01.04.2023 – 31.03.2024

Thematic Areas of Social Science Research of ICAR-CIFRI Since Establishment

Secondary data for the period 1950-2024 were collected from ICAR-CIFRI annual reports, research papers, bulletins and other publications) and were analysed for the study. Temporal analysis was carried out for economic parameters after they were inflation-adjusted with the help of Consumer Price Index (CPI).

The study showed that social science research was started at ICAR-CIFRI in 1970 with the project 'Economics in fishery investigations'. Till 2024, 150 research activities on social sciences were done. Initially the focus was on conventional economic analysis of pond culture. In the 1990's and first decade of 2000's the socio-economic profiling of the fishers, institutional arrangement, governance, ICT started replacing the conventional economic analysis. In the last decade focus on production economics was further reduced and livelihood analysis, impact assessment, climate change institutional arrangement, governance, gender analysis, environmental economics, and ITK grabbed the researcher's attention.

Study of resource-wise distribution of social science research of ICAR-CIFRI showed that in the 1970's and 1980's majority of the social science research was concentrated on ponds. Other resources, mainly wetlands replaced the ponds in the 1990's, and 2000's. In the last decade rivers, estuaries, wetlands, got significant share.

Table: Share of different regions in social sciences research of ICAR-CIFRI (% of total)

Year	Eastern	North eastern	Southern	Western	Northern	Central
1970-1990	93.75	6.25	6.25	6.25	6.25	6.25
1990-2010	70.00	25.00	7.50	2.50	10.00	5.00
2010-2023	72.34	30.85	17.02	13.83	15.96	12.77
Overall	74.00	26.67	13.33	10.00	13.33	10.00

Regional Distribution of Social Science Research of ICAR-CIFRI

In the 1970's and 1980's majority of the social science research was concentrated in the Eastern region of the country. Gradually other regions gained importance, specifically the north-eastern region. In the last decade all the regions got around 13-17% share except north eastern which gets 31% activities.

Temporal Analysis of Economic Returns from Fishery Enterprise

Attempt was made to analyse the economic returns of pond culture of IMC in 2021 as compared to 1974. IMC culture in West Bengal gave a net return of ₹6238 to ₹26787 in 1974. When inflation adjusted, the values of 1974 in 2021 become ₹1,64,116 to ₹7,04,744. In 2021 the farmers received a net return of ₹22200 to ₹586183. Hence, they are not better off in 2021. The farm gate prices also are lower than what should have been as compared to those of 1974's. Similar to West Bengal, the Andhra Pradesh farmers also got comparable less return. The farm gate price was also less than what should have been in this state.

Similar analysis in reservoir fisheries showed that fishing in reservoir of Gujarat gave net return of ₹935 per fisher per year in 1984. The same during 2021 was found be ₹12,913. When inflation adjusted, the values of 1984 become ₹12,972 in 2021. Hence, in Gujarat the fishers remain in same economic condition. On the other hand, the Andhra Pradesh reservoir fishers are better-off as the net return is more than the trend. However, the farm gate prices are significantly lower than what should have been as compared to those of 1984's. Fishing in wetlands in West Bengal gave net return of ₹4185 per fisher/ year in 1988-89; the same during 2021 was found be ₹81,565. When inflation adjusted, the values of 1988-89 in 2021 become ₹41,676. The Assam fishers are also better off as the net return has increased over time. The farm gate prices are also significantly higher than what should have been as compared to those of 1988's.

In riverine fisheries the study was conducted taking Subansiri river (Sarmah, 1996) and input cost study of ICAR-CIFRI involving Brahmaputra and Kolong river of Assam in 2021. As compared to 1996 in 2021, the literacy rate was higher (3.5% as compared to 2.3%), average household size became lower (4.9 as compared to 5.8). The average income was ₹76,700 the value of which is ₹3,72,527 at present time. While the actual income was found to be ₹1,87,528 in 2021. Hence the riverine fishers are worse off in 2021 as compared to 1996.

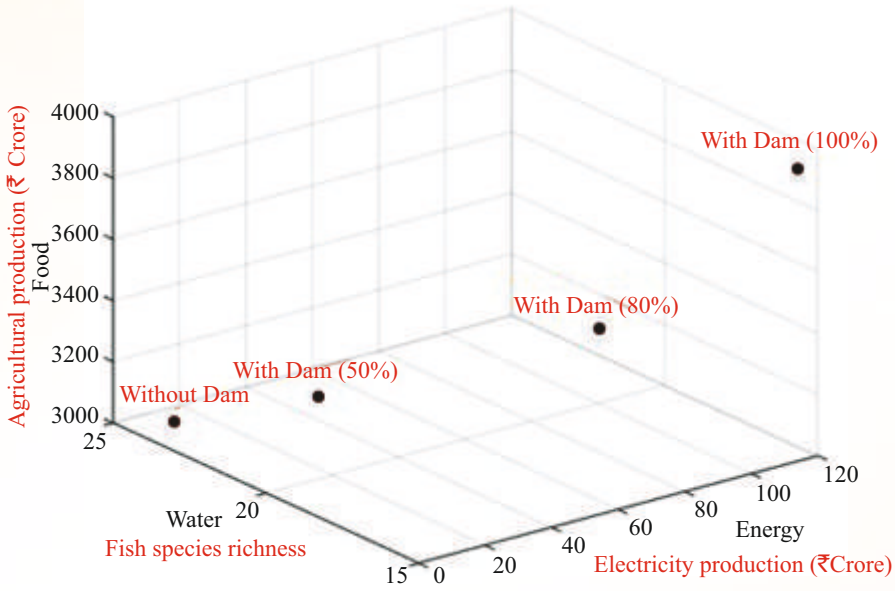
Project Code: FSE/20-23/06

Project Title: Investigating the Feasibility of the Food-Energy-Water Nexus in the Cauvery River Basin

Duration: 01.04.2023 – 31.03.2024

The flow regime of rivers, shaped by topography, land cover, climate, human activities, etc. plays a crucial role in governing ecosystem services. In recent decades, rising water demand and significant investments in water infrastructure have led to substantial hydrological alterations of rivers. Large-scale hydropower projects, while providing economic benefits, often entail complex trade-offs involving ecological, social, and environmental impacts. This study employs hydro-economic modeling to assess the trade-offs between agricultural production, hydropower generation, and fish species richness across different dam operation scenarios.

The analysis considers four scenarios: without a dam, and with dam operations at 50 %, 80 %, and 100 % capacity. In the absence of a dam, fish species richness is the highest at approximately 25, agricultural production is around 3000 tonnes, and there is no electricity generation, suggesting better biodiversity preservation but limited economic benefits. In contrast, operating the dam at 50 % capacity results in a slight reduction in fish species richness, an increase in agricultural production to about 3200 tonnes, and moderate electricity generation, indicating a balanced approach with moderate trade-offs. At 80 % capacity, fish species richness decreases further, agricultural production remains stable at around 3200 tonnes, and electricity production rises significantly, highlighting a shift towards maximizing economic returns from hydropower at the expense of biodiversity. The scenario with the dam at 100 % capacity shows the lowest fish species richness, the highest agricultural production at about 3400 tonnes, and the maximum electricity generation, emphasizing substantial economic benefits but at the cost of severe ecological impacts.



Trade-off analysis of fish species richness, agricultural production, and electricity generation under different dam operation scenarios

This trade-off analysis underscores the need for careful decision-making that balances the benefits of hydropower and agricultural production against the potential loss of biodiversity. It highlights the importance of adopting sustainable development practices that seek to optimize multiple objectives, ensuring energy security, biodiversity conservation, and economic well-being.

Project Code: FSE / 20-23 / 04

Project Title: Sustainable Inland Fisheries Development Pathways to Ensure Sustainable Development Goals

Duration: 01.04.2020 – 31.03.2025

Sustainable Reservoir Fisheries Management to Address SDG 1, SDG 2 and SDG 8

The area of Baghua reservoir in Odisha is 122 ha where culture-based fisheries is practiced through pen culture with the support of the institute. Pens and gill nets were provided to the fishers of the Primary Fisheries Co-operative Society. Socio-economic surveys showed that the majority of fishers (57.14%) belonged to SC Category and 85.71% fishers were in BPL category. The average age of fishers was 49.17 years. Primary education was attained by 71.43% fishers. Fishing

was the primary occupation of 62.15% fishers along with agriculture (28.57%), fish vending (9.25%), daily wage labourer (32.13%) and Govt. pensioners (0.03%) as secondary occupation. The average monthly household income was ₹ 11,500. Pucca houses were owned by 42.86% fishers and mud-thatched housing was possessed by 57.14% fishers. The fish catch was disposed off at local markets and local vendors and wholesalers purchased the harvest.

The institute carried out production enhancement through *in-situ* fish seed raising in pens. The production of the Baghua reservoir was 7 tonnes before the intervention which increased to 21 tonnes in the first year. Three lakh fish seed were released in the pen for *in-situ* raising of fish seed in the reservoir. It is estimated that the fish seed stocked has helped in achieving an additional 14 ton from the reservoir with an additional income of Rs. 16.80 lakh.



Puntius sarana



Seeds of *Puntius sarana*

Small Indigenous Fish to Attain SDG 12 and SDG 13

A total of 288 kg of climate resilient fish species *Puntius sarana* seed (Average 04.71±00.2g)were stocked in two CIFRI HDPE-pen systems in Garapota beel as part of the sustainable fishery enhancement initiative. Additionally, 4 tons of fish feed were distributed to support their growth. Over three months, the fishes were carefully reared in these pens under controlled conditions, ensuring optimal growth (Average 43.77±13.38g) and health. Once the fish attained a stable size, they were released into the wetland as a measure to support conservation efforts which will help in sustainable production and consumption.

Small Indigenous Fishes (SIF) for Nutritional and Livelihood Security in Inland Open Waters

Wetlands and small reservoirs provide a suitable breeding habitat for Small Indigenous Fishes (SIF), making them an important resource for fish production. Due to its self-recruiting capacity in wetlands and small reservoirs, SIFs play an important fishery in these water bodies. The role of SIFs in wetlands and small reservoirs is significant, contributing 10-20% of the total fish catch in selected wetlands and small reservoirs of West Bengal and Odisha. The most common SIFs including *Amblypharyngodon mola*, *Chanda nama*, *Puntius* spp., and *Salmophasia* spp., are naturally breeding in these ecosystems and do not require external seed stocking for production of these species.

SIFs are rich in essential nutrients and are primarily used for household consumption, providing food security to local fisher communities.



Status of SIF in inland open waters



SIF catch from inland open waters

Fishery of SIFs is a type of small-scale fisheries which play an important role in providing both livelihood and income to the local fishers.

However, these self-recruiting species face multiple issues including habitat degradation, pollution, over exploitation, jute retting, climate change, and other anthropogenic activities which has drastically impact the diversity and abundance of these species in wetlands and reservoirs. These issues pose conservation challenge, as the decline of these species can have a severe impact on both fisheries and aquatic ecology and the livelihoods of communities.

Integrating Economic, Ecological and Cultural Values of Oxbow Lakes to Attain SDG1, SDG 2, SDG 13, SDG 14 and SDG 15

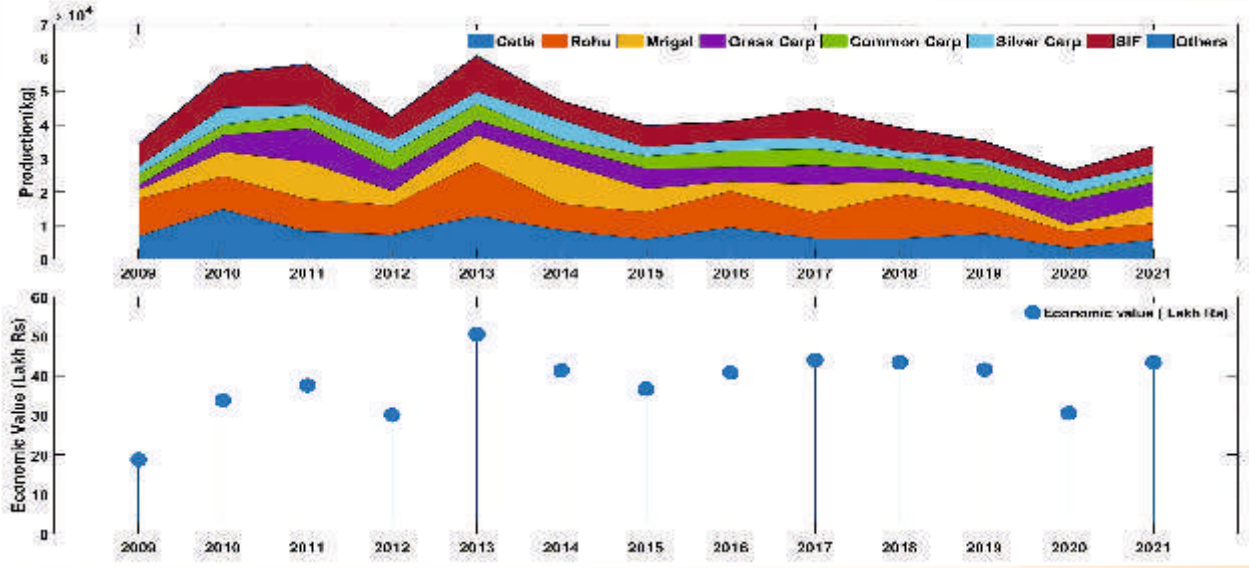
Hydrological connectivity between rivers and oxbow lakes plays a pivotal role in maintaining ecosystem function, biodiversity, and sustainable livelihoods. In the Gangetic plains, oxbow lakes are vital socio-ecological systems, directly impacting the livelihoods of surrounding communities. Beledanga oxbow lake, located in the lower Gangetic basin and connected to the Ichamati River, exemplifies the ecological and socio-economic importance of such wetlands. This study highlights the significance of preserving vital resources.

Using the Millennium Ecosystem Assessment (MEA) framework, the study evaluated the provisioning, regulating, cultural, and supporting services of Beledanga lake. The provisioning services include fisheries, which contribute an average annual fish yield valued at ₹ 37.89 lakhs and agriculture, generating ₹ 65.2 lakhs annually. The hydrological link between the lake and the Ichamati River is vital for nutrient flow, fish migration, and irrigation support, benefiting 5,235 individuals engaged in agriculture and 3,850 individuals in fisheries.

The lake also plays a key role in regulating services, such as carbon sequestration and bioremediation. Though relatively small in extent, oxbow lakes like Beledanga capture and store carbon in sediments, helping mitigate climate change. Aquatic plants such as *Eichhornia crassipes* and *Lemna* sp. aid in bioremediation, removing heavy metals and organic pollutants from water. The Ecopath model revealed complex food-web dynamics, showcasing the lake's high ecological productivity and its role in sustaining biodiversity.

Supporting services are evident through the lake's contribution to fish biodiversity, with 36 fish species identified, including 19 small indigenous species (SIFs) that serve as vital food sources and support local fish populations. The surrounding floodplains act as breeding and nursery grounds, ensuring a steady supply of fish and contributing to the ecological resilience of both the lake and its connected river system. Cultural services of the lake enhance community well-being through religious rituals, festivals, and recreational activity like bird watching. These cultural interactions reflect the deep socio-ecological connection between communities and the lake, further strengthening its conservation value.

Despite its importance, Beledanga wetland faces several challenges, including seasonal water scarcity, macrophyte infestation, sedimentation, and link channel closures, which disrupt the hydrological link with the Ichamati River. This has led to a reduction in



Year-wise yield and economic value of major fish species harvested from the Beledanga oxbow lake (Source: Beledanga Fisheries Cooperative Society)

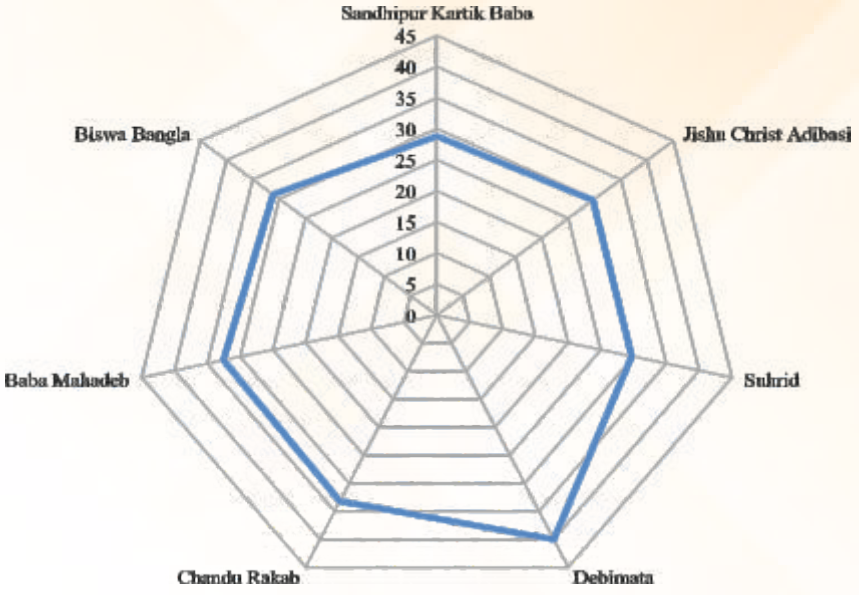
the lake's area from 65.15 hectares in 1980 to 46.0 hectares in 2020, affecting fish diversity and overall productivity.

To address these challenges, the study advocates for collaborative management, involving local stakeholders in developing water budgeting strategies and removing macrophytes using MGNREGA funds. Continuous river-lake connectivity will enhance nutrient flow, support fish populations, and secure critical ecosystem services for future generations.

From a policy perspective, recognizing river-lake connectivity can shape more effective water management and wetland conservation strategies. Integrating the economic, ecological, and cultural value of oxbow lakes into planning aligns with several SDGs, particularly those related to poverty reduction (SDG 1), food security (SDG 2), climate action (SDG 13), and life on land and below water (SDGs 14 and 15). Strengthening community involvement and promoting sustainable practices are essential steps toward achieving these goals.

Role of SHGs to Attain SDG 1 & SDG 2

Self-Help Groups (SHGs) have the potential of providing self-employment opportunities and enhancing livelihoods there by reducing the poverty. A study was conducted among the fishery-based Self-Help Groups (SHGs) in Birbhum district, West Bengal, with the aim to assess the group dynamics of self-help groups and the economic viability of community-based fish farming. Data were collected from eight different SHGs, comprising a total of 80 SHG members, through structured interviews and data were analyzed using inferential statistics. Socio-economic profile of the respondents reveals a significant involvement of the younger generation in SHGs (50%) and highlights diversified occupational engagements within these groups. Correlation analysis indicates that variables such as education and family size were positively correlated with income, Cost-return analysis shows promising results for fish farming, as benefit-cost ratio for overall SHG's was found to be 1.35 when self-consumption is not considered and 1.15 including self-consumption. Furthermore, the analysis of group dynamics using the Group Dynamics Effectiveness Index (GDEI) suggests opportunities for improvement in areas such as group atmosphere and gender differences. ANOVA results indicate significant differences in group dynamics among SHGs.

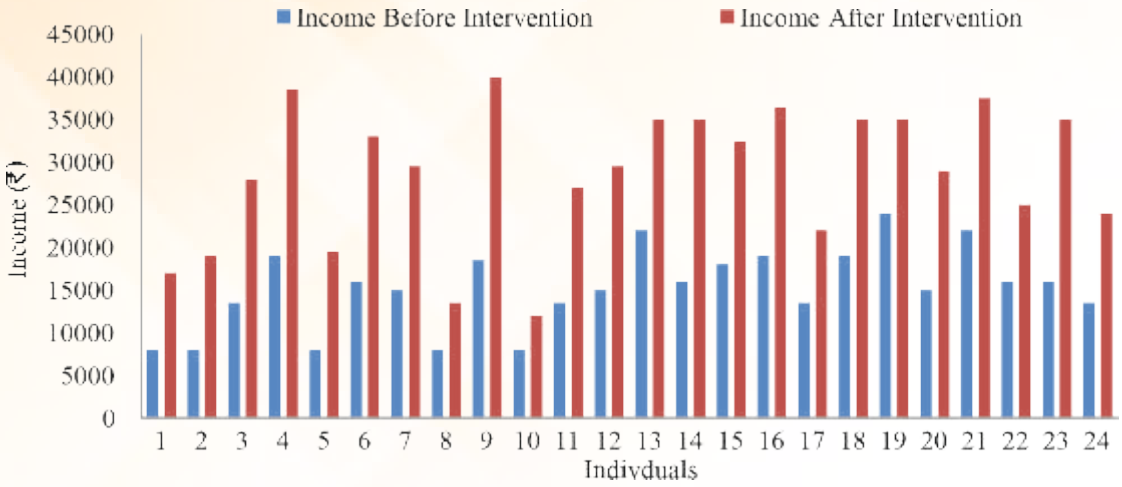


Group Dynamics Effectiveness Index (GDEI) score of Self Help Groups

Small-Scale Aquaculture Initiatives in Rainfed Water Bodies of Sundarbans for Attaining SDG 5

Small-scale aquaculture plays a pivotal role in the economies of rural communities, especially in the biodiversity-rich region of the Sundarbans. By efficiently utilizing local resources and family labor, it generates wealth, diversifies livelihoods, and fosters social harmony. In the Sundarbans, women are integral to the aquaculture value chain as they engage themselves in various activities which include the stocking of ponds, feeding fish, managing pond ecosystems, and harvesting fish. ICAR-CIFRI has recognized the crucial role of women in this sector and has actively supported their participation through training and demonstration projects aimed at enhancing their economic and social empowerment.

The role of women in small-scale aquaculture and impact of ICAR-CIFRI intervention in the Sundarbans area of West Bengal was studied involving 122 women from 10 villages, including Amjhara, Charavidya, Goranbose, Gaurdaspara, Masjitbati, Phulmalancha, Pochapara, Ramchandrakhali, Uttarmokamberia, and Uttarsonakhali. The study reveals that women beneficiaries, with an average age of 40.6 years, have achieved secondary level of education and are intensively involved in small-scale aquaculture activities. Their tasks include stocking of ponds, feeding of fish, pond management, fertilization, and liming, with some also engaged in ornamental fish breeding under ICAR-CIFRI's initiative. The



Income comparison before and after ICAR-CIFRI's intervention

average income from fish production nearly doubled following CIFRI's intervention, representing a substantial increase in economic returns for the community. This underscores the critical impact of empowering women in the aquaculture sector.

Distribution of Income across SHGs

Source-wise income data of the 8 SHGs of Sriniketan, Suri II and Illambazar blocks of Birbhum district were analysed. The name of the SHGs are:Sandhipur Kartik baba, Jishu Christ Adibasi, Suhrid SHG, Biswa Bangla, Kalamuddin, Baba Mahadev SHG, Chandurakab SHG, Debi Mata SHG.A total of 80 members were selected from these 8 SHGs to collect the data. Among the selected members 29 were male and 51 were female and 42.5% and 51.5% were SC and ST, respectively.

The Table shows that the average income was Rs. 66,775 ranging from Rs. 53,360 in labour-based profession to Rs. 83,000 in business-based profession. Fishery-based households earned Rs. 73045 per year which is third highest among all the profession. The income was higher for the fishers whose primary occupation was business and skilled trade like masonry, carpentry. However, the income differences are not statistically significant.

The SHG-wise income distribution shows that Sandhipur Kartik Baba and Biswa Bangla were the two SHGs giving maximum income to their members.

Income Distribution

The Gini Coefficient (GC) was applied to measure the income inequality. In this index higher the value of GC, the greater is the degree of inequality. The Ginni Coefficient of the income of the present study as estimated to be 0.08. In another study in Chilika (Pandit et al., 2024) it was seen that the GC was much lower in fishing income (0.23) than those of fishery (0.87) and non-fishery income (0.73). Other researchers like Radhakrishnan et. al. (2017) also supported this. Hence, the income is more homogenous and equitable in fishery than the other sources of income.

Primary occupation-wise annual income of the SHG members

Primary occupation	₹
Fishery	73045
Skilled trade	80000
Business	83000
Labour	53360
Agriculture	62667
Pvt job	60000
Average income	66775

SHG-wise annual income (Rs.) of the fishery-based households

SHG	₹
SandhipurKartik Baba	170000
Jishu Christ Adibasi	66000
Suhrid	65900
Debimata	71000
Baba Mahadeb	60000
Kalamuddin	51300
Biswa Bangla	99333
Average	73045

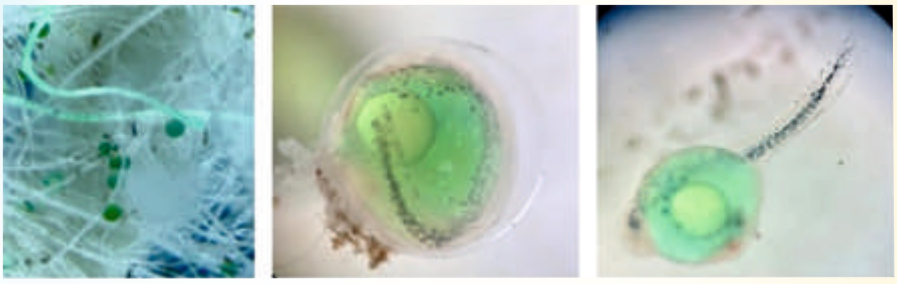
Project Title: Breeding of Indigenous Fish Species of Ornamental Value from West Bengal and Assam

Breeding of First Generation of Captive Bred *Macrognathus aral*

Captive bred One-stripe spiny eels (*M. aral*) were successfully raised in captivity and their maturation was attained in controlled conditions. The successful captive breeding to produce second generation with better survivality was achieved. The brooder fish were injected with synthetic hormone Spawn Pro (SGnRH +Domperidone), at the base of the pectoral fin at 45° angle @ 0.04 ml/kg body weight and @ 0.03 ml/kg body weight for female and male, respectively in three different sets. Tanks were provided with nylon threads and the eggs were found attached to it. Males and females encircled themselves during courtship. The eggs were round in shape, green in colour and found attached to the nylon threads. Highest hatching rate was obtained in set-I 55.73% followed by 46.15% in set-II whereas in Set-III no hatchlings were found. The yolk absorption was achieved 3rd day post hatch and larvae started accepting artificial feed 4th day onwards. Two batches of the larvae survived and at the end of 3 months, larvae attained a length of 6.3-7.8 cm.



M. aral breeding pair of F1 generation



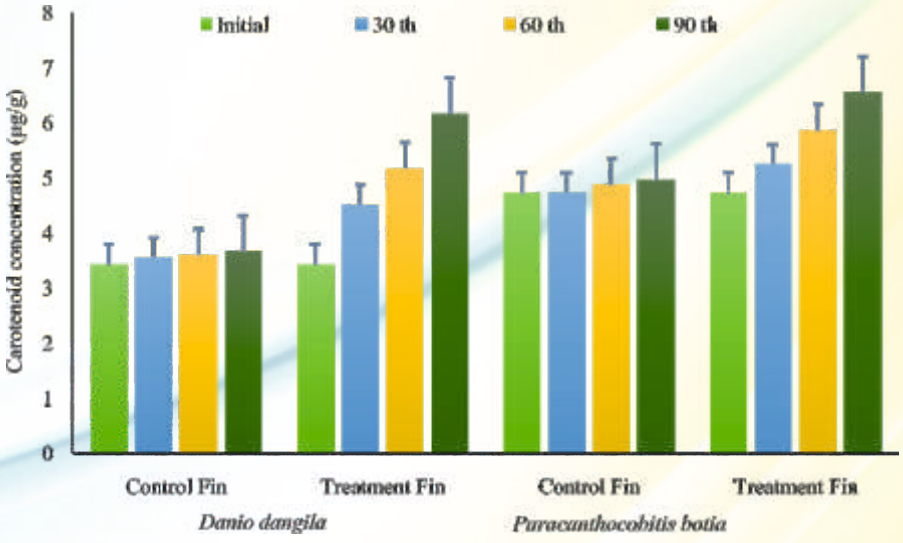
Larval developmental stages of *M. aral* (F2 generation)

Table: Proximate composition and carotenoid analyses of papya based diet

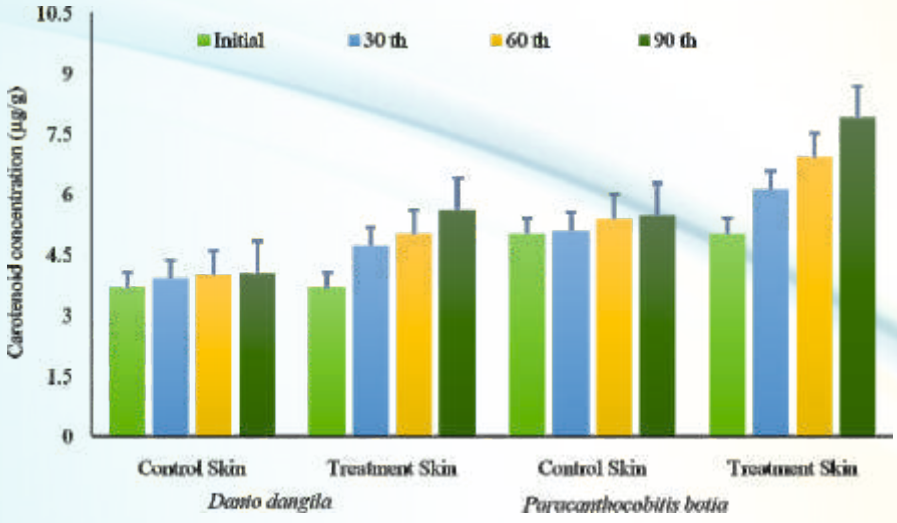
Ingredients	Control	Treatment
Moisture (%)	7.84±0.03	7.89±0.03
Crude protein (%)	30.12±0.02	30.23±0.02
Crude fat (%)	8.14±0.01	8.43±0.01
Crude fiber (%)	6.32±0.02	6.87±0.03
Total Ash (%)	11.46±0.02	12.14±0.02
Carotenoids (mg/g)	--	3.57±0.03

Effect of Papaya Based Dietary Supplementation on *Danio Dangila* and *Paracanthocobitis botia*

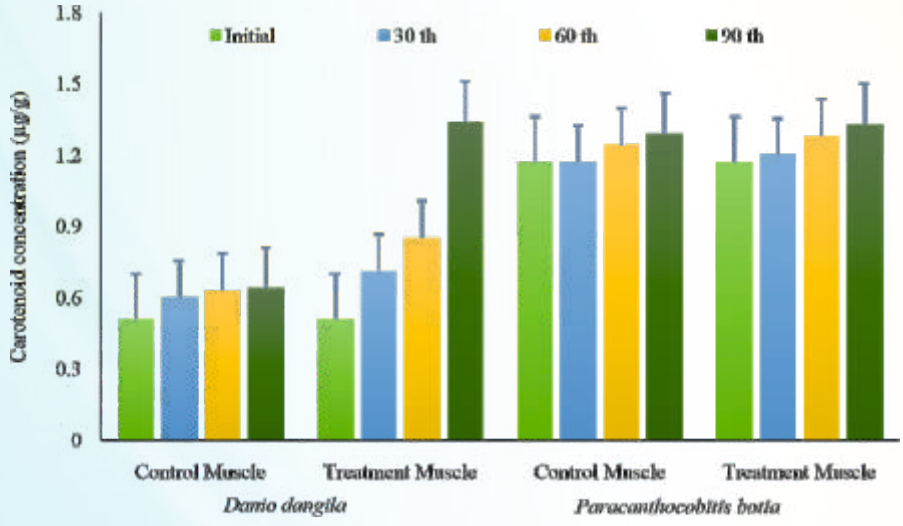
The rising popularity of ornamental fish in global trade highlights their aesthetic and economic value. However, prolonged captivity often leads to colour loss due to the lack of natural food sources, as aquatic animals cannot synthesize carotenoids. Supplementing fish diets with natural or synthetic carotenoids is essential to maintain vibrant coloration, enhancing the market value of indigenous species. Carotenoid pigments like β-carotene, abundant in papaya pulp powder, play a vital role in fish pigmentation.



Carotenoid concentration in fin of *Danio dangila* and *Paracanthocobitis botia*



Carotenoid concentration in skin of *D. dangila* and *P. botia*



Carotenoid concentration in muscle of *D. dangila* and *P. botia*



Captive maturation of *Nandus nandus* in planted aquarium mimicking natural environment

Papaya also contains lycopene, thiamine, riboflavin, niacin, amino acids, and organic acids, contributing to color modulation and improved feed conversion, growth, and survival rates. An experimental diet comprising 30.23% crude protein, 8.43% crude fat, 6.32% crude fiber, and 3.57% carotenoids was fed to fish twice daily until satiation. Carotenoid concentration was analyzed using Olson's (1979) method, measuring optical densities at 380, 450, 475, and 500 nm with a spectrophotometer.

Successful Maturation of *Nandus nandus* in Indoor Aquarium

Nandus nandus, the Gangetic leaf fish, holds significant aquaculture potential due to its adaptability and nutritional value. However, captive rearing is challenging due to cannibalism and low food acceptance, especially in plain glass tanks. Two experimental setups - a plain tank with hideouts and a planted tank mimicking a natural habitat - were tested. Fish (7.2 - 10.3 cm, 7.1 - 12.8 g) were introduced under controlled water conditions. Over three months, fish in the planted tank exhibited superior growth (11.3 cm, 15.7 g), reduced disease occurance, and improved feed acceptance. The planted setup enhanced coloration, minimized fin rot, and reduced cannibalism. Captive maturation was successfully achieved in six months, confirmed by the presence of oozing milt in males and eggs in females.

Domestication and Collection of Brood stock of Assamese Snakehead, *Channa stewartii*

Endemic Assamese/golden snakehead *Channa stewartii* were collected from wild, acclimatized and kept in cemented cistern of 100 liters of water with mud bottom, provided hideouts and aquatic vegetation. A total of 12 pairs of *C. stewartii* were kept in the system for breeding purpose. The brooders are acclimatized for three months and fed

with live feed, small fishes, worms, etc. Water quality parameters were found to be suitable for breeding and culture of the fishes such as temperature 26-27°C, pH 7.3-8.2 and dissolve oxygen 5.5-6.2 mg/l. In the breeding season, mature males were seen to develop nuptial tubercles in the pectoral fins, which appear as hard white pimples about a size of pinhead. In males, milt oozes out when slightly pressed whereas females are having swollen stomach, eggs oozes with slight press in stomach. The mature brooders were transferred in a pond for natural breeding.



Stewartii male brooder with nuptial tubercles at the pectoral fins



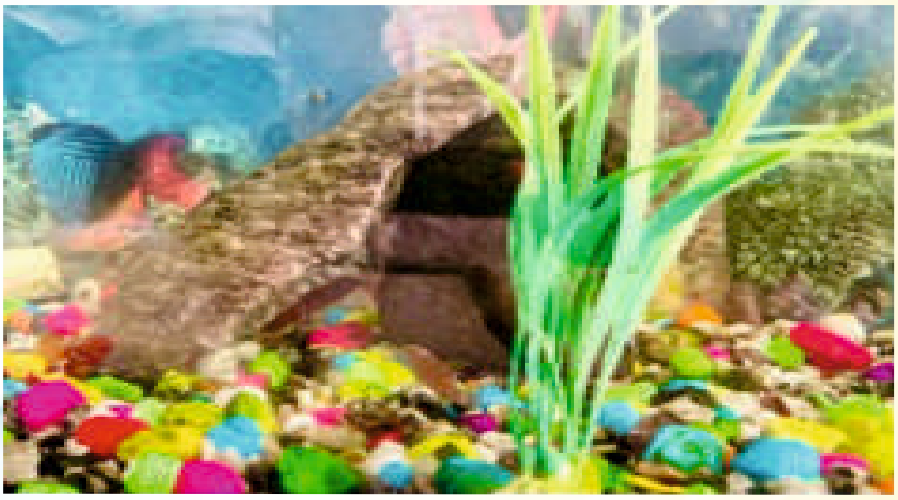
Sewartii female brooder with swollen stomach

Natural Breeding of *Badis blosyrus* in Captive Condition for Second Consecutive Year

The brooders of indigenous dwarf chameleon fish (*Badis blosyrus*), collected from Brahmaputra tributaries in Kamrup, Assam were successfully bred for the second consecutive year in captivity. After two months of acclimatization in glass tanks, courtship behavior was observed in March-April. A breeding pair was transferred to an FRP tank with pebbles, plants, and hideouts under controlled water conditions (20-28°C, pH 7.0, DO 6-8 mg/l). Spawning was observed during the month of June, with males guarding eggs for 10 days. Hatching occurred within 2-3 days, but survival was low (10-20%) spawn to fry due to size heterogeneity and cannibalism.



Brooders of *Badis blosyrus*



Cave spawning behaviour of *B. blosyrus*

Market Dynamics and Demand Trends of Ornamental Fish in Kamrup District, Assam

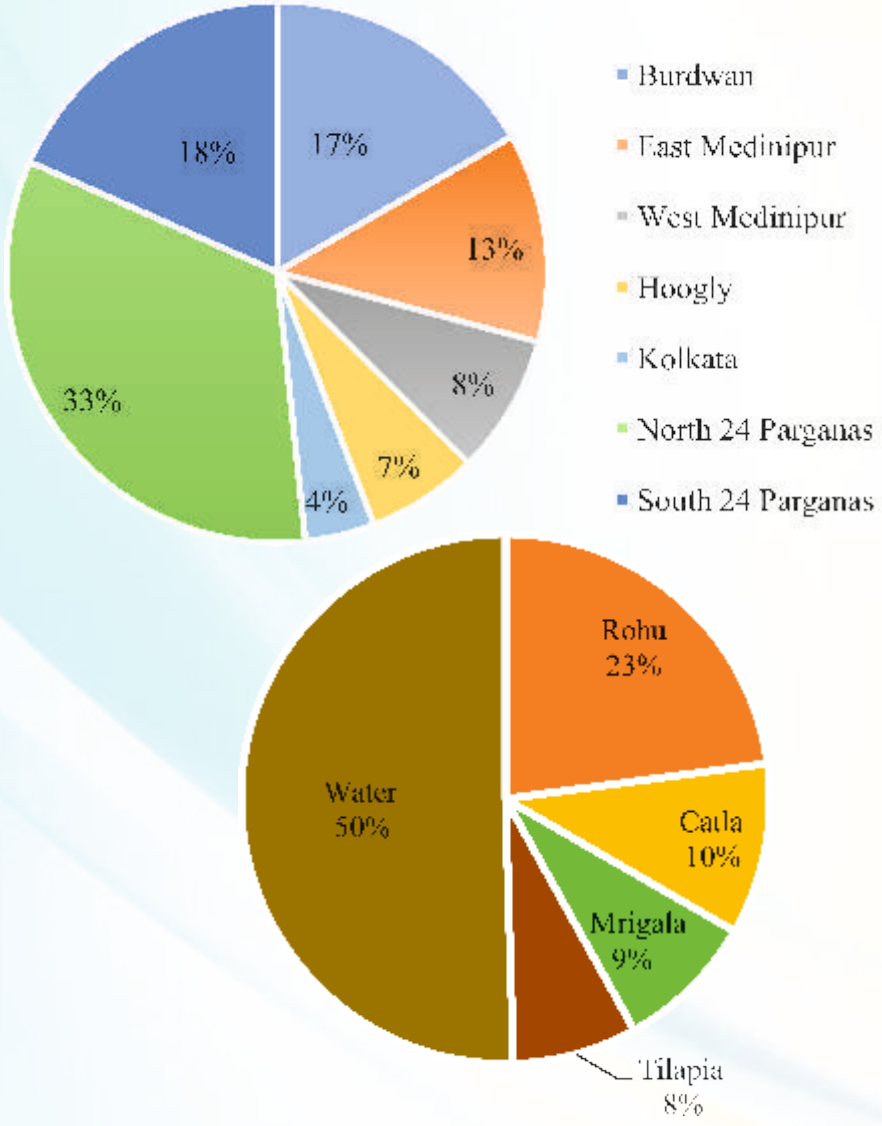
A market survey in Kamrup district, Assam, revealed the growth of the ornamental fish industry over the past decade. Demand for both indigenous and exotic species has increased, with over 80 species sold locally. Exotic species like goldfish and arowana are imported, while indigenous species such as Gourami and Barbs are sourced locally. Demand for *Channa*

Table: Decadal shift in ornamental fish market in Kamrup district

Particulars	2010 - 2015	2022 - 2024
Aquarium stores	5-10	30-40
Most demanding fish species	Gold fish, Angel fish	Gold fish, Angel fish, tetra, live bearers, fighter fish, koi carp
Price of most demanding fish	₹50-60 per pair	₹150-250 per pair
Most demanding indigenous fish species	Barbs, gourami	Barbs, gourami and endemic snakeheads
Price of indigenous ornamental fish species	₹20-200 per pair	₹50-2000 per pair

species has risen sharply, with prices increasing from ₹50-60 (2010-2015) to ₹150-250 (2022-2024). The number of aquarium stores has also grown. Sustainable practices, native species conservation, and improved supply chains are crucial for economic and environmental balance.

Project Title: All India Network Project on Antimicrobial Resistance in Fisheries and Livestock



Details of samples collected from different districts of West Bengal and fishes

All India Network Project on Antimicrobial Resistance (AMR) in Fisheries and Livestock was initiated to systematically monitor, assess, and mitigate AMR in animal husbandry and aquatic ecosystems across India during 2024 for a period of three years upto 2027. This project, implemented under the support of the Indian Council of Agricultural Research (ICAR), aims to generate scientific data on AMR patterns, identify risk factors contributing to antimicrobial resistance, and develop strategies for responsible antimicrobial use in aquaculture practices.

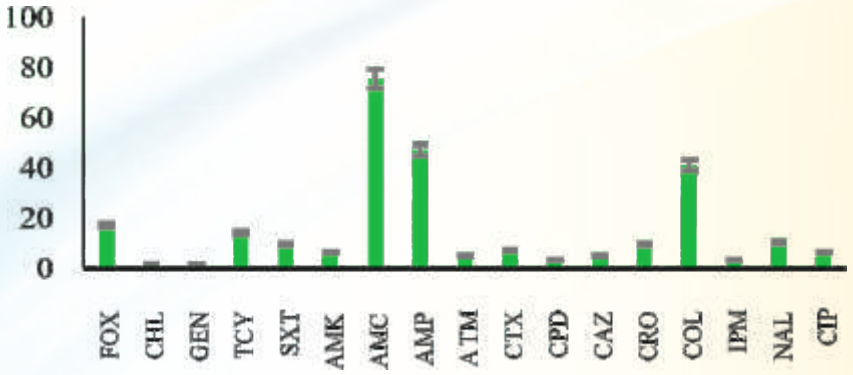
During 2024, a total of 66 farms consisting of 66 fish species and 66 water samples were studied for understanding the AMR pattern in *Escherichia coli*, *Aeromonas* sp., and *Staphylococcus* sp.by AST and molecular methods. A total of 120 *E. coli*, 116 *Aeromonas* sp., and 68 *Staphylococcus* sp. isolates were identified from nine districts of West Bengal, including North 24 Parganas, South 24 Parganas, Hoogly, Howrah, Malda, Murshidabad, Kolkata, Burdwan, and East and West

Medinipur, focusing on Rohu (53%), Catla (16%), Mrigal (27%), and Tilapia (4%).

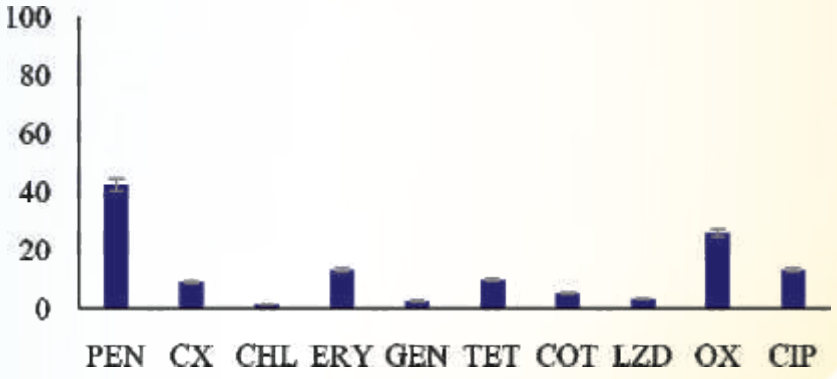
In the phenotypic resistance study, notable resistance to frequently used antibiotics such as tetracyclines, fluoroquinolones, and beta-lactams were documented. *E. coli* exhibited over 75% resistance to Amoxyclave (AMC), while *Aeromonas* demonstrated a higher resistance of nearly 46% to Ampicillin/Sulbactam (SAM) and 24% resistance to Cephalexin (CEP). Additionally, *Staphylococcus* sp. showed more than 42% resistance to Penicillin. Among the 68 *Staphylococcus* isolates, 5 were identified as *Staphylococcus aureus* through the nuc gene, while the remaining isolates were categorised as coagulase-negative *Staphylococcus* (CONS).

Among 120 *E. coli* isolates, 88 were positive for beta-lactamase production. Within this group, 62 isolates tested positive for the TEM gene, 10 isolates for the CTX-M gene, and 22 isolates for the SHV gene. Among the 116 *Aeromonas* isolates, 59 exhibited positive results for beta-lactamase production. Specifically, 42 isolates tested positive for the blaTEM gene, 8 isolates for the blaCTX-M gene, and 17 isolates for the blaSHV gene.

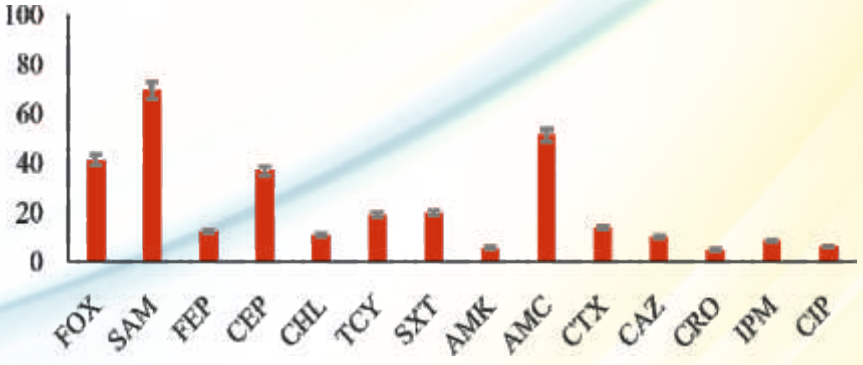
A series of awareness programs on AMR were conducted across different regions to inform farmers, fishermen, and industry stakeholders about the future health impacts of AMR. The aim was to enhance public understanding of AMR's effects on food safety and human health, as well as to encourage responsible use of antimicrobials in fisheries and livestock. Organized five awareness sessions focused on antimicrobial resistance, during which information



Phenotypic % of resistance in *E.coli*



Phenotypic % of resistance in *Staphylococcus* sp.



Phenotypic % of resistance in *Aeromonas* sp.

booklets, posters, and pamphlets were distributed. The AMR Awareness Week 2024 marked a significant advancement in advocating for responsible antibiotic usage in fisheries and livestock. During the period, more than 1000 fishermen, students and research faculties from different organisations were brought under discussions and interactions on AMR.



Awareness Programme on AMR for the farmers from Bihar in ICAR-CIFRI

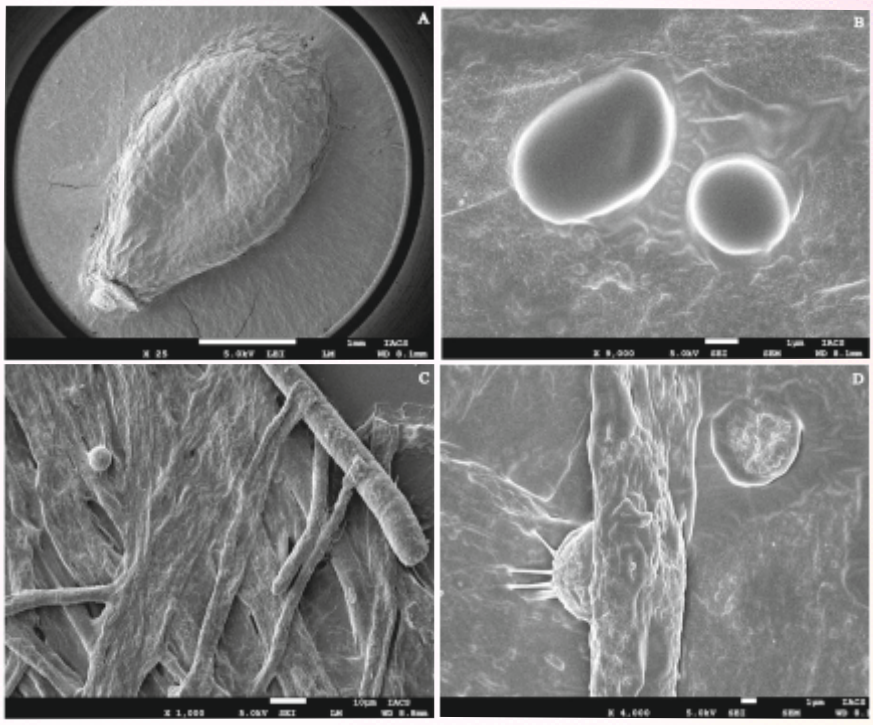


Awareness Programme on AMR for the farmers in Hasnabad, West Bengal

Project Title: All India Network Project on Fish Health

Identification of Fungal Pathogen in *Pangasianodon hypophthalmus*

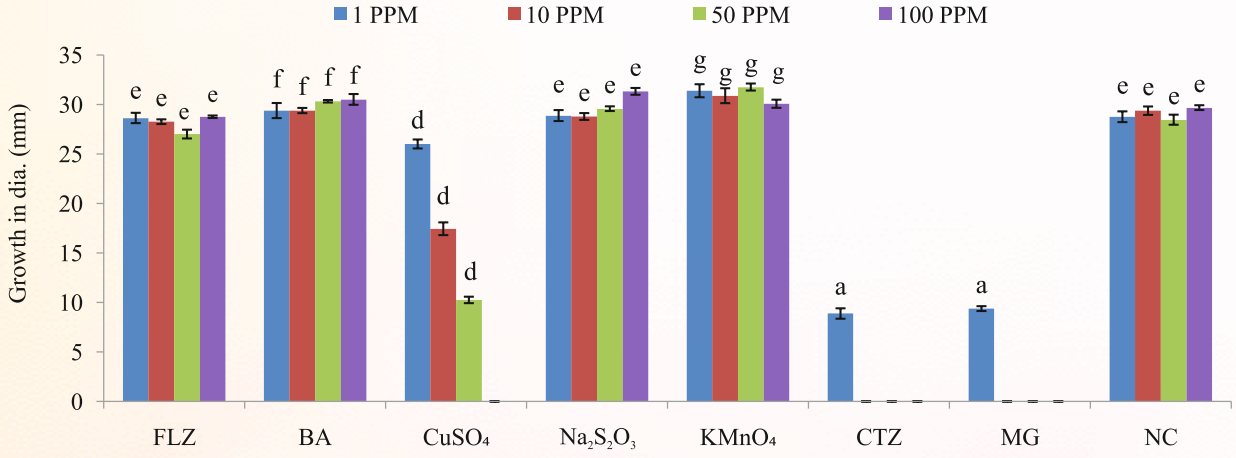
Pangasianodon hypophthalmus contributes about 50% to the global catfish production, but suffers from heavy mortality due to saprolegniasis. A study was conducted to isolate and identify the causative agent of saprolegniasis through culture techniques, and study of ultrastructure morphology. Inoculation of infected tissue of fish from freshwater cage culture on to Sabourad dextrose agar, inhibitory mould agar, peptone yeast extract agar, and potato dextrose agar yield one type of fungal growth which, under light microscope, showed morphological features of presence of gemma in abundant numbers, elongated mycelium, non-septate hyphae, zoosporangia, primary zoospores, and mature zoosporangia containing numerous zoospores. Electron microscopic observation of the hyphae revealed detailed hyphal structures, resting stage of zoospores, cysts with bundles of long hairs with terminal hooks on the cyst surface which is a typical ultrastructure feature of *Saprolegnia parasitica*. Based on the morphology the isolates were tentatively identified as *Saprolegnia parasitica*.



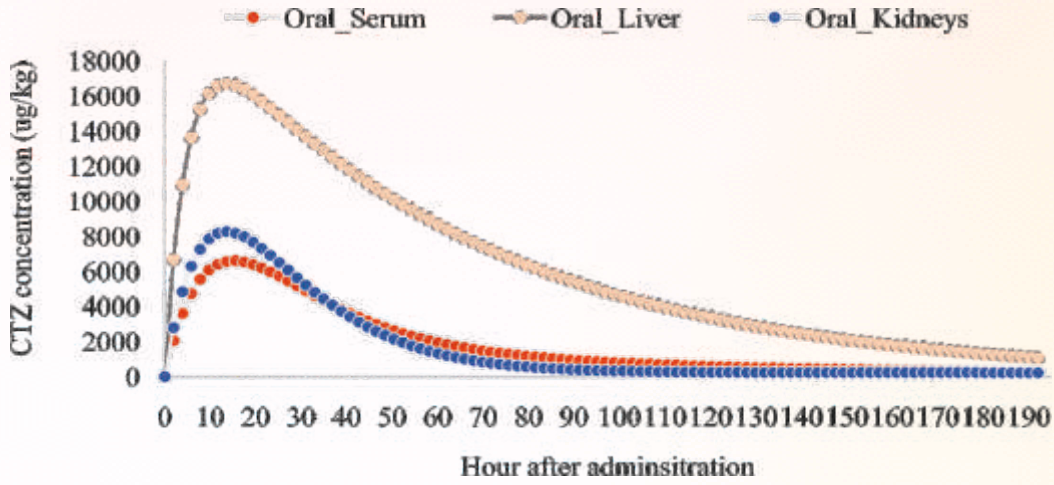
Scanning electron microcopy of *Saprolegnia parasitica* with sessame seed as bait. Showing: A: The hyphae of *S. parasitica* attahced to sesame seed surrounding; B: Primary zoosposres; C: Numerous branched hypahe with encysted spores; D: Presence of long hairs on the surface of spore

Determination of MIC of Antifungal Compounds against *Saprolegnia parasitica*

In vitro sensitivity of the fungus to various antifungal compounds was studied for their potential use in the disease control. The inhibitions of growth of the fungal mycelium and zoospores by fluconazole, clotrimazole, malachite green, potassium permanganate, copper sulfate, sodium thiosulfate and boric acid, were tested in potato dextrose agar and glucose yeast extract broth, respectively. The results showed



MIC of different antifungal chemicals and drugs against *S. parasitica* hyphae



Clotrimazole concentration in different tissues, predicted by two-compartment model, following oral administration

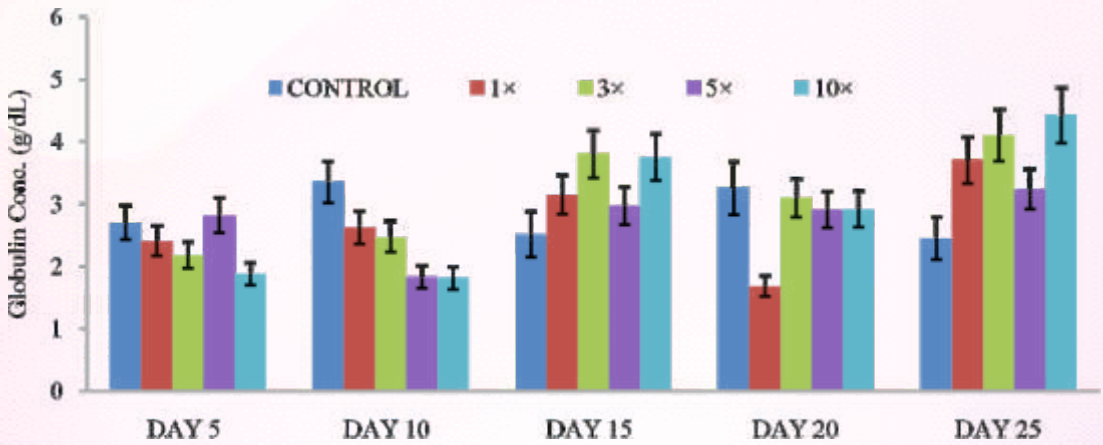
clotrimazole and malachite green as the most effective chemical against the fungus with minimum inhibitory concentrations (MIC) of 1-2 mg/L; copper sulfate was moderately effective while other compounds including fluconazole did not show significant inhibitory activity. Since use of malachite green is unsafe, the study indicated clotrimazole as the only effective and safe antifungal that might be used against the fungus.

Determination of Pharmaco-kinetics and Clinical Efficacy of Clotrimazole

Pharmacokinetic behavior of antifungal drug clotrimazole was studied, for the first time, in widely consumed catfish *Pangasianodon hypophthalmus*. Following in-feed bolus administration of clotrimazole @ 5 mg/kg body weight in the catfish, the drug residue in fish tissues was quantified at different time points using LC-MS/MS. The results fitted in various drug-distribution models showed very slow kinetics including slow absorption/distribution, and very high residence time of the drug which underwent first pass metabolism but with negligible clearance from liver. Affinity of clotrimazole towards liver was also evident from 2-2.5 times higher C_{max} in relatively shorter T_{max} in liver as compared to kidneys and blood. Despite poor kinetics, pharmaco-kinetic data, viz, *f*AUC/MIC ratio, C_{max}>MIC, %T>MIC predicted high clinical efficacy of the clotrimazole and a single administration could protect the fish for more than 24 h. The data generated would be instrumental in determining future use of clotrimazole for control of saprolegniasis in fish.

Evaluation of Biosafety of Antibiotic Enrofloxacin in *Pangasianodon hypophthalmus*

Enrofloxacin is one of the widely used antibiotics in controlling animal and fish diseases in Asia. To investigate safety of the drug in *P. hypophthalmus*, fingerlings were in-feed administered the drug @ 10 mg/kg (1×) - 100 mg/kg (10×) body weight of fish daily for 15 days. Study of haematology, biochemistry, liver and kidney functions and histological examination of different organs revealed no major toxic effects of the drug except increase in blood



Plasma globulin concentration in control and Enrofloxacin treated fish

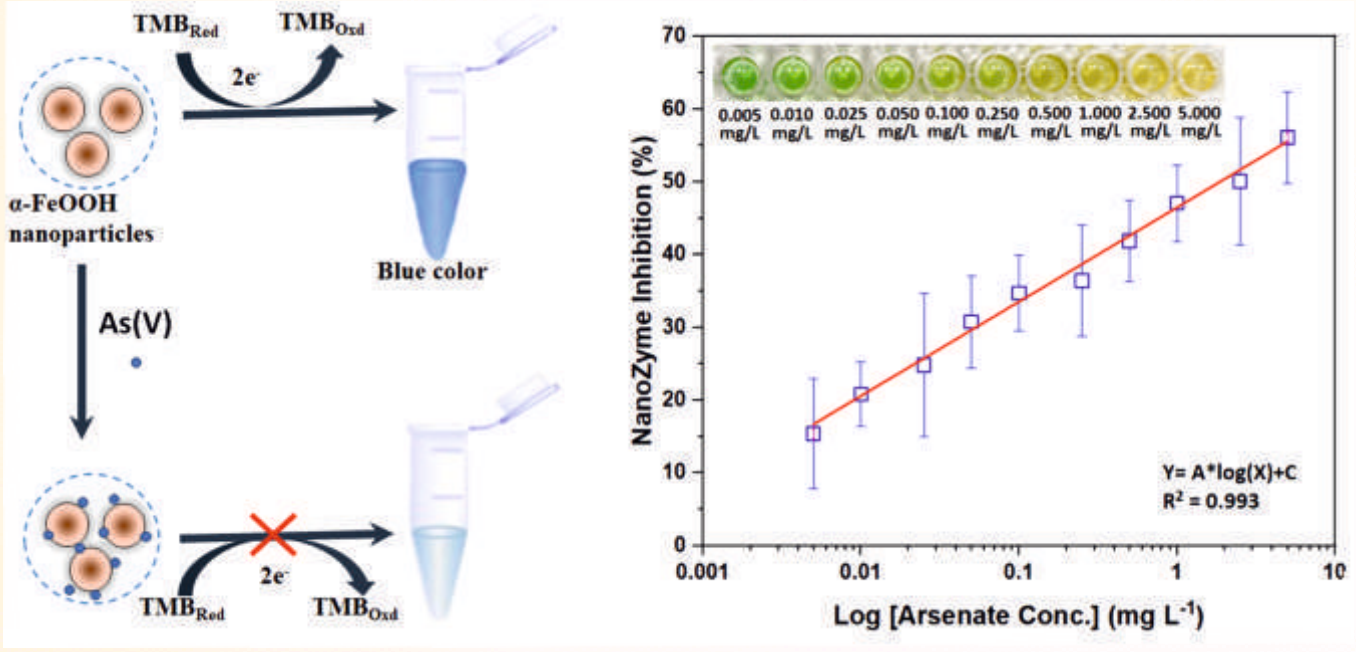
glucose, albumin but decrease in globulin levels. Feed intake decreased at higher doses, but there was no fish death indicating that the drug is safe in the catfish.

Two-Day Workshop-Cum Training on "Better Health Management Practices in Cage Culture and Aquaculture Farms"

This workshop was conducted at Bhopal during 5-6 September 2024. Dr. A. K. Bera and Dr. N. Das from ICAR-CIFRI delivered lectures on various topics of fish disease diagnosis, preventive measures, etc. The workshop benefitted 31 cage culture farmers, 30 aquaculture/tank culture farmers besides 30 state fishery officers who shared their valuable inputs in prioritizing different aspects of fish culture towards development of better management practices.

Project Title: Development of Biosensors for Detection of Fish Pathogenic Bacteria and Hazardous Metalloids in Selected Water Bodies

Arsenic poses serious hazards for both human and environmental health. Therefore, a reliable sensing technique is needed to track the amount of arsenic in food and water matrices. Under the project, a quick and easy method for measuring arsenate in fish and water was developed by employing feroxyhyte (FeOOH) nanoparticles as a sensor probe. In the presence of H_2O_2, the FeOOH nanoparticles exhibited peroxidase mimetic activity by oxidizing 3,5,3'5'-tetramethyl-benzidine (TMB) to a blue product (oxTMB, λmax 650 nm). Nevertheless, by attaching themselves to the catalytic active sites, arsenate prevents the peroxidase activity of FeOOH nanoparticles. The current approach achieved an excellent linear response (R^2= 0.99) spanning the range of 0.005 to 5.000 mg L^{-1} arsenate with a detection limit of 0.006 mg L^{-1}, which is less than the WHO-recommended limit (0.010 mg L^{-1}) for drinking water.

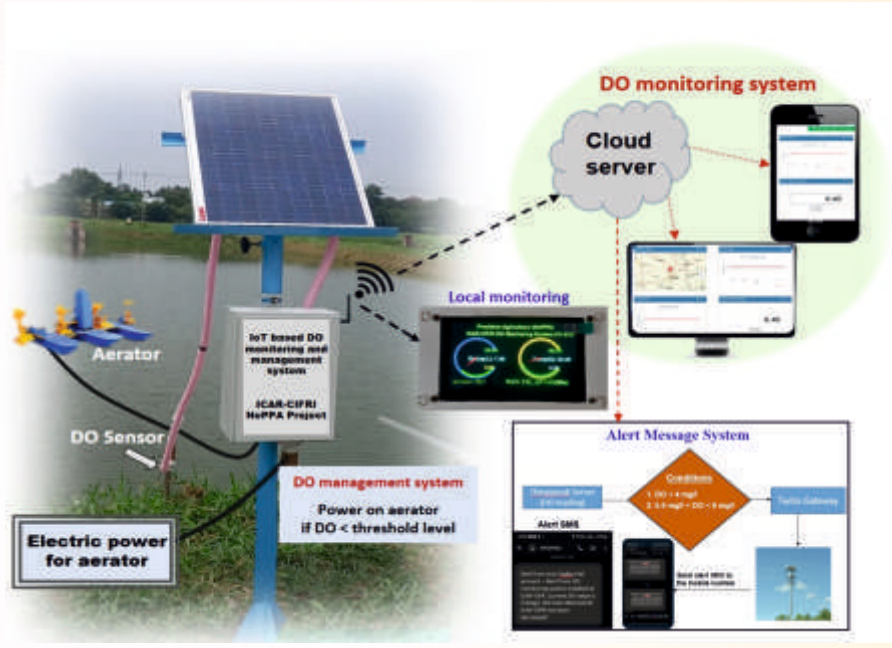


Schema of arsenate detection using FeOOH nanoparticle and the obtained linearity curve

Project Title: IoT Based Precision Enclosure Culture and Fisheries Management in Inland Open Waters

IOT Based Dissolved Oxygen (DO) Monitoring and Management System with Automated Alert Messaging Service

An IoT based DO monitoring and management system has been developed which measures the water DO and temperature level using optical DO sensor at a particular time interval and sends the data to the dedicated cloud server. The system has the capability to automatically operate the aerator in low DO level condition and sends real-time message to the farm owner through SMS as alert message. The system has been tested in different water bodies and validated the DO reading with other commercially available DO sensor and lab tested results which was found satisfactory.

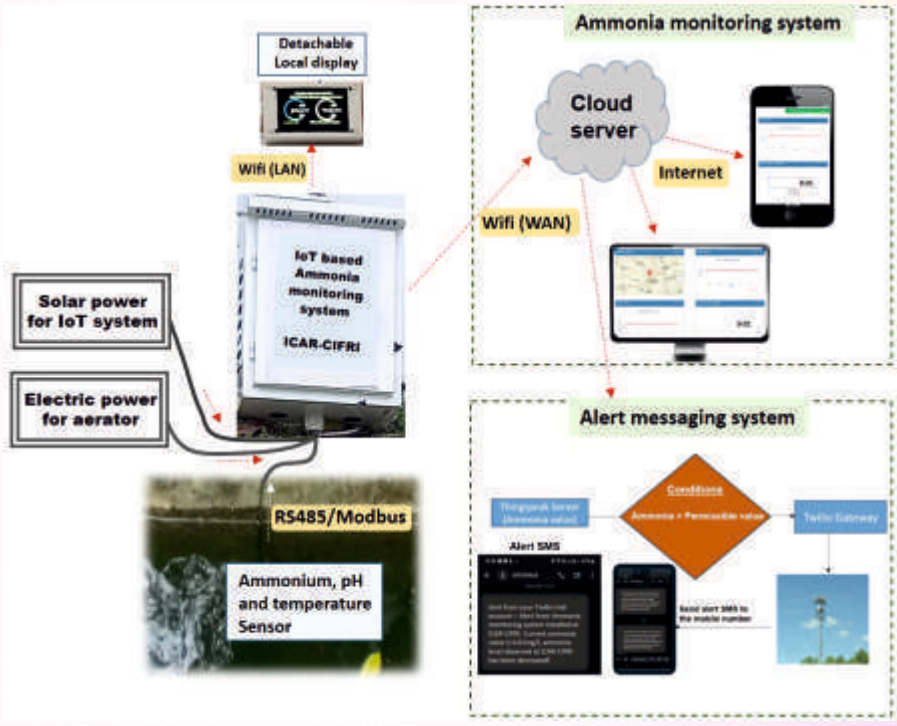


Schema of IoT based DO monitoring and management system

The device is connected to the cloud via Internet. It senses the DO level and temperature at particular interval and uploads the data in the cloud in real-time. For real-time monitoring of the DO and temperature data, cloud based online monitoring application has been developed which can be accessed through any devices via internet. Automated real-time messaging service has been embedded in the online application to alert the farm owner through SMS for any DO stress condition.

Development of Turbidity Monitoring System

A turbidity monitoring system has been developed to measure water turbidity in real-time with enhanced accuracy, reliability, and efficiency. Fiber optic turbidity sensor has been used to detect the turbidity on the principle of scattered light detection at a 90° angle with better repeatability and stability. A similar system based on microcontroller used to develop for DO has been used here. Automatic alert messaging system



Schema of automated ammonia monitoring system

helps to send the real-time alert message to the farm owner in high turbidity condition. This helps to take immediate management practices for minimising the risk associated with the high turbid conditions to the fish health and production.

Development of Ammonia Monitoring System

An ammonia nitrogen (NH_4^+-N) sensor-based ammonia monitoring system has been designed for real-time monitoring of ammonia levels in various water environments. An IoT system based on microcontroller has been used here. The controller box is attached with the ammonium (NH_4^+) sensor and temperature sensor. The ammonium sensor measures the ammonium nitrogen and pH level of the waterbody. An online application has been developed to calculate ammonia (NH_3) level of the waterbody from sensor's data using standard conversion algorithm as described in Emerson et al. (1975). When there is an increase of ammonia in the water beyond the threshold, the application sends alert message to the farm owner. The system is powered by a battery and solar energy.

Project Title: Environmental & Aquatic Animal Health Monitoring in Hirakud Reservoir Under Cage Culture Programme

A detailed study was undertaken by ICAR-CIFRI to monitor the water and sediment quality parameters of the Hirakud reservoir at 14 sites keeping in view the need for long-term environmental health and the aquatic animal health surveillance in cage fish and the wild population of the reservoir. Fish diversity and seasonal dynamics of fish abundance were studied through stratified random sampling. The reservoir was divided into lotic/flowing zone, intermediate or transitional zone and lentic/stagnant water zone. Cages were placed in the lentic or dam site zone of the reservoir.

Water and Sediment Quality

Water Quality Index (WQI) was calculated based on the 11 measured water quality parameters, namely, temperature, pH, DO, TA, EC, turbidity, TH, TDS, NO_3–N, PO_4– P and SO_4– for suitability assessment of potability of the reservoir water. Based on the calculated values of WAWQI, ranging from 16.42 to 32.58, the reservoir water falls in “good to excellent” category during pre-monsoon and post-monsoon seasons. During some period of monsoon, the water reached 'poor to very poor' category - unsuitable for drinking' with WAWQI value >100. During pre-monsoon, the mean values of sediment pH, specific conductivity, available nitrogen, available P_2O_5, organic carbon, free $CaCO_3$ and sediment texture (sand, silt and clay) were 6.614±0.94, 0.535±0.33 mS cm^{-1}, 16.32±3.42 mg/100g, 2.67±1.36 mg/100g, 0.71±0.44%, 8.24±2.34%, 59.79±13.88% sand, 19.7±12.7% silt and 20.5±9.56% clay respectively.

Reservoir Productivity

During pre-monsoon, the highest chlorophyll-a concentration (mgm^{-3}) was 0.455 at Kurla/Ibb PFCS and lowest at Cage Zone 3 (0.0221). The pre-monsoon mean chlorophyll-a concentration was 0.0972±0.1152 mg m^{-3}. During monsoon, chlorophyll-a concentration was highest at Cage Zone 1 (0.802 mg m^{-3}) and lowest at Samaleswari PFCS (0.089 mg m^{-3}). During post-monsoon, chlorophyll-a concentration was highest at Zero point (0.474 mg m^{-3}) and lowest at Thebra PFCS (0.0911 mg m^{-3}). Based on the calculated CTSI (Carlsons Trophic State Index) value of 44.21 – 49.46, the reservoir was found to be 'mesotrophic' throughout the year.

Fisheries

The study recorded 68 species under 25 families and 9 orders from the reservoir. The dominant fish families include family Cyprinidae (22 species),Bagridae (6 species), Danionidae (5 species), Ailiidae (4 species), Channidae (3 species) and Ambassidae (3 species). Among the study sites, 59 species was observed at Zeropoint, 33 species at Mahamadpur reference site and lowest at cage sites (23 species). *Oreochromis niloticus, Clarias gariepinus, Pangasianodon hypophthalmus, Hypophthalmichthys molitrix, Hypophthalmichthys nobilis, Cyprinus carpio* and *Pterygoplichthys disjunctivus* were the exotics recorded from the reservoir. Fish landings were majorly constituted by carps (35%), catfishes (33%), barbs & minnows (6%), clupeids (6%), perches (8%), freshwater eels (5%), and featherbacks (4%).

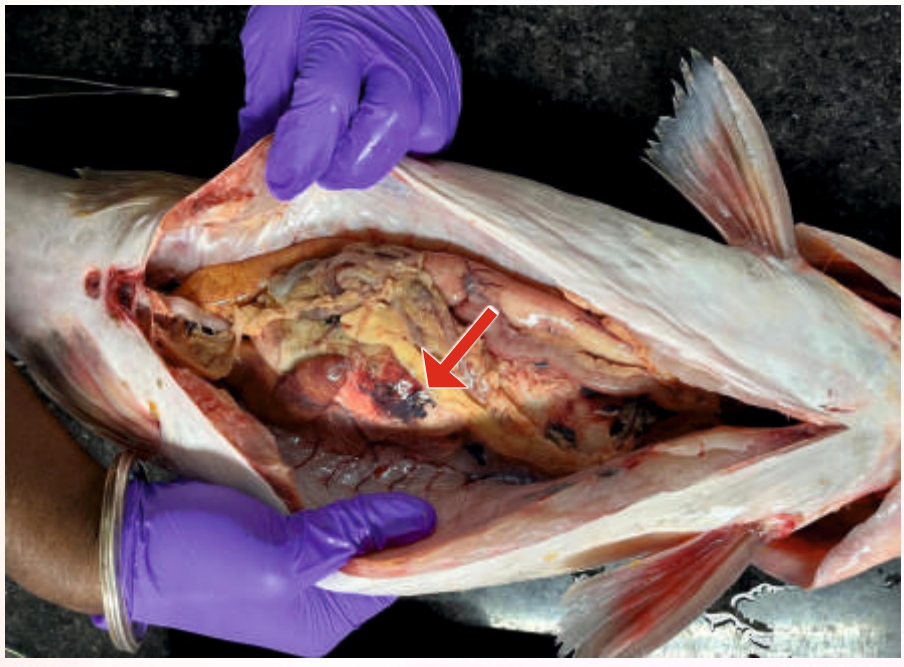
The catch per unit effort (CPUE) of various fishing fleets revealed spatio-temporal variations. In case of gillnet fishing, the CPUE (kg/day/fisher) varied from 2 (at Zero point) to 10.9 (Biren bandh) during pre-monsoon. The CPUE ranged from 2.5-4.5 at cage site while it was 2.75-5.2 at reference site. The dragnet operations were reported to exhibit highest CPUE (100-150 kg/day/net). The hook and line fishing reported lowest



Hook and line fishing in Hirakud reservoir



Sperata aorella from Hirakud reservoir



Parasitic infestation in *Sperata seenghala*
(Red arrow indicates attachment of parasites in inter organs)

CPUE (0.25-1.17 kg/day/fisher) among the fishing fleets.

Record of *Sperata aorella* from Hirakud Reservoir

The occurrence of *Sperata aorella,* a species belonging to the family Bagridae, was reported in the Hirakud Reservoir, Odisha, through morphometric, meristic, and molecular analyses. The findings enhance the understanding of freshwater fish diversity in the region. Molecular identification using the COI gene (650 bp) validated the species' presence, with BLAST analysis showing 98–99% similarity to other *Sperata* species. Phylogenetic analysis confirmed its genetic distinctiveness within the *Sperata* clade and *Sperata seenghala*.

Fish Disease Diagnosis and Surveillance

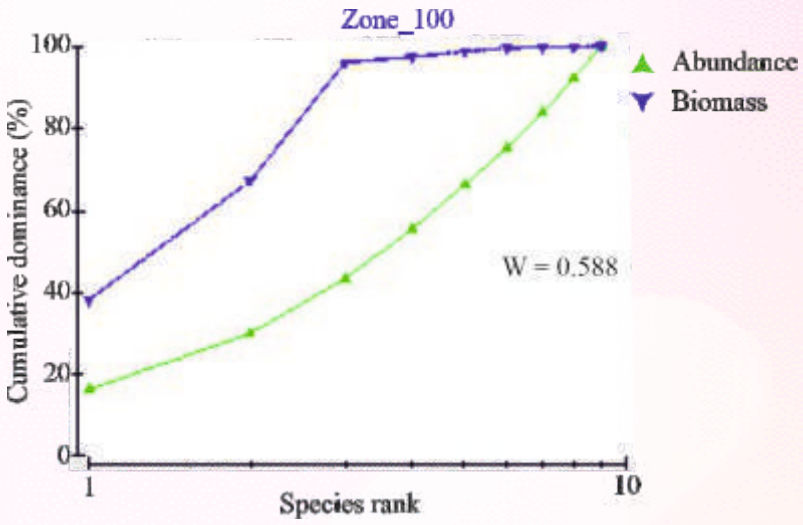
Aermonas veronii was isolated from blood, liver, and kidneys of diseased *Pangasianodon hypophthalmus* (GenBank Acc. KC210794). The isolate (*A. veronii* MT259014) exhibited resistance to 11, out of 27 tested, antibiotics including ampicillin, tetracycline, and vancomycin, indicating multidrug resistance. The experimental infection of *P. hypophthalmus* resulted in behavioral abnormalities, organ damage, and cumulative mortality, with an LD50 value of 1.6×10^6 CFU/fish, confirming its virulence. A total of 16 *Isoparorchis hypselobagri* specimens were recovered from swim bladder of a single *Sperata seenghala* specimen.

Impact of Cage Operation on Reservoir Ecology

Abundance Biomass Comparison (ABC) (phytoplankton abundance and biomass) was applied for assessing a comparative biomass status between the cage sites, and 50 m and 100 m away from cage sites. The ABC curves extracted the positive Warwick-statistics ranged from 0.407 – 0.588 with maximum in Z_100 distance (W = 0.588). Thus, it implies that an undisturbed phytoplankton community assemblage in the respective sites and the congeniality increases with the increasing distances. The results indicated that there was no eutrophication due to the cage culture the reservoir, so far. Although eutrophication was not observed, cage sites provide a favorable environment for higher growth of phytoplanktons.

A total of 58 taxa of periphyton belonging to 12 major groups were recorded. Bacillariophyceae alone contributed to 49% of the total periphyton community followed by Chlorophyceae (21%) and

Cyanophyceae (10.6%). Zooplankton population was the least (<1%) and was represented by Rotifera, Protozoa and Ciliophora. Mean quantitative abundance of periphyton was maximum at the cage site (52,213±19,485 nos.cm^{-2}) and lowest at reference site (Zero point; 36,197±21547 nos.cm^{-2}). Season had higher influence on periphyton colonization and growth than cage aquaculture intervention, so far. However, the community compositions and the abundance were similar between the cage sites and at a distance of 50 m (Zone_50).



Abundance biomass comparison (ABC) curve 100 m away from cage sites

Seasonal heterogeneity was also noted in macrobenthos with highest abundance in monsoon season (848 ind.m^{-2}). Ecological functional groups – SC/SH (46%) were the major contributors to the total macrobenthic population. A total of 25 taxa of macrobenthos were recorded with Gastropoda was the chief contributor. *Melanoides tuberculata, Filopaludina bengalensis, Tarebia granifera* and *T. lineata* were consistently present in all the seasons.



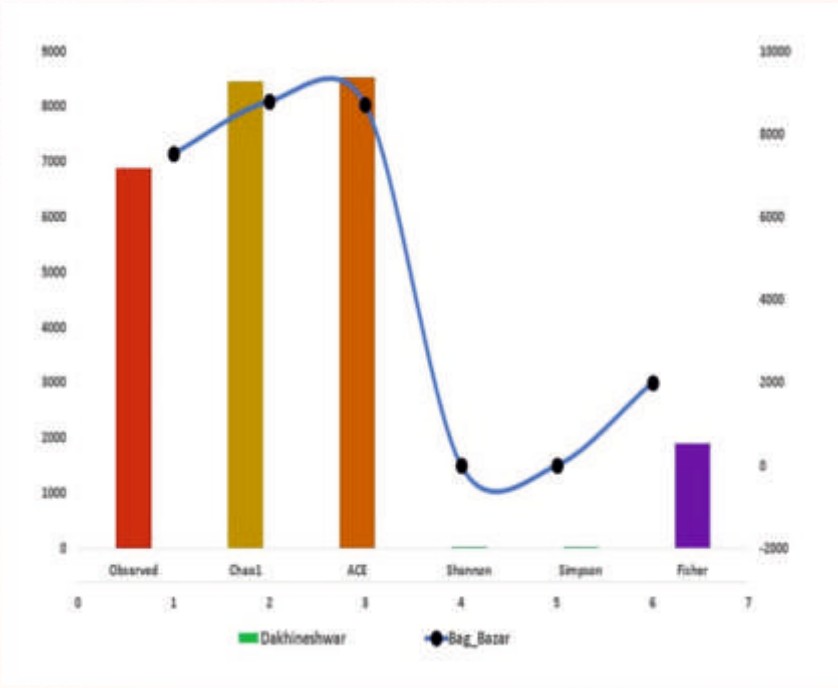
Inauguration of Environmental Impact Assessment (EIA) Laboratory by Shri Dharmendra Pradhan, Hon'ble Minister of Education, Government of India

Other Activities

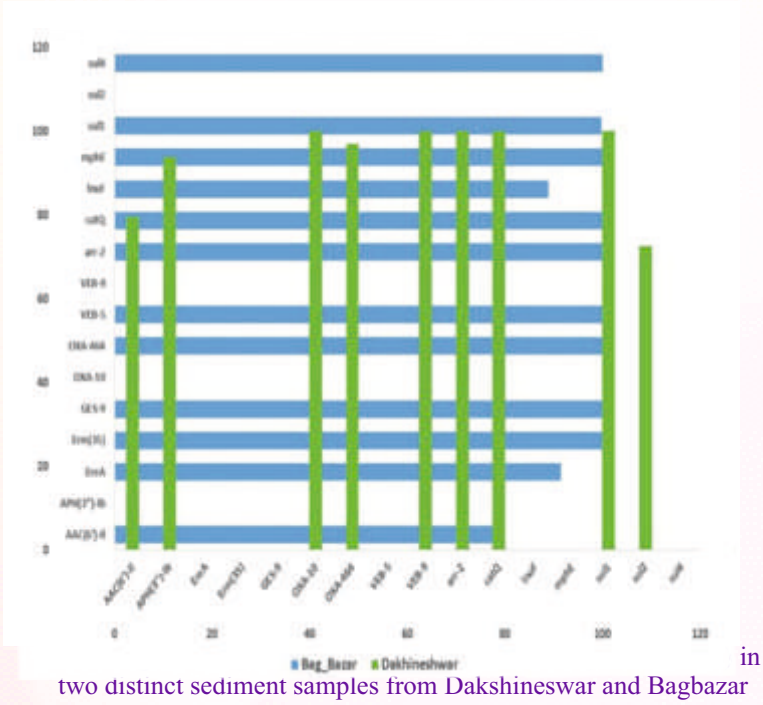
Hon'ble Union Minister of Education Shri Dharmendra Pradhan inaugurated the "Environmental & Aquatic Animal Health Monitoring Laboratory", developed by ICAR-Central Inland Fisheries Research Institute in Sambalpur, Odisha. The laboratory is set to primarily assess environmental impact of cage culture operation in Hirakud reservoir, aquatic animal health surveillance in the cage culture and monitor the water and sediment quality parameters in the reservoir with an aim of protecting aquaculture operations from detriment of excessive nutrient load in water and sediments for promoting sustainable fisheries development in Odisha.

Project Title: Microbiome Metatranscriptomics Assessment of Indian River Basins for Ecosystem Health Monitoring

The Ganga, India's most important and holiest river, plays a critical role in the health of our communities, economy, and ecosystems. In recent times, however, most of the inland open waters, especially Ganga, have been the victim of enhanced anthropogenic perturbations and are in a critical phase of ecological transition. To understand the impact of anthropogenic activities, this study conducts first-ever meta-transcriptomic investigation of Ganga River sediments, offering insights into transcriptionally active microbial communities and their functional roles at two urban-influenced locations in Kolkata, namely Dakshineswar and Bagbazar. Meta transcriptomic data were analyzed for gene expression,



Microbial community diversity indices (alpha diversity) of sediment samples from the Ganga River at Dakshineswar and Bagbazar



in two distinct sediment samples from Dakshineswar and Bagbazar

followed by functional annotation, microbial diversity assessment, and detection of antibiotic resistance and plastic-degrading genes.

Alpha Diversity

Four ecological biodiversity indices were employed based on diversity measures: Shannon diversity index, Simpson index, Fisher's alpha, and Chao1richness index. The Shannon diversity index values for the sediment samples were 7.103 for Dakhineshwar and 7.459 for Bagbazar. Accordingly, the Shannon's H index was relatively high in Bagbazar and low in Dakhineshwar. Similarly, the Sampson index follows the same trend with the value of 0.99 for Dakhineshwar and Bagbazar. However, the species richness was higher for Bagbazar 8798.44, followed by Dakhineshwar 8445.80.

Antibiotic Resistance Genes (ARGs)

At Dakshineswar, 9 distinct ARGs were detected, including arr-2, sul1, OXA-10, sul2, AAC(6')-Il, OXA-464, APH(3")-Ib, catQ, and VEB-9. Similarly, the Bagbazar location revealed presence of 12 different antibiotic resistance genes (ARGs) including *arr-2, sul1, mphE, GES-9, EreA, OXA-464, sul4, catQ, VEB-5, lnuF, AAC(6')-Il,* and *Erm*35. The identified ARGs were further analyzed based on their resistance mechanisms and associated bacterial taxa. These findings highlight the urgent need to address antibiotic resistance in these locations.

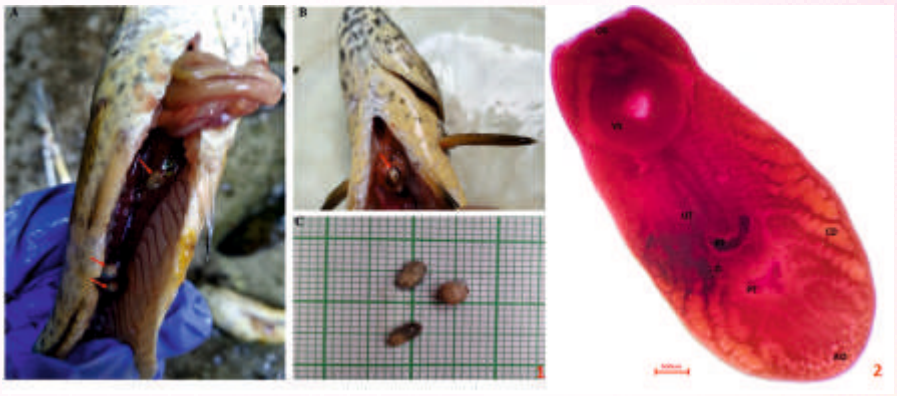
Search for Plastic Degrading Enzymes

The meta-transcriptome analysis revealed presence of several plastic-degrading enzymes among the bacterial communities. At Dakshineswar location, the identified enzymes included PEG dehydro-genase, PEG aldehyde dehydro-genase, 3HV dehydro-genase, polyesterase, PHB depolymerase, alkane monooxygenase, protease, PHA depolymerase, and PETase. At Bagbazar, the identified enzymes included PHB depolymerase, PHA depolymerase, PEG dehydrogenase, alkane monooxygenase, hydrolase, protease, and PETase.

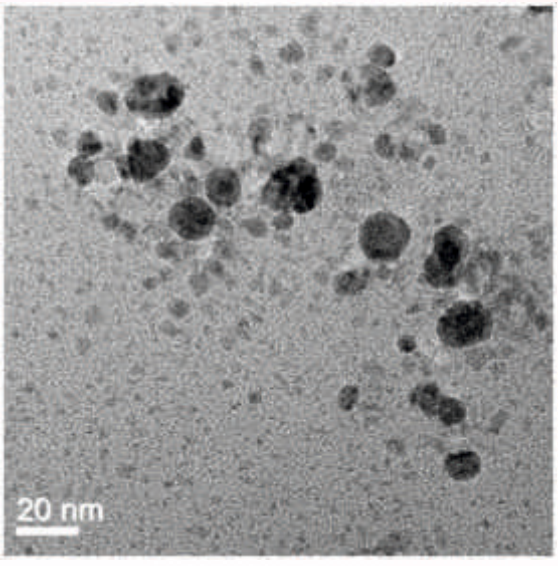
Project Title: National Surveillance Programme on Aquatic Animal Diseases Phase-II

Incidence and Pathological Effects of *Euclinostomum heterostomum* Metacercariae Infection in Snakehead

Samples of *Channa punctata* were collected from Tilaiya Reservoir, Koderma, Jharkhand during pre-monsoon, monsoon, and post-monsoon seasons. The encysted metacercariae trematodes were isolated from *Channa punctata* and characterized. Morphological study identified the encysted metacercariae as Digenean trematode of genera *Euclinostomum*, and amplification of partial sequence of 18S rRNA and phylogenetic analysis revealed the isolated metacercariae were *Euclinostomum heterostomum*. The histopathological study of the kidney showed hepatocyte degeneration, cytoplasmic vacuolation, and nuclear transformations. There was hepatic fibrosis. The prevalence during pre-monsoon, monsoon, and post-monsoon seasons ranged from 66.1% to 81.1%, abundance from 0.74 to 0.92, and intensity from 1 to 1.14 using the Margolis formula.



(1) A. Congested kidneys of *C. punctata* with encysted metacercariae of *Euclinostomum spp.*; B & C. Metal sliver with encysted metacercaria (*Euclinostomum spp.*) in liver. (2) Pictorial representation of stained *E. heterostomum* isolated from *C. punctata*



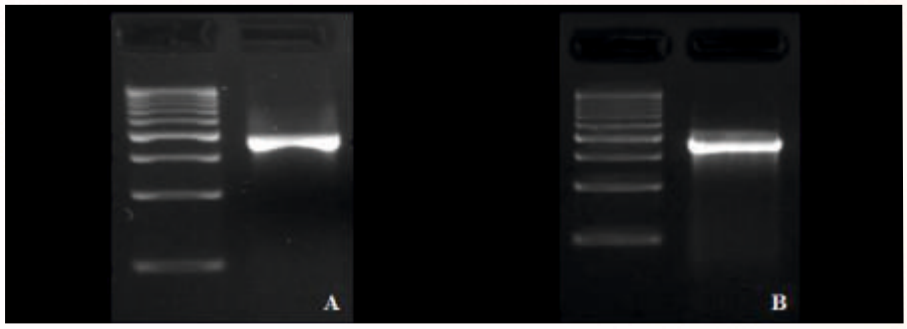
TEM image of AgNPs revealing spherical shape of biosynthesized AgNPs

Biogenic Synthesis of Silver Nanoparticles with Potential Antimicrobial Properties

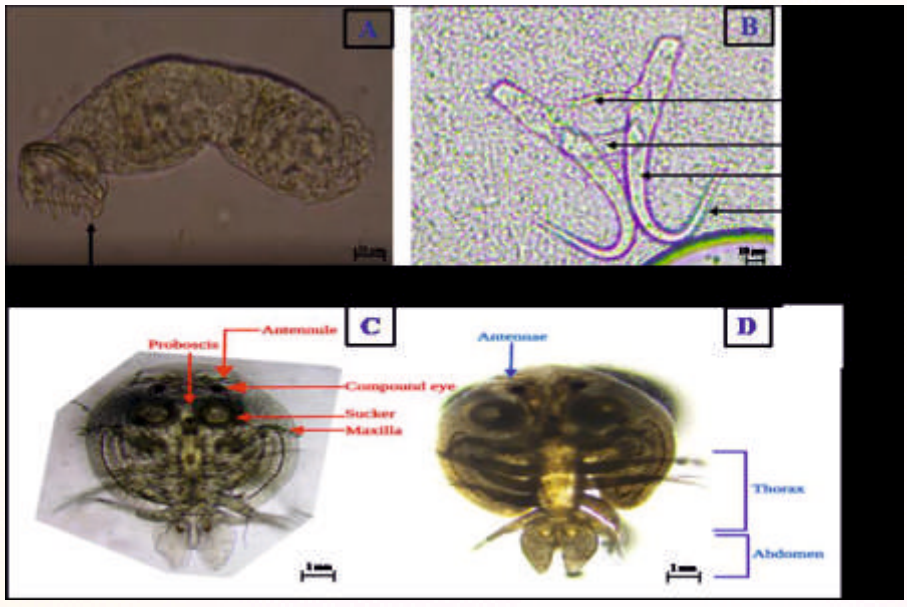
This study isolated bacterium *Cytobacillus firmus* from polluted river sediment and characterized using biochemical, 16S rRNA sequencing and antibiogram assays. The bacteria was tested non-pathogenic to *Labeo rohita* fingerlings. Further, it was found to synthesize silver nanoparticles (AgNPs) using $AgNO_3$ as a substrate. The obtained AgNPs were characterized by UV–vis spectroscopy, FTIR (Fourier-transform infrared spectroscopy), and transmission emission microscopy (TEM). The study found that the AgNPs were 20 nm in size on average. The antimicrobial activity of the synthesized AgNPs was examined against pathogenic *Edwardsiella tarda*; the MIC (minimum inhibitory concentration) and MBC (minimum bactericidal concentration) were 0.156 µM. In comparison, biofilm inhibition activity was also observed at 0.156 µM. The AgNPs showed no hemolytic activity at 0.313 µM. Our findings suggest that *C. firmus*-mediated bacteriogenic AgNPs modulate the activity of common pathogenic bacteria *E. tarda*. The thoroughness of our research instils confidence in the prospective application of AgNPs in aquaculture as a significant strategy for controlling *E. tarda* infection.

Morphological and Molecular Evidence of Fish Parasite Isolated from Ornamental Fish (*Carassius auratus*)

The present study identified the emerging parasites, *Gyrodactylus kobayashi* and *Argulus japonicus*, in infected *Carassius auratus*, using morphological characterization and molecular tools. The morphological results highlighted that the *Gyrodactylus* parasite had an



Gel images of amplification of 18S rRNA gene of *Gyrodactylus* (A) and *Argulus* (B) specimens



Microscopic images of the *Gyrodactylus* (A) along with their opisthaptoral hard parts (B) dorsal view (C) ventral view (D) of *Argulus* isolated from goldfish



Shrimp farms affected by White Feces Syndrome (WFS) and (C-D) white feces observed

opisthohaptor consisting of 16 marginal hooks, a dorsal bar, and a hamulus point curve angle (HPCA). Moreover, *Argulus* contained the proboscis, antennule, compound eye, sucker, maxilla, antennae, thorax, and abdomen.

Molecular characterization, including DNA extraction, 18S rRNA amplification, and Sanger sequencing, demonstrated that the parasite specimens (PP922389 and OQ660496) have higher sequence similarity with other reported *Gyrodactylus* and *Argulus* species. A prevalence study was investigated, and month-by-month analysis revealed that *G. kobayashi* infection was highest in July and December in male and female goldfish, respectively. For both male and female goldfish, *A. japonicus* infection was higher in June and July. Furthermore, the sex-wise comparative study showed that the mean intensity and mean abundance rates of *Gyrodactylus* and *Argulus* were higher in female fish. Further studies are needed to develop suitable management strategies to control the infection of parasites in fish species.

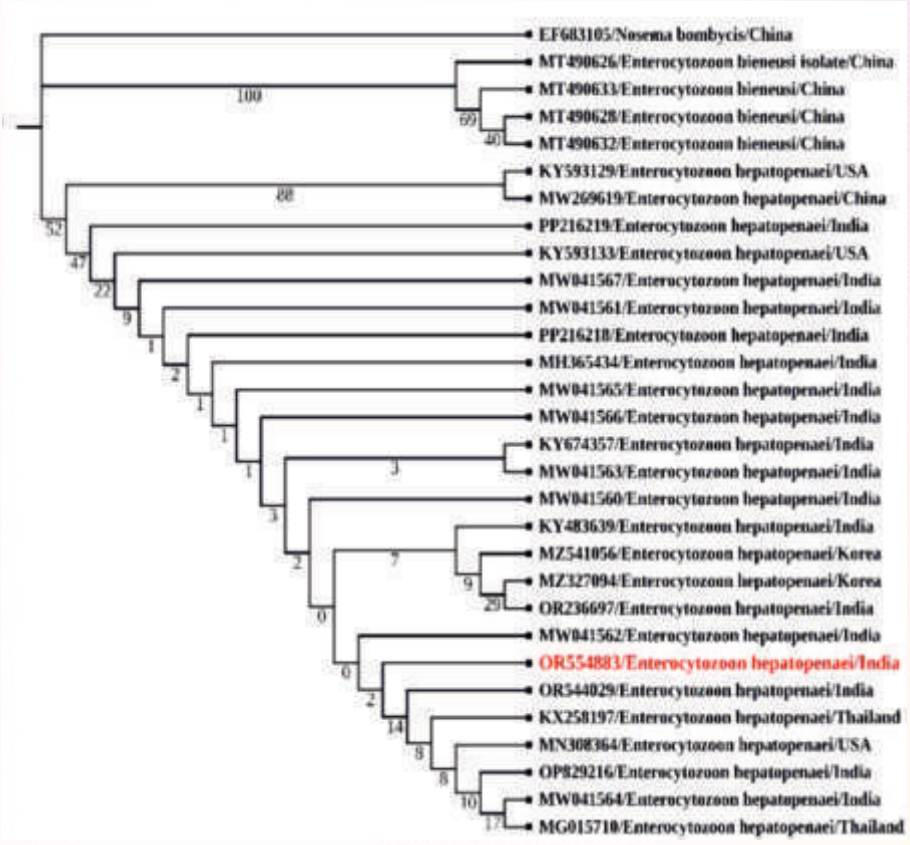
Ecytonucleospora hepatopenaei (EHP) Disease Prevalence and Mortality in *Litopenaeus vannamei*

We studied the shrimp farms suffering from the disease condition. Shrimps exhibited growth retardation and increased size variability, particularly in advanced stages exhibiting soft shells, lethargy, reduced feeding and empty midguts. Floating white feces were observed on surface of the pond water. A nested PCR of shrimp tissue, feces, feed and environmental samples detected presence of *Ecytonucleospora hepatopenaei*. Histopathological investigation revealed mature spores in the HP tubule lumen and epithelial cells along with necrotic tubule in the symptomatic animals. Further, the transcription analysis revealed that ProPO, Hsp70 and α2-macroglobulin

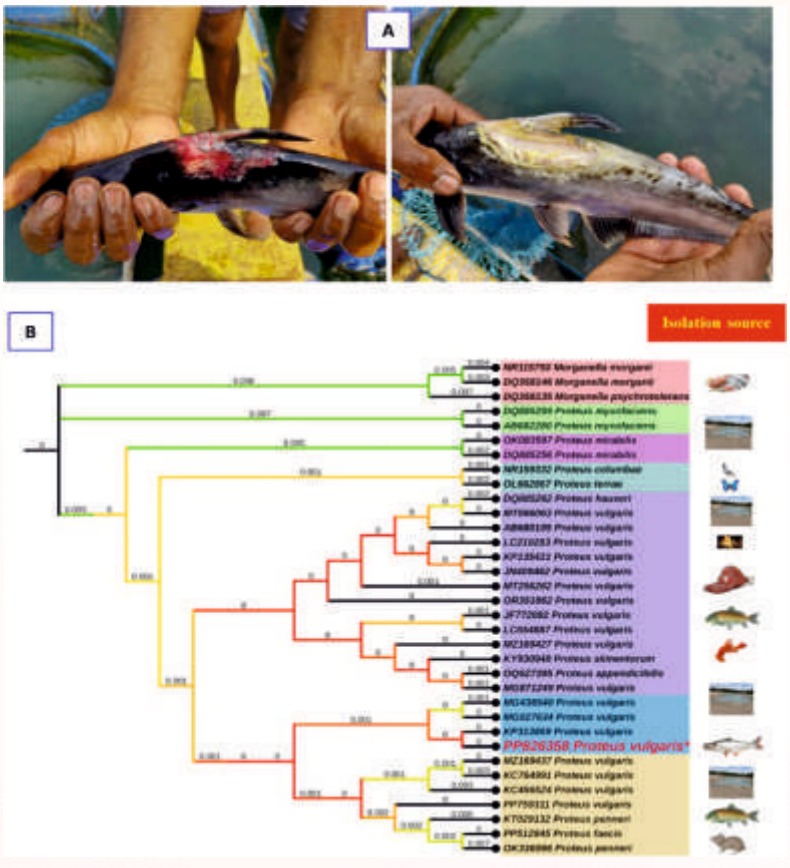
genes were significantly upregulated, while decreased expressions of LGBP, PXN and Integrin ß were observed in infected shrimps. Furthermore, compared with the healthy group, significant intestinal bacteria changes were observed in the EHP-infected group. The in *vivo* survival assay, using crustacean animal model *Artemia franciscana*, suggests that symptomatic shrimp gut samples also harbour pathogenic *Vibrio parahaemolyticus*, *V. harveyi* and *V. campbellii*.

The Emergence of Multidrug-Resistant *Proteus vulgaris* Infection in Cage-Reared *Pangasianodon hypophthalmus*

The study investigates the causative agent responsible for massive mortality in *Pangasianodon hypophthalmus* cage farms. The infected fishes were lethargic, anerectic and had exophthalmia, deep ulceration, and hemorrhages on the ventral body surface. Bacteria were isolated from infected tissue samples, and was preliminarily identified as *Proteus vulgaris* based on morphology, biochemical tests, 16S rRNA PCR sequencing, and phylogenetic analysis. Further study established association of *P. vulgaris* with the disease outbreak, as confirmed by the biofilm formation, swimming activity, and survival assay results. The isolated *P. vulgaris* was resistant to several antibiotics, including doxycycline, dicloxacillin, polymyxin B, chloramphenicol, and imipenem. Furthermore, a host-pathogen model was developed to investigate the *in vivo* effect of emerging *P. vulgaris* infection in the striped catfish. *P. vulgaris* infection exhibited varying degrees of cellular changes in the kidney, liver, and gill tissues of infected fish. The transcription analysis further highlights that *P. vulgaris* modulates the antioxidants, immune activation, growth regulator, homeostasis, degradation of invading DNA, and DNA damage-related gene



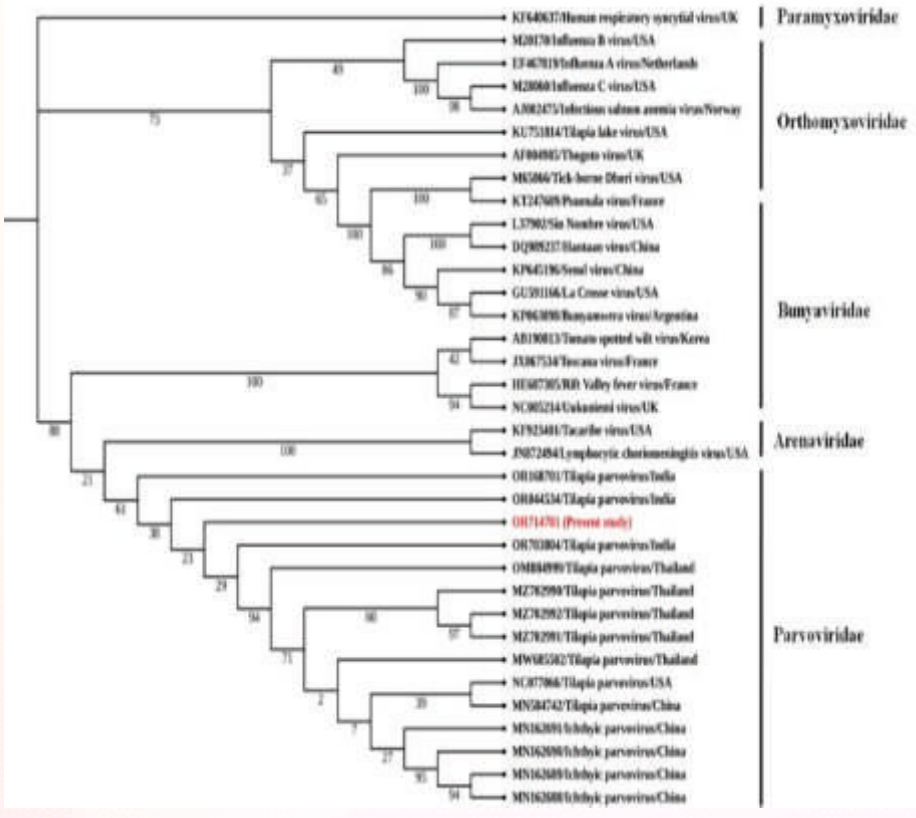
Phylogenetic tree analysis of EHP based on spore wall protein nucleotide sequences following the neighbor-joining method by the MEGA11 software



(A) *P. hypophthalmus* (pangasius) samples showing clinical signs (B) Phylogenetic tree analysis of *P. vulgaris* based on 16S rRNA nucleotide sequences



Symptomatic tilapia samples were collected from wetland and cage farms



Phylogenetic tree analysis of TiPV isolate based on nucleotide sequences

expression in liver, kidney, spleen, skin, and gill tissue samples of infected *P. hypophthalmus*.

Pathological Effects and Immune Modulation During Tilapia Parvovirus (Tipv) Outbreak in Cage and Wetland Tilapia Farms

We investigated a case of disease outbreak and severe mortality in cage and wetland farms of tilapia in West Bengal and Odisha. The symptomatic fish showed clinical signs of hemorrhage, discoloration, ulcer, and redness on the body surfaces. PCR, phylogenetic analysis, and cell line assay revealed that Tilapia Parvovirus was associated with the infection. Presence of the virus was detected in gills, heart, spleen, liver, and kidneys of apparently healthy (asymptomatic) and symptomatic tilapia samples collected from cage and wetland farms, while negative results were found in brain and skin tissue samples. The histological study revealed that TiPV invariably induces severe damage in almost all studied tissues, *viz*. liver, kidneys, spleen, gill, heart, and brain. The viral quantification analysis showed that the viral genome was more in liver, spleen, and heart than in gills, kidneys or brain tissue. The infected tilapia exhibited an immune reactivity toward TiPV infection (upregulation of chemokine receptors, CRs and interleukin 1β, IL-1β), and the majority of the studied immune genes (interleukin 8, Toll-like receptors 7, tumour necrosis factor α, major histocompatibility complex II, and nuclear factor kappa B) were significantly downregulated in the kidneys, spleen and liver tissue samples. Further, *in vivo* challenge assay confirms that the isolated TiPV is a novel parvovirus pathogen that causes massive mortality in tilapia.

Awareness Programme

The institute organized four awareness programmes on fish disease surveillance and health management under the NSPAAD phase II project. The places of awareness programme were 4 No Bheri (16 April 2024) and Sardar Bheri (17 april 2024) Kolkata, East Kolkata Wetlands (EKWs) on 29 August 2024, West Bengal and Minakhan block, South 24 Parganas (23 June 2024).



Farmer-scientist interaction on fish disease surveillance



Sensitization on fish disease surveillance

Social Media/ Newspaper



Sensitization program on application of Drone technology for fish disease management and feed application

The Kalinga Chronicle, 20 October 2024



ICAR-CIFRI organized an awareness program on fish disease surveillance and health management

The Kalinga Chronicle, 28th June 2024



Sensitization on fish disease surveillance and Plant 4 Mothercampaign

The Kalinga Chronicle, 4th September 2024

Project Title: Addressing Skill Gap in the FPO Ecosystem in Eastern and North Eastern Parts of India

The potential of FPOs to act as transformative agents for agricultural and rural development is increasingly recognized. By functioning as "engines" of development, FPCs can drive agricultural growth, enhance rural incomes, and contribute to broader societal progress.

There are 33,711 registered FPOs in India, with over 28.20 lakh farmers affiliated across 28 states and 7 Union Territories (Anand *et al.*, 2023; FPO Platform of India, Tata Cornell Institute, 2023). Bihar, Maharashtra, Odisha, Rajasthan, Tamil Nadu, and Uttar Pradesh are the primary contributors, accounting for 21,285 FPOs (63%) and 18.36 lakh shareholders (65%). The bulk of FPOs in the nation still struggle to build strong, long-lasting business models that generate sizable revenues and provide returns to members. Many FPOs lack efficient management and performance. Three key linkages i.e., technical, market, and financial are the key to the success of any business organization. The FPOs operates in an ecosystem where these linkages are offered by various service providers, support agencies and promoting organizations. It is very essential to study the status and challenges faced by the farmer producer organizations/ companies in order to provide a better picture about the benefits of collective efforts which will help the farmers to keep up with current economic scale and the most prominent issues which hindering the organizations/companies from getting the best out of its potential.

The study was conducted in Assam, Tripura and West Bengal state of India by taking 23 FPOs from West Bengal, 10 FPOs from Assam and 5 FPOs from Tripura. Two office bearers including the CEO and director, and twenty farmer members were selected through simple random sampling method from each FPO. Therefore, a total of 760 member and 76 office bearers were acted as the sample of the study.

Institutional Resource Support of FPOs for the Members

As the result suggests, members did not get enough supportive environment from the FPOs. The majority of respondents found most of the statements as 'least supportive' regarding the supportive environment. The market facilities, which had a mean score of 2.23, and inputs for farming, which came in second with a score of 2.14, and extension advisory services came third with the score of 2.02 were found to have the most supportive environments, while credit or financial assistance from banks had the least supportive environments, as per the institutional resource support data analysis. Regarding value addition and processing of farm commodities some members were fully satisfied but some were indifferent and some respondents disagree of having any facilities from the FPO.

Table: Institutional resource support of FPOs for the members

Component	Score	Rank
Market facilities	2.23	I
Inputs for farming	2.14	II
Extension advisory services and training	2.02	III
Custom hiring	1.97	IV
Value addition and processing	1.63	IV
Drudgery reduction technologies for farm	1.61	V
Credit/finance from Banks	1.52	VI

Factors Determining the Performance of FPOs

An investigation was conducted to determine the performance of FPOs and its associated factors. The study used multiple regression analysis to establish the relationship between these factors and performance of FPOs. As the findings approximately 88.9 per cent of the variance can be explained by the variables included in the regression equation. Among all the independent variables, four variables were found to be significant i.e., attitude of farmers towards FPOs, share capital, functional effectiveness and managerial competency which was significant at 0.01 level of probability. The findings suggest that attitude of farmers towards FPOs, share capital, functional effectiveness and managerial competency can increase performance of FPOs.

Technical Efficiency of Farm of the Members

In this study, five inputs and the situation of a single output (the gross return) were taken into consideration. Each input was exchanged for cash so that various farmers might use it. The inputs were field/pond preparation, seed (including seed treatment), labour, fertilizer/feed/chemical/ micronutrients and others. Technical efficiency of scale and pure technical efficiency make up the technical efficiency obtained in the DEA model as shown in the table below. Maximum net returns were identified in fishery that is Rs. 141236/ acre for member farmers of West Bengal as compared to horticulture and paddy crop. Similarly, the members of FPOs in Assam witnessed highest maximum net returns of Rs. 102883/acre from fishery as compared to horticulture and paddy crops. Among the FPO members in

Table: Technical efficiency of the member farmers of West Bengal, Assam and Tripura

Particular	Overall technical efficiency			Scale efficiency			Pure tech efficiency		
	Paddy	Horti	Fish	Paddy	Horti	Fish	Paddy	Horti	Fish
West Bengal									
Average	0.404	0.468	0.762	0.892	0.897	0.905	0.362	0.403	0.846
Minimum	0.013	0.097	0.407	0.070	0.780	0.483	0.015	0.119	0.435
Assam									
Average	0.376	0.426	0.731	0.743	0.791	0.959	0.460	0.640	0.757
Minimum	0.025	0.023	0.506	0.025	0.241	0.909	0.088	0.034	0.538
Tripura									
Average	0.440	0.657	0.472	0.869	0.958	0.700	0.501	0.685	0.673
Minimum	0.330	0.464	0.399	0.780	0.889	0.597	0.355	0.510	0.602
Pooled data									
Average	0.291	0.477	0.653	0.772	0.899	0.838	0.419	0.532	0.772
Minimum	0.013	0.023	0.399	0.025	0.241	0.483	0.015	0.034	0.435

Tripura highest net return found in the horticultural commodities at Rs. 175192/ acre as compared to Rs. 134849/ acre in fishery and Rs. 33284/ acre in paddy crop. However, among the three selected states, the highest net returns of Rs. 141236/ acre were found in fishery in West Bengal. Second maximum net returns were observed in horticulture in all the three states. However, net returns for paddy farmers were found to be comparatively lower that is Rs. 19821/ acre in West Bengal, Rs. 12586/ acre in Assam and Rs. 33284/ acre for member farmers of FPOs in Tripura.

In fish farmers, the overall technical efficiency was better at 0.762, 0.731 in West Bengal and Assam respectively but lower at 0.472 in Tripura. Average scale efficiency was estimated at 0.892, 0.897 in paddy and vegetable in West Bengal, 0.543 and 0.691 in Assam and 0.869, 0.958 in Tripura. The scale efficiency in fish farmers is also better at 0.905, 0.959 in West Bengal and Assam respectively but lower at 0.700 in Tripura. Hence, the results indicated that the fish farmers were more efficient in all the two measures of technical efficiencies in West Bengal and Assam but less efficient in Tripura.

The average efficiency scores indicate that the pure technical inefficiency was primarily responsible for overall technical inefficiency in crop and vegetable. All the fish farmers have efficiency score of above 0.70.

Computation of scale efficiency scores proves that on average the FPO farmers in West Bengal suffer from scale inefficiency at a level of 11%, 11% and 10%, respectively for paddy, vegetable and fish. Whereas, the FPO farmers in Assam suffer from scale inefficiency at a level of 25%, 21% and 0.05%, for paddy, vegetable and fish, respectively. FPO farmers in Tripura suffer from scale inefficiency at a level of 13%, 0.05% and 30%, respectively for paddy, vegetable and fish. Both management practices (pure technical inefficiency) and production scale (scale inefficiency) affect efficiency level.

Project Title: Imparting State of Art Knowledge on Fish Breeding to the Local Fishermen for Livelihood Improvement and Enhancing the Native Fish Population through Ranching Programme in River Ganga

Captive Breeding and River Ranching of Fingerlings

Brooders of selected species, including *Labeo calbasu, Systomus sarana, and L. rohita* of average weights ranging from 350-1200 g, were reared in circular cages and the NTPC PTS pond in Farakka. The induced breeding was successfully carried out with intra-peritoneal injection of Spawn-Pro, with females receiving 0.5 ml/kg and males receiving 0.3 ml/kg.



Injecting synthetic hormone



Fertilized egg collection

The fertilization rate achieved was 85%. The fertilized eggs were kept for 24-36 hours, resulting in a hatching rate of 60%. The larvae were subsequently reared in the PTS pond until they reached the fingerling stage.

Breeding of indigenous carp *S. sarana* weighing between 300-350 g, were selected based on external maturity observations and injected with Spawn-Pro at a dose of 0.5 ml/kg. The breeding yielded approximately 80,000 spawns, with a fertilization rate of 70% and a hatching rate of around 80%. The hatchery maintains optimal water quality, temperature, and aeration to maximize survival rates. Initially, the newly hatched larvae rely on their yolk sacs for nutrition, with external feeding commencing after 72 hours. A total of 80,000 IMC spawn, consisting of fry weighing 2-5 g each, and 65,000 *Systomus sarana* fry, weighing 0.25-0.5 g each, have been stocked in the PTS pond , where they will be reared to fingerling size for river ranching.

Regular feeding and health monitoring, effective pond management practices were implemented, including proper manuring and liming, to maintain a healthy and balanced environment. To ensure the water quality optimal for the fish, weekly water quality monotoring were carried out. The



Brooder collection



Brooder selection



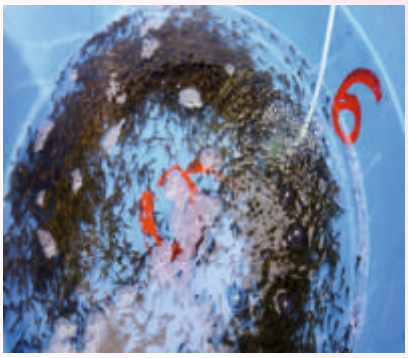
Brooder stocking in cage



IMC Spawn stocking in PTS Pond



Fingerlings of Catla & Rohu



Spawn of *Systomus sarana*



Length monitoring of IMC fingerlings



weight monitoring of IMC fingerlings

outcome of this approach has been the successful rearing of fingerlings, and the system is now well-established and functioning effectively.

Growth assessment showed that the Indian Major Carp (IMC) fingerlings had performed well. The successful growth of the fish is a positive indicator of the effectiveness of the rearing strategies and pond management practices in PTS Pond of NTPC for the first time under the CSR programme.

River Ranching of Fingerlings in Ganga under CSR programme

To promote the conservation and restoration of the River Ganga's natural fish populations, ICAR-CIFRI has implemented a river ranching program. This initiative involves releasing advanced fingerlings of Indian Major Carps and Calbasu, into the river. The goal of this program is to enhance biodiversity, support the livelihoods of local fishermen, and maintain the ecological balance of the riverine ecosystem. Specifically, the program aims to achieve the following objectives: restore the natural fish populations, conserve native species, and promote the overall health and sustainability of the River Ganga. During the period 2024-25, 2 lakh fingerlings have been released into the river as part of this program, marking a significant step towards achieving these objectives. By reintroducing native species into the river, ICAR-CIFRI is working to ensure the long-term conservation of the River Ganga's ecological balance and the livelihoods of those who depend on it.

Awareness Programme and Hands on Training to the Local Fishermen on Fish Breeding and Fingerling Raising

During March 2024 and February 2025, a comprehensive series of awareness programs and hands-on training sessions were conducted in various locations, including Farakka, Jharkhand, Malda, and Dhuliyan to Shreeghar, with the primary focus on educating fishermen on the best practices for Indian Major Carp (IMC) breeding and culture. A total of 82 sessions were held, benefiting 1,055 fishermen and enhancing their understanding of modern fish



Ranching of IMCs in river Ganga

aquaculture techniques, which included topics such as pond preparation and management, artificial breeding and hatchery management, new fish breeding technologies, seed raising and production, and natural and artificial feed production. In addition to these technical aspects, the programs also emphasized the importance of biodiversity conservation, Ganga river sanitation, and the negative impacts of harmful fishing practices, with the aim of promoting sustainable and responsible fishing practices.

A notable highlight of the project was an on-site demonstration and training program on fish broodstock management and carp breeding, held under the NTPC Project. Overall, the project's awareness programs and training sessions have contributed significantly to the development of the fishing community, equipping them with the knowledge and skills necessary to adopt modern and sustainable fishing practices, and ultimately promoting the conservation of the Ganga river and its aquatic resources.

Project Title: Production Systems, Agribusiness and Institutions - Component I: Impact of Agricultural Technology

Techno-Economic Feasibility of Cage Culture

The techno-economic feasibility of cage culture for various fish species in reservoirs, based on data collected from state governments, indicates varying degrees of productivity and economic returns. Nile Tilapia, cultured in HDPE cages with a stocking density of 50 fishes/m³, achieved a productivity of 32 kg/m³ and a benefit-cost ratio of 1.25, suggesting moderate economic viability. *Pangasianodon hypophthalmus* reared in HDPE cages at a slightly higher stocking density of 52 fish/m³, has higher productivity at 47 kg/m³ and a better benefit-cost ratio of 1.30, making it more economically attractive. *Ompok bimaculatus*, with a lower stocking density of 35 fish/m³ in GI cages, has a productivity of 5 kg/m³ but a high benefit-cost ratio of 1.63, indicating significant economic returns despite lower productivity. *Labeo bata*, also cultured in GI cages at a high stocking density of 50 fish/m³, showed a productivity of 8 kg/m³ and a benefit-cost ratio of 1.57, indicating a strong balance between productivity and economic feasibility. Overall, *P. pangasius* in HDPE cages and *L. bata* in GI cages stand out for their strong economic returns, whereas Nile Tilapia and *O. bimaculatus* are also viable options. Furthermore, the profitability of cage culture was examined in comparison to pond culture using the economic surplus approach (Varian et al., 2014). The economic surplus is the sum of the consumer and producer surpluses. This represents the total net benefit to producers and consumers. Economic surplus was calculated using the following formula:

Economic Surplus=Consumer Surplus + Producers Surplus

Mathematically, it can be written as:
Economic Surplus= 0Q[PQ-Pm] dQ+ 0Q[Pm-C(Q)]dQ

Where P(Q) is the demand curve or the maximum price consumers are willing to pay for quantity Q; C(Q) is

Table: The techno-economic feasibility of fish species grown in cage culture in reservoirs

Species	Cage type	Stocking density (no. / m^3)	Productivity (kg/m^3)	Benefit: cost ratio
O. bimaculatus	HDPE	50	32	1.25
P. pangasius	HDPE	52	47	1.30
Ompok bimaculatus	GI cage	35	5	1.63
Labeo bata	GI cage	50	8	1.57

Table: A comparative assessment of cage culture and pond culture in Chhattisgarh

Particulars	Cage culture (₹/sq.m)	Pond culture (₹/sq.m)
Operational cost	3592.20	12.32
The gross value of Output	4687.50	32.20
Net value of output	1095.30	19.98
Reservoir area under fisheries in the state (million ha)	0.086	
Potential area under cage culture (0.1 %) in the state (ha)	86	
Estimated value of fish from pond culture in the state (million)	6.4	
Estimated value of fish from cage culture in the state (million/ha)	1720	
Economic surplus (million)	1710	
Economic surplus (million/ha)	20	

the supply curve or the minimum price at which producers are willing to sell the quantity. Pm is the market price, and Q is the quantity of the goods consumed.

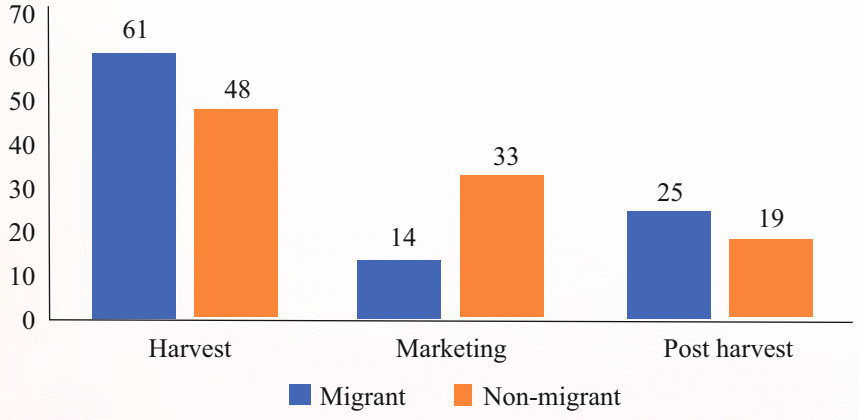
The operational cost for cage culture was substantially higher at ₹3592/m^2 compared to ₹12 /m^2 for pond culture. Despite the higher costs, the gross value of output from cage culture was significantly higher, ₹4687/m^2). Consequently, the net value of output from cage culture is ₹1095/m^2, with a net return of ₹75,420 per cage unit per year.

In terms of scale, the reservoir area under fisheries is 0.086 million hectares, with only 0.1 % (86 hectares) utilized for cage culture (estimated for Chhattisgarh). The estimated economic value of fish produced through pond culture was ₹1720 million. This results in an economic surplus of ₹1710 million for cage culture, demonstrating its superior economic viability. When this surplus is normalized per hectare, cage culture generates an economic surplus of ₹20 million per hectare.

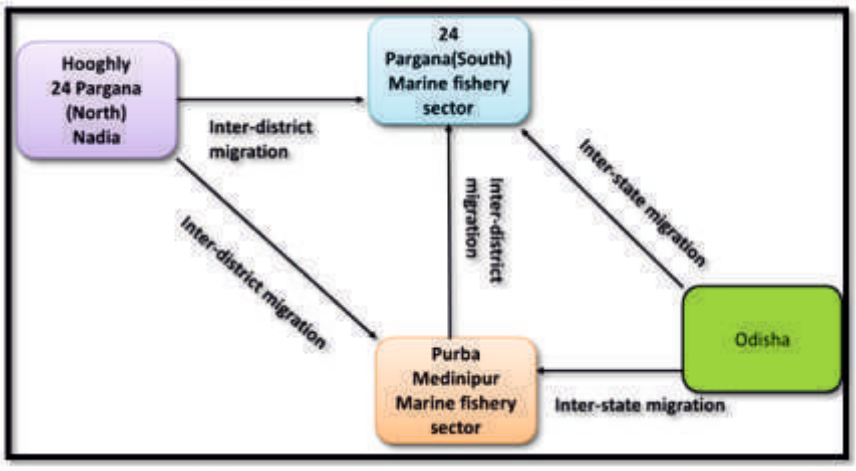
This substantial difference in economic surplus indicates that cage culture is a more economically advantageous and efficient method for fish farming and is capable of significantly enhancing the economic output of fisheries in reservoir areas. The higher productivity and profitability of cage culture render it a highly favorable option for maximizing the economic benefits of aquaculture.

Project Title: The Changing Dynamics of Labour Migration on Employment, Livelihoods and Resource Productivity Patterns in the Indian Marine Fisheries Sector

Labour migration/labour mobility is a balancing act bridging the labour demand-supply gap and resource inequalities. The process has both positive and negative externalities in the socio-political and economic arenas of origin and destination places. The project is an attempt to understand the labour migration pattern in the marine as well as inland fisheries sector and its subsequent consequences. Data were collected from Kakdwip, Diamond Harbour, Digha and Ramnagar of West Bengal with the pre-tested interview schedules. It was found that the age structure of the native and non-native people is more or less similar. However, the majority (46%) of the migrant fishers belong to the age



Role of respondents in the fishery sector



Labour migration scenario in marine fisheries sector

group 41-50 years. The majority of the respondents are Hindu (74%) and belong to Scheduled Caste (62%), followed by OBC (24%), General (11%) and ST (3%). Fishery is a full-time job for the majority of the non-migrants (92%); a part-time job for 32% of the migrants. The year of experience in fishing-related job are 16 years in case of migrants and 21 years for non-migrants. It was reported by native fishers that their entry in fishing is by birth (64%), and for employment (31%); however migrants reported entry in fishing due to employment (53%) followed by persuasion (24%). The average annual household income for the migrants and non-migrants are ₹22,500 and ₹19,800, respectively.

The inter-state migration and inter-district migration was found in marine sector also. The former involves crossing state borders for work, while the latter involves moving between different administrative districts within a single state. Both inter-district and inter-state migration was noticed in the study area. In inter-state migration, 56% of the migrant labourers are recruited by the boat owners, where 27% have migrated in consultation with friends and family members and 8% by agents.

Project Title: Improving Livelihood of Tribal Communities Through Scampi Fisheries Enhancement Technologies in Under-Utilized Reservoir Resources of Jharkhand

Macrobrachium rosenbergii, commonly called 'scampi', is the most important freshwater species of prawn with a fairly high growth rate, high market value, growth in wide range of temperature (15-35°C) and salinity tolerance. The Govt. of Jharkhand has shown interest in popularizing scampi fisheries in its underutilized reservoir areas to ensure species diversification and livelihood security of tribal communities. Three reservoirs, *viz.* Ghagra (100 ha) in Hazaribag, Kelaghagh (162 ha) in Simdega and Masaria (110 ha) in Gumla districts were selected for enhancing scampi fisheries, followed by stocking of scampi seeds in September 2023, and from monsoon season in 2024.

Table: Estimated catch of scampi in Jharkhand reservoirs

Catch Estimate	Kelaghagh	Ghaghra	Masaria
Total members of society (No.)	210	42	38
Active members (No.)	91	25	22
Pro-active members (No.)	52	18	15
Initial Stocking (No.)	4,00,000	2,00,000	2,00,000
Survival rate (%)	42	40	38
Current stock of scampi (No.)	1,68,000	80,000	76,000
Harvesting rate (%)	50%	68%	62%
Total harvested stock (No.)	84,000	54,400	47,120
Scampi harvesting size (g)	98-400	90-300	95-350
Average weight (g)	150.47	135.23	144.58
Total harvest (t)	12.60	7.40	6.80
Scampi selling rate range (₹/kg)	400-1125	350-900	400-1000
Average price (₹/kg)	600.00	500.00	575.00
Total Gross income (₹)	75,83,688	36,78,256	39,17,250
Expenditure (₹)	0	0	0
Total Net Income (₹ in Lakh)	75.84	36.78	39.17

Prior to stocking in 2024, bays in the Kelaghagh and Ghaghra reservoirs were enclosed with floating pens, effectively restricting the movement of juvenile scampi. 30-days old scampi post-larvae, measuring 20-24 mm, were stocked at a density of @ 2.01 lacs each in Ghaghra and Masaria reservoirs and @ 4.14 lacs in Kelaghagh reservoir. Tribal fishers, particularly women, played a vital role in the stocking process, actively participating in counting the seeds, acclimatizing them, and releasing the

seeds into the reservoirs. In a noteworthy effort, tribal Fishers' Cooperative Societies (FCS) actively took part in the distribution and release of scampi post-larvae across the three reservoirs. The fishers are also actively engaged in management measures, including the eradication of predatory fish like *Channa punctata*, *C. striata, C. marulius*, *Wallogoattu* and *Clarias gariepinus,* etc. using lines and hooks. Additionally, they broadcast feed in the afternoon, incorporating mineral salt during full moon and new moon phases, apply lime/zeolite periodically and installed bushes in various spots around the reservoir to provide shelter for juvenile scampi. The tribal fishers received regular sensitization and guidance from the field professionals.

Periodic water quality monitoring revealed conditions congenial for scampi habitation. The existing stock of 2023 demonstrated remarkable growth. Harvesting recorded largest size scampi, of weight 150.47 g ± 1.65 g, from Kelaghagh reservoir. This was notably higher than those recorded in Masaria (144.58 g ± 1.66 g) and Ghaghra (135.23 g ± 1.71 g), highlighting Kelaghagh as the most productive among the three reservoirs. Notably, within four months of second stocking, scampi exhibited remarkable growth in all the three reservoirs: the highest growth was observed in Kelaghagh reservoir (average weight 14.78 g ± 0.52 g), followed by Masaria (average weight 13.37 g ± 0.53 g), and Ghaghra reservoir (avg. weight 12.87 g ± 0.53 g).

Scampi Harvest by Fishers

An estimate of catch has been assessed involving individual active beneficiaries functioning in three reservoirs, to assess the profitability and sustainability of this developmental project. As a part of the initiative, fishers have begun partial harvesting and selling the harvested scampi in nearby markets. The results show that the scampi fisheries enhancement project is transforming the lives of tribal fisher communities of Jharkhand.



Stocking program





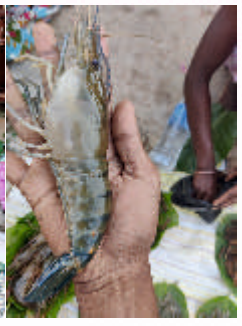
Scampi- new stock & old stock





Partial harvest of scampi





Selling scampi in market

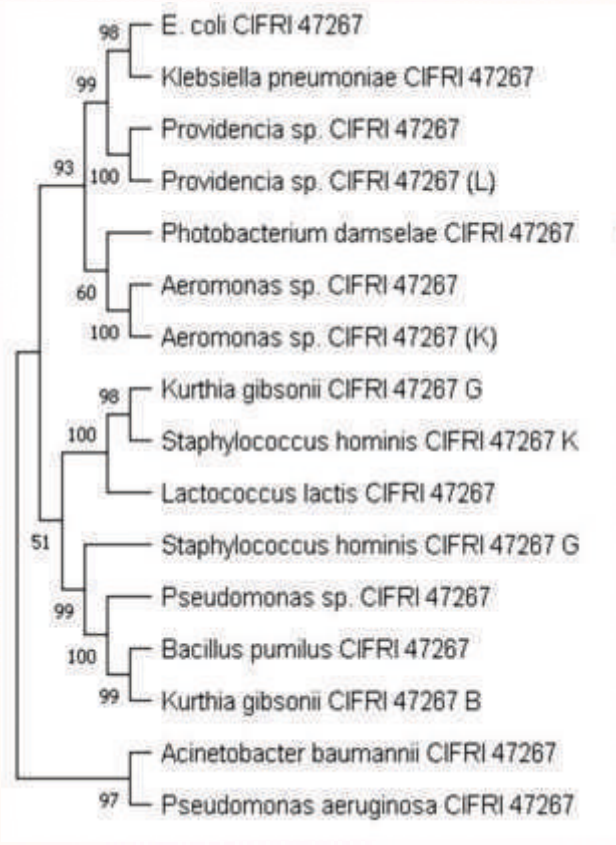


Stocking in floating pen in Kelaghagh

Launching of a New Technology

A new technology, Round Floating Pen, which is the first of its kind in India has been installed at Masaria reservoir, Gumla on November 28, 2024 and was inaugurated by Ms. Kusum Lata, DFO, DoF, Gumla, Jharkhand in the presence of ICAR-CIFRI officials. A total of 1,72,000 scampi seeds of 30 PL size have been stocked in the pen, which would be released into the main reservoir as soon as they attain 10-20 g size. Through this technology the livelihood of the tribal beneficiaries working in Masaria reservoir would be sustainably enhanced.

Project Title: Identification and Comparative Expression analysis of Novel Immune-Related Genes against Prevalent Bacterial Infections and Development of Remedial Measures in Asian Seabass, *Lates calcarifer*



Phylogenetic analysis of the isolated strains

Lates calcarifer or Asian seabass is an important aquaculture species but highly susceptible to bacterial diseases that can significantly harm its culture. An extensive survey was carried out in *bheries* in North 24 Parganas, South 24 Parganas and Purba Medinipur districts of West Bengal to examine the occurrence of bacterial illness in Asian seabass.

The study recorded diseased seabass mainly during April to June, and less frequently during September to October, but not during December to March, and July to August. The study recorded, for the first time, new pathogenic bacteria in Asian seabass, *viz. Kurthia gibsonii* (NCBI Acc. No. PQ363084), *Staphylococcus hominis* (NCBI Acc. No. PQ363089), *Staphylococcus hominis* (NCBI Acc. No. PQ363125) and *Providencia* sp. (NCBI Acc. No. PQ363107).The 16SrRNA nucleotide sequences of these microorganisms were used to generate a phylogenetic tree in MEGA 11 program.

Project Title: Fish Conservation and Stock Enhancement of Fishery of Ganga River Basin (Phase-III) under Namami Gange Mission

Component I: Captive Breeding of Commercially Important Fish Species and Ranching Programme through Livelihood Enhancement and Conservation in Arth Ganga Concept

Captive Breeding of Wild Germplasm

A captive breeding programme of Indian Major Carps was conducted at Balagarh, West Bengal in August 2024 with production of 76 lakh spawns to restore prized indigenous fishes of river Ganga through ex-situ conservation. Thirty different ranching activities over the year was conducted to conserve and restore Indian Major Carps (IMC) and Mahseer in the river, by releasing 54.44 lakhs fingerlings (generated through induced breeding of Gangetic brooders) of IMC and Mahseer. Maximum fish ranching activities were conducted in the state of West Bengal (68%), followed by Bihar (17%), Uttar Pradesh (9%), Jharkhand (5%) and Uttarakhand (1%).



Captive breeding of IMC



Ranching at Barrackpore by Dr. Himanshu Pathak, DG, ICAR



Ranching at Farakka by Mr. Ashok Kumar, IAS, Former DG NMCG



Ranching at Bally by Maharaj Satishananda, Assistant General Secretary, Belur Math



Ranching at Ballia, Uttar Pradesh, by Shri Bipin Bihari Ojha, DFO



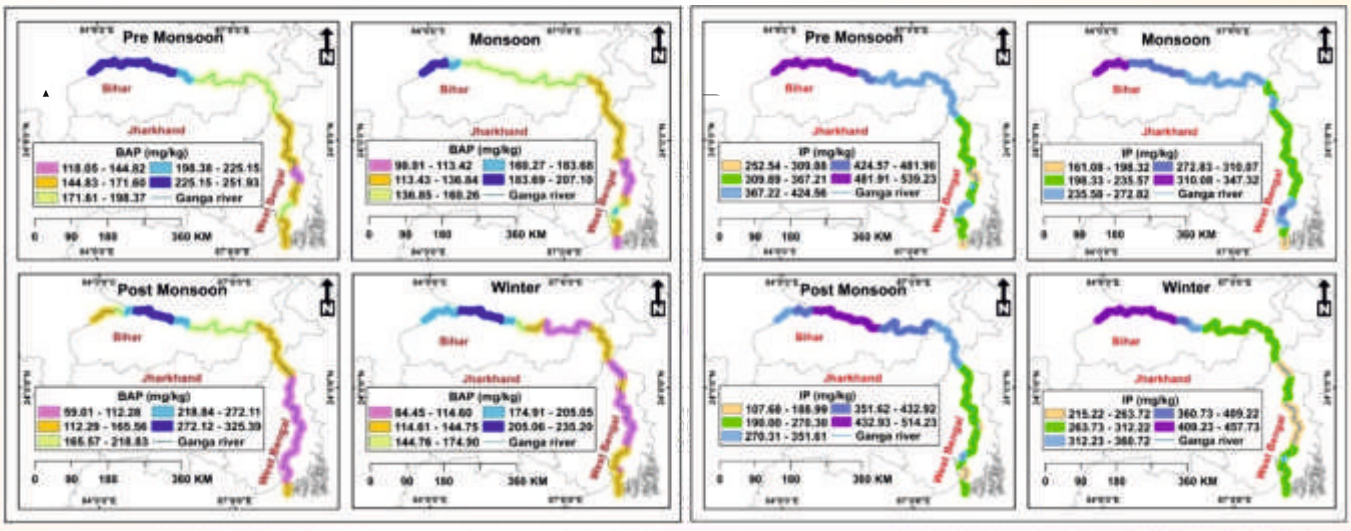
Ranching by Dr AbhilakshLikhi, Secretary, Department. of Fisheries, Government of India at Barrackpore



Ranching by Shri C.R. Patil, Hon'ble Union Minister of Jal Shakti, Govt of India at Haridwar



Fish species richness recorded at different places of river Ganga (2024)



Distribution of Bioavailable and inorganic P in surface sediments from Ganga River

Ichthyofaunal Diversity of River Ganga

A total of 184 species (177 native and 7 exotics) belonging to 132 genera, 51 families, and 16 orders were recorded in the Ganga River under the Namami Gange project. The evaluation of the conservation status of the fish species has shown that 81% of the recorded fishes are classified under least concern, 5% under near threatened, 3% under vulnerable, 2% under endangered 6% as data deficient and 3% as not evaluated category as per The IUCN Red List.

Geochemical Partitioning of Sediment-Bound Phosphorous in River Ganga

Chemical fractions, bio-availability, and ecological risk of phosphorus in the surface sediment of river Ganga were investigated. A significantly higher level of total P was recorded in the pre-monsoon season (438.49 ± 95.76 mg/kg), than in other [winter (345.68 ± 110.62 mg/kg), post-monsoon (319.20 ± 136.30 mg/kg), and monsoon (288.63 ± 77.32 mg/kg)] seasons and was primarily composed of inorganic P.

Thirty food fishes, especially the small indigenous fishes (SIFs), were collected from different sampling sites along the lower stretch of River Ganga for gross chemical composition, amino acid analysis and fatty acid composition. The analysis showed that the top three fat-rich fishes were *Anodontostoma chacunda*, *Cynoglossus cynoglossus*, and *Crossocheilus latius*. Among the fishes analyzed, the essential amino acids lysine (LYS), leucine (LEU) and arginine (ARG) were dominant and *Eleotris fusca*, *Sardinella melanura* and *Mystus cavasius* were rich in these essential amino acids. Moreover, species like *Lepido-cephalichthys guntea*, *Clupisoma*





Ranching of Hilsa in River Ganga at Farakka, West Bengal





Breeding and ranching of Hilsa fertilized eggs and spawn at upstream of the Farakka Barrage, West Bengal

garua, *C. latius*, *A. chacunda*, and *Colia dussumeri* were rich in fatty acids.

Component II: Establishment of Hilsa Stock in Middle Stretch of River Ganga through Ranching of Hilsa Seed Bred through Captive and Wild Adults

Establishment of Hilsa Fishery in River Ganga

During the period between December 2023 -2024, a total number of 47,755 adult and juvenile Hilsa fishes have been ranched in river Ganga upstream of the Farakka Barrage to conserve the native germplasm in the open waters. The average length and weight of the ranched fishes were 25.5 cm and 367 gm respectively.

Four successful artificial breeding of Hilsa involving controlled spawning techniques were conducted to enhance its production for both commercial and ecological benefits. Through artificial breeding activities, a total of 30,000 Hilsa spawn and 5.6 lakhs Hilsa fertilised eggs were ranched in order to restore the Hilsa population in diminishing portions of River Ganga.

Artificial Rearing of Hilsa

Hilsa (*Tenualosa ilisha*), a commercially and culturally significant fish species in South Asia, plays a vital role in regional economies and food security. In this context, ICAR-CIFRI under the Namami Gange project has maintained and stocked Hilsa in two types of artificial rearing facility *viz.*pond aquaculture system and Cage culture both located in Farakka, West Bengal.

Component III: Seed Production, Restoration, and Stock Assessment of Selected Mahseer Species in Upper Stretches of River Ganga

A total of 73 prospective mahseer brooders were collected (length 19-47 cm, weight 0.3-1.9 kg) from Tehri and surrounding during the sampling and were stocked in Koteswar, Uttarakhand, for attaining maturity. 6000 Mahseer fingerlings were also collected from several tributaries of the upper stretch of river Ganga and then transported with great care to the rearing ponds in the city of Koteshwar, Uttarakhand.



Hilsa stocking in different types of artificial rearing facility in West Bengal

Seed production of selected golden mahseers of the River Ganga using riverine germplasm was conducted and 1500 fertilized eggs were produced. ICAR-CIFRI, under its flagship project, regularly monitors and assesses the present stock status of two Himalayan endemic fish species: golden Mahseer (*Tor putitora*) and Snow trout (*Schizothorax richardsonii*). The findings suggest that the exploitation ratio (E) was observed below the optimum level of 0.50, suggesting that the population is exploited judiciously.

Component IV: Stock Assessment of Important Fishes in Selected Tributaries and Wetlands of Ganga River Basin for Conservation and Management

Sixteen significant tributaries of the Gangetic Basin spanning several Indian states, including Uttarakhand, Uttar Pradesh, Bihar, and West Bengal were monitored for fish diversity and ecological status. The survey has estimated the maximum fish abundance in River Saryu (n=73) Uttar Pradesh and minimum at River Churni (n=23) West Bengal. The diversity is largely influenced by the geography, water temperature, and salinity of the rivers. The fish diversity supports not only the ecosystems but also the livelihoods of many communities reliant on fishing in these regions.

Component V: Community Sensitizaton on Biodiversity Conservation, Including River Dolphin, along with Fish Biodiversity including Hilsa for Improving the Livelihood of Fishers

The Institute, under National Mission for Clean Ganga, conducted 144 awareness programmes on dolphin and fish biodiversity conservation sensitizing 7,916 fisher folks and local communities along different rivers. The number of participants in the awareness were highest in West Bengal (80%) and minimum in Uttarakhand (3%).



Fish species richness in different tributaries of River Ganga



Awareness activities conducted at different places on River Ganga

The Institute commemorated 'National Dolphin Day' on October 5, 2024 at various places of River Ganga including Barrackpore, Falta, Balagarh, Farakka (West Bengal); Bhagalpur (Bihar); and Prayagraj (Uttar Pradesh) highlighting importance of conservation efforts to protect this beautiful species and its ecosystems, which are in jeopardy due to pollution, dam construction, and climate change.

Project Title: Sub-project 1: Multiple value assessment

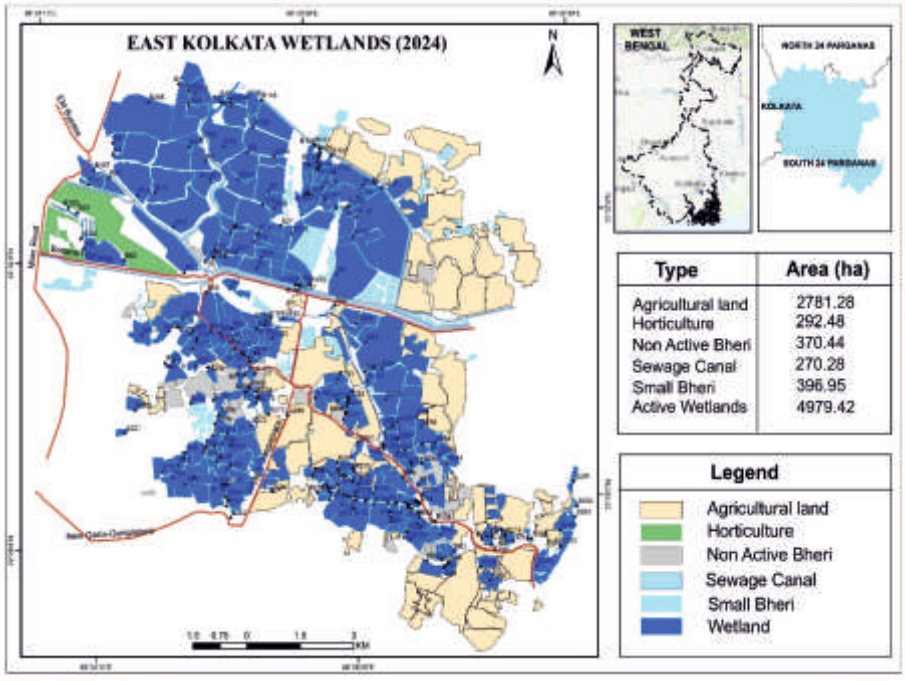
(A) Assessment of Production of Fish, Fish Disease and Feasibility Study of Certification for Fish Produced in East Kolkata Wetland

(B) Assessment of agriculture (Paddy), horticulture, medicinal plants, floriculture and uses

Sub-project 2: Culture of indigenous fish species

Sub-project 3: Assessment of invasive fish species with special emphasis on *Pterygoplichthys* spp. for control / eradication in East Kolkata Wetland

The East Kolkata Wetlands (EKWs), spanning 12,500 hectares, is a designated Ramsar site and serves as Kolkata's natural wastewater treatment system, saving approximately ₹4,680 million annually by processing 65% of the city's sewage. As one of the world's largest integrated resource recovery systems, EKW supports aquaculture, agriculture, and horticulture, sustaining 6,100 hectares of fish



GIS map of East Kolkata wetland



Health assessment of diseased fish

farms and 3,335 hectares of agricultural land, with an annual production of 20,000 metric tons of fish and 50,000 metric tons of vegetables. The wetlands sustain the livelihoods to 1,50,000 people, including 20,000 dependents on fisheries. This project aims to assess the spatio-temporal fish production trends, establish baseline data on fish disease occurrence, and evaluate the feasibility of certifying fish produced in EKW. Additionally, the project explores the culture of indigenous fish species to enhance profitability and sustainability, ensuring better income opportunities while conserving native fish diversity in this unique ecosystem.

A survey of 308 active *bheries* spanning 4,883 hectares was conducted to assess culture systems and sewage water distribution. Fish production ranged from 1,829 to 2,095 kg/ha/year, yielding a total of 8,931 to 10,242 metric tonnes. The *bheries* were categorized into wastewater-fed and feed-based systems, with production levels of 1,916-2,197 kg/ha/year in feed-based systems and 1,810-2,062 kg/ha/year in wastewater-fed systems. Despite marginally lower production, the wastewater-fed *bheries* generated higher revenue due to savings in feed costs. Amino acid analysis indicated that EKW fish were more nutrient-rich compared to traditionally farmed fish.

Fish samples collected for disease screening revealed the presence of pathogenic bacetria like *Aeromonas* sp., *Vibrio* sp., *Proteus* sp., *Klebsiella* sp., *Providencia vermicola*, *Kurthia gibsonii*, *Alcaligenes faecalis*, and *Pseudomonas stutzeri*. The isolates were analyzed for antimicrobial resistance and antibacterial activity. Additionally, viruses (TiLV, TiPV), fungi (*Aphanomyces invadens*), and parasites (*Argulus japonicus, Gyrodactylus kobayashi*) were also identified. Immune gene expression tests were conducted on fish samples to assess the health of cultured fish.

Water, sediment, and fish species (*Labeo rohita, Labeo catla, Cirrhinus mrigala, Labeo bata, Oreochromis niloticus*) were analyzed for heavy metal contaminations. While fish flesh was deemed safe for human consumption, sediment samples contained high concentrations of Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Cd, and Pb.

EKW farmers primarily rely on aquaculture, with limited floriculture and coconut cultivation. However, poor management practices have led to canal siltation, sewage shortages, reduced sewage treatment efficiency, solid waste dumping, etc. In water



Inception workshop of the project

phytoplankton, dominated by Bacillariophyceae, Chlorophyceae, and Cyanophyceae, outnumbered zooplankton, while high chlorophyll-a levels indicated a nutrient-rich environment. Macrobenthos density was higher in wastewater-fed *bheries* (2048±759/m²) compared to feed-based ones (1732±655/m²), highlighting the biological productivity of the ecosystem.

Inception Workshop on Revitalizing the East Kolkata Wetlands (EKW)

On December 6, 2024 an Inception Workshop was organized at Nalban Food Park, Kolkata, to discuss strategies for revitalizing the East Kolkata Wetlands (EKW). The event brought together key stakeholders from various government departments, research institutions, and environmental organizations. The workshop was graced by Dr. Rajesh Kumar, IPS, Principal Secretary, Department of Environment, West Bengal, as the Chief Guest. Distinguished Special Guests included Dr. Kalyan Rudra, Chairman, WBPCB, Shri Atanu Kumar Roy, Sr. Spl. Secretary, Department of Fisheries, West Bengal, and Shri Smrutiranjan Mohanty, IAS, Director, Department of Fisheries, West Bengal. The event also witnessed the presence of representatives from EKWMA, DoF, WRIDD, WBPCB, the Departments of Agriculture and Horticulture, KMC, BMC, IESWM, WBUAFS, and various ICAR institutes, including CIFA, CIFE, and NBSSLUP. The interactive session focused on educating stakeholders and beneficiaries about sustainable practices and productivity enhancement within the EKW. Discussions emphasized conservation strategies, improved resource management, and innovative approaches to maintain ecological balance while enhancing fishery productivity.

Indigenous Fish Culture

A survey was conducted for the selection of beneficiaries for the demonstration of culture of indigenous high value fish species. Polyculture of indigenous fishes *Systomus sarana* and *Labeo bata* were initiated in a pond at Chacharia *bheri*. *S. sarana*, of average size 6.66 cm and 5.22 g and *L. bata*, average size 6.38 cm and 4.23 g, were stocked in the pond in December 2024 at the rate of 10900 no/ha in a ratio of 6:4. The demonstration of the fish culture is being carried out in co-management mode with the stakeholder. Another pond has been prepared at Uttar Gorumara *bheri* for demonstration of indigenous catfish.

Threat of Invasive Sailfin Catfish (*Pterygoplichthys* sp.)

The study recorded presence of *Pterygoplichthys* sp. (sailfin catfish)



Sampling of fish for growth study



Dissected specimen of *Pterygoplichthys* sp.



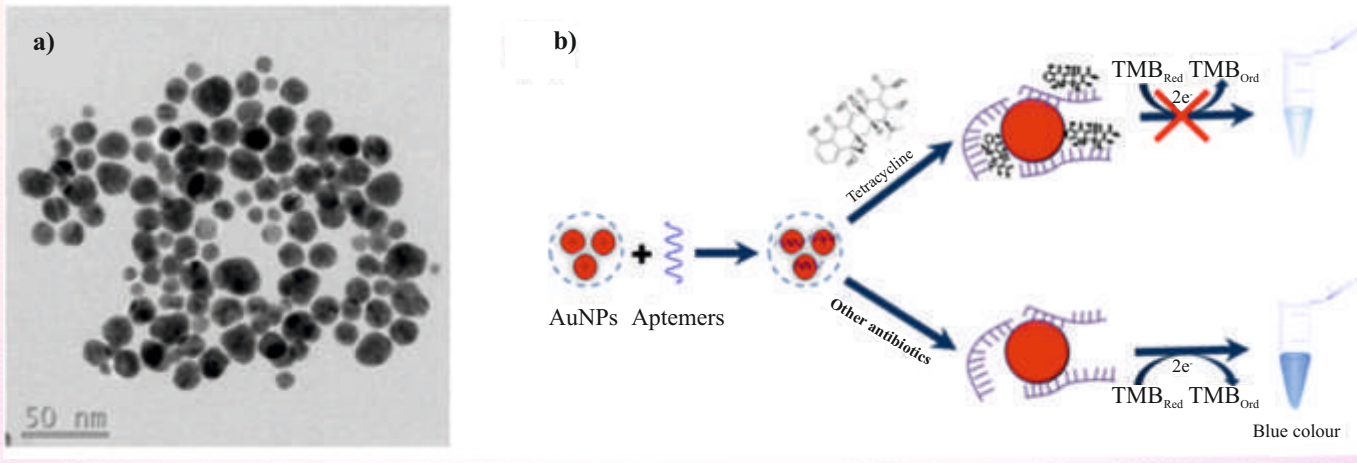
Discarded sailfin catfish on the bank of *bheri*

in 171, out of 308, *bheries* with its catch ranging from 62.7 to 87.05 kg/ha/year, contributing 3.39% to 4.18% of total fish production. The infestation was notably higher in sewage-fed fisheries (80.3–109.5 kg/ha/year) compared to feed-based fisheries (14.6–21.9 kg/ha/year).

The sharp pectoral fins of the crocodile fish not only damage fishing nets but also contribute to bank instability due to their burrowing habit in the breeding season, leading to significant economic losses for local fish farmers. These fish were predominantly found in large *bheries* (>40 ha), followed by medium-sized *bheries* (15–40 ha), while they were absent in smaller *bheries* (<15 ha), where periodic drying naturally controlled their population. Traditional control measures such as repetitive netting proved ineffective in larger water bodies due to the extensive water distribution, allowing the species to persist year-round.Analysis of the Gastro-Somatic Index (GaSI) revealed an omnivorous diet consisting primarily of detrital matter and phytoplankton (Bacillariophyceae, Cyanophyceae, Chlorophyceae), with a mean GaSI of 4.62 ± 0.72%. The Gonado-Somatic Index (GSI) showed seasonal variation, with female GSI peaking in August and male GSI in October. The high reproductive potential of the species, with 2269–8072 eggs per kilogram, underscores its rapid proliferation and ecological threat to the wetlands.

Project Title: NASF-Point of Care Nanobiosensors for Antibiotic Residue Detection in Fish

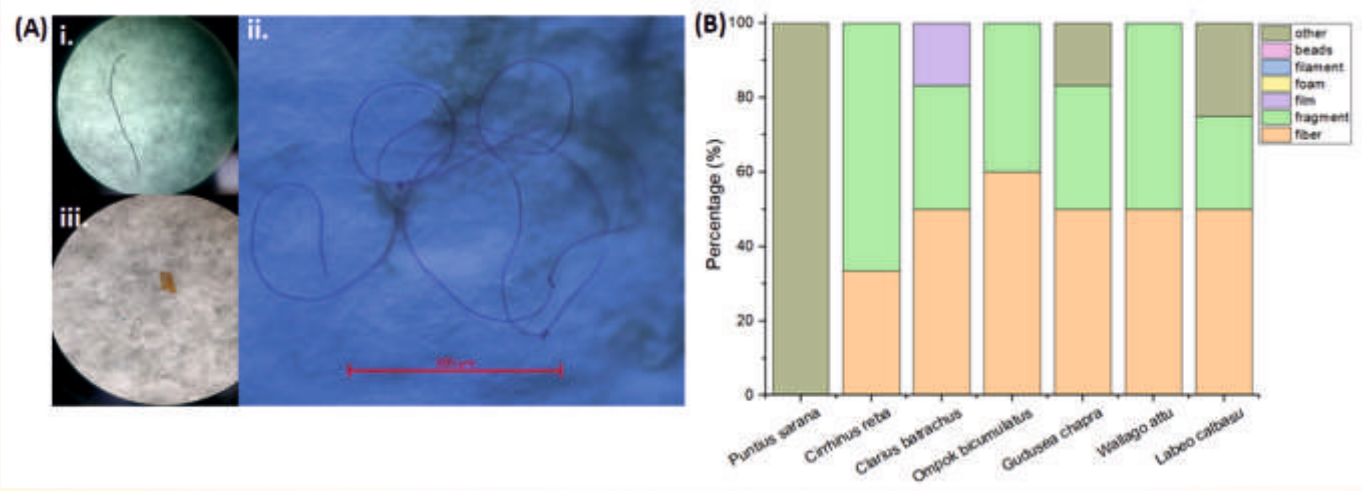
Antibiotic residues in food fishes poses a serious risk to human. Traditionally they are being detected using high-end instruments which are costly and the methods are cumbersome. Hence, simple, robust, and efficient analytical methods are needed to monitor the presence of antibiotic residue in food fish. Until now under this project, a colorimetric sensing technique was developed for the detection of antibiotic tetracycline which is recommended for the treatment of disease in cultured fish species. The sensing mechanism involves inhibition of peroxidase-mimic catalytic activity of gold nanoparticle (AuNPs) through aptamer-induced surface adsorption of tetracycline leading to colorimetric response. In contrast, the sensor is insensitive to its other nontarget antibiotics (trimethoprim, ampicillin, erythromycin, cefalexin etc.). The current investigation used TMB as an enzyme substrate in the presence of H_2O_2. Under optimized conditions, the method obtained a good linearity range (0.01– 0.5 mg/L, r^2 =0.996) with LOD of 17 ppb. The developed analytical method is very simple using only gold nanoparticles and tetracycline-specific aptamer.



TEM images of tyrosine capped AuNPs (A); Tetracycline detection mechanism using Aptamer-AuNP conjugates as sensor probe (B)

Project Title: Benchmarking Microplastic Pollution in the River Ganga and Brahmaputra in Relation to Native Edible Fish Fauna

Water and sediment samples were collected from eleven sites (from Dhola in upstream to Dhubri at downstream) of the Brahmaputra River. Additionally, eight common native fish species (*Systomus sarana, Cirrhinus reba, Clarias magur, Ompok bicumulatus, Gudusia chapra, Wallago attu, Labeo calbasu,* and *Labeo catla*) were collected. Water, sediment and fish samples were processed according to standard guidelines of ISO 24187: 2023 for microplastics (MP) estimation. MP concentrations in water samples ranged from 140 to 420 particles/m³, while sediment samples contained 13.63 to 53.33 ± 0.96 particles/kg. Among fish species, *G. chapra* exhibited the highest MP contamination (5.33 ± 1.15 MPs/individual), followed by *Clarias magur* (5.00 ± 1.73 MPs/individual) and *O. bicumulatus* (4.66 ± 0.58 MPs/individual). *L. calbasu* (4 ± 1 MPs/individual) and *C. reba* (2.66 ± 0.58 MPs/individual) also showed notable contamination. The lowest MP presence was observed in *L. catla* (0.33 ± 0.58 MPs/individual), followed by *S. sarana* (1 ± 0 MPs/individual) and *W. attu* (1.66 ± 1.53 MPs/individual).



(A) Microscopic view of microplastic found in water (i), sediment (ii) and fish (iii) samples;
(B) Percentage distribution of microplastics morphotypes found in fishes of Brahmaputra River

Project Title: ICAR-WorldFish Collaborative Research Project (Window -3): Small-Scale Fisheries in Wetlands for Livelihood and Nutritional Security

The collaborative work of ICAR-CIFRI with WorldFish is being implemented through community participation in Rishia Reservoir (Odisha) and Chamta, Beledanga (West Bengal) and Tamranga wetlands (Assam). It includes the demonstration of CIFRIHDPE-pen culture technology and the distribution of inputs (CIFRIHDPE-pen, fish seed and fish feed) to enhance fishers' livelihoods.



Rishia reservoir, Odisha

Activities in Rishia Reservoir

Initially, a group meeting was conducted with the tribal fishers'



Fish stocking in progress in Chamta wetland



Size of fish at the time of release from HDPE-pen

community to identify their specific needs and requirements. Based on these discussions, essential inputs, including 35 kilograms of fishing nets and 4 tons of high-protein fish feed, were distributed on time. Following this, a demonstration of CIFRIHDPE-pen culture activities was carried out during September and October. Once the IMC seed fish reached a advanced fingerling size, they were released into the reservoir under a culture-based fisheries approach to enhance productivity and support the fishers' livelihoods.

Activities in Chamta Wetland

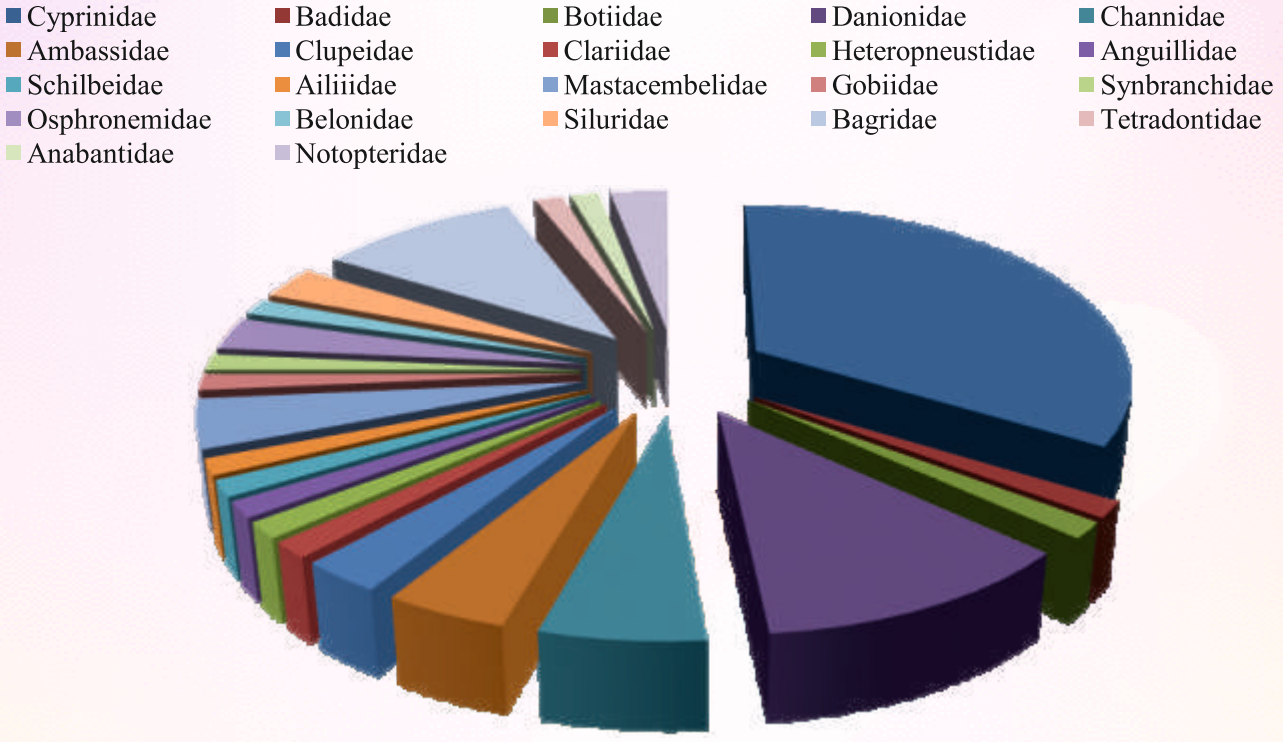
A total of 108 kg of high-value *Ompok bimaculatus* seed was stocked in three CIFRIHDPE-pen systems to promote sustainable aquaculture practices. To support the growth and development of the stocked fish, 4 tons of fish feed were distributed among the participating communities. The culture process is ongoing and the fish are approaching marketable size, indicating promising outcomes. Additionally, two training-cum-awareness programs were conducted to educate the fishers on best practices in pen culture technology and sustainable fisheries management, ensuring their active participation and capacity building.

Activities in Beledanga Wetland

A total of 559.48 kg of advanced fingerlings of Indian Major Carps (IMCs), *Labeo bata* and *Systomus sarana* were stocked in three CIFRIHDPE-pen systems and six units of GI-cage systems. Additionally, 4 tons of fish feed were distributed to support their growth. The fish were reared for four months, from June to October. Once they attained a stable size, they were released into the wetland to support culture-based fisheries and contribute to conservation efforts.

Activities in Tamranga Wetland

An investigation into the fish diversity and ecological attributes of



Percentage contribution of different families to the total fish diversity in Tamranga beel, Assam

the Tamranga Wetland in Assam was conducted. The wetland is rich in fish diversity and so far we have recorded more than 68 fish species under 22 families. Fish diversity during monsoon was higher (68 species) compared to that in post-monsoon (54 species). Cyprinidae was the most dominant family contributing 33.82% of the total species diversity followed by Danionidae (11.76%), Bagridae (10.29%).

During post-monsoon, the catch from the beel was dominated (more than 90%) by single species, *Gudusia chapra*, locally known as Karoti. During winter season, fish catch from the beel was dominated by Indian major carps (IMCs) and exotic carps, contributing roughly 70% of the total fish catch. Catch of *G. chapra* during this period came down to around 10%. During pre-monsoon, fish catch from the *beel* was dominated by *Chanda nama*, contributing approximately 60% of total fish catch, followed by IMCs (20%) and exotic carps (10%). Again during monsoon *C. nama* emerged as the most dominant species contributing roughly 80% of total fish catch.

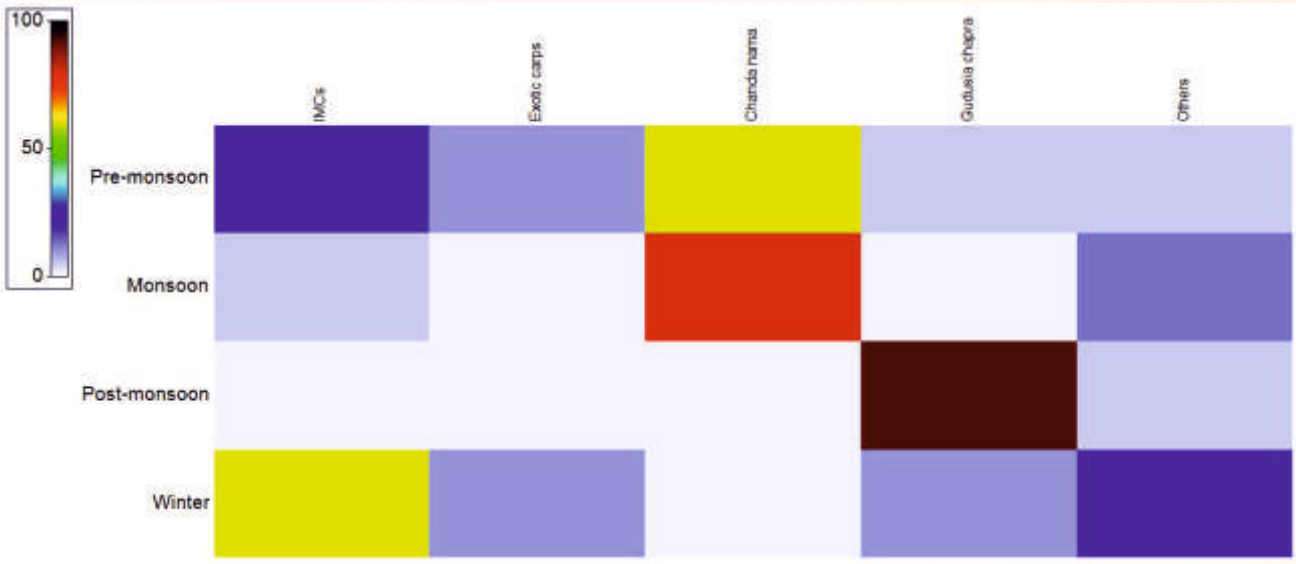


Fishers boat with their harvest from Tamranga beel, Assam



A haul of *G. chapra* from Tamranga beel, Assam

Additionally, the water quality parameters assessed during the study were found suitable for fish culture, indicating potential for sustainable aquaculture practices. To support the implementation of CIFRI HDPE-pen culture technology, an initial input distribution was carried out, which included the provision of 12 CIFRI HDPE-pen systems and 10 tons of CIFRI CAGEGROW Feed to enhance fish production and contribute to the livelihoods of local



Catch composition of dominant fish species/ groups across seasons in Tamranga beel

communities dependent on the wetland ecosystem.

Project Review Meeting

Dr.Jörn Schmidt, Director for Sustainable Aquatic Food Systems at WorldFish, Malaysia, visited the Institute during 22 – 24 October, 2024. During his visit, a review meeting was held briefing on the institute's past and ongoing works, future perspectives and initiatives. As part of the visit, a field trip was organized to the nearest project site at Chamta Wetland. This provided an opportunity to showcase the maintenance of the HDPE-pen culture system and the growth performance of high-value species such as *Ompok bimaculatus*. The practical demonstration highlighted the institute's commitment to advancing sustainable aquaculture technologies. The field visit and subsequent discussion session witnessed active participation from all scientists and scholars involved in the project, fostering an engaging platform for knowledge exchange and the planning of future strategies. This collaborative effort underscored the importance of integrating research, innovation and community involvement in achieving sustainable fisheries development.



ICAR-WorldFish project (Window-3) meet at ICAR-CIFRI, Barrackpore

Project Title: National Agricultural Innovation Fund (NAIF) Component-1 ITMU

Patent Granted

- "Vertical Slab Gel Electrophoresis" was granted on 11 March 2024 with patent No. 523365.
- "A Portable Split Beam Transducer Assembly on Water Craft for Measuring Exact Transducer Position below the Water" was granted on 12 September 2024 with patent No. 550182.

Patents Filed

- "Do it Yourself (DIY) type Out-Staged Bio-Filter Recirculatory Aquarium (OBRA) System for Ornamental Fish Rearing" was filed on 20 March 2024 with patent application No. 202431021172.
- "Incorporating *Antheraea mylitta* Pupae Meal in Fish Feed, Restricting Fish Meal, Methods Thereof" was filed on 02 May 2024. with Patent application No. 202431034963.
- "IOT Based Dissolve Oxygen Management System with Aerator Controller and Cloud Based Monitoring System" was filed on 20 May 2024 with Patent application No. 202431039433.

Trademarks Registered/Granted

The Institute has received grants of four trademark registration in the year 2024. One trademark applications were also filed in this period.

- "CIFRI Fish Tanavhari" has been registered on 06 February 2024, under the class 5, in respect of Anaesthetic/sedative formulation for fish derived from Plant with Trademark No. 5164182.
- "RESHMEEN" has been registered on 11 June 2024, under the class 31, in respect of Fish Feed with Trademark No. 6232063.
- "CIFRI NutriFishIn" has been registered on 07 May 2024, under the class 35, in respect of Database containing nutritional information on food fishes of India with Trademark No. 6063896.
- "CIFRI-ALGA S+" has been registered on 05 October 2024, under the class 5, in respect of Nutrient medium for microalgae culture with Trademark No. 6364884.

Trademark Filed

- *"CifriAquapromo"* has been filed on 14 May 2024 under the class 5 in respect of Probiotics feed for fish and shrimp. The Trademark application no. is 6432012.

Copyrights Registered/Granted

The Institute has received grants of 11 copyrights registration from copyright registry of India, two copyrights applications were also filed this year.

- "Mapping of Inland Water Bodies of Telangana" got registered on 18 January 2024 with Copyright Regn no. L-141507/2024.
- "Inland water bodies of Bihar" got registered on 30 January 2024 with Copyright Regn no. L-142372/2024.
- "Success stories from wetlands" got registered on 12 February 2024 with Copyright Regn no. L-143399/2024.
- "Catch Assessment Software for the Chhattisgarh state, India" got registered on 20 February 2024 with Copyright Regn no. SW-18310/2024.
- "Catch Estimation Methodology for Inland Water Bodies" was registered on 01 April 2024 with Copyright Regn no. L-146050/2024.
- "GIS Mapping of Inland Water Bodies of Odisha" got registered on 23 April 2024 with Copyright Regn no. L-146952/2024.

  "*Sundarbaner Khudra Matsya Chasider Daridta Durikarner Mahat Prayas*" got registered on 30 May 2024 with Copyright Regn. No. CF-5695/2024.
- "Sarana - A Lucrative Species in Pen Based Model in Wetland for Auto Recruitment" got registered on 23 July 2024 with Copyright Regn no CF-5720/2024.
- Copyright entitled "Success Stories of Wetlands of Bihar Series-II" got registered on 06th August 2024 with Copyright Regn No. L-152230/2024.
- "Inland Fisheries Development in Mayurbhanj" got registered on 06 August 2024 with Copyright Regn no. L-152231/2024.
- "Indian Major Carps Conservation Plans and Fish spawn prospecting in River Ganga" got registered on 18 September 2024 with Copyright Regn no. L-153837/2024.

Copyrights Filed

- Copyright application entitled "Eco Restoration of Duma Fisheries – CIFRI Intervention" has been filed on 24 January 2024 with copyright dairy No. 2816/2024-CO/CF.
- Copyright application entitled "Mapping of Inland Water Bodies of Manipur" has been filed on 13 December 2024 with copyright dairy No. 39102/2024-CO/L.

Commercialization and Licensing of Technologies

ICAR-CIFRI has commercialized three technologies namely "CIFRI Fish Tanavhari", "CIFRI Pen HDPE" and "CIFRI Argcure" and non-exclusive license were granted for a period of five years for manufacturing and sale in the territory of India. The commercialization process was completed through Agrinnovate India Ltd, commercial arm of ICAR.

- *CIFRI Fish Tanavhari:* Technology was commercialized on April 16, 2024 to M/s Glaucus Agrochem Pvt Ltd. Kolkata, West Bengal, with a license fee Rs. 7.5 Lakh.
- *CIFRI PEN HDPE:* Technology

was commercialized on September 04, 2024 to M/s M. R. Aquatech, Bhubaneswar, Odisha, with a license fee Rs. 7.5 Lakh.

- *CIFRI ARGCURE®:* Technology was commercialized on November 12, 2024 to M/s Envozyme Technology Pvt. Ltd., Hyderabad, Telangana, with a license fee Rs. 7.5 Lakh.

Memorandum of Understandings (MoU) signed

Ten MoUs were signed in the year 2024, four with central government departments/public institutions and one with state government department and two for technical guidance to Non-government organizations and three with private companies for technology commercialization.

MoU Signed with Central Government Department/Public Institution/Public Sector unit

- Memorandum of Understanding was signed on 19 March 2024 at Maithon, Jharkhand with Damodar Valley Corporation (DVC) for *establishing Cage Culture station at Maithon reservoir, Jharkhand.*
- MOU was signed with CSR-Brahmaputra Cracker and Polymer Limited (BCPL) on 14 June 2024 for *Nutritional profiling of fishes of Sessa River, Dibrugarh, Assam and sensitization on health benefit of fish consumption*.
- MOU was signed with CSB-Central Tasar Research & Training Institute, Ranchi, Jharkhand on 20 September 2024 for *Nutraceutical solution for sustainable aquaculture: Extraction and utilization of tasar pupae oil and meal in feed formulation*.
- MOU was signed with State Bank of India, Kolkata on 23 December 2024 for Project: *Backyard Pond aquaculture in Sunderban through model village development for sustainable livelihood development*.

MoU Signed with State Government Department

- MoU was signed with Department of Fisheries, Government of Odisha on 27 June 2024 at Cuttack, Odisha for *Establishing Cage culture facility at Zone 5 Hirakud reservoir, Odisha.*

MOU Signed for Technical Guidance (NGO)

- MoU was signed between ICAR-CIFRI, Barrackpore and Ramakrishna Sevashrama, Kulana, Manjuri Road, Bhadrak, Odisha on 31 July 2024 for *establishing training facility at Ramakrishna Sevashrama, Kulana, Manjuri Road, Bhadrak, Odisha*.
- MoU was signed between ICAR-CIFRI, Barrackpore and Development Foundation Rural Access, New Delhi on 08 June 2024 for *Training and capcity-building programs for farmers and officers on inland fisheries as an alternate source of income in inland fisheries*.

MOU Signed for Technology Commercialization

- MoU was signed with M/s Glaucus Agrochem Pvt. Ltd., Kolkata and ICAR-CIFRI, Barrackpore through Agrinnovate India Ltd. (AgIn) on 16 April 2024 at ICAR-CIFRI, Barrackpore, Kolkata for non-exclusive license agreement of ''CIFRI Fish Tanavhari '' technology.
- MoU was signed with M/s M.R. Aquatech, Bhubaneswar, Odisha and ICAR-CIFRI, Barrackpore through Agrinnovate India Ltd. (AgIn) on 4 September 2024 at ICAR-CIFRI Barrackpore, Kolkata for non-exclusive license agreement of "CIFRI PEN HDPE" technology.
- MoU was signed with M/s Envozyme Technology Pvt. Ltd., Hyderabad, Telangana and ICAR-CIFRI, Barrackpore through Agrinnovate India Ltd. (AgIn) on 12 November 2024 at ICAR-CIFRI Barrackpore, Kolkata for non-exclusive license agreement of "CIFRI ARGCURE®" technology

Technology Certificates from the ICAR

- Dr. Aparna Roy (Lead Developer), Dr. Malay Naskar (Lead Developer), Dr. Basanta Kumar Das, Dr. Archana Sinha, Dr. Ranjan Kumar Manna, Mr. Sanjeev Kumar Sahu have been granted Technology certificate by ICAR on 16 July, 2024 for development of "Methodology to quantify the determinants of willingness to-participate and willingness-to-pay".
- Dr. Hemanta Chowdhury (Lead Developer), Dr. A. K. Bera, Dr. D. J. Sarkar, Dr. H. S. Swain, Dr. A. Saha and Dr. B. K. Das have been granted ICAR Technology certificate on 16 July, 2024 for developing "CIFRI Fish Tanavhari: an unique herbal fish sedative/anaesthetic"
- Dr. Sajina A. M. (Lead Developer), Dr. D. Sudheesan, Dr. S. Samanta, Dr. B. K. Das, Dr. S. M. Nair have been granted ICAR technology certificate for development of "Fish-based multi-metric Index of Biotic Integrity for assessing the ecological health of Indian rivers".

Project Title : Planning and Design of Fish Hatchery at Bichom Dam Site Along with Studies on Reproductive Biology of Snow Trout, *Schizothorax richardsonii* for Conservation and Artificial Propagation in River Bichom, Arunachal Pradesh

The Kameng Hydroelectric Project in West Kameng, Arunachal Pradesh, is an ongoing project on the Bichom River, a tributary of the Kameng River. A scientific study was carried out in the Bichom River to facilitate the development and design of a fish hatchery for snow trout (*Schizothorax richardsonii*). The feasibility of establishing a snow trout hatchery has been evaluated through assessing the availability of broodstock, seasonal availability of water, water quality, and the natural reproduction of *S. richardsonii* in the river. Recommendations for the preservation of the snow trout population were given based on the findings. The project involved surveying a 10 km stretch of the Bichom River and its reservoir, both upstream and downstream of the dam. Throughout the study period, 29 parameters of water quality and 9 parameters of sediment quality were examined. The diversity of plankton, periphyton, benthic invertebrates, and fish was documented. Furthermore, data on length frequency distribution, gut content analysis, and several aspects of the reproductive biology of *S. richardsonii*-including maturity stages, ova diameter, fecundity, gonadosomatic index, length at first maturity, and sex ratio-were collected. The viability of establishing a hatchery was also explored.

With regard to fish diversity, a total of 31 species were recorded from the study area. *S. richardsonii* was the most abundant species in the lotic zones (upstream and downstream of the dam), followed by *Neolissochilus hexagonolepis*. The exotic species *Cyprinus carpio* was found to dominate the lentic zone of the Bichom Reservoir, raising serious concerns for the conservation of native fish species. The gut content analysis of *S. richardsonii* revealed



Lotic zone



Lentic zone

Sampling sites at Bichom River, Arunachal Pradesh

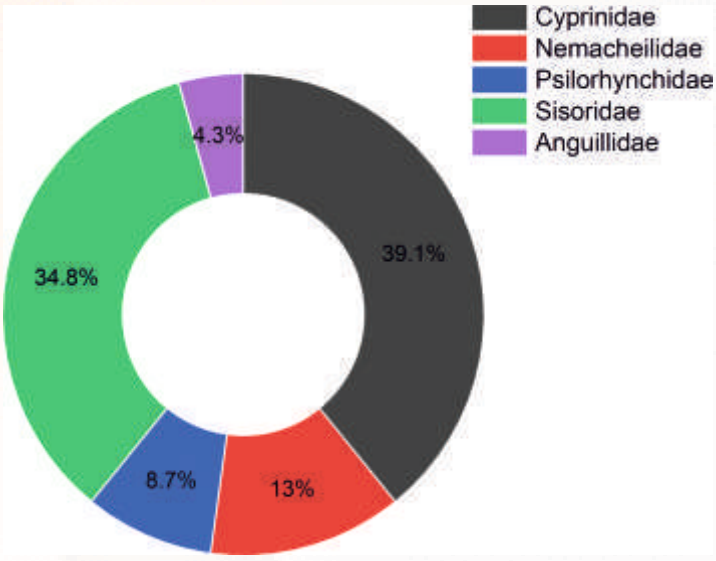


Snow trout (*Schizothorax richardsonii*)

that the species exhibits an omnivorous feeding habit, with diatoms comprising the major part of its diet. Additional components identified in the gut comprised whole algal colonies, insect body parts (e.g., legs and larvae), lipid droplets, sand particles, detritus, as well as both semi-digested and fully digested matter. The species was found to ingest almost any small-sized item regardless of its own size, hence confirming its omnivorous nature. The reproductive biology aspects of *S. richardsonii* have been studied comprehensively.

The reproductive cycle indicated six maturity stages in the pre-monsoon season, two in the monsoon, and six in the post-monsoon season. The findings indicate that the pre-monsoon and early post-monsoon periods are optimal for broodstock collection and rearing in large tanks for breeding purposes (Fig. 2). A design for trout raceways and a proposed layout for the snow trout hatchery, along with essential requirements for hatchery planning and design, have been provided. These initiatives are intended to improve the stocking of *S. richardsonii* brooders, hence facilitating artificial breeding and larval development.

Project Title : Assessment of Fisheries and Ecology in Kameng Basin of Arunachal Pradesh in Relation to Proposed Hydro Power projects at Gongri and Dinchang (Phase I and II)



Percentage contribution of different families to fish diversity of Dirang river, Arunachal Pradesh



S. richardsonii caught from Dirang river

The present study on fisheries and ecology of Dirang river was conducted across seven sampling stations, starting from Dirang town till its confluence with Bichom during 2023 and 2024.

Fish Diversity and Conservation Status

A total of 23 fish species belonging to five families were recorded in our study which includes 22 indigenous species and one exotic species (*Cyprinus carpio*). Cyprinids (9 species) were the most dominant group, followed by Sisorid catfishes (8 species), loaches and eels. Among the indigenous fish species documented, *Schizothorax richardsonii* has been categorized as Vulnerable (VU) according to the IUCN, *Neolissochilus hexagonolepis*, *Bagarius bagarius*, and *Anguilla bengalensis* are categorized as Near Threatened (NT), whereas *Psilorhynchus arunachalensis* and *Creteuchiloglanis kamengensis* are designated as Data Deficient (DD). The indigenous fish species collected from the Dirang River have been classified under Least Concern (LC) category.

Fish Catch

The survey campaign revealed that *S. richardsonii* is the major fish species in the capture from River Dirang, Arunachal Pradesh, at all sampling



A fisherman operating cast net in Dirang river

stations, except at the Bichom Dam site, where the exotic common carp (*C. carpio*) is the most prevalent, followed by chocolate mahseer (*Neolissochilus hexagonolepis*) and snow trout. According to reports from local fishers, both snow trout species, *S. richardsonii* and *S. progastus*, are present in the catch throughout the year from the river. The chocolate mahseer is predominantly caught during the monsoon season and is found occasionally in the other seasons in River Dirang. *Garra* spp., *Glyptothorax* spp., *Schistura* spp., and *Psilorhynchus* spp. have been reported in substantial quantities in catches from the Dirang River during the monsoon, especially when the water becomes turbid.

Fishing Gears and CPUE

Common fishing gears operated in the river include cast nets, gill nets, hook and line, noose and line, while in Bichom reservoir/ Bichom Dam site, gill nets were the only gear operated. As observed, catch per unit effort (CPUE) for noose and line fishing in the river was found to be 1.5-4.0 kg/day. CPUE in case of cast net was observed to be 0.5-1.5 kg/net/hour.

Water Quality Parameters

The recorded water temperature ranged from 8.3 to 12.0° C. Water depth ranged from 0.5-13 m across the studied sites. Most of the sites had clear water and were visible upto bottom. Turbidity of the water ranged between 0.4-1.18 NTU. Specific conductivity, pH and dissolved oxygen (DO) varied from 49.5-74.2 µS/cm, 7.92–8.16 and 8.0–8.8 mg/l respectively. pH and DO were found to be in favourable range for fisheries in River Dirang (Handbook of Fisheries and Aquaculture, 2011; CPCB). Total alkalinity ranged from 24 - 36 mg/l, total hardness from 16-42 mg/l and total dissolved solids from 0.012-0.044 g/l across all the sampling sites. The recorded values ranged from 2.6-4.8 mg/l for free CO_2 and from 5.99-8.99 mg/l for chlorinity across all the sites. Nutrient parameters of water samples were measured and the silicate values were found to be ranging from 12.92 to 19.83 mg/l, sulphate from 0.0079 to 0.0149 mg/l, nitrate from 0.0216 to 0.0553 mg/l, total nitrogen from 0.0323 to 0.0619 mg/l, phosphate from 0.0112 to 0.0269 mg/l and total phosphorus from 0.1457 to 0.2825 mg/l respectively. Biological Oxygen Demand (BOD) was found to range from 0.02-0.08 mg/l.

Project Title : Watershed Development Plan for Micro-Watershed Within 10 km Radius of the 1440 MW Malshej Ghat Bhorande Pumped Storage Project in Thane and Pune District (Maharashtra)

The project endeavors to develop a watershed plan for the Malshej Ghat catchment zone, encompassing a 10 km radius surrounding the proposed Malshej Ghat PSP site at Adoshi and Bhorande villages, situated on the border of Pune and Thane districts in Maharashtra State. The plan complies to the Detailed Project Report (DPR) requirements and involves the construction of two dams: an upper dam situated at a hill summit, harnessing a minor tributary that flows into the Kukadi River, and a lower dam positioned over another minor tributary that merges with the Kalu River. The investigation was carried out by ICAR-CIFRI, Barrackpore, and its affiliated center in Vadodara, and forms a part of the comprehensive Detailed Project Report (DPR) planned for submission to Adani Green Energy Ltd. (AGEL), the official entity regulating renewable power generation in Maharashtra State. The watershed development plan seeks to mitigate anticipated adverse impacts arising from the PSP project, thereby enhancing comprehensive environmental management and the implementation of stringent impact evaluations. The study area extends



Micro watersheds of Malshej Ghat pumped storage project sites

from Latitude 19° 8' 35.1816" N to 19° 27' 58.7628" N and Longitude 73° 30' 23.4504" E to 73° 53' 16.7208" E, covering essential geospatial characteristics crucial for formulating accurate and effective strategies for resource optimization and minimizing environmental impact.

Analysis and Recommendations

A team of multi-disciplinary scientists and technical personnel visited the Malshej Ghat watershed and collected information on various aspects for planning watershed development. The existing information on soil, water, land uses, agricultural scenario, socio-economic status, agri-forestry system, and SWC practices was analyzed, and thematic maps were generated. The research location is home to 20 fish species among seven families. The proposed upper reservoir does not receive runoff from any single watershed, but within a 10 km radius, there exist seven micro-watersheds that contribute their flows to both the Kukadi and Kalu rivers. These watersheds exhibit considerable variation in their respective sizes, ranging from 7087.60 hectares to 20238.42 hectares, and have a total stream length of 1038.18 km, accompanied by variable slopes oscillating between 10% and 60%. The population demographics revealed a total of 74,875 inhabitants, with a literacy rate of 76.58%, and nearly three-quarters of the farming community occupying these lands fall under the classification of marginal, small, or semi-medium scale landholders. The prevailing land uses showed that agriculture is the dominant activity, accounting for almost a quarter of the aggregate watershed area, whereas barren landscapes contributed meagrely to the overall composition. The strengths found in these watersheds include existing soil conservation initiatives, active participation from extension services, widespread adoption of diversified seasonal crops, prevalence of drip irrigation, and flourishing agri-horticultural activities. However, weaknesses such as relatively smaller individual farmlands, erratic and deficient rainfall, degradation caused by soil erosion, suboptimal productivity in borewells, limited supply of animal fodder, and scarcity of innovative farming tactics were also observed.

Implementation and Anticipated Outcomes

To capitalize on arising opportunities, several strategies were put forward to augment rainwater harvesting efficiency, including compartmental bunding, pest management, establishment of Farmer Producer Organizations (FPOs) focused on horticulture, improving soil moisture retention through excavated trenches beneath fruit trees, replenishing aquifers utilizing Soil Water Conservation (SWC) measures, and installing water preservation facilities. An array of remediation proposals amounting to INR 7.58 crores has been devised exclusively for addressing watershed advancement purposes. Key recommendations involve the deployment of assorted infrastructure, such as Loose Boulder Check Dams (LBCD), Gabion Check Dams (GCD), Masonry Check Dams, tiered trenches, and trench cum bunds (TCB)/Field bounds. Additional suggestions entail capacity building programs and consciousness campaigns centered on dryland cultivation methodologies, added-value enhancement of agricultural commodities, vocational education schemes for jobless populations, female empowerment initiatives, and alternate income sources. The anticipated outcomes incorporate a decrease in soil loss (15-22%), increase in groundwater tables (9-14%), amplification of crop returns (14-18%), intensified cropping pattern, increased labor engagement, diminished urban drift, and overall prosperity elevation. Collectively, these endeavors seek to induce transformative improvements in agricultural settings whilst simultaneously endorsing ecological stability inside the Malshej Ghat watershed.

Project Title: Watershed Development Plan for Micro- Watershed Within 10 km Radius of the 1200 MW Warsgaon Warangi Pumped Storage Project Village Teckpole and Warangi, Tehsil Velhe and Mahad, District Pune & Raigad (Maharashtra)

The Warasgaon-Warangi watershed, situated in the Pune-Raigad region of Maharashtra, India, is a vital region that requires a comprehensive development plan to ensure the sustainable utilization of its natural resources. This plan aims to align economic growth with ecological stewardship, creating a resilient and thriving ecosystem where human welfare and ecological sustainability are inextricably linked. The study area covers around 150,600.75 hectares and is comprised of nine interconnected micro-watersheds, each exhibiting a variety of topographical features, demographics, and agricultural practices. The resident population of 32,667 individuals have a commendable literacy rate of 81.25%. The watershed is home to19 fish species across seven families, indicating a rich ichthyofaunal diversity. The watershed exhibits several strengths, such as established soil and water conservation efforts, proactive extension services, and widespread adoption of field bunds for annual crops. However, constraints such as smaller land holdings, erratic rainfall, soil erosion, and limited fodder accessibility needs to be addressed.



Micro watersheds of Warsgaon Warangi pumped storage project sites

Analysis and Recommendations

The analysis of the watershed's strengths, weaknesses, opportunities, and threats (SWOT) reveals that there are opportunities for improvement, including enhancing rainwater utilization efficiency, integrated nutrient and pest management, and establishment of Farmer Producer Organizations (FPOs) and Self Help Groups (SHGs). To capitalize on these opportunities, the report suggests implementing a range of measures, including compartmental bunding, integrated nutrient and pest management, and establishment of FPOs and SHGs. Additionally, the report recommends implementing soil and water conservation (SWC) methods, including engineering and agronomic measures, to reduce soil erosion and improve water quality. The report also suggests promoting dry land farming systems, value addition in agriculture products, and skills enhancement for landless persons. Furthermore, the report recommends implementing ecologically sound solutions like agro-forestation, social forestry, and afforestation to promote biodiversity and ecosystem services.

Implementation and Anticipated Outcomes

The recommended treatments require an investment of INR 4.42 crores, which will be used to implement diverse structures for drainage line and area treatments, such as Loose Boulder Check Dams (LBCD), Gabion Check Dams (GCD), and Masonry Check Dams. The execution of these recommendations is expected to result in a range of benefits, including a 16-22% decrease in soil erosion, a 10-15% rise in groundwater levels, and a 15-18% intensification in crop output. Additionally, the plan is expected to lead to changed cropping patterns and increased cropping intensity, livestock development, and conservation of aquatic biodiversity. The plan will also contribute to improved livelihood and nutritional security, and reduced migratory trends. The Watershed Development Plan for Warasgaon-Warangi micro-watersheds aims to create a sustainable and resilient ecosystem, promoting economic development while conserving natural resources, and ultimately improving the quality of life for the local communities.

Project Title: Study on Impact of Water Intake Due to Gadarwara STPP on Ecology of Narmada River

NTPC Limited is operating the Gadarwara Super Thermal Power Project (STPP), capacity 1600 MW in the Narasinghpur district of Madhya Pradesh for fulfilling the power requirements of the western region. To operate the power station, water is sourced from River Narmada. A pumping station has been established at Kakraghat, which is 30 km distant from the thermal power station. The present demand of water is about 6000 m^3/hr. Realizing the importance of maintenance of desired flow in the river Narmada, as per the requirements of NTPC, Gadarwara, a study was conducted by the Institute to understand the impact of water withdrawal on flow and aquatic ecology of River Narmada. Additionally, the aspect of effluent discharge from the power plant into river Sitareva was also assessed.

Narmada is most important west-flowing river with tremendous ecological significance but is having limited flow in the non-monsoon months. Water is abstracted for agricultural use and power generation. After withdrawal of water by the NTPC, Gadarwara @ 6000 m^3/h, the river is maintaining a steady flow even in the pre-monsoon months when the minimum flow was recorded. The previously established BLA power plant, which is drawing water from the lower stretch at Tuiyapani of river Narmada, is also facing no shortfall of water during the lean period.



NTPC Gadarwara super thermal power project



NTPC water intake channel at Kakraghat

The present state of water and sediment quality were evaluated as good and suitable for supporting growth and development of the aquatic communities. The studied stretch of River Narmada is maintaining wide diversity of microbial community, which is conducive for the development of other biotic communities. The plankton and benthic diversity were moderate as evaluated by the abundance study and various diversity indices. From the study, it was inferred that the aquatic communities of river Narmada are not facing any stress due to present level of water withdrawal from river Narmada by the NTPC Gadarwara STPP.

A detailed study was undertaken to understand the present diversity of fish species. A total of 63 finfish and 1 shellfish species were recorded from the explored stretches of rivers Narmada and Sitareva. Earlier report mentioned 53 finfish and 3 shellfish species (ICAR-CIFRI Bulletin 157, 2009) from the Gadarwara to Harsud stretch of river Narmada. The present status of riverine fisheries has been studied in detail with emphasis of fish diversity, abundance, fishing gears operated, and catch per unit effort. No decrease in fish catch was recorded in comparison to the previous reports.

The water management system of the NTPC Gadarwara plant was noted to be unique and highly efficient. A significant part of water is recycled for internal use including ash pond management. The NTPC Gadarwara

STPP is thus, true to its committed Zero Liquid Discharge (ZLD) system. Since no discharge was recorded to enter into the designated effluent discharge site of river Sitareva, as recorded from the present study, no associated risk is anticipated. From the information generated out of the study and considering all the aspects including the present level of flow in river Narmada, it was recommended that a quick survey may be made at least in every 2 years preferably during pre-monsoon months as a monitoring measure to avoid any unwanted scenario.



Fishing activity in upper Hooghly esturay

वार्षिक प्रतिवेदन

Annual Report

2024

The research and development activities in the North-East Himalayan region were executed in the form of following projects:

Project Code: NEH/20-23/03

Project Title: Refinement of Management Strategies for Open-Water Fisheries of Northeastern Region Through Location and Ecosystem-Based Approaches

Duration: 01.04.2020 – 31.03.2024

Sub-project 1: Sustainable Utilization of Openwater Fisheries in Assam and Nagaland Through Community Participation

Culture-Based Fisheries in Closed Beels

Culture-based fisheries protocols were demonstrated to create awareness among fishers through supplementary stocking in six closed beels (Bamuni, Saren, Charan, Borboi, Go, and Lakhanabandha beel) located in five districts of Assam. A total of 2.36 lakh advanced fingerlings of IMCs and minor carps were stocked in the beels resulting in increase in fish yield from 270.61 kg/ha to 448.12 kg/ha. Following the intervention, average fish yield in the beels increased by 65.6% with highest increase (115%) noted in Bamuni and Saren beels. The program benefitted over 500 fisher families of six beels in terms of fish production. Revenue were shared equally among the fishers.



Fishing in Bamuni beel

Fish Stock Enhancement in Seasonally Open Beels

A study in 10 seasonally open beels (Rowmari, Rupahi, Kapla, Borkona, Ghorajan, Hiragota-Roumari, Duamara-Batamara, Dandua, Kachodhara and Dhamal) in Central and Lower Brahmaputra Valley of Assam revealed 21.6% increase in average fish yield following stocking of 4.09 lakh advanced fingerlings of IMCs and minor carps by ICAR-CIFRI. Maximum increase in fish yield was observed in Duamara-Batamara beel (148%). The gross revenue was shared in 60 (lessee):40 (fishers) basis in all beels except Dhamal *beel* where the revenue was equally shared among fishers. More than 900 fisher families got benefit in terms of per capita fish production and revenue per fisher per year by adopting CIFRI's intervention.

Sub-Project 2: Enclosure Culture in Openwaters of Manipur Incorporating Locally Important Fish Species for Stock Replenishment and Table Fish Production

Cage Culture Technology Demonstration in Takmu Pat

Takmu pat (wetland) in Bishnupur district of Manipur was studied for ecology and fisheries which showed congenial environment for fisheries with 6.5-7.0 mg/l dissolved oxygen, undetectable level of free carbon dioxide, 85-95 cm Secchi disc visibility, 25-30 mg/l of total alkalinity, 6.6-6.8 pH and 23.8-28°C water temperature. Fish catch from the lake is dominated by exotic fishes such as *Cyprinus carpio*, *Ctenopharyngodon idella*, *Hypophthalmichthys molitrix*, *Hypophthalmichthys nobilis* and tilapia. The indigenous fish species caught included *Labeo catla*, *Labeo rohita* and *Cirrhinus mrigala*, *Amblypharyngodon mola*, *Puntius* spp., *Channa punctatus*, *Channa striatus*, *Glossogobius giuris*, etc.

ICAR-CIFRI in collaboration with the Department of Fisheries, Govt. of Manipur demonstrated cage culture technology in Takmu pat. In the first trial, monoculture of *Osteobrama belangeri* (locally called *Pengba*)



Fishers engaged in cage culture in Takmu pat

was carried out in HDPE cages for table size production. Fingerlings of *Pengba* (12.20 ± 0.37 cm size) were stocked @ 10, 20, 30, 40 and 50 No./m^3 stocking densities and fed CIFRI CageGrow feed (28% crude protein). After 8 months of rearing, the growth performance of the reared fish was found to be inversely proportional to the stocking density while the mortality was directly related to stocking density. The net fish yield was highest (2.06 kg/m^3) at stocking density of 30 no./m^3. However, economic analysis indicated decreased benefit cost ratio (B:C) with increase in stocking density, mainly because of high fingerling cost. Thus, at present cost structure, stocking density of 20 no./m^3 would give better economic returns for rearing *O. belangeri* in cages. The cage-grown fish were released in the wetland for their further growth and propagation.

In the second trial, monoculture of *Osteobrama belangeri*, *Ctenopharyngodon idella* and *Labeo bata* was carried out to compare growth and economics of production in cages. The three species were stocked at 30 fingerlings/m^3 and fed pelleted diet containing 28% crude protein. The initial average weight of the stocked fish were 8.68±0.66 g for *O. belangeri*, 20.32±1.22 g for *C. idella* and 7.68±0.25 g for *L. bata*. It was observed that *C. idella* gained the highest growth followed by *O. belangeri* and *L. bata* with specific growth rates of 1.76, 1.43 and 1.05, respectively.



Director, ICAR-CIFRI visiting cage culture site in Dumbur reservoir

Sub-project 3: Refinement of Cage Culture and Species Enhancement in Dumbur Reservoir of Tripura

Cage Culture in Dumbur Reservoir

ICAR-CIFRI in collaboration with Dept. of Fisheries, Govt. of Tripura initiated cage culture in Dumbur reservoir to standardize and demonstrate culture protocols of *Cyprinus carpio* and *Ctenopharyngodon idella* in cages. At present, a total of 1512 no. of cages (1176 no. in Dhalai and 336 no. in Gomati districts) are there in the reservoir and fishers mainly culture IMCs (catla, rohu, mrigal), *Pangasius* sp., exotic carps (grass carp, common carp). With this demonstration of cage culture in the reservoir in active collaboration with Department of Fisheries, Govt. of Tripura, it is expected that the fishers will take up culture of diverse species as a profitable enterprise.

Governance and Management Guidelines

Dumbur reservoir is under the administrative control of the Department of Fisheries (DoF), Govt. of Tripura. Licenses for fishing in the reservoir are issued to fishers by the DoF. Based on our investigations and interactions with stakeholders, following action plans are recommended for sustainable fisheries management in Dumbur reservoir: (i) effective implementation of the fishing ban during monsoon season to facilitate auto-stocking of many fish species, (ii) stocking size of >10 cm and 1000 number of major and minor carp fingerlings per hectare is recommended, (iii) large number of cage units already installed in the reservoir can

be utilized for fish production, (iv) capacity building (including exposure visits) of departmental staff and farmers on cage culture, (v) ensuring supply of quality seed and feed for cage culture operations in the reservoir and (vi) formation of cohesive groups for better operational convenience.

Sub-Project 4: Refinement of Cage Aquaculture Technology in Reservoirs of Mizoram

Cage Culture Practice in the Reservoirs of Mizoram

The medium reservoir Serlui-B (4,000 ha) is under the administrative control of the Department of Fisheries, Govt. of Mizoram. The reservoir is usually leased out to individuals or groups for fishing an annual basis by the Government. ICAR-CIFRI generated data on fisheries of the reservoir. A total of 46 fish species belonging to 6 orders, 18 families and 35 genera were recorded from the reservoir. A total of 7 batteries of 16 cages (6 x 4 x 4 m^3) were installed in the reservoir in 2012 under RKVY where fish species like Pangus (*Pangasianodon hypophthalmus*) and grass carp (*Ctenopharyngodon idella*) were cultured without remunerative returns. At present, the cages remained unused.

Certain management and conservation strategies for sustainable utilization of the reservoir need to be addressed immediately: (i) lease period may be increased to reduce fishing pressure, (ii) cage culture of locally demanded fish species following scientific protocol, (iii) banning of destructive fishing practices, (iv) capacity building of departmental staffs and fishers on reservoir fisheries management including cage culture technology.



Present state of cages in Serlui-B reservoir

Sub-Project 5: Sustainable Utilization of Reservoir Fisheries of Meghalaya Through Community Participation

Cage Culture in Mid-altitude Reservoirs as a Summer Crop

Cage culture can greatly enhance reservoir productivity. However, cage culture protocols of diversified fish species at mid-altitude sub-tropical areas are yet to be developed. In this context, polyculture of carps in Umiam reservoir through fisherwomen participation was assessed. Umiam reservoir (500 ha) in Meghalaya is situated above 900 m MSL. A battery of six CIFRI GI cages was installed in the reservoir and fingerlings of *Cyprinus carpio*, *Barbonymous gonionotus* and *Labeo rohita* in 60:20:20 ratio was stocked in the cages at 3 stocking densities *viz*., 10, 15 and 20 no./m^3. Fishes were fed twice daily with CIFRI-



Cages in mid-altitude reservoir in Meghalaya



Fish harvest from cages in Umiam reservoir

CAGEGROW (CP 28%) floating feed @ 2-5% of body weight by the local fisher women under Ri-Bhoi Farmers' Union. Growth and water quality were monitored at monthly intervals. After six months of rearing, an average fish production of 5-6 kg/ m^3 cage was achieved. Common carp was the best performing species followed by Silver barb in terms of growth and survival. Silver barb also acted as cleaner of net cages. Present study indicated that common carp in combination of silver barb can be a model for cage culture in mid-altitude reservoirs of Northeast India as a summer crop.



Growth of Common carp reared in cages in mid-altitude reservoir



Growth of Silver barb reared in cages in mid-altitude reservoir



Macrophyte covered Bor *beel* and its cage culture facility

Sub-project 6: Refinement of Enclosure Culture Technologies for Stock Enhancement and Table Fish Production in Open Waters of Arunachal Pradesh

Feasibility of Enclosure Culture in Weed-Choked *Beel* in Arunachal Pradesh

Department of Fisheries, Government of Arunachal Pradesh, installed a battery of 16 cages in Bor *Beel*. However, the *beel* is heavily infested with macrophytes, making it

unsuitable for cage culture and fisheries activities. Local fishers may be encouraged for removal of the macrophyte to make space for fisheries and enclosure culture activities through community participation. In this direction, ICAR-CIFRI successfully demonstrated pen culture of fish in Bor *Beel*. The pens were stocked with *Labeo rohita*, *Hypophthalmichthys molitrix*, *Cirrhinus mrigala*, *Cyprinus carpio*, *Labeo gonius*, and *Labeo bata* and offered CIFRI CAGEGROW feed (28% CP). Pen culture has helped diversify the income sources for the *beel* fishers.

Project Code: NEH/2024-27/04

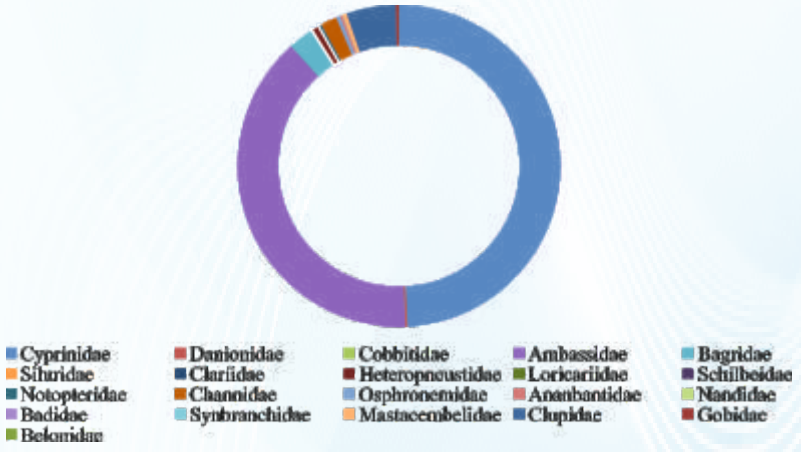
Project Title: Sustainable Management of Inland Open Water Fisheries of North-eastern India

Duration: 01.04.2024 – 31.03.2027

Implication of Sustainable Management on Production and Conservation of Open-water Fisheries of NE

Northeastern states, comprising Arunachal Pradesh, Assam, Manipur, Meghalaya, Nagaland, Mizoram, Tripura, and Sikkim, have predominantly hilly landscape with diverse inland open-water fisheries resources in the form of rivers and canals (20,875 km), floodplain wetlands (1,34,209 ha), reservoirs (21,237 ha) and derelict water bodies (1,03,211 ha). There are 58 notable rivers in the region besides numerous rivulets/ hill streams. These important fisheries resources support livelihood and nutritional security of millions of people. More than 90% of the population along the region are fish eaters. The region is considered as one of the hot spots of freshwater fish diversity with 422 fish species belonging to 133 genera and 38 families.

These resources have immense fisheries potentials. Floodplain wetlands and reservoirs of the region have high fish production potential with 1000-1500 and 100-500 kg/ha/yr respectively . The potential productivity has been estimated at 900 kg/km/yr for river Brahmaputra and 450 kg/km/yr for its tributaries including Barak River. Efforts are required from all stakeholders, including policy makers, to realize huge fish production potential of these aquatic resources in a sustainable manner.



Relative abundance of different fish families in Deepor *beel*

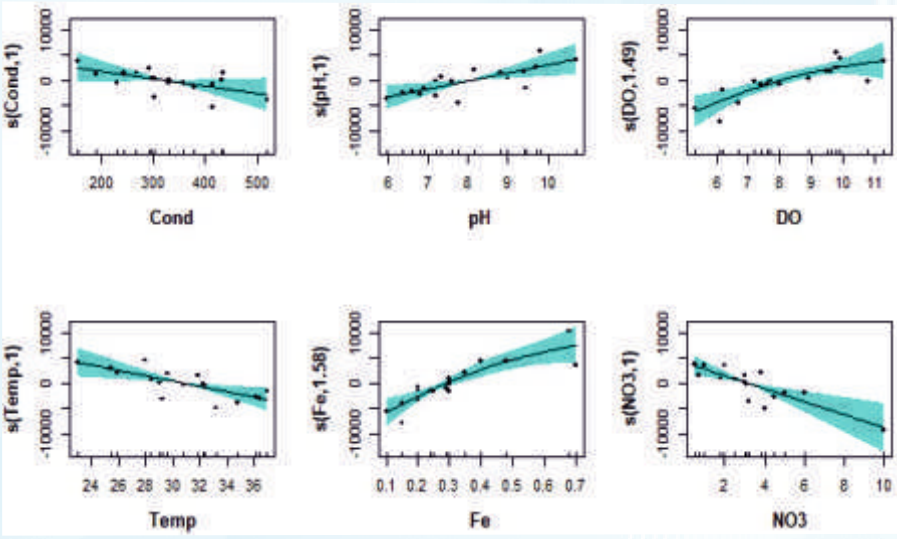
Fish Community Structure and ecology of Deepor *beel*, Assam

A total of 55 fish species, belonging to 21 families and 9 orders, were recorded from Deepor *Beel*, Assam. Among these, the order Cypriniformes (carps) was the most diverse, comprising of 24 species, followed by Siluriformes(11 species), Anabantiformes (9 species), and Perciformes (4 species). In terms of relative abundance, the family Cyprinidae accounted for the largest proportion (49.15%), followed by Ambassidae (38.98%), Clupeidae (4.97%), Bagridae (2.66%), and Channidae (1.63%).

The association between environmental variables and abundance of dominant species, viz. *Amblypharyngodon mola, Chanda nama* and *Paramabassis ranga* were examined. General Additive Modelling (GAM) revealed that abundance of *A. mola* is influenced by total dissolved solids (TDS), dissolved oxygen (DO), pH, iron and nitrate (NO_3), while *C. nama* is influenced by specific conductivity (Cond), pH, DO, Water Temperature (Temp.), iron and NO_3. The abundance of *P. ranga* is influenced by free carbon-dioxide (FCO_2), transparency (Trans), NO_3 and Ammonia (NH_4).

Feasibility of Sustainable Fisheries in Openwater Bodies of BTC, Assam

ICAR-CIFRI carried out field visits to four open-water bodies of Bodoland Territorial Council (BTC), Kokrajhar, Assam to assess feasibility for sustainable fisheries



Relationship between environmental variables with abundance of *C. nama*

utilization in collaboration with the Department of Fisheries (DoF), BTC. These open-water bodies include Sareswar *Beel*, Shilai-Nalia *Beel*, Diplai *Beel* (Kokrajhar District) and Champamati Irrigation Project (Bijni District). Sareswar *Beel*, a seasonally open *beel* connected to River Gadhadhar, is the most important capture fisheries resource of BTC with a total area of 478 ha. Shilai-Nalia *Beel* (a meander-scroll depression) is another potential capture fisheries resource having 709.5 ha area. Diplai *Beel* integrates natural fisheries, eco-tourism and forest. Champamati Irrigation Project is a small run-of-the-river project (weir length: 258.50 m) commissioned in 2005-06 for irrigation and limited electricity generation.

The wetlands are characterized by moderate transparency (45-50 cm), alkaline pH (7.8-8.7), optimal dissolved oxygen concentrations (6.7-7.1 mg/l), medium levels of total alkalinity (14-37 mg/l) and total hardness (10-68 mg/l), low to medium TDS (23.7-110.0 mg/l) and electrical conductivity (33.3-153.6 µmhos/cm) and moderate available phosphorus levels (0.005-0.0117 mg/l) indicating that the wetlands are suitable for fish production.

Fisheries

Sareswar, Shilai-Nalia and Diplai *beel* are under the administrative



Champamati Irrigation Project, BTR, Assam



Sareswar *beel*, BTR, Assam



Shilai-Nalia *beel*, BTR, Assam



Diplai *beel*, BTR, Assam

control of BTC who lease the water bodies to fishers' cooperative society (in Sareswar *beel*) or to private parties for three years through competitive bidding. All the *beel*s are managed as capture fisheries at present and no fisheries management options are practiced except for Diplai *beel* where limited fish stock enhancement is practiced by the lessee. No record of fish production is maintained by the *beel* managers/lessees. Apparently, fish production is low in all the *beel*s as indicated by the low annual lease value. For example, Sareswar *beel* has been leased for Rs 12 lakh/yr. Shilai-Nalia *Beel* (709.5 ha) fetches a revenue of Rs. 11.9 lakh/yr. Approximately 37 ha of beel area is leased by the DoF, BTC to a private party at a lease value of Rs 3.5 lakh/yr for 5 years. The lessee reportedly collects 25% share of catch from the fishers as revenue. Sareswar *beel* has an active fisher population of 110 (including 40 scheduled caste and 70 Muslim). The other wetlands support a few local fishers/villagers. Migratory fishers are engaged by the lessee for katal fishing in Diplai *Beel*. Champamati Irrigation Project is an open access water body under the Irrigation department of BTC and people belonging to Bodo and Tea Tribes carry out subsistence fishing in the small water body.

Fish catch of all the wetlands are reportedly dominated by small indigenous fishes (*Puntius* spp., *Trichogaster* spp., *Chanda nama, Pseudambassis* spp., *Notopterus notopterus, Anabas testudineus, Channa punctata, C. striata, Wallago attu*, *Heteropneustes fossilis, Clarias magur*, *Macrognathus* spp., *Mastacembelus armatus*, *Mystus* spp.) and small prawns (*Macrobrachium* spp.). The Indian major carps (Rohu, Mrigal, Catla), *Chitala chitala, Sperata* spp.,and *C. marulius* are reportedly caught is low numbers. Dry puthi (*Puntius* spp.) from Shilai *beel* reportedly fetches high price in the Jagiroad dry fish market. The main fishing gear used are gill net, dip net, cast net and katal/jeng fishing. In Diplai *beel* 6 katals were recorded.

Major problems faced by the wetlands

Siltation and reduction of available water area for fisheries are the most serious problems faced by fisheries of the selected wetlands, except in Diplai *beel*. An estimated 150 ha area have reportedly been reduced in Shilai-Nalia *beel* over the years due to siltation. Heavy infestation of free-floating (mainly water hyacinth), submerged (mainly *Hydrilla verticellata, Vallisneria spiralis, Najas* sp.,) and rooted emergent macrophytes (mainly *Nymphaea nucifera*) is another major problem affecting fisheries in all the wetlands. In Sareswar *beel*, installation of screens by the local people in the connecting channel with River Gadhadhar reportedly hampers auto-recruitment of fishes from the river. Siltation and encroachment of the connecting channel with Silai river (10 km), use of destructive fishing gear (mosquito net/seed *jal*, Ring *jal*/ *Pagla jal*) and use of pesticides in Ravi rice (IRRI) cultivation are the other major problems affecting sustainability of natural fisheries. In Diplai *beel*, auto-stocking from Diplai river is hampered due to intense fishing in the narrow sluice gate with mosquito net (*mosori jal*) and dip nets (*Khora/ Dheki jal*).

Sustainable utilization of the wetlands for fisheries

Sareswar and Diplai *beels* are suitable for practicing fish stock enhancements considering their shallow depth (maximum recorded depth 9 feet during December) and high recapture potential. Pen culture can be practiced in marginal areas of all the wetlands (except Shilai-Nalia *beel*) during the non-rainy months since these are shallow. Water level fluctuation is minimal in Champamati Irrigation Project due to operation of floodgates during high discharge periods rendering it suitable for pen culture. There is need to undertake need-based control of macrophytes (habitat enhancement) in all the wetlands for rejuvenation of their natural fisheries especially in Shilai-Nalia *beel*. Most of the areas of Shilai-Nalia *beel* nearly dry up during the winter and pre-monsoon seasons rendering it a fit case for undertaking habitat enhancement to re-juvenate and conserve its natural fisheries. There is a need to create deep pools and need-based desiltation of the connecting channels for conservation of indigenous fish stocks and rejuvenation of natural fisheries.

Exotic Vermiculated Sailfin Catfish Documented from Open-waters in Assam

Pterygoplichthys disjunctivus, commonly known as Vermiculated Sailfin catfish, is a species native to South America, specifically found in the Amazon River Basin and various river systems throughout Peru, Ecuador, Brazil, and Colombia. A single specimen of *P. disjunctivus* measuring 28.1 cm and 20.7 cm in SL has been documented from the Deepor *beel*, the only Ramsar site in Assam raising serious concern for the *beel* ecosystem, which harbors rich faunal diversity as well as has river connectivity.



Sailfin catfish *Pterygoplichthys disjunctivus* from Deepor *Beel*



Inner view of *Dori*



Dori set in slow-moving water



View of *Moi* jal operated in lower stretches of river Brahmaputra

Invasion by the fish has also been documented for the first time in the Chiri River (Silchar, Assam), a tributary of Barak River. The total length of the single specimen was 29.5 cm, with a total weight of 166.5 g.

Traditional Fishing Gears in Barak Valley

A traditional fishing trap, locally known as *Dori*, is an energy efficient and cost-effective fishing gear widely used by fishers of Sone *beel* in Karimganj district of Assam. It is a box trap, made up of split bamboo structure with 'V' shaped inlet valves, and 'U' shaped cross section at the rear. It is vertically set in the slow-moving water and marginal areas of *beel* with its mouth directed towards water current. The major catch in this trap comprises of *Puntius* spp., *Chanda* spp., *Mystus* spp., *Macrognathus* spp., etc. including prawns. The quantity of catch varies from 250 g to 3.5 kg in one operation. Reportedly, the cost of the trap varies from Rs. 350-1500 depending on the size, with a life span of 2-3 years.

A dragged gear, locally known as *Moi jal*, is a moderate sized-net primarily operated in shallow riverine waters and mainly observed in lower stretches of river Brahmaputra in post-monsoon season. Its lower margin is provided with bag-like pockets designed to trap fish effectively. Mesh size at the bottom of the net is about 1.0 cm, which gradually increases to 4.0-5.0 cm near the head rope. The net is kept vertical while dragging through water by attaching appropriate floats and sinkers. The major catch in gear comprises of *Gagata* spp., *Mystus* spp., small prawns, etc. Reportedly, the cost of the gear varies from Rs. 750-1500 depending on the size, with a life span of 2-3 years. The CPUE varies from 2.5 kg-5.0 kg/net/day.

Formaldehyde Detection in Fish Samples of Guwahati Fish Markets

A survey was conducted in two wholesale fish markets of Guwahati, namely, Uzanbazar and Betkuchi for detection of formaldehyde in fish. One, out of six muscle samples, collected from local fish were found to have traces of formaldehyde (0.0169 to 0.0785 µg/g) which might be safe for human health and produced naturally in fish during post-mortem degradation. On the contrary, fishes brought in from Andhra Pradesh or West Bengal did not have any traces of formaldehyde.

Exploratory Survey in Caves of Meghalaya

ICAR-CIFRI surveyed fish diversity in two unexplored caves, *viz*. Krem Tyngheng, located near Samasi village and Krem Lymmit, located near Kseh village, East Jaintia Hills, Meghalaya. A total of 11 fish species, *viz*. *Channa aristonei, Channa gachua, Puntius sophore, Cyprinus carpio, Neolissochilus hexagonolepis, Badis badis, Badis assamensis, Schistura multifasciata, Devario aequipinnatus, Devario dangila, Amblyceps* sp., were recorded. *Channa aristonei* and *C. gachua* are high value ornamental species. In addition, crabs and freshwater prawns were also recorded in both the caves.

Water quality parameters of Krem Tyngheng and Krem Lymmit caves were also studied. Specific conductivity, total dissolved solids (TDS), calcium Hardness are on the higher side in both the caves, which may be attributed to the limestone formations.

Habitat Ecology and Fisheries of Umiam Reservoir

Umiam reservoir in the Northeastern state of Meghalaya is situated at an altitude of 900 m above mean sea level with water spread area 500 ha. Most of the critical water quality

parameters including temperature (16.50-28.50ºC), pH (5.98-8.90), dissolved oxygen (5.62-8.68 mg/L), free CO_2 (1.5- 5.5 mg/L), total alkalinity (22-56 mg/L), transparency (1.65-2.27 m), total phosphorous (45-125 µg/L) chlorophyll-a (22-45 µg/L), specific conductivity (38-87 µS/cm) and total dissolved solids (15-44 mg/L) indicate favourable condition for fisheries. Sediment is sandy loam in nature with highest content of sand (65-75%), followed by silt (15-25%) and clay (10-20%). The pH (5.45-6.25) of the sediment was acidic. Phytoplankton population was dominated by Bacillariophyceae (47.15-74.34%), followed by Chlorophyceae (16.76-29.73%), Desimidaceae (2.74-14.11%), Myxophyceae (4.07-9.01%) and Gonatozygaceae (2-2.81%). Periphyton population was dominated by Bacillariophyceae (47.60-62.13 %), followed by Chlorophyceae (14.9-20.65%), Myxophyceae (14.16-19.52%), Gonatozygaceae (6.29-8.17%) and Desimidaceae (1.29-3.45%). Plankton (663.64-848.49 no./L) and periphyton density (565-975 no./cm^2) recorded were moderately high indicating availability of natural food for fishes. Gross primary productivity (130-250 mgC/m^3/day) of Umiam indicated productive ecosystem for fisheries.

There is no organized fishery in this reservoir and it has remained as an open-access capture fishery resource. Subsistence fishing and limited commercial fishing (using gill nets) by some local people (belonging to Khasi tribe) in an unorganized manner were being carried out in the reservoir. Fishing is majorly done by employing gill net, cast net and angling; angling has been a major tourist attraction as sports fishing. *Cyrprinus carpio* has established in the reservoir and dominates fish catch, while indigenous chocolate mahseer (*Neolissocheilus hexagonolepis*) occur in low numbers. We recorded five varieties/strains of *Cyprinus carpio* viz., *Cyprinus carpio* var. *communis* (Scale carp), *Cyprinus carpio* var. *specularis* (Mirror carp), *Cyprinus carpio* var. *nudus* (Leather carp), *Cyprinus carpio* var. *koi* (Koi carp) and *C. carpio* var. *haematopterus* (Amur carp). Among these, scale carp is recorded most frequently and contributes significantly to fishers' livelihood since catch of indigenous fishes including *N. hexagonolepis* has been declining in the reservoir. We recorded Leather and Amur carp in the reservoir for the first time. A total of 38 fish species has been documented from the reservoir. Order Cypriniformes and Cyprinidae family contributed the maximum number of species. Exotic carnivore *Clarias gariepinus* was also recorded from the reservoir, indicating threat to icthyofaunal diversity of the reservoir.

Table: Salient water quality parameters of KremTyngheng and KremLymmit caves

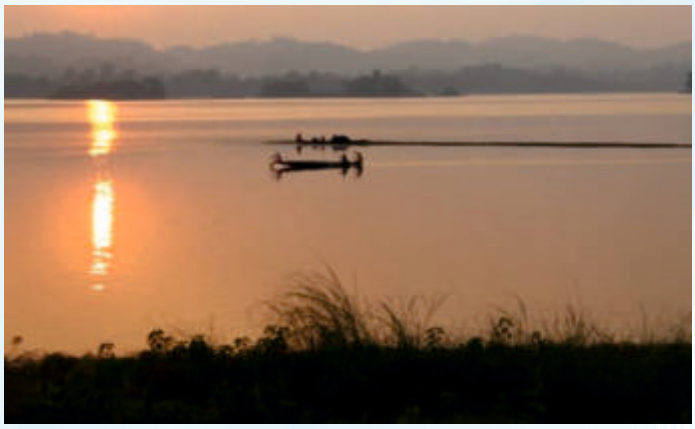
Parameter	KremTyngheng, Samasi	KremLymmit, Kseh
Water Temperature (°C)	24	22.5
pH	8.65	8.4
Specific Conductivity (µS/cm)	644.0	442.0
Total Dissolved Solids (mg/L)	458.0	308.0
Dissolved Oxygen (mg/L)	6.6	6.4
Total Alkalinity (mg/L)	90.0	70.0
Total Hardness (mg/L)	190.0	88.0
Calcium Hardness (mg/L)	177.0	70.0
Magnesium Hardness (mg/L)	3.237	4.482
Sodium (mg/L)	2.5	3.2
Potassium (mg/L)	0.3	0.37
Available Phosphorus (mg/L)	0.011	0.024



Fishing boats operated in Umiam reservoir, Meghalaya

First Report of *Pethia guganio* in Dumbur Reservoir

Pethia guganio was documented from the Dumbur reservoir, Tripura for the first time. The finding adds to expansion of distribution range of the species. The cyprinid is distributed in



Fishing in Dumbur reservoir



Pethia guganio recorded from Dumbur reservoir

Ganga-Brahmaputra basin, India, Nepal and Bangladesh. In India, it was reported from Ganga-Brahmaputra basin and Arunachal Pradesh. *P. guganio*, previously known as *Cyprinus guganio*, was first reported by Hamilton in 1822 from the Brahmaputra and Barak drainage system of Assam.

Project Code: NEH/2024-27/05

Project Title: Assessing Fisheries and Habitat Characteristics of River Brahmaputra and Rivers of Sikkim in Response to Natural and Anthropogenic Changes

Duration: 01.04.2024 – 31.03.2027

Sub-Project 1: Revitalizing River Brahmaputra for Assessing Fisheries and Habitat Characteristics in Response to Natural and Anthropogenic Changes

Fisheries Management Regimes of River Brahmaputra

River Brahmaputra is a major trans-boundary river. It traverses 1,625 km in China (known as Yarlung-Tsangpo) and 918 km in India (known as Siang and Brahmaputra), before flowing 337 km through Bangladesh and emptying into the Bay of Bengal. River Siang flows through the hills and mountains of the north-eastern state of Arunachal Pradesh and meets Dibang and Lohit rivers near Pasighat. The combined river is called the Brahmaputra in Assam plains. It flows westward through Assam for about 640 km until near Dhuburi, where it abruptly turns south to enter Bangladesh.

River Brahmaputra is a source of fish and livelihood for the riparian population. The administrative control of the river lies with the Revenue & Disaster Management, Government of Assam. At present, 10-25 km long river stretches are leased by the Revenue Department through the respective District Commissioners to fishers' cooperative societies for 7 years for fishing. Closed fishing season is being implemented in the river stretch in Assam for 4 months from April 15 to July 31 to ensure spawning success of fishes and survival of juveniles.

Fish Species Diversity

A total of 70 finfish species belonging to 52 genera under 23 families and 9 orders were recorded in the main river stretch between Dhola (Tinsukia District) and Dhubri during the monsoon and post-monsoon seasons. In addition, one commercially important prawn, *Macrobrachium gangeticum* was also recorded from the river. Confluence points of tributaries with the main river and river stretches near protected areas recorded higher fish diversity, with Guijan ghat (Tinsukia District) recording the highest diversity (35 species), followed by Bishwanath ghat and Dhubri (33 each). *Labeo angra*, *L. boggut, Channa stewartii* and *Ompok padba* recoded by us appears to be new addition to the published list of fishes from the river stretch in Assam (Bhattacharjya *et al.*, 2017).

Catch of high value *Tenualosa ilisha* was observed in the lower Assam stretch of the river between Dhubri (bordering Bangladesh) and Uzanbazar Landing Centre at Guwahati. *Cabdio morar* was the most dominant fish (60-90% of the total catch) followed by *Puntius* spp. Juveniles of many major fish species like *Sperata* spp. and *Bagarius bagarius* were observed in catch indicating recruitment over-fishing

in the river. Juveniles of migratory *Anguilla bengalensis* were recorded at Dhubri landing centre.

Population Characteristics of *Cabdio morar*

Cabdio morar has emerged as the single-most dominant fish species in river Brahmaputra in Assam. Length-frequency data of the fish, collected from Uzanbazar landing centre, were fitted in to ELEFAN I module of FiSAT II (FAO-ICLARM Stock Assessment Tools) to assess population parameters. The estimated von Bertalanffy growth parameters of *C. morar* are $L\infty$=147.53 mm and K=1 year^{-1}. A higher growth coefficient indicates that a fish attains its $L\infty$ in a relatively shorter period, indicating that the species reaches $L\infty$ in 1 years of life history. The instantaneous total mortality coefficient (Z) is estimated at 2.77 year^{-1}. The natural mortality (M) is calculated at 1.09 and fishing mortality (F) at 1.68. The natural mortality coefficient is comparatively less than the fishing mortality indicating that the fish is over-exploited. The current exploitation rate is calculated as E = 0.61.

Fish measuring 20.5 mm in length exhibited the highest survival rates, while those exceeding 100.5 mm have the lowest survivability. The majority of the catch is concentrated in the length groups between 60.5 mm and 100.5 mm. The species is recruited year-round, with peak activity observed in December, March and April.

Water Quality of River Brahmaputra

Seasonal study was conducted to determine ecological status of the Brahmaputra River at 10 sampling stations during monsoon and post-monsoon. The result indicated that the river water is suitable for all aquatic lives, domestic and agricultural uses.



a) *Labeo angra*



b) *Labeo boggut*

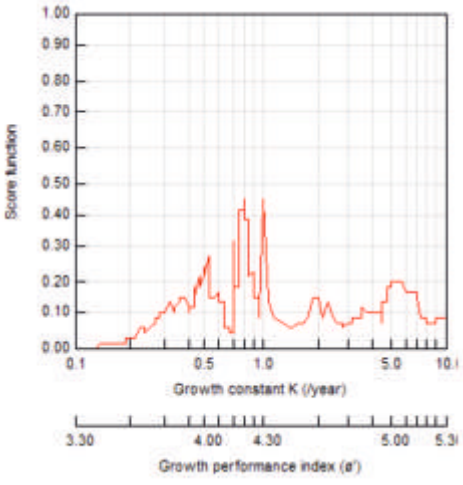


c) *Channa stewartii*

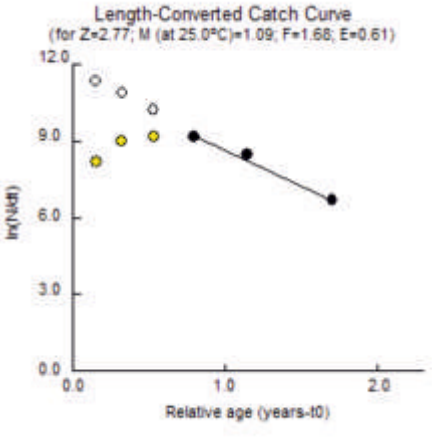


d) *Tenualosa ilisha*

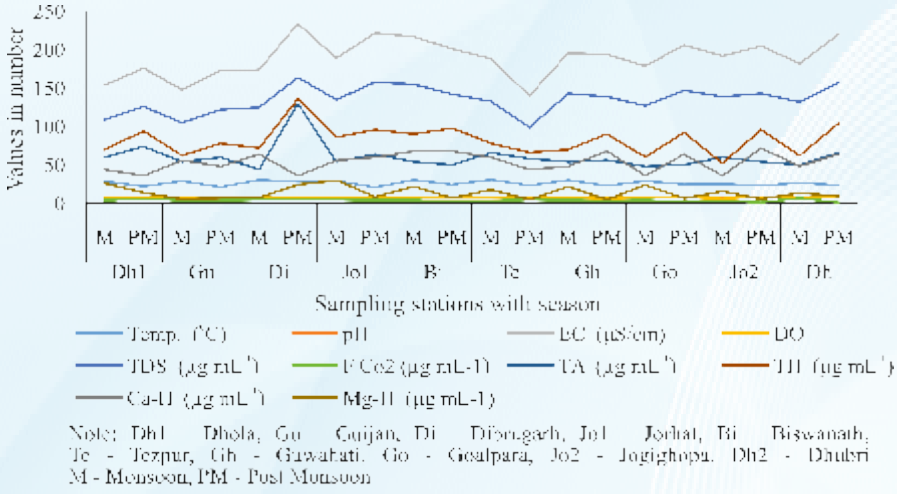
New records of fish species from River Brahmaputra



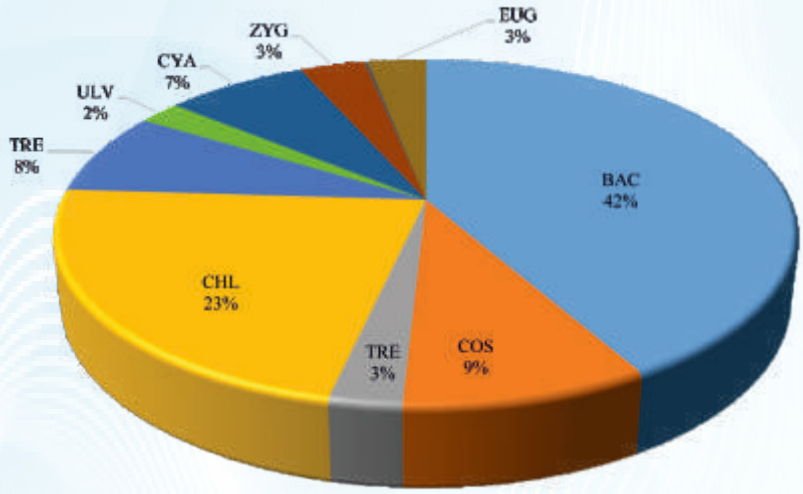
Von Bertalanffy growth parameter (K) of *C. morar*



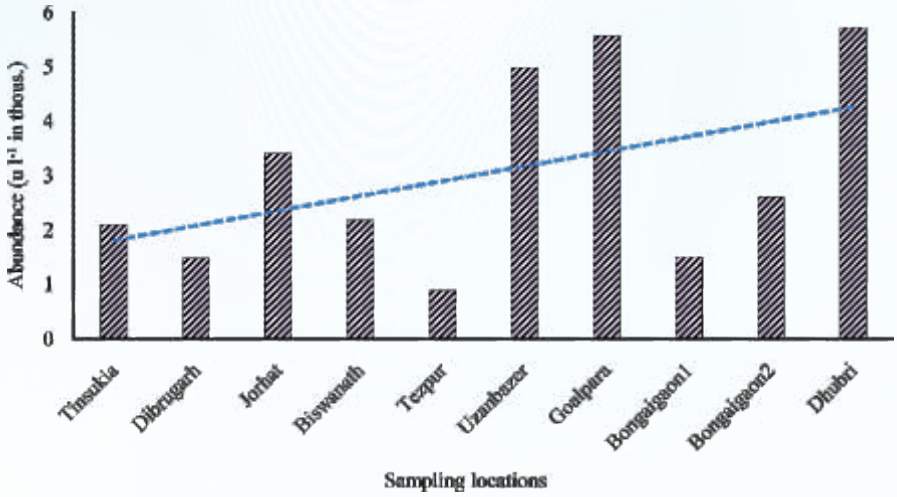
Length converted catch curve of *C. morar*



Water quality parameters of Brahmaputra River



Contributions of various phytoplankton groups to total phytoplankton population. BAC: Bacillariophyceae, CHL: Chlrophyceae, TRE: Trebouxiophyceae, COS: Coscinodiscophyceae, CYA: Cyanophyceae, ULV: Ulvophyceae, EUG: Euglenophyceae, MED: Mediophyceae, DIN: Dinophyceae, ZYG: Zygnematophyceae



Phytoplankton abundance at different sampling locations in Brahmaputra River

Phytoplankton Assemblage

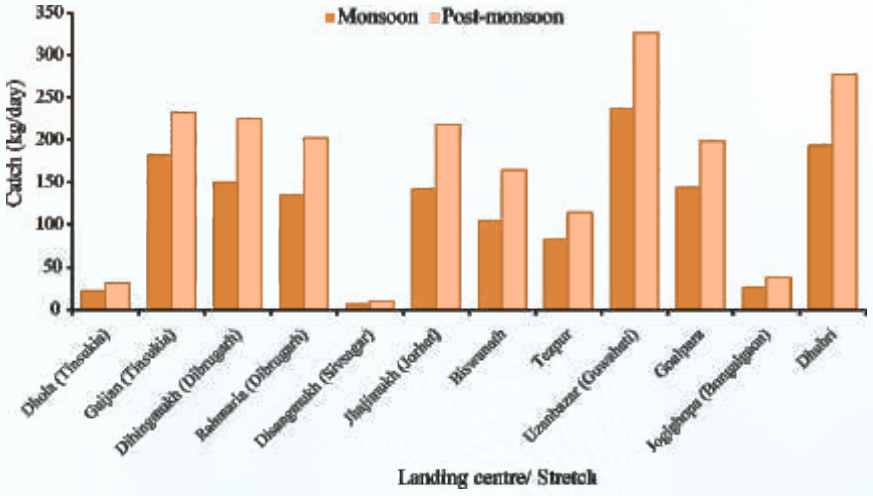
Among microfloral components, diatoms were the most dominant group, however presence of green algae and blue green algae were also noticeable in the river. A total of 67 species (57 genera) of phytoplankton were recorded, dominated by pennales. Bacillariophyceae (22 species) contributed 42% of the total phytoplankton community, followed by Chlorophyceae (23%) and Coscinodiscophyceae (9%). Coscinodiscophyceae, represented by single species *Aulacoseira granulate*, contributed 2.5-26% of the total phytoplankton population. The quantitative spectrum of phytoplankton ranged from 0.413-5.072x10^3 u/l with maximum abundance at Dhubri and lowest at Tezpur.

Among diatoms, genera *Fragilaria, Navicula, Nitzschia, Amphora* and filamentous algae such as *Spirogyra, Oedogonium* and *Oscillatoria* were most conspicuous in all the stretches. The calculated values of Margalef's richness (*d'*) and Shannon diversity (*H'*) index were more than 3.0 indicating moderate phytoplankton diversity in the river system. The *H'* value was highest at Uzanbazer (3.21) and lowest at Tezpur (2.67).

Macrobenthic Population

A total of 15 macrobenthic species comprising of 8 gastropods, 3 insects, 3 bivalves, and 1 annelid were recorded from the middle and lower stretches of the river. Gastropods were the most dominant group (47-67%), followed by bivalve (11-53%), insects (6-14%), and annelids (2.8-11%). The macrobenthos population varied from 99-711 ind./m^2 with highest abundance at Dhubri and lowest at Tezpur. Insects (*Caneis* sp. and *Anax* sp.) were observed only at Bishwanath Ghat (each with 11 ind./m^2). Among Annelids, oligochaets (*Tubifex tubifex*) were recorded from the different sampling sites ranging from 11-33 ind./m^2 with

maximum abundance at Dhubri. Molluscs belonged to gastropods viz., *Filopaludina bengalensis, Mekongia crassa*, *Pila globose, Melanoides tuberculata, Brotia costula, Taribia lineata, Lymnaea acuminata, Gyraulus convexiusculus* and bivalves (*Corbicula striatella, Parreysia favidens* and *Lamellidens corrianus*). The population of gastropods and bivalves varied from 66-467 and 11-189 inds/m^2, respectively in the different sampling sites.



Fish landings at different study sites of river Brahmaputra

Fish Landing and Catch Composition

Fish catch ranged from 6-237 kg/day and 10-326 kg/day during monsoon and post-monsoon seasons at different study sites. Considering the number of fishing days, the total estimated catch from the river was 72.7 tonnes during monsoon season and 122.1 tonnes in post-monsoon season.

The catch is dominated by a small cyprinid, *Cabdio morar* which contributed 60-90% to the total fish catch across all landing centres. Catch of *Hilsa* (*Tenualosa ilisha*), were recorded in lower stretches, specifically up to Uzanbazar (Guwahati). The size of the landed *Hilsa* ranged from 250 g to 1.2 kg, with wholesale price varying between Rs. 300 and 1,200 per kg. The study also recorded catch of juveniles of several fish species, including *Sperata seenghala* and *Bagarius bagarius*, which is a major concern for sustainable fisheries in the river and fishers livelihood.

Sub-Project 2: Exploring Fish Diversity, Catch Pattern and Habitat Ecology of the Major Rivers in Sikkim

Habitat Ecology of Major Rivers of Sikkim

The Himalayan state of Sikkim is blessed with plenty of open water bodies in the form of rivers, lakes, and streams, along with many tributaries at various altitudes. Rangit River, Teesta River along with eight tributaries, *viz.* Ringchu, Rihichu, Kankha River, Lachung chu, Yungthang Chu, Rangpo Khola, Rani Khola, Khani Khola were studied in post-monsoon and winter seasons.

The water temperature varied from 18.0 to 25.3 °C in post-monsoon, and from 4.56 to 20.7 °C in winter season. The dissolve oxygen content of the river water was high, ranging from 8.33 to 8.80 mg/l during post-monsoon and 8.27 to 9.36 mg/l during winter. Other water quality parameters were: total alkalinity 23.8-47.33 mg/l, specific conductivity 53.33-151.0 µS/cm, secchi disc transparency 0.2-2.50 m, total dissolved solids 44.8- 147.33 mg/l and total hardness 21.0-85.67 mg/l. The rivers sediment was mostly sandy. The sediment pH ranged from 7.1 to 8.73, electrical conductivity 35.53 to 179.6 µS/cm, total dissolved solids 23.63 to 128 mg/l and free $CaCO_3$ 8 to 3.71 % respectively.

Plankton and Periphyton Diversity

Plankton diversity in the studied rivers is dominated by Bacillariophyceae in both the seasons. During post-monsoon, Bacillariophyceae contributed highest (35.72-100%), followed by Cyanophyceae (22.73-42.6%) and Chlorophyceae (21.43-36.37%). In winter season, Bacillariophyceae dominated (58.33-100%), followed by Cyanophyceae (16.27-41.66%). The plankton abundance was higher in winter, ranging from 66.54- 408.74 U/litre, compared to post-monsoon (57.03- 209.12 U/litre). Among periphytons, Bacillariophyceae dominated (70.58-88.24%), followed



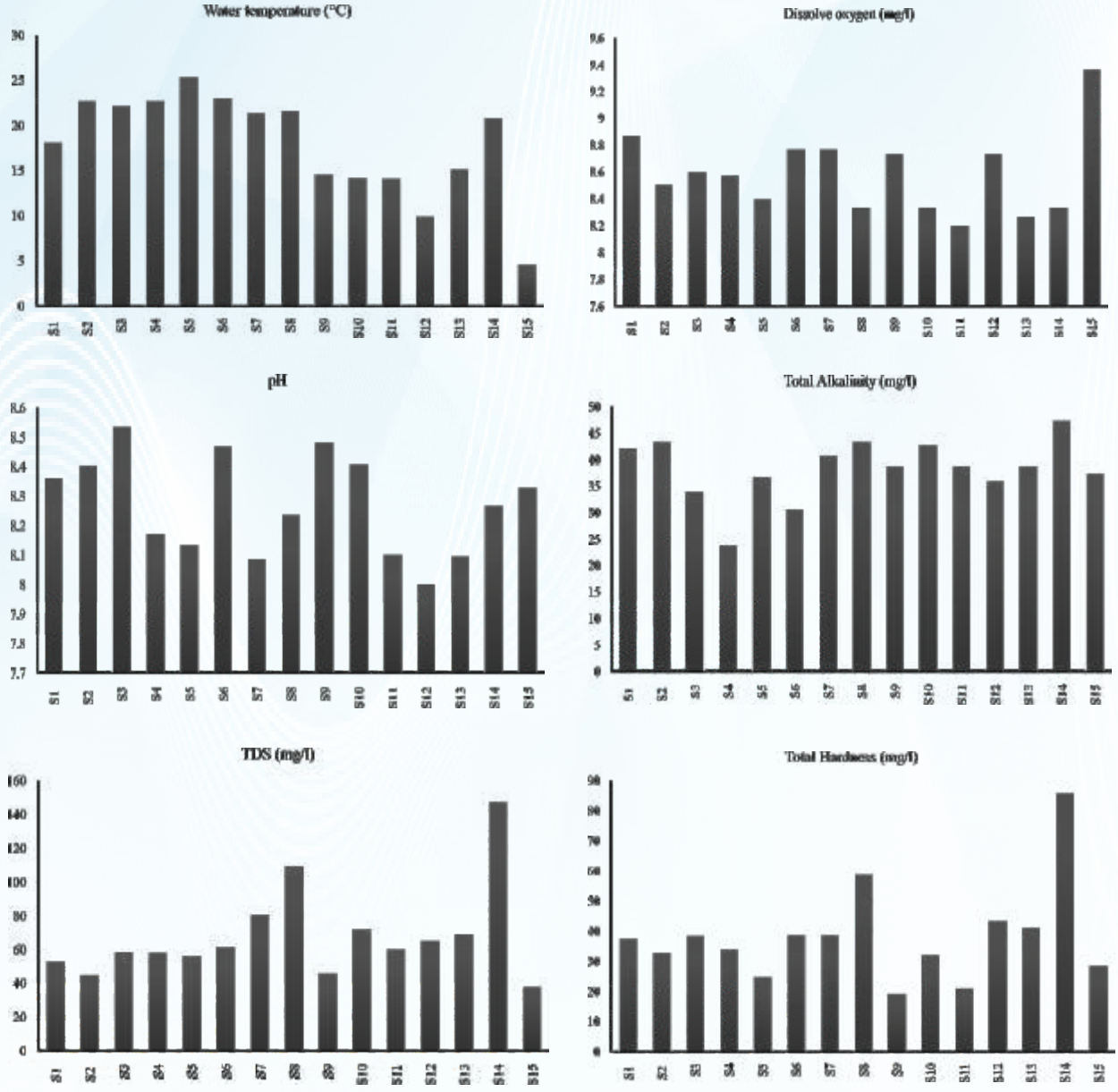
River Teesta in Sikkim



River Rangit in Sikkim

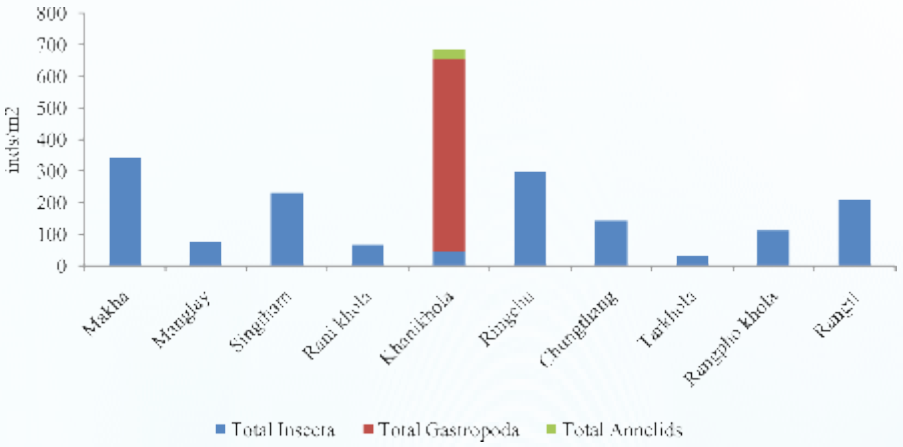
Table: Sediment quality parameters of major rivers of Sikkim

Sediment Parameters	Teesta River	Rangit River	Rani Khola	Rangpo Khola	Khani Khola	Ring Chu	Yungthang Chu
Texture	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy
pH	8.36	7.8	8.73	8.25	7.9	7.1	7.4
	±0.06	±0.18	±0.12	±0.15	±0.12	±0.21	±0.18
EC (µS/cm)	95.1	72.46	110.03	170.8	179.6	74.3	35.53
	±2.55	±1.22	±0.84	±1.06	±2.18	±2.32	±0.76
Potassium (mg/100 g of sediment)	2.93	6	6.2	5.4	6.6	6.13	3.4
	±0.15	±0.11	±0.35	±0.25	±0.43	±0.18	±0.15
Sodium (mg/100 g of sediment)	9.48	11.1	11.4	11	11.7	11.76	9.6
	±0.18	±0.25	±0.56	±0.32	±0.46	±0.49	±0.11
Free $CaCO_3$ (%)	3	1.83	3.71	1.76	3.13	1	0.8
	±0.28	±0.16	±0.12	±0.43	±0.18	±0.28	±0.33



Major water quality parameters of Sikkim Rivers. S1: Teesta R., Makha, E. Sikkim; S2: Confluence point Teesta & Rangpo R.; S3: Teesta R, Singtham; S4: Teesta R & Rani Khola; S5: Rani Khola; S6: Rangpo Khola; S7: Teesta R & Khani Khola; S8: Khani Khola; S9: Ring Chu; S10: Rihi Chu; S11: Teesta R. Kankha; S12: Lachung Chu; S13: Teesta R., Tar Khola; S14: Rangit R. and S15: Yungthang Chu

by Cyanophyceae (5-28.57%), Chlorophyceae (9.1-28.57%), Zygnematophyceae (11.76-15%) and Oligohymenophorea (1-17.64%) during winter while Bacillario-phyceae (61.76-70.52%), Cyanophy-ceae (4.21-29.42%), Chlorophyceae (7.36-8.83%), Zygnematophyceae (0-10.52%), Trebouxiophyceae (0-5.26%) and Euglenida (0-2.10%) were predominant during post-monsoon. The number of periphyton varies from 253.12-318.75 nos/cm^2 during post-monsoon to 112.50-375 nos/cm^2 during winter season.



Benthic macro-invertebrate community abundance in rivers of Sikkim

Benthic Macro-Invertebrate Communities

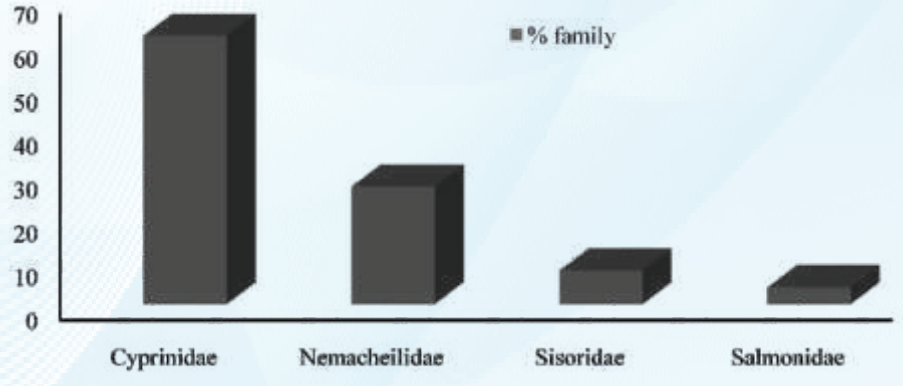
A total of 17 benthic macro-invertebrate taxa comprising of 15 insects, 1 gastropod and 1 annelid were recorded from the Teesta River and its tributaries. The benthos abundance varied from 33-688 ind./m^2 with maximum abundance at Khani khola and minimum at Tar khola. Insecta was found to be dominated in all the sampling sites except at Tar khola. Gastopod *Physella acuata*, which prefers polluted water, was recorded with abundance of 611 ind./m^2 from Rani khola. Insecta from five orders *viz.,* Mayflies (Ephemeroptera), Stoneflies (Plecoptera), Caddies flies (Trichoptera), Aquatic Beetles (Coleoptera), and Alderflies (Megaloptera), comprising of 10 families were recorded. Insect fauna recorded were *Baetis* sp.*, Platybaeti* sp., *Leptophlebia* sp., *Heptagenia* sp., *Cinygma* sp., *Epeorus* sp., *Ironodes* sp., *Psephnus* sp., *Hygrotus* sp., *Corydalus* sp., *Agapetus* sp., *Hydropsyche* sp., *Rhyacophila* sp., *Isogenus* sp., and *Capnia* sp., Among Annelids *Hirudinaria* was recorded from Khani khola with abundance of 33 ind./m^2.

Diversity, Distribution and Conservation Status of Fishes

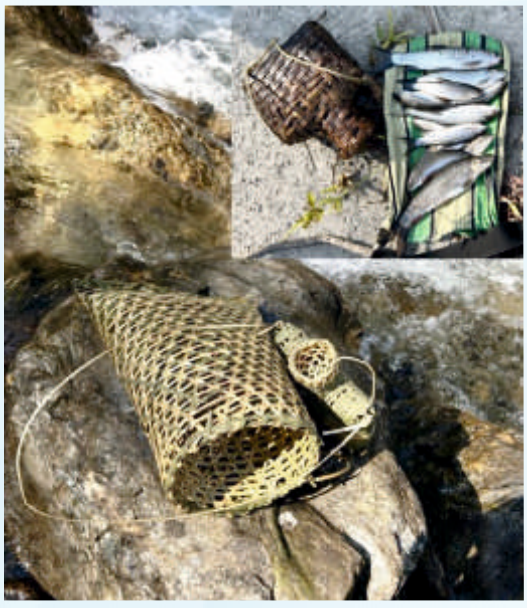
A total of 26 fish species, 14 genera, 4 families and 3 ordesr and a freshwater prawn species were recorded from the Sikkim rivers. At family level, Cyprinidae (61.53%) dominates, followed by Nemachei-lidae (26.92%), Sisoridae (7.69%) and Salmonidae (3.85%). The most dominat species was chocolate mahseer (*Neolissochilus hexagono-lepis*) contributing 42.0-78.5% and snow trout (*Schizothorax richard-sonii*) contributing 33.87-90% in both the seasons. In the upper stretches of the Teesta River at an *elevation* of 3,370 metres (11,057 ft), brown trout (*Salmo trutta*) dominated in winter season. Other major fish group observed were *Garra*, *Barilius*, *Danio*, Nemachelids, stone loaches, torrent catfishes, and golden mahseer. According to IUCN, one species falls under Endangered category, two species under Vulnerable category, three species under Near threatened and 20 species under Least concern category. Most of the fish species observed were indigenous, with a few endemic and rare species in the region.

Estimation of Fish Catches Composition

The average CPUE were estimated to be 2-3 kg/fisher/day and3-4 kg/fisher/day for Teesta and Rangit rivers, respectively. During peak fishing season CPUE goes up to 10-12 kg/fisher/day. The peak fishing months in the rivers were during April-May and October-November months. Fishing is a secondary occupation and contribute majorly to family consumption. In general, fishing activities in the rivers of Sikkim are very limited and majority of the population involved in fishing are either farmer, serviceman, or businessman. The fishing activities



Family-wise distribution of fish diversity in Sikkim



Indigenous fishing traps of Sikkim



'Buk trap' with indigenous fish storage basket

were seen to be higher in the lower stretches of the rivers with higher fish catch per day.

Fishing Gear Used in Major Rivers

Major gears used for fishing in rivers of Sikkim are the cast nets and rod & lines. Small cast nets are used by the fishers of mesh size 1 cm or less, for easy operation in the fast flowing rivers. Among the indigenous traditional traps, a tubular shaped trap known as 'Buk trap' and box trap known as 'Minno trap' are used for catching common snowtrout (*Schizothorax richardsonii*), *Garra* sp. and *Pseudecheneis* sp. The tubular trap 'Buk' is made of split bamboo tethered with nylon thread, with valve located closely on the trap lateral side. The valve on the trap is designed to serve as trap doors from which the fish enter, but gets restricted from escaping. The trap typically has 0.5–1.0 m in length and 0.3–0.4 m in width. The box trap 'Minno trap' is made up of stainless steel with GI pipe frames. The minno trap has an opening valve for entrance of fish. Trap shape and size can vary from one area to another.

Besides traditional fishing gears, an indigenous storage basket made of split bamboo of varying sizes, resembling an earthen pot is usually carried by the fisherman, wearing it around the waist, to store the catch during fishing. The rivers are facing several threats such as illegal fishing (electric fishing, poisoning, dynamiting, etc.), and anthropogenic activities.

Input Distribution and Awareness Programme to Promote Self-Reliance in Sunderbans

The institute organized the *Mahila Matsyajibi Sammelan* 2.0 in collaboration with NFDB, Hyderabad, and the NAAS Regional Chapter, Kolkata on 17 August 2024 at Kultali. The event was presided over by Dr. J. K. Jena, DDG (Fisheries Science), ICAR. The program was concluded with the distribution of inputs to 100 selected tribal women beneficiaries from 50 villages across 11 Gram Panchayats in the Gosaba and Basanti Blocks of the Sundarbans. Each beneficiary received 100 kg of CIFRI cage grow feed and 6 kg of IMC fish seeds.

An 'Input distribution-cum-awareness programme' was organized in collaboration with Joygopalpur Gram Vikas Kendra at Joygopalpur, Basanti, in the Sundarbans on 06 September 2024 with the objective of providing vital fisheries inputs and training to promote sustainable development and self-reliance among the tribal community through small-scale aquaculture development. The event saw the participation of local tribal community members, government officials, NGO representatives, and subject matter experts. Approximately 130 tribal fishers from various villages in the Basanti block attended the programme.

Empowering Tribal Women of Chhotanagpur Plateau

Purulia, a district situated in the western part of West Bengal, is predominantly inhabited by tribal communities. The institute has taken an initiative to empower the tribal women to secure their livelihoods and nutritional security in the drought-prone areas of Gobindapur, Manbazar and Purulia in West Bengal. This initiative focused on community-managed aquaculture in locally available rainfed waterbodies called *bandhs*. A total of eight *bandhs*, covering an area of over 40 acres were selected for community fish culture involving 22 Self Help Groups (SHGs). The beneficiaries received 1,600 kg of fish seeds and 16 tons of CIFRI Cage Grow feed to initiate fish farming in these waterbodies. Prior to the distribution, tribal women underwent comprehensive training on community pond management, equipping them with the knowledge to sustainably manage water resources and improve their income and food security.

Ornamental Fish Tank Distribution in Birbhum

ICAR-CIFRI conducted a sensitization-cum-input distribution programme at A. K. Dasgupta Centre For Planning & Development (A Centre sponsored by the NITI AAYOG, Government of India), Visva-Bharati, Santiniketan, Birbhum, West Bengal, on 07 October 2024 in collaboration with Visva Bharati and NAAS Regional Chapter, Kolkata. Ornamental fish tanks, along with ornamental fish kits, were distributed to the tribal fish farmers of Birbhum district. The programme was graced by Dr. B. K. Das and Prof. Debasis Bhattacharya. Before inputs distribution, the farmers were trained at the ICAR-CIFRI Barrackpore campus on ornamental fish culture.

Awareness Generation and Input Distribution in Gujarat

An awareness generation cum input Distribution programme was conducted on 27 September 2024 at Ukai Dam, Tapi District, Gujarat. In the programme, CIFRI CAGEGROW FEED (6 ton) and FRP boat with OBM engines were distributed to fishers of Bavli Vibhah Majudur Kamdar Co-operative Society, Songadh, Ukai. In the awareness programme, potential of CIFRI HDPE pen for seed production in reservoirs was highlighted by Dr. S. P. Kamble, Scientist and In-charge of Vadodara Research Station. The programme was attended by 30 fishers of the society.

Sensitizing Fishermen on the Role of Cage Culture in Enhancing Fish Production

The ICAR-CIFRI, Regional Centre, Bengaluru conducted an awareness program on "Cage culture of fishes in reservoirs for enhanced fish production" to sensitize fishermen on role of cage culture in enhancing fish production on 29 August 2024. Around 50 tribal fishers, members of Banasurasagar ST-SC Fishermen Co-operative Society attended the program.



Mr. B. K. Sudheer Kishan, Joint Director of Fisheries, North Zone, Kerala, addressing the fishers of Banasurasagar reservoir

Sensitization Program on Enhanced Fish Production in Open Waters and Distribution of Coracles

The Bengaluru Regional Centre of the Institute conducted a sensitization program on "Enhanced Fish Production in Openwaters" at Krishnagiri reservoir in Krishnagiri district, Tamil Nadu on 03 September 2024. Coracles were distributed to five tribal fishers including two women beneficiaries. The program was attended by 50 fishers of Krishnagiri district.



Distribution of coracles among fishers of Krishnagiri reservoir

Mass Awareness Program and Distribution of FRP Boat with OBM Engines

The Bengaluru Regional Centre conducted a mass awareness programme on "Significance of sustainable fishing" at Kabini reservoir in Mysore District, Karnataka on 22 October 2024. One FRP boat with OBM engine was handed over to the *Girijanara Meenugarara Sahakara Sangha* with 304 Scheduled Tribe members at Kabini. The program was attended by 50 fishers of Mysore district.



Awareness programme at Kabini reservoir

Popularization of CIFRI-ARGCURE Among Fish Farmers of Kamrup (R), Assam

CIFRI ARGCURE - a product developed by the institute to control argulosis disease in fish. In order to popularize the product among the fish farmers of Assam, the Guwahati Regional Centre of the institute in collaboration with the Department of Fisheries (DoF), Govt. of Assam organized a "Demonstration-cum-input distribution programme" at Boko, Kamrup (R) District, Assam on 04 October. On the occasion, a total of 200 bottles (100 ml each.) of CIFRI ARGCURE were distributed among 50 tribal fish farmers (including 22 fisherwomen). Mr. Gautam Medhi, FD of Kamrup (R) appreciated the ICAR-CIFRI for their support to the fish farmers of the state.

The Guwahati Regional Centre of the institute carried out another demonstration of CIFRI ARGCURE



Tribal fish farmers of Boko displaying ARGCURE received from ICAR-CIFRI



Tribal fish farmers receiving ARGCURE from Shri Parag Kumar Kakaty, ACS, DC, Darrang district, Govt. of Assam

in the fish farm of Mr. Abhijit Boro, 1 No. Bhatipara Village, Damalchos, Kamrup (R) district of Assam to control argulosis in carps reared in his farm. Mr. Boro is a progressive fish farmer in the locality and carrying out composite fish culture of carps and producing quality fish seed in his farm. As per the directives of ICAR-CIFRI team, he applied CIFRI ARGCURE in his pond to control Argulus infection during 1st week of October, 2024. A total of 8 CIFRI ARGCURE bottles (100 ml each bottle) was provided to him. Reportedly, the infection was reduced by 80% upon application of the medicine. The results suggest that CIFRI ARGCURE can be used effectively by fish farmers to control Argulus infection in carps.



Fishers of Sundarbans

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Activities and Achievements under Scheduled Caste Sub-Plan (SCSP)



Mahila Matsyajibi Sammelan 2.0

Improvement of fishers' livelihood through SCSP programmes is one of the most important activities of the Institute. Fisheries technologies including wetland and reservoir fisheries management using culture-based fisheries (CBF) and pen culture, backyard pond fish culture, ornamental fish culture, hill area fish farming have been demonstrated in different parts of the country along with in difficult and vulnerable areas like Sundarbans. Community mobilization, involvement of fishing community and empowering rural women were the main focus of the technology demonstration. Several fisheries inputs were distributed among the fishing community for the demonstration of the different fisheries technologies. Additionally, mass awareness campaigns, capacity building and sensitization programme were organised to strengthen the skills and knowledge of SC fishers in various inland open water fisheries technologies. The SCSP scheme has benefitted more than 8,000 SC fishers through inputs distribution and various capacity building programmes.

Backyard Pond Fish Culture

Backyard pond fish culture is a viable option for empowering rural women and sustainable livelihood development by increasing fish production. Women Fishers Meet (*Mahila Matsyajibi Sammelan* 2.0)was organized to create awareness on the inland open water fisheries management among the women of Sundarbans. Dr. J. K. Jena, DDG (Fisheries Science), ICAR, New Delhi presided over the programme and inspired the women fishers to utilize available water



Director speaks at Mahila Matsyajibi Sammelan 2.0

resources for small-scale fish culture, including backyard pond fish culture. During the programme, fish feed and fish seeds were distributed to 500 women beneficiaries from 50 villages across 11 Gram Panchayats in the Gosaba and Basanti blocks of Sundarbans.

Women Fish Farmers' Day

Women Fish Farmers' Day "*Mahila Matsyajibi Diwas*" was observed for the first time on 26 December 2024 at Kultali, Sundarbans. The event aimed at honoring the vital contributions of women in fisheries and aquaculture, particularly in the Sundarbans. The celebration witnessed participation of about 5000 SC women. During the event, an additional 500 SC women were selected as new beneficiaries. During the programme, 80 kg fish feed and 6 kg fish seed were distributed to each of the beneficiary.

Ornamental Fish Culture

The institute has been promoting the ornamental fish farming in Odisha, West Bengal and Jharkhand by involving the women group. In 2024, ICAR-CIFRI distributed 313 ornamental fish culture units to the SC women and students through College of Fisheries, Rangeilunda, Odisha and 10 KVKs of Odisha for livelihood development.



Ornamental fish tank distribution



Pen culture demonstration in the beels of West Bengal

Wetland and Reservoir Fisheries Development

For sustainable fish production and biodiversity conservation, the institute has adopted eight wetlands viz, Akaipur, Maniknagar, Bijpur, Kundipur, Chamordaha, Kumli, Khalsi, and Sindrani located in the North 24 Parganas and Nadia districts of West Bengal. FRP fishing boats equipped with outboard engines and CIFRI HDPE pens were distributed for managing wetlands fisheries. Fisheries inputs, including 825 kg of fish seed and 13 tons of fish feed were distributed to the SC fishers of eight wetlands to demonstrate pen culture technology for seed raising, facilitating stocking in wetlands for CBF demonstration.



Distribution of crates among the fishers of Gayathri reservoir

Pen Culture Demonstration in the Beels of West Bengal

An awareness programme on reservoir fisheries management along with distribution of fisheries input was held at Manchanbele reservoir in Ramanagara District, Karnataka. Similarly, another programme was organized at Gayathri Reservoir, Karnataka. Both the programmes were attended by 50 fishers each. At Manchanbele



Fish seed stocking in Manchanbele reservoir

reservoir, 40,000 fingerlings, consisting of IMC and endemic carps such as Carnatic carp and Fringe-lipped carp were stocked and crates were distributed to 20 fishers. At Gayathri reservoir, 50,000 fingerlings of *Labeo rohita* were stocked and crates were distributed to 20 fishers, including seven women beneficiaries.

Fisheries Development in Hilly Region

The small and marginal fish farmers of the hilly region of West Bengal struggle to utilize the cemented tank for fish production due to lack of proper knowledge and technical support on fish farming. An awareness program, along with input distribution was organized by the ICAR-CIFRI at Sittong, Darjeeling District, West Bengal on 09 June 2024 to improve their livelihoods by providing technical support for enhancing the fish production from these small units. With the aim of improving livelihood of rural hill community, the institute is promoting the Amur Carp culture. The institute distributed 50,000 Amur Carp seeds to 50 beneficiaries from Sittong and Mongpu of Darjeeling district.



Distribution of Amur Carp seeds in Darjeeling

Laying the Foundation Stone for a New Laboratory Building at the Institute Headquarters

Dr. J. K. Jena, Deputy Director General laid down the foundation stone of a new laboratory building adjacent to the administrative building of Institute Headquarter on 16 August 2024. He also opened the 'Selfie Point' in front of 'Block A' of the main building and also inaugurated the new GC-MS/MS facility.



Laying the Foundation Stone for a New Laboratory Building

26th December as '*Mahila Matsya-jibi Diwas'*

The institute declared 26th December as the '*Mahila Matsyajibi Diwas'* in a programme at Basanti, Sundarbans. The day was marked to acknowledge the contributions of women in fisheries and aquaculture. Since 2013 the institute has encouraged and supported over 5,000 fishers through capacity building trainings and provision of technological inputs for their backyard ponds and ornamental fish farming to boost the rural economy. The event at Kultali has witnessed the participation of around 5000 SC women. The programme was organized in collaboration with the NFDB, Hyderabad, NAAS Regional Chapter, Kolkata and Kultali Milon Tirtha Society.



Felicitating women fishers on Rashtriya Mahila Matsyajibi Diwas

NABL Accreditation of Institute Laboratory

The National Accreditation Board for Testing and Calibration Laboratories (NABL) gave accreditation to one of the institute labs in accordance with ISO/IEC 17025: 2017 for chemical testing in the area of "Arsenic (as As) in Surface Water" from 01 November 2024 to 31 October 2028. Dr. S. K. Nag received the certificate during a NABL event for newly accredited laboratories in New Delhi on 09 December 2024.



CERTIFICATE OF ACCREDITATION

ICAR-CENTRAL INLAND FISHERIES RESEARCH INSTITUTE

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

TESTING

NABL acreditation certificate

GC-MS/MS Facility Established at Institute Hqs

Gas Chromatography Tandem Mass Spectrometer (GC-MS/MS) facility has been established at the institute Hqs with the financial assistance of the project "National Mission for Clean Ganga-Phase III". This high-end analytical technique has a wide range of applications for identifying trace-level organic pollutants such as pesticides, polycyclic aromatic hydrocarbons (PAHs) etc. in diverse matrices, from food safety analysis to environmental monitoring. The system complies with stringent regulatory standards, with sensitivity



GC-MS/MS facility



Natural farming trial in pens with *Systomus sarana* in Kholsi beel



Experimental trial with cages for restoration of SIFs in wetland

that exceeds regulatory requirements and can deliver robust sensitive results to the end-users.

Pen Culture Trial of *Systomus Sarana* in 'Natural Farming' Mode

Considering 'Natural farming' as a national priority, a new initiative was undertaken for experimental trial of pen culture using indigenous small fish *Systomus sarana* in wetland. Two pens of 100 sq m (10 m x 10 m) each were installed in Kholsi beel, a wetland of Nadia district, West Bengal. A total of 1000 numbers of *Systomus sarana* seeds (av. size 0.4 g) were stocked in each pen. Supplementary feeding is being done in one pen, whereas fishes of the other pen are totally dependent on naturally available food *i.e.* plankton following protocol of zero-input 'Natural farming'. Fishes were performing well in both the pens with slightly lower growth in pen without supplementary feed during first two months of culture.

Experimental Trial towards Nature-Based Solution for Fish Diversity Conservation

Due to different anthropogenic interferences, many small indigenous fishes (SIF) have vanished or severely declined from wetlands. An experimental trial was conducted to restore selected SIFs in wetlands through auto-recruitment by creating natural breeding habitat using submerged macrophytes in cages of 1 m^3 dimension. SIFs like *Colisa fasciata*, *Lepidocephalych-thys guntea* and *Nandus nandus* which have vanished from Kholsi beel, a wetland of Nadia district were stocked separately in the floating cages in wetland environment. No external feed was given; the stocked fishes were thriving well depending on natural plankton available inside cages. Six months (October-March)

rearing observed that the fishes are quite healthy inside the cages.

Development of Alternate Option for Mitigation of Jute Retting Pollution in Wetland

Biodiversity of wetlands are often impacted badly due to jute retting. In a collaborative effort by ICAR-CIFRI and ICAR-CRIJAF, the nutrient-rich slurry and waste water after jute retting was experimentally utilized as fish feed, especially detritivores through intensive aquaculture in a micropond (38.5 sq m surface area, 1 m water depth; suitable for jute retting of crop from 1 bigha *i.e.* ⅓ acre). Also, jute slurry was effectively mineralized to release nutrients for producing plankton to be utilized by stocked planktivorous fishes using appropriate dose of liming. A total of six indigenous and exotic fishes *viz. Oreochromis niloticus* (Tilapia), *Anabas testudineus* (Vitenam strain) (Koi), *Heteropneustes fossilis* (Singi), *Ctenopharyngodon idella* (grass carp), *Cyprinus carpio* (Common carp), *Clarias batrachus* (Magur) were taken in experimental trial. The initial trial indicated a good prospect where utilization of jute slurry for fish culture can be a model of 'waste to wealth' conversion and provide a circular economy, thereby encouraging the jute farmers to adopt the micropond-based jute retting technology and saving the precious biodiversity of floodplain wetlands.



Micropond for utlisation of jute retting slurry in fish culture

Sustainable Utilization of Abandoned Open Coal Pits for Fishery

Three abandoned Open Coal Pits (OCPs) in two districts of Jharkhand and one OCP in Anuppur district of Madhya Pradesh have been chosen for this study. These abandoned pits, a part of more than 100 such pits in the area with depths ranging from 15 to 50 meters, are adopted for Culture-Based Fisheries (CBF) and cage culture activities. Cage farming was initiated at Ara Khadan 8 in 2021, Ara Khadan 13 in 2022, and Shondha in 2023. The primary species cultured in cages of these coal pits include Tilapia and Pangas. The transformation of abandoned coal pits into productive aquaculture sites demonstrates a sustainable approach for utilization of unused resources. Major concerns regarding water and fish quality of OCPs are the major focus of the present survey. Study by ICAR-CIFRI can support the recent initiatives which can substantially improve the local livelihoods through sustainable fish production from the OCPs.



Cage culture in abondoned OCPs

Drone Application for Fish Transport

Drones, the unmanned aerial vehicles (UAVs), offer a range of applications, from monitoring and precision spraying to data analysis, empowering Indian farmers with valuable insights for efficient and sustainable farming. The remote catch areas like diverse delta zones, large waterbodies like reservoir where transporting fish harvest from catch site to the bank or main collection hub is very difficult task, more time consuming and labour intensive. To explore the potential of drone technology in the fishery sector, the Department of Fisheries, Govt. of India assigned a pilot project on "Developing drone technology for live fish transport" to ICAR-CIFRI. The project aims at designing and developing an efficient drone which will be able to carry upto 100 kg live fish and deliver it to the selected fish market or assembly hub. The pilot project will open a new horizon in fisheries sector with an efficient and promising alternatives for transporting fresh fish with less time and minimum human involvement while minimizing stress to the fish.



Demonstration of drone application in fish transport

Exploration of Caves of Meghalaya for Fishery Resources

According to the Department of Fisheries, Meghalaya the cave fisheries of the state are a potential area for scientific research. The institute's Guwahati centre researchers have explored fish diversity in two caves of the state, Krem Um Ladaw (East Khasi Hills) and KremChympe (East Jaintia Hills), and have reported a fish species, *Neolissochilus pnar*, which is the world's largest cave fish recorded to date.

Point of Care Nano-biosensors for Antibiotic Residue Detection in Fish

Antibiotic as contaminants in water bodies and food fishes has become major concerns faced by the different quality regulatory agencies. Several lab-scale techniques are available for the detection and quantification of antibiotic residues in different matrices. However, on-site/real-time detection of antibiotic residues remains a challenge. In this regard, a project was sanctioned by ICAR-NASF to develop sensors that have the potentiality to solve this issue by introducing various molecular recognition element (MRE) viz. aptamer, molecular imprinted polymers (MIPs), etc. The current research focuses on using highly stable and specialized MREs to create nano-biosensors that can detect antibiotic residues in water and fish food matrices.

Benchmarking Microplastic Pollution in the River Ganga and Brahmputra in Relation to Native Edible Fish Fauna

Indian rivers are subject to plastic deposition including microplastics from its catchment areas. Research efforts are needed on characterizing microplastics pollution level in their abiotic and biotic compartment of rivers. However, microplastics load and their toxicity is still unknown for native fish fauna which might rise a greater concern for the socio-economic livelihood of fishers as well as for the public health. This new study, sponsored by the Department of Biotechnology, Government of India, aims at characterization and quantification of the microplastics in the various trophic niches and benchmarking microplastics interaction with native fish fauna in relation to river health.

Assessment of Production of Fish, Fish Disease and Feasibility Study of Certification for Fish Produced in East Kolkata Wetland

The study is funded by the East Kolkata Wetlands Management Authority, Department of Environment, Government of West Bengal. It focuses on multiple value assessment: fish production potential, fish diseases occurrence, agriculture and horticulture. Greater profitability was recorded from wastewater-fed fisheries compared to the feed-based systems. The role of nutrients in water and associated plankton production will be focused

now. Although the heavy metals in sediments were recorded relatively high (within respect to the associated permissible limits), their presence in fish fleshes were recorded low. The human health safety aspects will be assessed in the future studies. Presence of pathogenic micro-organisms from the abiotic and biotic components were monitored and the immunological responses of the organisms are under study to understand the impact of wastewater on fish health and the ecological sustainability.

The project's second component emphasize promotion of culture of indigenous fish species in the *bheries* of the East Kolkata Wetlands. This initiative has yielded a successful harvest of *Labeo bata* and *Systomus sarana*. *Heteropneustes fossilis* has been stocked in one pond, while another pond is being prepared for more such culture practices. The target is to understand the feasibility of culture of indigenous fish species for improving livelihood of the fishers.

The third component focuses on the evaluation of invasive fish species, specifically targeting *Pterygoplichthys* sp. Owing to its prevalence in most of the *bheries*, it is competing with the cultured fish species for nutrients and space. Effort will be made for suitable utilization of the biomass. Workshop will be conducted to generate awareness among the fishers.

Nutritional Profiling of Fishes of Sessa River, Dibrugarh, Assam and Sensitization on Health Benefit of Fish Consumption

This new study is sponsored by the Brahmaputra Cracker and Polymer Limited (BCPL), Dibrugarh, Assam. Assessment of status of indigenous fish species in the river, nutritional profiling of prioritized indigenous fish species occurring in the River, and sensitizing potential health benefits of fish consumption among local communities are the major objectives under this project.

Environmental Impact Assessment of Cage Culture in Inland Open Waters

Maharashtra Pollution Control Board, Mumbai has requested the institute to study the EIA of cage culture in their reservoirs.

Study on Fish Incidence Due to Chemical Water Discharged into Jagbudi and Vasishta River at Ratnagiri Which Meets Dabhol Creek in Maharashtra

Impact assessment of industrial effluent on environmental parameters including biotic communities are the major objectives under this new study sponsored by the Maharashtra Pollution Control Board.



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State-wise and Resource-wise Reach of ICAR-CIFRI in 2024

State	Resource	Activity
Andhra Pradesh	Lagoon	• Ecology, fisheries of Pulicat
Arunachal Pradesh	River	• Planning and designing of fish hatchery at Bichom dam site • Ecology and fisheries of Dirang river
Assam	River	• Ecology, habitat, fish catch and management regimes of fisheries of River Brahmaputra • Assessment of population characteristics of *Cabdio morar* in River Brahmaputra • Benchmarking microplastic pollution in the River Brahmaputra in relation to native edible fish fauna • Analysis for formaldehyde contamination in fish samples collected from Uzanbazar and Betkuchi wholesale markets
	Wetland	• Fish community structure and its relationship with water quality of Deepor Beel • Assessment of suitability of fisheries enhancement in Sareswar Beel, Shilai-Nalia Beel, Diplai Beel and Champamati Irrigation Project in BTC • Demonstration of CIFRI HDPE-pen culture technology and the distribution of inputs in Tamranga Beel
	Ornamental fishes	• Market survey for assessing the growth of the ornamental fish industry over the past decade in Kamrup district • Breeding of indigenous dwarf chameleon fish (*Badis blosyrus*) collected from Brahmaputra tributaries
	Livelihood and HRD	• "Demonstration-cum-input distribution programme" at Boko, Kamrup (R) District • Training programmes on pen and cage culture for production enhancement • Capacity building program of 25 fishers on 'Status, prospects and management of river, wetland and reservoir fisheries in Northeast India' • Awareness-cum-input distribution programme among the beel fishers in Tamranga Beel • Organized National fish farmers day at Guwahati
Bihar	River	• Assessment of fish and fisheries of the Ganga river system • Ranching of IMC and awareness among the fishers in depleted stretches of river Ganga
	Wetland	• Assessment of ecology and fisheries of Manika, Simra and Bhusra wetlands of Muzaffarpur district • Phylogenetic analysis of fishes of the Manika Maun
	Livelihood and HRD	• 19 training programs on 'Inland Fisheries Management' for 570 fishers/fish farmers of 17 districts of the state • Three awareness programmes on Hilsa, Dolphin and fish biodiversity under NMCG • Field day on fish safety and wetland management at Manika Maun
Chhattisgarh	Reservoir	• Techno economic feasibility of cage culture
	Livelihood and HRD	• Capacity development of 10 DFO officials on inland fisheries management

State	Resource	Activity
Gujarat	River	• Fish catch estimation, crafts and gears and socio-economics of river Narmada
	Estuary	• Ecology, fisheries of Mahi estuary
	Livelihood and HRD	• Awareness generation and input distribution programme at Ukai • Awareness-cum-field day program for the fishers of the Narmada River, at Bharuch, Narmada and Mandla
Jharkhand	River	• Ranching of IMC fingerlings into the river Ganga
	Reservoir	• Ecology and fisheries of Maithon, Bhairavi and Getalsud reservoirs • Cataloguing ectoparasites of selected fishes in Panchet • Incidence and pathological effects of *Euclinostomum heterostomum* metacercariae infection in snakehead in Tilaiya reservoir
	Coal pits and quarries	• Fish and plankton diversity, water quality, proximate composition of fish muscle of 3 coal pits in Ramgarh area
	Livelihood and HRD	• Capacity building of 46 fishers/fish farmers of Pakur and Sahibganj districts • 5 awareness programmes on Hilsa, Dolphin and fish biodiversity under NMCG
	Reservoir	• Scampi production at Ghagra in Hazaribag district, Kelaghagh in Simdega district and Masaria in Gumla district
	Livelihood and HRD	• Capacity development on inland fisheries management of 30 nos. of officials under JOHAR programme, Jharkhand State Livelihood Promotion Society
Karnataka	River	• Fish catch estimation, crafts and gears and socio-economics of river Cauvery • Resilience of native fish communities, *Systomus sarana, Cirrhinus reba* and *Ompok bimaculatus* of River Cauvery and River Bhima
	Reservoir	• Fish assemblage, fish productivity, plankton diversity, habitat parameters study on Kanva reservoir • Habitat preferences and growth patterns of Tilapia in Manchanbele reservoir
	Livelihood and HRD	• Mass awareness program on “Significance of sustainable fishing” at Kabini reservoir • Distribution of FRP boat and OBM engine under TSP to the *Girijanara Meenugarara Sahakara Sangha* of Kabini reservoir. • Awareness program on "Management of reservoir fisheries in Chiklihole reservoir; distributed crates and iceboxes to 15 tribal fishersunder TSP • Sensitization programme on “Fish seed stocking for species enhancement in reservoirs”at Manchanbele reservoir, along with stocking of 40,000 fish fingerlings in the reservoir under SCSP • Distributed crates to 20 fishers at Manchanbele reservoir under SCSP • Sensitization program on reservoir fisheries management in openwaters at Gayatri reservoir; stocked 50,000 *Labeo rohita* fingerlings in the reservoir • Distributed crates to 20 fishers at Gayatri reservoir under SCSP

State	Resource	Activity
Kerala	River	• Fish catch estimation, crafts and gears and socio-economics of river Pamba
	Estuary	• Ecology, fisheries of Kayamkulam
	Reservoir	• Ecology and fisheries of Meenkara, Malampuzha reservoirs • Preliminary assessment of Tilapia growth patterns in Meenkara and Malampuzha reservoirs • Fish assemblage, fish productivity, plankton diversity, habitat parameters study on Banasurasagar reservoir • Cage culture of *Etroplus suratensis* in Banasurasagar reservoir
	Livelihood and HRD	• Sensitization program on "Cage culture of fishes in reservoirs for enhanced fish production" and distribution of fish seed and feed to the Banasurasagar Fishermen Co-operative Society under TSP • Input distribution and awareness programme at Meenkara reservoir • Sensitization programme on "Sustainable development on inland fisheries in Elappully, Palakkad' • Participation in the Matsya Mela at Ernakulam • Participation in the Exhibition of '2nd Fisheries Summer Meet' at Madurai • Participation in entrepreneurship meet, "AquaBiz 2.0 at Zonal Technology Management - Agribusiness Incubation Centre (ZTM-ABI) in Ernakulam
Madhya Pradesh	River	• Ecology and fisheries status in Gadarwara stretch of river Narmada • Study on impact of water intake due to Gadarwara STPP on ecology of Narmada River • Fish catch estimation, crafts and gears and socio-economics of river Narmada
	Reservoir	• Ecology, institutional management of fisheries in Gandhisagar
	Livelihood and HRD	• Workshop-cum training programme on "Better health management practices in cage culture and aquaculture farms" at Bhopal • Awareness-cum-field day programs for the fishers of the Narmada River, focusing on sustainable fisheries management at Jabalpur and Khargone
	Coal pits	• Fish and plankton diversity, water quality, proximate composition of fish muscle obtained from Dolacoal pits in Anuppur district
Maharashtra	River	• Fish catch estimation, crafts and gears and socio-economics of river Narmada • Development of watershed plan for the Malshej Ghat catchment zone at Pune and Thane districts • Development of watershed plan for the Warsgaon Warangi pumped storage project at Pune and Raigad districts
Manipur	Reservoir	• Cage culture of *Hypophthalmichthys molitrix* in cages in Mapithel reservoir
Meghalaya	Cave	• Study of fish diversity in three unexplored caves, Krem Tyngheng, Um Ladaw and Krem Lymmit, East Jaintia Hills
Nagaland	Livelihood and HRD	• Exhibition on the National Conference on Hill Agro-Ecosystem • Participation in angling event organized by the Department of Fisheries, Nagaland on the occasion of the Hornbill Festival

State-wise and Resource-wise Reach of ICAR-CIFRI in 2024

State	Resource	Activity
Odisha	Reservoir	• Cataloguing ectoparasites of selected fishes in Hirakud • Environmental and aquatic ecosystem health monitoring and impact of cage operation on ecology in Hirakud reservoir • Ecology and fisheries of Nesa reservoir • Socio-economics of fishers and culture-based fisheries through pen culture in Baghua reservoir • Demonstration of CIFRI HDPE pen culture technology and the distribution of inputs in Rishia reservoir • Culture of IMC and Pangas in circular cages installed in Hirakud reservoir
	Ornamental fishery	• Distribution of 313 ornamental fish culture units to the SC women and students through College of Fisheries, Rangeilunda, 10 KVKs
	Livelihood and HRD	• Training on "Inland fisheries management' for 129 fishers/fish farmers of Gajapati, Kalahandi, Keonjhar, Mayurbhanj, Bhadrak, Baleswar, Jagatsighpur, Kendrapara and Cuttack districts • Capacity development of 30 DoF officials on 'Lab testing and fish disease management'
Punjab	River	• Ecology, fish catch estimation, crafts and gears and socio-economics of river Sutlej
Sikkim	River	• Ecology, fisheries and fish catch of Teesta, Rangit and their major tributaries, namely Ringchu, Rihichu, Kankha, Lachung chu, Yungthang Chu, Rangpo Khola, Rani Khola, Khani Khola in Sikkim
	Livelihood and HRD	• Interactive workshop on 'Exploring Fish Diversity and Catch Estimation of Major Rivers in Sikkim' • Awareness-cum-input distribution programme for the ornamental fish farmers
Tamil Nadu	River	• Fish catch estimation, crafts and gears and socio - economics of river Cauvery • Resilience of native fish communities, *Systomus sarana, Cirrhinus reba* and *Ompok bimaculatus* of Thenpennai river
	Lagoon	• Ecology, fisheries of Pulicat
	Reservoir	• Fish assemblage, fish productivity, plankton diversity, habitat parameters study of Sathanur reservoir
	Livelihood and HRD	• Sensitization program on "Enhanced fish production in open-waters" at Krishnagiri reservoir. • Distributed coracles to five fishermen under the TSP.
Tripura	Ponds	• Input distribution to 492 flood affected farmers located in five districts of Tripura
Uttar Pradesh	River	• Ecology, fish catch estimation, crafts and gears and socio-economics of river Gomati • Assessment of ecology and fish and fisheries of river Ganga • River ranching programme at different stretches of river Ganga • Eco-variability and impact study of river Yamuna on river Ganga including environmental parameters and fish diversity
	Livelihood and HRD	• 31 awareness programmes at different sites along river Ganga on Hilsa, Dolphin and fish biodiversity under NMCG
Uttarakhand	River	• Study of fisheries of Ganga under NMCG • Collection and maintenance of Mahseer brooders and fingerlings • Seed production of selected Golden Mahseers of the River Ganga • Assessment of stock status of Golden Mahseer (*Tor putitora*) and Snow trout (*Schizothorax richardsonii*) • Breeding of wild fish germplasm and ranching in depleted stretches of river Ganga • Survey of Fish diversity in Goriganga River in Munsiyari, Pithoragadh district of Uttrakhand for Uttarakhand JalVidyut Nigam Ltd.
	Livelihood and HRD	• 6 awareness programmes at different sites along river Ganga on Hilsa, Dolphin and fish biodiversity under NMCG

State	Resource	Activity
West Bengal	River	• Assessment of fish and fisheries of the Ganga river system for developing suitable conservation and restoration plan • Breeding of wild fish germplasm and ranching in depleted stretches of river Ganga • Hilsa fisheries ranching and awareness at Farakka • Resilience of native fish communities, *Systomus sarana* and *Cirrhinus reba* of Ganga • Benchmarking microplastic pollution in the River Ganga in relation to native edible fish fauna • Microbiometa-transcriptomics assessment of Ganga river basins for ecosystem health monitoring
	Estuary	• Ecosystem health, fish catch structure, mangrove landscape patterns in Indian Sundarbans • Assessment of Petroleum Hydrocarbon, PFAS and phenolic micropollutants in surface water and their effect on ecosystem health in Hooghly estuary • Changing dynamics of labour migration on employment, livelihoods and resource productivity patterns at estuarine region
	Reservoir	• Experiment on post-stocking morbidity and mortality of *Pangasianodon hypophthalmus* fish seeds • Cage culture technology in Kangsabati reservoir
	Pond	• Study of 66 farms for understanding the AMR pattern • Analysis of functioning and technical efficiencies of 23 FPOs • Survey of *bheries* in North 24 Parganas, South 24 parganas and Purba Medinipur districts to examine the occurrence of bacterial illness in Asian seabass
	Wetland	• Fish disease occurrence, evaluation of feasibility of certifying fish produced in EKW • Assessment of GHG emission and carbon sequestration in Kulia beel and Noai Khal • Impact of submerged macrophyte removal and jute retting on ecology, development of natural farming protocol for culture-based fisheries in Kholsi beel, Nadia • Surveys for identification of microalgae with potential bio remediating properties against potentially toxic elements (PTEs) in the Kulia and Shantipur wetlands • Stocking of climate resilient *Puntius sarana* seed in CIFRI HDPE-pen systems in Garapota beel • Estimating provisioning, regulating, cultural and supporting services of Beledanga • Distribution of income across SHGs of Birbhum • Meta-transcriptomic investigation of Ganga River sediments • Role of women in small-scale aquaculture of Sundarbans • Assessment of group dynamics fishery-based Self-Help Groups (SHGs) in Birbhum district • Disease surveillance in the farmers' field of East Medinipur, Howrah, South 24 Parganas districts of West Bengal • Fish seed stocking in the captive nursery pond adjacent to Beledanga wetland

State	Resource	Activity
West Bengal	Livelihood and HRD	• Workshop to formulate strategies for revitalizing the East Kolkata Wetlands • *Mahila Matsyajibi Sammelan* 2.0 at Kultali • Distribution of fish feed and fish seeds among 500 women beneficiaries of 50 villages across 11 Gram Panchayats in the Gosaba and Basanti blocks of Sundarbans • Input distribution-cum-awareness programme at Joygopalpur • Training and input distribution among women for fish culture in bandhs and of Purulia • Ornamental fish culture for women of Birbhum district • "*Mahila Matsyajibi Diwas*" was observed for the first time on 26 December 2024 at Kultali, Sundarbans • 4 Awareness programmes on anti microbial resistance at EKW and South 24 Parganas district • Distribution of inputs to the fishers of Akaipur, Maniknagar, Bijpur, Kundipur, Chamordaha, Kumli, Khalsi, and Sindrani under the SCSP • Awareness program, technical support and input distribution for fisheries at Sittong, Darjeeling District • Capacity building on 'Inland fisheries management' for 34 tribal fishers/farmers of Purulia and Sundarbans • 112 awareness programmes at different sites along river Ganga on Hilsa, Dolphin and fish biodiversity under NMCG • Training on 'Ornamental fish farming for income generation', 24 tribal fishers/fish farmers of Birbhum • Awareness programmes on fish disease surveillance and health management at East Kolkata Wetland • Awareness programme and hands on training to the local fishermen on fish breeding and fingerling raising at Farakka • Workshop on fish proteomics at Barrackpore • 13th Indian Fisheries and Aquaculture Forum: "Fostering Growth of Fisheries and Aquaculture for Sustainable Development" at Kolkata • Farmer Scientist Interaction on fish disease surveillance and health management at EKW • Demonstration-cum-awareness program on the potential of drone technology in fisheries at East Kolkata Wetland • River Field School on "Exploring the Food-Energy-Water Nexus in River Ecosystems" at different sites of river Ganga from Dakshineswar to Farakka • Workshop on "Futuristic Approach for Inland Fisheries Informatics: Role of Tools and Techniques Hybridization" at Barrackpore • Inception workshop of the project "Multiple Value Assessment: Fisheries & Agriculture, Culture of Indigenous Fish Species & Management of Invasive Fish Species" at Kolkata • Workshop on "Drone Technology and Its Applications" at the Institute HQs, Barrackpore • National Fish Farmers Day,World Rivers Day, National Dolphin Day at Barrackpore • World Fisheries Day at Sundarbans

Demonstration of Scientific Fish Culture in The *Bandhs* of Purulia

The demonstration of scientific fish culture in the *bandhs* of Purulia is a crucial initiative aimed at enhancing aquaculture productivity and improving rural livelihoods. The scientific approach begins with selection of suitable *bandhs* that retain water year-round, followed by pond preparation, which includes removing unwanted weeds. High-yielding fish species such as Rohu, Catla, Mrigal, were stocked in appropriate densities to ensure optimal growth. A balanced feeding regimen was followed to enhance fish health and productivity. Regular monitoring of water quality parameters like dissolved oxygen and pH, along with preventive disease management ensures sustainable fish culture. A total of eight *bandhs* (rainfed water-bodies), covering an area of over 40 acres were selected by the ICAR-CIFRI for community fish culture. This scientific demonstration plays a pivotal role in transforming traditional water bodies into profitable aquaculture units, fostering economic growth and nutritional security of the fishers of purulia.



Pen Culture and Culture-Based Fisheries Demonstration

The Institute consistently endeavours to demonstrate pen culture and culture-based fisheries for managing wetland and reservoir fisheries, with the objectives of enhancing the livelihood of the SC community. The institute has adopted eight wetlands - Akaipur, Maniknagar, Bijpur, Kundipur, Chamordaha, Kumli, Khalsi, and Sindrani situated in the districts of North 24 Parganas and Nadia of West Bengal for sustainable fish production and biodiversity conservation. Fisheries inputs, including 825 kg of fish seed and 13 tons of fish feed were distributed to the SC fishers of 8 wetlands to demonstrate pen culture technology for seed raising, facilitating stocking in wetlands for CBF demonstration.

Demonstration of CIFRI - ARGCURE at Farmer's Pond in Assam

CIFRI ARGCURE is a product developed by the Institute to control Argulosis disease in fish culture. The product was licensed to Glaucus Agrochem Pvt. Ltd., Kolkata, West Bengal. The Scientific team of RRC Guwahati carried out a demonstration of CIFRI ARGCURE in the fish farm at Bhatipara Village, Damalchos, Kamrup (R) District of Assam to control Argulosis disease in carps reared in the farm.

Argulosis disease in carps is one of the major problem faced by the fish farmers of the state. A total of three dosages at an interval of seven days were applied. Team CIFRI also provided management measures for maintenance of better water quality regime in fish culture pond. Reportedly, the infection was reduced >80% after application of the liquid. The results suggest that CIFRI ARGCURE can be used effectively by the fish farmers of Assam for control Argulus infection in carps.



Mr. Abhijit Boro, a progressive fish farmer of Assam displaying CIFRI ARGCURE

वार्षिक प्रतिवेदन

Annual Report

2024

Training of Bihar Fishers/Fish Farmers

A total of 19 training programs were organized during the year 2024 on 'Inland Fisheries Management' for the Bihar fishers/fish farmers at the CIFRI HQ. Thirty fishers/fish farmers participated in each of the training progrmmes. The details are as follows:

Sl. No.	Date	Fishers/fish farmers from the district
1.	30 January - 05 February	Gopalganj
2.	03-09 February	Sheohar
3.	07-13 February	Darbhanga
4.	05-11 March	Katihar
5.	02-08 April	Munger
6.	11-17 April	Jamui
7.	23-29 April	Sheikhpura
8.	02-08 May	Saran
9.	14-20 May	Madhepura
10.	07-13 June	Rohtas
11.	02-08 July	Muzaffarpur
12.	10-16 July	Bhagalpur
13.	04-10 September	Nawada
14.	11-17 September	East Champaran
15.	18-24 September	Siwan
16.	26 September - 02 October	Patna
17.	19-25 November	Madhepura
18.	03-09 December	Madhubani
19.	17-23 December	Bhagalpur



Trainees from Katihar district



Trainees from Gopalganj district

Other Trainings for Fishers / Fish Farmers

Sl. No.	Title of the training programme	Date	No. of participants	Venue
1.	ATMA sponsored training on "Inland fisheries management"	16-20 January	21 fishers/fish farmers from Sahibganj, Jharkhand	CIFRI HQ
2.	Pen and cage culture for production enhancement in inland open-waters	13-15 February	25 fishers/fish farmers from Assam, Meghalaya, Nagaland, Manipur and Tripura	ICAR-CIFRI Regional Centre, Guwahati
3.	ATMA sponsored training on " Inland fisheries management"	27 Feb - 02 March	25 fishers/fish farmers from Pakur, Jharkhand	CIFRI HQ
4.	Status, prospects and management of river, wetland and reservoir fisheries in Northeast India	12-14 March	25 fishers/fish farmers from Arunachal Pradesh, Assam, Meghalaya and Sikkim	ICAR-CIFRI Regional Centre, Guwahati
5.	Training on "Inland fisheries management" in collaboration with Development Foundation (NGO)	28-31 May	21 fishers/fish farmers from Gajapati District, Odisha	CIFRI HQ
6.	Training on "Inland fisheries management" in collaboration with Development Foundation (NGO)	26-29 June	21 fishers/fish farmers from Kalahandi District, Odisha	CIFRI HQ
7.	Inland fisheries management (under STC)	02-04 September	34 tribal fishers of Purulia and Sundarbans, WB including 17 women fishers	CIFRI HQ
8.	Ornamental fish farming for income generation (under STC)	25-27 September	24 tribal fishers of Shantiniketan, Birbhum, WB	CIFRI HQ
9.	Inland fisheries management (DoF, Odisha sponsored)	04-08 November	30 fishers/fish farmers from Keonjhar and Mayurbhanj districts of Odisha including 06 women	CIFRI HQ
10.	Inland fisheries management (DoF, Odisha sponsored)	11-15 November	27 fishers/fish farmers from Bhadrak and Baleswar districts of Odisha including 02 women	CIFRI HQ
11.	Inland fisheries management (DoF, Odisha sponsored)	26-30 November	30 fishers/fish farmers from Jagatsighpur, Kendrapara and Cuttack districts of Odisha including 05 women	CIFRI HQ



The DDG (Fy. Sc.) and the Director with the trainees of ATMA, Sahebganj



Trainees from Bihar at the ornamental fish unit





Training programme conducted by Guwahati center

Trainings for Students

Sl. No.	Title of the training programme	Date	No. of participants	Venue
1	Inland fisheries management	11-20 January	10 nos. of 3rd semester students of FRM Dept, ICAR-CIFE, Mumbai	CIFRI HQ
2	Fish proteomics	16-18 January	18 participants (Faculty, UG and PG students, researchers, and faculties)	CIFRI HQ
3	Bioinformatics tools and its application in predictive ecology and fisheries	19-25 January	16 participants (Faculty, researchers, and students)	CIFRI HQ
4	Collaborative training programme of ICAR-CIFRI and MANAGE, Hyderabad on Nutri-Fish to nutrional security of the rural populace	20-22 March	20 participants	CIFRI HQ
5	A fundamental training pro gamme on GIS mapping	29 April-01 May	38 research scholars	CIFRI HQ
6	Basics of GIS mapping on open source software	21-24 May	36 participants including scientists, research scholars	CIFRI HQ
7	Hands on training on 'Molecular tools for aquatic resource management'	27 May-01 June	32 trainees including Assistant professor, students (UG, PG, and PhD) and researchers from various universities, colleges and research institutes across the country	CIFRI HQ
8	Concept building in basic statistics for biological data analysis	31 July-02 August	21 students, researchers and departmental staff	Prayagraj RRC
9	Exploring the 'Food-Energy-Water Nexus' in river ecosystems	21-26 October	15 participants including students, scientist from different parts of the country	CIFRI HQs
10	Ecosystem based management of wetland fisheries	23-29 October	22 students from various Universities and Research Institutes of West Bengal, Tripura, and Madhya Pradesh	CIFRI HQs
11	Inland fisheries management	03-09 November	11 nos. of M. F. Sc. (FRM) students of ICAR-CIFE, Mumbai including 8 female students	CIFRI HQs
12	Application of scientific tools for management of inland fisheries	05-07 November	26 (students, officials from KVKs, Universities and state departments)	Bengaluru RRC(Online mode)
13	Concept building in basic statistics for biological data analysis	18-20 November	21 students, researchers and departmental staff	Prayagraj RRC
14	Management of open water fisheries to doubling the farmers' income	26-28 November	20 farmers, students, entrepreneurs and fisheries officers	Prayagraj RRC
15	Advances in heavy metal analysis (ICP-MS)	09-13 November	20 students from different Universities and Research Institutes across the country	CIFRI HQs
16	Inland fish taxonomy and biodiversity assessment	12-18 November	11 nos. of students and research scholars from the WBUAFS (WB) RLCAU (Jhansi), CIFRI (WB), NSOU and NMCG project	CIFRI HQs



Training programme at Prayagraj



Training on inland fish taxonomy and biodiversity

Trainings for Officials at the Institute HQs

Sl. No.	Name of the training	Date	Participants
01.	Inland fisheries management	29 January-02 February	30 nos. of officials under JOHAR programme, Jharkhand State Livelihood Promotion Society under Dept. of Rural Development, Jharkhand
02.	Hands-on-training on e-HRMS 2.0	19 June	30 officials of different ICAR institutes
03.	Inland fisheries management	25-27 July	10 nos. of DoF officials from Chhattisgarh including 4 female officials
04.	Lab testing and fish disease management	28-30 August	30 nos. DoF officials from Odisha including 20 female officials



Training on e-HRMS 2.0



Training on lab testing & fish disease management



Training on inland fisheries management



Training on inland fisheries management

Exposure Visits

Sl. No.	Particulars of visitors	Date of visit	Venue
1.	23 nos. farmers from Rahe, Ranchi, Jharkhand under *Jharkhand Samajik Kalyan Sansthan* sponsored by ATMA, Dhanbad un der Dept. of Agri, AH and Co -Operative, Govt. of Jharkhand	23 January	CIFRI HQ
2.	40 nos. B.Sc. (Hort.) students (7th semester) of College of Horticulture, Chaibasa under BAU, Ranchi	31 January	CIFRI HQ
3.	15 nos. of B. F. Sc. students of ICAR-CIFE, Kolkata	05 February	CIFRI HQ
4.	16 nos. fish farmers from Tehri, Garhwal, Uttarakhand	12 February	CIFRI HQ
5.	41 nos. B. F. Sc. students of CoF, Tripura under CAU, Imphal	29 February	CIFRI HQ
6.	45 nos. B. F. Sc. Students, and two Asst. Professors from College of Fisheries, Mangalore, Karnataka	14 March	ICAR-CIFRI Regional Centre, Bangalore
7.	40 nos. B. F. Sc. 4th year students of TNJFU, Tamil Nadu	16 March	CIFRI HQ
8.	02 nos. trainees from ICAR-CIFE, Kolkata	19 March	CIFRI HQ
9.	15 nos. students from Gurukul College, Sonarpur, WB	03 April	CIFRI HQ
10.	30 nos. B. F. Sc. students from CoF, OUAT, Rangeilunda, Odisha	09 April	CIFRI HQ
11.	35 nos. 4th Year B. F. Sc. students from TNJFU, Tamil Nadu	12 April	CIFRI HQ
12.	21 nos. students of Allen Career Institute, Barrackpore, West Bengal	06 June	CIFRI HQ
13.	29 nos. students of B. Sc. Zoology Hons. 3rd year students of Bhairab Ganguly College, Belgharia, West Bengal	28 June	CIFRI HQ
14.	42 nos. of fishery officials from DoF, Odisha	18 July	CIFRI HQ
15.	23 nos. of B. Sc. Zoology Hons. 2nd semester students of Lady Brabourne College, Kolkata	06 August	CIFRI HQ
16.	40 farmers from Odisha by DoF, Odisha (JFTA and SFTA)	09 August	CIFRI HQ
17.	45 nos. of 4th year B.F.Sc. students from CoF, Mangalore	19 August	CIFRI HQ
18.	20 nos. of B.Sc. Zoology Hons. 2nd semester students of Serampore College, Hooghly	29 August	CIFRI HQ
19.	27 nos. of B.Sc. Zoology Hons. 2nd semester students of SBSS Mahavidyalaya,Goaltore, Midnapore	30 August	CIFRI HQ
20.	28 nos of trainee-fishers under training programme of CRIJAF, Barrackpore, WB	05 September	CIFRI HQ
21.	37 nos. of B. F. Sc. students form Dr. Rajendra Prasad Central Agriculture University, Dholi, Samastipur, Bihar	14 October	CIFRI HQ
22.	46 nos. of B. F. Sc final year students of CoF, Ratnagiri, Maharashtra	30 October	CIFRI HQ
23.	28 nos. of B. Tech students (Electronics and Communication/ Electronics and Instrumentation) from Narula Institute of Technology, WB	07 November	CIFRI HQ
24.	98 nos. students of Class XI, XII from PM Shri Kendriya Vidyalaya, Cossipore, Kolkata	12 November	CIFRI HQ
25.	102 nos. students of Class XI, XII from PM Shri Kendriya Vidyalaya, Army, Barrackpore	13 November	CIFRI HQ
26.	13 nos. of 2 nd year M. F. Sc. (FNBP) students of ICAR -CIFE, Mumbai	22 November	CIFRI HQ
27.	31 nos. students of Class IX from the God's Grace School, Barrackpore	05 December	CIFRI HQ
28.	26 nos. of rural youth from Jhargram, West Bengal under Biodiverse Farming Pvt. Ltd (TONA Organization Farm) for formulating agri and allied community business	13 December	CIFRI HQ
29.	10 nos. of fish farmers from Raigarh district of Chhattisgarh	13 December	CIFRI HQ
30.	26 nos. of rural youth from Maldah, West Bengal under Biodiverse Farming Pvt. Ltd . (TONA Organization Farm) for formulating agri and allied community business	20 December	CIFRI HQ
31.	40 nos. farmers from ATMA, Samastipur, Bihar	24 December	CIFRI HQ



Students from College of Fisheries, Mangalore at ICAR-CIFRI Regional Centre, Bangalore

Exhibitions/Mela Where ICAR-CIFRI Participated

Sl. No.	Date	Particulars	Place
1.	03-05 January	Exhibition at the 'Farmers' Fair' organized by ICAR-NINFET	Ranikuthi, Tollygunj, Kolkata
2.	12-14 January	Exhibition at 'Krishi Samridhi Mela' cum National Seminar 2023-24	Sargachi, Murhidabad, WB
3.	02-04 February	'Aqua Goa Mega Fish Festival'	Panjim, Goa
4.	03-05 February	'Regional Agricultural Fair for Eastern Region - 2024'	KVK, Diyankel, Torpa Block, Khunti, Jharkhand
5.	07-09 February	'Krishi Mela' at Sashya Shyamala KVK	Sashya Shyamala KVK, Sonarpur
6.	08-10 February	'Regional Farmer Fair' RLBCAU, Jhansi	Rani Lakshmi Bai Central Agricultural University, Jhansi
7.	16-18 February	F&ARD fair 'Matsya-Pranee Samavesh Odisha (MPSO)-2024'	Janata Maidan, Bhubaneswar, Odisha
8.	23-25 February	Exhibition at 13th Indian Fisheries and Aquaculture Forum on 'Fostering Indian Fisheries and Aquaculture for Attaining Sustainable Development Goals'	Biswa Bangla Convention Centre, Kolkata
9.	02 March	Exhibition at the 'Kisan Mela cum farmers-Scientists Interaction' on 'Livestock Fiesta: Raising Resilient Livelihood in Eastern India' organized by NDRI, Kalyani Centre	ICAR-NDRI, ERS, Kalyani
10.	09-11 March	Exhibition at 'Dairy and Krishi Mela', Chaibasa organized by ICAR-NDRI	Chaibasa, Jharkhand
11.	14 July	2nd Fisheries Summer Meet	Ida Scudder Auditorium, Madurai
12.	11-14 September	'27th Agriculture Exhibition' organized by Central Calcutta Science and Culture Organization for Youth at Science City, Kolkata	Science City, Kolkata
13.	29-30 November	Exhibition at national conference on 'Hill Agro-Ecosystem: Challenges and Opportunities for Achieving Sustainable Development Goals' organized by ICAR Research Complex for NEH Region, Nagaland Centre	ICAR Nagaland Centre, Jharnapani, Medziphema, Nagaland
14.	21-25 December	'22nd National Agricultural Exhibition' organized by Shree Srikhetra Soochchana, Puri	Puri, Odisha
15.	22-31 December	'Sundarbans Yuba Mela' organised by Taldi Bohurupee Sangha	Taldi, South 24 Pgs, Sundarban, WB
16.	26-29 December	'03rd A. P. C. Roy Smarak Vigyan Mela O Pradarshani' organized by WBUAFS, WB	Belgachia, Kolkata
17.	26-28 December	Exhibition at 'Odisha Research Conclave 2024' organized by Fakir Mohan University, Balasore, Odisha	Balasore, Odisha





ICAR-CIFRI, Prayagraj stall at RLBCAU, Jhansi

Shri Rajiv Ranjan Singh, Hon'ble Union Minister, Shri George Kurian, Hon'ble Union Minister of State for Fisheries, Animal Husbandry and Dairying and Dr. Abhilaksh Likhi, Secretary (Fy), Department of Fisheries, Govt. of India visiting the ICAR-CIFRI stall along with Dr. J. K. Jena, DDG (Fisheries), ICAR on 12 July 2024

Mass Awareness Campaigns

Name of the Camp	Purpose	Date	Venue	Participants
Awareness programmes on Hilsa, Dolphin and Fish Biodiversity	Biodiversity Conservation under Namami Gange	January - March	25 programmes in West Bengal at the following places: Haldia, Kalighat, Narghat (Purba Medinipur), Taki (North 24 Parganas), Islampur (Murshidabad), Tehatta Ghat (Nadia), Farakka, Nabadwip, Barrackpore, Krishnanagar, Ashisnagar (Durgapur Barrage); Rajnagar, Rajnagar-2, Gajipur, Khejuri Ghat, Khejuri Ghat-1, Khejuri Ghat-2 of Malda; Baliara (Fraserganj), Diamond Harbour, Godakhali of South 24 Parganas	864 fishers
			16 programmes in UP, Bihar and Jharkhand at the following places: Ayodhya of UP, Bhagalpur, Gandhi Ghat, Ahilya Ghat Khagaria Jahanabad Supaul, Naugachia of Bihar; Sikarpur, Radhanagar, Basanta Ghat, Dak Bangla Ghat, Shreeghar, Shreeghar-2, Shreeghar 8 no, Dumaria Ghat, Murahia fishing Village, Rajmahal, of Jharkhand	321 fishers
Awareness-cum-input distribution programme for the fish farmers of Assam at Guwahati	Input distribution programme	29 February	ICAR-CIFRI Regional Centre, Guwahati	30 fishers

Name of the Camp	Purpose	Date	Venue	Participants
Awareness programmes on Hilsa, Dolphin and Fish Biodiversity	Biodiversity Conservation under Namami Gange	April-June	30 awareness programems at different places of West Bengal as per the following: Rajnagar Ghat-1and 2, Bin Nagar, Sikarpur, Khejuria Ghat, Pagla Ghat, Panchanandapur (all from Malda), Farakka, Balagarh, Barrackpore, Kalna, Tribeni, Mayapur, Lalbag, Berhampore, Bally 14 programmes in UP, Bihar and Jharkhand at the following places: Kada Dham (Kausambi), Sirsa, Prayagraj, Mirzapur from UP and Begamganj futanibazer, and Radhanagar from Jharkhand	1219 fishers
Awareness on anti-microbial resistance	Awareness on ill-effects of indiscriminate uses of anti-microbials	16 April	4 No Bheri, East Kolkata Wetland, Kolkata, West Bengal	32 farmers, including 14 women and 18 men
		17 April	Sardar Bheri, East Kolkata Wetland, Kolkata, West Bengal	48 farmers, including 18 women and 30 men
Awareness-cum-input distribution programme for the fish farmers of Sikkim held at Gangtok, Sikkim	Input distribution programme	11 June	Department of Fisheries, Gangtok, Sikkim	50 fish farmers
Awareness on anti microbial resistance	Awareness on ill-effects of indiscriminate uses of anti-microbials	23 June	Minakhan block, South 24 Parganas, West Bengal	40 fishers
Awareness programmes on Hilsa, Dolphin and Fish Biodiversity	Biodiversity Conservation under Namami Gange	July-September	31 awareness programems at different places of West Bengal as follows: Radhnagar, Khejuria Ghat, Khejuria Ghat-2, Binnagar Ghat of Malda; Farakka, Kulideyar Ghat, Hossenpore Ghat of Murshidabad; Adi Krishnanagar Ghat and Islampur of Nadia; Goran Bose I and II, Fraserganj, Diamond Harbour and Godakhali of South 24 Parganas and Barrackpore 5 programmes in UP, Bihar and Jharkhand at the following places: Rajmahal of Jharkhand; Raja Ghat (Patna), Kamarganj, and Sojhi Ghat (Munger) of Bihar; Hukum Chapra Ghat (Ballia) of Uttar Pradesh	828 fishers

Name of the Camp	Purpose	Date	Venue	Participants
Awareness on anti-microbial resistance	To aware about the ill-effects of indiscriminate uses of anti-microbials	29 August	East Kolkata Wetlands (EKWs), West Bengal	30 Assistant fisheries officials, of the Government of Odisha, and 15 EKWs fishermen
Awareness programmes on Hilsa, Dolphin and Fish Biodiversity	Biodiversity Conservation under Namami Gange	October-December	26 awareness programems at different places of West Bengal as follows: Farakka, Khejuriya Ghat, Lalutola Ghat; Bin nagar, Rajnagar, Nayagram (Malda) Barrackpore, Diamond Harbour, Kultoli Mela, Tribeni (Hooghly), Kalna (East Burdwan), Nabadwip (Nadia) 10 programmes in UP, Bihar and Jharkhand at the following places: Tehri, Haridwar, Alakananda (Badrinath), Koteshwar Tehri, Koti colony and Garhwal University of Uttarakhand; Prayagraj and Boat Ghat, Yamuna River of UP; Sikarpur, Pipra, Shridhar, and Nimtola of Jharkhand	5024 fishers



Awareness at Kolaghat, West Bengal


Awareness-cum-input distribution programme at Gangtok, Sikkim


Awareness cum input distribution programme at Guwahati, Assam


Awareness-cum-field day at Alirajpur, MP

वार्षिक प्रतिवेदन

Annual Report

2024

Empowering Women through Small-Scale Aquaculture: A Pathway to Sustainable Livelihoods in the Indian Sundarbans



Table: Activity profile of women in Sundarbans

Category	Women's Role
Productive (income generating)	• Fish feeding • Casting net & harvesting • Fish drying • Pond management
Reproductive (unpaid household labour)	• Child care • Cooking • Collecting fuel and water • House cleaning
Community role	• Attending religious ceremonies



Impact of ICAR-CIFRI intervention on annual income (Rs.)

Small-scale fisheries (SSF) and aquaculture are vital for food security, income and livelihood of millions of marginalised fishing communities. The Indian Sundarbans, a fragile mangrove ecosystem, supports small-scale fishers across 282 villages (DoF, WB, 2011). However, climate change impacts, such as rising sea levels and salinity intrusion, threaten the livelihoods of its 4.5 million inhabitants, including those dependent on fisheries. In these vulnerable conditions, small-scale aquaculture presents a significant opportunity to enhance the livelihoods of rural communities in the Sundarbans. One of the most significant aspects of small-scale aquaculture in the Sundarbans is its ability to empower women, who are central to the small-scale aquaculture production process.

ICAR-CIFRI has recognized the crucial role of women in the sector and has actively supported their involvement through the SCSP project. Since 2019, CIFRI's intervention in the Sundarbans was focused on empowering women by providing training and demonstration projects to enhance their economic and social well-being. This initiative has equipped women with the necessary skills and resources to improve their fish farming practices and outputs, resulting in a doubling of average income from fish production. Additionally, it has addressed nutritional security by increasing the supply of protein, thereby, contributing to the overall health and well-being of their families.

The role of women in small-scale aquaculture and the impact of ICAR-CIFRI's intervention in the Sundarbans was studied. The study involved 100 women from ten villages viz, Amjhara, Charavidya, Goranbose, Gaurdaspara, Masjitbati, Phulmalancha, Pochapara, Ramchandrakhali, Uttar Mokamberia and Uttar Sonakhali.
The study revealed that the majority of respondents had a limited educational background and belonged to the middle-age group and were involved in various aquaculture activities. They play a key role in productive, income-generating activities such as feeding fish, casting nets, harvesting, fish drying, and pond management. Some women were also engaged in ornamental fish breeding through ICAR-CIFRI's initiative. In addition to these productive roles, they contribute significantly to reproductive, unpaid household labour, including child care, cooking, collecting fuel and water, and house cleaning. Women also participate in community activities, such as attending religious ceremonies.

The average income from fish production before CIFRI's intervention was Rs. 12,322 per year, which has almost doubled to Rs.

23,646 per year (an increase of 91.8%) following CIFRI's support. This underscores the critical impact of empowering women in the aquaculture sector.

Thematic analysis of women respondents involved in small-scale fisheries, using Braun & Clarke's (2006) thematic analysis framework, highlights the impact of CIFRI interventions. The major themes that emerged from the analysis of women respondents involved in small-scale fisheries under ICAR-CIFRI interventions are increased production and economic growth, leading to higher income and financial stability, increased household fish consumption, improving nutrition and food security, improved technical knowledge and problem-solving skills, enabling better fisheries management, better livelihood and household well-being, contributing to education, healthcare, and quality of life, and gratitude for the support received, reflecting social and economic empowerment. These themes highlight the positive impact of ICAR-CIFRI interventions in transforming the lives of women in small-scale fisheries. ICAR-CIFRI's intervention in small-scale aquaculture not only empowers women and fosters economic growth but also promotes responsible consumption, production, and habitat conservation, thereby contributing significantly to multiple SDGs.

B. K. Das, Aparna Roy, Lianthumulaia, Yateesh D. C., Liton Paul, Anurag Singh, Shreya Bhattacharya

Success Stories of the Fishing Community in Sundarbans: The Impact of ICAR-CIFRI Intervention in Small-Scale Fisheries

Small-scale aquaculture is a cornerstone of rural economies, particularly in the biodiversity-rich Sundarbans region. Deeply embedded in local traditions and values, it not only sustains livelihoods but also drives sustainable rural development. By making efficient use of local resources and family labor, it creates wealth, diversifies income sources, and strengthens social cohesion.The major livelihood options for the population of the Sunderbans include agriculture, fisheries, aquaculture, and coastal fishing. However, due to the uncertainty caused by climate change, crop and fish yields are becoming increasingly unpredictable, leading to livelihood insecurity among the inhabitants.



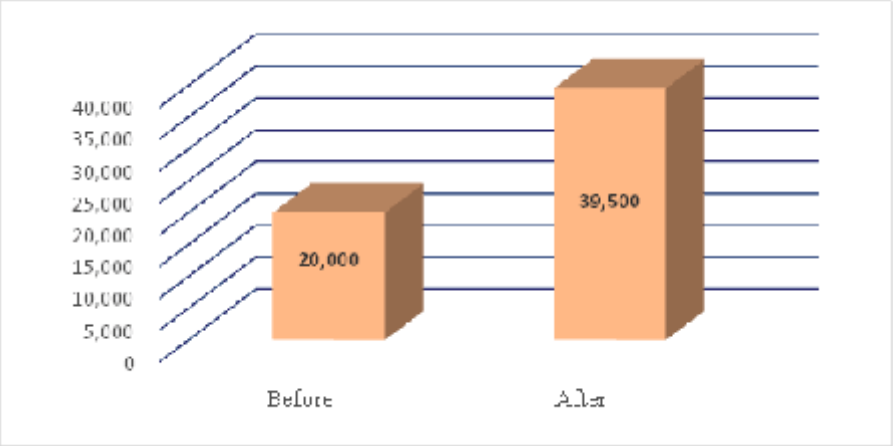


Scientific adoption of composite fish culture practices in the Sundarbans has helped these vulnerable communities maximize the efficient use of available water resources by utilizing different ecological niches. Backyard ponds in the Sundarbans offer a valuable opportunity to improve both income and nutrition for the region's vulnerable communities. Recognizing this potential, ICAR-CIFRI has highlighted the importance of small-

scale aquaculture and actively encourages wider community involvement. To support these efforts, ICAR-CIFRI through SCSP project has provided crucial inputs, including 7 kg of fish, 100 kg of feed, and lime to each fisher, to promote sustainable aquaculture practices. These initiatives aim to benefit approximately 5,000 residents. Through focused training and demonstration projects, ICAR-CIFRI has equipped individuals with the knowledge to adopt climate-resilient aquaculture practices, such as scientific composite fish culture and the promotion of SIFs (Small Indigenous Fish).

These initiatives are helping to improve economic stability and enhance household nutrition, contributing to the overall resilience and well-being of communities. Also addressed broader community participation by emphasizing the essential role of all individuals regardless of gender in small-scale aquaculture within the Sundarbans.

An impact study revealed that these beneficiaries, with an average age of 50.2 years and most having at least a primary education, are actively engaged in aquaculture activities.



Impact of ICAR-CIFRI intervention on annual income (Rs.)

Increase in Income

The ICAR-CIFRI intervention has had a significant impact on the livelihood and income fishers depicted in figure in the region. Before the intervention, the average income of the beneficiaries was around ₹20,000. However, after receiving support and adopting the aquaculture practices promoted by ICAR-CIFRI, their income has risen to approximately ₹39,500 showing significant income increment.

In addition to the significant increase in income, the focused discussions with respondents revealed that post - intervention, there has been a notable adoption of scientific fish farming methods. Fish consumption levels have risen, contributing to improved nutrition, while technical knowledge and problem- solving skills among the fishers have also seen substantial growth.

The ICAR-CIFRI intervention through SCSP project has not only boosted income but has also fostered a holistic improvement in the quality of life for the beneficiaries. By empowering the community with knowledge and resources, the program has laid the foundation for long-term, sustainable development.

B.K. Das, Aparna Roy, Lianthumulaia, Gitashree. T, Manisha Molla, Aryama Bhattacharya, Shreya Bhattacharya

Pabda Catfish Culture in CIFRI Pen Culture System: A Success Story from West Bengal

Under the ICAR-WorldFish Collaborative Project (Window-3), ICAR-CIFRI, Barrackpore, has been steadfast in its mission to enhance fishers' income by equipping them with scientific fish culture techniques. One of the most effective strategies for achieving this goal has been fish stocking in wetlands, which has significantly improved fish production, ensuring both economic stability and food security for local communities.

Chamta Wetland situated in the Bongaon Block of North 24 Parganas, West Bengal, has historically been a vital freshwater resource, supporting local fishers and biodiversity. However, years of overfishing, habitat degradation, and climate changes have severely impacted its aquatic ecosystem, threatening the livelihoods of those dependent on its resources. Recognizing the urgent need for intervention, ICAR-CIFRI introduced pen culture technology as a sustainable solution for seed raising and table fish production.

In 2024, ICAR-CIFRI initiated the pen culture of high-value indigenous catfish, Pabda (*Ompok bimaculatus*), in this wetland. Juvenile fishes (7.69 cm; 2.5 g) were stocked in three HDPE pens, each spanning 0.1 hectares, at a density of 5 fishes per square meter (5,000 fishes per pen). This method leveraged existing water

resources while providing a controlled environment within the pens to optimize fish growth and survival.

The pen system not only protected the fish from predators but also enabled precise management, ensuring ideal conditions for their growth. The local community played an active role in the daily maintenance of the pens, conducting regular inspections and monitoring water quality, including pH, oxygen levels, and temperature. The fishes were fed with artificial floating pelleted feed containing 32% crude protein and 4% crude fat at a rate of 5-3% of body weight. After seven months of careful monitoring and management, the fishes reached an average weight of 68g. Approximately 50% of the stock was released back into the wetland to support species conservation efforts, ensuring ecological balance.



HDPE-Pen culture system for Pabda fish culture installed at Chamta wetland



Pabda fish harvest from HDPE-Pen culture system at Chamta wetland

Workshop on Fish Proteomics

The 3-day workshop on proteomics was organized by the institute for faculty, researchers, and students during 16 to 18 January 2024 at Barrackpore. Dr. B. P. Mohanty, ADG (Inland fisheries), New Delhi, and Dr. B. K. Das, Director inaugurated the programme. Dr. B. P. Mohanty highlighted the importance of proteomics tools in the food industry, disease diagnosis, clinical studies, biomarker discovery, and drug discovery. Dr. B. K. Das emphasized the role of proteomics technology in the study of interactions, function, composition, and structures of proteins and their cellular activities in fish, bacteria, fungi, or any organism or cell type.



Workshop on fish proteomics

13th Indian Fisheries and Aquaculture Forum: "Fostering Growth of Fisheries and Aquaculture for Sustainable Development"

The Institute, in association with the Inland Fisheries Society of India, Asian Fisheries Society (Indian Branch) and Professional Fisheries Graduates Forum (PFGF) organized the 13th Indian Fisheries and Aquaculture Forum (IFAF) during 21-23 February 2024 at the Biswa Bangla Convention Centre, Kolkata with a theme of "Fostering growth of fisheries and aquaculture for



Hon'ble Minister of Fisheries, Animal Husbandry and Dairying, Government of India addressing the audience



Dr. B. K. Das welcoming the dignitaries and delegates



Dr. J. K. Jena delivering inaugural address



Secretary, DARE & DG, ICAR delivering his speech



Hon'ble Minister at the ICAR-CIFRI stall



Hon'ble Minister unveiling the ICAR-CIFRI products

sustainable development". Covering a wide range of topics including open water fisheries resource management, innovations in aquaculture, sustainable small-scale fisheries, advances in fish nutrition, fish health management, post-harvest technology, value addition, emerging contaminants, precision farming, biotechnological interventions, fisheries extension governance, and policies, the conference aimed to highlight recent advances in the fisheries and aquaculture sector aligned with the sustainable development goals, set by the United Nations. Altogether 13 themed sessions with many sub-themed sessions, 4 satellite symposia and five conclaves were organized in the forum.

Around 1500 delegates from India and abroad including galaxy of scientists, entrepreneurs including women entrepreneurs, fishers and fish farmers, scholars, Government officials, industrialists and students attended the inaugural programme of the conference. The event was inaugurated by Shri Parshottam Rupala, Hon'ble Minister of Fisheries, Animal Husbandry and Dairying, Government of India in the august presence of Dr. Himanshu Pathak, Secretary, DARE and DG, ICAR, Dr. Joykrushna Jena, DDG (Fy. Sci.), ICAR, Dr. C. N. Ravishankar, Director & Vice Chancellor, ICAR-CIFE and Dr. B. K. Das, Director, ICAR-CIFRI.

The Hon'ble Minister urged all stakeholders including researchers, government officials, farmers, industry representatives, civil society organizations, and students to unite in the country's efforts towards increasing production and maintaining sustainability in fisheries and aquaculture sector. The DG, ICAR stressed on nature-friendly, climate resilient and profit making fisheries sector with introduction of genetically improved

species, smart and precise practices, proper regulatory mechanism and skill development. On this occasion, various awards of national importance such as Prof. H.P.C. Shetty Award, Professors T. J. Pandian and A. J. Matty Award, Dr. T.V.R. Pillai Award, Dr. M. C. Nandeesha Award, Shri J.V.H. Dixitulu National Award, IFSI fellows and AFSIB Young Scientist Awards and awards to industrial partners were presented by the Hon'ble minister.

The Key-note address on "Fisheries higher education for Viksit Bharat" was delivered by Dr. C. N. Ravishankar while Dr. V.R.P. Sinha Memorial Lecture on "Aquaculture development in India: R&D perspectives for attaining SDGs" was delivered by Dr. J. K. Jena. Dr. K. Riji John, Former VC, KUFOS, Kochi delivered Dr. S.D. Tripathy Memorial Lecture on "Viral diseases in aquaculture – Indian perspective".

Four satellite symposia *viz*. 'Fish genetic resources and conservation', 'Sustainable fisheries and aquaculture in Northeast India', 'Riverine fisheries, habitat mapping, and environmental Health', 'Natural Farming' were also organized under the forum. Five conclaves, namely 'Industry conclave', 'Women empowerment in fisheries', 'Farmers conclave', 'Department of Fisheries (DoF) conclave' and 'Student interface meet' were organized. The launch workshop for the BIMSTEC-India Marine Research Network (BIMReN) was held on 23 February. The plenary-cum-valedictory programme was graced by Dr. J. K. Jena.

Exploring fish production from all the available water resources, including newly excavated Amrit Sarovars, establishing National Fish Coordination Committee (NFCC), reduction of post-harvest losses, quality seed production, development of easy seed transport mechanisms, diversification of fish species and culture techniques including enclosure culture of high value fish species, maintaining water quality, reduce disease loss, higher use of unconventional feed resources, addressing the environmental degradation in fish/shrimp production systems, management of illegal, unreported and unregulated (IUU) marine fishing, managing the bycatch and juvenile catch, regional conflicts and cross-border fishing, climate change impacts, anthropogenic interface, tapping the sea weed cultivation, developing nutraceuticals and therapeutics from aquatic plants and animals, development of national brood bank, satellite hatcheries and nurseries, promotion of cluster approaches in farming, creation of value chains, and linking producers and buyers, promotion of natural farming were some of the recommendations of the conference.



A section of delegates



Industry conclave



Conclave on career opportunities



Technical session on precision farming, ICT, sensors, GIS and robotics

Industry Conclave During the 13th IFAF

The institute organized Industry Conclave during the 13th IFAF at Kolkata on 24 February 2024. Shri Sagar Mehra, Joint Secretary, Department of Fisheries, Government of India graced the conclave as Chief Guest. The session was chaired by Dr. L. N. Murthy, Chief Executive (I/C), National Fisheries Development Board, Dr. George Ninan, Director, ICAR-CIFT and Shri Amit Saraogi, Managing Director, Anmol Feeds Ltd. & Chairman, Livestock Task Force of the Confederation of Indian Industries. The dignitaries briefed about the importance of industrial promotion and collaborative research and development in the fisheries and aquaculture sectors.

Conclave on Career Opportunities in Fisheries and Aquaculture Sector

The Conclave was held on 23 February 2024. Prof. Manimaran Baskaran, Former VC, TNJFU; Prof. Iddya Karunasagar, Research Advisor, NITTE University, Mangalore and Prof. S.D. Singh, Former ADG, ICAR chaired the session, while Prof. S.K. Udgata, Dean, CoF, Odisha, Prof. R.K. Trivedi, WBUAFS, Kolkata, and Dr. S.K. Majhi, Head, ICAR-CIFRI, Regional Centre, Guwahati acted as panellists.

Technical Session on Precision Farming, ICT, Sensors, GIS and Robotics

A technical session on "Precision farming, ICT, sensors, GIS, and robotics in fisheries" was conducted on 25 February 2024 during the 13th IFAF at Biswa Bangla Convention Centre, Kolkata. The session was chaired by Dr. Amitabha Bondyopadhyay, Chairman (TAC), ICAR-NePPA, Dr. Rabi N. Sahoo, Principal Scientist, IARI, and

Program Leader (ICAR-NePPA). The dignitaries, Dr. J. K. Jena, DDG (Fishery Science), ICAR, New Delhi; Dr. B.P. Mohanty, ADG (Inland Fishery), ICAR, New Delhi; Dr. Dilip Kumar, Former Director, ICAR-CIFE, Mumbai; Dr. B.K. Das, Director, ICAR-CIFRI, Barrackpore and Dr. P. K. Sahoo, Director, ICAR-CIFA, Bhubaneswar were also present in the session.

52nd Institute Management Committee Meeting

The 52nd Institute Management Committee (IMC) meeting was held at Barrackpore on 20 March 2024. Dr. B.K. Das, Chairman, IMC, and Director, ICAR-CIFRI, Barrackpore, briefed the research and development activities being carried out in the institute, overall institute management, and linkages established with others. The Chairman emphasized the initiative of "doubling the income of fishermen" and appraised the committee members on the successful completion of the 13th Indian Fisheries and Aquaculture Forum held during 23-25th February 2024 at Kolkata.



The 52nd Institute Management Committee meeting

RAC Meeting

The Research Advisory Committee Meeting of the institute was held during 15-16 March 2024. Dr. (Mrs.) B. Meenakumari, former DDG (Fisheries Science) was the Chair person of the RAC. Dr. B. K. Das, Director, ICAR-CIFRI warmly welcomed the Chairperson and Members of RAC and delivered the opening remarks, expressing gratitude to the Chairperson and members for the research guidance and identifying the key research areas for the coming years. Dr. Das also highlighted notable accomplishments, including the publication of 109 research articles, 6 patents, 2 trademarks, and 7 copyrights, along with the signing of a few MOUs. The members of RAC, Dr. Madan Mohan, former ADG (marine fisheries), Dr. A. K. Singh, former Director, ICAR-DCFR, and Dr. B. P. Mohanty, ADG (inland fisheries), expressed their satisfaction with the overall research achievements of the institute. Dr. A. K. Sahoo, Member Secretary of RAC proposed formal vote of thanks.



RAC meeting



Demonstration on drone-based technology at East Kolkata Wetlands

Farmer-Scientist Interaction on Fish Disease Surveillance

ICAR-CIFRI has organized two awareness programmes on fish disease surveillance and health management under the NSPAAD phase-II project, funded by Pradhan Mantri MatsyaSampada Yojana (PMMSY). The program was conducted at 4 No Bheri and Sardar Bheri, Kolkata, West Bengal on 16 and 17 April 2024, respectively. At 4 No Bheri, a total of 32 farmers including 14 women and 18 men participated in the programme, while at Sardar Bheri 48 farmers including 18 women and 30 men participated in the programme. Dr. B. K. Das, Director enlightened the fishers on several areas such as sustainable fish farming, disease and health management of fish, and the application of drone-based technology for disease management in East Kolkata Wetlands by spraying liquid medicine to reduce time and manpower.



IRC meeting

IRC Meeting

Institute Research Committee (IRC) Meeting for the year 2023-24 was held during 22-25 April 2024 at the Institute headquarters. All the scientists of the headquarters as well as regional centers and stations attended the meeting and presented their achievements. The Member Secretary, Dr. Arun Pandit briefed the house regarding the current status of 21 institutional projects including two network projects during 2023-24. He informed that most of the institutional projects have been concluded by 31.03.2024. The Director and the Chairman IRC, Dr. B.K. Das gave a brief overview of the recent developments in the research, and development works of the institute. He stressed that scientists should strive for product/patent/IPR/ copyright/high impact publications signifying the institute's growth. He informed that from now on project-

based budgeting will be followed where the expenditure in the project will be governed by the budget prescribed in the RPP-I. The Chairman suggested that all HODs should monitor the performance of the scientists, address their weakness and make efforts to convert their weakness into strength for developing synergy in research activities. He further advised the house to execute activities like Natural Farming, Atmanirbhar Bharat, Viksit Bharat, and 100 days programme for the development in the inland fisheries sector.



Dr. S. K. Majhi presenting the progress report of Guwahati centre before the IRC

Interactive Meeting with NABARD Officials

Scientists of ICAR-CIFRI Regional Centre, Guwahati participated in an interactive meeting with officials of NABARD at the NABARD Regional Office, Guwahati on 27 May 2024. Dr. S. K. Majhi, Head, Dr. S. C. S. Das, Senior Scientist and Dr. Simanku Borah, Scientist from ICAR-CIFRI, and Shri Loken Das, CGM, NABARD, Assam Regional Office, Guwahati, Shri Nabin Kumar Roy, GM, NABARD with their team participated in the interactive meeting. A host of issues, including possible collaboration between NABARD and ICAR-CIFRI for the development of the fisheries sector in North-East India were discussed in the meeting. It was decided to focus on skill development of the farmers and fishermen of the region by conducting trainings with active involvement of both organizations.



Interactive meeting with NABARD officials

Input distribution-cum-Awareness Programme for the Fish Farmers of Sikkim

The institute, in collaboration with the Department of Fisheries (DoF), Govt. of Sikkim, organized an awareness cum input distribution program in Gangtok, Sikkim on 11 June 2024. Inputs such as FRP tanks and accessories for ornamental



Awareness programme for the fish farmers of Sikkim



Input distribution among the fish farmers of Sikkim



Meeting with the DoF officials of Meghalaya



Field day at Manika Maun, Bihar

fisheries in the state were distributed among 52 beneficiaries in the 5 (Gangtok, Soreng, Geyzing, Namchi, and Mangan) districts of Sikkim under the SCSP and NEH programs of the institute. Ms. Roshni Rai, Secretary, DoF, Sikkim; and Mr. K. K. Shrestha, Director, DoF, Sikkim graced the occasion. The programme was also attended by the Director and Scientists from ICAR-CIFRI, Barrackpore; Secretary, DoF, Govt. of Sikkim; Director and Joint Director, DoF, Sikkim; DoF officials from all 5 districts; and fish farmers of Sikkim.

Interactive Meeting on Development of Cave Fisheries of Meghalaya

Dr. S. K. Majhi, Head, and Dr. Simanku Borah, Scientist from the institute's Guwahati centre attended the meeting with the officials of the Department of Fisheries, Meghalaya on 04 July 2024. Ms. A. L. Mawlong, MCS, Director of Fisheries, Meghalaya, informed that cave fisheries of the state are a potential area for scientific research. Fish diversity in two caves of the state, Krem Um Ladaw (East Khasi Hills) and KremChympe (East Jaintia Hills) was explored by the researchers. They have found *Neolissochilus pnar*, the world's largest cave fish recorded to date.

Field day on Fish Safety and Wetland Management at Manika Maun, Bihar

The institute organised a field day on 24 July 2024 at Manika Maun, Muzaffarpur (Bihar), focussing on fish safety, wetland management and the impact of climate change on small indigenous fish species. Experts from ICAR-CIFRI, the College of Fisheries (Dholi), and state fisheries offices addressed farmers' concerns about low yields and fish health. Dr. Archana Sinha, Dr. Pranab Gogoi and Dr. Kavita Kumari were present from the institute.

Mahila Matsyajibi Sammelan 2.0 at Kultali

Dr. J. K. Jena, DDG (Fisheries Science) inaugurated the 'Mahila Matsyajibi Sammelan 2.0' at the Kultali, Sundarbans on 18 August 2024. The sammelan was organized by the institute in collaboration with the NFDB Hyderabad and NAAS Regional Chapter, Kolkata. This was a part of the institute initiatives to empower the women fishers in the Indian Sundarbans. Women in the Sundarbans play a crucial role in the fisheries sector, including engaging themselves in small-scale aquaculture to support their families. The region faces frequent threats from the natural disasters, jeopardizing the livelihood of the fishers. The fisheries provides a vital source of income for their families. The harsh environmental conditions, combined with socio-economic constraints, make it difficult for women fishers to sustain their livelihoods and achieve economic stability. Dr. B. K. Das, Director, ICAR-CIFRI; Dr. Pradip Dey, Director, ICAR-ATARI, Kolkata were among the dignitaries present on the occasion. In the programme fish feed and fish seed were distributed to 500 selected women beneficiaries.



DDG (F. Sc.) in the Mahila Matsyajibi Sammelan 2.0

53rd IMC Meeting

The 53rd Meeting of the Institute Management Committee was held in hybrid mode at Barrackpore on 21 August 2024. The external members namely, Dr. H. N. Dwivedi, Prof. Shyam Sundar Dana, Shri Madhu Sudan Das, Shri Anupam Bera, Dr. Gayatri Tripathi, Dr. Pravata Kumar Pradhan, Dr. Subhendu Kumar Otta, Dr. Devika Pillai and Shri Ravindra Kumar joined the meeting on-line. The Director, the HoDs, HoCs, CAO and SFAO attended the meeting. A total of 13 agenda items were discussed in the meeting.



IMC meeting

Workshop on "Better Health



Workshop on cage culture and aquaculture disease at Bhopal

Management Practices in Cage Culture and Aquaculture Farms"

The institute, in collaboration with the DoF, MP conducted a two-day workshop on cage culture and aquaculture disease diagnosis and better management practices under the All India Network Project on Fish Health for capacity building of fish farmers and fishery officials of the state. The CCPI of the project, Dr. S. K. Manna conducted the workshop from 5-6 Sept 2024 at the Department of Fisheries, Bhopal, MP. Dr. A. K. Bera and Mr. N. Das delivered lectures on various topics of fish disease diagnosis, preventive measures, intensive aquaculture, aquaculture drug use planning, etc to 31 cage culture farmers and 30 aquaculture farmers and 30 state fishery officers.



Interactive meeting at Gangtok

Interactive Meeting on 'Exploring Fish Diversity and Catch Estimation of Major Rivers in Sikkim'

Guwahati centre of the Institute and the Department of Fisheries (DoF), Govt. of Sikkim, jointly organised this interactive meeting on 23 September 2024 at the Department of Fisheries, Gangtok, Sikkim. Mrs. Roshni Rai, Secretary of Fisheries, Govt. of Sikkim; and Shri K. K. Shrestha, Director, DoF, Sikkim were among the dignitaries attended the meeting. Dr. Niti Sharma and Dr. S.C.S. Das discussed about the major rivers of Sikkim and methodology for collecting data to estimate fish population structures.

Dr. Abhilaksh Likhi, Union

Secretary, Dept. of Fisheries, Govt. of India Reviewed the Activities on Drone Application for Fisheries Management

The institute is attempting to design and develop an efficient drone-based solution to transport up to 100 kg of live fish from fishers to the fish market. In this connection, Dr. Abhilaksh Likhi, Union Secretary, Department of Fisheries visited ICAR-CIFRI, Barrackpore on 24 September 2024 for reviewing the institute's research and development work in drone application. Dr. B. K. Das, Director elaborately presented the institute achievements and progress made in drone-based technologies.



The Director delivering a speech on drone-based technologies

Bengaluru Regional Centre of ICAR-CIFRI Organized a Field Day

The Bengaluru Regional Centre conducted a field day to create awareness among fishermen on sustainable fisheries management on 30 September 2024. On this occasion, 50,000 fingerlings of *Labeo rohita* were stocked in Gayathri reservoir, Chitradurga district, Karnataka, and crates were distributed to 20 fishers, including seven women beneficiaries. Dr.Preetha Panikkar, Principal Scientist & HoC, Bengaluru elaborated various issues of reservoir fisheries management. Mr. Shrinivas S.T., Assistant Director of Fisheries, Karnataka spoke on the fisheries development schemes of the state.



Demonstration of uses of drone

Sensitization Program on Application of Drone Technology for Fish Disease Management and Feed Application

Drone technology may act as an efficient tool for precise and periodical monitoring of waterbody health status, spraying disinfectants, and insecticides to control pathogens, fish disease, and macrophyte



Organizing field day by Bengaluru Regional Centre of ICAR-CIFRI,



Inaugural programme of river field school



River field school trainees and instructors at Farakka barrage



Speech by Prof. Saket Pande (left)



Speech by Prof. G Thampi

infestation, and applying feed in the large fish farm with less time, inputs, and human resources. The Institute organised a demonstration-cum-awareness program to showcase the potential of drone technology in fisheries at Charcharia wetland, East Kolkata Wetland on 03 October 2024 under the ICAR Agri-Drone and NSPAAD Phase II project.

Understanding Rivers Beyond Science: A Field School Experience

The Institute, in collaboration with the Delft University of Technology, The Netherlands, National Institute of Technology (NIT), Calicut, and NamamiGange Project, organized a unique River Field School on "Exploring the Food-Energy-Water Nexus in River Ecosystems" from 21-26 October 2024. The event brought together 15 participants, including students, scientists, and stakeholders from various parts of India. The 'school' was enriched by 15 resource persons from leading academic and research institutions, including ICAR-CIFRI, TU Delft, IIT Guwahati, IIT Roorkee, NIT Calicut, NTPC Farakka.

The primary objective of the River Field School was to enhance the understanding of river ecosystems, taking Ganga as a case study, focusing on the interconnections between food, energy, and water. The River Ganga exemplifies its vital role in sustaining livelihoods, promoting biodiversity, and supporting cultural and spiritual practices. The program emphasized an interdisciplinary approach, integrating hydrology, ecology, socio-economics, and governance frameworks to manage river resources sustainably. Key contexts explored during the field school included stakeholder participation, river health assessment, impact of hydrological alterations, and the spiritual and cultural significance of rivers.

ICAR-WorldFish Collaborative Project Meeting

ICAR-WorldFish Collaborative Project meeting (ICAR-Window 3) held at the Institute HQs, Barrackpore during 22–24 October, 2024. Dr.Jörn Schmidt, Director for Sustainable Aquatic Food Systems, WorldFish, Malaysia; Dr. Arun Padiyar, WorldFish Lead, India; Dr. Sourabh Kumar Dubey, WorldFish; and a multidisciplinary team of scientists and scholars from ICAR-CIFRI attended the meeting. The purpose of the meeting was to review the work done under the ongoing ICAR-W3 World Fish Collaborative project and also to discuss the potential for future collaborations and explore scientific and management interventions specific to inland fisheries.



ICAR-WorldFish collaborative project meeting



Field visit of the ICAR-WorldFish project staff

Mid-term IRC

The Mid-Term Institute Research Committee (IRC) Meeting for the 2024-25 period was held on 28 October 2024 at the Institute headquarters. All scientists from the headquarters attended in-person, while those from regional centers and stations joined online. Project and Sub-project Principal Investigators (PIs) presented the interim progress and achievements. Dr. B. K. Das, Director and Chairman of the IRC explained that the Mid-Term IRC meeting's purpose was to review the interim progress of ongoing projects, with a special emphasis on the Action Taken Report (ATR) covering key achievements. He emphasized on the importance of IPRs such as products, patents, and technology development to enhance the institute's competitive standing against industries. All the 21 institute projects and 10 sub-projects were discussed in detail and recommendations were given.



Mid-Term Institute Research Committee (IRC) meeting



Workshop on futuristic approach for inland fisheries informatics

Workshop on "Futuristic Approach for Inland Fisheries Informatics: Role of Tools and Techniques Hybridization"

The institute organised the one-day workshop on 04 December 2024 highlighting the development of data systems based on environmental and biological parameters, taxonomic information, catch assessment methodologies, and generic data science pipelines. The event was attended by 60 participants from Agricultural and Fisheries universities, technology institutes, C-DAC, and ICAR institutes across the country. The session was chaired by Dr. Nabarun Bhattacharyya, Professor and Director of the School of Information and Technology at MAKAUT, West Bengal. Dr. Atul Kumar Singh, Former Director of ICAR-DCFR and Dr. Sudhir Raizada, Former ADG, ICAR attended the workshop.



Distribution of CIFRI HDPE Pen and CIFRI CAGEGROW feed among the fishers of Tamranga beel, Assam

Popularization of CIFRI HDPE Pen and CIFRI CAGEGROW Feed among Beel Fishers of Assam

With the objective of popularizing ICAR-CIFRI-developed high-density polyethylene (HDPE) pen culture technology and CIFRI CAGEGROW feed, an awareness-cum-input distribution program was organized under the NEH programme among the beel fishers in Tamranga Beel, Bongaigaon, Assam on 05 December 2024. Ten tonnes of CIFRI CAGEGROW feed and twelve CIFRI HDPE Pens (each 1000 m^2) were given to twenty beel fishermen as part of the program which was organized by Drs.Simanku Borah, Pronob Das, B. K. Bhattacharjya, S. K. Majhi under the guidance of Dr. B. K. Das.

Inception Workshop of the Project

on East Kolkata Wetland

The inception workshop of the project entitled "Multiple Value Assessment: Fisheries & Agriculture, Culture of Indigenous Fish Species & Management of Invasive Fish Species" was held on 6 December, 2024 at Salt Lake, Kolkata in the gracious presence of Dr. Rajesh Kumar, IPS, Principal Secretary, Dept. of Environment; Dr. Kalyan Rudra, Chairman, WBPCB; Shri Atanu Kumar Roy, Sr. SPL Secretary, DoF; Shri Smrutiranjan Mohanty, IAS, Director, DoF; Ms. Sarmistha Das, IAS, MD, BENFISH; Dr. B.K. Das, Director, ICAR-CIFRI and officials from local ICAR institutes.



Inception workshop

Workshop on "Drone Technology and its Applications"

This one-day training-cum-workshop was organized on 11 December 2024 at the Institute HQs, Barrackpore. This was the first-ever initiative focusing on the potentials of drone technology in inland fisheries management. These unmanned aerial vehicles (UAVs) offer a range of applications, from monitoring and precision spraying to data analysis, empowering Indian farmers with valuable insights for efficient and sustainable farming.



Workshop on Drone technology and its applications

Awareness-cum-Field Days for Fishers of the Narmada River

The institute conducted a series of awareness-cum-field day programs for the fishers of the Narmada River, focussing on sustainable fisheries management, improving the livelihoods of fishers, and increasing awareness of conservation practices. The awareness programs were organised at several places along the river course covering Gujarat and Madhya Pradesh, including Bharuch (27.11.2024), Narmada (28.11.2024), Mandla (28.11.2024), Alirajpur (29.11.2024), Jabalpur (29.11.2024), and Khargone



Awareness-cum-field days for fishers of the Narmada



Awareness program at Jabalpur, M.P.



Celebration on Mahila Matsyajibi Diwas

(03.12.2024). In the events there were active participation of more than 250 local fishers, stakeholders, and representatives from fisheries cooperatives. Scientists from ICAR-CIFRI provided important insights into sustainable fishing techniques, resource conservation, and efficient and safe post-harvest practices.

ICAR-CIFRI Declares 26th December as '*Mahila Matsyajibi Diwas*'

The institute declares 26th December as the '*Mahila Matsyajibi Diwas*' in a programme at Basanti, Sundarbans. The day was marked to acknowledge the contributions of women in fisheries and aquaculture. Since 2013, the institute has encouraged and supported over 5,000 fishers through capacity building trainings and provision of technological inputs for their backyard ponds and ornamental fish farming to boost the rural economy. The event at Kultali, which witnessed the participation of around 5000 SC women, was organized in collaboration with the NFDB, Hyderabad, NAAS regional Chapter, Kolkata and Kultali Milon Tirtha Society.

Observance/Celebration/Other events

Secretary, DARE and DG (ICAR) Visited the Institute and Inaugurated National Ranching Programme 3.0

Dr. Himanshu Pathak, Secretary DARE, and DG, ICAR visited ICAR-CIFRI, Barrackpore on 19 January 2024 and inaugurated the 3rd Phase of National Ranching Programme under the 'Namami Gange' at Seoraphuli Ghat, Barrackpore. Dr. J.K. Jena, DDG (Fisheries Science) also accompanied him. The ranching programme aimed at enhancement of stock in open water resources and is vital for the restoration, conservation, and upliftment of this declining fish fauna. In the 2nd Phase of NMCG, about 63.5 lakh advanced fingerlings were released in the river Ganga. Dr. Pathak released fifty thousand advanced fingerlings of Indian Major Carps in the river Ganga. He also inaugurated the experimental boat '*Matsyiki Manthan*' and newly constructed 3rd floor of the main building. He also addressed all the staff and elaborated the vision of ICAR in the context of Viksit Bharat.



DG, ICAR addressing the institute staff



Inauguration of 3rd phase of National ranching programme



Inauguration of the experimental boat



Inauguration of 3rd floor of the main building



DDG (Fy. Sc.) addressing the institute staff



Dr. S. K. Nag (right) receiving the NABL accreditation certificate



GC-MS/MS facility



Observance of the Republic Day

Institute Laboratory Gets NABL Accreditation

The National Accreditation Board for Testing and Calibration Laboratories (NABL) gave accreditation to one of the institute labs in accordance with ISO/IEC 17025: 2017 for chemical testing in the area of "Arsenic (as As) in Surface Water" from 01 November 2024 to 31 October 2028. The institute NABL team, which is led by the Director, Dr. B. K. Das also includes Dr. S. K. Nag as Quality Manager, Dr. D. J. Sarkar as Technical Manager, Shri Lokenath Chakraborty (Technical Officer), Shri Anjan Talukder (Technical Assistant), and Ms. Sadrupa Bhowmick (Technical Assistant). Dr. S. K. Nag received the certificate during a NABL event for newly accredited laboratories in New Delhi on 9th December 2024.

GC-MS/MS Facility Established at the Institute Hqs

Gas Chromatography Tandem Mass Spectrometer(GC-MS/MS) has been installed at the institute HQs with the financial assistance of the project "National Mission for Clean Ganga-Phase III". This high-end analytical technique has a wide range of applications for identifying trace-level organic pollutants such as pesticides, polycyclic aromatic hydrocarbons (PAHs), etc., in diverse matrices from food safety analysis to environmental monitoring. The system complies with stringent regulatory standards, with sensitivity that exceeds regulatory requirements and can deliver robust sensitive results to the end-users.

Republic Day

The 75th Republic Day was observed on 26 January at ICAR-CIFRI with great enthusiasm and joy. Dr. B. K. Das, Director unfurled the National Flag and addressed the staff. He emphasized that the Institute has achieved many milestones. He praised the staff members for their

untiring and sincere efforts as well as encouraged all to work hard to keep the Institute's success on the higher note. Cultural programme was also organized on this occasion.

World Wetland Day

The World Wetland Day was celebrated on 02 February 2024 at Institute headquarters which was attended by a number of dignitaries. Dr. Sandeep Behera, Sr. Consultant, Biodiversity, NMCG, elaborated the genesis and purpose of the wetland day celebration and mentioned the importance of wetlands. Prof. B. B. Jana, University of Kalyani appreciated CIFRI's accomplishments in wetland development and emphasized the critical role of wetlands in sustaining human well-being. Prof. (Dr.) Ashis Kumar Panigrahi, Pro-Vice Chancellor, University of Burdwan, WB, mentioned the need for conservation of wetland and praised the role of CIFRI in wetland development at grass-roots level. Prof. Soma Mukherjee, HoD, Department of Environmental Science, University of Kalyani, WB, highlighted the importance of wetland for human wellbeing.



World Wetland Day



International Women's Day

International Women's Day

The Institute organized International Women's Day on 8 March 2024, at the Barrackpore HQs, in which a brainstorming session on "Accelerate progress in economic empowerment of women in inland fisheries"was organized based on the theme "Invest in women: Accelerate progress."All staff members of the institute participated and contributed to the brainstorming session. The Chairperson, Women Cell has delivered the welcome address, all the women staff have shared their experience. Director ICAR-CIFRI has congratulated all female staff for their contribution to economic empowerment in the fisheries sector.



Institute staff at the International Women's Day



Institute Foundation Day celebration



Dr. B. Meenakumari, Former DDG (Fy. Sc.), ICAR, addressing on Institute's Foundation Day



Felicitation of Director, ICAR-CIFRI by DoF, Govt. of Assam

78th Foundation Day of the Institute

ICAR-CIFRI commemorated its 78th Foundation Day on 17 March 2024, at its headquarters in Barrackpore. Since its establishment in 1947, the institute has been actively engaged in research, training, and extension activities, aimed at the comprehensive development of fisheries in inland open waters. The event was chaired by Dr. B. Meenakumari, Former Deputy Director General (Fy. Sc.), ICAR, as Chief Guest. Dr. B. P. Mohanty, ADG (Inland Fisheries), ICAR; Prof. Gautam Saha, Vice Chancellor of BCKV; Dr. Pradip Dey, Director of ICAR-ATARI; Dr. A. K. Singh, Former Director of ICAR-DCFR; and Dr. Madan Mohan, Former ADG (Marine Fy.), ICAR, were present as Guests of Honour. Dr. B. K. Das, Director highlighted the institute's achievements and contributions over the past 77 years, focusing on enhancing fisheries in inland open waters, biodiversity conservation, stakeholder empowerment, and the integration of cutting-edge technologies like drones and sensor-based systems.

Director, ICAR-CIFRI Visited Directorate of Fisheries, Government of Assam

Dr. B. K. Das, Director visited the Directorate of Fisheries, Guwahati, Assam on 04 May 2024. He was accompanied by Dr. S. K. Majhi, Head, CIFRI Regional Centre, Guwahati; Dr. B. K. Bhattacharjya, Principal Scientist; Dr. A. K. Das, Principal Scientist and Dr.Simanku Borah, Scientist of the Institute. A meeting was organized between the officials of the Department of Fisheries, Assam led by Mr. Gauri Shankar Das, Director of Fisheries, Government of Assam, and ICAR-CIFRI with the objective of deciding the plan of action and technical aspects of the Asian Development Bank's (ADB)-sponsored Sustainable Wetland and Integrated

Fisheries Transformation (SWIFT) Project to be implemented by the Department of Fisheries, Assam.

Institute Scientists Visited Bichom Reservoir, Kameng HEP, West Kameng, Arunachal Pradesh

The Kameng Hydroelectric Project in West Kameng, Arunachal Pradesh is developed by NEEPCO. The project comprises two components, one each at the Bichom and Tenga rivers, both of which are tributaries of the Kameng river. ICAR-CIFRI team, under the leadership of Dr. B. K. Das, Director, and Principal Investigator of the NEEPCO-sponsored consultancy project on "Planning and design of fish hatchery at Bichom dam site along with studies on reproductive biology of snow trout, *Schizothorax richardsonii*, for conservation and artificial propagation in river Bichom, Arunachal Pradesh" visited the site on 03 May 2024.



Sampling at Bichom river



Felicitation of Director, ICAR-CIFRI by DoF, Govt. of Arunachal Pradesh

World Environment Day

The institute celebrated the day on 5 June 2024 with a series of programmes in collaboration with the National Academy of Agricultural Sciences, Kolkata Chapter. On World Environment Day, ICAR-CIFRI carried out a ranching program at Seoraphuli Ghat, followed by an awareness camp on plastic pollution. Under the "NamamiGange" program, ICAR-CIFRI has been executing the river ranching program under the NMCG project since 2017. About 3.22 lakh fingerlings, including 3 lakh IMC, and 0.22 lakhs of indigenous fish, *Systomus sarana* (Olive Barb), were released into the River Ganga at Monirampore Ghat. 'Team-CIFRI' conducted a public awareness campaign on biodiversity conservation by involving local communities.



World Environment Day



Ranching and awareness at Barrackpore on World Environment Day



Fish farmers being awarded at Barrackpore



National Fish Farmers' Day celebration at Guwahati Centre



Independence Day celebration

National Fish Farmers' Day

The institute celebrated "National Fish Farmers Day" in Barrackpore in the august presence of Shri Biplab Roy Chowdhury, Hon'ble Minister of the Department of Fisheries, Government of West Bengal, and Shri Gabriel D. Wangsu, Hon'ble Minister, Agriculture, Horticulture, Animal Husbandry & Veterinary & Fisheries, Food & Civil Supply, Legal Metrology & Consumer Affairs, Govt. of Arunachal Pradesh, in collaboration with the Kolkata NAAS Chapter on 10 July 2024. Arround 150 fishers and fish farmers, including 17 women, entrepreneurs, NGOs, and researchers, participated in the event. The institute awarded eleven progressive farmers from West Bengal, Bihar, Jharkhand, Odisha, Manipur, Kerala, Gujarat, and Uttar Pradesh. The day was also celebrated in all the Regional Centres. At Guwahati, the program was attended by more than 50 aquapreneurs, fish farmers, fishers, and media representatives.

78th Independence Day

The Institute, along with all the centres, celebrated the 78th Independence Day on 15 August 2024 with great fervour. As part of *Aazadi Ka Amrit Kaal*, the '*Har Ghar Tiranga*' campaign was launched from 9-15 August 2024. Dr. Basanta Kumar Das, Director, hoisted the national tricolour in the event at the institute. Officers, staff members, research scholars, and contractual staff, along with their family members and locals of Barrackpore, have attended the flag-hoisting ceremony. The Director in his address, greeted and congratulated all the members of the ICAR-CIFRI family and emphasise on our duty to attain Viksit Bharat by 2047.

DDG (Fisheries Sciences) Laid Foundation Stone of New Building of the Institute

Dr. J. K. Jena, Deputy Director General, visited the institute Headquarters, Barrackpore on 16 Aug 2024 and addressed the staff. He laid down the foundation stone of a new laboratory building adjacent to the administrative building. He also opened the 'Selfie Point' in front of 'Block A' of the main building and inaugurated the new GC-MS/MS facility.



Foundation stone laying by DDG (Fy. Sc.)



DDG (Fy. Sc.) addressing institute staff

The Institute Stood by The Flood-Affected Fish Farmers of Tripura

The state of Tripura witnessed heavy monsoon rainfall, resulting in severe flooding and landslides in different districts during 19-22 August 2024. This resulted in significant damages to the state's fisheries including breaches of pond dykes, inundation of fishponds, damage to fish production units and hatcheries, siltation, and the escape of fish and fish seed. The flood reportedly affected around 19875 ha of water bodies, adversely affecting over 1,30,832 fish farmers. The institute took humble steps to stand by the flood affected farmers of the state under the NEH programme. A team of scientists, namely Dr. S. C. S. Das and Dr. P. Gogoi along with the fishery officials of the Govt. of Tripura visited many of the flood-affected areas of Gomati, Dhalai, and Sepahijala districts during 15-19 October 2024. The team discussed measures to be taken in a post-flood situation for the development of the fisheries sector in the state with the Director of Fisheries and other fishery officials of the Department of Fisheries, Government of Tripura.



Discussion with the Director of Fisheries, Govt. of Tripura



Visit to water body by the team at Sepahijala district



Inputs being distributed to flood affected fish farmers



Ranching at Barrackpore ghat on the occasion of World River Day



National Dolphin Day

The institute distributed inputs among selected flood-affected fish farmers of Tripura on 24 December at Udaipur, Gomati district in the august presence of Dr. B. K. Das, Director of the institute and Shri S. Das, TCS, SSG, Director of Fisheries, Govt. of Tripura. Six hundred flood-affected fish farmers of Unakoti, West, Sipahijala, Gomati, and South districts of the state was provided with 30 tonnes of CIFRI Cage Grow feed, 12 tonnes of lime, and 480,000 fish seeds. The Director advised the fish farmers to combat the natural calamities like floods with scientific fish culture incorporating diversified fish species. The program was also witnessed by Shri Jitendra Majumder, Hon'ble MLA and representatives of district including Shri Debal Debroy.

World River Day

The institute celebrated the World Rivers Day on 24 September 2024 through ranching of 50,000 wild-bred carp fingerlings in River Ganga (Barrackpore Ghat) for improving the riverine ecosystem and fishers' livelihoods. Dr. Abhilaksh Likhi, Secretary, Department. of Fisheries, Government of India, and Dr. Bijay Kumar Behera, Chief Executive, NFDB were present on the occasion. Besides the Institute staff, about 100 fishermen and women participated in the event.

National Dolphin Day

The Institute celebrated the 'National Dolphin Day' on 5 October 2024 at Daspara Ghat and Sheoraphuli Ghat on the bank of the river Hooghly under the NamamiGange Program. This special day highlights the importance of conservation efforts aimed at protecting the 'Gangetic River dolphin' (*Platanista gangetica*) and their ecosystems, which are in jeopardy because of pollution, dam construction, and climate change. On

this occasion, more than 100 personnel, including active fishermen, social activists, and students residing on the banks of the river participated.

Hon'ble Union Minister of Jal Shakti Ranched Endangered Mahaseer at Haridwar

On the occasion of Ganga Utsav, Sri C. R. Patil, Honourable Union Minister, Ministry of Jal Shakti, ranched endangered Mahaseer at Haridwar. He released about 6,000 Mahseer fingerlings into the river Ganga on 04 November 2024 at Chandi Ghat to conserve and restore them. The event was organised under the National Mission of Clean Ganga project with the aim to increase and restore the population of decreasing Mahseer in the Himalayan stretch of the Ganga River.

Vigilance Awareness Week

The institute observed Vigilance Awareness Week during 28 October-3 November 2024 under the theme "Culture of Integrity for Nation's Prosperity." The observance included administering a pledge, displaying posters, banners, and placards, formation of human chain, walkathon to the local ferry ghat. The event attracted considerable interest from locals and commuters. Drawing and extempore speech competition were also organized which included participation from staff, students, young professionals, and others.

Hon'ble Union Minister of Education Inaugurated Environmental & Aquatic Animal Health Monitoring Laboratory at Sambalpur

Shri Dharmendra Pradhan, Hon'ble Minister of Education, Govt. of India, inaugurated the "Environmental & Aquatic Animal Health Monitoring Laboratory," developed by the Institute in Sambalpur, Odisha. The laboratory is set to assess the



Ranching at Haridwar



Vigilance awareness rally



Shri Chandrasekhar Meena, Deputy Director, DGGI, SNU (East), Kolkata speaking at the valedictory session of vigilance awareness week



Antimicrobial Resistance awareness rally



World Fisheries Day at Sundarbans

environmental impact of cage culture operation, aquatic animal health surveillance in the cage culture, and monitor the water and sediment quality parameters in the Hirakud reservoir.

Antimicrobial Resistance Awareness Week

On World Antimicrobial Resistance Awareness Week 2024, an awareness program was organised under the project "All India Network Project on Antimicrobial Resistance (AINP-AMR) in fisheries and livestock," focusing the theme on "Educate, Advocate, Act now" during 18-24 November 2024. The inaugural event was witnessed by Dr. Gopal Krishna, former Director of ICAR-CIFE, Mumbai, and Dr. B. K. Das, Director, ICAR-CIFRI, along with trainees and fishermen from Madhepura district, Bihar. On 21 November 2024, the event was conducted in the gracious presence of esteemed dignitaries, Dr.Purnendu Biswas, former Vice Chancellor, WBUFAS; Dr. B. K. Das, Director, ICAR-CIFRI, Barrackpore; Mr. Ganesh Sengupta, Chairman, IGF, Denmark; and Mr. Niels Bo Karlsson from Denmark at Basanti block, Sundarbans, in collaboration with Joygopalpur Gram Vikash Kendra (JGVK).

World Fisheries Day

World Fisheries Day was observed on 21 November to raise the global awareness on the critical contributions of fisheries to food security, nutrition, and livelihoods. Since its inception, it has served as a platform for promoting responsible fisheries management while addressing challenges such as overfishing, illegal fishing, and the impacts of climate change. The theme for World Fisheries Day 2024 is "Let the waters teem with living creatures," which highlights the indispensable role of small-scale fisheries in promoting sustainable aquatic ecosystems and safeguarding biodiversity.

His Excellency, Governor of Nagaland inaugurated ICAR-CIFRI Exhibition Stall in HAES-COSDG, 2024

The institute participated in the exhibition on the National Conference on Hill Agro-Ecosystem: Challenges and Opportunities for Achieving Sustainable Development Goals (HAES-COSDG, 2024) organised by the Indian Association of Hill Farming and ICAR Research Complex for NEH Region, Nagaland Centre, Medziphema, Nagaland during 29-30 November 2024. His Excellency, Hon'ble Governor of Nagaland, Shri La. Ganesan visited and inaugurated the CIFRI Exhibition Stall. Dr. B.K. Das, Director briefed the activities of ICAR-CIFRI in the eight North-East Indian states. He also co-chaired session and delivered a keynote lecture in the conference.

Fish Angling Event Held in Hornbill Festival of Nagaland

The annual Hornbill Festival in Nagaland is celebrated in the first week of December and is often referred to as the "Festival of Festivals" because it brings together a vibrant collection of cultural displays, music, dance, art, and traditional rituals from the diverse tribes of Nagaland. As part of this festival, the Department of Fisheries and Aquatic Resources (DoF&AR) of the Government of Nagaland organized an angling event. Dr. B.K. Das, Director of the institute inaugurated this angling festival on 01 December 2024. On 30 November 2024 Dr. B.K. Das, Director; Dr. Raju Baitha, Senior Scientist; and Dr.Simanku Borah, Scientist participated in the interactive meeting with the DoF officials including Shri Rongsennungba, Director and Shri Neitho Koutso, Joint Director at the Directorate of Fisheries and Aquatic Resources, Kohima. They discussed several issues including sustainable development of reservoir fisheries, mapping of resources, cataloguing of



Dr. B. K. Das, Director, ICAR-CIFRI inaugurated fish angling event



Interactive meeting with the DoF officials



Feed distribution at Rangpo, Sikkim



Feed distribution at Rothak, Sikkim

fish diversity, conservation of fisheries and aquatic resources, skill development of fish farmers, and fish seed shortage.

Awareness-Cum-Feed Distribution Programme for the Fish Farmers of Sikkim

The Guwahati Regional Centre of the Institute, in collaboration with the Department of Fisheries (DoF), Govt. of Sikkim organised an awareness-cum-feed distribution programme for popularisation of CIFRI CAGEGROW feed among fish farmers of Sikkim in Pakyong and Soreng districts, Sikkim on 05 December 2024. Ten tonnes of feed were distributed among 50 beneficiaries in the 5 districts (Gangtok, Soreng, Geyzing, Namchi, and Mangan) of Sikkim. Ms. Roshni Rai, Secretary, DoF, Shri. K. K. Shrestha, director, DoF; Dr. S. K. Majhi, Head, ICAR-CIFRI, Guwahati were present on the occasion. In Rangpo Fish Farm, Pakyong District the feed was distributed to 25 fish farmers of 3 districts, namely Gangtok (15), Namchi (5), and Mangan (5). Similarly, 25 fish farmers from Gyalshing (10) and Soreng (15) districts received feed from the Rothak carp fish farm. Drs. Niti Sharma and S. C. S. Das actively participated in the programme.

Other Important Events



Director addressing the audience in Moyna Aqua Expo on 6 January 2024



Demonstration of drone for sample collection for fisheries research at Moyna on 6 January 2024



Visit of Ms. Madhumita Basu, DG (Audit) and her team on 24 January 2024



Ganga Arati by DG, NMCG on 11 Feb 2024



Dissemination workshop on improvement required in fish marketing infrastructure and modern fish marketing system (12 February 2024)



Interaction meeting at Rishisa dam (05 April 2024)



Minister of Fisheries, Govt. of West Bengal, visited Hilsa rearing ponds at Kolaghat (17 June 2024)



Rabindra Jayanti celebration (09 May 2024)



Review meeting of NePPA project (20 June 2024)



International Yoga Day (21 June 2024)



Workshop on application of online Hindi translation tools (25 June 2024)



Rajbhasa Nirikshan (27 June 2024)



Ek ped Maake Naam on 30 August 2024



Lecture by the Director at Army Public School on Digital Aquaculture for Enhancing Productivity on 23 December 2024

वार्षिक प्रतिवेदन

Annual Report

2024

Women empowerment for a Viksit Bharat









The Institute has undertaken various initiatives to promote women empowerment particularly from marginalized communities in inland small-scale fisheries. In collaboration with Kultali Milan Tirtha Society, ICAR-CIFRI organized several training-cum-mass awareness programs in the Sundarbans region, engaging over 500 fisherwomen. Additionally, a mass sensitization program was conducted among students to promote awareness on aquarium fish keeping. On 25 February 2024 a mass awareness programme was organized jointly with Sasya Shyamala Krishi Vigyan Kendra and Ramakrishna Mission Vivekananda Educational and Research Institute (RKMVERI), Narendrapur, targeting 100 Scheduled Caste (SC) women from four Gram Panchayats (GPs) of Sonarpur Block. These women, each possessing ponds of 0.02 to 0.04 hectares, were adopted under the SCSP programme to demonstrate backyard pond fish culture. Similarly, under the Scheduled Tribe Component (STC) programme, a fisheries management training and sensitization program for tribal women was conducted in Manbazar, Purulia, involving more than 200 fisherwomen. To support tribal women of the Chhotanagpur Plateau

region, the institue selected eight rainfed waterbodies (bandhs), spanning over 40 acres, for community-based fish culture, and provided fish seed and feed. Furthermore, Mahila Matsyajivi Diwas was started at Kultali, where over 3,000 fisherwomen participated, and 500 beneficiaries were adopted for livelihood enhancement through backyard fish farming, demonstrating CIFRI's sustained efforts in promoting gender-inclusive fisheries development.



Women empowerment initiative at Kulatali, Sundarbans

Swachh Bharat Activities

The Swachh Bharat Abhiyan, initiated nationwide on 2nd October 2014 on Gandhi Jayanti is a massive cleanliness campaign by the Government of India. The nation has achieved quite a lot towards cleanliness during the first and second phases, ending in 2019 and 2024. The current phase emphasizes on sustainable swachhata. In the last one year, numerous programs were undertaken by the institute including all regional centres. Few glimpses of the various activities are given below.



Pledge taking on 16th December 2024 at Barrackpore



Regular cleaning activities at Barrackpore HQs



Regular cleaning activities at Vadodara centre



Cleaning activity at Guwahati centre

Cleaning and Beautification of Surrounding Areas



Cleaning of approach road to Mangalavanam Bird Sanctuary, Kochi



Cleaning of the local Ganga Ghat, Barrackpore



Awareness generation at Kariyala village (Gayatri, reservoir), Karnataka

Waste to Wealth



Vermicompost pit at the Institute HQs for utilization of waste

Community Awareness on Swachhta



Akaipur wetland, North 24 Pgs, WB



Kuliabeel, Nadia district, WB



MPFISHFED office premises of Gandhi Sagar Dam in Neemuch District of Madhya Pradesh



On the bank of river Ganga, Prayagraj, UP



The Director at the Swachhata selfie point, Barrackpore HQs

वर्ष 2024 के दौरान राजभाषा हिन्दी की उपलब्धियां

ऑनलाइन अनुवाद टूल्स पर कार्यशाला – राजभाषा हिन्दी कार्यान्वयन की दिशा में एक प्रयास

भाकृअनुप–केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान, बैरकपुर ने राजभाषा हिन्दी कार्यान्वयन की दिशा में एक नवीन प्रयास किया है। संस्थान मुख्यालय में दिनांक 25 जून 2024 को "ऑनलाइन अनुवाद टूल्स का प्रयोग" विषय परएक–दिवसीय कार्यशाला का आयोजन किया गया। इस कार्यशाला का उद्घाटन डा. श्रीकान्त सामन्ता, प्रभागाध्यक्ष एवं सर्वकार्याधिकारी, हिन्दी कक्ष के स्वागत सम्बोधन के साथ किया जिसमें उन्होंने राजभाषा कार्यान्वयन में हिन्दी अनुवाद की भूमिका के बारे में बताया। इस अवसर पर संस्थान के निदेशक, डा. बि. के. दास ने माननीय प्रधानमंत्री के वर्ष 2047 तक के विकसित भारत के लक्ष्यों पर प्रकाश डालते हुए हिन्दी भाषा के बढ़ते प्रयोग के बारे में विस्तार से चर्चा की। उन्होंने आधुनिक तकनीक जैसे इंटरनेट ऑफ थिंग्स (IoT), कृत्रिम बुद्धिमत्ता (Artificial Intelligence) में अनुवाद की महत्ता के बारे में बताया।

इस कार्यशाला में दो सत्र रखे गए – प्रथम सत्र में श्री संजीव कुमार साहु, वैज्ञानिक तथा श्री प्रवीण मौर्य, वैज्ञानिक ने कार्यशाला का संक्षिप्त विवरण के साथ हिन्दी अनुवाद की उपयोगिता पर चर्चा किया। दूसरे सत्र में श्री संजीव कुमार साहु, वैज्ञानिक तथा सुश्री सुनीता प्रसाद, स.मु. तक.अधि. (हिन्दी) द्वारा "ऑनलाइन टूल्स के प्रकार एवं प्रयोग पर एक पावरपॉइंट प्रस्तुत किया गया। अंतिम सत्र, ऑनलाइन अनुवाद टूल्स के अभ्यास पर केंद्रित था जिसमें प्रतिभागियों को अनुवाद और हिन्दी टायपिंग पर प्रशिक्षण दिया गया। इस अभ्यास सत्र में उपरोक्त प्रशिक्षकों के साथ श्रीमती सुमेधा दास, तकनीकी सहायक (हिन्दी) ने योगदान दिया। कार्यशाला में वैज्ञानिक, तकनीकी और प्रशासनिक वर्ग से कुल 20 संस्थान कर्मियों ने भाग लिया।

इस कार्यशाला का सफल कार्यान्वयन संस्थान के निदेशक, डा. बि. के. दास के मार्गदर्शन में डा. श्रीकान्त सामन्ता, प्रभागाध्यक्ष एवं सर्वकार्याधिकारी, हिन्दी कक्ष; श्री संजीव कुमार साहु, वैज्ञानिक; श्री प्रवीण मौर्य, वैज्ञानिक; सुश्री सुनीता प्रसाद, स.मु.तक.अधि. (हिन्दी) तथा श्रीमती सुमेधा दास, तकनीकी सहायक (हिन्दी) द्वारा किया गया।



अनुवाद और हिन्दी टायपिंग पर प्रशिक्षण



ऑनलाइन अनुवाद टूल्स का प्रयोग" पर कार्यशाला

सतत विकास लक्ष्यों एवं अन्तर्स्थलीय मात्स्यिकी पर दो दिवसीय हिंदी कार्यशाला का आयोजन

भाकृअनुप–केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान (सिफ़री) बैरकपुर में "सतत विकास लक्ष्यों (एसडीजी) की पूर्ति में अन्तर्स्थलीय मत्स्य पालन और जलकृषि की भूमिका" विषय पर दो दिवसीय हिन्दी कार्यशाला (दिनांक 10–11 सितम्बर, 2024) का आयोजन किया गया। इस कार्यशाला का उद्देश्य संयुक्त राष्ट्र (यूएन) के सतत विकास लक्ष्य (एसडीजी) की पूर्ति में मत्स्य पालन और जलकृषि के योगदान पर चर्चा के साथ मात्स्यिकी क्षेत्र में नवीनतम अनुसंधान, विकास योजनाओं और प्रद्योगिकियों पर विचार–मंथन करना था। राजभाषा हिन्दी के कार्यान्वयन तथा विकास के साथ–साथ हिन्दी के प्रगामी प्रयोग में भी इस कार्यशाला की महत्वपूर्ण भूमिका रही। इस दो–दिवसीय कार्यशाला में भारतीय कृषि अनुसंधान परिषद, कृषि भवन; मात्स्यिकी विश्वविद्यालय एवं महाविद्यालय, परिषद के अधीनस्थ संस्थानों जैसे प्रतिष्ठित संगठनों के गणमान्य उच्चाधिकारीगण, वैज्ञानिक और शोध छात्रों ने भाग लिया।

इस समारोह का उद्घाटन मुख्य अतिथि, डॉ स्वपन कुमार दत्ता, पूर्व उपमहानिदेशक (फसल विज्ञान) एवं पूर्व कुलपति, विश्व भारती विश्वविधालय और विश्व बांगला विश्वविधालय; डॉ बसंत कुमार दास, संस्थान के निदेशक, डॉ श्रीकांत सामंता, सर्वकार्यधिकारी (हिंदी कक्ष), श्री प्रवीण मौर्य, वैज्ञानिक एवं श्री एस. के. साहू, वैज्ञानिक ने दीप प्रज्जवलित करके किया। मंच संचालिका, डा. अंजना एक्का, वैज्ञानिक ने इस कार्यशाला के महत्त्व को संक्षिप्त शब्दों में प्रस्तुत किया और डॉ श्रीकांत सामंता ने अपने स्वागत भाषण में संस्थान की राजभाषा हिंदी कार्यों पर प्रकाश डाला। श्री संजीव कुमार साहू, वैज्ञानिक ने कार्यशाला के बारे में विस्तार पूर्वक जानकारी प्रस्तुत की। संस्थान के विभिन्न क्षेत्रीय केंद्रों के प्रभारी एवं प्रभागाध्यक्षों ने इस अवसर पर ऑनलाइन मोड में अपने विचार साँझा किये और अपने–अपने केंद्रों की राजभाषा गतिविधियों के बारे में बताया। इसके पश्चात मंच पर आसीन विशेष व्यतिगण एवं सम्पादकों ने सार ग्रन्थ का विमोचन किया। मुख्य अतिथि डॉ स्वपन कुमार दत्ता ने अपने वक्तव्य में संस्थान की हिंदी गतिविधियों एवं कार्यो की भूरी–भूरी प्रशंसा की और सभी को इस कार्यशाला के लिए बधाई दी। इसके उपरांत संस्थान के निदेशक महोदय ने अपने भाषण के दौरान सार ग्रन्थ और कार्यशाला के क्रियान्वयन पर हिंदी समिति को अपनी शुभकामनाएं दी और सभी कर्मचारियों से हिंदी में अधिक से अधिक कार्य करने के अपने संकल्प को दोहराया। समारोह का समापन श्री प्रवीण मौर्य, वैज्ञानिक के धन्यवाद ज्ञापन से किया गया ।



डॉ स्वपन कुमार दत्ता, मुख्य अतिथि द्वारा दीप प्रज्वलन



प्रतिभागियों द्वारा प्रस्तुति

हिन्दी पखवाड़ा (09–23 सितंबर 2024) का आयोजन

संस्थान में हिन्दी पखवाड़ा दिनांक 09–23 सितंबर 2024 के बीच मनाया गया। इसका उद्घाटन दिनांक 09 सितंबर 2024 को संस्थान मुख्यालय में ऑफ़लाइन तथा ऑनलाइन दोनों ही मोड में किया गया, जिसमें संस्थान के विभिन्न क्षेत्रीय केंद्रों ने ऑनलाइन मोड में भाग लिया। उद्घाटन समारोह का शुभारंभ डॉ. श्रीकान्त सामन्ता, प्रभागाध्यक्ष एवं सर्वकार्यभारी, हिंदी कक्ष के स्वागत सम्बोधन के साथ किया गया जिसमें उन्होंने संविधान सभा द्वारा राजभाषा हिन्दी की स्वीकृति तथा अनुमोदन के पृष्ठभूमि पर प्रकाश डाला। तत्पश्चात राजभाषा प्रतिज्ञा ली गई। आगे संस्थान के वरिष्ठ अधिकारियों और क्षेत्रीय केंद्र प्रमुखों ने अपने–अपने विचार साझा किए। डॉ. बसन्त कुमार दास, निदेशक ने संस्थान के राजभाषा हिन्दी के कार्यकलापों और उपलब्धियों पर प्रकाश डाला। कार्यक्रम का समापन श्री संजीव कुमार साहू, वैज्ञानिक के धन्यवाद ज्ञापन से हुआ।

संस्थान में हिन्दी पखवाड़ा के दौरान कई प्रतियोगिताएं आयोजित की गईं। दिनांक 12 सितंबर 2024 को 'अंकन एवं स्लोगन प्रतियोगिता' से शुभारंभ किया गया। इसके बाद दिनांक 13 सितंबर 2024 को कविता पाठ; 17 सितंबर 2024 को एक्सटेम्पोर/आशु भाषण प्रतियोगिता; दिनांक 18 सितंबर 2024 को ऑनलाइन टूल्स आधारित 'हिन्दी टायपिंग प्रतियोगिता' 19 सितंबर 2024 को कार्य समीक्षा और 20 सितंबर 2024 को क्विज (प्रश्नोत्तरी)। हिन्दी पखवाड़ा का समापन, 23 सितंबर 2024 को किया गया। इस समारोह की मुख्य अतिथि डा. रेशमी पांडा मुखर्जी, एसोसिएट प्रोफेसर (हिन्दी), गोखले मेमोरियल महिला महाविद्यालय, कोलकाता, पश्चिम बंगाल ने इस अवसर पर राजभाषा हिन्दी के प्रचार–प्रसार और कार्यान्वयन संबंधी विभिन्न पहलुओं के बारे में बताया तथा हिन्दी भाषा के विकास में क्षेत्रीय भाषाओं के योगदान पर प्रकाश डाला। संस्थान के निदेशक, डा. बि. के. दास ने हिन्दी पखवाड़ा के सफल संचालन के लिए परिचालन समिति को धन्यवाद दिया। पखवाड़ा के दौरान आयोजित प्रतियोगिता के विजेताओं को पुरस्कार दिया गया। हिन्दी पखवाड़ा 2024 का सफल कार्यान्वयन संस्थान के निदेशक, डा. बि. के. दास के मार्गदर्शन में डा. श्रीकान्त सामन्ता, प्रभागाध्यक्ष एवं सर्व–कार्याधिकारी, हिन्दी कक्ष; श्री संजीव कुमार साहु, वैज्ञानिक, श्री प्रवीण मौर्य, वैज्ञानिक; डा. सुमन कुमारी, वैज्ञानिक; सुश्री सुनीता प्रसाद, स.मु.तक.अधि. (हिन्दी) तथा श्रीमती सुमेधा दास, तकनीकी सहायक (हिन्दी) द्वारा किया गया।



कार्यशाला सार ग्रंथ का विमोचन



हिन्दी प्रकाशन, "अन्तर्स्थलीय जल निकायों के लिए मत्स्य प्रग्रहण की आँकलन पद्धति" का विमोचन

प्रकाशन

1. संजीव कुमार साहू, मलय नस्कर, चायना जाना, थांगजम निरूपदा चानु, बसंत कुमार दास, 2024। अन्तर्स्थलीय जल निकायों के लिए मत्स्य प्रग्रहण की आँकलन पद्धति।आईएसबीएन सं : 81–85482–67–5 (पृष्ठ संख्या 168)।
2. गुंजन कर्नाटक, बसंत कुमार दास, मिशाल पी एवं सुनीता प्रसाद। पिंजरा पालन में उपयोगी बटर कैटफिश। खेती, अंक 43, दिसंबर 2024।
3. नमामि गंगे पैम्फ्लेट – बि. के. दास, सी जॉनसन, ए. सिंह, एल.पॉल, डी. सी. यतीश, एस. प्रसाद और जी. थेंगल, 2024। गंगा नदी के मछुआरों की आजीविका पर आपदा उन्मुख अनिश्चितता को कम करना – गंगा नदी में सतत मत्स्य प्रबंधन।



कविता पाठ प्रतियोगिता



पुरस्कृत संस्थान प्रतिभागी



मुख्य अतिथि, डा.रेशमी पांडा मुखर्जी

Library and Informatics Section

The library and informatics section serves as the main repository of ICAR-CIFRI publications, which include annual reports, newsletters, bulletins, and leaflets along with relevant publications from various agencies and other institutes. With 62 additional volumes acquired and added to the collection in 2024, the library currently has a total of 12,927 books. The section obtained 13 Indian magazines, 20 pamphlets, and 19 ICAR-CIFRI publications covering a diverse range of topics. The library and the libraries of the institute's regional centres together play a crucial role in distributing numerous ICAR-CIFRI publications to various SMDs, key government offices, and a multitude of other institutes and universities across the country. Visitors can take advantage of a spacious reading room on the first floor. The reading room on the ground floor has been transformed into the ARIS Cell. A mini-conference room is available for users, featuring an Android Smart TV and Wi-Fi, ideal for discussions, small group gatherings, and other activities. The library section features a computer linked to the KOHA server, along with a book scanner designed for the efficient scanning of books and documents. This year, KOHA has transitioned to an upgraded cloud server version, replacing the old physical server.

The Library and Informatics Section is organized into four distinct sections for effective management: scientific books, journals, ICAR-CIFRI publications, and Hindi literature and publications. KOHA Open-Source Library Management software oversees the library's digitized cataloguing system, accessible to users through ICAR-CIFRI website and AGRICAT, a union catalogue open to all NARS Institutes. ICAR-CIFRI, as part of the CeRA Consortium has effectively used Document Delivery Requests (DDR) to send 35 documents to various NARS institutes. The library provides complete access to research publications from specific scientific journals through CeRA, which is accessible exclusively on-campus using the "J-gate Next" login.

Most of the Indian journal subscriptions are being carried over into this year as well. A committee constituted by Competent Authority carried out the physical verification of books and other documents in the library for the year 2023–24, as per statutory practice.



वार्षिक प्रतिवेदन

Annual Report

2024

Publications

Research Papers

1. Alam A, Kumar J, Sarkar UK, Jha DN, Sahu SK, Das SCS, Srivastava SK, Kumar V and Das BK (2024). Linking ecological characteristics with fish diversity, assemblage patterns and feeding guilds, and GIS applications along the temporal and spatial gradients in a large subtropical reservoir, India, for sustainable management. *Journal of Water and Climate Change* 15(2), 607-627.

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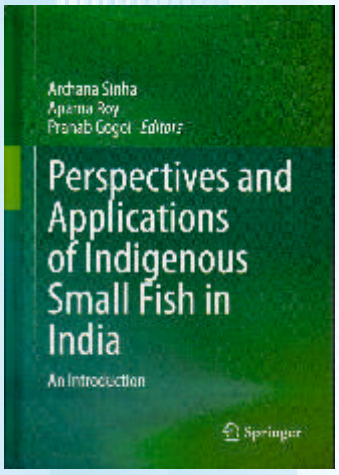
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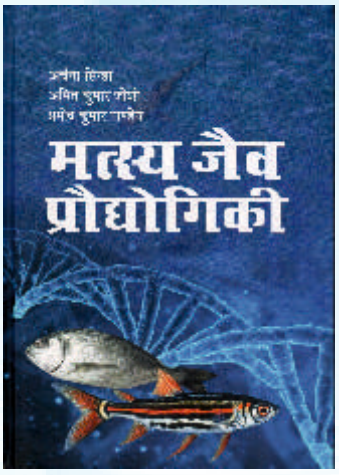
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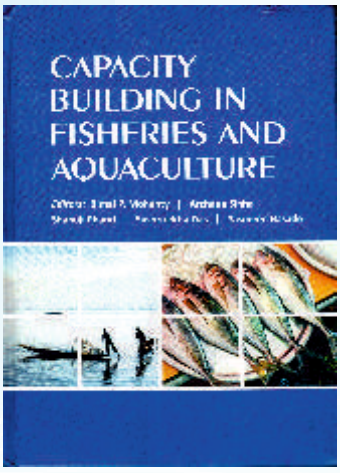
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हिन्दी मासिक न्युजलेटर (जनवरी 2024 से दिसंबर 2024) का प्रकाशन – 12, प्रकाशक : बसंत कुमार दास, निदेशक

सम्पादनः संजीव कुमार साहू, प्रवीण मौर्य, सुनीता प्रसाद एवं सुमेधा दास, प्रकाशक : बसंत कुमार दास, निदेशक









Awards and Recognitions

Awards

A. Awards won by the Institute Scientists in the 13th Indian Fisheries and Aquaculture Forum (13 IFAF) 2024: Fostering Indian Fisheries and Aquaculture for Attaining Sustainable Development Goals

The following institute scientists won various awards under different themes in the 13 IFAF, jointly organized by the ICAR-CIFRI, Inland Fisheries Society of India and the Asian Fisheries Society Indian Branch at Kolkata during 23–25 March 2024:

- **Dr. Srikanta Samanta** received the *Best Oral Presentation* award for the paper "Conservation aquaculture the potential management tool for protection of hilsa fisheries in India".
- **Dr. A. K. Sahoo** received Best Oral Presentation in the Satellite Symposium on Riverine Fisheries: Habita Mapping and Environmental Health.
- **Dr. Dibakar Bhakta** received the *Best Oral presentation* award for the paper "Status of Gangetic River dolphin *Platanista gangetica* (Lebeck, 1801) in the lower stretch of the Ganga River, India, with emphasis on treats, conservation, and recommendations".
- **Dr. Sona Yengkokpam** received the *Best Oral presentation* award for the paper "Polyculture of *Amblypharyngodon mola* with major carps in pens in a floodplain wetland of Manipur, India".
- **Dr. Suvra Roy** received the *Best Oral Paper Presentation* Award for the paper "Parental conditioning with phloroglucinol protects their offspring from biotic and abiotic stressors in brine shrimp and freshwater prawn". She also bagged the *Best Poster Presentation* Award for the paper "A metagenomic tale: new insights into the microbial community of East Kolkata Wetland natural sewage treatment system".
- **Dr. Simanku Borah** received the *Best Poster Presentation* award for the paper "Fostering food and livelihood security of small scale beel fishers through culture-based fisheries and stock enhancement".
- **Dr. Jesna P. K.** received the *Best Poster Presentation* Award for the paper "The phytoplankton dynamics in a tropical reservoir, indicating the health of the system".
- **Dr. Vikash Kumar** and **Dr. Santhana Kumar V.** were awarded with the '*Best Speaker*' award. While **Dr. Lianthuam-luaia and Mrs. Sangeetha M. Nair** received Best Oral Presentation award.
- **Dr. M. Shaya Devi** received '*Dr. J. K. Jena Young Scientis*t' award
- **Dr. Santhana Kumar V.** received '*Best Young Scientist*' award from Asian Fisheries Society during the IFAF 2024.
- **Dr. T. T. Paul** received '*Best Poster*' award for the paper 'Impact of stocking in Kerala reservoirs'.



Dr. S. Samanta (centre)



Dr. D. Bhakta (centre)



Dr. Jesna P. K. (third from left)



Dr. S. Yengkokpam (second from right)



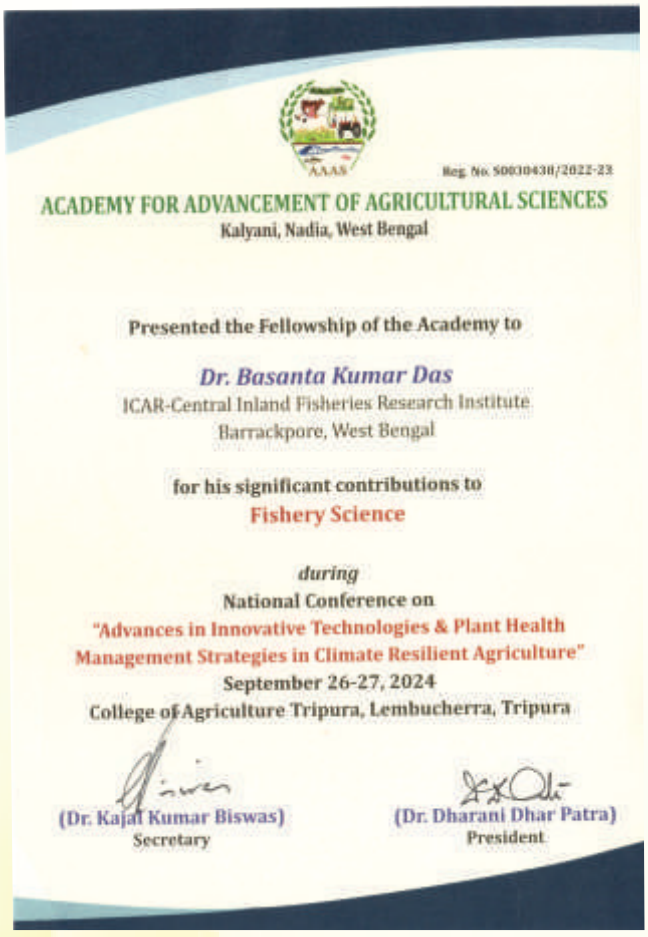
Dr. S. Roy (centre)

B. The following scientists won different awards in the workshop on 'सतत विकास लक्ष्यों (एसडीजी) की पूर्ति में अन्तर्स्थलीय मत्सय पालन और जलकृषि की भूमिका' at ICAR-CIFRI HQ, Barrackpore during 10-11 September 2024

- **Dr. M. Shaya Devi** and **Dr. Santhana Kumar V.** received *Best Oral Presenter Awards*.
- **Dr. Sajina A. M.** received second *Best Oral Presenter Award.*
- **Dr. Simanku Borah** got the 3rd *Best Oral Presenter Award.*

C. Awards/fellowships won in the other fora

- **Dr. B. K. Das**, Director was awarded with the *Fellowship* of the Academy for Advancement of Agricultural Sciences, Kalyani, West Bengal in the National Conference on Advances in Innovative Technologies & Plant Health, Management Strategies in Climate Resilient Agriculture" held during 26-27 September 2024 at College of Agriculture, Tripura. He also received the *Reviewer Excellence Award*, 2024 from the Agricultural Research Communication Centre on 17 June 2024.
- **Dr. Archana Sinha** was awarded with the *BASA Fellowship* for the year 2024.
- **Dr. Sullip Kumar Majhi** was awarded with *Prof. D. K. Belsare Medal* of Zoological Society of India for significant contribution to fish reproductive biotechnology on 05 June 2024.
- **Dr. Soma Das Sarkar** received the *Best Oral Presentation* Award in the 2nd International Conference on Sustainable Fisheries and Aquatic Resource Management: Life Below Water (SFARM-2024) at Science City Kolkata held during 12-14 September 2024.
- **Dr. Pronob Das** was awarded with the "*Scientist of the Year Award*" for his outstanding contribution in the field of fisheries science during the 1st International Conference on 'Emerging Technologies in Agriculture and Allied Sciences" organised by the Society for Agriculture, Allied Sciences and Technology, Odisha; School of Agriculture, SR University, Warangal; and Meadow



ACADEMY FOR ADVANCEMENT OF AGRICULTURAL SCIENCES
Kalyani, Nadia, West Bengal

Reg. No. S0030430/2022-23

Presented the Fellowship of the Academy to

Dr. Basanta Kumar Das
ICAR-Central Inland Fisheries Research Institute
Barrackpore, West Bengal

for his significant contributions to
Fishery Science

during
National Conference on
"Advances in Innovative Technologies & Plant Health Management Strategies in Climate Resilient Agriculture"
September 26-27, 2024
College of Agriculture Tripura, Lembucherra, Tripura

(Dr. Kajal Kumar Biswas)
Secretary

(Dr. Dharani Dhar Patra)
President

Fellowship awarded to Dr. B.K. Das



Certificate No. C/SEA/24/16

SABUJEEMA

An International Multidisciplinary E-magazine
In association with
Society for Agriculture, Allied Sciences and Technology
(SAAST), Odisha

The Executive Committee of Award Ceremony confers its

Excellence in Research Award

To

Dr. Pronob Das

Senior Scientist, ARS
ICAR-Central Inland Fisheries Research Institute
Regional Centre, Guwahati - 781006, Assam

for his outstanding contribution in the field of Fisheries Sciences on the occasion of SABUJEEMA EMINENCE AWARD CEREMONY on the eve of World Environment Day (05.06.2024)

Chief Executive Editor, SABUJEEMA
Joint Secretary, SAAST

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"Excellence in Research Award" awarded to Dr. Pronob Das



Dr. Soma Das Sarkar receiving the best presentation award at Kolkata

Agriculture Pvt. Ltd., UP, during 10-11 August 2024. He was also awarded the "*Excellence in Research Award*" by the Society for Agriculture and Allied Sciences, Odisha, for his outstanding contribution in the field of fisheries science.

- **Dr. Suvra Roy** received *Best Presentation Award* in the 2nd International Conference on Sustainable Fisheries and Aquatic Resource Management: Life below Water', held during 12-14 September 2024 at Science City, Kolkata.
- **Dr. Vikash Kumar** was awarded with the *Best Scientist Award, 2024* of the Institute.
- **Ms. Jesna P. K.** was awarded *Ph. D. degree in Aquaculture* (Topic: Investigation on ectoparasite remediation using nano/micro-encapsulated formulation in cultured fish) from ICAR-CIFE, Mumbai.
- **Dr. Suman Kumari** was awarded with the *Prasasthi Patra* for Hindi work by ICAR-CIFRI in September 2024
- **Mrs. Sangeetha M. Nair** won the *Second Prize in Hindi Translation* during Hindi *Saptah* organized by ICAR-CIFRI, Barrackpore.
- **Shri Mitesh H. Ramteke** received the *First Prize in Hindi Poetry* competition in Hindi *Saptah* 2024 held on 14-20 September 2024.
- **Shri Mishal P** joined Wageningen University and Research, The Netherlands as *Netaji Subhas ICAR International Fellow*.

Recognitions

- **Dr. B. K. Das**, Director delivered a *keynote address* on "Aquaculture and Inland Fisheries of India: Status, Challenges, and Opportunities" on 22 March 2024 in the National Seminar on "Recent Innovations in Animal Science Research" at U.N. Autonomous College, Adaspur, Cuttack. He also delivered a *keynote address* (online mode) on "Fisheries Enhancement in River Ganga: A holistic approach in the last eight years" in the 4th international conference on River Corridor Research Management (RCRM) on 09 March 2024. He also served as the *keynote speaker* in the National Conference on Hill Agro-Ecosystem: Challenges and Opportunities for Achieving Sustainable Development Goals during 29-30 November 2024 at the ICAR Research Complex for NEH Region, Nagaland.
- **Dr. B. K. Das** delivered *Dr. V. G. Jhingran Memorial Lecture* in National Seminar on "Advances in Environment Management for Sustainable Fisheries & Livestock Production" at College of Fisheries, Kishanganj on 19 November 2024. He was also one of the *panellists* in the Odisha Research Conclave 2024 in the session on R & D in Science and Technology for Higher Education



System at Fakir Mohan University, Odisha during 26 to 28 December 2024.

- **Dr. B. K. Das**, Director, graced as the *Chief Guest* in the International Seminar on "Green Management of the Environment Using Eco-Friendly Technology-2024", organized by the University of Kalyani, Kalyani, on 20 February 2024. He also served as the *Chief Guest* in the capacity-building program on "Scientific Agri. Horticultural Practices to Augment the Income from Small Farming" for PC, SMS, and other technical

staff of KVKs of West Bengal on 08 January 2024.

- **Dr. S. Samanta** delivered *lead lecture* on "Arsenic contaminations in the aquatic ecosystems: its mitigation for food safety and health" in the 13th IFAF held at Kolkata, West Bengal, India. He also served as a *Chairperson* of a session in the 13th IFAF.
- **Dr. S. Samanta** delivered *lead lecture* on "Aquaculture initiatives to protect hilsa fisheries in India" in the 2nd International Conference on Sustainable fisheries and aquatic resource management: life below water. SFARM held at Science City, Kolkata.
- **Dr. S. Samanta** served as a *Member of Assessment Committee* of scientists and in the clearance of probation of Scientists at ICAR-CRIJAF, Barrackpore. He also served as *External Expert* in the Career Assessment of Professor and Associate Professors at Maharashtra Animal & Fishery Sciences University, Nagpur. Further, Dr. Samanta served as *external expert* in the selection of Project Fellow of the UGC-DAE CSR funded research project at the University of Kalyani.
- **Dr. S. Samanta** served as a *Member* of the Institute Management Committee of ICAR-ATARI, Kolkata. He is serving as the *member* of the State Wetlands Authority of West Bengal
- **Dr. R. K. Manna** delivered a *Lead Lecture* on "Impact of impoundment on riverine habitat and fisheries: experience learnt from peninsular rivers of India" at the 13thIFAF held at Kolkata, West Bengal, India.
- **Dr. Sullip Kumar Majhi** acted as a *Keynote Speaker* and delivered a talk on "Development of reproductive biotechnology tool and techniques for conservation of elite fish germplasm" during NAAS brainstorming session on "Positioning Northeast Agriculture towards Amrit Kaal" organized by NAAS, Barapani Chapter on 05 July 2024.
- **Dr. B. K. Bhattacharjya, Dr. Pronob Das** and **Dr. S.C.S. Das** acted as *Expert Members* of the selection committee for the recruitment of Assistant Professor & equivalent under the College of Fisheries, Assam Agricultural University, Jorhat.
- **Dr. B. K. Bhattacharjya** acted as *a Member, Assessment Committee* of ICAR-CIFE, Mumbai and ICAR RC for NEH Region, Umiam for promotion of ARS Scientists (FRM) through CAS. Dr. Bhattacharjya also acted as a *Member, Official Language Implementation Committee*, of ICAR-ATARI, Guwahati and *member of the tender evaluation committee* of AFDC Ltd., Guwahati
- **Dr. B. K. Bhattacharjya** acted as an *Expert Member* (Fisheries), Assam State Wetlands Authority, Govt. of Assam. He also acted as a *Member, Board of Directors*, Assam Fisheries Development Corporation (AFDC) Ltd., Guwahati
- **Dr. Dhruba Jyoti Sarkar** was inducted as *Associate Editor* of the journal "Water, Air, & Soil Pollution", Springer Nature and as an *Editorial Board Member* of the journal "Scientific Reports", Springer. He *co-chaired a session* at the 2nd International Conference on Sustainable Fisheries and Aquatic Resource Management Life below Water' at Science City, Kolkata during 12-14 September 2024.
- **Dr. Arun Pandit** acted as *Session Convener* for the 'Industry Conclave: Innovations in fisheries and aquaculture technologies' under the I3th Indian Fisheries and Aquaculture Forum: Fostering Indian Fisheries and Aquaculture for Attaining Sustainable Development Goals held at Kolkata during 22-25, February 2024. He was also the *Session Convener* for the technical session 'Social science research in fisheries and aquaculture' in the forum.
- **Dr. Arun Pandit** acted as *Chairman* of the poster session on 'Social science research in fisheries and aquaculture' in the 13th IFAF. He has also acted as *Chairman* of technical session 3 in the workshop in Hindi on 'Role of inland fisheries and aquaculture in SDG' during 10-11September 2024 at ICAR-CIFRI Barrackpore.
- **Dr. Arun Pandit** was invited and attended as the *Subject Matter Expert* for the 'Technology Prioritization Workshop' organized by the ICAR-CRIJAF and TIFAC, DST at ICAR-CRIJAF, Barrackpore on 19-20 August 2024.
- **Dr. A. K. Sahoo** served as the *Technical Member* of Expert Appraisal Committee, River valley and Hydropower projects, MoEFCC, Govt. of India. He got a special assignment on NGT River Valley Projects.
- **Dr. A. K. Sahoo** provided scientific inputs as *Technical member* Biodiversity Sectional Committee, Environment and Ecology Department (EED)TC-331, on the Inland fisheries and open waters biodiversity towards developing ISO guidelines under BIS, New Delhi. He attended virtually in the Indian Delegation Participation in ISO/TC331.
- **Dr. A. K. Sahoo** was the *Executive Committee Member* of Asian Fisheries Society Indian Branch. He was the Chairman of Co-ordination Committee and Abstract Committee in 13th IFAF during 23 to 25 February 2024.Dr. Sahoo served as the Editor-In-Chief of Journal of Inland Fisheries Society of India. He was also the review editor in Frontiers in Aquaculture.
- **Dr. A. K. Sahoo** was the Invited Speaker to deliver lecture on

Biological Assessment for River Health at a seminar on "State of Art Techniques in River Corridor Research and Management: An Indo-French Perspective. Organised by IIT Jammu and INRAE, France during 4th to 5th July 2024. He was also the invited Speaker in the Department of Ecology and International Centre for Ecological Engineering, University of Kalyani, on 19 December 2024.

- **Shri Mishal P** acted as *session convener* in 13thIFAF for the technical session on 'Advances in Fish Nutrition Research' held at Kolkata during 23-25 February 2024.
- **Dr. Suman Kumari** delivered a talk as *Resource person* in one-day Aqua farmer meet on "Enhancing Aquaculture Productivity with Innovative and Unique Solution" organized by R R Animal Health Cop. Ltd. on 05 May, 2024 at Kolkata.
- **Dr. Suman Kumari** becomes *IUCN Commission* on Ecosystem Management (CEM), for the period of 2021-2025.
- **Dr. Pronob Das** was inducted into the *Editorial Board* as an associate editor for the BMC Aquaculture Science and Management journal and *Board Member* to BMC Environmental Science journal published by Springer Nature and as an *Academic Editor* in Aquaculture Nutrition journal and Journal of Applied Ichthyology published by Wiley and *academic editor* in PLOS ONE published by PLOS.
- **Dr. Pronob Das** acted as an *Expert Member* of selection committee for recruitment of Assistant Professor & Equivalent (Fish Health Management) under College of Fisheries, Assam Agricultural University, Jorhat. He performed the special assignment as *member of committee* to assess the potentiality of DSP Farm of Coconut Development Board at Abhyapuri, Bongaigaon district, Assam.
- **Dr. Simanku Borah** acted as the *Guest Editor* for the special issue on "Ecotourism and Conservation of Biodiversity" of the journal BMC Environmental Science.
- **Dr. Simanku Borah** inducted as an *Editorial Board Member* of the Journal 'BMC Environmental Science' Journal 'Discover Applied Sciences' of Springer Nature and the *Guest Editor* for the special issue on "Ecotourism and Conservation of Biodiversity" of the Journal BMC Environmental Science.
- **Dr. A. K. Yadav** acted as an *external expert member* in the committee for the auction of animals of AICRP Unit at KVK, Dudhnoi, Goalpara, Assam and fixation of base value. He also acted as a *member in the selection committee* for selection of YP-I at ICAR-NRC on Pig, Rani, Guwahati.
- **Dr. Deepa Sudheesan** handled the session 'Theme III: Small-scale fisheries addressing SDGs' and 'Theme I: Open water fisheries resource management' during the 13th IFAF- Fostering Indian Fisheries and Aquaculture for Attaining Sustainable Development Goals held at Kolkata during 23-25 February 2024.
- **Dr. Deepa Sudheesan** acted as an *External Expert* for selecting Young Professional-II under the project tiled 'Marine Mammal Stock Assessment of India' at ICAR-CMFRI, Kochi.
- **Dr. T. T. Paul** acted as an *External Expert* for the engagement of consultant for the development of technology for artificial propagation of seaweed in MBEMD, ICAR-CMFRI.
- **Dr. T. T. Paul** *handled two sessions* titled 'Innovations in fish harvest and post-harvest technology (IFPT)' and 'Satellite symposium session titled 'Mariculture and Seaweed Farming (MRSF)'during the 13th IFAF- Fostering Indian Fisheries and Aquaculture for Attaining Sustainable Development Goals held at Kolkata during 23-25 February 2024.
- **Mrs. Tanuja Abdulla** acted as *External Expert* in the committee for the selection of Young-Professional-II under the Project "Genetic and genomic tools for sustainable marine fisheries, mariculture and conservation: MBT/GNM/25" at ICAR-CMFRI, Kochi. She also acted as *External Expert* in the committee for the selection of two young professional 1 for Project entitled "Integrating Risk Assessments and Future Projections for Sustainable Coastal Resilience" at ICAR-CMFRI, Kochi. Further. She also acted as *External Expert* in the committee for the selection of Project Associate under the DBT Project titled "Omics approaches in the Indian Pompano, *Trachinotus mookalee* and the Indian edible oyster *Crassostrea bilineata* (*Magallana bilineata*) to develop fenomic resources for ensuring sustainable aquaculture" at ICAR-CMFRI, Kochi.
- **Dr. Kavita Kumari** acted as *Coordinator* for 'Fish Genetics Symposium' and reception and registration committee under the 13th Fisheries and Aquaculture Forum held from 23-25 February 2024, Kolkata. She has also acted as *Session Convenor* in the same forum.
- **Dr. Santhana Kumar V.** *coordinated* "Students interface meet" in 13th Fisheries and Aquaculture Forum held from 23-25 February 2024, Kolkata.
- **Dr. B. K. Behera** was selected as the *Dean* of the College of Fisheries, RLB Central

Agricultural University, Jhansi. Later on, he was also selected as the *Chief Executive*, NFDB, Hyderabad.

Other Recognitions

- **Dr. S. Samanta** served as *External Evaluator* of Ph.D. thesis of one student from Department of Agricultural Chemistry and Soil Science, and one more student from the Department of Agricultural Chemicals, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia.
- **Dr. Archana Sinha** was recognized as *Question Setter and Evaluator* for competitive examination of ASRB and NTA, New Delhi.
- **Dr. B. K. Bhattacharjya** acted as an *Expert, for the Ph.D. research synopsis presentation* of Department of Zoology, USTM, Baridua, Meghalaya.
- **Dr. B. K. Bhattacharjya**, **Dr. Pronob Das** and **Dr. Simanku Borah** acted as *External Examiner* for the comprehensive viva voce of a Ph.D. scholar of the College of Fisheries, AAU, Raha.
- **Dr. Hemanta Chowdhury** has acted as *Judge of a Session* (Session: e-Poster (Display#3): Theme, Aquatic Emerging Health Contaminant (AEHC) at 13th IFAF held in Kolkata
- **Dr. Arun Pandit** acted as *Question Setter and Evaluator* for the course FEC 506: Fisheries Financing & Project Management and FEC-503: Fish Marketing Management of ICAR-CIFE, Mumbai. He evaluated the Ph.D. thesis entitled "Ecosystem Services, Fisheries Resource Management and Trade-offs In River Jhelum Basin" submitted by Mr.Shahid Gul of the ICAR-CIFE. Mumbai.
- **Dr. Arun Pandit** conducted Ph.D. *comprehensive viva-voce examination* for Shri Mani Selvam J of ICAR-CIFE Mumbai. He was also the *external examiner* for conducting the thesis viva voce examination of Mr. Khemraj Bunkar, Ph.D. scholar and external examiner for evaluation of MFSc dissertations of Shri Mahesh Sharma and Ms. Ranjana Choudhury of the University.
- **Shri Mishal P** acted as *Question paper setter* for MFSc course in KUFOS, Kochi and as Question paper setter for BFSc course in GBPUA&T, Pantnagar.
- **Dr. Sajina A. M.** acted as *External Examiner* for Ph.D. comprehensive examination in Dept. of Fisheries Resource Management, F/O. Fishery Sciences, WBUAFS, Kolkata
- **Dr. Pronob Das** served as the *External Examiner* for the evaluation of the Ph.D. thesis of the Division of Aquaculture, ICAR-Central Institute of Fisheries Education, Mumbai.
- **Dr. Pronob Das** acted as an *External Examiner* for comprehensive viva voce of a Ph.D scholar of Department Aquatic Environment Management (AEM) College of Fisheries, AAU, Raha. He also acted as an *External Examiner* for evaluation of Ph.D thesis of Division of Aquaculture, ICAR-Central Institute of Fisheries Education, Mumbai.
- **Dr. Simanku Borah** acted as an *External Examiner* for Comprehensive viva voce of a Ph.D scholar of College of Fisheries, AAU, Raha.
- **Dr. Simanku Borah** acted as a *Question Paper Setter* for theory examination 2023-24 for the UG course titled 'Fish Population Dynamics and Stock Assessment (FRM-313). He also acted as a *Question Paper Setter* of CAU-Imphal Entrance Test 2024 (CET-2024). Dr. Borah acted as an *External Examiner* for evaluation of PG Thesis of College of Fisheries, CAU, Lembucherra, Tripura.
- **Ms. Niti Sharma** acted as a *Paper*



Dr. B. K. Behera (third from left) was selected as the *Dean* of the College of Fisheries, RLB Central Agricultural University, Jhansi. Later on he was selected as the Chief Executive, NFDB, Hyderabad

Setter for theory examination (external) 2023-24 for PG course FGB-504 'Fish Breeding Plans' of College of Fisheries, CAU, Tripura.

- **Dr. T. T. Paul acted** as *Examiner* for evaluation of answer papers for 'Climate Change Impact and Management' at Kerala University of Fisheries and Ocean Studies, Kochi, Kerala.
- **Dr. Kavita Kumari** was recognized as *Postgraduate Teacher* for COF, Mangalore, Karnataka Veterinary and Animal Science University, Bidar, acted as *Member of Advisory Committee* for PhD student of AAU, Raha and CIFE, Mumbai.
- **Mr. A. Kakati** acted as an *External Examiner* for PFGF examination held at College of Fisheries, AAU, Raha.



Dr. Santhana Kumar V. (3rd from right) receiving Best Speaker Award during 13th IFAF



Ms. T. Nirupada Chanu (at the middle) receiving Best Oral Presentation Award during Hindi Workshop



Dr. Vikash Kumar (2nd from right) receiving Best Institute Scientist Award during ICAR-CIFRI Foundation Day

Linkages Developed



The institute maintained close linkages with the stakeholders involved in fisheries research and development in India and abroad. Linkages help to transmit knowledge and skills between the linked organizations. The purpose of such linkages are research and development, extension, education, outreach activities, seminars, workshops, publications, etc. Linkages are important in the spread and diffusion of knowledge, innovation, and developmental activities. During 2024, the Institute maintained linkages with the following organizations.

International Multilateral Organizations

- Food and Agriculture Organization, UN
- Bay of Bengal Programme Inter-Governmental Organization
- International Union for Conservation of Nature, Indonesia
- Network of Aquaculture Centres in Asia-Pacific, Bangkok
- World Fish Centre, Malaysia
- Deutsche Gesellschaft fürInternationale Zusammenarbeit (GIZ), Germany
- SCATEC ASA, Norway

Foreign Universities

- Ghent University, Ghent, Belgium
- University of Manitoba, Canada
- University of Ottawa, Canada
- University of Waterloo, Canada
- Wageningen University, Netherlands
- Freie Universität, Berlin, Germany
- The University of Arizona, United States
- RMIT University, Australia
- Sylhet Agricultural University, Bangladesh

International Societies and Humanitarian Organizations

- Aquatic Ecosystem Health & Management Society, Canada
- Rotary International
- International Collective in Support of Fishworkers
- Wetlands International South Asia
- World Wide Fund for Nature, India

Linkages within India

Central Departments, Boards and Authorities

- Agrinnovate India Ltd., New Delhi
- Akashvani, Kolkata
- Brahmaputra Board, Ministry of Jal Shakti, Govt. of India
- Bureau of Indian Standards, New Delhi
- Central Water Commission, New Delhi
- Department of Animal Husbandry, Dairying and Fisheries, New Delhi
- Department of Bio-technology, New Delhi
- Farakka Barrage Authority, Murshidabad, West Bengal
- Indian Council of Social Science Research
- Indian Science Congress Association, Kolkata
- Ministry of Environment, Forest & Climate Change, Govt. of India, New Delhi
- Narmada Control Authority, Department of River Development

& Ganga Rejuvenation, Ministry of Jal Shakti, Govt. of India, Indore
- National Bank for Agriculture and Rural Development
- National Biodiversity Authority
- National Fisheries Development Board, Hyderabad
- National Thermal Power Corporation (NTPC)
- National Mission for Clean Ganga, Department of River Development & Ganga Rejuvenation, Ministry of Jal Shakti, Govt. of India, New Delhi
- National Statistical Organization, National Accounts Division, Min. of Statistics and Programme Implementation, Govt of India
- Zoological Survey of India, Kolkata
- Central Silk Board- CSRTI, Mysore and CTR&TI, Ranchi, Ministry of Textiles
- Central Pollution Control Board, Govt. of India
- Centre for Development of Advanced Computing, Kolkata
- State Bank of India, Kolkata

National Central Universities & Institutes

- Assam Agricultural University, Jorhat
- Banaras Hindu University, Varanasi
- Bihar Animal Science University, Patna
- Central University of South Bihar, Patna
- Chaudhury Charan Singh National Institute of Agricultural Marketing, Jaipur
- College of Fisheries, Central Agricultural University, Lembucherra, Agartala
- Department of Zoology, University of Calcutta, Kolkata
- Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur
- G.B. Pant University of Agriculture & Technology, Pantnagar
- Indian Institute of Technology, Hyderabad
- Indian Institute of Technology, Jammu
- Indian Institute of Technology, Kharagpur
- Indian Statistical Institute, Kolkata
- Visva-Bharati University, Santiniketan
- Wildlife Institute of India, Chandrabani, Dehradun
- Central Agricultural University, Imphal Manipur

ICAR Organizations

- Dhaanyaganga KVK, North 24 Parganas, Nadia, West Bengal
- Ashokenagar KVK, South 24 Parganas, West Bengal
- Gayeshpur KVK, Nadia, South 24 Parganas
- ICAR Research Complex for NEH Region, Umiam
- ICAR-Agricultural Technology Application Research Institute, Kolkata
- ICAR-Central Institute of Brackishwater Aquaculture, Chennai
- ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar
- ICAR-Central Institute of Fisheries Education, Mumbai
- ICAR-Central Institute of Fisheries Technology, Kochi
- ICAR-Central Institute of Subtropical Horticulture, Regional Research Station Malda, West Bengal
- ICAR-Indian Institute of Soil and Water Conservation, Dehradun
- ICAR-Central Marine Fisheries Research Institute, Kochi
- ICAR-Central Research Institute of Jute & Allied Fibre, Barrackpore
- ICAR-Directorate of Coldwater Fisheries, Bhimtal
- ICAR-Indian Agricultural Statistics Research Institute, New Delhi
- ICAR-National Academy of Agricultural Research Management, Hyderabad
- ICAR-National Bureau of Agricultural Insect Resources, Bengaluru
- ICAR-National Bureau of Fish Genetic Resources, Lucknow
- ICAR-National Bureau of Agricultural Insect Resources, Karnataka
- Krishi Vigyan Kendra, DRPCAU, Piprakothi, East Champaran, Bihar
- CHIS-Krishi Vigyan Kendra, Malda, West Bengal
- Rathindra Krishi Vigyan Kendra, Visva-Bharati, Sriniketan, Birbhum, West Bengal

State Departments, Boards and Authorities

- Assam Fisheries Development Corporation Ltd.
- Assam Rural Infrastructure and Agricultural Services Society (ARIAS)
- Chilika Development Authority, Bhubaneswar
- Department of Fisheries & Aquatic Resources, Nagaland
- Department of Fisheries, Govt. of Gujarat
- Department of Fisheries, Govt. of Manipur
- Department of Fisheries, Govt. of Tripura
- Department of Fisheries, Govt. of Uttarakhand
- Department of Forest, Govt of

Gujarat, Ukai
- Department of Environment, Forest and Climate Change, Government of Bihar, Patna
- Department of Forest, Govt. of Odisha
- Department of Forest, Govt. of West Bengal
- Department of Forest, Govt. of Madhya Pradesh
- Directorate of Fisheries, Govt. of Andhra Pradesh
- Directorate of Fisheries, Govt. of Arunachal Pradesh
- Directorate of Fisheries, Govt. of Assam
- Directorate of Fisheries, Govt. of Bihar
- Directorate of Fisheries, Govt. of Chhattisgarh
- Directorate of Fisheries, Govt. of Himachal Pradesh
- Directorate of Fisheries, Govt. of Jharkhand
- Directorate of Fisheries, Govt. of Karnataka
- Directorate of Fisheries, Govt. of Kerala
- Directorate of Fisheries, Govt. of Madhya Pradesh
- Directorate of Fisheries, Govt. of Maharashtra
- Directorate of Fisheries, Govt. of Meghalaya
- Directorate of Fisheries, Govt. of Odisha
- Directorate of Fisheries, Govt. of Telangana
- Directorate of Fisheries, Govt. of Tripura
- Directorate of Fisheries, Govt. of Uttar Pradesh
- Directorate of Fisheries, Govt. of West Bengal
- East Kolkata Wetland Management Authority, Department of Environment, Govt. of West Bengal
- Gujarat Maritime Board, Bharuch
- Narmada Control Authority, Gujarat
- Narmada Control Authority, Indore
- Narmada Water Resources, Water Supply and Kalpasar Department, Gandhinagar
- Sardar Sarovar Narmada Nigam Limited
- Sundarban Development Board, West Bengal
- Swami Vivekananda State Police Academy, Barrackpore
- West Bengal Biodiversity Board
- Rural Livelihood Mission, West Bengal
- ATMA, Bhagalpur, Bihar
- Krishi Vigyan Kendra, BAU, Sabour, Bihar
- Madhya Pradesh Fisheries Federation Limited, Bhopal
- Maharashtra Pollution Control Board, Mumbai

State Colleges/Universities

- Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia
- Bihar Agricultural University, Sabour, Bihar
- College of Fisheries, Kishanganj, Bihar
- Fakir Mohan University, Balasore
- Munger University, Bihar
- University of Kalyani, Kalyani
- West Bengal University of Animal and Fishery Sciences (WBUAFS), West Bengal
- Manipur University, Imphal
- Utkal University, Bhubaneswar
- Vidyasagar University, Midnapore
- College of Fisheries, Gumla, Jharkhand
- Vidyasagar College for Women, Kolkata
- College of Fisheries, Raha, Assam
- Hooghly Mahsin College
- BKC College, West Bengal
- D. M. College, Imphal
- Dr. Rajendra Prasad Central Agricultural University, Dholi, Bihar
- College of Fisheries, Udgir, Maharashtra
- Tamil Nadu Dr. J. Jayalalithaa Fisheries University, Tamil Nadu
- Nehru Gram Bharti University, Prayagraj
- Maharaja Agrasen University, Solan, Himachal Pradesh
- Odisha University of Agriculture and Technology, Bhubaneswar
- Himalayan University, Arunachal Pradesh
- The Neotia University, West Bengal

Central Public Sector Units

- National Hydroelectric Power Corporation (NHPC) Limited
- North Eastern Electric Power Corporation (NEEPCO) Limited
- Satluj Jal Vidyut Nigam (SJVN) Limited
- National Thermal Power Corporation Ltd., Farakka
- National Thermal Power Corporation Ltd., Gaderwara
- Damodar Valley Corporation (DVC)
- Brahmaputra Cracker and Polymer Limited (BCPL)

Other Organizations/ NGOs

- Assam Agribusiness and Rural Transformation Project (APART)
- BANO Charitable Trust, Odisha

Linkages Developed

- Glaucus Agrochem Pvt. Ltd., Kolkata
- MR Aquatech, Bhubanaswar
- NIRMAN, Odisha
- RKMVERI,Belur
- Odisha Environmental Society, Bhubaneswar
- Pradan
- Ramakrishna Mission Ashram, Sargachi, Murshidabad
- Ramakrishna Mission Ashram, Ranchi
- Ramakrishna Mission, Bhadrak
- Ramakrishnayan Society of Moyna, West Bengal
- Ri-Bhoi Farmers' Union, Meghalaya
- SKSVYCS, NGO, Sundarbans
- Hemnagar Sundarban Dream, West Bengal
- Gitanjali Limited, Nadia West Bengal
- Development Foundation Rural Access, New Delhi
- Envozyme Technology Pvt. Ltd., Hyderabad



Linkages with fisheries cooperative society, Balagarh, Hooghly

ICAR-CIFRI in Media



Television Programmes



DD Bangla and DD National

Program : Krishi Darshan

Topic : Captive Culture of Hilsa in Pond (in Bengali)
Duration : 30 Minutes
Date of Broadcast : 14 August, 2024 (17:30 hrs.)
Expert Speakers: Dr. Basanta Kumar Das, Director, ICAR-CIFRI, Barrackpore; Dr. Srikanta Samanta, Principal Scientist; Dr. Ranjan Manna, Principal Scientist and Shri Dipanjan Jana, Progressive Farmer

DD Bangla and DD National

Program : Krishi Darshan

Topic : Pabda Culture in Pen (in Bengali)
Duration : 30 Minutes
Date of Broadcast : 25 December, 2024 (17:30 hrs)
Expert Speakers: Dr. Basanta Kumar Das, Director, ICAR-CIFRI, Barrackpore; Dr. Gunjan Karnatak, Senior Scientist; Dr. Aparna Roy, Senior Scientist; Shri Sanjit Debnath, Project Scientist and Shri Pronoy Bala, Progressive Farmer

Radio Programmes



Akashvani Kolkata

Program : Khabarer Aynay

Topic : National Fish Farmers Day (in Bengali)
Duration : 12 Minutes
Date of Broadcast : 11th July, 2024 (18:15 hrs) & 18th July, 2024 (18:15 hrs)
Speaker : Dr. Basanta Kumar Das, Director, ICAR-CIFRI & Dr. Aparna Roy, Senior Scientist, ICAR-CIFRI

Radio FM 91.2

Palli Bangla Krishi Katha

Topic : Mahila Matsyajibi Diwas at Sundarban
Duration : 15 Minutes
Date of Broadcast : 26 December, 2024 (18:30 hrs)
Speaker : Dr. Basanta Kumar Das, Director, ICAR-CIFRI; Dr. Pradip Dey, Director, ATARI & Dr. Aparna Roy, Senior Scientist, ICAR-CIFRI

Documentary Film Developed by ICAR-CIFRI (2024-2025)



- Conservation of Hilsa – ICAR-CIFRI's Intervention towards Sustainability (English Version)
- ICAR-CIFRI Empowered Fisher Community of Chamardaha Beel, West Bengal Through Culture based Fisheries (English Version)
- Eco Restoration of Duma Fisheries – CIFRI Intervention (English Version)

Training and Capacity Building of ICAR-CIFRI Employees

The Annual Training Plan (ATP) of all categories of employees of the Institute for the year 2024 was prepared based on the training needs assessment. There was 100% realization of trainings planned during the year. Apart of a winter school on "Ecosystem Health Monitoring and Fisheries Management in Inland Open Waters" three training programmes viz., "Basics of GIS Mapping on open source software","Advances in Heavy Metal Analysis (ICP-MS)"and "Inland Fish Taxonomy and Biodiversity Assessment" were also organised at the institute where scientists and technical persons participated.

Annual Physical and Financial Targets and Achievements

A. Physical Targets and Achievements

Sl. No.	Category	Total No. of Employees	No. of trainings planned for each category during 2024 as per ATP	Total No. of employees undergone training during the year
1	Scientist	74	42	42
2	Technical	53	31	31
3	Administrative & Finance	42	31	31
4	SSS	17	9	9
	Total =	186	113	113

B. Financial Targets and Achievements (April -December 2024)

BE 2024 for HRD (Rs in lakhs)	Actual Expenditure (up to 31st December 2024)(Rs in lakhs)	% Utilization of allotted budget
1.0972	1.0972	100



Dr. R. K. Manna (2nd from right) receiving MDP training certificate from ICAR-NAARM, Hyderabad

वार्षिक प्रतिवेदन

Annual Report

2024

Participation of the Staff Members in Workshops/Seminars /Symposia/ Conferences/Meeting in India and Abroad

Sr. No.	Event	Venue	Duration	Participant(s)
1.	Training program on induced breeding and seed production of Peninsular carps and hatchery technology	ICAR-CIFA, Bengaluru Centre	02 January	V. L. Ramya, Jesna P. K., Sonalika Sahoo, Vijaykumar M. E.
2.	International bioinformatics workshop on 'Genome informatics - 6th edition'	On-line mode	06 January -2 February	Kavita Kumari
3.	One-day Hindi workshop	ICAR-NBAIR, Bengaluru	10 January	Jesna P. K.
4.	International Fisheries Congress 2024	Kerala University of Fisheries and Ocean studies, Kerala	12-14 January	Thankam Theresa Paul, Sajina A. M.
5.	Startup grand challenge to promote startup ecosystem in fisheries sector organized by the Dept. of Fisheries, Govt of India	On-line mode	12 January	S. Samanta Ganesh Chandra
6.	Samiksha review meeting of ITMU	IP& TM Division, ICAR,New Delhi	12 January	Ganesh Chandra
7.	TOLIC meeting	Central Manufacturing Technology Institute, Bengaluru	12 January	Preetha Panikkar, Jesna P. K.
8.	Interactive meeting among the representatives from JICA and officials of DoF, Assam	ICAR-CIFRI Regional Centre, Guwahati	22 January	S. K. Majhi, B. K. Bhattacharjya, A. K. Yadav, P. Das S.C.S. Das, S. Borah N. Sharma, R. Kumar
9.	Meeting with the CAG team, Kolkata	ICAR – CIFRI, Barrackpore	24 January	B. K. Das, Arun Pandit
10.	NIAP project review meeting	On-line mode	25 January, 11 March	Arun Pandit, Anjana Ekka
11.	State credit seminar	NABARD, Kolkata	03 February	B. K. Das
12.	Foundation Day celebration of ICAR-CRIJAF	ICAR-CRIJAF, Barrackpore	09 February	B. K. Das
13.	Launch workshop of the NMCG project (Phase III) at Farakka, West Bengal	Farakka, West Bengal	10 February	D. Bhakta, A. K. Sahoo, D. K. Meena, C. Johnson, Vikas Kumar, Santhana Kumar V.
14.	One day dissemination workshop on study on improvement in fish marketing infrastructure of Howrah fish market organized by National Productivity Council, Kolkata	ICAR – CIFRI, Barrackpore	12 February	B. K. Das, Arun Pandit, Piyashi Debroy
15.	Workshop on utilization of probiotics and prebiotics in fisheries	ICAR-CIFRI Regional Centre, Guwahati	12 February	S. K. Majhi, B. K. Bhattacharjya, A. K.Yadav, P. Das, S.C.S. Das, S. Borah, N. Sharma, R. Kumar, B. C. Ray, A. Kakati
16.	SRIJAN: Empowering ZTMCs/ITMCs of ICAR Institutes	IP& TM Division	13-15 February	Ganesh Chandra
17.	Krishi-O-Udyan Mela2024 organised by Bidhan Chandra Krishi Viswavidyalaya	Bidhan Chandra Krishi Viswavidyalaya	16 February	B. K. Das
18.	ICAR Regional Committee VIII meeting	NIOT, Chennai	16 February	Preetha Panikkar (Off-line) Arun Pandit (On-line)
19.	Facilitating species conservation planning workshops by IUCN	Online	19 February-12 April	Suman Kumari

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Sr. No.	Event	Venue	Duration	Participant(s)
20.	International Seminar – on "Green management of the environment using eco-friendly technology-2024"	University of Kalyani, Kalyani	20 February	B. K. Das
21.	International conference on "Recent advances in aquaculture and fisheries sciences" organized by Subharti University, Uttar Pradesh	On-line mode	22 February	P. Das
22.	13th Indian Fisheries and Aquaculture Forum: Fostering Indian fisheries and aquaculture for attaining Sustainable Development Goals"	Biswa Bangla Convention Centre, Kolkata	23-25 February	B. K. Das, S. K. Majhi, B. K. Bhattacharjya, A. K. Yadav, P. Das, S.C.S. Das, S. Borah, N. Sharma, R. Kumar, D. N. Jha, A. Alam, V. R. Thakur, J . Kumar, Vikas Kumar, Deepa Sudheesan, Thankam Theresa Paul, Vikash Kumar, Preetha Panikkar, V. L. Ramya, Jesna P. K., Sonalika Sahoo, Vijaykumar M. E., S. K. Manna, A. Sinha, A. Bera, D. J. Sarkar, Arun Pandit, Kavita Kumari, Santhana Kumar V., Vikash Kumar, P. Maurye, Suvra Roy, M. Shaya Devi, S. K. Nag, Piyashi Debroy, Soma Das Sarkar, Suman Kumari, Srikanta Samanta, Anjana Ekka
23.	Industry conclave under the 13th IFAF	Biswa Bangla Convention Centre, Kolkata	24 February	B. K. Das, Arun Pandit, Ganesh Chandra, Gunjan Karnatak
24.	Women empowerment conclave under the 13th IFAF	Biswa Bangla Convention Centre, Kolkata	25 February	Preetha Panikkar, Sona Yengkokpom, Aparna Roy, Suman Kumari, Gunjan Karnatak, Sonalika Sahoo, Paushali Mukherjee
25.	Meeting with NITI Aayog on strategic paper on inland fisheries	On-line mode	26 February	Arun Pandit, D. K. Meena
26.	Annual conference of Vice Chancellors and ICAR Directors	NASC Complex, ICAR, New Delhi	26-27 February	B. K. Das
27.	Discussion on the draft landscape report of 'Nonylphenol and its ethoxylates' organized by Toxic Linkat New Delhi	On-line mode	28 February	S. K. Nag
28.	Mid term meeting of Regional Committee II	On-line mode	01 March	Arun Pandit

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Sr. No.	Event	Venue	Duration	Participant(s)
29.	33rd Governing Council meeting of the Network of Aquaculture Centres in Asia - Pacific (NACA)	New Delhi	05 March	B. K. Das
30.	Assessment Committee of CAS	ASRB, New Delhi	06 March	B. K. Das
31.	4th international conference on River Corridor Research Management (RCRM) and keynote address on "Fisheries Enhancement in River Ganga-A holistic approach in the last eight years"	On-line mode	09 March	B. K. Das
32.	13th Audit advisory board meeting	Office of Director General of Audit, Kolkata	12 March	B. K. Das
33.	Meeting with Director of Fisheries, Govt. of West Bengal regarding Cage Culture in Kangsabati river		13 March	B. K. Das
34.	Meeting with Secretary, DoWR, RD, GR and National Mission for Clean Ganga (NMCG) project meeting	Shram Shakti Bhavan, New Delhi	14 March	B. K. Das
35.	Workshop-cum-training on aquarium maintenance and care	ICAR-CIFRI Regional Centre, Guwahati	15 March	S. K. Majhi, B. K. Bhattacharjya, A. K. Yadav, P. Das, S.C.S. Das, S. Borah, N. Sharma, R. Kumar, B. C. Ray, A. Kakati
36.	ITU/FAO Workshop jointly organized by ICAR and DoT	NASC Complex, New Delhi	18 March	B. K. Das
37.	Meeting with DDG (Fy. Sc) for Budget, ICAR	On-line mode	18 March	B. K. Das
38.	Meeting on 'Downstream Environmental flow in river Narmada from Sardar Sarovar Dam' with Narmada Control Authority (MoJS, DoWR, RD & GR)	On-line mode	19 March	B. K. Das
39.	Aqua Biz Summit	ICAR-CIFT, Cochin	20 March	Ganesh Chandra
40.	National Seminar on "Recent innovations in animal science research" organised in collaboration with Zoological Society of Odisha	U.N. Autonomous College, Adaspur, Cuttack	22 March	B. K. Das
41.	BOBLME phase II project-National consultative workshop	Egmore, Chennai	21–23 March	D. Bhakta
42.	Meeting of Adani PSP project -Status of the project work	On-line mode	03 April	B. K. Das
43.	Meeting on 'Comprehensive guidelines for the foreign visits of the Scientists/Officials of ICAR'	On-line mode	03 April	B. K. Das and all the scientists
44.	Interactive meeting of DG, ICAR, New Delhi with Scientists of ICAR	On-line mode	03 April	B. K. Das and all the scientists
45.	Meeting for certification of technology product model in agriculture extension	On-line mode	04 April	B. K. Das and all the scientists

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Sr. No.	Event	Venue	Duration	Participant(s)
46.	Meeting with Director of Fisheries, Government of Tripura	ICAR-CIFRI, Barrackpore	04 April	B. K. Das
47.	Interactive meeting to mobilize the fishing community to carry out the reservoir fisheries development programme in a participatory mode to meet the SDG:8 'Decent work and Economic Growth' under the ICAR window 3 programme (World Fish project)	Rissia Dam, Odisha	05 April	B. K. Das, Lianthuamluaia
48.	Institute Technology Management Committee Meeting of ICAR-CRIJAF	ICAR-CRIJAF, Nilgunj, Barrackpore	08 April	Ganesh Chandra
49.	Meeting on the Ecoregional working group under the theme 'Enhancing productivity, profitability and resilience of the agri-food Systems' by the NASC, ICAR, New Delhi	On-line mode	12 April	B. K. Das and all the scientists
50.	Meeting on 'Viksit Bharat' with respect to various commodities like Rice, Wheat, Maize, Oilseed, Pulses, Meat etc at NASC, ICAR, New Delhi	On-line mode	16 April	B. K. Das and all the scientists
51.	Business to Business (B2B) meeting for licensing of 'CIFRI Fish Tanavhari'	ICAR-CIFRI, Barrackpore	16 April	B. K. Das, Ganesh Chandra, S. K. Samanta, Archana Sinha, S. K. Manna, A. U. Muzaddadi, Hemanta Choudhury, A. K. Bera, Ajoy Kumar Saha
52.	Meeting with Director of Fisheries, Govt. of Odisha regarding discussion on Hirakud Project	On-line mode	27 April	B. K. Das
53.	Interactive meeting of ICAR-CIFRI team with NEEPCO officials and local villagers of Bichom, Arunachal Pradesh	Bichom, Arunachal Pradesh	02 May	B. K. Das, A. K. Das B. K. Bhattacharjya, S. Borah
54.	Stakeholder consultation workshop "Study on impact of the dolphins of inland waterways operations" organized by the WWF India	Salt Lake, Kolkata, West Bengal	03 May	S. Samanta, D. Bhakta
55.	Workshop on Gangetic Dolphin	Salt Lake, Kolkata, West Bengal	03 May	S. Samanta, D. Bhakta
56.	Interactive meeting of Director, ICAR-CIFRI with Scientists of Guwahati Centre	ICAR-CIFRI Regional Centre, Guwahati	04 May	S. K. Majhi, B. K. Bhattacharjya, A. K. Yadav, P. Das, S.C.S. Das, S. Borah, N. Sharma, R. Kumar, B. C. Ray, A. Kakati
57.	Interactive meeting of ICAR-CIFRI team with Directorate of Fisheries officials, Government of Assam	Directorate of Fisheries, Guwahati	04 May	B. K. Das and all the scientists of Guwahati centre
58.	CSR webinars	On-line mode	06 June, 20 September, 08 November	Arun Pandit

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Sr. No.	Event	Venue	Duration	Participant(s)
59.	Pradhan Mantri Matsya Kisan Samridhi Sah-Yojana (PM-MKSSY), Dept. of Fisheries, Govt. of India	On-line mode	10 May	S. Samanta
60.	International workshop on microbial genomics: bacteria and viruses	On-line mode	11 May – 06 June	Kavita Kumari
61.	Meeting with Director of Fisheries, Government of Tripura regarding cage installation in Dumbor reservoir	On-line mode	18 May	B. K. Das
62.	Interactive meeting with the dealers/stakeholders about the uses of the products for supporting the aqua-farmers to promote ICAR-CIFRI products through Dealers Meet under GlacusAgro Chem	Digha, West Bengal	21-22 May	B. K. Das
63.	Interactive meeting of ICAR-CIFRI team with officials of NABARD	NABARD Regional Office, Guwahati	27 May	S. K. Majhi, S.C.S. Das, S. Borah
64.	Viksit Bharat meeting (Fisheries Science)	On-line mode	30 May	Preetha Panikkar
65.	NAAS Annual General Body meeting and Foundation Day Function	NASC, New Delhi.	04-05 June	B. K. Das
66.	Meeting to discuss different technical and administrative matters with eight Fisheries Research Institutes	Fisheries SMD, KAB-II, Pusa, New Delhi	06 June	B. K. Das
67.	Meeting regarding project on 'Fish conservation and stock enhancement of fishery of Ganga river basin (Phase III)' project including the completed projects of Phase I & II, indicating the achievement, outcome and actionable points	NMCG, New Delhi	07 June	B. K. Das
68.	"Emergency preparedness for unexpected food safety" organised by ICAR-CIFT	On-line mode	07 June	V. R. Thakur
69.	World Accreditation Day Celebration, NABL Kolkata	NABL Kolkata	10 June	S. Samanta
70.	International webinar on " Changing status of the ecosystem health of the river Ganga: an update and review" organized by South and South East Asia chapter of Aquatic Ecosystems Health and Management in collaboration with Central University of South Bihar, ICAR-NBFGR, and Vigyan Bharti Bihar	On-line mode	10 -11 June	P. Das
71.	Meeting with World Bank representative for the upcoming project 'Uttar Pradesh agriculture growth and rural enterprise ecosystem strengthening project (UPAGREES)'	UPDASP, Lucknow	15 June	B. K. Das
72.	International workshop on sustainable development and management of floodplain wetlands (beels) of Assam organized by Directorate of Fisheries, Govt. of Assam	AAU International Guest House, Guwahati	19 June	B. K. Das, B. K. Bhattacharjya, A. U. Mazaddadi, G. Chandra, S. Borah
73.	Review Meeting of ICAR- NePPA Project	On-line mode	20 June	B. K. Das

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Sr. No.	Event	Venue	Duration	Participant(s)
74.	Interactive meeting of Dr. B. Meenakumari, Former DDG (Fisheries Sc., ICAR) with staff of ICAR-CIFRI Regional Centre Guwahati	ICAR-CIFRI Regional Centre, Guwahati	21 June	S. K. Majhi, A. K. Yadav, S.C.S. Das, S. Borah, N. Sharma, B. C. Ray, A. Kakati, S. Dungdung
75.	ऑनलाइन अनुवाद टूल्स का प्रयोग पर एक दिवसीय कार्यशाला	ICAR-CIFRI, Kolkata	25 June	Sajina A. M., Gunjan Karnatak
76.	Start-up meeting with JICA officials & preparatory survey team for Assam Fisheries Development and Livelihood Project (AFDLP)	Directorate of Fisheries, Guwahati	01 July	S. K. Majhi S. Borah
77.	Meeting of officials of ICAR-CIFRI Regional Centre, Guwahati with Director of Fisheries, Government of Meghalaya and officials of Department of Fisheries, Government of Meghalaya on cave fisheries	Directorate of Fisheries, Shillong	04 July	S. K. Majhi S. Borah
78.	96th ICAR Foundation day & technology day programme	ICAR, New Delhi	15-16 July	B. K. Das
79.	Technical discussion meeting on ICAR - WorldFish collaborative project under Window 3 at WorldFish, and "International Institute of Fisheries Economics & Trade (IIFET) Conference: Aquatic food systems in the blue economy" 2024	WorldFish, Penang, Malaysia	15 - 19 July	Gunjan Karnatak
80.	One-day workshop on Indigenous fishes of Peninsular India: Present status and future prospects organized by ICAR-CIFA	Karnataka Science and Technology Academy, Bengaluru	20 July	Ramya V. L. Jesna P. K. Sibina Mol S.
81.	Institute Technology Management Committee Meeting of ICAR-CRIJAF	ICAR-CRIJAF, Nilgunj, Barrackpore	24 July	Ganesh Chandra
82.	International conference on "Aquaculture Sustainability (AquaSustain 2024)" organized by the Chulalongkorn University, Bangkok	SamyanMitr town, Bangkok	24-26 July	B. K. Das B. K. Bhattacharjya
83.	National stakeholder consultation on sustainable development of ornamental fisheries	ICAR-CIFA, Bhubaneswar	01-02 August	Suman Kumari
84.	Meeting of project personnel of WorldFish project of ICAR-CIFRI with WorldFish team	ICAR-CIFRI, Barrackpore	05 August	B. K. Das, Arun Pandit, B. K. Bhattacharjya, P. Das S. Borah, Gunjan Karnatak, Lianthuamluaia, Aparna Roy
85.	Exit Workshop 2 organized by WorldFish, Penang	Guwahati	06 August	P. Das, S. Borah N. Sharma
86.	1st International conference on 'Emerging technologies in agriculture and allied sciences" organized by the Society for Agriculture, Allied Sciences and Technology, Odisha; School of Agriculture, SR University, Warangal and Meadow Agriculture Pvt. Ltd., UP at Bhubaneswar, Odisha	On-line mode	10-11 August	P. Das

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Sr. No.	Event	Venue	Duration	Participant(s)
87.	Meeting on 'Innovative projects/technology and presented proposals on the innovative projects'	National Fisheries Development Board, Hyderabad	13 August	B. K. Das
88.	"Technology prioritization workshop for agriculture and allied sectors" organized by ICAR-CRIJAF in collaboration with the Technology Information, Forecasting and Assessment Council (TIFAC)	ICAR-Central Research Institute for Jute and Allied Fibres (CRIJAF) Barrackpore, Kolkata	19 August	B. K. Das, Arun Pandit
89.	91st Institute Management Committee meeting of ICAR-CMFRI	ICAR-CMFRI, Kochi	21 August	Preetha Panikkar
90.	ICAR Regional Committee II Meeting	NRRI, Cuttack	23 August	B. K. Das
91.	International webinar on "Fish stock assessment" organized by Department of Marine Science and Fisheries, Sultan Qaboos University, Oman	On-line mode	25 August	P. Das D. Bhakta
92.	Meeting with Prof. S. P. Singh Baghel, Minister of State for Fisheries, Animal Husbandry, and Dairying, Government of India	ICAR-CMFRI, Kochi	25 August	Deepa Sudheesan
93.	ICT Steering Committee meeting	On-line mode	29 August	Preetha Panikkar
94.	Consultation meeting on e-Flow assessment for Periyar River with Water Resources Department, Govt. of Kerala	On-line mode	02 September	B. K. Das
95.	Stakeholders' consultation organized by Ministry of Agriculture and Framers Welfare in association with other concerned Departments/Ministries	On-line mode	03 September	B. K. Das
96.	Business to business (B2B) meeting for technology transfer of CIFRI PEN HDPE	ICAR-CIFRI, Barrackpore	04 September	B. K. Das, Ganesh Chandra
97.	1st Half-yearly meeting of TOLIC (2024-25)	Guwahati, Assam	04 September	S. K. Majhi A. K. Yadav
98.	Hilsa awareness and conservation workshop	ICAR-CIFRI, Barrackpore	05 September	B. K. Das, Arun Pandit
99.	Hindi workshop on सतत विकास लक्ष्यों (एसडीजी) की पूर्ति में अन्तस्थलीय मत्सय पालन और जलकृषि की भूमिका	ICAR-CIFRI, Barrackpore	10 - 11 September	S. K. Majhi,B. K. Bhattacharjya, A. K. Yadav, P. Das, S. C. S. Das, S. Borah, N. Sharma, R. Kumar, B. C. Ray, A. Kakati, S. Dungdung, Sajina A.M., R. K. Manna, Kavita Kumari, Suvra Roy, M. Shaya Devi, Absar Alam, Jeetendra Kumar, Vikash Kumar, Sibina Mol S. Sonalika Sahoo, Arun Pandit, Piyashi DebRoy, Soma Das Sarkar, Suman Kumari, Gunjan Karnatak, Anjana Ekka

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Sr. No.	Event	Venue	Duration	Participant(s)
100.	2nd International conference on "Sustainable fisheries & aquatic resource management: life below water"	Science City, Kolkata, West Bengal	12 - 14 September	Pritijyoti Majhi, Lianthuamluaia, Sajina A. M., Suman Kumari, R. K. Manna, D. Bhakta, Sangeetha M. Nair, Pranab Gogoi, A. Sinha, D. J. Sarkar, Kavita Kumari, Vikash Kumar, Suvra Roy, M.Shaya Devi, Soma Das Sarkar, S. Samanta, Gunjan Karnatak
101.	One day training-cum-workshop on J-Gate@CeRA for Eastern region	Bidhan Chandra Krishi Viswavidyalaya, Nadia	13 September	S. K. Das
102.	Hindi workshop: "मनुष्य और प्रकृति के बीच बिगडते व्याकरण की पडताल: हिंदी कहानी के माध्यम से"	On-line mode	17 September	All staff of ICAR-CIFRI, Regional Centre, Bengaluru
103.	Sectional Committee meeting of National Academy of Agricultural Sciences (NAAS) on Fisheries Sciences	New Delhi	17-18 September	B. K. Das
104.	International workshop on genome networks and pathways	On-line mode	18 - 21 October	Kavita Kumari
105.	Webinar on 'Leveraging CSR to scale R&D Initiatives' organized by the CSIR - IMTECH	On-line mode	20 September	Arun Pandit, Deepa Sudheesan, Thankam Theresa Paul, Tanuja Abdulla
106.	Hindi workshop: "हिंदी भाषा का विकाश और विविध भाषा के रूप में उसका स्थान"	ICAR-CIFRI, Regional Centre, Bengaluru	23 September	Scientists and staff of ICAR-CIFRI, Regional Centre, Bengaluru
107.	Demonstration of "Drone technology for live fish transport"	ICAR-CIFRI, Barrackpore	24 September	B. K Das, Srikanta, Samanta, Chayna Jana, Kaushik Mandal and all the staff
108.	National conference on 'Blue revolution for sustainable fisheries development'	Karnataka Science and Technology Academy, Bengaluru	24 -27 September	Sibina Mol S., Jesna P. K., V. L. Ramya, Sonalika Sahoo
109.	National workshop on 'Matsya sanrakshan vigyan me nayi disaye'	ICAR-NBFGR, Lucknow	25 September	Kavita Kumari
110.	IPS Zonal Meet & AAAS (Academy for the Advancement of Agricultural Sciences) National conference on 'Advances in innovative technologies & plant health management strategies in climate resilient agriculture'	Agartala, Tripura	26-27 September	S. K. Nag
111.	Meeting on gene bank project (SCoPIF) implemented by College of Fisheries, AAU, Raha	Directorate of Fisheries, Guwahati	01 October	S. K. Majhi, S. Borah
112.	Demonstration of drone technology in agriculture & fisheries sector	East Kolkata wetland	03 October	Chayna Jana, Vikash Kumar, Kaushik Mandal
113.	Technology commercialization assessment meeting of ICAR-NBFGR technologies organized By ICAR-NBFGR, Lucknow	On-line mode	03 October	Ganesh Chandra

Contd....

Sr. No.	Event	Venue	Duration	Participant(s)
114.	Meetings of State Wetlands Authority, Govt. of West Bengal	Kolkata	04 October	S. Samanta as Member
115.	Credit associated issues in fisheries organised by the Department of Fisheries, Govt. of India	On-line mode	09 October	S. Samanta
116.	Workshop on 'Promotion of agricultural exports: prospects and challenges"organized by The National Academy of Agricultural Science (NAAS), New Delhi	On-line mode	10 October	Scientists of ICAR-CIFRI
117.	Meeting to discuss the progress on the development of 100 coastal fishermen villages as climate resilient coastal fishermen villages (CRCFV) under PMSSY, organized by Ministry of Fisheries, Govt. of India	On-line mode	11 October	Pranab Gogoi
118.	Intellectual property (IP) awareness Seminar under NIPAM 2.0 organized By ICAR- CAZRI, Jodhpur	On-line mode	18 October	Ganesh Chandra
119.	Area of application of drone technology in Fisheries, agriculture & aquaculture	Gyan Bhavan, Patna, Bihar	20 September	B. K. Das, Chayna Jana, Kaushik Mandal
120.	ICAR-WorldFish collaborative project meeting	ICAR-CIFRI, Barrackpore	22 -24 October	B. K. Das, Arun Pandit, B. K. Bhattacharjya, P. Das, S. Borah
121.	National conference on managing agro-biodiversity in North Easter India (NCMAN-2024)	ICAR Research Complex for North Eastern Hill Region, Umiam, Meghalaya	23 – 24 October	S. C. S. Das
122.	Stakeholder's meet	Chamta wetland, North-24-Parganas, West Bengal	23 October	B. K. Das, B. K. Bhattacharjya, Arun Pandit, A. K. Sahoo, A. Roy, Lianthuamluaia, P. Das, G. Karnatak, S. Borah
123.	Interactive meeting with the QRT as IMC member of ICAR-IIFSR, Modipuram	ICAR-IIFSR, Modipuram (Meerut), UP	24 October	S. K. Das
124.	Review meeting of the ICAR network project on "Ornamental fish"	On-line mode	28 October	P. Das S. Kumari N. Sharma
125.	Ganga Utsav, under National Mission for Clean Ganga, Ministry of Jal Shakti, Govt. of India	Haridwar	04 November	B. K. Das
126.	Workshop-cum-demonstration of potential drone applications in the fisheries sector	ICAR-CMFRI, Kochi	08 November	Deepa Sudheesan, Thankam Theresa Paul, Tanuja Abdulla, P. V. Shajil
127.	State Level Technical Committee (S LTC) meeting regarding Support for Statistical Strengthening at Directorate of Fisheries, Govt. of Uttar Pradesh	Lucknow	11 November	B. K. Das

Contd....

Sr. No.	Event	Venue	Duration	Participant(s)
128.	Business to Business (B2B) meeting with M/s Envozyme Technology Pvt. Ltd., Hyderabad, Telangana	ICAR-CIFRI, Barrackpore	11 November	S. Samanta, Ganesh Chandra, A. K. Bera, D. J. Sarkar, Raju Baitha.
129.	Mid-term Meeting of ICAR Regional Committee III	On-line mode	11 November	Arun Pandit
130.	Brainstorming session on 'Automation in agriculture using sensor-based networks'	C-DAC, Kolkata	13 November	B. K. Das
131.	Review meeting regarding implementation of integrated management plan of east Kolkata wetland	On-line mode	13 November	B. K. Das
132.	ICAR Regional Committee IV meeting	On-line mode	14 November	B. K. Das, Arun Pandit
133.	National Seminar on "Advances in environment management for sustainable fisheries & livestock production". Also delivered Dr. V. G. Jhingran Memorial Lecture	College of Fisheries, Kishanganj	18-19 November	B. K. Das
134.	International workshop on 'Perspective, opportunities and challenges for research in fisheries sciences in a changing climate'	KSNUAH at Navule, Shivamogga	19-23 November	Sonalika Sahoo
135.	World Fisheries Day	Directorate of Fisheries, Govt. of Assam	21 November	S. K. Majhi A. K. Yadav P. Das
		Ministry of Fisheries, Animal Husbandry and Dairying, New Delhi	21 November	S. Samanta
136.	Meeting with Deputy Director Fisheries (Reservoir), Govt of Odisha regarding development of Hirakud project	On-line mode	27 November	B. K. Das
137.	State-level workshop on taking nutrition-sensitive carp-sis polyculture technology to scale being organized by WorldFish, Penang	Guwahati	28 November	P. Das
138.	National conference on 'Hill agro-ecosystem: Challenges and opportunities for achieving Sustainable Development Goals'	ICAR Research Complex for North Eastern Hill Region, Nagaland Centre, Medziphema	29-30 November	B. K. Das, R. Baitha, S. Borah
139.	Interactive meeting on status of open-water fisheries in Nagaland and scope for development	Directorate of Fisheries and Aquatic Resources, Kohima	30 November	B. K. Das, R. Baitha, S. Borah
140.	Inaugural meeting of the 6th Nagaland Hornbill angling festival 2024 organized by Department of Fisheries & Aquatic Resources, Government of Nagaland in collaboration with Anglers Association Nagaland & All India Game Fishing Association	Directorate of Fisheries and Aquatic Resources, Kohima	01 December	B. K. Das, R. Baitha, S. Borah
141.	Workshop on 'Futuristic approach for inland fisheries informatics: Role of tools and techniques hybridization'	ICAR-CIFRI, Barrackpore	04 December	S. K. Majhi, B. K. Bhattacharjya, A. K. Yadav, P. Das, S.C.S. Das, S. Borah, N. Sharma, R. Kumar, Pritijyoti Majhi, Sajina A. M., Malay Naskar, Arun Pandit

Contd....

Sr. No.	Event	Venue	Duration	Participant(s)
142.	Awareness-cum-input distribution program for pen culture at Tamrangabeel	Tamrangabeel, Bongaigaon, Assam	05 December	P. Das, S. Borah
143.	International conference on "Recent advances in statistics and its applications"	Dibrugarh University, Assam	05-06 December	A. K. Yadav
144.	Inception workshop of the project 'Multiple value assessment – fisheries and agriculture, culture of indigenous fish species and management of invasive fish species' in East Kolkata Workshop	Salt Lake, Kolkata	06 December	S. K. Nag
145.	Outreach campaign on PMMSY, NFDP Portal Registration, FIDF, Entrepreneur Model Scheme, KCC Camp, etc. organized by NFDB, Hyderabad	Directorate of Fisheries, Assam	07 December	B. K. Bhattacharjya P. Das
146.	Outreach campaign on PMMSY, NFDP portal registration, FIDF, entrepreneur model scheme, KCC Camp, etc. organized by NFDB, Hyderabad	Directorate of Fisheries, Meghalaya	09 December	R. Borah
147.	Training cum workshop on "Drone technology and its applications	ICAR-CIFRI, Barrackpore	11 December	B. K. Das, Srikanta Samanta, Armaan. U. Muzaddadi, D. K. Meena, A. K. Das, A. K. Sahoo, Chayna Jana
148.	IARI Alumni association lecture delivered by Padmashri Prof. Rattan Lal on the topic 'The soil centric green revolution for environmental restoration in India'	On-line mode	11 December	S. K. Nag
149.	Workshop: Revisiting Citizen Science India's Data toolkit: emerging considerations	On-line mode	12-13 December	Suman Kumari
150.	Field School, organized by V2V, University of Waterloo	Eluru, Andhra Pradesh	13-14 December	B. K. Das
151.	Outreach campaign on PMMSY, NFDP Portal Registration, FIDF, Entrepreneur Model Scheme, KCC Camp, etc. organized by NFDB, Hyderabad	Directorate of Fisheries, Tripura	14 December	B. K. Bhattacharjya
152.	ICAR online lecture series: 'Best practices for project formulation' by Dr. Himanshu Pathak, Secretary, DARE and DG, ICAR	On-line mode	16 December	Arun Pandit, Suman Kumari, Deepa Sudheesan, Thankam Theresa Paul & all scientists
153.	National conference on "Digital agriculture: Empowering Indian farming," jointly organized by NAAS, ICAR, and ICRISAT	NASC, New Delhi	17-18 December	B. K. Das
154.	Meeting for marine fisheries census 2025 organised by Dept. of Fisheries. Govt. of India	On-line mode	18 December	All Scientists of ICAR-CIFRI
155.	Seminar on "GIS and remote sensing tools" organised by ICAR-NIAP	On-line mode	18 December	V. R. Thakur

Contd....

Sr. No.	Event	Venue	Duration	Participant(s)
156.	2nd Half-yearly meeting of TOLIC (2024-25)	Guwahati, Assam	20 December	A. K. Yadav, R. Kumar
157.	Brainstorming on 'Climate adaptive conservation on aquatic genetic resources' at NASC Complex, ICAR, New Delhi	On-line mode	20 December	S. K. Nag
158.	Institute of Animal Ethics Committee meeting	On-line mode	27 December	A. K. Bera, Mitesh Ramteke, Suman Kumari, Md Aftabuddin
159.	Stakeholder's meet towards SDG:1,2&5	Rishia reservoir, Kuldhia, Odisha	28 December	B. K. Das, Arun Pandit



Participants attending the inception workshop on project on East Kolkata Wetlands

Distinguished Visitors



Dr. H. Pathak (centre) and Dr. J.K. Jena (right)

Date	Place	Visitor(s)
16 January	Barrackpore HQ	• Dr. B. P. Mohanty, ADG (Inland Fisheries), ICAR, New Delhi
19 January	Barrackpore HQ	• Dr. Himanshu Pathak, Secretary, DARE and DG, ICAR, New Delhi • Dr. J. K. Jena, DDG (Fisheries Science), ICAR, New Delhi
24 January	Barrackpore HQ	• Ms. Madhumita Basu, Deputy CAG O/O CAG, New Delhi • Ms. Debolina Thakur, DG, Central Audit, Kolkata
02 February	Barrackpore HQ	• Dr. Sandeep Behera, Sr. Consultant, Biodiversity, NMCG • Dr. B. B. Jana, University of Kalyani • Prof. Ashis Kumar Panigrahi, Pro-Vice Chancellor, University of Burdwan
11 February	Barrackpore HQ	• Shri G. Asok Kumar, IAS, former DG, NMCG • Dr. Sandeep Behera, Sr. Consultant, Biodiversity, NMCG
17 March	Barrackpore HQ	• Dr. B. Meenakumari, Former Deputy Director General (Fy. Sc.), ICAR, New Delhi • Dr. B. P. Mohanty, ADG (Inland Fisheries), ICAR, New Delhi • Prof. Gautam Saha, Vice Chancellor, BCKV, • Dr. Pradip Dey, Director, ICAR-ATARI, Kolkata • Dr. A. K. Singh, Former Director, ICAR-DCFR, Bhimtal • Dr. Madan Mohan, Former ADG (Marine Fy.) ICAR, New Delhi
04 April	Barrackpore HQ	• Shri Santosh Das, Additional Secretary and Director, Fisheries, Govt. of Tripura
27 June	Barrackpore HQ	• Shri Omprakash Prasad, Research Officer, Rajbhasha, Vibhag, Ministry of Home Affairs, Kolkata Regional Centre

Date	Place	Visitor(s)
10 July	Barrackpore HQ	• Shri Biplab Roy Chowdhury, Hon'ble Minister of State (Independent Charge), Department of Fisheries, Government of West Bengal • Shri Gabriel D. Wangsu, Hon'ble Ministerof Agriculture, Horticulture, Animal Husbandry & Veterinary & Fisheries, Food & Civil Supply, Legal Metrology & Consumer Affairs, Govt. of Arunachal Pradesh • Shri Moloy C. Chakraborty, Jute Commissioner, Govt. of India • Shri Hage Tari, Secretary (Fisheries), Govt. of Arunachal Pradesh
10 August	Barrackpore HQ	• Prof. Swapan Dutta, Former DDG (Crop Sc.), ICAR and Former Vice Chancellor, Visva Bharati University
16 August	Barrackpore HQ	• Dr. J. K. Jena, Deputy Director General (Fisheries Science), ICAR, New Delhi
13 September	Barrackpore HQ	• Shri Santosh Das, Director and Addl. Secretary, Fisheries, Govt. of Tripura
24 September	Barrackpore HQ	• Dr. Abhilaksh Likhi, Secretary, Department of Fisheries, Govt. of India • Dr.Bijay Kumar Behera, Chief Executive, NFDB
03 October	Barrackpore HQ	• Ms. Priyanka BasuIngty, IAS, Secretary, Labour & Employment, Printing & Stationary, Fisheries, and Youth Services & Sports, Government of Himachal Pradesh
04 October	Barrackpore HQ	• Major General Balakrishnan, Commandant CMDC (EC) & Comd. Dental Advisor, Alipore, Kolkata
21 October	Barrackpore HQ	• Dr. Saket Pande, Professor, TU-Delft, The Netherlands • Dr.Subashisa Dutta, Professor, IIT, Guwahati
22 October	Barrackpore HQ	• Dr. Jörn Schmidt, Director for Sustainable Aquatic Food Systems, WorldFish, Malaysia • Dr. Arun Padiyar, WorldFish Lead, India • Dr. Sourabh Kumar Dubey, WorldFish, India
23 October	Barrackpore HQ	• Dr. Santosh G Thampi, Asso. Prof, NIT, Calicut
24 October	Guwahati Regional Centre	• Dr. J. K. Jena, Deputy Director General (Fisheries Science), ICAR, New Delhi
25 October	Barrackpore HQ	• Dr. Sandeep Behera, Sr. Biodiversity Consultant, NMCG, New Delhi
04 November	Barrackpore HQ	• Shri Chandrasekhar Meena, Deputy Director, DGGI, SNU (East), Kolkata
18 November	Environmental & Aquatic Animal Health Monitoring Laboratory of ICAR-CIFRI, Hirakud reservoir	• Shri Dharmendra Pradhan, Hon'ble Minister of Education, Govt. of India
04 December	Barrackpore HQ	• Dr. Nabarun Bhattacharyya, Professor and Director of the School of Information and Technology, MAKAUT, West Bengal • Dr. Atul Kumar Singh, Former Director, ICAR - DCFR, Bhimtal • Dr. Sudhir Raizada, Former ADG, ICAR, New Delhi



Ms. Madhumita Basu (centre), and Ms. Debolina Thakur (right)



Dr. B. Meena Kumari (extreme right), Dr. B. P. Mohanty (2nd from right),
Dr. A. K. Singh (centre), Dr. Madan Mohan, (2nd from left)



DDG (Fisheries Science), ICAR, New Delhi at Guwahati Regional Centre



Shri Biplab Roy Chowdhury (left), Hon'ble Minister, Govt. of West Bengal



Ms. Priyanka BasuIngty, IAS (left)



Shri Chandrasekhar Meena, IPS (left)

वार्षिक प्रतिवेदन

Annual Report

2024

Staff Information

Staff Position as on 31.12.2024

Category	Sanctioned Strength	Filled up	Vacant
R.M.P	1	1	-
Scientist	88	74	14
Technical	86	51	35
Administrative	66	40	26
Skilled Support Staff	65	18	47
TOTAL	306	184	122

New Joining






Name & designation ▶	**Dr. Armaan U. Muzaddadi** PS & HoD, OWAPM	**Shri Biswajit Barua** Administrative Officer	**Shri Rikesh Sarkar** Technical Trainee	**Abdul Ajij Al Amin** Technical Trainee
Place of posting ▶	ICAR - CIFRI Headquarters Barrackpore	ICAR - CIFRI Headquarters Barrackpore	ICAR - CIFRI Headquarters Barrackpore	ICAR - CIFRI Headquarters Barrackpore
Date of joining ▶	12 March	01 May	24 April	29 April






Name & designation ▶	**Shri Chandan Kumar** Technical Trainee	**Shri Manish Kumar** Technical Trainee	**Shri Sandeep Kumar Saw** Technical Trainee	**Shri Chandan Kumar** Technical Trainee
Place of posting ▶	ICAR - CIFRI Headquarters Barrackpore	ICAR-CIFRI Regional Centre Prayagraj	ICAR - CIFRI Headquarters Barrackpore	ICAR - CIFRI Headquarters Barrackpore
Date of joining ▶	30 April	30 April	02 May	02 May






Name & designation ▶	**Shri Pankaj Kumar** Technical Trainee	**Shri Abhijeet Kumar Gupta** Technical Trainee	**Shri Sumeet Dungdung** Technical Trainee	**Shri Sitanshu Kumar** Technical Trainee
Place of posting ▶	ICAR - CIFRI Headquarters Barrackpore	ICAR - CIFRI Headquarters Barrackpore	ICAR-CIFRI Regional Centre Guwahati	ICAR-CIFRI Regional Centre Vadodara
Date of joining ▶	02 May	06 May	08 May	08 May

New Joining



Name & designation ▶ **Shri Shubham Kumar**
Technical Trainee
Place of posting ▶ ICAR - CIFRI Headquarters Barrackpore
Date of joining ▶ 09 May



Shri Hansraj Kumar
Technical Trainee
ICAR - CIFRI Headquarters Barrackpore
03 June



Shri Soham Adhikari
Assistant
ICAR - CIFRI Headquarters Barrackpore
13 September (F.N.)



Shri Kanhai a Kumar
Assistant
ICAR - CIFRI Headquarters Barrackpore
18 September



Name & designation ▶ **Shri Naveen Kumar**
Assistant
Place of posting ▶ ICAR - CIFRI Headquarters Barrackpore
Date of joining ▶ 20 September



Ms. Aditi Biswas
Assistant
ICAR - CIFRI Headquarters Barrackpore
26 September



Shri Gaurav Kumar
Assistant
ICAR - CIFRI Headquarters Barrackpore
18 October



Name & designation ▶ **Shri Vishal Kumar**
Assistant
Place of posting ▶ ICAR - CIFRI Headquarters Barrackpore
Date of joining ▶ 27 November



Ms. Meghasree Nandy
Assistant
ICAR - CIFRI Headquarters Barrackpore
02 December

Superannuations

Name & Designation	Last Place of posting	Date of superannuation
Shri S. Kalita, Skilled Support Staff	Regional Centre, ICAR-CIFRI, Guwahati	31 January
Shri U. S. Ram, Skilled Support Staff	Regional Centre, ICAR-CIFRI, Prayagraj	31 January (VRS)
Shri M Pennapaa, Technician	Regional Centre, ICAR-CIFRI, Bangalore	31 May
Shri Raban Chandra Mandi, Chief Technical Officer	ICAR-CIFRI, Barrackpore	31 December



Mr. R. C. Mandi (left) ▶

Promotions

Scientific Staff

Name, Designation	With effect from
Promoted to Senior Scientist with RGP ₹9000; Revised Pay Level 13A as per 7th CPC	
Dr. Absar Alam, Senior Scientist	14 August 2022
Dr. Deepa Sudheesan, Senior Scientist	01 September 2022
Dr. Sajina A.M, Senior Scientist	01 September 2022
Dr. Soma Das Sarkar, Senior Scientist	01 September 2022
Dr. Anil Kumar Yadav, Senior Scientist	09 November 2022
Dr. Ajoy Saha, Senior Scientist	27 April 2023
Dr. Pronob Das, Senior Scientist	15 September 2023
Dr. Dhruba Jyoti Sarkar, Senior Scientist	23 January 2024
Scientist with RGP ₹ 9000; Revised Pay Level 13A as per the 7th CPC	
Shri Roshith C.M, Scientist	15 December 2022
Ms. Chayna Jana, Scientist	15 December 2022
Senior Scientist with RGP ₹ 8000; Revised Pay Level 12 as per the 7th CPC	
Dr. Pranaya Kumar Parida, Scientist	19 April 2022
Dr. Dibakar Bhakta, Scientist	01 January 2023
Dr. Kavita Kumari, Scientist	01 January 2023
Dr. Lianthuamluaia, Scientist	01 January 2023
Dr. Suman Kumari, Scientist	04 June 2023
Dr. Suhas Prakash Kamble, Scientist	01 July 2023
Dr. Raju Baitha, Scientist	04 December 2023
Dr. Gunjan Karnatak, Scientist	01 January 2024
Dr. Suvra Roy, Scientist	01 January 2024
Dr. Venkatesh R. Thakur, Scientist	01 January 2024
Dr. Vikash Kumar, Scientist	01 January 2024
Dr. V.L. Ramya, Scientist	01 January 2024
Dr. Piyashi Debroy, Scientist	21 January 2024
Scientist with RGP ₹ 8000; Revised Pay Level 12 as per the 7th CPC	
Ms. Anjana Ekka, Scientist	23 June 2019
Scientist with RGP ₹ 7000; Revised Pay Level 11 as per the 7th CPC	
Dr. Sangeetha M. Nair, Scientist	24 August 2022
Dr. Santhana Kumar V., Scientist	31 January 2023

Administrative Staff

Name & Designation	Promoted to	With effect from
Ms. Sreemanti Saha, LDC	Upper Division Clerk	10 April
Shri Aritra Datta, LDC	Upper Division Clerk	10 April
Shri Debasish Acharya, LDC	Upper Division Clerk	10 April
Shri Syed Abol Kabi, LDC	Upper Division Clerk	10 April
Shri Somenath Banerjee, LDC	Upper Division Clerk	10 April
Shri Manish Kumar Singh, UDC	Assistant	19 April

Promotions

Technical Staff

Name, Designation	With effect from
Promoted to Chief Technical Officer; Level 12 as per the 7th CPC	
Shri Sujit Chowdhury, Assistant Chief Technical Officer	22 July 2023
Ms. Abhijita Sengupta, Assistant Chief Technical Officer	27 August 2023
Ms. Sunita Prasad, Assistant Chief Technical Officer	04 October 2023
Promoted to Assistant Chief Technical Officer; Level 11 as per the 7th CPC	
Shri Bipul Chandra Ray, Senior Technical Officer	14 September 2021
Promoted to Senior Technical Officer; Level 10 as per the 7th CPC	
Dr. Vijay Kumar M.E., Technical Officer	01 November 2022
Promoted to Technical Officer; Level 7 as per the 7th CPC	
Shri Rabiul Sk., Senior Technical Assistant	12 June 2023
Promoted to Senior Technical Assistant; Level 6 as per the 7th CPC	
Shri Anjon Kumar Talukder, Technical Assistant	02 November 2023
Ms. Sumedha Das, Technical Assistant	02 November 2023
Ms. Sadrupa Bhowmick, Technical Assistant	03 November 2023
Ms. Sangeeta Chakraborty, Technical Assistant	12 November 2023
Shri Kausik Mondal, Technical Assistant	13 November 2023
Dr. Avishek Saha, Technical Assistant	08 January 2024
Shri Mohammed Naim, Technical Assistant	01 February 2024
Shri Rakesh Pal, Technical Assistant	20 February 2024
Ms. Ambily M.N., Technical Assistant	27 February 2024

Transfers

Name & Designation	From	To
Inter institutional		
Shri Kumar Vivek, Chief Administrative Officer	ICAR-CIFRI, Barrackpore	ICAR-IGFRI, Jhansi
Syed Abol Kabi, Upper Division Clerk	ICAR-CIFRI, Barrackpore	ICAR-Research Complex for NEH Region, Barapani, Umiam, Meghalaya
Ms. Ambily M. N., Technical Assistant	ICAR-CIFRI, Barrackpore	Regional Station – PAGR Centre, ICAR-NBFGR, Kochi
Mr. Subhankar Dey, Finance & Accounts Officer	ICAR-CIFRI, Barrackpore	ICAR-NINFET, Kolkata
Intra-institutional transfer		
Mr. Arijit Ghosh, Sr. Technical Assistant	Barrackpore HQs	Guwahati RRC
Mr. Soham Adhikary, Assistant	Barrackpore HQs	Guwahati RRC
Mr. Kanhaiya Kumar, Assistant	Barrackpore HQs	Prayagraj RRC
Mr. Gaurav Kumar, Assistant	Barrackpore HQs	Bengaluru RRC
Mr. Bijoy Kumar Roy, Assistant	Guwahati RRC	HQs Barrackpore



Shri Kumar Vivek (at the right)

Foreign Visit

Name of the Employee	Place Visited	Period	Purpose
Dr. Gunjan Karnatak, Scientist	Penang, Malaysia	15 to 19 July, 2024	Attended International Conference
Dr. Basanta Kumar Das, Director	Samyan Mitrtown Hall, Bangkok	24 to 26 July, 2024	Attended International conference
Dr. B. K. Bhattacharya, Principal Scientist	Samyan Mitrtown Hall, Bangkok	24 to 26 July, 2024	Attended International conference

Foreign Visit (Higher Study Leave)

Name and Designation	Study Leave period	Place
Shri Mishal P., Scientist	06 May 2024 to 06 May 2027	Wageningen University & Research, Droevendaalsesteeg 4, 6708PB, Wageningen, The Netherlands

List of Staff as on 01 January 2025

Head Quarter, Barrackpore

Director

Dr. B. K. Das

Head of Division

Dr. Srikanta Samanta
Dr. Sanjib Kumar Manna
Dr. Ranjan Kumar Manna
Dr. Archana Sinha
Dr. Arman Ullah Muzddadi

Principal Scientist

Dr. Malay Naskar
Dr. Subir Kumar Nag
Dr. Archan Kanti Das
Dr. Md. Aftabuddin
Dr. Sanjay Kumar Das
Dr. Bijay Kumar Behera (on lien)
Dr. Arun Pandit
Dr. Hemanta Chowdhury
Dr. Asit Kumar Bera

Senior Scientist

Dr. A. K. Sahoo
Dr. Aparna Roy
Dr. Sajina A.M.
Dr. Soma Das Sarkar
Dr. D. K. Meena
Dr. D. J. Sarkar
Dr. Ajoy Saha
Dr. Raju Baitha
Dr. Suvra Roy
Dr. Kavita Kumari
Dr. Suman Kumari
Dr. Vikash Kumar
Dr. Lianthuamluaia
Dr. Gunjan Karnatak

Scientist

Dr. P. K. Parida
Dr. Dibakar Bhakta
Dr. Piyashi Debroy
Mr. Praveen Maurye
Mr. Ganesh Chandra
Dr. Debabrata Das
Mr. Sanjeev Kumar Sahu
Ms. Prajna Ritambhara Swain
Mr. Roshith C.M.
Mr. Satish Kumar Koushlesh
Mr. Mitesh H Ramteke
Ms. T. N. Chanu
Mr. Mishal P. (on study leave)
Ms. Pritijyoti Majhi
Ms. Anjana Ekka
Ms. Tanushree Banerjee
Dr. J Canciyal
Mr. Rahul Das
Mr. Pronob Gogoi
Ms. Chayna Jana
Dr. Sangeetha M Nair
Dr. M. Shaya Devi
Dr. Santhana Kumar V



Technical Staff

Mr. Sujit Chowdhury
Ms. Sunita Prasad
Ms. Abhijita Sengupta
Md. Yousuf Ali SK
Mr. Manabendra Roy
Mr. Ashish Chakraborty
Mr. Rabiul Sk.
Mr. Bablu Kumar Naskar
Mr. Sanjay Kumar Das
Mr. Asim Kumar Jana
Mr. Arun Kumar Mondal
Mr. Sudarson Bandopadhyay
Ms. Shuvra Saha
Mr. Subrata Das
Mr. Lokenath Chakraborty
Mr. Anjon Kumar Talukder
Ms. Sumedha Das
Ms. Sadrupa Bhowmick
Ms. Sangeeta Chakraborty
Mr. Kausik Mondal
Mr. Avishek Saha
Mr. Rakesh Pal
Md. Naim
Mr. Ratan Das
Mr. Binod Kumar Sahani
Mr. Rikesh Sarkar
Abdul Ajij Amin
Mr. Chandan Kumar (S/o Shri Brij Kumar)
Mr. Sandeep Kumar Saw
Mr. Chandan Kumar (S/o Shri Ravindra Chaudhary)
Mr. Pankaj Kumar
Mr. Abhijeet Kumar Gupta
Mr. Shubham Kumar
Mr. Hansraj Kumar

Head Quarter, Barrackpore

Administrative Staff

Shri Nirmal Sarkar
Ms. Anasua Majumdar
Shri Biswajit Barua
Mr. Shyam Sunder Ghosh
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Acronyms

Abbreviation	Expanded form
µg	Micro gram
µS	Micro Siemens
^{0}C	Degree Celsius
AFDC	Assam Fisheries Development Corporation
avg.	Average
Avl.	Available
BOD	Biochemical Oxygen Demand
C	Carbon
CaCO3	Calcium carbonate
CCC	Criterion continuous concentration
Cd, Cr, Cu, Pb, Zn, Fe	Cadmium, chromium, copper, lead, zinc, iron
CF	Cat Fishes
Chl-a	Chlorophyll a
Cm	Centimetre
CP	Crude Protein
CPUE	Catch per Unit Effort
DD	Data Deficient
DO	Dissolved Oxygen
DOM	Dissolved Organic Matter
EC	Electrical Conductivity
EN	Endangered
ESBN	Estuarine Set Bag Net
FAD	Fish aggregating device
FCE	Feed Conversion Efficiency
FCR	Feed Conversion Ratio
FRL	Full Reservoir Level
g/gm	gram
GPP	Gross Primary Productivity
ha	Hectare
hr	Hour
IMC	Indian Major Carps
IUCN	International Union for Conservation of Nature
kg	Kilogram
km	Kilometre
L	Litre
LC	Least Concern
m	Metre
mg	Milligram
mgC	Milligram carbon
ml	Millilitre
Mm	Millimetre
Mn	Manganese
MON	Monsoon
MP	Madhya Pradesh
mS	Specific conductivity
MT	Metric Tonnes
N	Nitrogen
NE	Not Evaluated
nos.	Numbers
NP	National Park

Acronyms

NT	Near Threatened
NTU	Nephelometric Turbidity Unit
OC	Organic carbon
P	Phosphorous
P2 O5	Phosphorus pentoxide
PCA	Principal Component Analysis
PER	Protein Efficiency Ratio
PFCS	Primary Fishermen Cooperative Society
POM	Post Monsoon
Ppt	Parts per thousand
PRM	Pre monsoon
R2	Coefficient of determination
RA	Relative abundance
Rs.	Indian Rupees
SCSP	Scheduled Caste Sub Plan
SD	Standard Deviation
T	Ton
TDS	Total dissolved Solids
TSI	Trophic State Index
U	Unit
u/L	Unit/litre
UP	Uttar Pradesh
VU	Vulnerable
WBNF	Winter Bagnet Fishery
WMBN	Winter migratory bag net
Yr	Year

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