2024

Annual Report
वार्षिक प्रतिवेदन

ICAR-Central Institute of
Freshwater Aquaculture

वार्षिक प्रतिवेदन

ANNUAL REPORT
2024

ICAR-Central Institute of Freshwater Aquaculture

(*An ISO 9001:2015 Certified Institute*)

Kausalyaganga, Bhubaneswar - 751 002, Odisha, India

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Director, ICAR-CIFA

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Preface

Warm Greetings from ICAR-CIFA!

ICAR-CIFA continues its excellence in advancing India's freshwater aquaculture through pioneering research, transformative technologies, and impactful outreach. Our efforts have contributed to strengthening food security, sustaining livelihoods, and improving nutrition in the country. It is with great pride that I present the Annual Report 2024, showcasing our achievements and commitment to sustainable growth. During the year, we got four technology certifications from the ICAR and commercialised 12 technologies along with 16 IPs. Our flagship genetic improvement programs achieved remarkable success, producing new generations of Jayanti Rohu, CIFA-Amrit Catla, and CIFA-GI Scampi®, with brood seed supplied to multiplier hatcheries for nationwide dissemination. Additionally, we developed the SMART Pond, which integrates an automated fish harvester, a mechanized pond applicator, and a cloud-based aeration system — enhancing management efficiency while reducing manual labour. We have also introduced automatic feeders for ponds, RAS systems, and aquariums, leveraging IoT to optimize feeding schedules, minimize waste, and enhance fish growth performance.

As part of the species diversification program, we standardized captive breeding protocols for the red-bellied pacu, dussumieri catfish, and various indigenous ornamental fishes. Significant progress was made in biofloc technology for seed rearing, with optimized stocking density for pengba achieving exceptional survival rates of over 95%. Under system diversification program, we have developed an FRP portable scampi hatchery, FRP floating raft and prototype of vertical aeration tower. Our nutrition research revealed that defatted black soldier fly larvae meal can effectively replace up to 75% of fishmeal in Pangasius diets, while herbal formulations exhibited notable growth-promoting and antibacterial properties in different fish species. Additionally, marine microalgal oil derived from *Nannochloropsis oceanica* in feed improved survivability and enhanced lipase activity in rohu spawn.

Our genome editing research led to the successful development of myostatin-edited zebrafish embryos. The genome size of *Macrobrachium rosenbergii* was estimated to be 3.2 Gb, with 247,252 high-quality SNP markers identified. In health management, we achieved significant milestones, including the development of an effective TiLV vaccine with 83.88% survival, a peptide vaccine against *Argulus*, and successful field trials of "CIFA-Brood-Vac" across multiple states. Notably, *Macrobrachium* Golda virus was reported in India for the first time. Additionally, AMR surveillance across 143 farms provided crucial insights into resistance patterns in *Aeromonas* sp., E. coli, and *Staphylococcus* sp.

In the digital domain, we developed the geospatial decision support system 'CIFA AquaNIRNAY', which leverages satellite imagery and machine learning algorithms to enable data-driven decision-making in aquaculture development planning. Additionally, we launched the 'Rangeen Machhli' mobile app to support ornamental fish hobbyists. Through our extension activities, we could reach thousands of farmers across the country, providing need-based technical guidance to state fisheries departments. We also promoted entrepreneurship development by supporting 32 agribusiness entrepreneurs through an incubation program and executed five technology licensing agreements. Inclusive development remained a priority, through the central sector schemes such STC, SCSP, and NEH, we could reach the tribal communities (588 beneficiaries), scheduled castes (3,833 trainees, 4,168 beneficiaries) and famers from north-eastern states (855 trainees and 1,060 beneficiaries).

The Institute and its RRCs has witnessed the visit of notable individuals including Shri Rajiv Ranjan Singh, Hon'ble Union Minister and Shri George Kurian & Prof. S. P. Singh Baghel, Hon'ble Union Ministers of State for Fisheries Animal Husbandry & Dairying; Dr. Mukesh Mahaling, Hon'ble Minister for Health & Family Welfare, Govt. of Odisha; Shri Gabriel D. Wangsu, Hon'ble Minister of Agriculture, Horticulture, Animal Husbandry & Veterinary, Dairy Development & Fisheries; Press Information Bureau (PIB) team from New Delhi; Dr. Himanshu Pathak, Secretary (DARE) & DG (ICAR); Dr J.K. Jena, DDG (Fy. Sc.), Dr R. C. Agrawal, DDG (Ag. Edn.), ICAR; Dr. (Mrs.) Dhriti Banerjee, Director, Zoological Survey of India (ZSI), Kolkata; Directors of Dept. of Fisheries from Jharkhand and Himachal Pradesh, team from World Bank and FAO.

I extend my gratitude to ICAR for its unwavering support to our partners for their collaboration, and to the entire CIFA family for their dedication I wish to take a moment to express my sincere thanks and gratitude to Hon'ble Secretary, DARE and DG, ICAR Dr Himanshu Pathak and Dr J.K. Jena, DDG (Fy. Sc.) for their sincere advice, supervision and support during the period. I also sincerely thank ADGs Dr S. Ghosh (M. Fy.) and Dr Devika Pillai (I. Fy.) and record appreciation to the Chairman and members of RAC for guiding us. Sincere thanks are due to the chairperson and members of the editorial team of Annual Report to bring out the publication timely. Together, we continue to strengthen India's freshwater aquaculture sector, contributing to food security, rural livelihoods, and the nation's blue economy.

P. K. Sahoo
Director, ICAR-CIFA

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कार्यकारी सारांश

अनुसंधान उपलब्धियाँ

सतत जलकृषि हेतु प्रजाति और प्रणाली विविधीकरण

- जलकृषि दक्षता बढ़ाने हेतु आईओटी आधारित नवाचारों से युक्त एक स्मार्ट तालाब विकसित किया गया है, जिसमें एआई-नियंत्रित फीडर, अर्ध-स्वचालित मछली हार्वेस्टर और क्लाउड-आधारित एरेशन सिस्टम शामिल हैं।

- एक उपयोगकर्ता-अनुकूल बायोफ्लॉक मछली पालन सुविधा को डिजाइन और विकसित किया गया है, जिसमें प्रमुख घटकों के रूप में मछली पालन टैंक, यांत्रिक सेटलर और बायोरिएक्टर शामिल हैं, तथा इसे प्रक्षेत्र की परिस्थितियों में सफलतापूर्वक परीक्षण किया गया ।

- भाकृअनुप-सीफा में एक पोर्टेबल एफआरपी स्कैम्पी हैचरी को विकसित और स्थापित किया गया है, जिसमें पाँच लार्वा पालन टैंक और एक समुद्री जल भंडारण प्रणाली है, जो प्रति चक्र 1,00,000 बीज उत्पादन की क्षमता रखती है।

- जलकृषि तालाबों के लिए एक ऊर्ध्वाधर एरेशन टावर का प्रोटोटाइप डिजाइन और विकसित किया गया है।

- तालाब में स्थापना हेतु एक एफआरपी फ्लोटिंग राफ्ट को डिजाइन और विकसित किया गया है, जो पौधारोपण के उद्देश्य से उपयोग के लिए उपयुक्त है तथा 34.125 कि.ग्रा. भार सहन करने में सक्षम है तथा इसका सफलतापूर्वक परीक्षण प्रक्षेत्र की स्थितियों में किया गया है।

- उच्च मूल्य वाली कैटफिश के बीज उत्पादन हेतु एक पुनः संचरित हैचरी प्रणाली विकसित की गई है।

- रेड-बेली पाकु की प्रेरित प्रजनन विधि को मानकीकृत किया गया, जिसमें 80% निषेचन, 62% हैचिंग और 68% लार्वा जीवित रहने की दर प्राप्त हुई। सर्वोत्तम वृद्धि और जीवितता सुनिश्चित करने के लिए नर्सरी में 10 लार्वा प्रति लीटर की आदर्श स्टॉकिंग घनत्व निर्धारित की गई।

- मादा *क्लेरियस डुसुमिएरी* की प्रेरित प्रजनन हेतु ओवाटाइड की खुराक (1 मि.ली./किग्रा शरीर भार) को मानकीकृत किया गया। लार्वा पालन टैंकों में आश्रय की व्यवस्था करने से जीवितता दर 97% तक बढ़ाई जा सकी। *सी. डुसुमिएरी* के लार्वा में हैचिंग के 10 दिन बाद फॉर्म्युलेटेड लार्वल फीड से वीनिंग संभव पाई गई।

- नर स्ट्राइप्ड मर्रेल (*चन्ना स्ट्रिएटा*) में एरोमाटेज़ इनहिबिटर लेट्रोज़ोल (7.5 मि.ग्रा./किग्रा) के उपचार से अंडकोषीय विकास में वृद्धि हुई, जिससे टेस्टोस्टेरोन स्तर में वृद्धि हुई और तनाव सूचकांक में कमी देखी गई।

- तिलापिया और रोहू में, तिलापिया मीठापानी मोती सीप *लैमेलिडेंस मार्जिनेलिस* के ग्लोचिडिया लार्वा के लिए अधिक उपयुक्त मेजबान है और गलफड़े इनके जुड़ाव के लिए प्राथमिक स्थल पाए गए हैं।

- *डैनियो डांगिला, डॉकिन्सिया एसिमिलिस* और *हलुदरिया फासिआटा* को नियंत्रित परिस्थितियों में हार्मोन प्रेरण के साथ सफलतापूर्वक प्रजनन कराया गया।

- कतला में मौसमी प्रजनन पर किए गए एक अध्ययन में शुरुआती और मौसमी प्रजनकों के बीच विशिष्ट जैविक लयों का खुलासा हुआ, जिसमें डिंबग्रंथि ऊतक संरचना, मेलाटोनिन और 17β-एस्ट्राडियोल के स्तर में स्पष्ट अंतर पाया गया। वहीं, सामूहिक पालन तालाबों में किए गए

आहार परीक्षणों में सभी प्रकार के आहार उपचारों में गोनैडल वृद्धि देखी गई।

- *हिप्सेलोबार्बस कोलस* के फ्राई पालन के लिए स्टॉकिंग घनत्व को मिट्टी आधारित सीमेंट टैंकों में 45 फ्राई प्रति वर्ग मीटर के स्तर पर अनुकूलित किया गया।
- पेंगबा मछली के फ्राई (100 फ्राई/घन मीटर) और जुवेनाइल (50 फिंगरलिंग/घन मीटर) पालन को बायोफ्लॉक प्रणाली में मानकीकृत किया गया, जिसमें 95% से अधिक जीवितता और अच्छी वृद्धि प्राप्त हुई।
- *लेबियो फिम्ब्रिएटस* का बायोफ्लॉक प्रणाली में पालन करते समय C:N अनुपात 15:1 रखने पर सर्वोत्तम वृद्धि और जीवितता दर्ज की गई।
- कतला फ्राई में अमोनिया का 96 घंटे का घातक सांद्रण (एलसी$_{50}$) 25.02 पीपीएम आंका गया। जैव रासायनिक विश्लेषण में रक्त शर्करा, एसजीओटी तथा एसजीपीटी के स्तर में उल्लेखनीय वृद्धि देखी गई, जो यकृत तनाव का संकेत देती है।
- रोहू जुवेनाइल्स में टाइटेनियम डाइऑक्साइड नैनो-पार्टिकल (TiO_2-NP) का 96 घंटे का घातक सांद्रण (96 h एलडी$_{50}$) 77.49 मि.ग्रा./लीटर निर्धारित किया गया।
- सीवेज मिश्रित जल में पाले गए बार्ड स्पाइनी ईल (*मैक्रोग्नाथस पैन्कलस*) ने 50% सीवेज सांद्रता और 9 पीपीएम बीओडी की स्थिति में सर्वोत्तम वृद्धि दर्ज की।
- मर्रेल (*चन्ना स्ट्रिएटा*) में अंडों के निषेचन, हैचिंग तथा लार्वा की जीवितता के लिए मध्यम स्तर की कुल कठोरता (100 पीपीएम) तथा कुल क्षारीयता (200 पीपीएम तक) को अनुकूल पाया गया।

आनुवंशिक सुधार, आणविक अनुवांशिकी एवं जैव प्रौद्योगिकी

- 13वीं पीढ़ी की जयंती रोहू तथा 14वीं पीढ़ी की सीफा-जीआई स्कैम्पी® ने मीठे पानी और निम्न लवणता वाले वातावरण में समान रूप से अच्छा प्रदर्शन किया।
- 14वीं पीढ़ी की एएचआर जयंती रोहू की 68 पूर्ण-भ्रातृ (full-sib) कुलों तथा 4वीं पीढ़ी की सीफा-अमृत कतला की 49 पूर्ण-भ्रातृ कुलों को नियंत्रण लाइनों के साथ सफलतापूर्वक उत्पादित किया गया।
- वर्ष 2024 की ईयर क्लास सीफा-जीआई स्कैम्पी® की कुल 97 पूर्ण-भ्रातृ कुलों का उत्पादन किया गया।
- एनएफएफबीबी और अन्य मल्टीप्लायर इकाइयों को एएचआर जयंती रोहू के कुल 54 लाख प्रजनक बीज (स्पॉन), सीफा -अमृत कतला के 14 लाख प्रजनक बीज (स्पॉन) और सीफा -जीआई स्कैम्पी® के 1.85 लाख प्रजनक बीज प्रदान किए गए।
- जीनोम संपादन दृष्टिकोण का उपयोग करके मायोस्टैटिन ए और मायोस्टैटिन बी जीन संपादित ज़ेब्राफ़िश भ्रूण सफलतापूर्वक उत्पादित किए गए।
- फ्लो साइटोमेट्री का उपयोग करके *एम. रोसेनबर्गी* के जीनोम का आकार 3.2 जीबी होने का अनुमान लगाया गया था। *एम. रोसेनबर्गी* में कुल 247,252 उच्च गुणवत्ता वाले एकल न्यूक्लियोटाइड बहुरूपता मार्करों की पहचान की गई।
- सरसों के तेल युक्त आहार खिलाए गए *सी. स्ट्रिएटा* में FAD और Elovl5 जीन का विनियमन बढ़ा, जो पूफा संश्लेषण में वृद्धि दर्शाता है।
- वयस्क रोहू के प्रजनन और गैर-प्रजनन दोनों प्रकार के ऊतकों में फीनिक्सिन (PNX) mRNA की उपस्थिति पाई गई, जो पाले गए कार्प में प्रजनन नियंत्रण में इसके संभावित योगदान का संकेत देती है।
- कुल 149 विभिन्न रूप से अभिव्यक्त प्रोटीनों की पहचान मास स्पेक्ट्रोमेट्री का उपयोग करके नियंत्रण बनाम ताप एवं लवणता तनाव वाले रोहू के बीच की गई।
- सात *एनाबास टेस्टुडीनस* स्टॉक के जनसंख्या आनुवंशिक विश्लेषण से पता चला कि सभी आनुवंशिक रूप से भिन्न हैं।
- चयन की 13 पीढ़ियों के उपरांत जयंती रोहू में अंतःप्रजनन स्तर 4.83% पाया गया, जबकि चयन की 12 पीढ़ियों के बाद सीफा-जीआई स्कैम्पी® में यह स्तर 6.12% दर्ज किया गया।
- अल्ट्रासोनोग्राफी के माध्यम से मूल्यांकन की गई रोहू कार्प मादाओं की गोनाडल परिपक्वता ने यह दर्शाया कि मछली के वजन में वृद्धि के साथ

अंडाशय के आकार और परिधि में निरंतर वृद्धि होती है, जो परिपक्वता की प्रगति का संकेत देती है।

मछली पोषण एवं आहार प्रौद्योगिकी

- धारीदार मरेल अंडे और जर्दी-कोश लार्वा विकास के दौरान फैटी एसिड संरचना में अस्थायी परिवर्तन ने MUFAs की तुलना में तेजी से PUFA खपत का खुलासा किया, जिसमें n-3 PUFAs का उपयोग हैचिंग से पहले (12 hpf तक) और n-6 PUFAs का उपयोग मुख्य रूप से हैचिंग के बाद (24 hpf) किया जाता है।

- अध्ययनों से पता चला है कि वसा रहित ब्लैक सोल्जर फ्लाई लार्वा भोजन उत्पादन प्रदर्शन से समझौता किए बिना *पंगासियानोडोन हाइपोफथाल्मस* के आहार में 75% तक मछली के भोजन को प्रभावी ढंग से विस्तापित कर सकता है।

- रोहू स्पॉन की फ़ीड में *नैनोक्लोरोप्सिस ओशियनिका* से निकाले गए समुद्री माइक्रोएल्गल तेल के अनुपूरण से सबसे अधिक जीवितता और लाइपेस सक्रियता प्राप्त हुई।

- *बारबोडेस कार्नेटिकस* को प्रदान किए गए वैलिसनेरिया-आधारित आहार से बेहतर वृद्धि और जीवितता प्राप्त हुई, जिससे इसकी शाकाहारी प्रवृत्ति की पुष्टि हुई।

जलीय स्वास्थ्य प्रबंधन

- भारत में पहली बार, *मैक्रोब्रैकियम रोसेनबर्गी* गोल्डा वायरस (MrGV) के कारण विशाल मीठे पानी के झींगा हैचरी में बड़े पैमाने पर मृत्यु दर की सूचना मिली।

- *लेक्टोकोकस गार्विया* को सफेद मांसपेशियों के लक्षण दिखाने वाले *मैक्रोब्रैकियम रोसेनबर्गी* के किशोरों में मृत्यु दर के लिए कारक के रूप में पहचाना गया। इसी जीवाणु को पाकु, *पियारैक्टस ब्रैकीपोमस* में मृत्यु दर का कारण बनने वाले एटिओलॉजिकल एजेंट के रूप में भी पहचाना गया।

- ओडिशा और आंध्र प्रदेश में 143 मीठे पानी के मछली फार्मों में एएमआर निगरानी की गई। एरोमोनस प्रजाति ने इमिपेनम (35.2%) और सेफॉक्सिटिन (32.6%) के प्रति सबसे अधिक प्रतिरोध दिखाया। *ई. कोली* ने टेट्रासाइक्लिन (30%), एम्पीसिलीन (23.3%) और सेफपोडॉक्सिम (22.9%) के प्रति महत्वपूर्ण प्रतिरोध प्रदर्शित किया। स्टैफिलोकोकस प्रजाति ने पेनिसिलिन (51%) और एरिथ्रोमाइसिन (46%) के प्रति सबसे अधिक प्रतिरोध प्रदर्शित किया।

- *बैसिलस एमाइलोलिकेफेसिएन्स* (Ba-CS5) पूरक, अकेले या बीटा-ग्लूकेन के साथ संयोजन में, *सी. स्ट्रिएटा* में वृद्धि, पाचन एंजाइम गतिविधि और इम्यूनोमॉड्यूलेशन को बढ़ाया।

- *बैसिलस थुरिंजिएंसिस* ने बायोफ्लोक से अलग किए गए 12 हेटरोट्रॉफ़िक बैक्टीरिया में सबसे अधिक फ़्लोक्यूलेशन और अमोनिया सुधार क्षमताएँ दिखाईं।

- फ़ीड में ओसीमम सैंक्टम पत्ती के अर्क को शामिल करने से विशिष्ट वृद्धि दर (एसजीआर) में महत्वपूर्ण सुधार हुआ और फ़ीड रूपांतरण अनुपात (एफसीआर) में कमी आई, जो *एल. रोहिता* पर इसके विकास को बढ़ावा देने वाले प्रभावों को दर्शाता है।

- *एंड्रोग्राफिस पैनिकुलाटा, थाइमस वल्गेरिस, मेंथा पिपेरिटा* और *ज़िंगिबर ऑफ़िसिनेल* के अर्क युक्त हर्बल फ़ॉर्मूलेशन ने मछली के जीवाणु रोगजनकों के खिलाफ़ प्रभावी एंटी-बैक्टीरियल गतिविधि दिखाई।

- *एरोमोनस हाइड्रोफिला* एटेन्यूएटेड वैक्सीन की प्रतिरक्षात्मकता और प्रभावकारिता ने फ़ीड आधारित टीकाकरण में 60% और विसर्जन टीकाकरण रोहू में 80% की सापेक्ष प्रतिशत सुरक्षा दिखाई।

- आंध्र प्रदेश में "सीफा-ब्रूड-वैक" वैक्सीन का फील्ड ट्रायल सफलतापूर्वक किया गया। इसके व्यापक पैमाने पर उपयोग को बढ़ावा देने के लिए, पश्चिम बंगाल और अंडमान और निकोबार द्वीप समूह में प्रशिक्षण और प्रदर्शन किए गए।

- फॉर्मेलिन-निष्क्रिय तिलापिया लेक वायरस (टीआईएलवी) अल्ट्रापेलेट वैक्सीन ने नियंत्रित चुनौती परीक्षण में 83.88% के सापेक्ष प्रतिशत उत्तरजीविता के साथ सुरक्षा दिखाई।

- आर्गुलस के खिलाफ 19-मर पेप्टाइड वैक्सीन के साथ किए गए परीक्षण में रोहू में आठ महीने तक परजीवी जुड़ाव में उल्लेखनीय कमी देखी गई।

- 15 मिलीग्राम/कि. ग्रा. बायोमास/दिन की दर से

लगातार 10 दिनों तक दिया गया आहार फ्लोरफेनिकॉल का उपयोग *एल. रोहिता* के लिए जीवाणु संक्रमण के खिलाफ़ सुरक्षित चिकित्सीय खुराक के रूप में उपयोग किया जा सकता है।

- 96 घंटे के स्थिर नवीनीकरण बायोएसे में, *एल. मार्जिनेलिस* के लिए नाइट्राइट की औसत घातक सांद्रता (एलसी50) 366 पीपीएम निर्धारित की गई।

- रोहू में ऑक्सोलिनिक एसिड के फार्माकोकाइनेटिक्स अध्ययन से पता चला कि दवा की सांद्रता आंत (18,839.01 µg/kg) और यकृत (13,756.66 µg/kg) में सबसे अधिक थी, जबकि गुर्दे, पित्त और प्लाज्मा में कम सांद्रता थी। आंत ने 2 घंटे के Tmax पर 17,500 µg kg-1 पर उच्चतम Cmax दिखाया।

- *क्लेरियस डुसुमिएरी* के संपूर्ण मेटाजीनोमिक्स विश्लेषण से पता चला कि *स्यूडोमोनास* प्रजाति नर की आंत में सबसे प्रचुर मात्रा में पाया जाने वाला जीनस है, जबकि मादा की आंत में *क्लॉस्ट्रिडियम* प्रजाति का प्रभुत्व है।

सामाजिक विज्ञान अनुसंधान एवं विकास

- क्लस्टर सीड विलेज (सीएसवी) कार्यक्रम के अंतर्गत, ओडिशा के बालासोर में 20 तालाबों में 5.42 हेक्टेयर में फ्राई पालन का प्रदर्शन किया गया, जिससे 99.52 लाख से अधिक फ्राई प्राप्त हुए, जबकि फिंगरलिंग पालन 43 तालाबों में 8.53 हेक्टेयर में किया गया।

- धारीदार मर्रेल के कैप्टिव ब्रूडस्टॉक विकास, प्रजनन और बीज उत्पादन के लिए तकनीकी मार्गदर्शन तमिलनाडु राज्य मत्स्य विभाग को प्रदान किया गया, जिसके परिणामस्वरूप 50,000 हैचलिंग और 20,000 फ्राई का सफल उत्पादन हुआ।

- ओडिशा, आंध्र प्रदेश और पश्चिम बंगाल में मछली पालक उत्पादक संगठनों (एफएफपीओ) के व्यापक मूल्यांकन में नेतृत्व की कार्यशैली, सामूहिक विपणन रणनीतियाँ और बीज उत्पादन में कौशल की कमी को सफलता के महत्वपूर्ण निर्धारक तत्वों के रूप में पहचाना गया।

- जनगणना के आंकड़ों के साथ उपग्रह इमेजरी को एकीकृत करके ओडिशा में जलाशयों के वितरण और संख्या को मान्य किया गया, जिससे रणनीतिक योजना के लिए जलीय कृषि संसाधन मानचित्रण की सटीकता में वृद्धि हुई।

- ढेंकनाल और कंधमाल जिलों में 120 महिला स्व-सहायता समूह (एसएचजी) सदस्यों की भागीदारी के साथ 200 से अधिक अनुसूचित जाति (एससी) मछली किसानों को मछली बीज उत्पादन, चारा प्रबंधन एवं तालाब रखरखाव से संबंधित विषयों पर व्यापक प्रशिक्षण और तकनीकी सहायता प्रदान की गई।

- इनक्यूबेशन कार्यक्रम के माध्यम से 32 कृषि-व्यवसाय उद्यमियों को समर्थन प्रदान करके उद्यमिता विकास को प्रोत्साहित किया गया तथा पाँच प्रौद्योगिकी लाइसेंसिंग समझौतों को क्रियान्वित किया गया।

- जलकृषि में महिला सशक्तिकरण सूचकांक (डब्ल्यूईएआई) विकसित किया गया, जिसके माध्यम से नौ स्व-सहायता समूहों (एसएचजी) की 98 महिलाओं का आकलन कर आय सृजन, प्रशिक्षण की उपलब्धता तथा सामाजिक सहभागिता जैसे प्रमुख सशक्तिकरण कारकों की पहचान की गई।

- एक्वेरियम के शौकीनों को बुनियादी जानकारी प्रदान करने के उद्देश्य से "रंगीन मछली" मोबाइल एप्लिकेशन लॉन्च किया गया, जिसे 6,000 से अधिक बार डाउनलोड किया गया है।

- मत्स्य सेतु मोबाइल एप्लिकेशन को कई क्षेत्रीय भाषाओं में शामिल करके इसका विस्तार किया गया, जिससे इसकी पहुंच और उपयोगिता में वृद्धि हुई।

- सीफा एक्वानिर्णय – एक भू-स्थानिक निर्णय समर्थन प्रणाली को जलकृषि विकास योजना के लिए विकसित किया गया।

Executive summary

Research highlights

Species and System Diversification for Sustainable Aquaculture

- A SMART pond integrating IoT-driven innovations, including an AI-controlled feeder, a semi-automated fish harvester, and a cloud-based aeration system, was developed to enhance aquaculture efficiency.
- A user-friendly biofloc fish-rearing facility has been designed and developed with key components including a fish culture tank, mechanical settler and bioreactor and successfully tested under field condition.
- A portable FRP scampi hatchery was developed and installed at ICAR-CIFA, featuring five larval rearing tanks and a seawater storage system, with a capacity to produce 1,00,000 seeds per cycle.
- A prototype of vertical aeration tower for aquaculture ponds has been designed and developed.
- Designed and developed a FRP floating raft for installation in pond which can hold a load of 34.125 kg (tested in field conditions).
- A Recirculating Hatchery System for high value catfish seed production was developed.
- Induced breeding protocol for Red Bellied Pacu was standardized, achieving 80% fertilization, 62% hatching, and 68% larval survival. The optimal nursery stocking density was identified as 10 larvae/litre for best growth and survival.
- Standardized the dose of ovatide (1 ml/kg b.w.) for induced breeding of female *Clarias dussumieri.* Provision of shelters in the larval rearing tanks enhanced survival up to 97%. Weaning with formulated larval feed was possible in *C. dussumieri* larvae from 10 days post-hatching.
- Aromatase inhibitor Letrozole treatment (7.5 mg/kg) in male striped murrel (*Channa striata*) enhanced male gonadal development, increasing testosterone levels while reducing stress markers.
- Among tilapia and rohu, tilapia is the more suitable host for glochidia larvae of freshwater pearl mussel *Lamellidens marginalis* and gills are the preferred site.
- *Danio dangila*, *Dawkinsia assimilis*, and *Haludaria fasciata* were successfully bred under controlled conditions, with hormone induction.
- A study on seasonal reproduction in catla revealed distinct biological rhythms between early and seasonal breeders, with variations in ovarian histology, melatonin, and 17β-estradiol levels, while dietary trials in communal rearing ponds showed gonadal growth across all dietary treatments.
- The stocking density for *Hypselobarbus kolus* fry rearing, was optimized at 45/

m^2 in soil-based cement tanks.
- Fingerling (100 fry/m^3) and juvenile (50 fingerling/m^3) rearing of pengba in biofloc system (BFS) has been standardized with high survival (> 95%) and growth.
- Biofloc rearing of *Labeo fimbriatus* showed best results at a C:N ratio of 15:1, ensuring better growth and survival during fry to fingerling rearing.
- The 96-hour lethal concentration (LC_{50}) of ammonia in catla fry was estimated as 25.02 ppm. Biochemical analysis indicated significant increase in blood glucose, SGOT, and SGPT, suggesting hepatic stress.
- The 96-hour lethal concentration (96 h LD_{50}) of TiO_2-NP in rohu juveniles was estimated to be 77.49 mg/L.
- Barred spiny eel (*Macrognathus pancalus*) rearing in sewage-fed water showed highest growth at 50% sewage concentration with 9 ppm BOD.
- Moderate total hardness (100 ppm) and total alkalinity levels (up to 200 ppm) were found to be optimum for egg fertilization, hatching, and larval survival in murrel (*Channa striata*).

Genetic Improvement, Molecular Genetics and Biotechnology

- The 13th generation Jayanti rohu and 14th generation CIFA-GI Scampi® performed equally in freshwater and low-saline environments.
- Successfully produced 68 full-sib families of 14th generation of AhR Jayanti rohu and 49 full-sib families of 4th generation CIFA-Amrit catla along with control lines.
- A total of 97 full-sib families of 2024 YC CIFA-GI Scampi® were produced.
- A total of 54 lakh breeder seed (spawn) of AhR Jayanti rohu, 14 lakh breeder seed (spawn) of CIFA-Amrit catla and 1.85 lakhs breeder seed of CIFA-GI Scampi® were provided to NFFBB and other multiplier units.
- Myostatin a and myostatin b gene edited zebrafish embryos were successfully produced using genome editing approach.
- The genome size of *M. rosenbergii* was estimated to be 3.2 Gb using flow cytometry. In total 247,252 high quality single nucleotide polymorphism markers were identified in *M. rosenbergii*.
- The *FAD* and *Elovl5* genes were upregulated in *C. striata* fed with diet containing mustard oil indicating enhanced PUFA synthesis.
- Phoenixin (PNX) mRNA was found in both reproductive and non-reproductive tissues of adult rohu, suggesting its potential role in reproductive regulation in farmed carp.
- In total 149 differentially expressed proteins were identified using mass spectrometry between control vs. heat and salinity stressed rohu.
- Population genetic analysis of seven *Anabas testudineus* stocks revealed that all are genetically different.
- The inbreeding level in Jayanti rohu after 13 generations of selection was 4.83%, while the same for CIFA-GI Scampi® after 12 generations of selection was 6.12%.
- Gonadal maturity of rohu carp females evaluated using ultrasonography indicated a consistent increase in ovary size and circumference with the fish weight.

Fish Nutrition and Feed Technology

- Temporal changes in fatty acid composition during striped murrel egg and yolk-sac larval development revealed faster PUFA consumption compared to MUFAs, with n-3 PUFAs utilized before hatching (up to 12 hpf) and n-6 PUFAs predominantly consumed post-hatching (24 hpf).
- Studies demonstrated that defatted black soldier fly larvae meal can effectively replace up to 75% of fishmeal in the diet of *Pangasianodon hypophthalmus* without compromising

production performance.
- Supplementation of marine microalgal oil extracted from *Nannochloropsis oceanica* in rohu spawn feed showed the highest survivability and lipase activity.
- Vallisneria-based diets fed *Barbodes carnaticus* showed improved growth and survival, confirming its herbivorous nature.

Aquatic Health Management

- For the first time in India, *Macrobrachium rosenbergii* Golda Virus (MrGV) was reported causing large-scale mortality in giant freshwater prawn hatcheries.
- *Lactococcus garvieae* was diagnosed as causative agent for mortality in *Macrobrachium rosenbergii* juveniles showing white muscle symptoms. It was also identified as aetiological agent causing mortality in pacu, *Piaractus brachypomus*.
- AMR surveillance was conducted in 143 freshwater fish farms across Odisha and Andhra Pradesh. *Aeromonas* sp. showed the highest resistance to imipenem (35.2%) and cefoxitin (32.6%). *E. coli* exhibited significant resistance to tetracycline (30%), ampicillin (23.3%), and cefpodoxime (22.9%). *Staphylococcus* sp. demonstrated the highest resistance to penicillin (51%) and erythromycin (46%).
- *Bacillus amyloliquefaciens* (Ba-CS5) supplementation, either alone or in combination with β-glucan, enhanced growth, digestive enzyme activity and immunomodulation in *C. striata*.
- *Bacillus thuringiensis* showed highest flocculation and ammonia amelioration capabilities amongst 12 heterotrophic bacteria isolated from biofloc.
- *Ocimum sanctum* leaf extract incorporation in feed led to significant improvements in specific growth rate (SGR) and reduced feed conversion ratio (FCR), indicating its growth-promoting effects on *L. rohita*.
- Herbal formulation containing extracts from *Andrographis paniculata, Thymus vulgaris, Mentha piperita* and *Zingiber officinale* showed effective anti-bacterial activity against fish bacterial pathogens.
- Immunogenicity, and efficacy of the *Aeromonas hydrophila* attenuated vaccine showed a relative percentage protection of 60% in feed based vaccination and 80% in immersion vaccinated rohu.
- "CIFA-Brood-Vac" vaccine field trial was successfully conducted in Andhra Pradesh. To promote its use at wider scale, training and demonstrations were carried out in West Bengal and Andaman and Nicobar Islands.
- Formalin-inactivated tilapia lake virus (TiLV) ultrapellet vaccine showed protection with relative percentage survival of 83.88% in controlled challenge trial.
- A trial with 19-mer peptide vaccine against *Argulus* showed significantly lower parasite attachments up to eight months in rohu.
- Dietary florfenicol at 15 mg/kg biomass/day for 10 consecutive days can be used as a safe therapeutic dose for *L. rohita* against bacterial infection.
- In a 96-hour static renewal bioassay, the median lethal concentration (LC_{50}) of nitrite for *L. marginalis* was determined to be 366 ppm.
- Pharmacokinetics study of oxolinic acid in rohu revealed that drug concentration was highest in the intestine (18,839.01 µg/kg) and liver (13,756.66 µg/kg), while the kidney, bile, and plasma had lower concentrations. Intestine showed the highest C_{max} at 17,500 µg/kg, at T_{max} of 2 h.
- Whole metagenomics analysis of *Clarias dussumieri* revealed *Pseudomonas* spp. as the most abundant genus in the gut of male, whereas the gut of female was dominated by *Clostridium* spp.

Social Science Research and Developments

- Under Cluster Seed Village (CSV) programme, fry rearing was demonstrated across 5.42 ha in 20 ponds, yielding over 99.52 lakh fry while fingerling rearing covered 8.53 ha across 43 ponds in Balasore, Odisha.
- Technical guidance for captive broodstock development, breeding and seed production of striped murrel was provided to Tamil Nadu State Fisheries Department which resulted in successful production of 50,000 hatchlings and 20,000 fry.
- A comprehensive evaluation of Fish Farmer Producer Organizations (FFPOs) in Odisha, Andhra Pradesh, and West Bengal identified leadership dynamics, collective marketing strategies, and skill deficiencies in seed production as critical determinants of success.
- Validated the distribution and number of waterbodies in Odisha by integrating satellite imagery with census data, enhancing the accuracy of aquaculture resource mapping for strategic planning.
- Provided extensive training and support in fish seed production, feed management, and pond maintenance to more than 200 Scheduled Caste (SC) fish farmers, while engaging 120 women Self-Help Group (SHG) members in Dhenkanal and Kandhamal districts.
- Facilitated entrepreneurship development by supporting 32 agri-business entrepreneurs through an incubation program, executing five technology licensing agreements.
- Developed the Women Empowerment in Aquaculture Index (WEAI), assessing 98 women across nine Self-Help Groups (SHGs) to determine key empowerment factors, including income generation, training access, and social participation.
- Launched the "Rangeen Machhli" mobile application for providing basic information for aquarium hobbyists, achieving over 6,000 downloads.
- Expanded the Matsya Setu mobile application by incorporating multiple regional languages to enhance accessibility and outreach.
- CIFA AquaNIRNAY – a geospatial Decision Support System was developed for aquaculture development planning.

Budget (2024-2025)

a) Institute (Rs. in lakhs) (up to 31.12.2024)

Items	Total allocation (Govt. grant)	Expenditure out of Govt. grant
Govt. grant	6904.11	6450.70

b) Revenue generated (Jan-Dec 2024) (Rs. in lakhs)

Source	Amount
Sale of Farm produce (Fish/seed etc.)	38.31
Training charges	48.95
Institutional Charges	17.27
Other sources	168.03
Total	272.56

Staff position (as of 31.12.2024)

Category (Scientific)	Sanction	In Position	Vacant
Director	1	1	0
Head of Division	4	4	0
Principal Scientist	3	0	3
Senior Scientist	14	6	8
Scientist	58	53	5
Total	80	64	16
Category (Technical)			
Sr. Tech. Officer (T-6)	4	0	4
Technical Assistant (T-3)	23	12	11
Technician (T-1)(including Driver)	25	12	13
Total	52	24	28
Category (Administrative)			
CAO	1	1	0
AO	2	1	1
AAO	6	6	0
Assistant	17	14	3
Upper Division Clerk	6	3	3
Lower Division Clerk	6	4	2
Category (Finance)			
CF&AO	1	0	1
F&AO	1	1	0
Category (Steno)			
Principal Private Secretary	1	0	1
Private Secretary	2	1	1
Personal Assistant	3	0	3
Total	46	31	15
Category (Skilled Support Staff)			
SSS	70	39	31
Grand Total	248	158	90

Staff position of KVK, Khordha (as on 31.12.2024)

Category	Sanction	In position	Vacant
Sr. Scientist & Head KVK	1	1	0
Subject Matter Specialist	6	2	4
Programme Assistant	3	1	2
Driver	2	2	0
Assistant	1	1	0
Jr. Steno-III	1	0	1
SSS	2	2	0
Total	16	9	7

Research Projects

Type of project	No
International	2
Institute-based (including ABI & ITMU)	44
Network project	5
Central Sector Schemes (STC, SCSP, NEH)	13
Externally-funded	28
Contract Research	1
Consultancy service	3
DST Inspire	1
DST SERB-National Post Doctoral Fellow	1
UNESCO-TWAS-DBT sandwich PhD scholarship	1

Training programmes

Level	No. of programmes	No. of participants
National	41	1268
International	1	16

Human Resource Development

Level	No
National	05
In-house	-

Conference/Seminar/Webinar/Workshops organized

Level	No
International	-
National	03

Participation in symposia/seminars/workshops/ webinar, etc.

Level	No. of participants
International	12
National	72

Central Instrumentation Facility

The Central Instrumentation Facility (CIF) of ICAR-CIFA offers advanced analytical instrument facilities to the researchers of the institute as well as from outside. The CIF has been registered with 'One Nation One Portal' for linking researchers and resources, i.e., the Indian Science Technology and Engineering Facilities Map (I-STEM).

The following instruments are avaialbe in the CIF:

- Ultra Sonicator
- Electrophoresis System
- Gel Doc System
- Shaker Incubator
- Ice flaker
- UV-Spectrophotometer
- Compound Microscope
- ELISA Plate reader
- PCR
- Fluorescence Microscope

- -80^{0} C Deep freezer
- Vertical Autoclave
- Freeze Dryer
- Real Time-PCR
- Automated Cell counter
- Milipore water purification unit

Instruments purchased during the reporting period are as follows:

- Tissue homogeniser
- Blood auto-analyser
- UV-VIS Spectrophotometer
- Colony doc imaging station
- -20^{0} C freezer

Additionally, trainees (300 no.), research scholars and students from different academic and research organisations visited the Central Instrumentation Facility of the institute to learn more on technical details of instruments for research work.

Infrastructure/ Resources created

Renovation of water harvesting Reservoir-I peripheral bund (2ha) at the headquarters

Installation of CCTV cameras across the farm and institute.

Koi Carp Breeding Facility in the ornamental fish rearing unit,

SMART Pond (1 ha) with mechanical fish harvester, automatic feeder, smart aerator and Mechanical applicator

Laying of the foundation stone for the Genome Editing Facility.

New Digital Outreach developed

CIFA-AquaNIRNAY–Geospatial Decision Support System

Rangeen Machhli – mobile app on basic information for popularization of ornamental fishes.

Seed production

Sl. No	Species	Spawn (in lakhs)
1	Jayanti rohu	135.00
2	Amrit catla	86.00
3	*Labeo catla*	104.41
4	*Labeo rohita*	102.60
5	*Labeo bata*	4.30
6	*Cirrhinus mrigala*	33.52
7	*Labeo calbasu*	7.16
8	*Labeo fimbriatus*	14.49
9	*Puntius gonionotus*	10.0
10	*Puntius sarana*	2.0
11	*Osteobrama belageri*	17.4
12	*Labeo kontius*	0.45
13	*Channa striata*	0.70
14	*C. marulius*	0.05
15	*Anabas testudenius*	1.01
16	*Ctenopharyngodon idella*	5.00
17	*Clarias magur*	0.46
18	*C. dussumieri*	0.11
19	*Pangasianodon hypophthalmus*	5.00
20	CIFA-GI Scampi® (PL)	3.02

	Species	Fry (in lakhs)
21	Labeo catla	4.00
22	Monosex tilapia	0.07
23	*Hypselobarbus pulchellus*	0.62
24	*Barbodes carnaticus*	0.41
25	*Hypselobarbus kolus*	0.15
26	*Ompok bimaculatus*	0.09
27	*Mystus gulio*	0.13
28	*Heteropneustes fossilis*	0.07
29	*Pangasianodon hypophthalmus*	0.015
30	*Ctenopharyngodon idella*	0.02

	Species	Fingerling (in lakhs)
31	*Labeo catla*	0.55
32	*Labeo rohita*	0.45
33	*Labeo bata*	0.60
34	*Ompok bimaculatus*	0.08
35	*Mystus gulio*	0.03

Health Services to Public

The dispensary of ICAR-CIFA provides preliminary health services to the staff and the patients from nearby villages. The total footfalls during 2024 are presented in the following Table.

Institutional patients			Outside patients			Total
Male	Female	Child	Male	Female	Child	
1600	1100	180	640	530	230	4280

1 Introduction

The ICAR-Central Institute of Freshwater Aquaculture (ICAR-CIFA) has a rich history that dates back to its inception as the Pond Culture Division under the ICAR-Central Inland Fisheries Research Institute in 1949. Originally situated in Cuttack, Odisha, the division was later upgraded as the Freshwater Aquaculture Research and Training Centre (FARTC) in 1976 with UNDP/FAO assistance and attained independent institute status on 1 April 1987. Since then, ICAR-CIFA has emerged as a leading institution in freshwater aquaculture research and development in India. The institute has quality infrastructure with fully equipped laboratories spanning various disciplines, including finfish and shellfish breeding and culture, soil and water chemistry, microbiology, fish physiology, nutrition, genetics, biotechnology, and pathology. Research efforts span indigenous species such as carps, catfishes, murrels, freshwater prawns, and pearl mussels, including ornamental fishes. The institute has the largest freshwater research farms in India, situated at Kausalyaganga, Bhubaneswar on Puri highway, comprising over 380 ponds of varying sizes dedicated to research on diverse indigenous freshwater fish and shellfish species. The institute has four regional research centers strategically located in different parts of the country, namely Rahara (West Bengal), Bengaluru (Karnataka), Vijayawada (Andhra Pradesh), and Bathinda (Punjab).

ICAR-CIFA's mandate spans research, training, education, and extension in freshwater aquaculture, driving advancements in the sector through collaboration with key government bodies such as the Department of Fisheries, Ministry of Fisheries, Animal Husbandry, and Dairying (MoFAHD), and the National Fisheries Development Board (NFDB). The institute focuses on species and system diversification, genetic improvement, optimized feed formulations, advanced fish health management, and socio-economic development through entrepreneurship and technology adoption. Notable achievements include the genetic enhancement of fish and shellfish, development of specialized feeds, and molecular diagnostics for disease management. As the Regional Lead Centre on Carp Farming under the Network of Aquaculture Centres in Asia-Pacific (NACA) and home to a Repository Library of the Food and Agriculture Organization (FAO) of the United Nations, ICAR-CIFA plays a crucial role in shaping sustainable aquaculture practices at both national and international levels.

In addition to technological advancements, ICAR-CIFA actively contributes to community development, through the development programmes of the Govt of India, particularly in disadvantaged regions, aiming to improve livelihoods and promote entrepreneurship. The institute utilizes Information and Communication Technology to create user-friendly tools and supports skilled entrepreneurs in value chain development. ICAR-CIFA is at the forefront of innovation, leveraging advanced technologies to shape the future of freshwater aquaculture in India. The institute is exploring gene editing to enhance disease resistance, growth efficiency, and environmental adaptability, while precision aquaculture technologies are being integrated to maximize productivity with minimal ecological impact. Cutting-edge molecular breeding protocols are accelerating genetic advancements, ensuring faster and more effective selection processes. Committed to addressing emerging challenges, ICAR-CIFA remains dedicated to pioneering sustainable solutions that drive the growth and resilience of the aquaculture sector.

Mandate

- Basic and strategic research for the development of sustainable culture systems for freshwater finfish and shellfish.
- Species and systems diversification in freshwater aquaculture.
- Human resource development through training, education and extension.

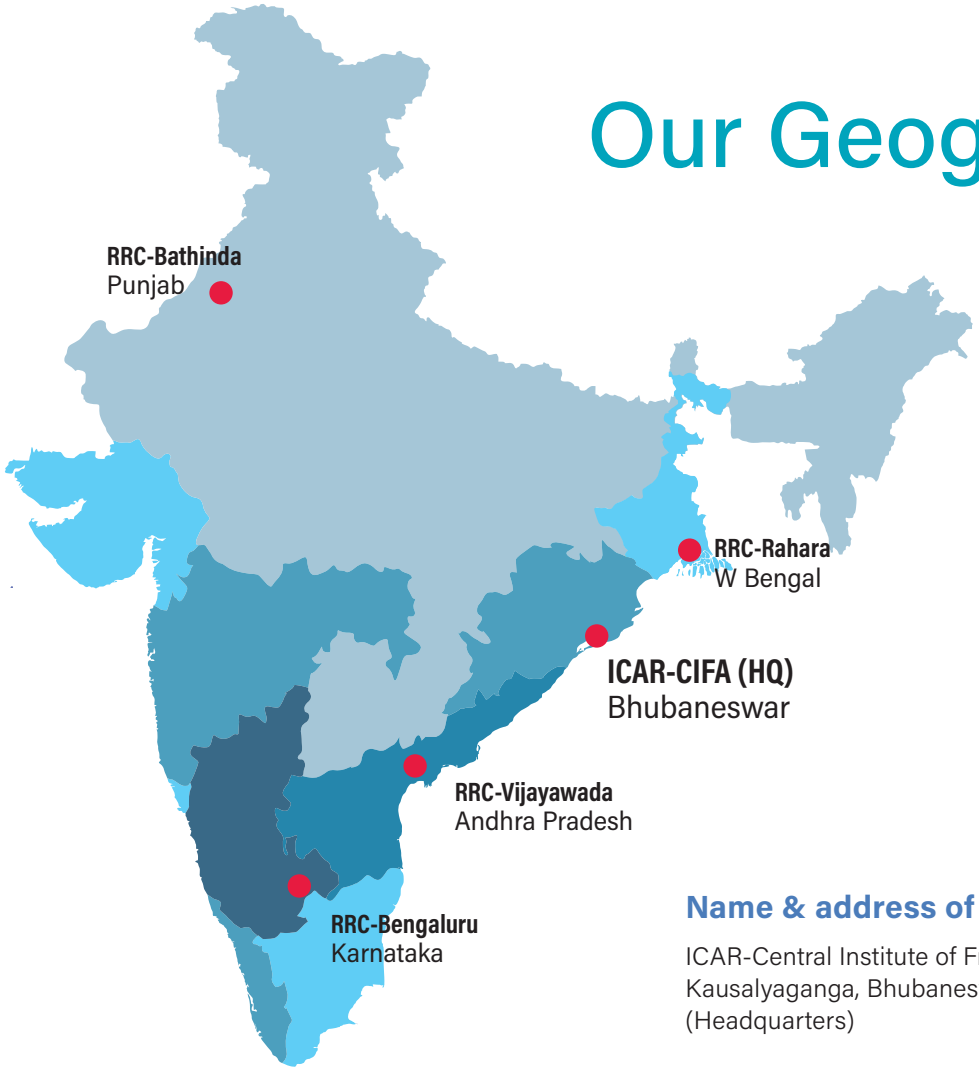
Vision

Making Indian freshwater aquaculture globally competitive through eco-friendly and economically viable fish production systems for livelihood and nutritional security

Mission

Excellence in research for developing sustainable and diversified freshwater aquaculture practices for enhanced productivity, quality, water use efficiency and farm income.

Our Geographies



Name & address of the Institute

ICAR-Central Institute of Freshwater Aquaculture
Kausalyaganga, Bhubaneswar–751 002, Odisha, India
(Headquarters)

a) Regional Centres

i) Regional Research Centre

Rahara Fish Farm, Rahara–700 118, Kolkata,
West Bengal (Kalyani Field Station, Santhalpara,
Kalyani–741 235, Nadia, West Bengal)

ii) Regional Research Centre

Hessarghatta Lake, Bengaluru–560 089, Karnataka

iii) Regional Research Centre

Penamaluru Fish Seed Farm, Penamaluru,
Vijayawada–521 139, Andhra Pradesh

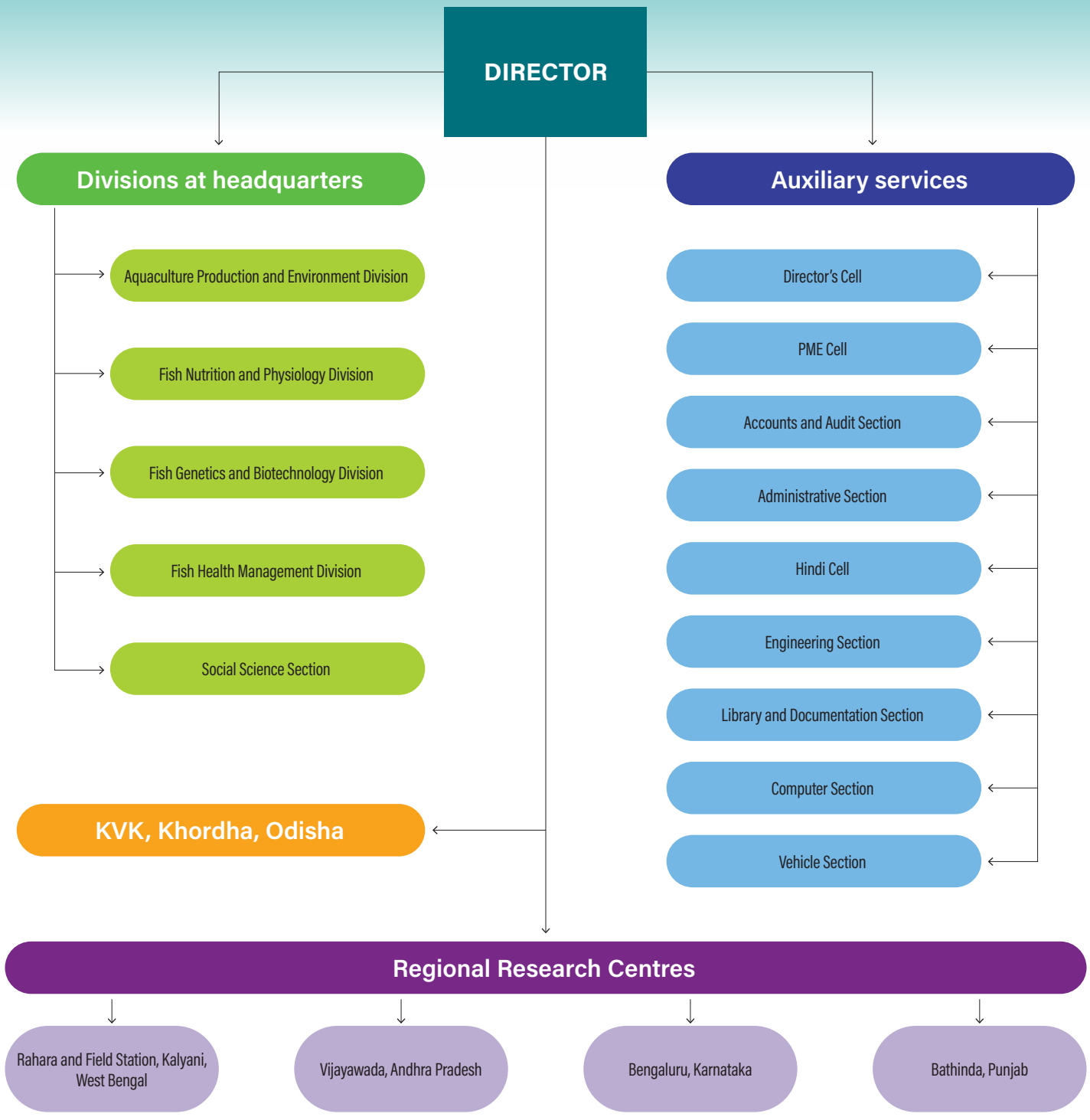
v) Regional Research Centre

Opp to AIIMS, Jodhpur Romana, Bathinda–151 001,
Punjab

b) KVK Krishi Vigyan Kendra (Khordha)

Kausalyaganga, Bhubaneswar–751 002, Odisha

ICAR-CIFA Organogram



2 Research Accomplishments

Species and System Diversification for Sustainable Aquaculture

A. Captive Breeding, Seed Production and Grow-out Technology

Standardization of captive breeding protocol for red bellied pacu, *Piaractus brachypomus*

Induced breeding trials were conducted to develop breeding protocol for pacu under controlled conditions. The matured male and females were selected for breeding at the age of 4 years and the average body weight was recorded as 2.5 kg and 3.5 kg, respectively. Different concentrations of PGE (pituitary gland extract) *viz.* 2, 4, 6, 8 and 10 times of primary dose (2 mg/kg) were administrated to the females. The females which were injected with PGE at 2 mg/kg body weight as primary dose followed by the final dose at 12 mg/kg after 10-12 h showed better breeding performance (Fig. 1). The male was injected with PGE at 2 mg/kg body weight while giving final dose to the female. The spawning took place after 8-10 h. Dry stripping was performed to fertilize the eggs. The relative fecundity was recorded as 1.68 lakhs per kg body weight. The absolute fecundity was estimated as 6.5-7.5 lakhs eggs per female. Fertilization and hatching rate were 80% and 62%, respectively. The hatching was completed between 18 to 24 h. The complete yolk sac was absorbed in hatchlings within 84 to 90 h and survival was recorded as 68%.

Growth and survival of pacu at different stocking densities during nursery rearing

To optimize the stocking density for nursery rearing of pacu, the growth and survival of spawn were evaluated at varying stocking densities of 2.5 (T1), 5 (T2), 10 (T3), 15 (T4), and 20 (T5) nos./L. The spawn was fed *ad libitum* for 30 days following a standard feeding regime. Significant differences in growth and survival were observed across the treatments. The highest weight gain, final length and SGR were found in T3 and lowest was observed in T1 (Table 1). The highest survival was found in T1. The treatment 3 gave superior results in terms of growth and survival indicating it to be the optimum stocking density for pacu during nursery rearing.

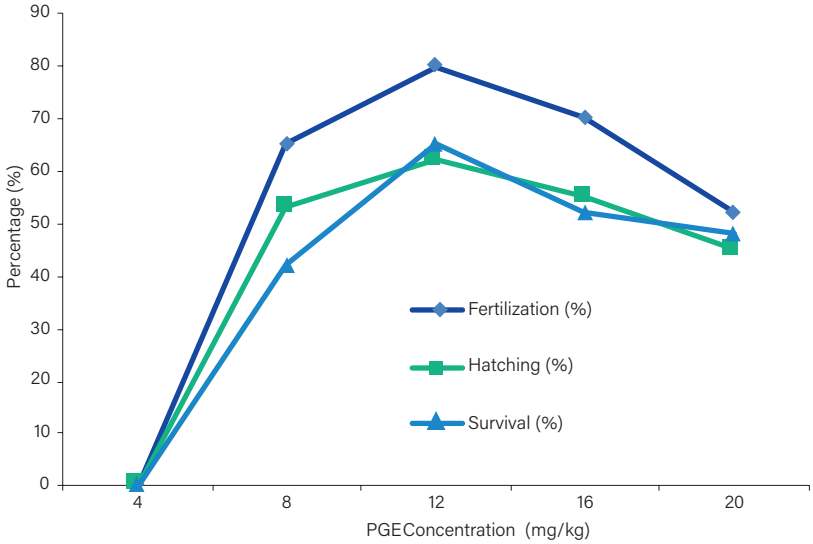


Fig.1 Breeding performance of pacu at different concentrations of PGE

Table 1. Growth and survival of pacu during nursery rearing

Parameters	T1	T2	T3	T4	T5
Initial weight (g)	0.05±0.01	0.05±0.01	0.05±0.01	0.05±0.01	0.05±0.01
Final weight (g)	0.90±0.08^{d}	1.10±0.10^{c}	1.50±0.11^{a}	1.21±0.13^{b}	1.22±0.14^{b}
Final length (cm)	3.86±0.24^{d}	4.07±0.13^{c}	5.11±0.18^{a}	4.42±0.15^{b}	4.18±0.10^{bc}
Weight gain (g)	0.85±0.10^{d}	1.05±0.03^{c}	1.45±0.13^{a}	1.16±0.12^{b}	1.17±0.14^{b}
SGR	9.63±0.50^{d}	10.30±0.78^{d}	11.33±0.42^{d}	10.62±0.50^{d}	10.64±0.56^{d}
Survival (%)	76.5±4.13^{a}	68.5±2.16^{c}	72.4±3.93^{b}	57.6±4.66^{d}	48.5±2.88^{e}

Data expressed in Mean ± Standard Error. Means with different superscripts in the same row are significantly different (P<0.05).

Standardization of captive breeding and seed production of *Clarias dussumieri*

During the 2024 breeding season, the optimum hormone dose requirement for induced breeding of female *C. dussumieri* was confirmed to be 1 ml of ovatide per kg body weight. The effect of provision of shelter during larval rearing was evaluated in seven-day-old larvae, averaging 6.7 mm in length and 6.3 mg in weight. Three treatments including one control was experimented with (Control (T1), provision of shelter (T2), and a completely covered tank (T3)). The larvae in the shelter tanks (T2) exhibited the highest survival rate (97%). The final average weights were 86 mg (T1), 90 mg (T2), and 82 mg (T3). The larvae accepted the formulated feed on the 10th day post-hatching. It is recommended to provide live feed up to 9th day and gradually introduce compound feed 14th day onwards.

Effect of Aromatase inhibitor (Letrozole) on inducing male gonadal maturation in striped murrel, *Channa striata*

Letrozole, an aromatase inhibitor was administered via injection with propylene glycol, at doses of 0 (C), 2.5 (T1), 5.0 (T2), 7.5 (T3), 10.0 mg/kg (T4) body weight for inducing gonadal maturation in male striped murrel (*C. striata*). After a three-week period, the treatment group receiving 7.5 mg/kg Letrozole showed the highest Gonadosomatic Index (GSI) of 0.287 (Fig. 2). Notably, this group exhibited reduced physiological stress, evidenced by lower cortisol, SGPT, and SGOT levels, along with significantly elevated testosterone. These findings support Letrozole's potential as an effective agent for enhancing gonadal maturation in male.

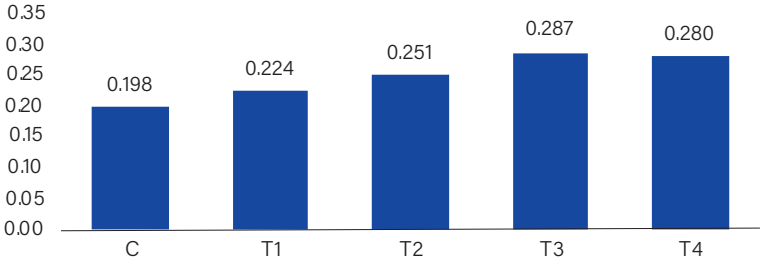


Fig. 2. Effect of Letrozole on GSI of male striped murrel

Organic aquaculture

The broodstock of catla, rohu, mrigal, and silver barb were raised in three organic ponds for induced breeding and seed production. Induced breeding was carried out using PGE and seven lakhs fish spawn were produced and reared up to fry stage in large concrete tank (300 m^2) following organic protocol.

Assessment of reproductive parameters of Indian Shad *Tenualosa ilisha*

The biometrics, reproductive parameters, and proximate composition of wild and pond-reared hilsa were analyzed. In one-year-old captive stage IV females, oocyte diameter ranged from 610 to 659 µm, whereas wild females had oocyte diameters of 750 to 865 µm. Fecundity varied significantly, with captive fish producing 110,000 to 145,000 eggs and wild fish producing from 189,000 to 589,000 eggs. The gonadosomatic index (GSI) ranged from 9.20% to 15.05% in stage IV captive females and 12.24% to 20.41% in stage V/VI wild females. Ovarian histology confirmed that wild females with GSI values above 14% predominantly represented stage V or VI during peak spawning season.

Fat content of muscle and eggs in female hilsa

The fat content analysis of muscle and eggs revealed notable variations in different maturity stages of wild fish collected from Godakhali and pond reared fishes at RRC of ICAR-CIFA, Rahara. The muscle fat content was significantly lower in mature female fish (2.5-3.5%) compared to earlier stages (15%). However, no significant difference in body fat content was observed between pond-reared and wild hilsa samples at maturity stage IV ($P>0.05$).

Stock development and growth of Indian shad in relation to environmental variables

In March 2024, the eggs of wild-caught mature fish were artificially fertilized on a boat in the Hooghly River at Godakhali, West Bengal, and transported to RRC-Rahara for incubation. Larvae were raised in FRP tanks following a phased feeding protocol, starting with rotifers in a green water system, followed by larger zooplankton and inert diets. Fry reared in a concrete tank (5 m^3) for 42 days at a low stocking density achieved an 85% survival rate. Fingerlings were then grown in concrete tanks (350 m^3) and earthen ponds (1500–3000 m^2) at Rahara, while year-old juveniles were raised in a 1000 m^2 cemented tank with an earthen bottom at Kalyani. After nine months of rearing, juveniles at Kalyani reached a maximum length of 28.5 cm and 234 g, while those at Rahara measured 13.8–21.2 cm and weighed 24.5–103 g.

Standardization of stocking density

Pond reared hilsa

of *Hypselobarbus kolus* for fingerling rearing

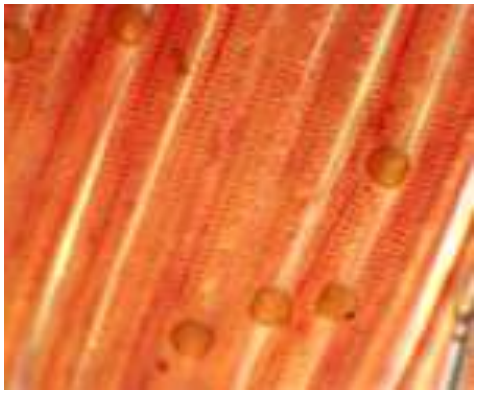
Fifteen-day-old *H. kolus* fry (10.89 ± 0.45 mg, 1.76 ± 0.11 cm) were stocked in outdoor, soil-based cement cisterns (24 m^2) at densities of 25, 35, 45, and 55 fry/m^2 to determine the optimal stocking density for fingerling rearing. Fry were initially fed a groundnut oil cake and rice bran mixture (1:1) at 10% of body weight for the first month, followed by a 2 mm pelleted feed containing 35% crude protein during the second and third

Table 2. Growth and survival of *H. kolus* maintained under different stocking densities reared for 90 days

Stocking density (nos./m²)	Final av. length (cm)	Final av. wt (g)	Condition factor	Survival (%)
25	6.97±0.36[b]	3.30±0.26[c]	0.98±0.07[a]	51.06±3.07[a]
35	6.71±0.87[b]	2.87±0.94[c]	0.94±0.05[a]	52.01±3.45[a]
45	6.56±0.08[b]	2.36±0.20[b]	0.84±0.04[a]	50.78±3.47[a]
55	5.98±0.16[a]	1.80±0.09[a]	0.84±0.07[a]	48.06±2.56[a]

months. After 90 days, fish were harvested and samples were taken for length and weight measurements. Growth in terms of length significantly decreased (P<0.05) at 55/m², while no differences (P>0.05) were observed among other treatments. However, weight declined beyond 35/m², though condition factor and survival rates remained unaffected across densities (Table 2). Considering the similar final length, condition factor, and survival, a stocking density of 45/m² is recommended for *H. kolus* fry-to-fingerling rearing in soil-based cement cisterns.

Artificial infestation of glochidia



Glochidia attachment in gills of Tilapia

Artificial infestation of glochidia larvae of pearl mussel *Lamellidens marginalis*

Experimental infestations of host fish with the parasitic larvae (*L. marginalis* glochidia) were conducted under laboratory conditions. Two fish species (tilapia and rohu) were simultaneously infested by using standard protocols. A total of 30 tilapia (30–45 g) and 20 rohu (20–30 g) were used, sourced from ICAR-CIFA hatcheries. Microscopic observations of glochidia attachment were conducted on various body parts, including gills, mucus, and fins. Gills were identified as the most preferred attachment site, followed by fins. Tilapia was found to be a more suitable host compared to rohu. The settled juveniles were transferred to a separate tank for continued rearing.

Loss of pigmentation in koi carp and rosy barb during indoor rearing

Koi carp (0.42 g) and rosy barb (0.6 g) fry were fed a commercial carp larval diet (40% crude protein) for three months

Table 3. Total carotenoid content of selected leafy vegetables

Plant Pigment Source	Total Carotenoids (µg/ 100 g)
Agathi leaves (*Sesbania grandiflora*)	44,560
Drumstick leaves (*Moringa oleifera*)	41,800
Curry leaves (*Murraya koeniggi*)	20,600
Amaranthus leaves (*Amaranthus dubius*)	19,700
Colocasia leaves (*Colocasia esculenta*)	15,600

with optimum water quality. Carotenoid content and pigmentation patterns were recorded. Rosy barb's carotenoid levels dropped from 24 µg/g to 7 µg/g, and koi carp's from 22 µg/g to 3 µg/g. To identify suitable plant pigment sources for improved colorations some of the leafy vegetables were screened for their total carotenoid contents (Table 3).

Breeding and culture of freshwater ornamental fishes, *Dawkinsia assimillis*, *Danio dangila* and *Haludaria fasciata*

The broodstock of the moustached danio (*D. dangila*) and the mascara barb (*D. assimilis*) were raised under controlled conditions. *D. dangila* was sourced from Assam, while *D. assimilis* was sourced from the Western Ghats, Kerala. Hormone induction was applied in breeding trials, leading to successful spawning, as environmental simulation alone proved insufficient. After two months of rearing, *D. dangila* larvae grew to 21-24 mm in length and 220-250 mg in weight with a survival rate of 63-72%. *D. assimilis* larvae measured 25-28 mm and weighed 400-430 mg, with a survival rate of 61-67%. It was also successfully bred using RO water without hormonal aid at RRC of CIFA, Bathinda. *H. fasciata* (melon barb) broodstock was also developed. Initial breeding efforts showed promising results. After one month of rearing the larvae grew to 110-117 mg with a survival rate of 42%.

Expanding breeding window of IMC (*Labeo catla*) for year-round seed availability

Early and late maturing founder populations of catla were collected during March-April 2024 from Kendrapara, Puri, and Khordha districts of Odisha. A total of 105 early maturing brood fish were reared at ICAR-CIFA and marked with reactive red dye. Spawning in March-April resulted in lower fecundity than normal breeding season (June-July). About 30% of spent fish regained maturity in July with normal fecundity. Further rearing of the brood fish is ongoing.

Environmental factors (zeitgeber) regulate seasonal reproduction via circadian and circannual rhythms. A study on early breeders (EB) and seasonal breeders (SB) was conducted during the monsoon at four time points (06:00, 12:00, 18:00, and 00:00 h). Sampling included central pacemakers (pineal organ, brain, retina) and peripheral pacemakers (gonads, gut, blood). EB and SB exhibited distinct biological rhythms in two phases. Ovarian histology showed four stages, while serum melatonin and 17β-estradiol levels varied diurnally and seasonally.

EB and SB are reared communally at 1000 kg/ha in three 0.02 ha ponds and fed with three iso-nitrogenous (31% CP) diets with different oil combinations (D-I: veg oil with n-6 + fish oil; D-II: two veg oils with n-6 and n-3 + fish oil; D-III: two veg oils with n-3 and n-6) keeping the lipid level similar (CF 5%). First sampling showed initiation of gonadal growth in all three treatment groups.

B. Advanced production system development

Growth performance of catla during fry rearing in biofloc system

A total of 12 biofloc system (BFS) tanks were used to rear catla spawn at 1000, 2000, 3000 and 4000 nos./m^3 stocking densities. Spawn were fed with dust feed (36% CP, 4% fat) at 400 g/lakh in two split meals with a 10% daily increment. The C/N ratio of 15:1 was maintained with daily addition of molasses as the carbon source and 'CIBA-floc' as the probiotic source for maintenance of floc volume at 7-8 ml/L. The study revealed higher survival rate (93-96%) in 2000-3000 nos./m^3 range, showing 3000 nos./m^3 as an ideal density for fry rearing in BFS. Whereas, spawn reared at 4000

nos./m³ showed reduced survival (52%) revealing limitation of this density for catla nursery.

Growth performance of mrigal during fry rearing in biofloc system

Fry rearing of mrigal were carried out with four stocking densities as treatments such as 4000 (T1), 6000 (T2), 8000 (T3) and 10000 (T4) spawn/m³ in BFS. The initial size of spawn was 6.04 ± 0.01 mm and 0.0024 g. The spawn was fed a commercial diet containing 38% crude protein, provided in two rations daily with a 15% increment in feed. At the end of the experiment, the highest survival rate was observed in T1 (84.67 ± 0.68%), which was significantly higher compared to the other treatments (70.4–80.7%). Significant variations in final size were also noted, with fry in T1 reaching 18.29 ± 0.23 mm and 0.06 g, outperforming T2 (17.09 ± 0.46 mm, 0.05 g), T3 (15.3 ± 0.29 mm, 0.04 g) and T4 (12.3 ± 0.29 mm, 0.04 g). These findings suggest that nursery rearing of mrigal in a BFS at a density of 4000 nos./m³ leads to superior survival, growth, and feed conversion efficiency, making it a more beneficial approach for intensive aquaculture practices.

Standardization of seed production of pengba, *Osteobrama belangeri* in biofloc system

Fingerling rearing of pengba conducted for 84 days in BFS at 50, 75 and 100 fry/m³ revealed higher survival ranging between 97.58–98.44%. While lower stocking density improved growth and FCR, the acceptable size (8.14 ± 0.24 g) at higher density suggests 100 fry/m³ is optimal for pengba fingerling rearing in BFS.

Long-duration (210 days) rearing of pengba fingerlings (6.34 ± 0.82 g) in a biofloc system at 20, 35, and 50 nos./m³ densities showed high survival (94.7–97.7%, P>0.05) with no variation among treatments. Despite lower final weight (56.1–60.7 g) and higher FCR at higher density, 50 nos./m³ yielded the highest biomass, making it the most profitable among treatments for juvenile production of pengba.

Production performance of peninsular carp, *Labeo fimbriatus* in biofloc-based seed rearing system

Spawn of *L. fimbriatus* (0.66 cm, 0.0016 g) were stocked at a density of 2000 individuals in 1000 L fiberglass tanks, with jaggery added daily to maintain C/N ratios of 10:1, 15:1, and 20:1. Fish were fed with powdered feed (35% CP) twice daily at 9:00 and 15:00 hrs. Results showed a general increase in growth and survival with higher C/N ratios (Table 4); however, no significant differences (P>0.05) were observed among CN10, CN15, and CN20 groups. Considering the cost-effectiveness of carbon sources, a C/N ratio of 10 is recommended for the spawn-to-fry rearing of *L. fimbriatus*.

Table 4. Growth performance (Mean ± SE) of *L. fimbriatus* reared in a biofloc systems with various C/N ratios during spawn to fry rearing

Parameters	C/N ratio				
	Control	CN5	CN10	CN15	CN20
Final length (cm)	2.19 ± 0.07^{b}	2.19 ± 0.17^{b}	2.5 ± 0.14^{ab}	2.66 ± 0.21^{ab}	2.74 ± 0.15^{a}
Final weight (mg)	99 ± 7.5^{b}	109 ± 11^{b}	135.5 ± 17.6^{ab}	162.0 ± 12.7^{a}	167.0 ± 16.7^{a}
Weight gain (%)	6087.5 ± 469.09^{b}	6712.5 ± 685.60^{b}	8368.75 ± 1100.57^{ab}	10025 ± 793.85^{a}	10337.5 ± 1046.44^{a}
SGR (%/day)	20.59 ± 0.38^{b}	21.06 ± 0.50^{b}	22.11 ± 0.66^{ab}	23.06 ± 0.39^{a}	23.19 ± 0.50^{a}
Survival (%)	78 ± 2.30^{b}	85 ± 2.88^{a}	89.5 ± 1.73^{a}	88.5 ± 0.86^{a}	87.5 ± 1.44^{a}

Table 5. Growth performance (Mean ± SE) of *L. fimbriatus* fry reared in a biofloc system with various C/N ratios

Parameters	C/N ratio				
	Control	CN5	CN10	CN15	CN20
Final length (cm)	4.66 ± 0.14^{d}	5.28 ± 0.12^{c}	5.94 ± 0.1^{b}	6.25 ± 0.1^{ab}	6.46 ± 0.18^{a}
Final weight (g)	0.88 ± 0.08^{c}	1.29 ± 0.09^{b}	2.03 ± 0.11^{a}	2.29 ± 0.14^{a}	2.34 ± 0.12^{a}
Weight gain (%)	434.55 ± 47.54^{c}	684.55 ± 54.58^{b}	1135.77 ± 68.66^{a}	1296.34 ± 84.49^{a}	1326.83 ± 73.93^{a}
SGR (%/day)	1.85 ± 0.1^{c}	2.28 ± 0.08^{b}	2.79 ± 0.06^{a}	2.93 ± 0.07^{a}	2.95 ± 0.06^{a}
Survival (%)	83.33 ± 1.33^{b}	84.67 ± 0.67^{b}	87.33 ± 0.67^{b}	91.33 ± 1.33^{a}	93.33 ± 1.76^{a}

Fry of *L. fimbriatus* (2.78 cm, 0.16 g) were stocked at a density of 50 nos./500 L circular cement tank, with jaggery added daily to maintain C/N ratios of 5:1, 10:1, 15:1, and 20:1 (Table 5). The results showed a general increase in growth and survival as the C/N ratio increased over the 90-day rearing period. However, no significant differences ($P > 0.05$) were observed in growth parameters among the CN10, CN15, and CN20 groups, nor in survival rates between the CN15 and CN20 groups. Considering both the economic feasibility of carbon supplementation and the statistical significance of growth and survival, a C/N ratio of 15 is recommended for optimal fry-to-fingerling rearing.

Development of user-friendly biofloc fish rearing facility

A biofloc fish-rearing facility was designed and developed with key components including a fish culture tank, mechanical settler and bioreactor. The fish culture tank is of 8000 L capacity and radial flow settler of 200 L capacity efficiently handles water loading of 150-300 LPH to remove excess sediment. The bioreactor with lava rocks and plastic bio-balls provides aeration and water treatment, ensuring efficient recirculation. A trial involving 600 rohu (*Labeo rohita)* fingerlings showed 92% survivability over 30 days in the developed system. The total cost for one biofloc unit is ₹75,500.

Biofloc tank in operation

Precision aquafarming

A smart pond of 1 ha was developed integrating three IoT-driven innovations: Semi-Automated Fish Harvester features a net-fenced concrete frame with a pulley for selective harvesting, solar-powered 'CIFA Smart Pond Feeder', app-controlled with AI, optimizes feeding, Cloud-Based DO Logging and aeration system from ICAR-CIFRI monitors oxygen levels, activating aerators below 5 ppm to prevent fish mortality. These technologies enhance efficiency, reduce waste, and improve water quality. The smart pond was stocked with 8000 advanced fish fingerlings (catla, rohu, mrigal, striped catfish, silver barb, and pengba) for staggered multi-harvest cycles, to ensure a higher production capacity of 15 t/ha.


Semi-Automated Fish Harvester

CIFA Smart PondFeeder

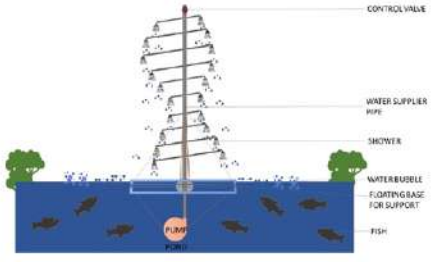
A recirculating hatchery system consisting of 15 rearing tanks, filters, and UV systems was developed for intensive catfish seed production where biomass of 51.8 kg/m^3 with 100% survival at a stocking density of 4000 fish/m^3 was achieved. The 'CIFA Smart RAS Feeder' automates precise feed management for RAS, Biofloc, and Aquaponics. The 'CIFA Smart Aquarium Feeder', with a 100 g capacity, uses IoT and a 5G router for remote feeding via mobile app. The 'CIFA AquaNIRNAY', a geospatial Decision Support System (DSS), developed using Sentinel-2A satellite imagery and machine learning for mapping water bodies and planning aquaculture activities. It aids ground-truthing and secure data management for state fisheries departments.

Larval rearing trials in the portable scampi seed production system

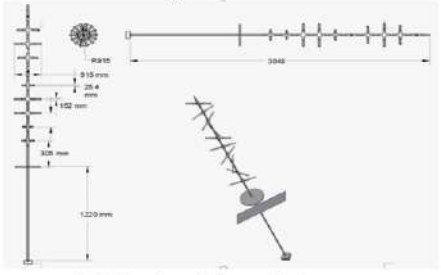
A portable FRP scampi hatchery consisting of five larval rearing tanks (LRTs) of each one-tonne capacity, a five-tonne seawater storage tank was designed, fabricated and installed at the ICAR-CIFA prawn hatchery complex. Aeration and water exchange systems were installed for continuous operation. Larval rearing trials carried out during April-May 2024, resulted in 17,000 scampi seeds. The unit is designed to produce 1,00,000 seeds per cycle with a low operational cost of ₹1 per seed. The system requires approximately 10 tonnes of larval media and 5 tonnes of freshwater per cycle.

Design and development of vertical aeration tower for aquaculture ponds

A vertical aeration tower for aquaculture ponds has been designed and developed.



Schematic Diagram of Cascade Aerator


CAD Design of Cascade Aerator

It is a type of aeration system that can be used in aquaculture to increase the oxygen levels in pond water by exposing it to air. This will enhance the oxygen transfer efficiency and improve water quality, which is crucial for maintaining healthy fish stocks in aquaculture systems.

Design and development of floating raft aquaponics systems

The floating rafts each with dimensions of 1005 mm × 885 mm and thickness 3.76 mm were designed and fabricated with 28 planting holes of dia 70 mm made up of FRP with PVC Pipe frame with buoyancy of 11.9 kg. Study on productivity evaluation of plant and fish biomass in floating raft aquaponic systems was done using rohu and *Ipomoea* sp. for a period of 90 days. Six treatments were taken in triplicate. The stocking densities of fish in first 3 treatments T1, T2, and T3 were 50, 100 and 150 nos., respectively, but, the plant density was kept same (28 nos.). In the

Ipomoea in raft aquaponics

Ipomoea harvest from raft

Raft for ponds

Rafts in ponds

next 3 treatments T4, T5 and T6 the plant densities were kept 14, 28 and 42 nos., respectively and fish density was kept same (100 nos.). The highest fish biomass gain was from T3–that is from 26.27 (± 0.62) g to 49.30 (± 1.41) g and highest plant biomass harvested was from T6 (366.33 ± 3.76 g).

Eighteen FRP floating rafts were also designed, developed and installed in fish culture ponds at ICAR-CIFA Farm.

C. Environmental Management

Nitrite tolerance in freshwater pearl mussel

A 96-hour static renewal bioassay was conducted to assess the median lethal concentration (LC_{50}) of nitrite in pearl mussel *L. marginalis*. The test concentration was established through a range-finding test, followed by a definitive test to determine the LC_{50} value. The range finding test (0 to 400 mg/L) was carried out using different concentrations of nitrite. The experiment was carried out in triplicate in 35 L capacity aquaria containing 20 L water. Each tank was stocked with 10 mussels (80-100 mm). Mussels were not fed during the experiment. Complete renewal of test concentration was done at 24 h. The range of LC_{50} was found to be between 350 to 390 ppm. Hence, further definitive test was conducted using different concentrations of nitrite *viz.* 360, 370, 380, 390 ppm. The LC_{50} of nitrite for *L. marginalis* was determined to be 366 ppm.

Effect of total hardness and total alkalinity of water on egg fertilization, hatching & larval survival in murrel (*Channa striata*)

An experiment was conducted to assess the impact of Ca^{2+} and Mg^{2+} concentrations, reflecting total water hardness, on egg fertilization, hatching,

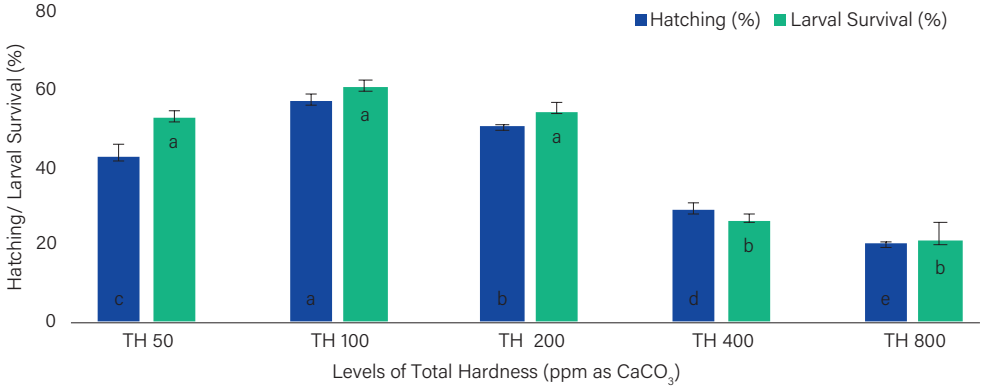


Fig. 3. Effect of total hardness of water on hatching (%) and larval survival (%) in murrel

Table 6. Effect of different total water hardness levels on egg fertilization in murrel

Treatment	Ca (mg/L)	Mg (mg/L)	Ionic composition		Fertilization (%)
			Ca^{2+} (meq/L)	Mg^{2+} (meq/L)	
H: 50 ppm (52)	16.8	1.9	0.84	0.16	67.7^{c}
H: 100 ppm (104)	32.0	4.8	1.60	0.40	82.7^{a}
H: 200 ppm (198)	63.2	10.1	3.16	0.84	75.8^{b}
H: 400 ppm (409)	132.8	16.3	6.64	1.36	29.3^{d}
H: 800 ppm (775)	272.2	16.8	13.61	1.40	18.8^{e}

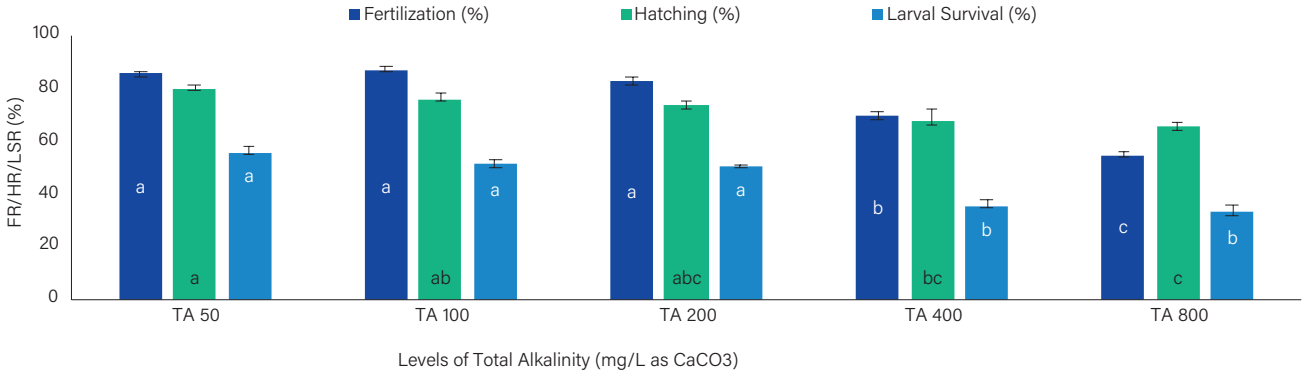


Fig. 4. Effect of total alkalinity of water on egg fertilization, hatching and larval survival in murrel

and larval survival in murrel. The hardness levels of 50, 100, 200, 400, and 800 ppm were prepared using various water sources and by adding calcium salts. The findings revealed that moderate water hardness was optimal for fertilization, peaking at 100 ppm with a rate of 82.7%. Fertilization rates decreased at lower (67.7% at 50 ppm) and higher levels (75.8% at 200 ppm, 29.3% at 400 ppm, and 18.8% at 800 ppm) (Table 6). Hatching (57.4%) and larval survival (60.8%) also peaked at 100 ppm, declining significantly at higher hardness levels. These results indicate that elevated water hardness adversely affects embryonic development and larval survival due to physiological stress (Fig. 3).

In order to assess the effect of CO_3^{2-} and HCO_3^- ions (total alkalinity) levels on egg fertilization, hatching and larval survival in murrel, an experiment was conducted with varying levels of total alkalinity: 50, 100, 200, 400 and 800 mg/L as $CaCO_3$ under ambient hatchery conditions. The results presented in Fig. 4 clearly indicated that egg fertilization was the highest at alkalinity of 100 ppm (86.9%) and decreased gradually as alkalinity increased, reaching 54.9% at 800 ppm. Hatching rates were relatively high across all levels, peaking at 50 ppm (79.7%) but showing a slight decline to 65.2% at 800 ppm. Larval survival showed a more pronounced decline, with the highest rate at 50 ppm (55.9%) and a steady decrease to 33.0% at 800 ppm. These trends suggest that lower total alkalinity levels (up to 200 ppm) are more favorable for fertilization, hatching, and larval survival.

Ammonia tolerance of catla fry

One experiment was conducted to study the effects of ammonia on catla fry by determining the 96-hour lethal concentration (LC_{50}) and analyzing physio-metabolic responses to sub-lethal ammonia exposure. The 96-hour LC_{50} was calculated as 25.02 ppm, and 100% mortality was observed at concentrations of 75 ppm and above, whereas, no mortality observed at concentrations up to 5 ppm. Fry were then exposed to sub-lethal concentrations of 12.51 ppm, 6.25 ppm, and 2.50 ppm for 30 days. Behavioral observations revealed erratic swimming, abnormal gill movements, and loss of equilibrium, intensifying with higher ammonia levels. Biochemical analysis indicated significant increases in blood glucose, SGOT and SGPT, suggesting hepatic stress. Total protein, albumin and globulin levels decreased, while the albumin-globulin (A/G) ratio increased at higher concentrations, indicating impaired protein synthesis. Elevated oxidative stress markers (SOD and catalase) highlighted adaptive responses to oxidative stress.

Genetic Improvement, Molecular Genetics and Biotechnology

A. Genetic upgradation of freshwater fish and shellfish

Production of 14th generation of AhR Jayanti rohu and 4th generation of CIFA-Amrit catla

Full-sib families of 14th generation AhR Jayanti rohu and 4th generation CIFA-Amrit catla were produced following nested mating design during July-Sept 2024. Total 68 full-sib families of AhR

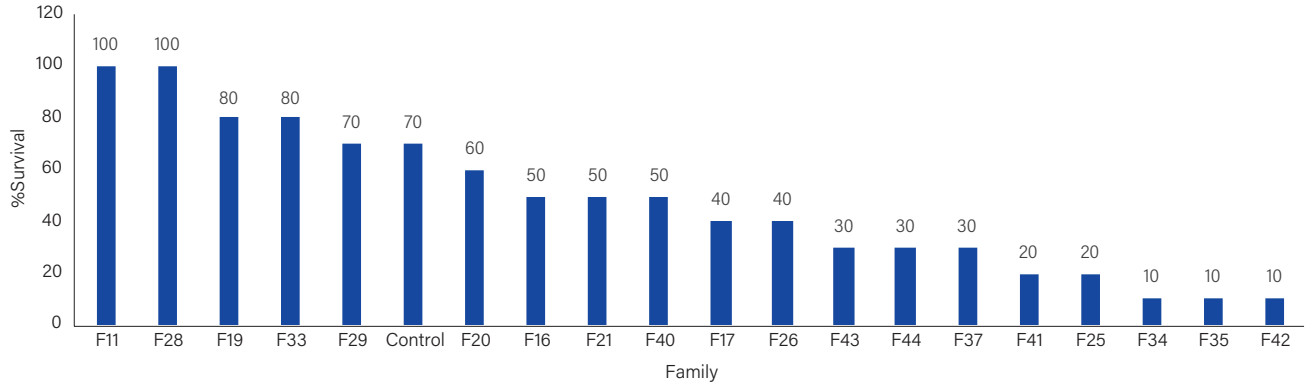


Fig. 5. Family wise survival (%) of AhR Jayanti rohu in challenge test

Correlating USG estimates and actual gonadal weight of late-maturing rohu at ICAR-CIFA Farm

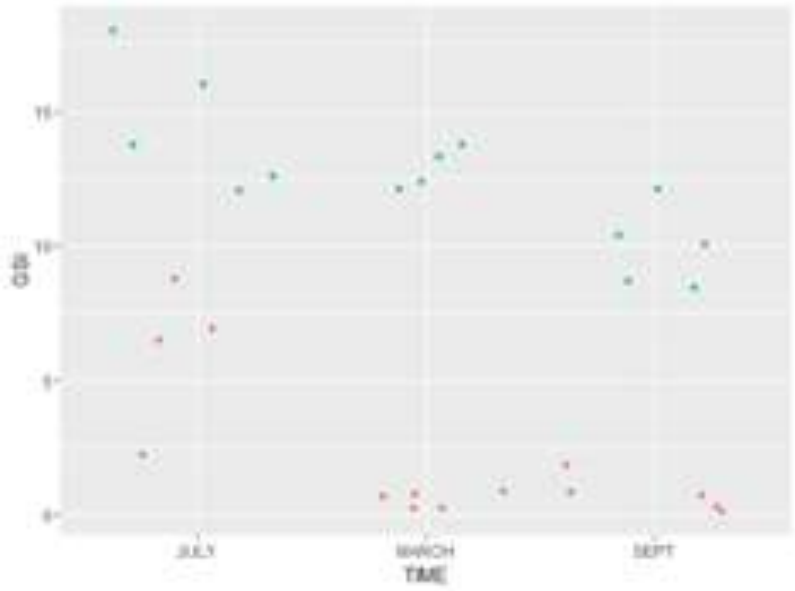


Fig. 6. GSI of mature and immature rohu brooder sampled from same pond during different time point

Jayanti rohu and 49 full-sib families of CIFA-Amrit catla were produced and stocked in separate nursery ponds. During breeding season total 135 lakh Jayanti rohu and 86 lakh CIFA-Amrit catla spawn were produced.

Fingerlings of Jayanti rohu (AhR Jayanti) and improved catla (CIFA-Amrit Catla) were tagged and stocked in three communal rearing ponds for growth evaluation during May 2024. A challenge test (against *Aeromonas hydrophila)* was conducted with 20 full-sib families of AhR Jayanti rohu (400 nos.) and varied level of survival ranging from 10.0% to 100.0% was observed in different families (Fig. 5). F11 and F28 showed 100% survival against *A. hydrophila* challenge whereas the lowest survival was observed for F34, F35 and F42 (10.0%).

Genetic characterization of rohu (*L. rohita*) brooder exhibiting variation in breeding window

Genetic characterization of rohu brooders showing differences in breeding time was studied using ultrasonography. The ultrasound examination of rohu brooders (40 nos. 2-2.5 kg) from September to October 2024 revealed a correlation between the fish weight and ovarian development stages. The data indicated a consistent increase in ovary size and circumference with the fish weight.

To develop an early maturing stock of rohu, fry and brooders were collected during February 2024 from Ramasagar, West Bengal and during March–April 2024 from Balakati, Odisha for developing a diverse genetic pool.

Rohu spawn from December 2022 breeding were reared in an earthen pond at ICAR-CIFA. In March 2024, a total of 110 fishes were sampled, with

only 7% reaching maturity while by July 85% (n= 240 fishes) attained maturity (Fig. 6). However, in September, out of the 56 brooders sampled, the maturity rate dropped to 23%.

Evaluation of maturity status of spawn collected from Bhimavaram in December and raised at CIFA Farm

Sampling was conducted on December 6, 2024, to assess the maturity status of rohu raised at ICAR-CIFA, Bhubaneswar from spawn brought from Bhimavaram, Andhra Pradesh in December 2022. Based on the phenotypic observations and GSI data collected from the sampled fish, signs of maturation were observed, indicating the initiation of the reproductive phase.

Inbreeding levels in improved rohu (Jayanti) and CIFA-GI Scampi® at Nucleus Breeding Centre (NBC), ICAR-CIFA

Pedigree data files were prepared generation-wise to estimate inbreeding levels in the ongoing selective breeding programs of improved rohu (Jayanti) and CIFA-GI Scampi®. Preliminary assessment of inbreeding level indicated 4.83% in rohu (Jayanti) after 13 generations of selection and 6.12% after 12 generations of selection in CIFA-GI Scampi®.

Carbon sequestration potential (CSP) in semi-intensive aquaculture

Six months' grow-out study on carbon sequestration potential (CSP) in semi-intensive farming of selected freshwater fishes (major carp, minor carp, and striped catfish) has been completed. Production ranges of 7.38 ± 0.27, 12.40 ± 0.45 and 13.45 ± 0.22 t/ha/year have been recorded in exclusively major carps, major carps + striped catfish, and major carps + minor carps + striped catfish systems, respectively. Required soil samples have been collected for carbon sequestration study.

Genetic variability levels and patterns in carp hatcheries of Odisha and West Bengal

Assessment of genetic variabilities using eight microsatellite markers in rohu populations collected from carp hatcheries of North Odisha and South-East Odisha revealed greater value of observed heterozygosity (Ho) than expected heterozygosity (He).

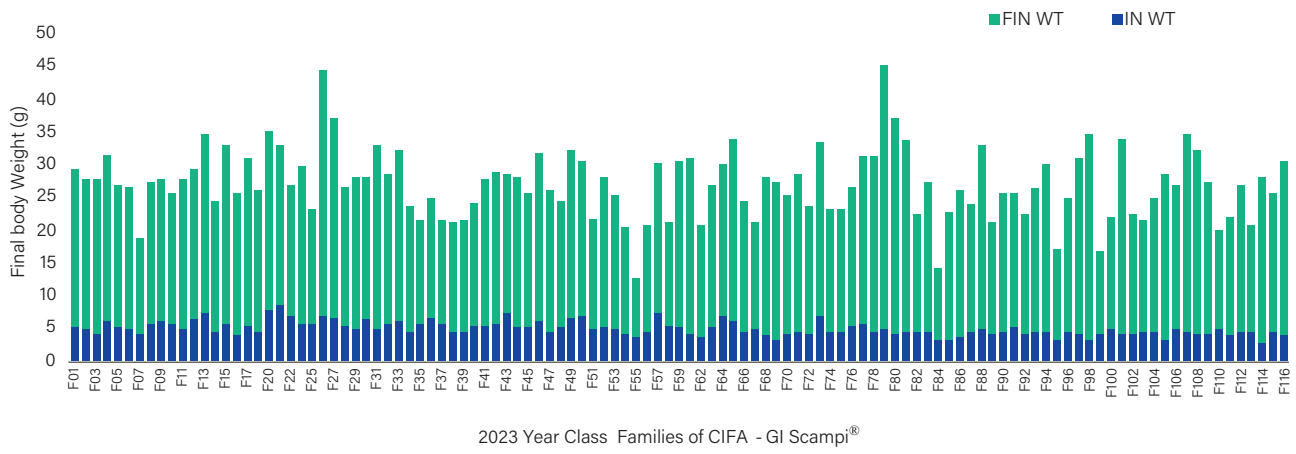


Fig. 7. Initial and final body weight in 2023 YC families of CIFA-GI Scampi® after grow-out.

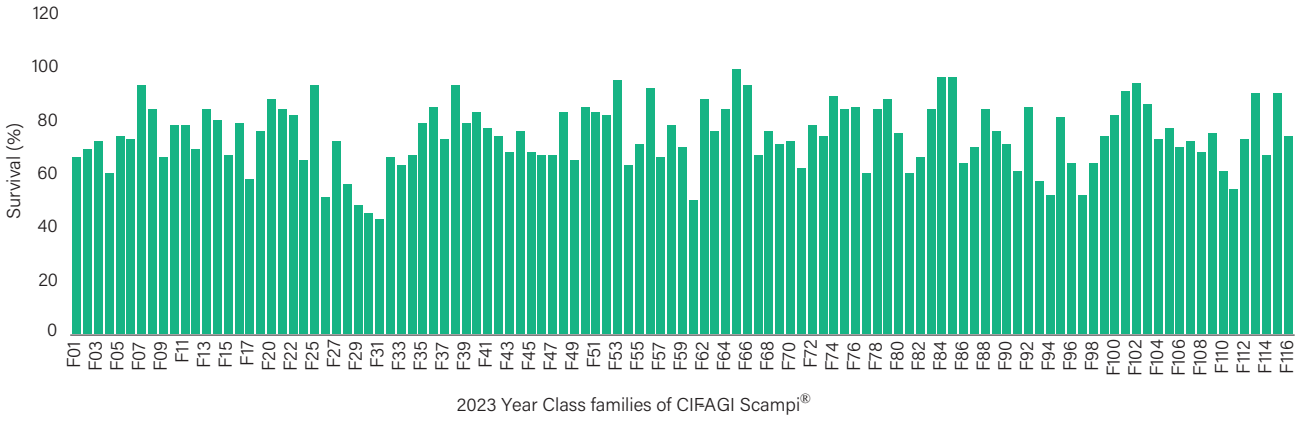


Fig. 8. Survival in 2023 YC families of CIFA-GI Scampi® after grow-out.

Grow-out performance of 2023 Year Class families of CIFA-GI Scampi®

Grow-out rearing and final data collection of 112 families of 2023 Year Class (YC) was completed during January to May 2024. The overall mean final survival of 112 families of 2023 YC reared in 10 m^2 hapa stocked at 8 nos./m^2 after a grow-out period of 107 ± 16.75 days was 65.55 ± 14.2%. The mean final size and survival of 2023 YC families after the grow-out is presented in Figs. 7 & 8.

Production of 2024 Year-Class of CIFA-GI Scampi®

A total of 97 post-larval batches were produced from April to October 2024 for further rearing as full-sib families of the new generation. In 2024, the total brood seed output was 3.02 lakhs. Twenty-day-old post larvae (PL) from all the 97 families were nursed in nylon hapas (2.5 x 1 x 1.0 m; two replicate hapas per family) for 10-12 weeks. The average final mean body weight of juveniles of the 90 families of the 2024 Year Class of CIFA-GI Scampi after completion of nursery rearing was 6.29 ± 1.2 g. The overall mean final survival of 90 families of 2024 YC after nursery rearing was 72.06 ± 13.62%. After completion of nursery rearing, the nursed juveniles from each of the 90 full-sib families were transferred to two large nylon net hapas (5 x 2 x 1 m) for grow-out rearing. Grow-out of 90 families and

nursery rearing of the remaining seven families is in progress.

Performance assessment of genetically improved varieties under low saline conditions

The fingerlings from full-sib and half-sib families of the 13th generation Jayanti rohu and 14th generation CIFA-GI Scampi® from the ongoing selective breeding program were used for the present study. Six to twelve fingerlings of Jayanti rohu per family were PIT tagged and stocked in two freshwater ponds (0.1 ha each) at ICAR-CIFA and two low saline ponds (4-7 ppt) in Brahmagiri, Puri district during July 2023. The carp-scampi polyculture system was followed with a stocking density of carps at 6000 fingerlings/ha (80% Jayanti rohu and 20% improved catla). CIFA-GI Scampi® was stocked at 10000 PL/ha. The stocking density was maintained by stocking extra fingerlings of Jayanti rohu of the same generation. Fishes were fed daily with floating feed (28% protein, 4% lipid) at 3% of the body weight. The final sampling was done after 240 days (March 2024) and the growth data (body weight and total length) was recorded for performance evaluation of the genetically improved strain in both freshwater and low-saline pond environments (Fig.9 &10). The G X E interaction analysis for growth trait in Jayanti rohu revealed no significant difference in the body weight of Jayanti rohu between freshwater and low-saline pond environments ($p>0.05$). The Jayanti rohu showed an average growth of 805 g in 240 days with an average daily growth of 3.3-3.4 g/day. The phenotypic correlation of the body weight of Jayanti rohu in two different culture environments was very high r=0.97 showing no G X E interaction.

The average final body weight of CIFA-GI Scampi® in low saline ponds after 180 days of rearing ranged from 38 to 45 g with an average daily growth of 0.24 g. The average body weight

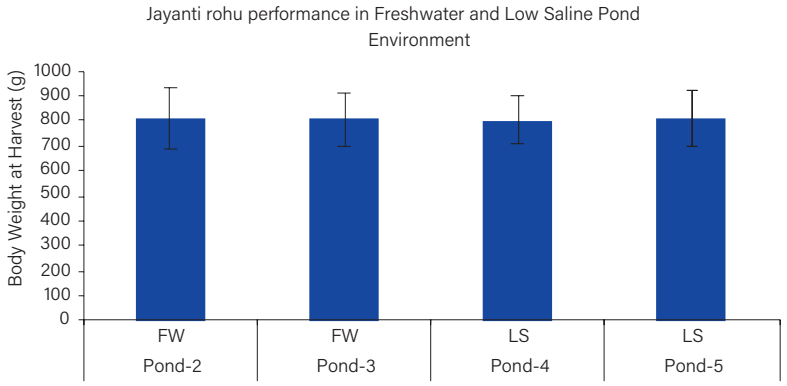


Fig. 9. Final body weight of Jayanti rohu in freshwater and low saline pond environment

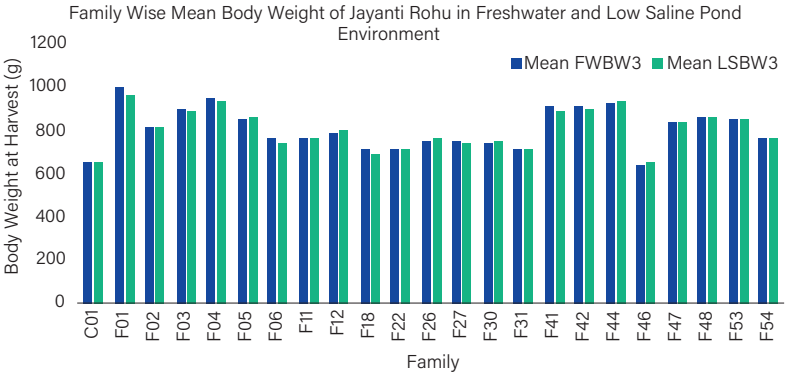


Fig. 10. Between family variations in Jayanti rohu body weight at harvest

in the freshwater environment after 153 days was 33.88 g with average daily growth of 0.22 g which was not significantly different from that of the low saline environment.

B. Population genetics

Population genetic analysis of seven stocks of *A. testudineus* using D-loop marker

Genetic analysis of Odisha stocks of *A. testudineus* was carried out using mtDNA D-loop marker. In total fin clips of 26 anabas individuals were collected and genomic DNA was extracted. A portion of mtDNA D-loop was sequenced after PCR amplification using a pair of species-specific primers. The genetic diversity

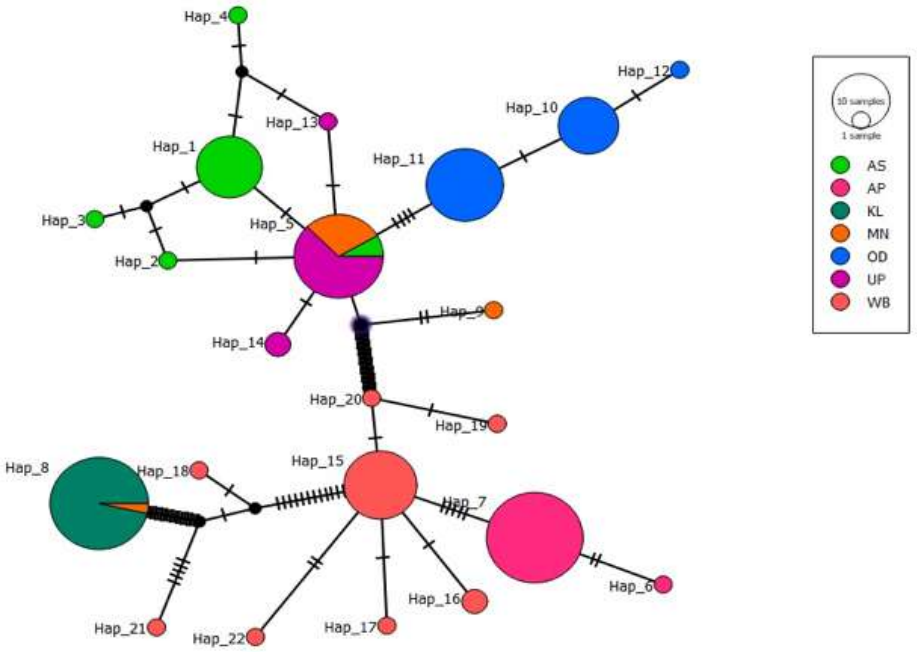


Fig. 11. Median-joining network of D-loop haplotypes across *A. testudineus* populations. AP: Andhra Pradesh, AS: Assam, KL: Kerala, MN: Manipur, OD: Odisha, UP: Uttar Pradesh, WB: West Bengal

and variation among seven Indian populations of *A. testudineus* (Andhra Pradesh, Assam, Kerala, Manipur, Odisha, Uttar Pradesh, West Bengal) were studied using the mitochondrial control region partial DNA sequences to determine their current population structure and heterogeneity. In total 22 haplotypes with haplotype 5 and 8 shared by more than one population were observed. Median joining haplotype (Fig. 11) network revealed that, the haplotype 5 is the ancestral haplotype.

The overall haplotype and nucleotide diversity was found to be 0.87858 and 0.07432, respectively suggesting the presence of genetic diversification, however no genetic diversity was observed in the Kerala population. The AMOVA analysis revealed that, in comparison to the population as a whole (96.47%), the genetic diversity within *A. testudines* populations are extremely low (3.53%). Significant genetic differentiation was observed among all the *A. testudineus* populations except between Uttar Pradesh and Manipur population. Moreover, the overall F_{ST} was observed to be 0.96467, which highlights, presence of significant genetic variation.

Reproductive performance of *Anabas* stocks from Odisha, West Bengal and Andhra Pradesh

The reproductive performance of *Anabas* stocks from Odisha, West Bengal (WB), and Andhra Pradesh (AP) was evaluated. The results showed the highest fertilization rate in Odisha stock (92.56 ± 3.60%), followed by AP (91.87 ± 8.13% stock) and WB stock (79.84 ± 11.98%). Hatching rates were stock 88.17 ± 4.28% for Odisha, 87.33 ± 4.43% for AP, and 84.10 ± 2.22% for WB stock. Relative fecundity was recorded as 604.7 ± 154.97 for Odisha, 573.8 ± 18.66 for AP, and 482.8 ± 21.83 for WB stock. Statistical analysis revealed no significant stock differences (p-value > 0.05) among the stocks for any parameter,

Collection of *B. carnaticus* at Satyagala

indicating uniform reproductive performance across regions.

Collection of different stocks of *Barbodes carnaticus* for genetic characterization

Sampling for different stocks of *B. carnaticus* was conducted from four locations (Satyagala handpost, Ramanathapura, Talakadu and Bhavanisagar) in Cauvery river stretch along with farm stock (RRC, Bengaluru). Live specimens of *B. carnaticus* from Ramanathapura were collected for further breeding studies as they are reported to be having higher growth compared to the individuals from other natural collection sites.

C. Genomics and Proteomics Tools for Genetic Improvement

Detection of Runs of Homozygosity (RoH) in genetically improved and normal rohu

Genome-wide ROH analysis was performed to assess homozygous stretches along the DNA of improved (Jayanti rohu) and unselected rohu

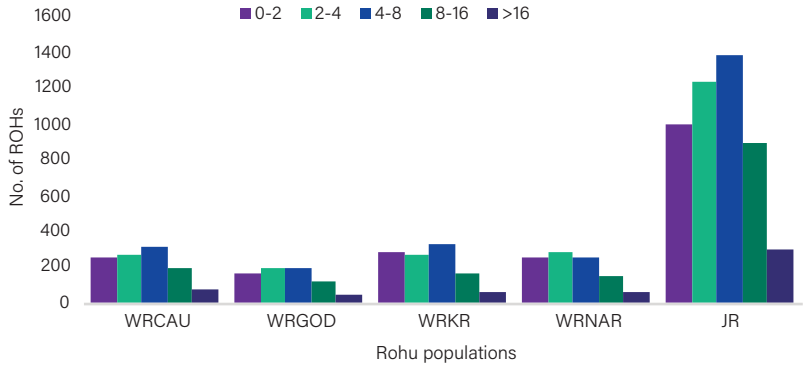


Fig. 12. Distribution of RoHs across different populations of *L. rohita*

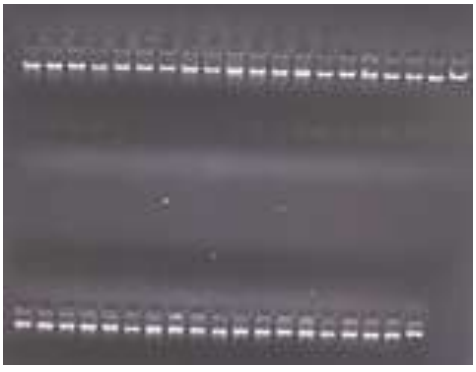


Fig. 13. Gel electrophoresis of gDNA of mapping family

populations (wild rohu collected from Cauvery- WRCAU, Godavari-WRGOD, Krishna-WRKR, Narmada-WRNAR). The Jayanti population exhibited the highest number of ROH segments (maximum 1387 in 4-8 kb size class), indicating a higher level of inbreeding compared to the wild population (Fig. 12). Highest number of SNPs were observed on Chr 7, Chr 3 and Chr 16, and were identified as potential ROH islands, suggesting regions of the genome that have been subjected to strong selection pressures.

Development of SNP based linkage map in *M. rosenbergii*

The linkage mapping family (F97) generated from most genetically diverse parents along with offspring was selected as the experimental mapping family. DNA isolation of the muscle tissue of 160 offspring was carried out followed by quality and quantity check (Fig. 13) and stored at -20°C for further processing.

Optimization of RE combinations for genotype-by-sequencing in *M. rosenbergii*

An *in silico* analysis on whole genome sequence of *M. rosenbergii* (available in NCBI database) to compare the genome coverage using 64 combinations of restriction enzymes using lg Coverage software carried out. The NlaIII-MluCI combination showed highest genome coverage (Fig. 14).

Identification and annotation of SNPs in *M. rosenbergii*

The quality analysis showed average number of reads was 2.8 million, GC content ranged from 34-68%, average read length 159 bp and average phred score ≥ 36 (Figs. 15 & 16).

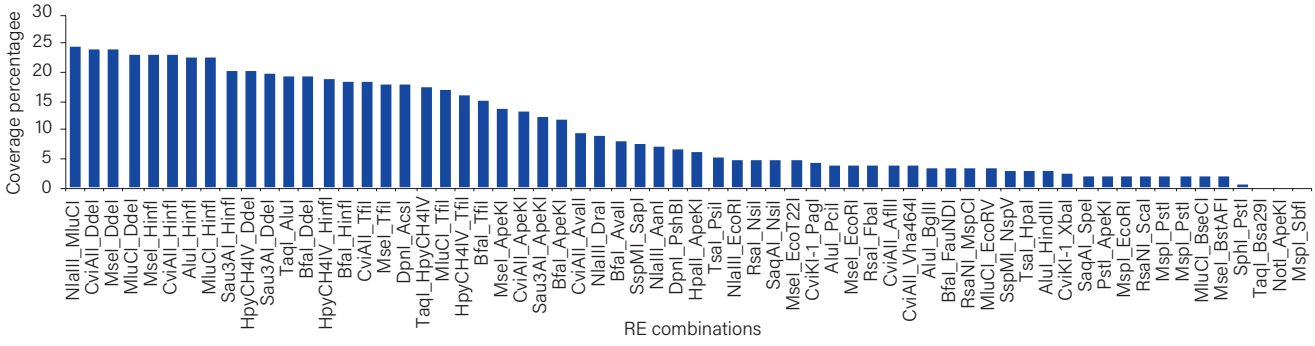


Fig. 14. Genome coverage of different RE combinations in *M. rosenbergii*

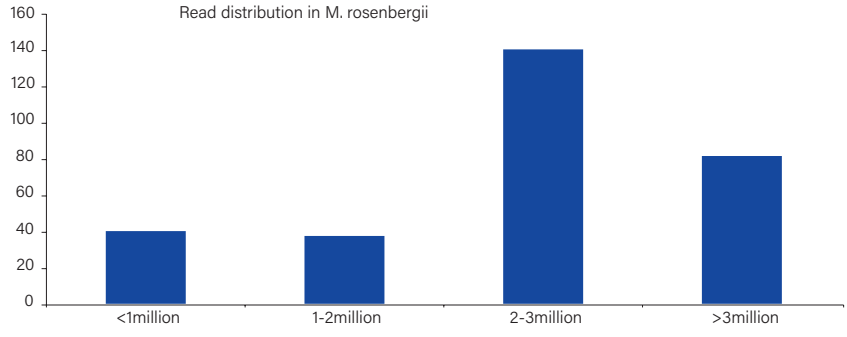


Fig. 15. Distribution of reads across samples

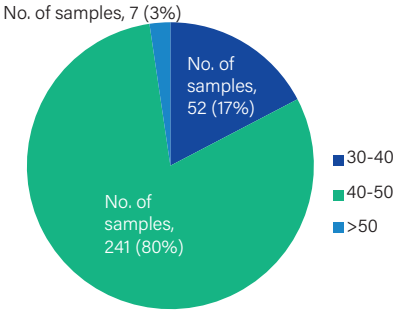


Fig. 16. Distribution of GC percentages across samples

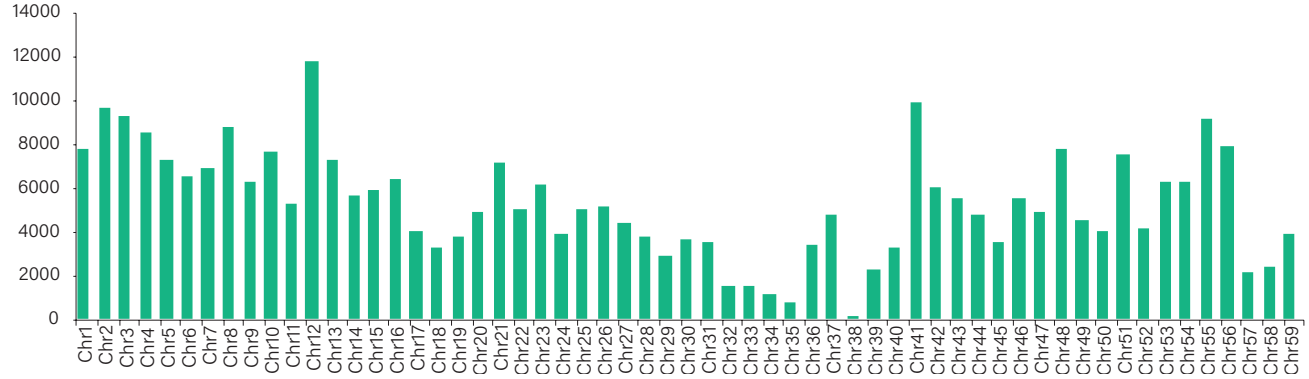


Fig. 17. Distribution of SNPs across chromosomes in *M. rosenbergii*

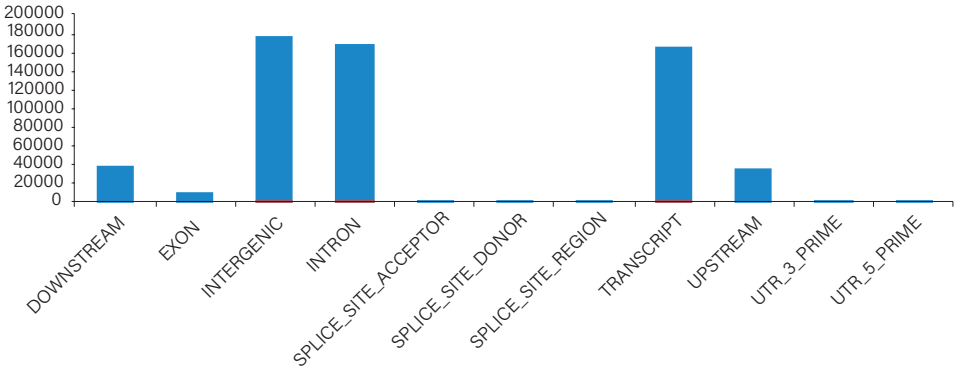


Fig. 18. Distribution of SNPs across the genome

SNPs identified using SAMtools and BCFTools software resulted in 247,252 quality SNPs which were subsequently filtered using Plink software resulting in 42,266 high quality SNPs. Further screening based on minor allele homozygous genotype frequency, a total of 1567 high-confidence SNPs were retained for the genome-wide association studies (GWAS) analysis. Annotation of 247,252 SNPs obtained after standard filtering were carried out. The highest and lowest numbers of SNP were observed in chromosome number 26 (11,451) and chromosome number 33 (161), respectively (Fig. 17). Highest number of SNPs were observed in intronic region (Fig. 18). Change of bases i.e., G > A was observed to be the highest and G>C was the lowest. In total 9,196,759 transitions and 4,772,750 transversions with Ts /Tv ratio 1.92 was observed.

Generation of draft genome of *M. rosenbergii*

Muscle and pleopod tissue samples in triplicate were collected from *M. rosenbergii* females weighing 120 g and high-quality DNA was isolated, quantified and sequenced for both short read (Illumina Novaseq) and long read (PacBio). A total of 352 Gb short read (150 x 2, PE) from 16 different libraries and 170 Gb of HiFi, PacBio sequence data were obtained. The short read data QC indicated Phred score > 30Q. The hifi reads were screened for adaptor contamination and foreign organism contamination using NCBI, FCS tool (Table 7).

The hifi reads were assembled using WTDBG v2.5 tool. The assembly contigs produced by wtdbg2 was screened for foreign contamination with NCBI FCS tool and contaminant contigs were removed.

Table 7. Statistics of PacBio hifi reads

Statistics	Raw reads	Clean reads
Number of reads	15,554,087	15,495,729
Size (Gb)	170.853	170.228
N50 (bp)	12,354	12,355
L50 (bp)	5,623,455	5,602,374
GC (%)	28.86	28.77

Table 8. Assembly statistics

Parameter	Statistics
Number of contigs	23,010
Genome size	3.216 Gb
N50	1.03 Mb
L50	728
Longest contig	14.25 Mb
GC	36.49%

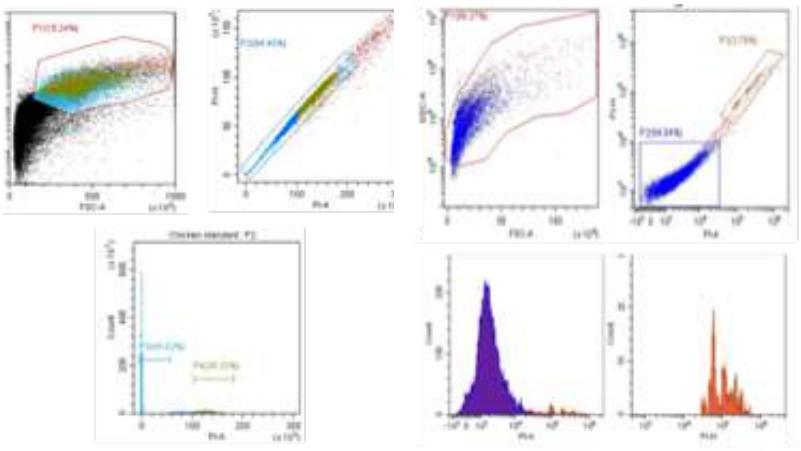


Fig. 19. Mean fluorescence intensity of a) Chicken RBCs, b) Prawn haemocytes

The duplicated contigs were also removed with *purge-dups* tool. The final statistics of the assembly contigs are provided in Table 8. The assembly was checked for completeness using BUSCO v5.7.0 against arthropoda-odb10 and found to be 95.3% complete.

Estimation of genome size of *M. rosenbergii* using flow cytometry

Flow cytometry was carried out to estimate the genome size of *M. rosenbergii* using CytoFLEX System B2-RO-V2, (Beckman Coulter) using chicken blood cells as standard. Genome size was estimated with the corresponding mean value of the unknown with the known genome size of chicken (*Gallus domesticus*) 1.25 pg (Fig. 19a). The genome size of *M. rosenbergii* was estimated to be 3.2 Gb (Fig. 19b) which is in the range of reported genome size (3.2-3.7 Gb) using K-mer values.

In silico gene structure prediction and physicochemical properties of CAST in *L. rohita*

For CAST gene structure prediction, the mRNA sequence of CAST obtained through mRNAseq was smartBlasted against the whole genome of rohu. The result showed highest similarity with CAST isoform X4 *(L. rohita)* having 97.79% identity with the template. The location of CAST gene was found to be on chromosome 21 and harbor 31 ORFs. The longest ORF was 1386nt encoding 461 amino acids. Physico-chemical

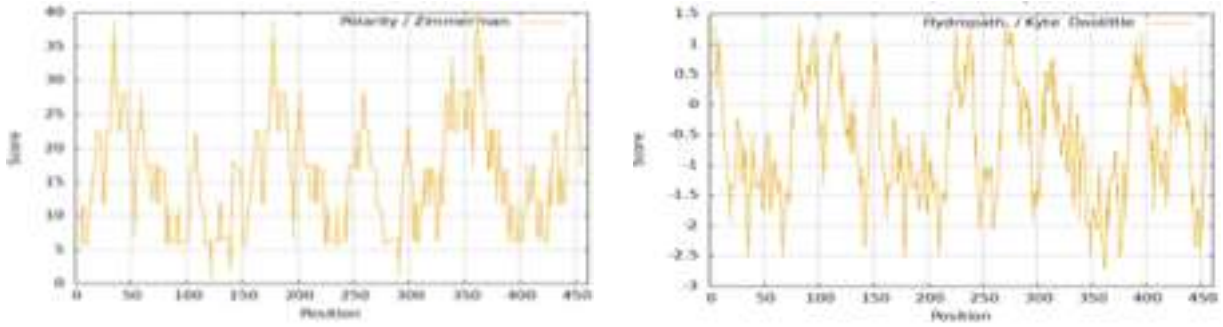


Fig. 20. Physico-chemical properties of CAST protein a) Polarity b) Hydropathy

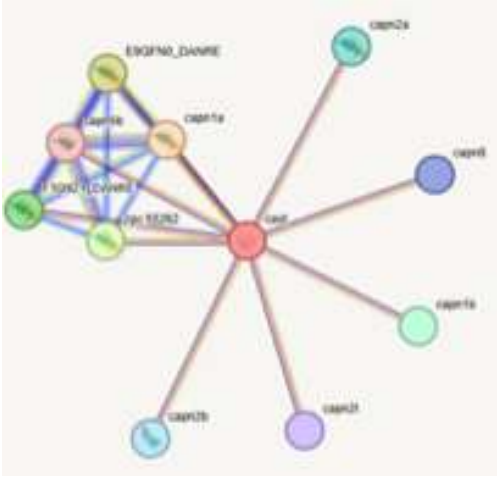


Fig. 21. PPI network of cast protein interacting with other related proteins

properties of CAST protein were analysed and results showed that the molecular weight was 48.859 kd. Theoretical pI was found to be 4.90 along with Aliphatic index of 71.37 indicating CAST protein is thermostable (Fig. 20). The Grand average of hydropathicity (GRAVY) was -0.634 indicating its hydrophilic nature.

The protein was found to be an extracellular protein, as indicated by PSLpred. More accessible residues and a high score for the polarity index indicate that it has high interaction with water and other polar molecules. PPI studies indicated significant interaction with calpain isoforms viz. capn1b, capn2b, capn2l, which CAST regulates negatively (Fig. 21). When the partial mRNA sequence of CAST (*L. rohita*) was compared with reported partial sequences of CAST in other vertebrates, it was clustered closest to *Danio rerio* (NCBI accession: MG387170), followed by a sub-cluster of *Oncorhynchus mykiss* (NM-001124538) and *Salmo salar* (NM-001173691).

Identification of differentially expressed proteins after exposure to heat stress, saline stress and combined heat and saline stresses in rohu

The effects of heat and salinity stress were examined in rohu (*L. rohita*) fingerlings by exposing them to 30 °C and subsequently to 36°C over 15 days, alongside a saline water environment of 6 ppt. Four groups were established: control, heat stress, salinity stress, and combined stress. Tissue samples from the liver, gills, and kidneys were analyzed using 2D gel electrophoresis and MALDI-TOF/TOF, identifying 149 differentially expressed protein spots, with 63 proteins confirmed via mass spectrometry (Fig. 22). The analysis revealed that these proteins were involved in nucleotide and prostanoid metabolism, indicating an inflammatory response and enhanced cellular repair mechanisms. Additionally, proteins related to hydrolase and esterase activities suggested increased detoxification and regulation of cell signaling. The enrichment of polymeric cytoskeletal fibers pointed to stress fiber assembly in response to various stresses. qPCR validated expression patterns for 11 selected genes, with nine showing consistency with the identified differentially expressed proteins, highlighting the stress response mechanisms in the fish.

Bioactive properties of small peptides derived from fish waste protein hydrolysates

Viscera, gills and fin of rohu samples were trypsin-digested and passed through

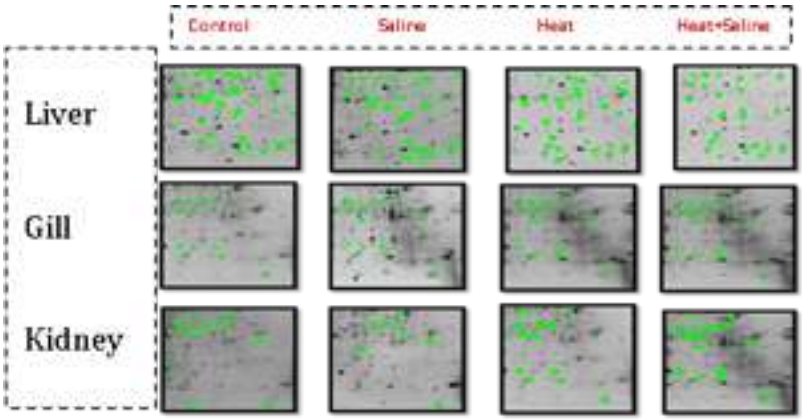


Fig. 22. Differentially expressed proteins after the exposure of heat stress and salinity stress and combine heat and salinity stress

sequential centrifugal filters of different cut-offs. All the concentrated samples of 3 kDa cut-off filters showed better antioxidant properties than the samples from other cut-off filters. These samples were analyzed further with other bioactive assays such as anti-inflammatory (albumin denaturation inhibition assay), anti-diabetic (α-glucosidase inhibition assay) and anti-hypertensive {angiotensin converting enzyme (ACE) inhibition assay} properties. The visceral hydrolysate inhibited the denaturation of albumin at 93.8%, whereas, the gills and fin hydrolysates were unable to inhibit the denaturation of albumin. The hydrolysates of viscera, gills and fin also showed anti-hypertensive activity inhibiting ACE at 73%, 99% and 104%, respectively. All the hydrolysates however, lacked anti-diabetic properties. Similarly, hydrolysates of different tissues of catla using trypsin (viscera) and papain (gills and fin) showed antioxidant properties in the concentrates of 3 kDa cut-off and were used for further bioactivity testing. The visceral tissue hydrolysate was able to inhibit the denaturation of albumin at 88.3%, whereas, the gills and fin hydrolysates lacked any anti-inflammatory properties. The gills and fin hydrolysates possessed the ability to inhibit α-glucosidase at 15.4% and 12.5%, respectively. The hydrolysates from viscera and gills could inhibit ACE at 84.7% and 23.6%, respectively.

D. Microbiome profiling

Studying the interaction between brain and gut microbes across different reproductive cycles in catla (*Labeo catla*)

Profiling of gut microbial community by 16s rRNA metagenome sequencing was done in catla for three different reproductive seasons i.e., pre-spawning, spawning, and post spawning. The composition of gut bacteria in fish showed significant variation across different reproductive

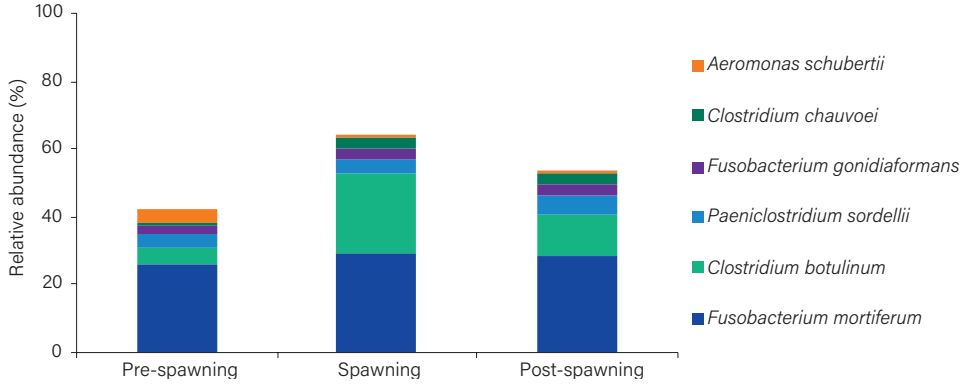


Fig. 23. Relative bacterial abundance in *L. catla* gut in different reproductive seasons

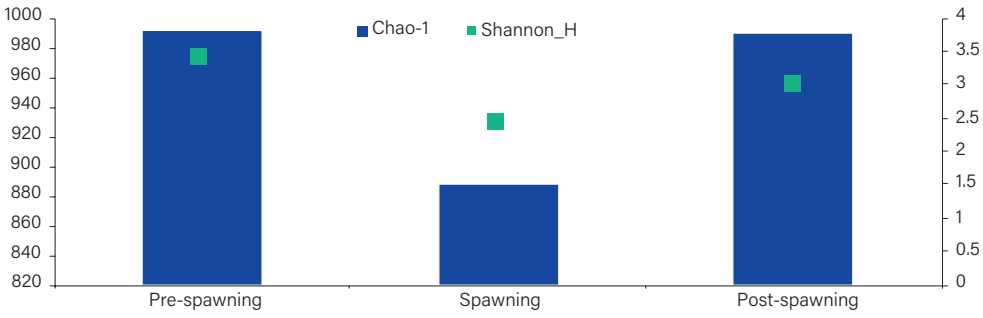


Fig. 24. Richness and evenness of bacterial community across different reproductive seasons

seasons. During the pre-spawning season, *Fusobacterium mortiferum* and *Aeromonas veronii* were the predominant bacterial species. In contrast, *Clostridium botulinum* became the second most dominant species during the spawning season, with its abundance increasing five-fold from pre-spawning season and two-fold from post-spawning season suggesting a potential shift in the microbial community linked to reproductive processes (Fig. 23). A significant decline in microbial diversity was noted during the spawning season. The Chao-1 index, which quantifies microbial richness, reached its lowest value during this period (888.25), indicating a drop in species abundance. Likewise, Shannon index, which accounts for both richness and evenness, also decreased (2.4051), highlighting a change in the microbial community structure as well (Fig. 24). This is indicative of physiological changes in the fish that promote the growth of specific bacterial species. These indices recovered during post-spawning period. Hemoglobin (Hb) levels were highest during the pre-spawning season in both male and female catla followed by spawning and post-spawning seasons. The pre-spawning period involves significant physiological changes and high-energy demands, supported by increased Hb and glucose level. Additionally, pre-spawning is characterized by a spike in blood plasma glucose, likely in response to rising environmental temperatures and heightened energy needs.

Expression profiling of the genes associated with PUFA biosynthesis and the immune system in *C. striata*

Total RNA was isolated from samples of each dietary group (control: fish oil; T1: soybean oil; T2: linseed oil; T3: mustard oil; T4: three-oil combination) and its

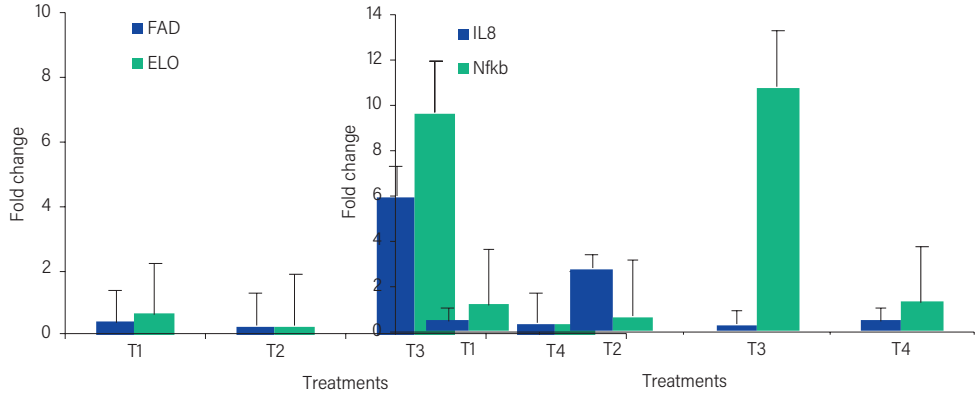


Fig. 25. Gene expression levels of FAD, Elovl5 (a) and IL-8, NFkb (b) genes in muscle tissue across all treatments (* *p*-value < 0.05).

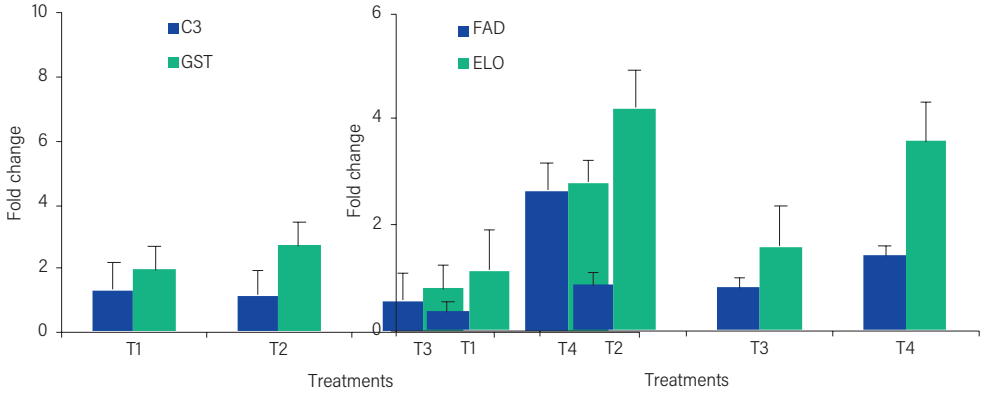


Fig. 26. Changes in gene expression levels of FAD, Elovl5 (a), IL-8, NFkb (b), and C3 and GST (c) genes in liver tissue across all treatments (*p-value < 0.05).

quality and quantity were assessed. The qPCR analysis revealed that FAD and Elovl5 were upregulated in T3 (Fig. 25a), indicating enhanced PUFA synthesis. In contrast, expression of these genes were negligible in other treatments. Furthermore, IL-8 gene expression in T2 showed two-fold up-regulation (Fig. 25b), indicating heightened inflammatory response in this group. NfκB gene expression in T3 showed ten-fold up-regulation, suggesting activation of pro-inflammatory signaling pathways. Distinct immune and inflammatory responses were observed with linseed oil and mustard oil diets.

In fish from T2 and T4, elongase 5 gene expression showed a significant four-fold increase in liver tissue (Fig. 26a), indicating enhanced fatty acid elongation. FAD gene expression was slightly up-regulated in T4, suggesting a modest boost in desaturation activity with the combined oil diet. IL-8 expression is markedly elevated (twelve-fold) in liver tissue of fish in T1, with moderate increases (four-fold) across other dietary groups (Fig. 26b). NfκB expression is significantly up-regulated (four-fold) in T2 and T4, indicating stronger activation of pro-inflammatory pathways in these groups. In T4, complement 3 (C3) and Glutathione S-transferase (GST) genes are highly upregulated (four-fold) (Fig. 26c), indicating robust activation of immune and detoxification pathways. GST also shows moderate up-regulation (two-fold) in T1 and T2, suggesting increased antioxidant and detoxification activity with these diets.

Metagenomic profiling of *Clarias dussumieri*

Whole genome metagenome sequencing of gut and skin tissues of *C. dussumieri* reared in captive condition was carried out using the Oxford Nanopore PromethION system, which yielded 3.63 million reads, out of which 3.6 lakhs classified reads were assigned to the microbial domain. Out of 366087 microbial reads, 64.61% were taxonomically assigned to bacteria, 22.13% to fungi and 2.08% to archaea, indicating higher abundances of bacteria in the gut and skin microbiome of *C. dussumieri.* Around 27.7% of the total OTUs were found conserved across all the samples as the core microbiome of captive-reared *C. dussumieri. Pseudomonas* was found to be the most abundant genus in the gut of male C. *dussumieri*, whereas the female

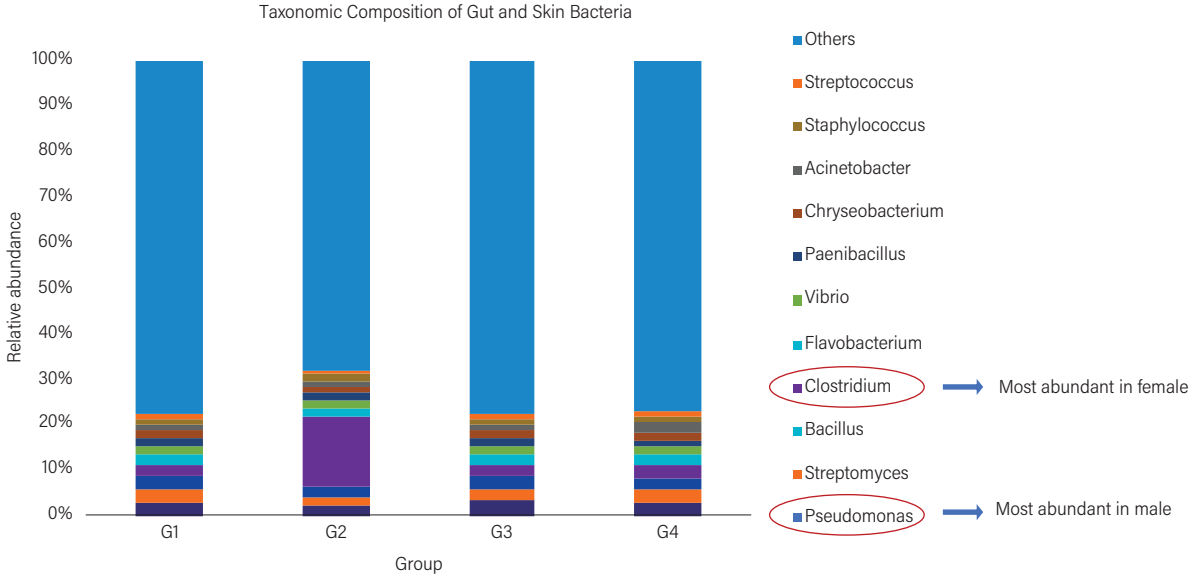


Fig. 27. Bacterial abundance in gut and skin sample of *C. dussumieri* (G1: Male gut, G2: Female gut, G3: Male skin, G4: Female skin)

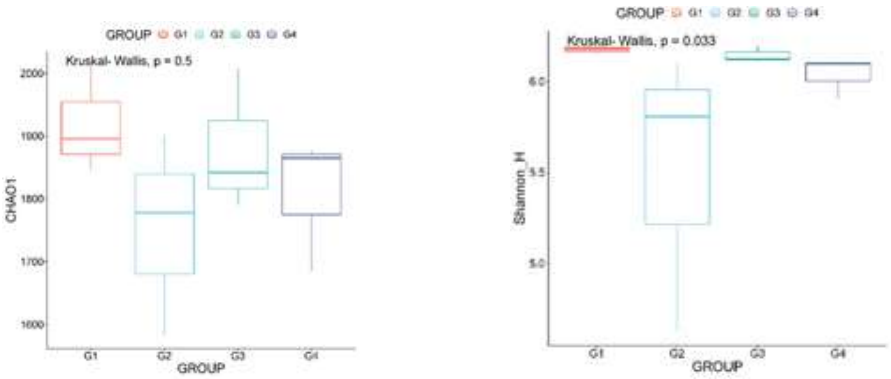


Fig. 28. Alpha diversity: Box plot showing bacterial diversity across gut and skin of C. dussumieri (A. CHAO1: Index of richness, B. Shannon-H: Index of diversity) (G1: Male gut, G2: Female gut, G3: Male skin, G4: Female skin) (Plotted using SR-Plot online tool)

system was dominated by *Clostridium* (Fig. 27). Alpha diversity of gut and skin samples (male, female) revealed that male fishes have a higher no. of microbial OTUs colonized in their gut (higher richness) in comparison to females, where higher diversification of microbes was seen in female samples (Fig. 28).

Polystyrene microplastic exposure in Zebrafish

Microplastics have become significant environmental pollutants in aquatic ecosystems, raising concerns about their effects on aquatic organisms. This study evaluates the impact of polystyrene microplastics (PS-MPs) on zebrafish (*Danio rerio*) by focusing on changes in bioaccumulation and condition factor after exposure to different concentrations of PS-MPs. Zebrafish (mean weight: 0.957 ± 0.07 g; mean length: 3.92 ± 0.11 cm) were exposed to 8 μm PS-MPs at concentrations of 0, 10, 100, and 1000 μg/L for 21 days. PS-MP exposure led to a significant reduction in the condition factor at concentrations of 100 and 1000 μg/L, indicating adverse effects on zebrafish health. Bioaccumulation of PS-MPs occurred in a concentration-dependent manner, with the highest levels observed in the gastrointestinal tract, followed by the gills and ovaries (Fig. 29). Notably, SEM analysis of the gills revealed that microplastic particles accumulated between the secondary gill filaments (Fig. 30), further demonstrating the direct interaction between PS-MPs and vital respiratory structures. This study shows that polystyrene microplastics

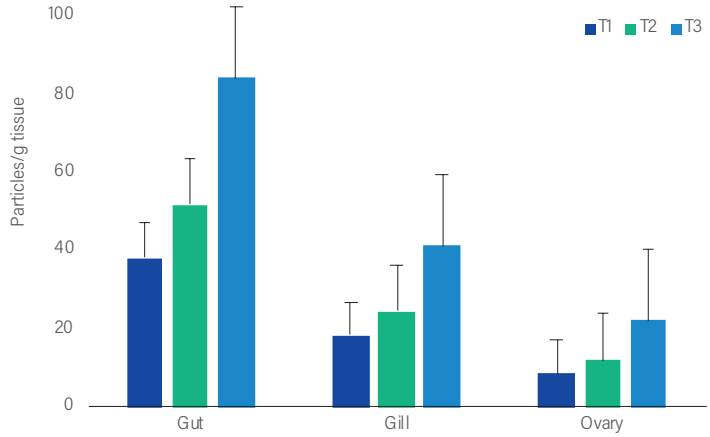


Fig. 29. Bioaccumulation of PS-MP in different tissues of Zebrafish. The data represented as Mean±SEM. (**p<0.01, ***p<0.001)

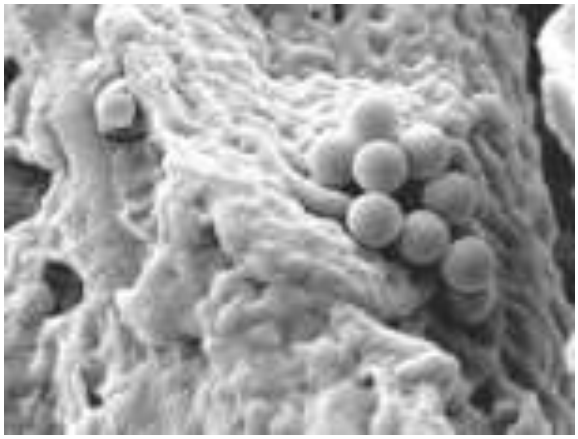


Fig. 30. Scanning Electron Microscopy images of the gills. The black arrow indicates the accumulation of PS-MP particles on the epithelium of secondary filament.

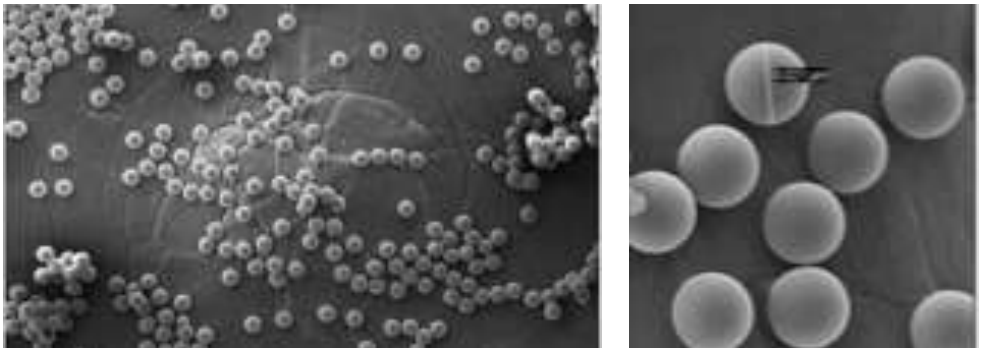


Fig. 31. Scanning electron microscopy (SEM) photomicrograph of polystyrene microplastics (PS-MPs)

have detrimental effects on zebrafish health, as reflected by decreased condition factor and significant bioaccumulation in key tissues. The accumulation of PS-MPs in the gills, particularly between secondary filaments as observed via SEM (Fig. 31), highlights the respiratory risks posed by microplastic pollution. These findings underscore the need for regulatory measures to control microplastic contamination in aquatic environments.

Elucidating the role of phoenixin in gonadal maturation of freshwater carp

To investigate the potential role of Phoenixin (PNX) in reproductive regulation in farmed carp, partial cDNA sequences of PNX (200 bp) were sequenced from rohu brain cDNA. Quantitative real-time PCR (qRT-PCR) analysis revealed PNX mRNA expression in both reproductive tissues (brain, pituitary, and gonad) and non-reproductive tissues (liver, muscle, kidney, heart, blood, spleen, gill, and intestine) of adult male and female rohu.

E. Genome Editing in Aquaculture

Evaluation of disease resistance/ sensitivity of gene-edited (perforin/ mucin) rohu and zebrafish

The perforin gene is associated with a defense mechanism against infectious

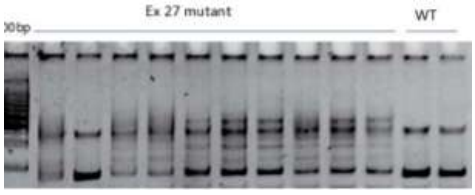


Fig. 32. Hetero-duplex assay in zebrafish embryos with Exon 27 gRNA of mucin2.

diseases. The characterization of the perforin gene promoter is in progress with the aim of mutating the repressor element by gene editing. The gRNAs were designed to target exons 5, 23, 26, and 27 of the mucin 2 gene for gene editing experiments in zebrafish. Following the microinjection of these gRNAs, the exon 27-targeting gRNA successfully incorporated mutation (Fig. 32). Additionally, genome-walking experiments are in progress to identify the promoter sequence associated with the mucin 2 gene.

Editing myostatin gene in rohu and zebrafish for enhanced skeletal muscle growth

To achieve full-proof myostatin gene editing, two gRNAs were designed to target distinct regions of the myostatin locus. Specifically, gRNAs were directed to exon 1 and exon 2 of myostatin a. These gRNAs were co-injected into zebrafish embryos to induce simultaneous mutation or deletion of both exons. Following microinjection, embryos were screened for successful gene editing, confirming

the presence of the desired mutations in both exons (Fig. 33). The mutated embryos harbouring the intended genetic indel alterations are currently being raised for further analysis, including phenotypic characterization as they continue to grow and develop.

In myostatin b, three distinct regions were targeted for gene editing: the promoter region, exon 1, and exon 2. In these three regions myostatin b were successfully edited individually Subsequently, in zebrafish, gRNAs targeting the promoter region and exon 1 were co-injected to achieve a double-mutations or knock-out. The hetero-duplex assay confirmed the successful incorporations of the intended gene edits in both target sites (Fig. 34). The mutated zebrafish embryos are currently being reared for subsequent experiments to raise F_1 generation.

Taking a clue from myostatin b editing in zebrafish, a single gRNA targeting exon 1 of myostatin b of rohu carp was capable of editing with approximately 50% mutation efficiency (Fig. 35). The myostatin b mutated rohu carps are currently being reared to grow further aimed at raising F_1 generation.

Results demonstrate that Myostatin b could be successfully edited in rohu carp based on the clue from zebrafish. While the role of myostatin b is known for increased skeletal muscle growth, the physiological function of another variant, myostatin a, remains elusive.

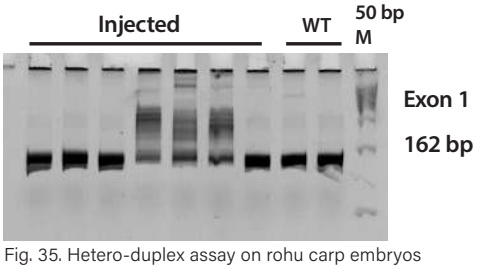


Fig. 35. Hetero-duplex assay on rohu carp embryos with gRNAs.

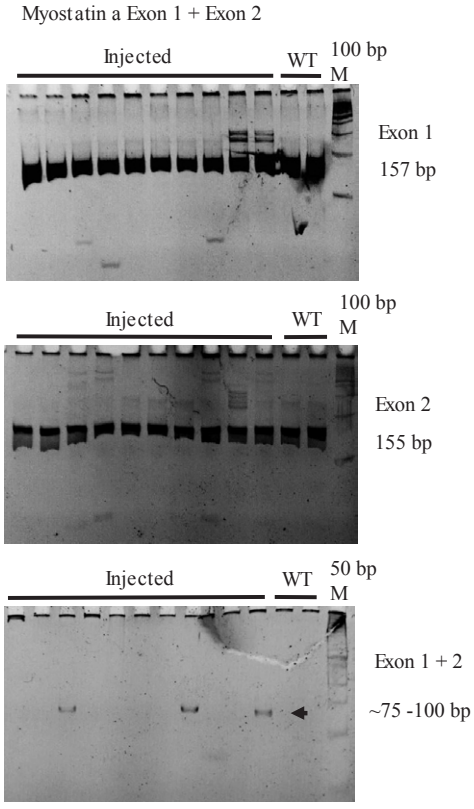


Fig. 33. Zebrafish embryos screened with gRNAs for myostatin Exon 1 and 2

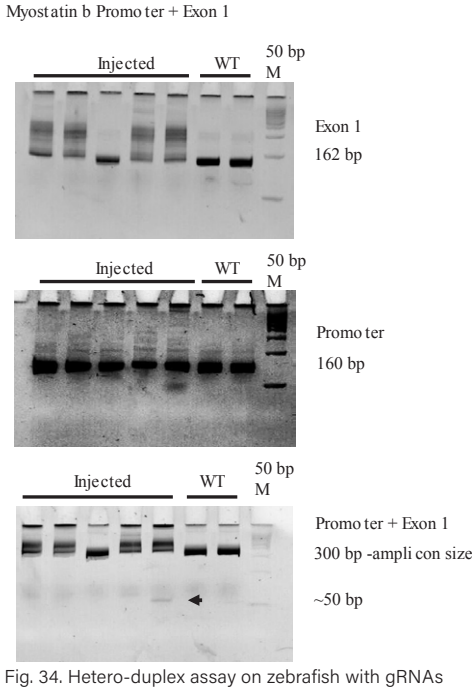


Fig. 34. Hetero-duplex assay on zebrafish with gRNAs targeting Exon 1 and 2 together

Fish Nutrition and Feed Technology

A. Feed Development for Diversified Species

Fatty acid utilization pattern in the developing eggs and yolk-sac larvae of striped murrel (*Channa striata*)

This study investigated the temporal changes in fatty acid composition during the eggs and yolk-sac larval development of striped murrel. The fatty acid profiles exhibited distinct patterns of evolution between developing eggs and yolk-sac larvae. The saturated fatty acid (SFA) content peaked at 32.39% at 48 hours post-fertilization (48 hpf) before declining to 28.46% at 72 hpf (Fig. 36). The mono unsaturated fatty acid (MUFA) content reached its highest value of 43.89% at 72 hpf. The PUFA content peaked at 46.64% at 12 hpf and progressively declined thereafter. PUFAs were consumed at a faster rate compared to MUFAs. After fertilization, n-3 PUFAs were primarily utilized up to 12 hours hpf, while n-6 PUFAs were predominantly consumed after hatching (24 hpf). These findings provide critical insights into the fatty acid requirements and metabolic dynamics during early developmental stages of *C. striata.*

B. Evaluation of Novel Feed Ingredients and Feeding Strategies

Black soldier fly larvae meal as fishmeal replacer in the diet of *Pangasianodon hypophthalmus*

The potential of defatted black soldier fly larvae meal (insect meal, IM) as a protein source in the diet of striped catfish, *P. hypophthalmus* was evaluated. Four iso-proteic (crude protein: 32%) and iso-lipidic (crude lipid: 5%) diets were formulated to contain 0 (control;

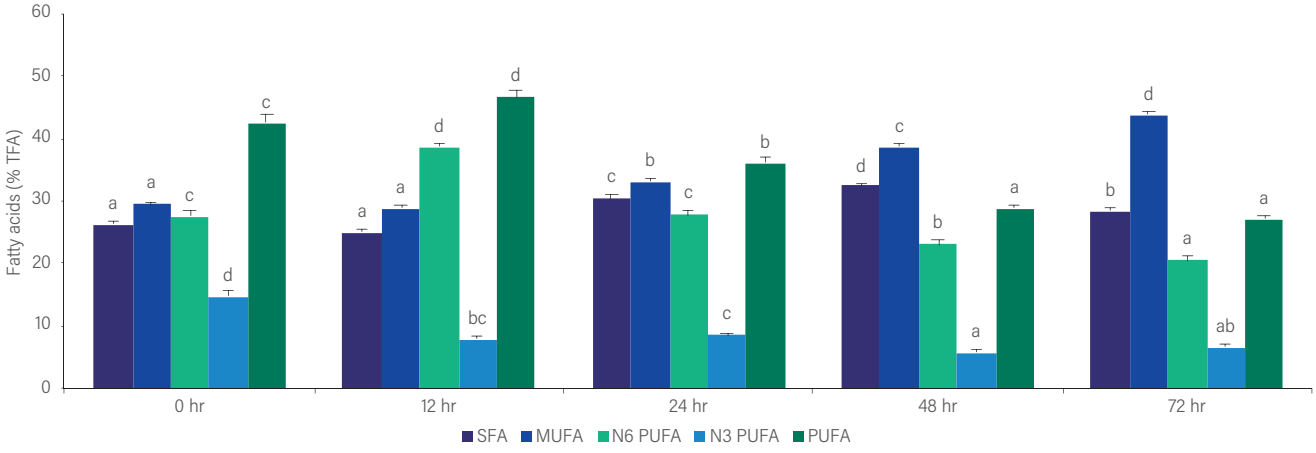


Fig. 36. Fatty acid composition (% total fatty acids) in developing eggs and yolk-sac larvae of the *C. striata*

Table 9. Growth performance of *P. hypophthalmus* fingerlings fed different dietary level of defatted black soldier fly larvae meal

	Control	IM 4	IM 8	IM 12
Initial weight (g)	20.26 ± 0.18	20.50 ± 0.19	20.08 ± 0.31	20.17 ± 0.25
Final weight (g)	32.01^{b} ± 0.62	31.18^{b} ± 0.52	31.37^{b} ± 0.74	29.32^{a} ± 0.67
Feed intake (g/fish)	22.69 ± 0.25	22.96 ± 0.27	22.48 ± 0.44	22.59 ± 0.35
Weight gain (g)	11.75^{b} ± 0.43	10.68^{b} ± 0.69	11.29^{b} ± 0.63	9.15^{a} ± 0.58
Specific growth rate (g %/day)	0.82^{b} ± 0.01	0.75^{b} ± 0.03	0.80^{b} ± 0.03	0.67^{a} ± 0.02
Protein efficiency ratio	1.62^{b} ± 0.02	1.45^{ab} ± 0.09	1.57^{b} ± 0.07	1.27^{a} ± 0.06

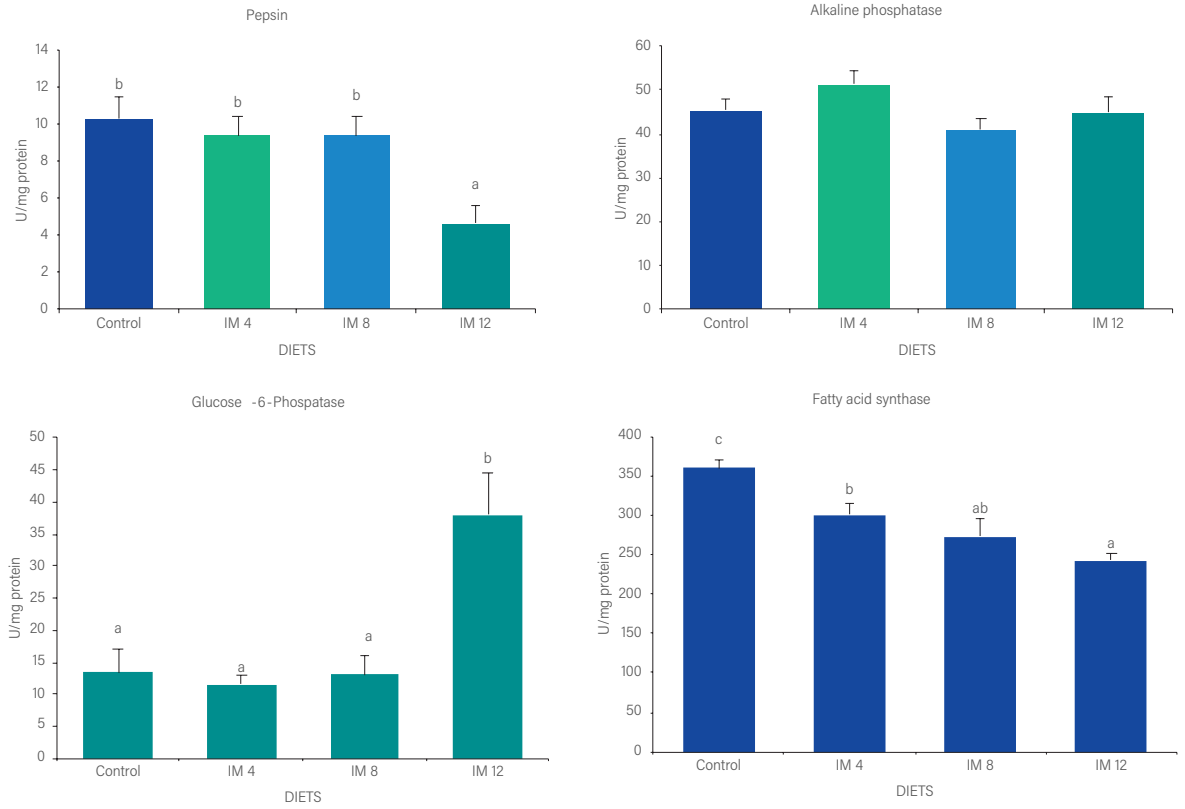


Fig. 37. Digestive and metabolic enzyme activities of *P. hypophthalmus* fed different dietary level of defatted black soldier fly larvae meal

fishmeal-based diet), 4 (IM 4), 8 (IM 8), and 12 percent (IM 12) of insect meal, corresponding to 0, 37.5, 75, and 100% replacement of fishmeal, respectively. A total of 180 fingerlings (initial mean weight: 20.3 ± 0.16 g) were randomly allocated to 12 individual tanks, with each tank stocked with 15 fish. The fish were fed to apparent satiety twice daily for 10 weeks. The findings demonstrated that dietary inclusion levels of insect meal had no statistically significant effect on feed intake. Weight gain (WG), Specific Growth Rate (SGR), and Protein Efficiency Ratio (PER) were similar in fish fed control, IM4, and IM8 diets. However, reduced WG, SGR, and PER were recorded in fish fed the IM12 diet compared to the control (Table 9). The dietary insect meal had no influence on intestinal trypsin, aminopeptidase, and alkaline phosphatase activities. Significantly lower levels of pepsin were observed in fish fed the IM 12 diet compared to other groups (Fig. 37). The activity of hexokinase was similar in all the treatments. Glucose-6-phosphatase activity was highest in fish fed the IM 12 diet compared to other groups. Based on the observed physiological responses, an inclusion level of up to 8% defatted black soldier fly larvae meal, corresponding to a 75% replacement of fish meal, is determined to be optimal for *P. hypophthalmus*.

Omega 3 fatty acid enriched edible algal biomass as feed supplements in *L. rohita*

Nannochloropsis oceanica is a marine microalga known for its exceptional ability to accumulate high levels of polyunsaturated fatty acids, especially omega-3 fatty acids. Four feeds were formulated and prepared for rohu spawn incorporating algae (*N. oceanica)* oil, fish oil, linseed oil and sunflower oil as source of oil, and fed to different treatment

Table 10. Performance of nursery rohu fed on different source of oil

Parameters	Fish oil	Algae oil	Linseed oil	Sunflower oil
Survival (%)	60.93[a]	74.38[b]	61.33[a]	61.37[a]
Weight gain (g)	0.134[b]	0.094[a]	0.093[a]	0.094[a]
FCR	0.920[a]	1.069[b]	1.326[c]	1.300[c]
Lipase (U/mg protein)	0.0032[b]	0.0046[c]	0.0017[a]	0.0012[a]

groups to study its effect in terms of growth performance, survivability, nonspecific immune parameters and gut enzymatic activity. The experiment was carried out in triplicate in 2000 L capacity tanks. The stocking density was 2000 rohu spawn per tank. The fish were fed twice daily for three weeks. Results showed that rohu fry had the highest survivability with algae oil, while growth rate was highest with fish oil (Table 10). Amylase activity peaked in fish fed with fish oil, whereas lipase activity was highest in those fed with algae oil.

Effect of varied dietary protein concentrations on digestive enzyme activities and immune response of *L. rohita*

Three iso-energetic diets for rohu were formulated and prepared using locally available fish feed ingredients, including maize, soybean meal, til oil cake, groundnut oil cake, mahua oil cake, fish meal, de-oiled rice bran, and a mineral-vitamin mixture. These diets were designed with three different levels of crude protein (CP): 22%, 25%, and 28%. Nine hundred rohu juveniles (50 g average weight) were acclimatized in a pond for seven days. Subsequently, the fishes were randomly stocked into nine ponds in a completely randomized design in triplicate, with a single feed assigned to three ponds. At the end of six months of feeding, fish blood and serum samples were analysed for the immunological parameters like respiratory burst, lysozyme, myeloperoxidase, bacterial agglutination, haemagglutination, and haemolytic activities. Five fish from each pond were analyzed for gut enzyme activities, including amylase, protease, and lipase. No significant differences ($p>0.05$) were observed in nonspecific immune parameters among treatments (Table 11).

Sustainable alternate feed resources for optimizing production performance in *P. hypophthalmus*

The chemical composition and ingredient digestibility of corn and rice dried distillery grain with solubles (DDGS) and brewery spent yeast (BSY) were evaluated. The chemical composition of the test ingredients were analysed following standard methods (AOAC, 2023). The crude protein content was found to be 32.41% in corn DDGS, 43.82% in rice DDGS, and 46.27% in BSY (Table 12). To assess the apparent digestibility coefficient (ADC) of test ingredients, three test diets and one reference diet were formulated, each consisting of 70% of a reference diet and 30% of specific test ingredients, based on dry matter. Each of these test diets

Table 11. Nonspecific immunity parameters of rohu fed on three levels of dietary protein

Parameters	T1 (22% CP)	T2 (25% CP)	T3 (28% CP)	P value
Lysozyme (Units/ml)	103.4	103.1	102.8	0.8459
Haemolytic activity (Log_2)	1.844	1.569	1.653	0.2046
Haemagglutination (Log_2)	1.896	1.740	1.694	0.0959

Table 12. Proximate composition (% DM) of corn DDGS, rice DDGS and BSY

	Corn DDGS	Rice DDGS	BSY
Dry matter	89.23 ± 0.81	91.28 ± 1.35	92.41 ± 0.62
Crude protein	32.41 ± 0.35	43.82 ± 0.81	46.27 ± 1.03
Crude fat	8.23 ± 0.52	3.86 ± 0.25	1.42 ± 0.11
Total ash	4.32 ± 0.34	8.51 ± 0.63	6.23 ± 0.27

included 0.7% chromic oxide as a marker. The fish (average weight of 21.6 ± 0.13 g), were acclimatized to the experimental setup (150 L FRP tank), for seven days prior to the commencement of the experiment. Faecal collection was initiated four days after the transition to the experimental diets to ensure the complete evacuation of any previously consumed material. Throughout the trial, the fish were fed twice daily at 09:00 and 17:00 hours till apparent satiety. Approximately 30 minutes post-feeding, any uneaten feed was removed from the system and the faecal samples were collected and subjected to nutrient analysis. ADC of corn DDGS, rice DDGS, and BSY was 82.64%, 79.31%, and 84.6%, respectively, for protein; 85.1%, 87.12%, and 90.81%, respectively, for lipid (Fig. 38).

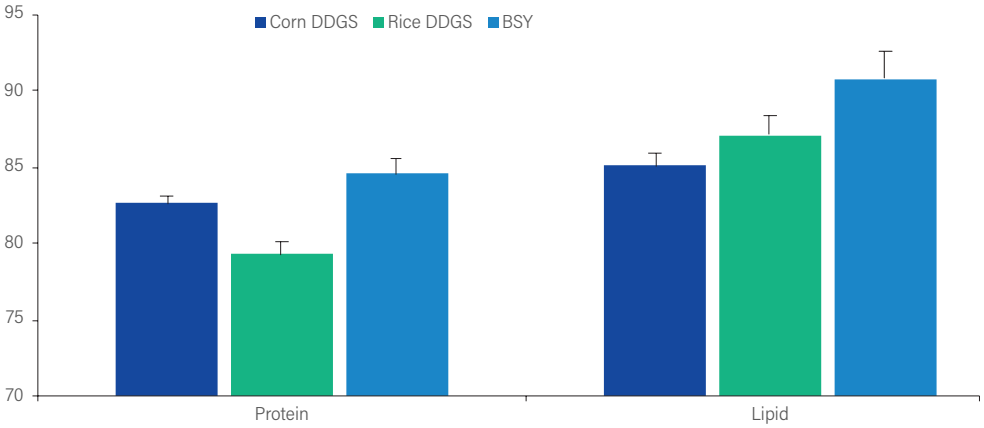


Fig. 38. Apparent digestibility coefficient (ADC) of corn DDGS, rice DDGS and BSY for *P. hypophthalmus*

Aquatic Animal Health Management

A. Antimicrobial Resistance in Fisheries and Aquaculture

Survey of antimicrobial resistance in Aquaculture

As part of an ongoing AMR surveillance initiative, survey and sampling were conducted in 2024 across 143 freshwater fish farms in Odisha and Andhra Pradesh. A total of 136 fish and 121 water samples were collected to isolate *Aeromonas* sp., *Escherichia coli*, and *Staphylococcus* sp. Among 648 bacterial isolates, 236 were *Aeromonas* sp., 210 *E. coli*, and 202 *Staphylococcus* sp. Antimicrobial susceptibility testing (AST) was performed using WHONET2023 software as per the Clinical and Laboratory Standards Institute (CLSI) guidelines. *Aeromonas* sp. showed the highest resistance to cefoxitin (32.6%) and imipenem (35.2%), while *E. coli* exhibited higher resistance to tetracycline (30%) and ampicillin (23.3%) as shown in Fig. 39 and Fig. 40, respectively. *Staphylococcus* sp. demonstrated the highest resistance to penicillin (51%) and erythromycin (46%) (Fig. 41).

Carbapenemase-producing *Escherichia coli* in aquaculture system

To document the prevalence of Carbapenemase-producing *Escherichia coli*

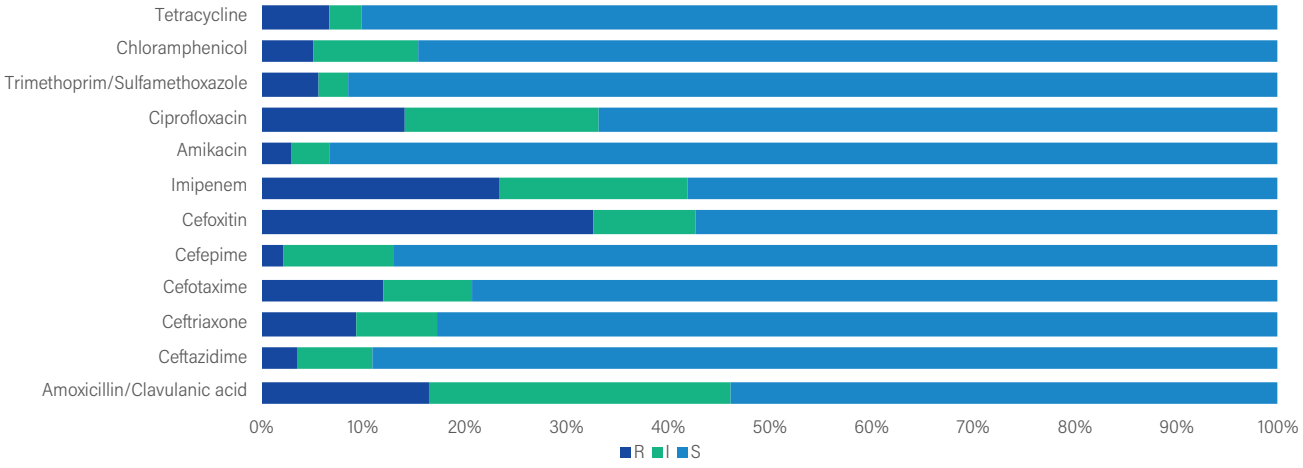


Fig. 39. Resistance pattern in *Aeromonas* sp.

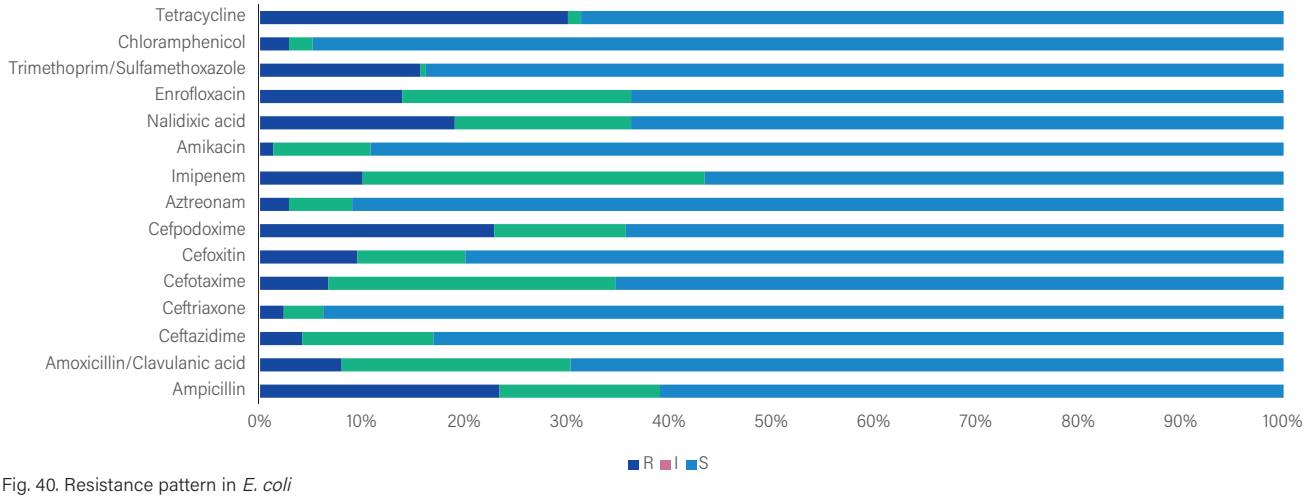


Fig. 40. Resistance pattern in *E. coli*

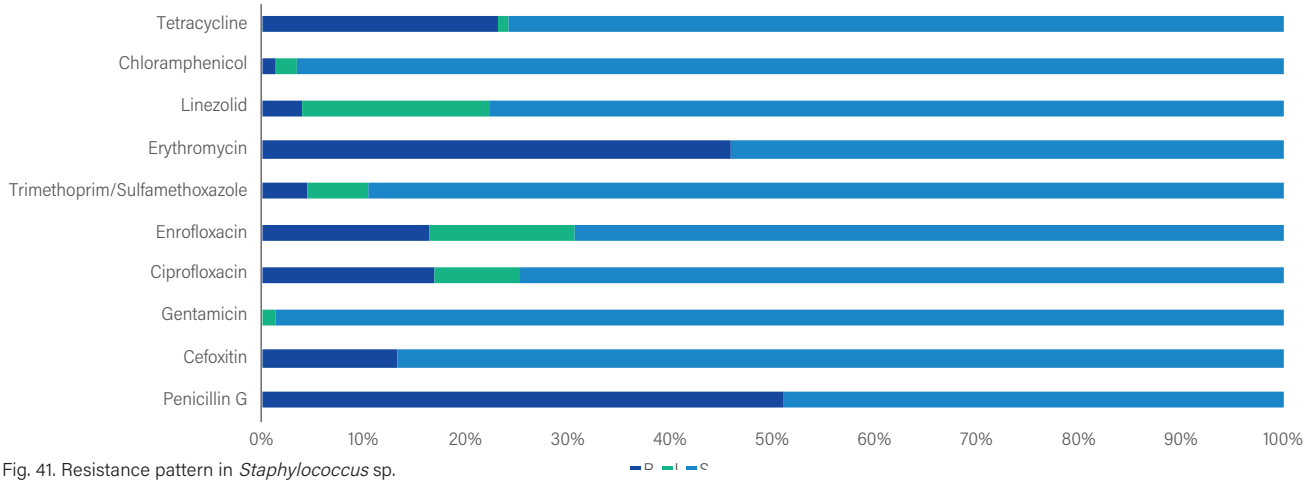


Fig. 41. Resistance pattern in *Staphylococcus* sp.

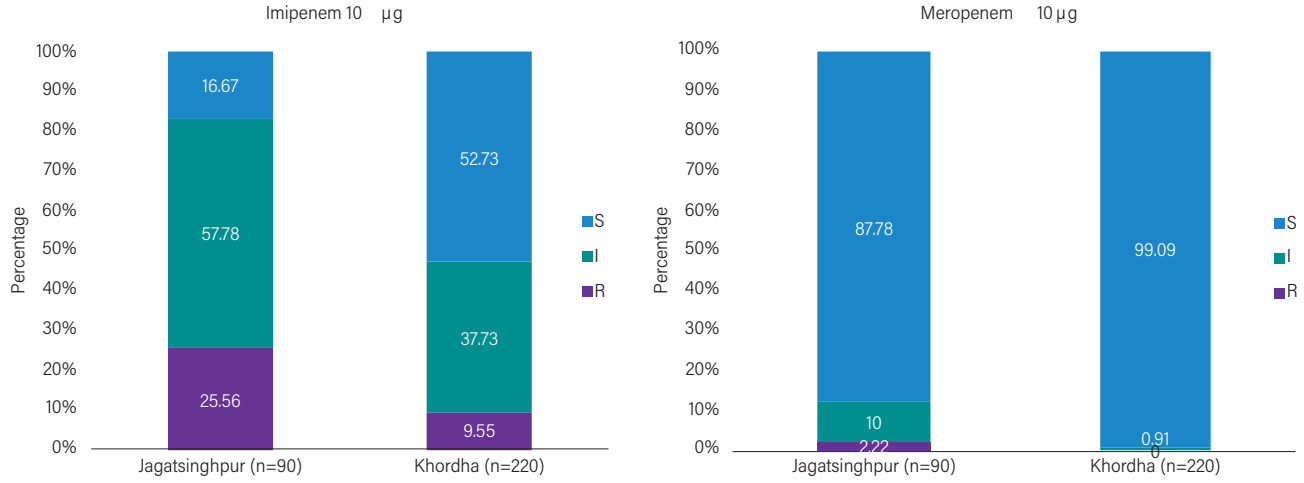


Fig. 42 a & b. Resistance pattern of *E. coli* isolates from Jagatsinghpur (n=90) and Khordha (n=220) district, Odisha against Carbapenem antibiotics (Imipenem and Meropenem).

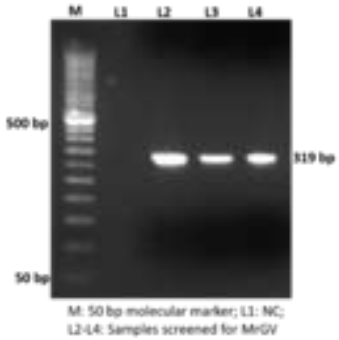
(CREC) in fish and water bodies, samples were collected from 51 fish farms and 9 markets in Khordha and Jagatsinghpur. A total of 53 fish and 51 water samples were processed for *E. coli* isolation, yielding 310 isolates. Screening for carbapenem resistance (Imipenem and Meropenem) by Disk Diffusion Method (CLSI guidelines) identified 44 Imipenem-resistant and 135 intermediate-resistant isolates. Two isolates were resistant to Meropenem, with 11 showing intermediate resistance (Fig. 42 a & b). Further, AST by MIC (VITEK) on 89 *E. coli* isolates revealed resistance to Ertapenem (18 isolates), Imipenem (17), and Meropenem (16).

B. Disease Surveillance and Reporting

Surveillance of aquatic animal diseases

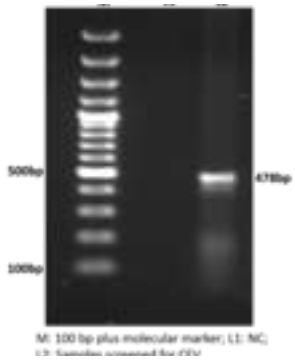
A total of 291 fish samples with GPS coordinates were collected for active surveillance from selected aquaculture farms in Odisha, while 113 passive surveillance cases were investigated, leading to targeted remedial measures. Four awareness meetings were held in Balipatana, Khordha, Bhagabanpur, Kendrapada, and Kanas, Puri, educating 159 farmers on fish disease management.

Piaractus brachypomus with co-infection of *A. hydrophila* and *A. veronii*



PCR for screening MrGV

Koi carp with CEV infection



PCR for screening CEV

Mortalities in *M. rosenbergii* and *P. brachypomus* were linked to *Lactococcus garvieae* through bacteriological and molecular diagnostics. Co-infections of *A. hydrophila* and *A. veronii* were also identified in *P. brachypomus*. In tilapia, heavy mortality cases were diagnosed with TiPV and *Streptococcus agalactiae*, TiLV and *Edwardsiella tarda*. Additionally, Carp Edema Virus (CEV) was identified in koi carp with sluggish movement and mortality.

M. rosenbergii Golda Virus (MrGV) was linked to large-scale mortality in giant freshwater prawn larvae. Mortality events (80–90%) were reported in two hatcheries of Odisha between July and September 2024. Samples sent to the National Referral Laboratory for Freshwater Fish Diseases, ICAR-CIFA, tested positive for MrGV through RT-PCR, sequencing, TEM, and challenge studies. This first Indian report of an MrGV outbreak adds to its known presence in China and Bangladesh, highlighting its emergence as a significant threat to *M. rosenbergii* seed rearing.

Incidence of infectious diseases in various aquaculture farms

Among parasitic diseases, like argulosis, lernaeasis, and myxoboliosis, and among bacterial agents *Aeromonas*, *Pseudomonas*, and *Edwardsiella* were predominant from 23 reported cases in West Bengal. Mixed infections led to mass mortality in *L. rohita* and *P. hypophthalmus* at farms in North 24 Parganas, West Bengal. Mass mortality of pacu was observed in Chebrolu, West Godavari, and carp infections were reported in Bapatla, Andhra Pradesh.

A severe mortality incidence of *H. kolus* and *L. rohita* fingerlings was reported in Karnataka due to infestation by a digenean parasite *Centrocestus*

Carp infested with Argulus and bacterial diseases in Bapatla district, Andhra Pradesh

formosanus. Microscopic examination revealed densely embedded cysts in the gill mid-/cartilages (Fig. 43). The mortality rate was 100% likely due to severe gill damage, leading to impaired oxygen uptake.

Fig. 43. Embedded cysts in gill mid cartilages

C. Development of Novel Therapeutics and Alternatives to Antimicrobials

Immunomodulatory effects of *Bacillus amyloliquefaciens* and β-glucan in murrel *C. striata* fingerlings

To evaluate the effects of *Bacillus amyloliquefaciens* (Ba-CS5) and β-glucan supplementation in snakehead farming, four diets were formulated: a control (basal diet),

Table 13. The effects of different immunostimulants supplemented diets on growth performance, feed utilization and survival of *C. striata* early fingerlings

Growth indices	Control	Bg	Ba-CS5	BgBa-CS5	*p value*
Initial weight (g)	$4.24^{a} \pm 0.08$	$4.47^{a} \pm 0.341$	$4.40^{a} \pm 0.21$	$4.38^{a} \pm 0.24$	0.917
Final weight (g)	$7.30^{a} \pm 0.35$	$9.50^{b} \pm 0.16$	$8.61^{b} \pm 0.52$	$11.41^{c} \pm 0.32$	0.000
Weight gain (%)	$72.03^{a} \pm 2.61$	$116.93^{c} \pm 3.0$	$97.12^{b} \pm 1.34$	$159.96^{d} \pm 1.88$	0.000
FCR	$3.54^{c} \pm 0.073$	$2.99^{b} \pm 0.083$	$3.21^{b} \pm 0.020$	$2.60^{a} \pm 0.147$	0.001
Survival (%)	$92.31^{a} \pm 2.91$	$94.31^{a} \pm 2.91$	$96.16^{b} \pm 2.71$	$96.13^{b} \pm 3.51$	0.102

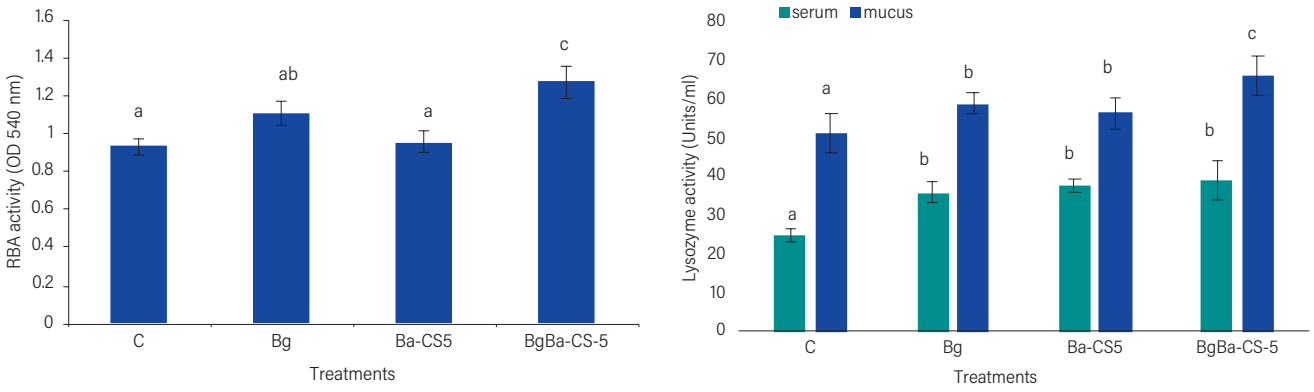


Fig. 44 a & b.Innate immune parameters in *C. striata* early fingerlings fed different immunostimulants supplemented diets

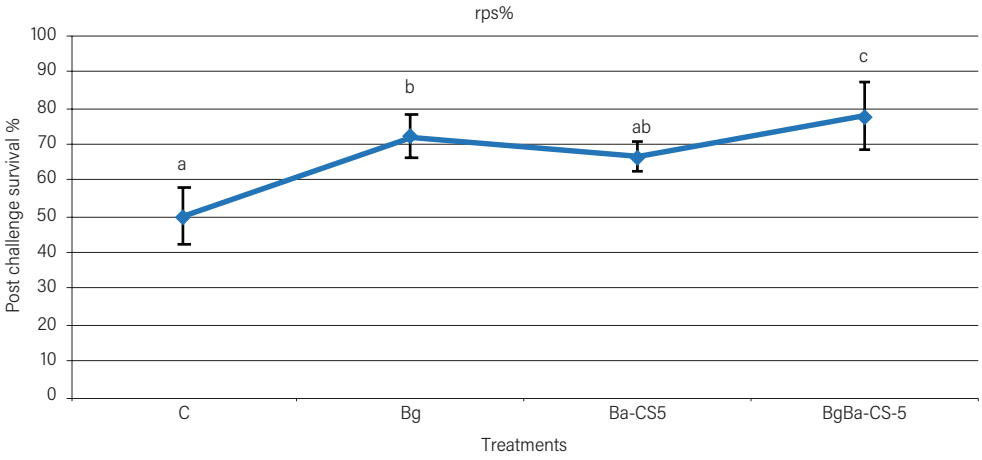


Fig. 45. Survival of *C. striata* early fingerlings challenged with *A. hydrophila* after feeding different immunostimulants diets

Bg (basal diet + 0.5% β-glucan), Ba-CS5 (basal diet + *B. amyloliquefaciens* at 10^8 CFU/g), and BgBa-CS5 (basal diet with both supplements). After 56 days of feeding trial, significant growth improvement ($P<0.05$) was observed in Bg and BgBa-CS5 fed groups (Table 13). Probiotic and β-glucan supplementation enhanced digestive enzyme activities (amylase and total protease) and non-specific immunity, including respiratory burst activity, lysozyme levels, and *insulin-like growth factor-1* (IGF-1) expression (Figs. 44 a & b). Post *Aeromonas hydrophila* challenge, relative survival was significantly higher in Ba-CS5 and BgBa-CS5 groups (Fig. 45). These findings suggest that Ba-CS5, alone or combined with β-glucan, enhances growth and acts as an effective immunomodulator in snakehead farming.

Evaluation of probiotic preparation

In a probiotic feeding trial, rohu (*L. rohita*) fingerlings were fed with diets supplemented with 10^9 CFU/g of four probiotic strains *Lactobacillus* spp. SMM1 (Group A), SMM2 (Group B), SMM19 (Group C), and *Pediococcus* spp. SMM14 (Group D) for 90 days. On Day 30, the highest intestinal lactic acid bacteria (LAB) count was recorded in Group B (7.53 ± 0.28 log CFU/g), followed by Group C (7.00 ± 0.41), Group A (6.58 ± 0.22), and Group D (6.41 ± 0.35), with no increase in the control group. Group B also exhibited significantly higher ($P<0.05$) respiratory burst and serum myeloperoxidase activity (Figs. 46 a & b). Following a 30-day probiotic feeding trial, challenge testing against *A. hydrophila*

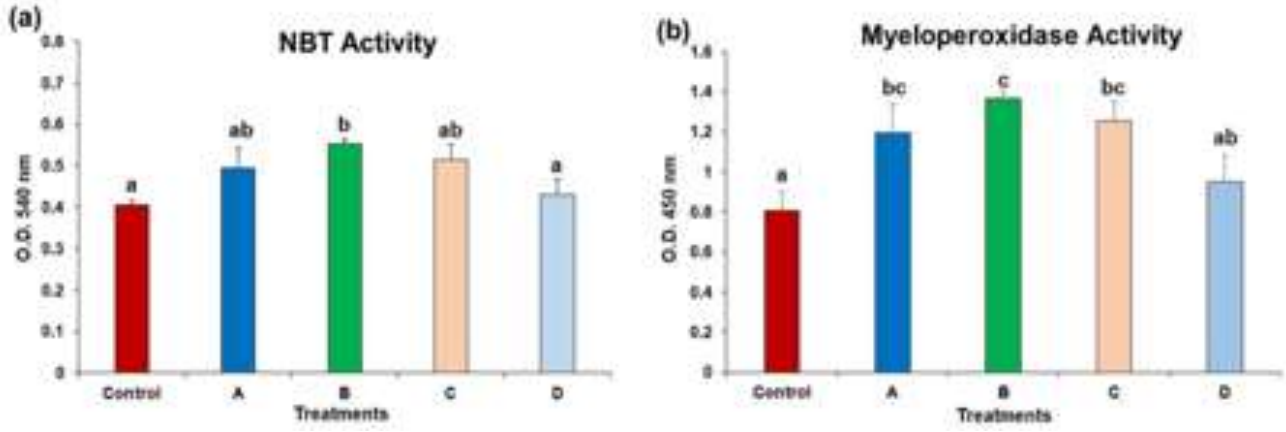


Fig. 46. (a) NBT activity of blood (b) Myeloperoxidase activity of serum from rohu fed control diet and probiotic supplemented diet on day 30 of the experiment

showed a non-significant increase in survival, with Group B having the highest survival rate (50%), followed by Group C (47%), Group A (43.33%), and Group D (36%), compared to 33.33% in the control.

Isolation and evaluation of Lactic acid bacteria

Lactic acid bacteria were isolated from rohu and catla intestines using standard protocols. Most colonies from MRS/LAMVAB plates were gram-positive rods or cocci, categorized by morphology and gram staining before biochemical and physiological testing. The isolates showed varying patterns in utilizing 16 different sugars. Partial 16S rDNA sequencing identified the isolates as strains of *Lactiplantibacillus plantarum*, *L. pentosus*, *L. argentoratensis* *Ligilactobacillus salivarius*, *Lactobacillus gallinarum*, *Lacticaseibacillus rhamnosus*, *Limosilactobacillus reuteri*, and *Pediococcus pentosaceus*. After 3 h of exposure to pH 3, the isolates showed good viability, ranging from 10^6 to 10^8 CFU/ml, and were able to survive bile concentrations of 0.3% even after 24 h. The isolates exhibited a zone of inhibition against *A. hydrophila* ranging from 11 mm to 16 mm (Fig. 47). Most isolates displayed high autoaggregation (>80%), and co-aggregation with *A. hydrophila* ranged between 15–60% (Fig. 48).

Isolation of a bacterial isolate for ammonia utilization

A probiotic microbial strain with potential bioremediation properties, isolated from the RRC, Bengaluru farm, was characterized

Fig. 47. Different LAB isolates showing zones of inhibition against *Aeromonas hydrophila*

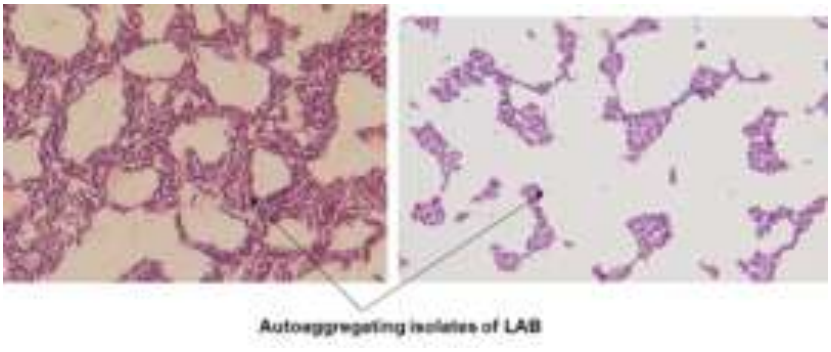


Fig. 48. Gram's stain images of LAB

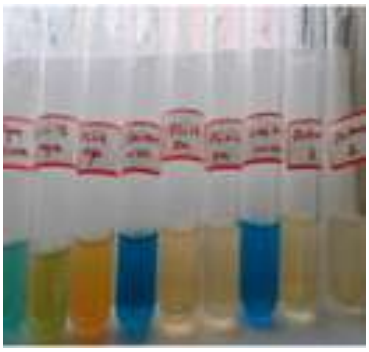


Fig. 49. Characterization of microbe for ammonia utilization

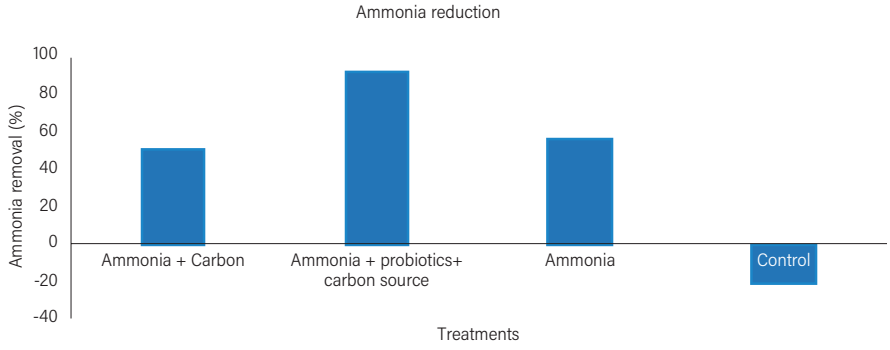


Fig. 50. Ammonia reduction by bacterial inoculum

for its ammonia utilization ability in an *in vitro* study by culturing it in nutrient broth spiked with ammonia (Fig. 49). To further validate its efficacy, an indoor experiment was conducted by inoculating the bacterial strain into ammonia (5 ppm) spiked water. After four days, ammonia levels were reduced by 92% in the presence of jaggery as a carbon source, whereas treatments with or without the probiotics but lacking a carbon source showed only a 50–55% reduction (Fig. 50). In contrast, the control (without ammonia spiking) exhibited a 21% increase in ammonia levels over the same period. These findings confirmed the *in vitro* results, demonstrating the bacterial inoculum's ammonia utilization capacity and making it a promising candidate for bioremediation in biofloc-based aquaculture.

Flocculation and ammonia amelioration properties of the isolated native heterotrophic bacteria in biofloc system

An experiment was conducted to evaluate the flocculation and ammonia amelioration properties of the 12 isolated bacteria. Pilot experiments were performed to screen the best-performing isolates based on water quality, flocculation, and floc formation ability. Two strains *Bacillus thuringensis* and *Bacillus* sp. demonstrated superior performance according to these criteria, leading to further experiments using these strains in the biofloc system.

Immunomodulatory efficacy of *Ocimum sanctum* extract in *L. rohita* against fish pathogen *Aeromonas diversa*

Based on the results of feed dose standardization study, *L. rohita* were fed an iso-nitrogenous diet supplemented with *O. sanctum* leaf extract (500 mg/kg feed; 4xMIC) for 60 days, followed by challenge exposure to *A. diversa* LRK3 at a sub-lethal dose of 2.3×10^5 CFU/ml. The fish exhibited significantly enhanced innate immune responses ($P<0.05$), including increased serum respiratory oxidative burst, anti-protease, myeloperoxidase, antioxidant (FRAP), ceruloplasmin, and C-reactive protein levels. Post-bacterial challenge, the treated group maintained a higher immune response from 1 to 10 days post-infection (dpi) compared to the placebo control and positive control groups. Haemato-biochemical parameters improved significantly ($P<0.05$) in the treated group. Treated group showed enhanced specific growth rate (SGR) and reduced feed conversion ratio (FCR), demonstrating its immunomodulatory and growth-promoting potential in *L. rohita*.

Efficacy of African basil, *Ocimum gratissimum* in boosting growth and haematological indices in *L. rohita*

Leaf extracts obtained using different organic solvents were tested *in vitro* against fish pathogens, including *A. diversa, A. sobria, A. jandaei, Edwardsiella piscicida, Escherichia coli,*

and *Pseudomonas putida*. The ethanolic extract exhibited the highest antibacterial activity, with inhibition zones ranging from 20–28 mm. Dietary supplementation with *O. gratissimum* leaf extract (OGE) significantly enhanced ($P<0.05$) growth performance in a dose-dependent manner over a 60-day feeding trial, as indicated by an improved specific growth rate (SGR). Additionally, haematological parameters, including red blood cell (RBC) and white blood cell (WBC) counts, haemoglobin (Hb) concentration, mean corpuscular haemoglobin concentration (MCHC), mean corpuscular volume (MCV), and mean corpuscular haemoglobin (MCH), were significantly improved in the OGE-supplemented group.

Evaluation of dietary Karanja leaf meal on non-specific immunity in rohu, *L. rohita*

Rohu fingerlings (8.52 ± 2.5 g) were randomly assigned to four dietary treatments (4Tx3R) with Karanja (*Pongamia pinnata*) leaf meal inclusion: 0.5% (T1), 1.0% (T2), 1.5% (T3), and a control (without extract) for 45 days. Fish were sampled at 15-day intervals (15, 30, and 45 days) to assess non-specific immune and biochemical parameters. Lysozyme activity was higher in T1 and T2 than in the control at 45 days, whereas respiratory burst activity declined across treatments. Serum glucose levels increased over time in all treatment groups, while serum protein and albumin levels decreased after 45 days. Overall, dietary Karanja leaf meal had a negative impact on non-specific immune and biochemical parameters in *L. rohita*.

Efficacy of selected herbal formulation against *A. hydrophila* and *E. tarda*

An herbal formulation containing *Andrographis paniculata*, *Thymus vulgaris*, *Mentha piperita*, and *Zingiber officinale* was developed and evaluated for antibacterial activity against *A. hydrophila* and *E. tarda*. GC-MS analysis identified key bioactive compounds, including acetosyringone and α-monostearin (*A. paniculata*), thymol, terpinene, and p-cymene (*T. vulgaris*), 1,8-cineole and p-cymene (*M. piperita*), and zingiberene, α-cedrene, and p-cymene (*Z. officinale*). Minimum inhibitory concentration (MIC) was assessed using a broth dilution assay. The formulation (HF-1) inhibited *A. hydrophila* within 20 min at 1:10 dilution and 25 min at 1:100, while *E. tarda* growth was inhibited within 15 min at 1:10 and 20 min at 1:100.

Biosafety evaluation of titanium dioxide (TiO_2) nanoparticles

Toxicity assessment of TiO_2 nanoparticles (TiO_2-NP) was conducted in *L. rohita* at

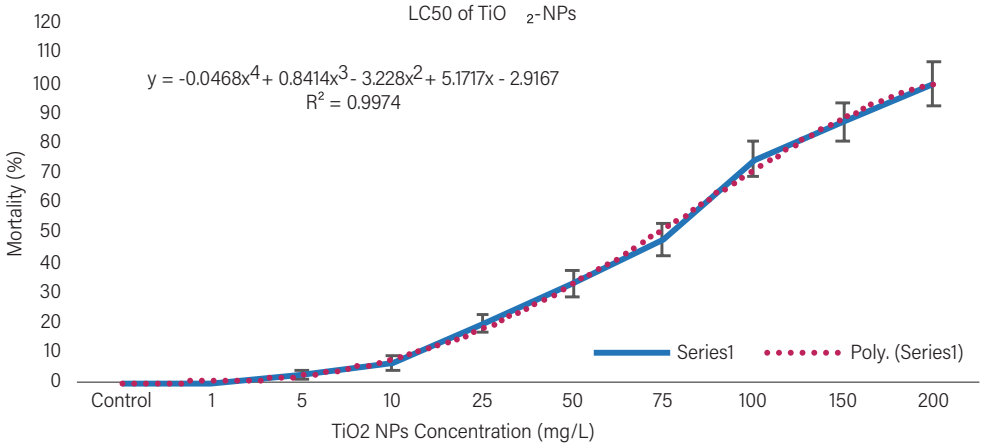


Fig. 51. The 96-hour lethal concentration (96h LC_{50}) value of TiO_2-NP in rohu, *Labeo rohita* exposed to different concentrations of TiO_2-NPs: 0, 1, 5, 10, 25, 50, 75, 100, 150 and 200 mg/L

sub-lethal concentrations of 1, 2.5, and 5 mg/L, with evaluations at 24 h post-exposure (hpe), 4 days post-exposure (dpe), and 14 dpe. The 96 h lethal concentration (LC_{50}) of TiO_2-NP in rohu was determined to be 77.49 mg/L (Fig. 51).

ICP-AES analysis was performed to assess titanium (Ti) bioaccumulation in various organs of *L. rohita* following immersion exposure at 5 mg/L, evaluated at 24 hpe, 4 dpe, 14 dpe, and 40 dpe. The highest Ti bioconcentration was observed in the intestine, followed by the liver, gills, kidneys, and spleen, with negligible accumulation in muscle tissue. Ti levels gradually increased, peaking at 14 dpe, before returning to baseline by 40 dpe in all organs.

Haematological and serum immune parameters

Myeloperoxidase activity (MPO) (Fig. 52 a) significantly increased upon exposure to 1 and 2.5 mg/L TiO_2-NPs from 24 hpe to 14 dpe, while the higher dose of 5 mg/L led to a significant decrease in MPO activity compared to the control. Respiratory burst activity (RBA) in blood (Fig. 52 b) and serum bactericidal activity (Fig. 52 c) were significantly enhanced at 1, 2.5, and 5 mg/L doses throughout the experimental period, with highest RBA and bactericidal activity observed at 14 dpe. Serum lysozyme activity and antiprotease activity significantly decreased across all TiO_2-NP doses throughout the experimental period.

Expression analysis of immune-oxidative, stress and apoptosis pathway genes

The pattern recognition gene, TLR22, was significantly upregulated from 24 hpe to 14 dpe following exposure to TiO_2-NPs (Fig. 53 a). Among pro-inflammatory cytokines, IL-1β and TNF-α genes (Fig. 53 b) were significantly upregulated during the same period, while the expression of IL-8 (Fig. 53 a) remained unchanged. No significant changes were observed in the expression of the anti-inflammatory cytokine, IL-10. Throughout the experiment, the expression of TGF-β, a regulatory cytokine, remained significantly elevated. Fold changes in the expression of immune-related, oxidative defense, and apoptosis-related genes were calculated using EF1α as the reference gene.

The oxidative stress marker genes SOD, CAT, and GPx were significantly upregulated at all-time points, with higher TiO_2-NP doses inducing a greater fold change in their expression. The highest fold change in SOD, CAT, and GPx expression was observed at 14 dpe (Fig. 54). However, apoptotic genes caspase3, BAX, and p53 showed significant upregulation only at 14 dpe in the high-dose 5 mg/L group. Exposure to TiO_2-NP at 1 and 2.5 mg/L had no effect on apoptotic gene expression at 14 dpe. Additionally, exposure to 5 mg/L TiO_2-NP at 24 hpe and 4 dpe did not influence apoptotic gene expression.

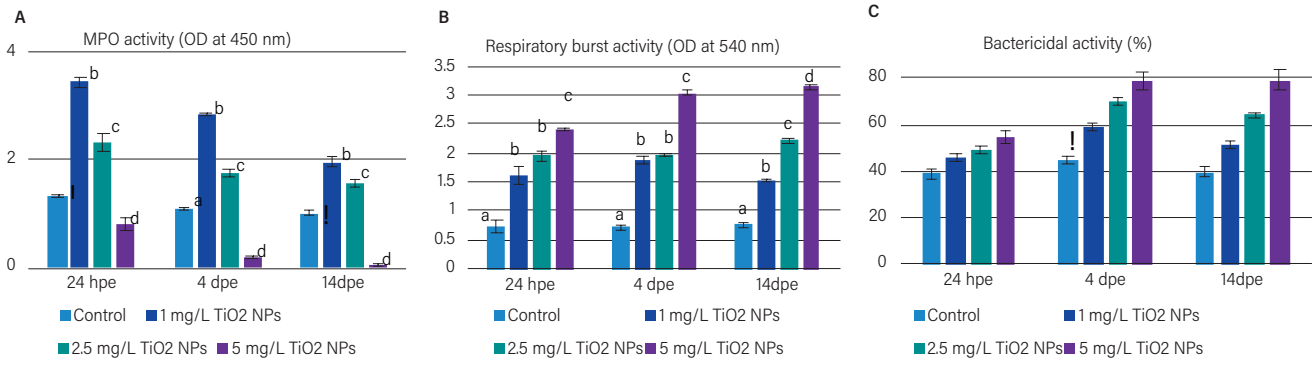


Fig. 52. Effect of sub lethal concentration of TiO_2 nanoparticle exposure at 0 mg/L (control), 1 mg/L, 2.5 mg/L, and 5 mg/L on serum immune parameters (a) myeloperoxidase activity (MPO), (b) respiratory burst activity (RBA), (c) bactericidal activity at 24 hpe, 4th dpe and 14th dpe in *L. rohita*.

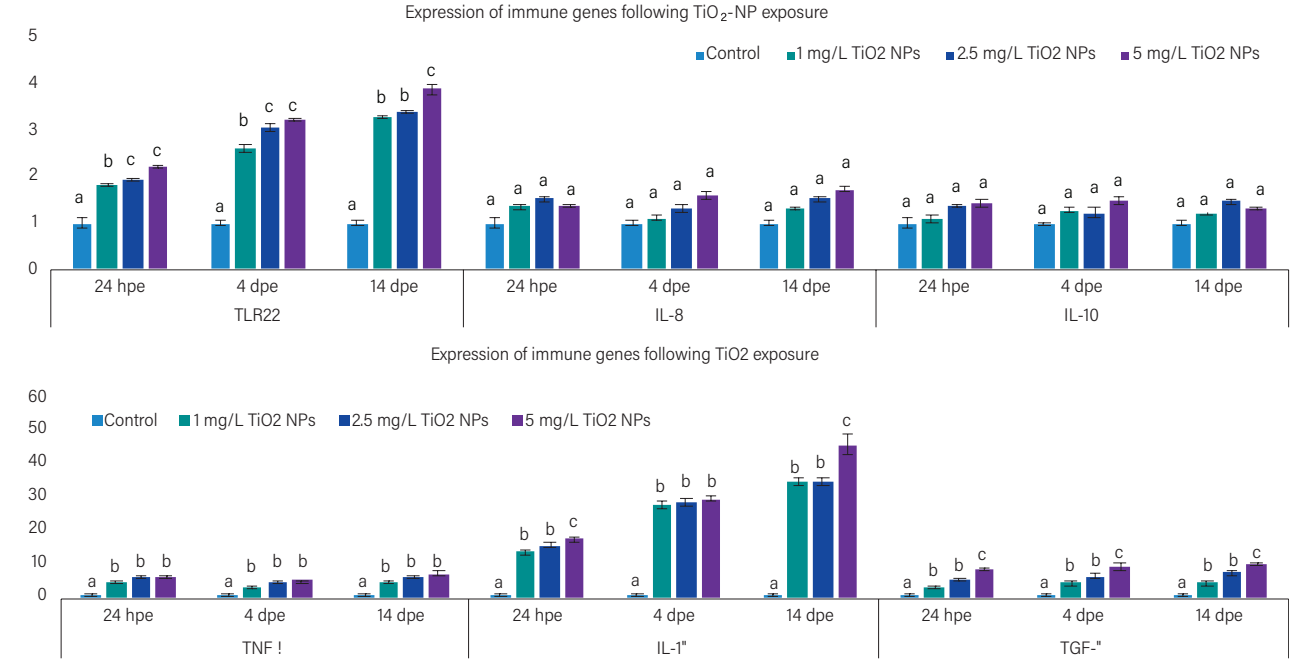


Fig. 53. Effect of sub lethal concentration of TiO_2-NP exposure at 0 mg/L (control), 1 mg/L, 2.5 mg/L, and 5 mg/L on immune-mediated biomarker gene expression (a) TLR22, IL-8, IL-10, (b) TNF α, IL-1β, and TGF-β at 24 hpe, 4th dpe and 14th dpe in *L. rohita*.

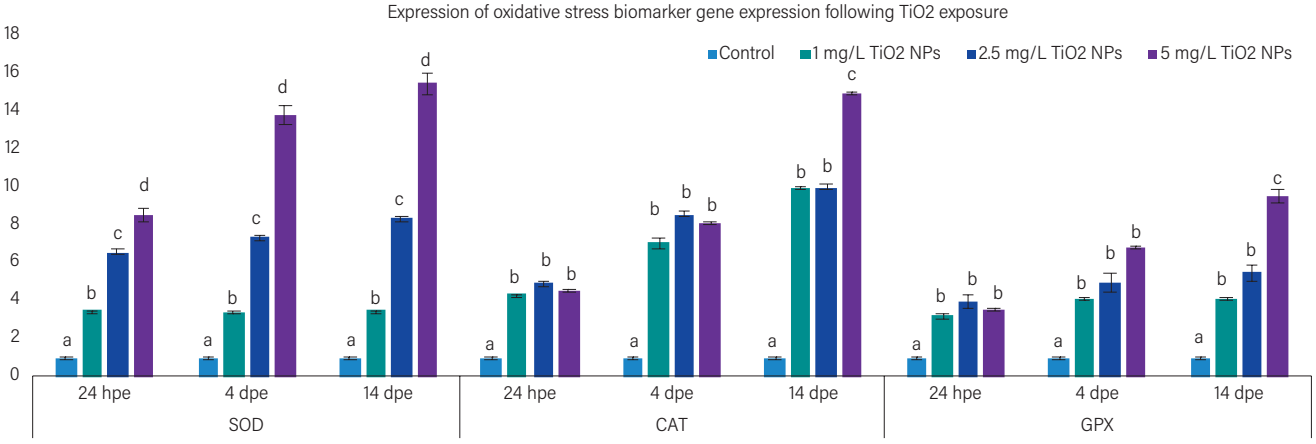


Fig. 54. Effect of sub lethal concentration of TiO_2-NP exposure at 0 mg/L (control), 1 mg/L, 2.5 mg/L, and 5 mg/L on (A) SOD, CAT and GPx oxidative stress biomarker genes and (B) caspase3, BAX and p53 apoptotic biomarker genes at 24 hpe, 4th dpe and 14th dpe in Indian major carp, rohu, Labeo rohita. All the data is presented as the average of three observations (n = 3). Bars presented as Mean ± SE. Different superscript above the bar denote statistically significant differences ($p \leq 0.05$) between treatment groups at experimental time points. The bars with same superscript indicate that there is no significant difference ($p \geq 0.05$).

Determination of withdrawal period of orally administered Florfenicol (FFC) in advance fingerlings of *L. rohita*

The study was designed to determine the withdrawal period of orally administered florfenicol (FFC) in advanced fingerlings of *L. rohita* (avg.wt.12.0 g). Fishes were administered FFC at a therapeutic dose of 15 mg/kg/day for ten consecutive days, and residue levels were analyzed in muscle (with skin), liver, and plasma at 2-day intervals post-treatment for up to 31 days using LC-MS/MS (Fig. 55). The highest FFC concentrations were observed on day 10 in muscle (2.73 µg/g), liver (0.169 µg/g), and plasma (0.118 µg/g). Residue levels declined over time, remaining quantifiable until

day 13 post-dosing. The withdrawal period, estimated based on the maximum residue limit (1.0 µg/g) set by the European Medicines Agency (2002), was determined to be 6 days. FFC residues fell below detectable levels by day 12 in the liver and day 8 in plasma. The findings support the use of dietary FFC at 15 mg/kg biomass/day for 10 days as a safe therapeutic regimen for *L. rohita*.

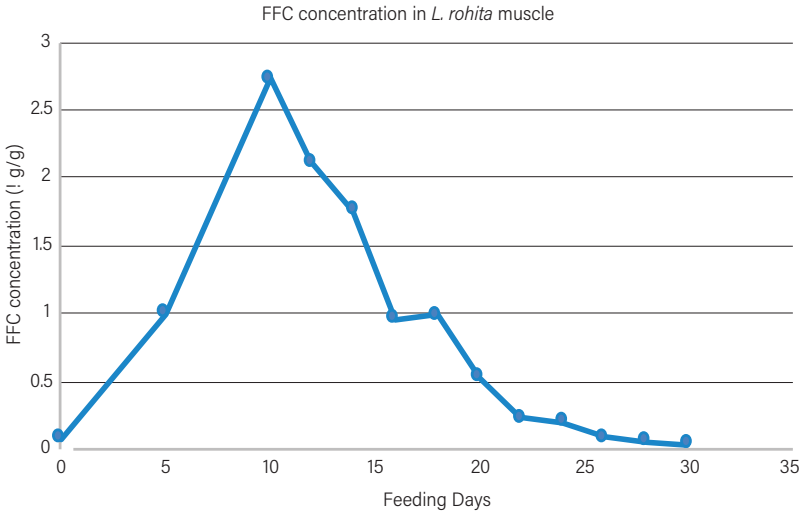


Fig. 55. FFC concentration in muscle of *L. rohita*

Biosafety and tissue residue evaluation of Florfenicol (FFC) in *L. rohita*

Rohu advanced fingerlings 300 nos. (avg. wt. 20 g) were fed with experimental diet containing FFC at 10 mg/kg (1X); 30 mg/kg (3X); 50 mg/kg (5X); 100 mg/kg (10X) of fish biomass per day along with basal diet without FFC at 3% body weight per day for 30 days. After the end of the medicated feed trials, basal diet without FFC were fed in all the groups for a further 10 days. Every 10th day, the fishes were sampled, and muscle tissue was analyzed for antibiotic residue. It was found that the FFC residue in fish muscle varied in a dose-dependent manner. However, the tissue residue level came to below MRL level (1000 µg/kg) within 10 days at all the doses.

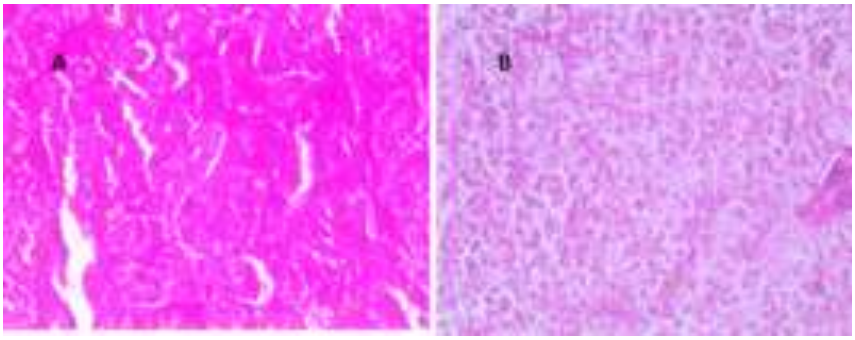


Fig. 56. Histopathological architecture of H & E stained kidney (A) and liver (B) tissue sections of *L. rohita* fed with oxolinic acid as feed additives at 180 mg/kg of fish biomass/day for 15 days

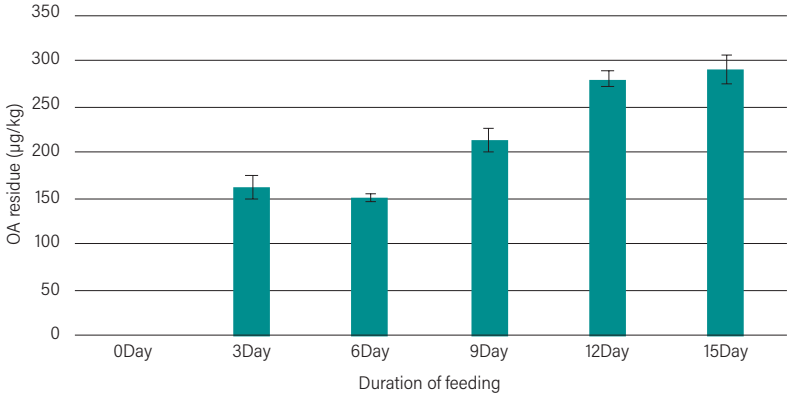


Fig. 57. Muscle tissue residual level of OA in *L. rohita* after 3-15 days of therapeutic recommended oral supplementation

Evaluation of biosafety and tissue level residues in rohu, *L. rohita* juveniles upon dietary administration of oxolinic acid

A study on biosafety and tissue residue dynamics of oxolinic acid (OA) in rohu demonstrated its accumulation and clearance patterns under graded dietary administration. Fingerlings (18 ± 2.5 g) were

fed OA at 0 (control), 60 (1X), 180 (3X), 300 (5X), and 600 (10X) mg/kg biomass/day for 15 days, followed by an 11-day withdrawal period. Sampling was conducted at three-day intervals. Higher-dose groups exhibited reduced feed intake and growth. Histopathological analysis of kidney and liver tissues in the 10X group revealed significant alterations, including glomerular shrinkage, tubular lumen reduction, hepatic vacuolation, and necrosis (Fig. 56). LC-MS/MS analysis indicated dose- and duration-dependent OA retention in muscle tissue (Fig. 57). Residue levels in the 1X group were significantly higher than the control ($P < 0.05$) but remained below the Maximum Residue Limit (MRL) set by the Food Safety and Standards Authority of India (FSSAI). These findings provide insights for policy formulation on the responsible use of OA in carp aquaculture to ensure fish health and safety.

Pharmacokinetics study of oxolinic acid in *L. rohita*

Pharmacokinetics and tissue distribution of oxolinic acid in rohu juveniles (90-110 g) were studied. Fish were randomly assigned to 12 FRP tanks (500 L; 15 fish per tank) and provided a single-dose medicated feed containing 60 mg oxolinic acid per kg biomass. Tissue samples (liver, kidney, bile, intestine, muscle, plasma) were collected at 2, 3, 4, 6, 8, 12, 24, 32, 48, 72, 96, and 128 h post-administration and analyzed using LC-MS/MS. The highest drug concentration (A) was observed in the intestine (18,839.01 µg/kg) and liver (13,756.66 µg/kg), with lower levels in kidney, bile, and plasma. The absorption rate constant (ka) was highest in muscle (9.85 h^{-1}) and intestine (8.98 h^{-1}), indicating rapid absorption, while plasma and bile showed slower rates. The intestine reached the highest C_{max} (17,500 µg/ kg) at T_{max} 2 h, followed by liver (11,100 µg/kg at 3 h) and bile (11,100 µg/ kg at 6 h). Muscle and plasma had C_{max} values of 4,050 µg/ kg (2 h) and 3,100 µg/ kg (8 h), respectively.

Medical leech

Collection, identification and culture of medicinally important leech

Towards establishing a medicinal leech farming protocol to ensure a sustainable supply for medical use, leeches were collected from multiple regions across India and morphologically identified as belonging to the order Arhynchobdellidae. Species confirmation was achieved through PCR amplification and sequencing of 28s and COI rDNA, revealing 96% similarity with *Poecilobdella nanjingensis* and 95% with *Hirudinaria manillensis*. A genus/species-specific PCR assay was developed using RAPD primers, with amplified segments cloned and sequenced. For leech maintenance, earthen pots were identified as the most suitable option compared to plastic containers and glass aquariums. Ethical feeding methods and materials have been standardized, with ongoing experimentation of live and sterile alternatives. A viable transportation prototype has been developed, successfully tested in the lab, and is now undergoing field trials. Additionally, breeding trials mimicking natural conditions are also in progress to optimize farming protocols.

D. Vaccine Development

Evaluation of formalin-inactivated Tilapia lake Virus (TiLV) ultrapellet vaccine

An vaccine trial was conducted in tilapia (*Oreochromis niloticus*) with formalin-inactivated TiLV ultrapellet vaccine by

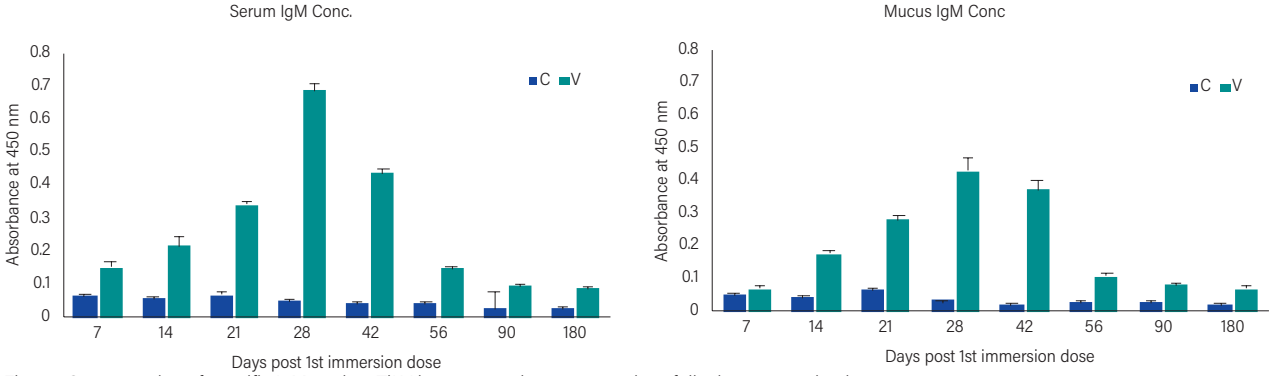


Fig. 58. Concentration of specific IgM against TiLV in serum and mucus samples of tilapia post vaccination

immersion mode. Forty-five numbers of tilapia were released in aerated water that contained the vaccine material at a dose of 4 µg/g body weight. The vaccine was mixed with Montanide adjuvant at 1:1 ratio prior to mixing with water. Another 45 tilapia were immersed in water mixed with same volume of PBS and Montanide as control. The fish were exposed to the vaccine for 5 h and then brought back to the corresponding maintenance tanks at 15 numbers per tank. A single booster dose was given similarly after 14 days of the 1st dose. The fish were challenged with TiLV virus (1.2×10^8 copy numbers per 100 µl) after 21 days of the booster dose and observed for 28 d for mortality. A total of 31 fish died out of 45 in the control group while only 5 died in the vaccinated group. Thus, the vaccine showed protection with relative percent survival of 83.88%.

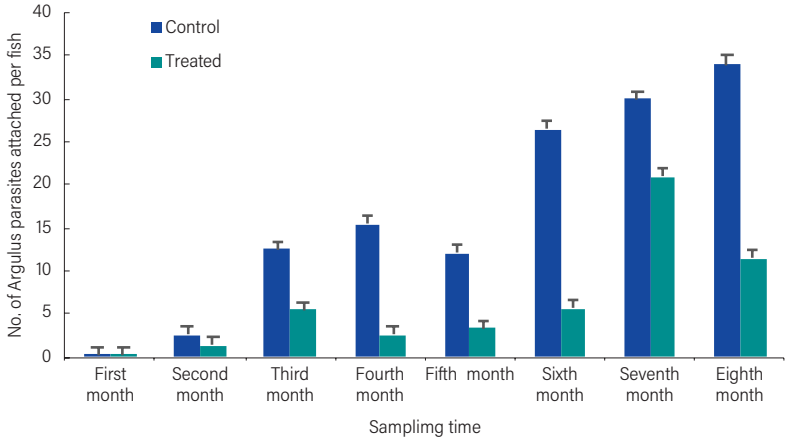


Fig. 59. Parasite load at different months of sampling on vaccinated rohu. *indicates significantly different from corresponding control

Also, the specific IgM antibody response against TiLV was evaluated in immersion-vaccinated fish. The fish were vaccinated following the dose and schedule as above and, serum and mucus samples were collected at 7, 14, 21, 28, 42, 56, 90 and 180 days post 1st dose of vaccine. As evident from Fig. 58, the concentration of IgM increased gradually and reached the highest at 28 d in both serum and mucus samples. Throughout the study, the concentration of IgM remained significantly higher in vaccinated group than that of the control except for the mucus samples at 7 day. The results thus support the antibody-mediated protection shown by the vaccine in the challenge test.

Evaluation of KLH-conjugated peptide vaccine against argulosis

Rohu fingerlings (17 g) maintained in 500 L cement tanks were divided into two groups (control and vaccinated). Hundred numbers of fish were immersion vaccinated with our developed KLH-conjugated peptide at 1 µg/g body weight of fish. The vaccine material (1 mg/ml) was mixed with Montanide adjuvant at 1:1 (v/v) prior to application. After immunization, the fishes were transferred to their original maintenance tanks. On 14th day of immunization, the fish were given booster immunization with the same dose and were then slowly released to one pond (size: 0.01 ha). The same numbers of control fish were also transferred to another adjacent pond of

similar size. Seventeen days after booster, the fishes were cohabitation challenged with argulus-infested rohu maintained in the laboratory. The fishes were tagged with PIT tags and equal numbers of infected fish were released to control and vaccinated ponds. The challenge process continued at 2 weeks intervals up to 5 months. The results clearly showed significantly lower parasite attachments up to the study period of eight months and confirmed the protection conferred by the developed vaccine (Fig. 59).

Isolation and virulence evaluation of *Aeromonas veronii*

Aeromonas veronii WSAV-01 was isolated, identified, and confirmed through 16S rRNA gene sequencing, with the sequence submitted to GenBank (Accession No. PQ856769). To assess its virulence, healthy rohu (*L. rohita*) were intraperitoneally injected with live bacterial cells, resulting in clinical signs mirroring natural infections, such as erythematous lesions, ulceration, stomach distension, exophthalmia, and hemorrhagic septicaemia. Virulence-associated genes, including those linked to secretory systems, were identified using standard PCR. Phylogenetic analysis confirmed that *A. veronii* WSAV-01 (PQ856769) clusters with other known *A. veronii* strains, supporting its classification within this species.

Feed-based and immersion vaccination study

A rough live attenuated variant of *A. hydrophila* (LAAHV), derived from a smooth virulent strain through continuous passage, was selected as a vaccine candidate. This variant demonstrated no disease or mortality in immunized fish. The lyophilized LAAHV vaccine, containing 8×10^{11} CFU/g, was supplied by Indian Immunologicals Ltd, Hyderabad, for laboratory evaluation. Healthy juvenile rohu (n = 50; 15 ± 2 cm length; 50 ± 4.54 g weight) were acclimatized for one month in 1000 L cement tanks for a feed-based vaccination study. Alginate-coated feed containing live attenuated A. hydrophila vaccine (LAAHV-feed) was prepared ($2X10^6$, $4X10^6$, $1X10^7$, $2X10^7$ CFU/ml). Control feed was prepared similarly using sterile distilled water. For immersion vaccination, healthy rohu fry (n = 150; 3.5 ± 1.5 cm length; 1 ± 0.5 g weight) were acclimatized for one month in 15 L aquarium tanks. Targeted concentrations for immersion vaccination were $2X10^5$, $4X10^5$, $1X10^6$, $2X10^6$ CFU/ml.

Vaccinated fish exhibited superior growth

Preparation of vaccine-coated feed & challenge experiment in rohu juveniles

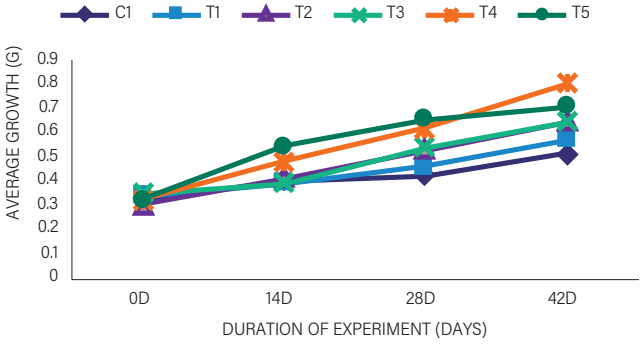


Fig. 60. Growth rate of rohu fry following immersion vaccination

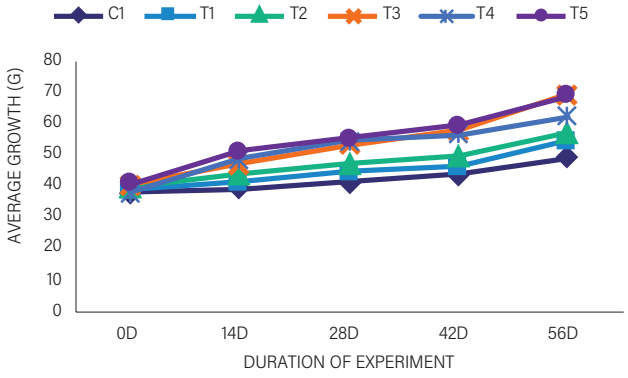


Fig. 61. Growth rate of rohu juveniles following feed vaccination

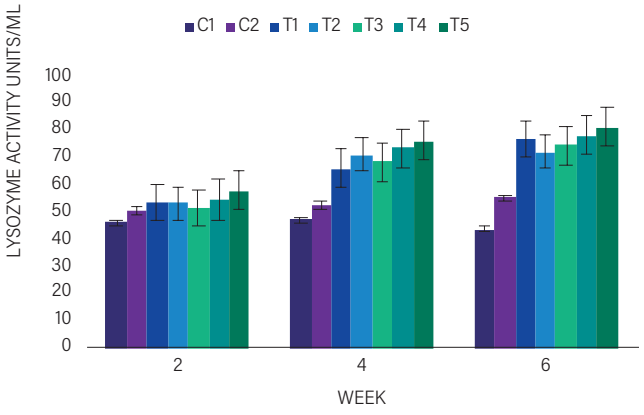


Fig. 62. Lysozyme activity in vaccinated and control group at 2 weeks, 4 weeks and 6 weeks of post feed-based vaccination. C1: control 1, C1: control 2, T1: 1X vaccine, T2: 1X vaccine + vitamin C, T3:2X vaccine, T4: 5X vaccine, T5: 10X vaccine groups.

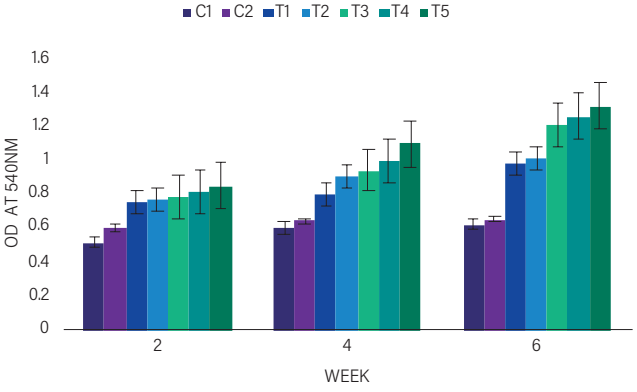


Fig. 63. Respiratory burst activity in vaccinated and control group at 2 weeks, 4 weeks and 6 weeks of post feed-based vaccination. C1: control1, C1: control2, T1: 1X vaccine, T2: 1X vaccine +vitamin C, T3: 2X vaccine, T4: 5X vaccine, T5: 10X vaccine groups

compared to non-vaccinated controls over four months' post-vaccination (Figs. 60, 61). Nonspecific immune parameters, including lysozyme, myeloperoxidase, and respiratory burst activity, were significantly higher in all vaccinated groups (Figs. 62, 63).

Immunity levels increased in a dose dependent manner. Specific protective immunity persisted up to 4 months in feed-based vaccinated juveniles and 2 months in immersion-vaccinated advanced fry, as confirmed by tube agglutination and anti-rohu IgM-based indirect ELISA. Relative protection rates were 60% and 80% for feed-based and immersion-vaccinated groups, respectively. The vaccine demonstrated non-toxicity at doses up to 100X in both fry and juveniles, validated through clinical observations and enzyme assays following intraperitoneal and immersion administration.

Social Science Research and Development

A. Assessing the aquaculture development initiatives

Strategic planning for ornamental fisheries value chain upgradation

A strategic implementation framework has been developed. The major focus areas are as follows: development of more ornamental fish farms in a cluster-based approach under FPOs, with new hubs in Kerala, Odisha, Gujarat, Karnataka, and Assam. Strengthening market infrastructure through centralized fish markets, ornamental fish malls (PPP model), and rural mobile sale points are crucial. A trade facilitation cell will support exporters in navigating trade challenges. Public engagement can be enhanced through aquariums in schools, transport hubs, and state capitals, alongside private partnerships for world-class aquariums. Encouraging indigenous manufacturing of aquariums, accessories, and feed will boost domestic production and exports. Regulatory reforms, including accreditation, quarantine, and quality control, will maintain industry standards. Research efforts should focus on breeding protocols, new varieties, disease control, and intensive production systems like RAS and biofloc to drive innovation and sustainability. The "Rangeen Machhli" mobile app, developed as a key deliverable of the project, provides multilingual information on ornamental fish in eleven Indian languages, offering guidance on care, breeding, and maintenance for hobbyists and farmers, along with tools like the "Find Aquarium Shops" directory and educational modules on aquarium care and ornamental aquaculture, and was downloaded by over 6000 users as on date.

Preference and consumption pattern of fish

A web portal has been developed to raise awareness about the benefits of fish consumption in India. The portal is accessible in English and 11 regional languages. A partial data collection was carried out with the developed tool and it could gather 1851 responses. The survey collected various attributes related to fish consumption including the barriers to fish consumption, with the top three being lack of easy availability (40.26%), difficulty in cleaning and preparation (40.59%), and challenges in eating due to spines or bones (39.93%), alongside lesser factors like children's difficulty in eating (18.48%) and disliking fish (5.94%).

Development of CIFA trainee Clientele Management System

As part of the institute's efforts to streamline the records and enhance accessibility, the compilation and digitization of data on training programs conducted from 2018 to 2021 have been successfully completed. Further, data digitization work for the period 2022-24 is in progress. Back-end database has been created using MS-SQL Server software for development of web based system. SQL Server Management Studio is being used for data management, import of data in csv/text format to the back-end SQL Server database ASP-NET Core. A component of MS-Visual Studio 2022 is being used to develop a cross platform responsive site using HTML, CSS, JavaScript/JQuery and C language. A data collection schedule has been designed for assessing of training effectiveness.

B. Information and Communication Technology (ICT) and Geographic Information System (GIS)

Data-driven aquaculture development planning

A multi-criteria decision-making model for aquaculture development in Odisha was implemented using Analytical Hierarchy Process (AHP) to evaluate and

prioritize suitable sites for aquaculture by considering multiple factors, including soil type, climate, water availability, drainage density, and infrastructure such as roads and railways. Social indicators like population density and undernutrition rates were also included to ensure aquaculture development benefits local communities. Additionally, the model accounts for constraints such as flood-prone areas and forested regions, which may limit site suitability. To further improve accuracy in site selection, the water body layers from the machine learning-based tool "WaterTracePro" was used. The final spatial suitability map integrates AHP-based rankings with waterbody mapping to highlight the more suitable areas for expansion of aquaculture in Odisha (Fig. 64).

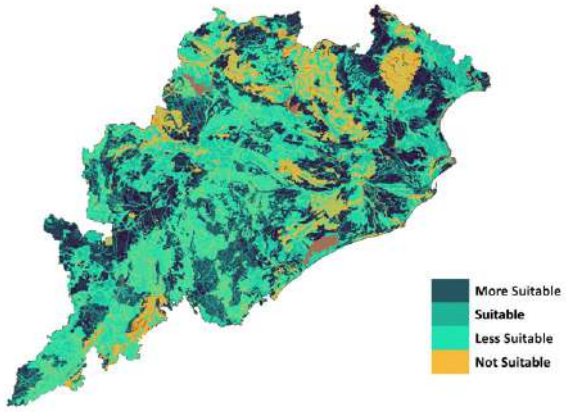


Fig. 64. Odisha map for sites suitable for aquaculture

Dissemination of aquaculture technologies through digital approaches

In order to reach more farmers from different states, the existing modules in Matsya Setu app were dubbed into multiple regional languages. In the initial phase, seven key modules–fish farm construction, carp seed rearing, carp grow-out culture, BMPs for hatcheries, freshwater prawn, magur, and murrel were translated into Telugu, Marathi, Tamil, Kannada, and Malayalam and uploaded on to the platform. Additionally, two new modules from CMFRI, seaweed culture and cage culture, were also added.

Technology application for livelihood improvement

The Farmer FIRST Project in Khordha district carried out key initiatives in 2024 to improve scientific agricultural practices and farmer livelihoods. Activities included exposure visits for progressive farmers, a farmer-scientist interface in Taraboi, and Kisan Diwas at Barijanga, each engaging over 150 farmers. Monitoring visits by ICAR scientists took place on 11 January, followed by an exposure trip to Ramakrishna Ashram KVK, West Bengal (26-29 Feb), covering apiculture, vermicomposting, and ornamental fish. National Fish Farmer's Day (10 July) at ICAR-CIFA brought together 30 beneficiaries, with a success story booklet in Odia released on 13 July 2024, recognizing progressive farmer Ajay Kumar Swain. On 12 September, FFP beneficiaries interacted with Union Minister Shri Rajiv Ranjan Singh at an ICAR-CIFA exhibition.

Kisan Diwas celebration at Barijanga village, Balianta

Kisan Mela cum Exhibition

Progressive Fish Farmer receiving award

Fish harvest- village Aloi, Balipatna

Table 14. Performance of different interventions under Farmer FIRST Project

Crop/Technology / Methodology	Yield (t/ha)		Net Return (Rs/ha)		B:C Ratio	
	Farmers' practice	Recommended practice	Farmers' practice	Recommended practice	Farmers' practice	Recommended practice
Scientific Fish Farming	3.0	3.75	2,08,000	2,27,750	1.86	2.50
Introduction of Cauliflower Var. Fujiyama	18	20	1,65,674	2,08,660	1.72	2.28
Introduction of Bush type of French bean var. Arka Arjuna & Arka Sharath	10	12	2,17,070	2,76,112	2.61	3.29
Introduction of Bitter Gourd	6.5	9	1,38,860	2,40,444	1.15	1.46

Interventions across five modules (crop, horticulture, livestock, enterprise-based, and integrated farming) focused on scientific advancements in production systems. Key initiatives in 2024 included scientific fish farming on 15 acres involving 110 farmers and the adoption of high-yielding crop varieties such as Fujiyama cauliflower (2 acres, 35 farmers), Arka Arjuna and Arka Sharath French beans (2.5 acres, 35 farmers), and Rushaan bitter gourd (6.5 acres, 55 farmers). Livestock improvements included the distribution of 2,000 Vanaraja and RIR chicks to 82 farmers. Integrated fish-based farming systems were demonstrated on 15 acres with six beneficiaries, enhancing resource optimization and sustainability (Table 14).

Capacity building for economic upliftment of SC fish farmers in two identified aspirational districts Dhenkanal and Kandhamal

To promote economic upliftment among Scheduled Caste fish farmers in Dhenkanal and Kandhamal districts of

Odisha, the project integrates scientific aquaculture practices with capacity-building efforts. In 2024, major activities included hands-on training in seed production and carp culture, practical demonstrations of pre and post-stocking management, field visits for monitoring progress, and the organization of two Kisan Mela cum Exhibitions at Dhenkanal and ICAR-CIFA. Critical inputs provided included 1,100 kg lime and 8,600 kg floating fish feed. Also supplied 22,000 IMC fingerlings (60–80 mm) to Kandhamal farmers for grow-out culture and 4.5 lakh fish fry (20–30 mm) to Dhenkanal farmers for nursery rearing. Skill training in freshwater aquaculture was imparted to 200 participants. A Stakeholders Meet for 'Promoting composite carp culture' and a 'Fish Harvest Mela' were organized in Phiringia, Kandhamal involving 200 fish farmers.

Agri-Business Incubation (ABI) for entrepreneurship development

Thirty-two entrepreneurs visited the ABI during 2024 expressing their interest in different aquaculture technologies, out of which seven numbers of incubatees graduated and started their enterprises (Table 15).

ABI organized workshops, trainings, and entrepreneurship programs, including Udak 1.0 for 30 fisheries start-ups, and a technology commercialization meet.

Agripreneurship for sustainable agricultural development: technological, institutional innovations and strategies

Field surveys were conducted to assess agriculture and aquaculture business in Odisha. A study of sugarcane clusters in Aska and Bhanjanagar and The Aska Co-operative Sugar Industries Ltd. explored the region's sugarcane value chain. Chilika's aqua-business was analyzed through data collection, while an aqua-tourism model was studied in Bhanjanagar. Surveys in Jajpur (vegetable value chain) and Umerkote, Nabarangpur (maize clusters) evaluated local farming systems. In Kalahandi, an in-depth study of aquaculture-based SHGs, FPOs, and hatcheries provided insights into the region's aquaculture sector.

C. Technology Dissemination

Demonstration of fry and fingerling rearing

The Cluster Seed Village model was implemented in three different Blocks of Balasore, Odisha where local fish seed

Table 15. List of inducted Incubatees

Sl. No.	Name of the Enterprise	Name of the Director	Nature of the firm	Address	Enterprise
1	Blessall Farmer Producer Company	Mr. Sanjay Kumar Pawar	FPO	Tuljapur, Dharashiv, Maharashtra	Pearl farming
2	Sona Pearl Farming	Mr. Dumavath Nageswar Naik	Small business enterprise	Nandyal, Andhra Pradesh	Pearl farming
3	Ribani Agrotech	Ms. Banasmita Das	Start-up company	Bhubaneswar, Odisha	Agriculture and allied sector
4	Tensift Farmers Fertilizer Pvt. Ltd.	Er. Sachidananda Dash	Start-up company	Aska Road, Berhampur, Ganjam	Cage culture and fish feed production
5	S.J Associates	Mrs. Sandhashree Jibin	Small business enterprise	Thrissur, Kerala	Pearl farming
6	Aradhya Agrovet Pvt. Ltd.	Mr. Amabrish Paikray	Start-up company	Bhusandapur, Khordha	Agriculture and allied sector
7	Boss Hatchery	Mr. Khairul Hassan	Small business enterprise	Chitrakote, Uttar Pradesh	Carp hatchery and zseed production

producers were organized into clusters to enhance resource utilization, knowledge exchange, and access to infrastructure. Fry rearing was demonstrated in a total of 5.42 ha pond area (20 ponds) comprising 2.56, 1.45 and 1.41 ha at Katisahi (Baliapal block) and Phuladi (Remuna block) and Nilagiri (Nilagiri Block) of Balasore, Odisha following cluster approach in 2024. A total of 246.92 lakhs spawn of Indian Major Carps were supplied along with required inputs for fry rearing. More than 99.52 lakh of fry were produced in the three different sites with average survival of 46.1, 32.9 and 36.5% at Katisahi, Phuladi and Nilagiri, respectively. Similarly, demonstration of fingerling rearing under the project has also been conducted in the above three sites covering 8.53 ha pond area.

3 Technology Transfer & Capacity Building

Training programmes

In 2024, ICAR-CIFA organized 40 training programs across its headquarters and regional research centers, covering key areas such as fish breeding, seed production, disease management, biofloc technology, genetic improvement, and entrepreneurship. These programs benefited 1,242 participants (1,008 males, 234 females), including farmers, students, entrepreneurs, and officials.


Business Development Centre
INTERNATIONAL TRAINING PROGRAMME ON
CARP BREEDING, CRYOBANKING, HATCHERY MANAGEMENT AND MONOSEX TILAPIA PRODUCTION


Feed Management in Aquaculture

Table 16. Training programmes conducted during 2024

Sl. No.	Title	Venue	Duration	No. of participants		
				Male	Female	Total
1	Feed Management in Aquaculture	ICAR-CIFA	8-12 Jan 2024	31	01	32
2	Recent Advances in Freshwater Aquaculture (For B.F.Sc. students of Neotia University, West Bengal)	RRC, Rahara	8-12 Jan 2024	16	6	22
3	Fish Disease Diagnosis and Management in Biofloc and Pond Culture	ICAR-CIFA	15-19 Jan 2024	14	05	19
4	Polyculture of CIFA-GI Scampi® with Indian Major Carps for Higher Production and Income	Virtual ICAR-CIFA	29 Jan 2024	330	82	412
5	Hands on Training Programme on "Molecular Techniques for Fish Disease Diagnosis" under NSPAAD Project-Phase II	ICAR-CIFA	29 Jan – 9 Feb 2024	06	04	10
6	Enhancement of pond productivity and fish production in freshwater aquaculture	Virtual RRC, Vijayawada	5-7 Feb 2024	52	19	71
7	Freshwater Pearl Farming for Entrepreneurship Development	ICAR-CIFA	5-9 Feb 2024	16	06	22
8	Biofloc Technology for Officers and Entrepreneurs of Assam	ICAR-CIFA	12-16 Feb 2024	18	02	20
9	Biofloc based Fish farming	ICAR-CIFA	4-8 Mar 2024	13	10	23
10	Hands on Training on "Fish Cell culture Techniques and the Application of Molecular Tools for Cell-Signalling Analysis"	ICAR-CIFA	11-15 Mar 2024	03	02	05
11	Breeding and culture of ornamental fishes with special reference to Northern India	RRC, Bathinda	19-21 Mar 2024	30	4	34
12	Scientific aquaculture for progressive farmers of Lakhisarai, Bihar	ICAR-CIFA	10-14 Jun 2024	30	00	30
13	Training cum Exposure Visit Programme on 'Freshwater Aquaculture – New dimensions' for FFPO members of Chhattisgarh	ICAR-CIFA	24-26 Jun 2024	11	02	13
14	Breeding, Seed Production and Culture of Murrel and Anabas	ICAR-CIFA	1-5 Jul 2024	24	02	26
15	Breeding and Seed Production of Catfishes	RRC, Rahara	2-5 Jul 2024	10	00	10
16	Breeding, Seed Production and Culture of Pabda and Tangra	RRC, Rahara	10-12 Jul 2024	16	02	18
17	Breeding, Seed Production and Culture of Indian Major Carps	RRC, Rahara	22-25 Jul 2024	21	03	24
18	Breeding and seed production of Catfishes for farmers from Jharkhand	RRC, Rahara	29 Jul–1 Aug 2024	25	00	25
19	Breeding, Seed Production and Culture of Giant Freshwater Prawn *Macrobrachium rosenbergii*	ICAR-CIFA	5-9 Aug 2024	25	03	28
20	Basics of fish farming in freshwater system	ICAR-CIFA	12-16 Aug 2024	30	02	32
21	Genetic management of carp brood stock for quality seed production	ICAR-CIFA	19-23 Aug 2024	18	07	25
22	Breeding and Seed production of Striped Catfish, *Pangasianodon hypophthalmus*	RRC, Vijayawada	19-23 Aug 2024	07	00	07
23	Specialized training for the Tamil Nadu State Officials on "Breeding, Seed production and Culture of Murrels"	ICAR-CIFA	22-24 Aug 2024	4	6	10
24	Breeding, Seed Production and Culture of Indian Major Carps	RRC, Bengaluru	26-30 Aug 2024	10	01	11
25	Breeding and culture of Ornamental fishes	ICAR-CIFA	27-30 Aug 2024	18	01	19
26	Breeding, Seed Production and Culture of Murrels for the Officials of Govt. of Tamil Nadu	ICAR-CIFA	28-30 Aug 2024	04	06	10

Sl. No.	Title	Venue	Duration	No. of participants		
				Male	Female	Total
27	Off-Season Breeding and Feed Management for Seed Production	ICAR-CIFA	2-6 Sept 2024	08	01	09
28	Fish Disease and Health Management in Freshwater Aquaculture	RRC, Rahara	3-6 Sept 2024	08	02	10
29	Freshwater Pearl Farming for Entrepreneurship Development	ICAR-CIFA	9-13 Sept 2024	19	01	20
30	Biofloc Based Freshwater Fish Farming	ICAR-CIFA	16-20 Sept 2024	14	00	14
31	Hands on training on Histo and Hormonal Techniques in Life Science Research	ICAR-CIFA	14-18 Oct 2024	5	14	19
32	Biological Data Analysis Using Computational Methods (organized in collaboration with ICAR-IASRI)	ICAR-CIFA	21-25 Oct 2024	4	6	10
33	Recent Advances in Integrated Fish Farming	ICAR-CIFA	23-25 Oct 2024	53	0	53
34	Hands-on-Training *on* "Application of Advanced Molecular and Microbiological Techniques for the Diagnosis of Viral, Bacterial and Parasitic Diseases in the Freshwater-Farmed Food Fishes"	ICAR-CIFA	4-8 Nov 2024	02	02	04
35	Entrepreneurship development in ornamental fish farming	ICAR-CIFA	12-14 Nov 2024	07	04	11
36	Freshwater Pearl Farming for Entrepreneurship Development	ICAR-CIFA	18-22 Nov 2024	18	02	20
37	Feeds and Feeding in Freshwater Aquaculture	ICAR-CIFA	25-29 Nov 2024	19	02	21
38	Integrated Multi-trophic Aquaculture and Freshwater Prawn Culture	ICAR-CIFA	9-13 Dec 2024	29	0	29
39	Integrated Multi-trophic Aquaculture and Freshwater Prawn Culture	ICAR-CIFA	16-20 Dec 2024	29	2	31
40	Freshwater Ornamental Fish Breeding and Culture	ICAR-CIFA	18-20 Dec 2024	11	22	33
	Total			1008	234	1242

Exposure visits to ICAR-CIFA

In 2024, ICAR-CIFA and its Regional Research Centers (RRCs) at Rahara, Bengaluru, Vijayawada, and Bathinda hosted 3,579 visitors across 97 groups, including farmers, students, and trainees from various institutes. The ICAR-CIFA headquarters saw the highest engagement, welcoming 2,235 visitors (1,223 males, 1,012 females) with students forming the largest group. RRC Rahara and FS Kalyani hosted 762 visitors, while RRC Bengaluru and RRC Vijayawada recorded 365 and 217 visitors, respectively.






Agricultural Technology Information Centre (ATIC)

The Agricultural Technology Information Centre seves as the Single Window System to the farmers and entrepreneurs for accessing the neccessaty information, products and publications. During the year 2024, total 2235 visitors visited ATIC and ICAR-CIFA facilities. This Centre has generated revenue of Rs. 18,350/- from sale of publications. A large quantity of pamphlets and booklets was given to visitors at no cost.

Farmers point

The Institute has a Farmers Point to efficiently manage visitors. In 2024, 318 visitors have been received, their needs assessed, and they have been guided to the appropriate units, sections, or divisions. At the Farmer's Point, samples are submitted, and user fees are collected for services such as soil and water analysis, disease diagnosis, and feed analysis. Customer satisfaction is regularly monitored to enhance service quality.

Exhibitions

The Institute participated in 24 exhibitions across 12 states of the country. These events served as platforms to showcase technologies, disseminate knowledge, and engage with farmers, stakeholders, and the public in the field of freshwater aquaculture.

The Institute participated in the following exhibitions

Sl.No.	Exhibition	Venue	Period
1	Krushi Odisha-2024 organized by Dept. of Agriculture & Farmers' Empowerment, Govt. of Odisha	Janata Maidan, Bhubaneswar	12-14 Jan 2024
2	Capacity building program for SC farmers	CHES (ICAR-IIHR), Bhubaneswar	17 Jan 2024
3	Agri Vision 2024	ICAR-NRRI, Cuttack	19-21 Jan 2024
4	Regional Agriculture Fair for Eastern Region 2024	KVK, Diyankel, Jharkhand	3-5 Feb 2024
5	Kisan Mela	SSKVK , Sonarpur, West Bengal	7-9 Feb 2024
6	Matsya Sampada Jagrutha Abhiyan	University of Agriculture Sciences, Raichur, Karnataka	10 Feb 2024
7	Atmanirbhar Krishi Sah Baagwani Vistaar evam Pashudhan Kalyaan Mela	KVK, East Champaran, Bihar	10-12 Feb 2024
8	Matsya & Pranee Samavesh, Odisha (MPSO) – 2024	Janata Maidan, Bhubaneswar	16-18 Feb 2024
9	Foundation Day – ICAR-CIWA, Bhubaneswar	ICAR-CIWA, Bhubaneswar	17 Feb 2024
10	13th Indian Fisheries and Aquaculture Forum (IFAF)	ICAR-CIFRI, Barrackpore	23-25 Feb 2024
11	SANGAM-2024–A Confluence and Interface of Researchers, State Department and Industry Leaders	ICAR- NRRI, Cuttack	15 Mar 2024
12	37th Foundation Day of ICAR-Indian Institute of Water Management (IIWM)	ICAR-IIWM, Bhubaneswar	12 May 2024
13	23rd Foundation Day of ICAR-NIFMD	ICAR-NIFMD, Arugul, Bhubaneswar	5 Jul 2024
14	2nd Fisheries Summer Meet, 2024	IDA Scrudder Trade Centre, Madurai, Tamil Nadu	12 Jul 2024
15	National Fish Farmers Day	ICAR-CIFA, Kausalyaganga	13 Jul 2024
16	96th ICAR Foundation and Technology Day	ICAR, New Delhi	15-16 Jul 2024
17	Indian Mobile Congress 2024	Bharat Mandapam, Pragati Maidan, New Delhi	15-18 Oct 2024
18	Workshop on "Technological Empowerment and Demonstration for SC Farm Women"	ICAR-CIWA, Bhubaneswar	6-8 Nov 2024
19	Matsya O Pranee Sampad Mela (organized by Fisheries & Animal Resources Development Department, Govt. of Odisha)	Saradhabali, Puri	21-22 Nov 2024
20	World Fisheries Day and Mathsyamela 2024	Murudeshwara, Uttara Kannada District, Karnataka	21-23 Nov 2024
21	3rd Indian Rice Congress – 2024	ICAR-NRRI, Cuttack	5-7 Dec 2024
22	28th Sundarban Krishi Mela O Loko Sangskriti Utsav	Kultali, South 24 Parganas	20-29 Dec 2024
23	15th Krishi Fair-2024	Golden Sea Beach, Puri	21-25 Dec 2024
24	Odisha Research Conclave 2024	Fakir Mohan University, Balasore	26-28 Dec 2024
25	3rd APC Roy Smarak Vigyan Mela O Pradarshani	West Bengal University of Animal and Fishery Sciences, Kolkata	26-29 Dec 2024

Success stories

Multi-Location Performance Evaluation of 'CIFA GI-Scampi®' in Assam: Assessing Growth and Productivity

Multi-location performance evaluation trials of the 'CIFA-GI Scampi®' in the carp-scampi polyculture system was conducted in Hajo Block; Rangia Block and Rampur Block of Kamrup district of Assam during 2023-24 under the PMMSY Central Sector Scheme. The stocking density of CIFA GI-Scampi® post larvae (0.02 g) was maintained at 10,000 per hectare, while advanced fingerlings of *Catla catla* (150.00 ± 8.27 g) and *Labeo rohita* (100.00 ± 9.87 g) were stocked at 6,000 per hectare in 1:4 ratios. The stocking was done during mid-September and were harvested on 19 March 2024. The final average body weight of CIFA GI-Scampi® ranged from

58.01±10.99 to 80.05 ± 20.42 g, while for *C. catla*, it was 768.05 ± 248.86 to 909.00 ± 279.36 g, and for *L. rohita*, it ranged from 546.00 ± 41.31 to 655.05 ± 66.97 g in the demonstration ponds after 185 days of culture. The average daily growth rate of CIFA GI-Scampi® ranged from 0.32 to 0.44 g, significantly surpassing typical scampi growth. Notably, this marks the first trial of 'CIFA-GI Scampi®' in the NEH states. The net profit to the farmers ranged between Rs. 3.25-5.50 lakh/ha/crop by incorporating 'CIFA-GI Scampi'® in polyculture.

Success Story of a SC Woman Farmer provided with ICAR-CIFA's FRP Pabda Hatchery

Ms. Ankita Parui of Nabaswasthya Pally village, Singur Block, Hooghly District, West Bengal has received a FRP pabda hatchery unit from ICAR-CIFA and currently using it for seed production of catfishes. Between May-July, 2024, she produced about 1,15,000 nos. of catfish seeds (fry) *viz*., pabda, *Ompok bimaculatus* (about 35,000 nos.); singhi, *Heteropneustes fossilis* (about 55,000 nos.) and magur, *Clarias magur* (about 25,000 nos.). Earlier, she was using cement tanks for for breeding and seed production, however, after using FRP pabda hatchery she found it to be superior to conventional cement tank system. Her fish seed production has increased, while water consumption and labor cost have decreased. As a result, she is now able to provide fish seeds at a much lower price to the farmers. It has tripled the production of seeds from the same unit area. A comparative estimate of seed production using FRP pabda hatchery unit vs. cemented tank is given in below (Table 17).

Mr Gobinda Ray's Journey from Grow-Out Farming to Profitable IMC Seed Rearing

Mr Gobinda Ray is a 37-year-old farmer from Katisahi village in Balasore district, Odisha, who has been involved in agriculture and fish farming since 2014. Initially, he earned only Rs. 50,000-55,000 from grow-out fish farming, which was insufficient for his household expenses. Seeking higher profits, he explored new fish farming techniques and participated in an inception workshop organized by the ICAR-CIFA project team in 2022. With his intermediate-level education, he quickly

Table 17. Comparative estimate of seed production

Fish Species	Cemented Tank	FRP Pabda hatchery
Pabda	4000 – 5000 early fry	7000 – 9000 early fry
Magur	3000 – 3500 fry	10000 fry
Singhi	5000 fry	10000 – 12000 fry

grasped IMC seed rearing practices and decided to join a cluster group. After a thorough inspection of his pond's water and soil, a 0.12-hectare area was selected for seed rearing. ICAR-CIFA provided technical guidance and essential farming inputs. Mr Ray stocked 13 lakh Rohu spawn, later harvesting 4,50,000 Rohu fry to sell. He also received additional fry from cluster farmers to enhance his production. After completing three phases of IMC seed rearing, he earned approximately Rs. 2,13,400, with a profit of Rs. 1,38,952 in 2022. This success allowed him to construct three additional ponds for seed rearing. In 2023 and 2024, his profits were Rs. 1,10,000 and Rs. 1,67,500, respectively. Compared to his earlier income from grow-out fish farming, these practices significantly improved his financial situation, and he plans to continue both seed rearing and grow-out farming in the future.

Dissemination and Demonstrations

Dissemination of Breeder Seed of AhR Jayanti rohu and CIFA-Amrit catla

Disseminated 54 lakh breeder seed (spawn) of AhR Jayanti rohu and 14 lakh breeder seed (spawn) of CIFA-Amrit catla to NFFBB and other multiplier units (Table 18).

Consignment of breeder seed supplied to multiplier unit

Table 18. Supply of breeder seed to multiplier unit from ICAR-CIFA Nucleus Breeding Centre

Sl. No.	Multiplier Unit	State	AhR Jayanti rohu spawn	CIFA-Amrit catla spawn
1.	Shri Saurav Kumar Biswal	Odisha	2 Lakh	2 Lakh
2.	Mrs. Jhina Parida	Odisha	2 Lakh	2 Lakh
3.	Shri. Debajit Barman	Assam	2 Lakh	2 Lakh
4.	Mr Jyotish Talukdar	Assam	2 Lakh	2 Lakh
5.	Mr Kumara Swamy	Andhra Pradesh	2 Lakh	2 Lakh
6.	Mrs. Jhulekha Firoj Tamboli	Maharashtra	2 Lakh	2 Lakh
7.	Shri. Ravichndran	Tamil Nadu	2 Lakh	2 Lakh
8.	National Freshwater Fish Brood Bank	Odisha	40 Lakh	-
9.	Department of Fisheries, Himachal Pradesh	Himachal Pradesh	2500 advance fry	2500 advance fry

Dissemination and on-farm trials of new generation of CIFA-GI Scampi® (2024 Year Class)

A total of 1.63 lakhs of breeder seeds were supplied to four multiplier hatcheries of CIFA-GI Scampi® for brood raising and commercial seed production. Another 22,000 brood seeds were supplied to the National Freshwater Fish Brood Bank (NFFBB), Eastern Regional Center of NFDB, Bhubaneswar for broodstock raising and further dissemination to the hatcheries. Additionally, a total of 0.385 lakh seeds have been supplied to farmers in Andhra Pradesh, Odisha, West Bengal and Arunachal Pradesh for on-farm trials in carp-scampi polyculture system.

On-station trial of portable scampi hatchery

On-station trial of the recently developed portable scampi hatchery was undertaken. One unit consists of five larval rearing tanks of one-tonne capacity each and two larval media storage tanks of 5.0 tonne each along with other accessories. After completion of one cycle in 40 days, more than 16,000 of scampi seeds were harvested. The water used for one operation cycle was estimated as 10 tonnes of larval media and 5.0 tonnes of freshwater.

Demonstration of murrel breeding and seed production technology in Tamil Nadu

In 2024, ICAR-CIFA provided technical guidance in raising murrel broodstock in captivity by successfully transitioning 250-300 striped by murrel brooders to pelleted feed in HDPE-lined ponds at the Lalpet murrel hatchery in Tamil Nadu. By July-August, the fishes matured, and during August 6-10, brooders were selected for breeding trials. Most female fishes successfully spawned after induced breeding trials using the protocols developed and standardized by ICAR-CIFA. Further, the state Department officials were provided hands-on training on breeding and larval rearing, resulting in the production of over 50,000 hatchlings. The spawn were nurtured, yielding around 20,000 fry. Protocols for the successful production of zooplankton was demonstrated in concrete and FRP tanks to support the early rearing of murrel hatchlings. Under this project, ICAR-CIFA also successfully organized a training programme for the officials of the Department of Fisheries, Government of Tamil Nadu on "Breeding, Seed Production and Culture of Murrels" during 28-30 August, 2024. The program was attended by 10 officials. The training provided hands-on


Portable scampi hatchery set up


Harvesting of post larvae in portable scampi hatchery

experience and covered various crucial aspects including broodstock development, captive breeding, seed rearing, culture and health management of murrel. During the valedictory program, trainees expressed their satisfaction about the training program.

Demonstration of "CIFA-Brood-Vac" vaccine

A demonstration and awareness programs on the "CIFA-Brood-Vac" vaccine were conducted in the Andaman & Nicobar Islands to promote stress-tolerant, disease-resistant fish seed production. The main demonstration was held at ICAR-CIARI, South Andaman, on December 4, 2024, where Ms. Jagtap Kalyani Rajendra, Director of Fisheries, A&N Administration handed over vaccine vials to a fish farmer in the presence of key officials, including Dr Eaknath B. Chakurkar, Director, ICAR-CIARI, and Dr Mrinal Samanta, the lead inventor. Two awareness programs were also organized—one at Diglipur, North Andaman, on December 2, 2024, attended by the Assistant Director of Fisheries and 45 fish farmers and hatchery owners, and another at ICAR-CIARI, South Andaman, on December 4, 2024, attended by 52 participants. The programs highlighted the vaccine's benefits and its potential to enhance fish seed quality.

Farmer–Scientist Interface Programmes

Farmer-Scientist Interface programme on Freshwater Aquaculture at Taraboi, Balipatna, Khordha

A one-day Farmer-Scientist Interface program on Freshwater Aquaculture was held at Taraboi, Khordha, on June 7, 2024, focusing on skill enhancement for beneficiaries under the Farmers FIRST Project. About 150 participants, including farm women attended. Scientists from ICAR-CIFA discussed the importance of aquaculture. Farmers like Mr Bikram Nayak and Mr Hata Kishore Swain shared valuable experiences, addressing practical challenges. The involvement of farmers from neighboring villages facilitated cross-learning, enhancing collective knowledge in scientific fish farming.

Empowerment of SC women fish farmers through aquaculture practices

On 9 April and 12-13 June 2024, scientists from ICAR-CIFA, Bhubaneswar, visited Dhenkanal and Kandhamal to monitor a DST Project to empower Scheduled Caste (SC) fish farmers. Over 80 SC women from three self-help groups (SHGs) and 29 beneficiaries in Dhenkanal are engaged in aquaculture through leased panchayat tanks. The scientists discussed pond management, emphasizing the need for regular water quality testing and advanced feed technology to enhance fish growth. They provided essential inputs like lime and fish feed. The project has economically empowered the SHGs and promoted community development through effective carp culture practices.

Awareness Programmes

A farmer awareness programme on "Responsible use of drugs and chemicals and AMR issues" was conducted at Derabish, Kendrapara, Odisha on 13 January 2024. A total of 66 farmers attended the programme.

On 23 January 2024, a one-day aquaculture awareness meeting under the SCSP component of the CRP on Vaccine and Diagnostic project took place in Dhanahara, Balipatna Block, Odisha, attended by around 100 participants from various SHGs. Beneficiaries received inputs like floating feed and drag nets. Subsequently, on March 2, 2024, an awareness drive in Bhagbanpur village

educated 32 farmers about disease surveillance's role in fish health. The event featured insights on fish welfare, common diseases, and NSPAAD project phase II, with participation from state officials and ICAR-CIFA.

Awareness programme on indigenous fishes and ranching of Carnatic carp

RRC of ICAR-CIFA, Bengaluru organized an awareness program on indigenous fish species and 'Carnatic carp' ranching at Hesaraghatta Lake, in collaboration with Sri Durgamba Fishermen Cooperative Society on 25 September 2024. Dr T.K. Behera, Director, ICAR-IIHR participated in the programme as Guest of Honour praised ICAR-CIFA's efforts in reviving threatened species and encouraged farmers to leverage research for improved livelihoods. Dr P.K. Sahoo, Director, ICAR-CIFA urged fishermen to enhance productivity in larger water bodies. Advanced fingerlings of *Barbodes carnaticus* were released into the lake. The programme was attended by 48 farmers and fishermen.

Fish Health Camps

ICAR-CIFA conducted following fish health camps at different locations to create awareness among fish farmers about the different kinds of fish diseases and their on-farm diagnosis, preventive and control measures to minimize the loss due to diseases. The fish farmers were also sensitized about the responsible use of chemicals, medicines and antibiotics in aquaculture.

Date	Venue of Fish Health Camp	No. of farmers benefitted
13.01.2024	Kendrapara, Odisha	65
14.03.2024	Moolalanka, Krishna District, Andhra Pradesh	60

Other Extension Activities

In 2024, ICAR-CIFA conducted various training and internship programs for fisheries students from institutions across India, benefiting a total of 117 students (Table 19). These included field training, summer internships, and in-plant training for M.F.Sc. and B.F.Sc. students from ICAR-CIFE, Centurion University, CAU, OUAT, CSAUT, and other colleges. The programs, held at ICAR-CIFA and RRC-Vijayawada, provided hands-on experience in aquaculture and fisheries science, supporting both male and female participants.

Table 19. Student/Education Programmes

Sl. No.	Title	Venue	Duration	No. of participants		
				Male	Female	Total
1	Field Training of M.F.Sc (Aquaculture) students of ICAR-CIFE, Mumbai	ICAR-CIFA	4-18 Jan 2024	7	5	12
2	Summer Internship of Final BF Sc. Student, Centurion University, Parlakhemundi, Gajapati	ICAR-CIFA	26 Feb–25 Apr 2024	1	0	1
3	In plant training programme for B.F.Sc students from College of Fisheries, CAU-I , Tripura	ICAR-CIFA	3-14 Mar 2024	20	19	39
4	Training in Freshwater Aquaculture to students from SRR & CVR Govt. Degree College, Vijayawada	RRC-Vijayawada	1 Apr -15 May 2024	04	02	06
5	Students Ready Programme for B.F.Sc. Students of College of Fisheries, Jabalpur, MP	ICAR-CIFA	2-6 Apr 2024	13	13	26
6	Final year B.F.Sc. student from OUAT, Bhubaneswar	ICAR-CIFA	26 Apr–06 Jun 2024	01	01	01
7	In-plant Attachment Training for B.F.Sc. Students of College of Fisheries Science & Research Centre, Etawah, CSAUT, Kanpur	ICAR-CIFA	5 Aug–29 Sep 2024	03	00	03
8	IVth year BFSc students from College of Fisheries, Raha, Assam	ICAR-CIFA	11-17 Dec 2024	14	15	29

Memorandum of Understandings signed between ICAR-CIFA and other organisations/ states

Table 20. List of MoUs signed

Sl. No.	Name of the Agency	Date signed	Purpose
1	CIPET: IPT, Bhubaneswar	8 Feb 2024	For Academic, skill training and research collaboration
2	Central Council for Research in Ayurvedic Sciences-CARI, Bhubaneswar (Ministry of AYUSH, Govt. of India)	16 Mar 2024	To carry out the collaborative project on "Standardization of sustainable medicinal leech farming technology and development of SoP for its storage, transportation and therapeutic application"
3	Zoological Survey of India, Kolkata	1 Apr 2024	For the promotion of research, innovation and education
4	Inovet Pharma, Shantagulab Industrial Park, Karvad, Gujarat	22 May 2024	Technology License Agreement for CIFA L-Check (a herbal formulation): for control of Argulosis/Lice infection in fish and CIFA M-Check for external injuries caused by Argulus or any secondary pathogens in fish
5	Dept. of Fisheries, Himachal Pradesh	7 Jun 2024	Dissemination of breeder seed of 'AhR Jayanti' and 'CIFA Amrit Catla' (multiplier unit)
6	Dept. of Fisheries, Himachal Pradesh	7 Jun 2024	Technology License Agreement for CIFABROOD™ (fechnical information and assistance)
7	Dept. of Forest, Environment and Climate Change, Govt. of Odisha	3 Jul 2024	For livelihood development through ornamental aquaculture for enhancing climate resilience of vulnerable coastal communities in four coastal districts of Odisha (Ganjam, Puri, Kendrapada and Balasore)

Sl. No.	Name of the Agency	Date signed	Purpose
8	NFDB-ERC (NFFBB), Kausalyaganga, Bhubaneswar	13 Aug 2024	To supply breeder seed of AhR Jayanti and CIFA Amrit Catla spawn
9	Neha Fabrications, Hooghly, West Bengal	11 Sept 2024	Technology Licensing Agreement for two technologies (FRP pabda hatchery and FRP carp hatchery)
10	M/S Mahabahu Fisheries Pvt. Ltd., Jokapora, Gohpur, Assam-784168	29 Nov 2024	Supply of breeder seed of improved rohu (AhR Janayati) and improved catla (Amrit catla) (by ICAR-CIFA)
11	NABARD	2 Dec 2024	Execution of the research project entitled "Demonstration and Dissemination of protocol for management of nutrient-plankton-microbe interactions in aquaculture ponds for better fish health management"

IPR issues (Patents, Commercialization of Institute's products, etc)

Table 21. Details of Patents/Trademark/Copyright

IPRs	Name of Innovation/ Technology/ Product/Variety	Application Granted/ Registered	Inventors
Trademark	CIFA L-Check®	01 August 2024	Dr P. K. Sahoo Dr Anirban Paul Ms. Samikshya Parida
	CIFA M-Check®	03 August 2024	Dr P. K. Sahoo Dr Anirban Paul Ms. Samikshya Parida
	CIFA-Amrit Catla®	01 August 2024	Dr K. D. Mohapatra Dr J. N. Saha Dr K. Murmu Mr A. R. Rasal Dr J. K. Sundaray Dr J Mohanty Dr P. K. Meher Dr L. Sahoo Dr R. Rathod Mr M.R. Badhe Dr K.D. Rasal Dr U. K. Udit Dr P.C. Nandanpawar
Copyright	A compendium of research publications of 33 years (1991-2024) of Journal of Aquaculture (digital download and online)	01/04/2024	Dr S. Ferosekhan Dr Anirban Paul Dr Farhana Hoque Dr B.S. Ananda Kumar
	A compendium of research publications of 33 years (1991-2024) of Journal of Aquaculture alloted (book)	01/04/2024	Dr S. Ferosekhan Dr Anirban Paul Dr Farhana Hoque Dr B.S. Ananda Kumar
	Peer reviewed publications of ICAR-CIFA 2023 (digital download and online)	01/04/2024	Mr S. K. Mohanty Dr S. Ferosekhan Dr P. Das Dr H. K. De
	Peer reviewed publications of ICAR-CIFA 2023 (book)	01/04/2024	Mr S. K. Mohanty Dr S. Ferosekhan Dr P. Das Dr H. K. De
	Peer reviewed publications of ICAR-CIFA 2022 (digital download and online)	15/02/2024	Dr S. Ferosekhan Dr P. Das Dr H. K. De Mr S. K. Mohanty
	Peer reviewed publications of ICAR-CIFA 2022 (book)	14/02/2024	Dr S. Ferosekhan Dr P. Das Dr H. K. De Mr S. K. Mohanty
	Peer reviewed publications of ICAR-CIFA 2021 (digital download and online)	09/09/2024	Dr H. K. De Mr S. K. Mohanty Dr U.L. Mohanty Dr P.K. Sahoo
	Peer reviewed publications of ICAR-CIFA 2021(book)	09/09/2024	Dr H. K. De Mr S. K. Mohanty Dr U.L. Mohanty Dr P.K. Sahoo
	Peer reviewed publications of ICAR- CIFA 2020 (digital download and online)	09/09/2024	Dr H. K. De Mr S. K. Mohanty Dr U.L. Mohanty Dr P.K. Sahoo

IPRs	Name of Innovation/ Technology/ Product/Variety	Application Granted/ Registered	Inventors
	Peer reviewed publications of ICAR-CIFA 2020(book)	09/09/2024	Dr H. K. De Mr S. K. Mohanty Dr U.L. Mohanty Dr P.K. Sahoo
	Peer reviewed publications of ICAR- CIFA 2019 (digital download and online)	09/09/2024	Dr H. K. De Mr S. K. Mohanty Dr U.L. Mohanty Dr P.K. Sahoo
	Peer reviewed publications of ICAR- CIFA 2019 (book)	09/09/2024	Dr H. K. De Mr S. K. Mohanty Dr U.L. Mohanty Dr P.K. Sahoo
	Madhura jala biofloc re machha chhasa (book)	30/11/2024	Dr P.C. Das Dr H. S. Swain Dr Husne Banu

Table 22. Commercialization of Technologies

Sl. No.	Technology	Status
1	CIFATIL-Grower	Commercialized
2	CIFA L-Check®	Commercialized
3	CIFA M-Check®	Commercialized
4	FRP Pabda Hatchery	Commercialized
5	Improved Catla (CIFA Amrit catla®)	Commercialized
6	Improved Rohu (AhR Jayanti)	Re- Commercialized
7	CIFABROOD®	Re- Commercialized
8	CIFAX	Re- Commercialized
9	FRP Carp Hatchery	Re- Commercialized
10	NANOPLUS@CIFA®	Re- Commercialized
11	CIFA-CARP GROWER®	Re- Commercialized
12	CIFA-CARP STARTER®	Re- Commercialized

Table 23. Technology Commercialized to 7 Contracting Parties

Name of Technology/ Know-How	Name of Contracting Party	Duration of License	Revenue Earned
CIFA Amrit Catla & CIFABROOD™	DoF, Himanchal Pradesh	16.05.2024–15.05.2027	Rs. 6.00 lakhs
CIFAX	RN Agarwal Trading LLP	30.05.2024- 29.05.2027	Rs. 37.50 lakhs
CIFAX	Durga Enterprises	21.05.2024–20.05.2027	Rs. 37.50 lakhs
CIFA L-Check & CIFA M-Check	Inovet Pharma	22-05-2024- 21.05.2027	Rs. 6.00 lakhs
FRP Pabda Hatchery & FRP Carp Hatchery	Neha Fabrication	12.09.2024-11.09.2029	Rs. 2.4 lakhs
NANOPLUS@CIFA, CIFA-CARP GROWER, CIFA-CARP STARTER, CIFATIL-Grower CIFABROOD™	Tensift Farmers Fertilizer Pvt. Ltd.	16.07.2024-15.07.2029	Rs. 9.15 lakhs
Improved Rohu (AhR Jayanti) & Improved Catla (CIFA-Amrit catla)	M/s. Mahabahu Fisheries Pvt. Ltd., Jokapora, Gohpur, Assam-784168	29.11.2024-28.11.2029	Rs. 2.00 lakhs

Table 24. Technologies/Product/Methodology/Process certified by ICAR, New Delhi

S. No.	Name	Year	Lead Developer	Associate Developer
1	Captive breeding, seed production and grow- out culture of Gangetic mystus, *Mystus cavasius*.	2024	Dr S. K. Sahoo	Dr S. Ferosekhan Dr P. K. Tiwari Dr S. N. Sahoo Dr S. S. Giri Dr B. Mishra
2	Portable FRP pabda hatchery	2024	Dr A. Hussan	Dr B. C. Mohapatra Dr P. P. Chakrabarti Mr A. Das Mr D. Majhi
3	Genetically improved catla (G-2)	2024	Dr K. D. Mohapatra	Dr J. N. Saha Dr K. Murmu Dr A. R. Rasal Dr J. K. Sundaray Dr J Mohanty Dr P. K. Meher Dr L. Sahoo Dr R. Rathod Mr M.R. Badhe Dr K.D. Rasal Dr U. K. Udit Dr P.C. Nandanpawar
4	Aquaculture Field School as an extension methodology	2024	Dr G. S. Saha	Dr H. K. De Dr I. Sivaraman

4 Research Co-ordination and Management

Project Monitoring Committee (PMC)

The 6th PMC meeting was conducted on 09 January 2024 under the Chairmanship of Director, ICAR-CIFA to review the new concept notes. During the meeting 26 concept notes were discussed in presence of all Heads of Divisions/ Sections, SICs of RRC, SIC and members of PME, along with an internal and an external expert.

Research Advisory Committee

The 37th RAC meeting of the institute was held under the Chairmanship of Dr C. Vasudevappa, Vice-Chancellor, NIFTEM during 15-16 February, 2024 in presence of other members Dr B.P. Mohanty, ADG (Inland.Fy), ICAR; Dr Devika Pillai, Director, Dept. of Aquatic Animal Health Management, KUFOS; Dr S. D. Singh, Former ADG (Inland. Fy), ICAR; Dr R. S. Biradar, Former Joint Director, ICAR-CIFE; Dr M. L. Bhowmik, Former Dean, College of Fisheries, CAU, Tripura. Dr P. K. Sahoo, Director, ICAR-CIFA welcomed the Chairman and the members of RAC and presented the achievements of the institute during the preceding period. Dr J.K. Sundaray, Member Secretary presented the ATR of 36th RAC recommendations and the committee agreed and accepted the ATR. The progress of ongoing research projects with major outputs and developmental activities were presented by the respective Heads of Divisions

and SICs. The Research Advisory Committee critically evaluated all the research programmes and developmental activities and suggested their views; also recommended the future course of actions. During the meeting, SICs of RRCs, all scientists and technical officers of the institute were also present.

Institute Research Council Meetings

The Institute convened the 38th Annual IRC Meeting from April 22-26 and May 1-3, 2024 to assess ongoing research projects and deliberate on new project proposals. Dr P.K. Sahoo, Director, ICAR-

CIFA and Chairman, IRC requested the house to identify the national priority areas and put more focus on translational research to create visible impact at the farm level. Dr H. K. De, SIC, PME Cell made a presentation of the roles and functions of the Project Monitoring and Evaluation (PME) Cell. He urged the house to be more vigilant and proactive in timely submission of information to the Cell. Dr D. Panda, Member Secretary, IRC made a brief presentation of the ongoing institute and externally funded projects during 2023-24. Dr J.K. Jena, Deputy Director General (Fisheries Science) was present in the IRC meeting during 25-26 April, 2024. He suggested that scientists should spend 75% of his/her time in own domain areas of expertise. A total of 97 research projects comprising of 42 on-going institute based projects including specially assisted centrally sponsored schemes, 40 externally funded and 15 new institute based proposals were presented and discussed at length during the eight days of deliberation. All Heads of the Divisions, Scientist-in-charge of RRCs, scientists, and technical officers attended the meeting. The Institute also conducted the Mid-term IRC meeting on 6 November, 2024 in hybrid mode. During the meeting the HoDs, SICs of Section & RRCs and coordinators of specially assisted central sector schemes (NEH, SCSP and STC) presented the interim progress and constraints of various projects for discussions.

Institute Management Committee

The 47th Institute Management Committee (IMC) meeting was held on 17

September, 2024 at ICAR-CIFA under the Chairmanship of Dr P.K. Sahoo, Director ICAR-CIFA, in which 9 members including SIC of PME , F&AO, ICAR-CIFA, and ADG (Inland Fy), ICAR (through virtual mode) participated. Shri H.L. Meena, CAO & Member-Secretary of the IMC presented the administrative progress of the Institute made during January-September 2024.

Prioritization, Monitoring and Evaluation (PME) Cell

During the reporting period, the PME Cell of the institute undertook the following activities:

- Documentation and dissemination of research, extension and training activities of the institute through ICAR-CIFA Newsletter, annual report and other publications.
- Organizing meetings with senior officers to discuss the monthly progress of various activities of the institute including research, teaching, training, publications, and other administrative and financial matters. The proceedings were prepared, and follow-up actions were monitored.
- Scrutiny of research project proposals for external funding, abstracts, research papers and e-publications submitted to journals, applications for awards, fellowships, foreign deputations and higher posts by the staff of the institute, etc. were done from time to time.
- Supported conducting RAC, IMC and IRC meetings.
- Evaluation and monitoring of institute-based and externally funded research projects. During this period the institute has initiated 6 in-house projects and 8 externally funded projects.
- Ten MoUs were signed with different academic, private, multiplier units and government organizations during the reporting period to provide academic and technical supports and dissemination of technologies.
- ATRs were prepared on recommendations of ICAR Regional Committee Meetings; Directors' conference; and responses to parliament queries.
- Release of special publications: During the period under report 19 new publications and one mobile App (Rangeen Machhli) were released during different occasions and 5 e-publications have been prepared.

Publications

- Annual Report 2023 (in English & Hindi)
- CIFA News Vol. 31 (Nos. 1, 2, 3, 4)
- Research Project Proposals – 2024-25
- Peer Reviewed Research Publications Volumes of ICAR-CIFA 2019-2021 and ICAR-CIFA-2023
- CIFA in Print Media-2023

Communication of reports

- Material for DARE-ICAR Annual Report 2024
- Action taken report on proceedings of the meeting of Directors of ICAR Institutes
- Weekly, monthly, and quarterly progress reports and other reports as desired by the Council
- Replies to the Parliament and RTI queries.
- Other strategic plan documents
- Reports for e-Samikshya and Niti Ayog, etc.
- Report for Sub-committee of the Parliament on Offiicial Language during inspection of the Institute
- ICAR-CIFA elaborate profile prepared for the Council in English and Hindi

5 Important Events Organized

National Science Day

On February 28, 2024, the Institute celebrated National Science Day with school children. Around 120 students visited the farm facilities and participated in a discussion on 'Indigenous Technologies for Viksit Bharat.' Expert scientists also delivered lectures on freshwater fish farming.

Annual Day

ICAR-CIFA celebrated its 37th Annual Day on 1 April, 2024 at the Headquarters at Kausalyaganga, Bhubaneswar. Dr. (Mrs.) Dhriti Banerjee, Director, Zoological Survey of India (ZSI), Kolkata graced the occasion as Chief Guest. Dr. A. K. Nayak, Director, ICAR-National Rice Research Institute, Cuttack and Dr D. Dash,

Table 25. Memorial awards of ICAR-CIFA (for the year 2023)

Category of Award	Winner
Dr T. Ramaprabhu Memorial Award	Ms Smruti Mahapatra JRF, DBT Project, FHMD, ICAR-CIFA
Smt. S. Susheelamma Memorial Scholarship	Mr. Indranuja Nath Pratap Sasan Govt. High School, Balakati, Khurdha
Girish Chandra Chaudhuri Memorial Scholarship	Mr. Aryan Baral Anmol Higher Secondary School of Science and Commerce, Pubasasan, Pipili, Puri

Director, DBT-Institute of Life Sciences (ILS), Bhubaneswar were also present as guests of honor. Dr. P.K. Sahoo, Director, ICAR-CIFA highlighted the Institute's achievements. Dr. Banerjee emphasized that for an agrarian country like ours, conservation of natural resources is very crucial. She further called upon protecting Mother Nature. Dr. Nayak congratulated the Institute on its outstanding achievements in the field of fisheries science and its initiatives in the development of downtrodden section of the society including women. He called

for greater collaboration in addressing food and nutritional security of the poor people. Dr. D. Dash emphasised on collaborations between ILS and ICAR-CIFA in the diverse fields of life sciences. On this occasion, nine publications of the Institute were released by the dignitaries. Winners of three memorial awards; instituted in the name of Smt. S Susheelamma, Dr. Girish Chandra Chaudhury and Dr. T Ramaprabhu for the year 2023 were also felicitated on the occasion. The representatives from all ICAR Institutes in and around Bhubaneswar and retired employees of ICAR-CIFA also participated in the function. All RRCs of the Institute joined the programme virtually, besides celebrating the day in their respective campuses.

Celebration of World Intellectual Property Day

The Institute in collaboration with KIIT-TBI Technology Transfer Office (KIIT-TBI TTO), Bhubaneswar organized a seminar on IP Management on 30 April, 2024 on the theme of World Intellectual Property Day 2024: 'IP and the SDGs: Building Our Common Future with Innovation and Creativity' to increase awareness and understanding of IP for all the scientists, technical officers, administrative staffs and research scholars. Dr. Amaresh Panda, Lead, KIIT-TBI TTO, KIIT University, Bhubaneswar gave lecture on Unlocking Innovations: IPR awareness, Strategies and Challenges.

Krishi Jagran-MFoI Samridh Kisan Utsav

The Institute and KVK, Khordha in association with Krishi Jagran and Mahindra Tractor organized Millionaire Farmer's of India (MFoI) Samridh Kisan Utsav on 11 June, 2024. Dr. P.K. Sahoo, Director, ICAR-CIFA graced this occasion as Chief Guest. In his address, he appreciated the activities of Krishi Jagaran in excelling in knowledge dissemination for the rural and farming communities in agriculture and allied sectors.

World Environment Day

On 5th June 2024, ICAR-CIFA celebrated World Environment Day with the theme, "Land Restoration, Desertification, and Drought Resilience," emphasizing the critical need to heal our land, combat desertification, and strengthen our resilience against drought, and held a plantation programme at the campus. Dr. S.S. Giri, In-charge Director of ICAR-CIFA, highlighted the importance of the theme and the significance of the plantation programme. To mark the occasion, 150 saplings of the bael plant (*Aegle marmelos*) were planted symbolizing the Institute's commitment to environmental sustainability and land restoration.

World Blood Donor Day

ICAR-CIFA observed World Blood Donor Day on 14 June, 2024 honoring Karl Landsteiner's contributions to modern blood transfusion. An awareness program was held at the Institute's dispensary, offering blood group, sugar, and nerve conduction tests. Employees took an oath for blood donation.

Live-telecast of PM Kisan Programme

KVK, Khordha, ICAR-CIFA organized the PM Kisan Programme on 18 June, 2024. Dr. Mukesh Mahaling, Hon'ble

Minister, Health & Family Welfare, PA, E & IT, Govt. of Odisha graced the programme as Chief Guest.

International Day of Yoga

The Institute celebrated International Day of Yoga with the theme "Yoga for Self and Society" on 21 June, 2024. On this occasion, Shri Dipak Kumar Swain, Yoga Trainer, Patanjali Yoga Prachara Samiti, Puri reiterated the importance of yoga and demonstrated different Asanas and Pranayamas to the staff of ICAR-CIFA.

National Fish Farmers' Day

The Institute celebrated National Fish Farmers' Day on 10 July, 2024, under the Farmer FIRST Project, with 30 farmers participating in it. The event was also observed at different RRCs. A training-cum-exposure visit for 21 PVTG beneficiaries from Gajapati, Odisha was held from July 11-13. On July 13, a gathering of fish farmers and entrepreneurs took place, attended by key dignitaries. Chief Guest Dr. Himanshu Pathak, Secretary (DARE) & DG (ICAR), urged scientists to develop customized technology packages and integrate AI in precision aquaculture. He laid the foundation stone for the Genome Editing Facility and inaugurated various infrastructure, including the Koi Carp Breeding Facility and SMART Pond. Dr. J.K. Jena and Dr. R.C. Agrawal, Guests

of Honour, emphasized research in fish breeding and quality production. An Exhibition-cum-Kisan Mela was held, 14 farmers were felicitated, and several commercialization agreements were signed. Over 200 stakeholders participated in the event.

Institute-Industry Interaction Meet

ICAR-CIFA conducted Institute-Industry Interaction Meet on "Commercialization of ICAR-CIFA technologies" on 12 July, 2024. The program was conducted in hybrid modes where 52 participants shared their views and expectations from ICAR-CIFA to contribute for the betterment of the society.

Live telecast of release of 109 crop varieties of ICAR, by Hon'ble Prime Minister

ICAR-CIFA and KVK-Khordha organized a special programme on 11 August, 2024 to mark the release of 109 high-

yielding, climate-resilient, and biofortified crop varieties by PM Narendra Modi. Demonstrations on drone applications in aquaculture and solar dryers were conducted. The event saw participation from 127 farmers and farmwomen from Khordha district.

Union Minister Shri Rajiv Ranjan Singh releases the "CIFA-Amrit Catla"

Union Minister for Fisheries, Animal Husbandry and Dairying and Panchayati Raj, Shri Rajiv Ranjan Singh Alias Lalan Singh, launched "CIFA-Amrit Catla," a genetically improved variety of Catla (*Labeo catla*), at ICAR-CIFA,

Bhubaneswar on 12 September, 2024. The National Freshwater Fish Brood Bank (NFFBB) of the National Fisheries Development Board (NFDB) received the CIFA-Amrit Catla, ensuring its wider distribution and availability for farmers across the country. "CIFA-Amrit Catla" received national recognition with the Best Technology Award at the 96th ICAR Foundation and Technology Day on 16 July, 2024, and was officially trademarked as "CIFA-Amrit Catla" on 1 August, 2024. Shri Rajiv Ranjan Singh emphasized the Ministry's commitment to scaling up research initiatives taken by ICAR-CIFA. He assured that the Ministry would provide substantial support for research endeavors in the fisheries sector to ensure sustainable growth and enhanced productivity. He also highlighted that the Ministry has recently declared ICAR-CIFA as the Nucleus Breeding Center for freshwater fishes, further solidifying its role in the development of high-quality fish seed in India.

Observation of Vigilance Awareness Week

ICAR-CIFA observed "Vigilance Awareness Week-2024" from 28 October to 4 November, 2024, with the theme "Culture of Integrity for Nation's Prosperity". Staff of the institute took the integrity pledge at headquarters and regional centers. Various programs, including debate and quiz competitions, were conducted. A sensitization workshop on "Preventive Vigilance" was held on 30 October, where Shri S.K. Upadhyaya, retired IPS, emphasized collective efforts to eradicate corruption. Dr. P.K. Sahoo Director, ICAR-CIFA, urged staff to ensure smooth services, while Dr. Bindu R. Pillai, Vigilance Officer, ICAR-CIFA highlighted awareness measures. Winners of competitions had been awarded with certificates. On 4 November, 2024 a Capacity Building Programme was conducted by Shri H.L. Meena on transparency in office work. An Awareness Gram Sabha at Rajas Gram Panchayat educated villagers on anti-corruption initiatives, concluding with an integrity pledge.

World AMR Awareness Week

World AMR Awareness Week (18-24 November, 2024) was observed at ICAR-CIFA, Bhubaneswar. Different programmes were organized to create awareness among the stakeholders on antimicrobial resistance and its impact on human and animal health, food production, and the environment. During this week different meetings and workshops were arranged by the Headquarters and its RRCs involving the villagers and farming communities to make them aware regarding judicious use of the antibiotics.

6 Workshops/Seminars/ Meetings Organized

Workshop on 'Importance of Improved Fish Varieties and Carp Broodstock Diet in Aquaculture'

ICAR-CIFA and the Department of Fisheries, Himachal Pradesh, signed MoUs on improved carps and carp broodstock diet during the above interactive workshop in Bilaspur on 7 June, 2024. Organized jointly, the workshop focused on the importance of improved fish varieties and specialized diets in aquaculture. Over 40 participants, including fisheries officials and stakeholders took part. Dr. Vikram Mahajan welcomed attendees, while Dr. P.K. Sahoo Director, ICAR-CIFA and Shri Vivek Chandel highlighted aquaculture advancements. The MoUs aimed to establish multiplier units for Jayanti rohu and CIFA-Amrit catla® and introduce CIFABROOD®. A Farmer-Scientist Interface session facilitated discussions on challenges, experiences, and innovations in aquaculture.

Workshop on 'Indigenous Fishes of Peninsular India: Present Status and Future Prospects'

On 20 July, 2024, RRC, Bengaluru, in collaboration with the Department of Fisheries, Karnataka, and KSTA, organized a workshop on 'Indigenous Fishes of Peninsular India.' Presided over by Dr. P.K. Sahoo, Director, ICAR-CIFA, the event featured Shri Dinesh kumar Kaller and Dr. A.M. Ramesh. Discussions focused on conservation, technological support, and a proposed MoU. Dr. Hemaprasanth, SIC, RRC, Bangaluru highlighted ICAR-CIFA's seed production technology for five peninsular carp species. Carnatic carp fingerlings were supplied for conservation. Experts shared insights on aquaculture advancements, with 47 participants attending, including officials and stakeholders.

National Stakeholder Consultation on Sustainable Development of Ornamental Fisheries in India

ICAR-CIFA, Bhubaneswar in collaboration with the NFDB, Hyderabad, organized the 'National Stakeholder Consultation on Sustainable Development of Ornamental Fisheries in India' during 1-2 August 2024 at its Headquarters at Kausalyaganga. Dr. B.K. Behera, Chief Executive, NFDB graced the occasion as Chief Guest and informed that NFDB plans to promote ornamental fisheries by developing the Cluster Approach. He urged the participants to avail the board's different promotional initiatives. Dr. P.K. Sahoo, Director, ICAR-CIFA highlighted the importance of adopting scientific practices to produce quality ornamental fish, thereby increasing India's share in the international market. A total of 65 stakeholders from across the country participated in the meeting.

Other Extension Activities

Table 26. Radio talks/Television programmes

Name	Date	Programme
Dr N.K. Chandan	28 Feb 2024	"Hello Kisan" Live Television Programme on 'Mithepani ke Talab me Machli Palan'
Dr Bindu R. Pillai	28 Feb 2024	"Vichaar Vimarsh programme on Freshwater prawn farming" on DD Kisan, New Delhi
Dr P.K. Sahoo Dr G. Barlaya	25 Sept 2024	Doordarshan Kannada News
Dr N.K. Chandan	27 Sept 2024	"Hello Kisan" Live Television Programme on 'Machli Palan'
Dr B.N. Paul	23 Oct 2024	AIR, Kolkata programme on Krishi Kathar Asar of Akashbani Kolkata, Gitanjali programme on the topic "*Mach Chase Unnatite ICAR-CIFA*"

7 International Collaboration

Dr P. K. Sahoo, Director, ICAR-CIFA attended 33rd Governing Council meeting of Network of Aquaculture Centres in Asia Pacific (NACA) held at NASC, New Delhi during 5-8 March, 2024.

Dr P. Swain, Principal Scientist participated in the meeting on bilateral collaboration on academic and research with delegates from Norway at The Royal Norwegian Embassy in New Delhi on 24 April, 2024.

Dr J. K. Sundaray, Head, FGBD attended International Institute of Fisheries Economic and Trade (IIFET) Conference held at Penang, Malaysia during 15-19 July, 2024.

Ms. Ibukun Esther Awoyemi from University of Ibadan, Oyo State, Nigeria successfully completed her Ph.D. research work under the UNESCO-TWAS SANDWICH Fellowship programme (December 2022 – June 2024) under the mentorship of Dr. S. S. Giri, Head, Fish Nutrition and Physiology Division and made a presentation on her work at the Institute on 21 June, 2024.

ICAR-CIFA organized an International Training Program on "Carp Breeding, Cryobanking, Hatchery Management and Monosex Tilapia Production" sponsored by FAO, Sri Lanka for the delegates (16 nos) from Sri Lanka during 02-13 September, 2024.

8 Reaching the Unreached

North-Eastern Hill (NEH) Scheme

Under this scheme, several activities were undertaken by ICAR CIFA during January–December 2024 under following 2 sub-projects:

(i) Development of fisheries in Assam along with livelihood of the people and

(ii) Livelihood development for fish farmers in Nagaland through diversified aquaculture

Capacity building

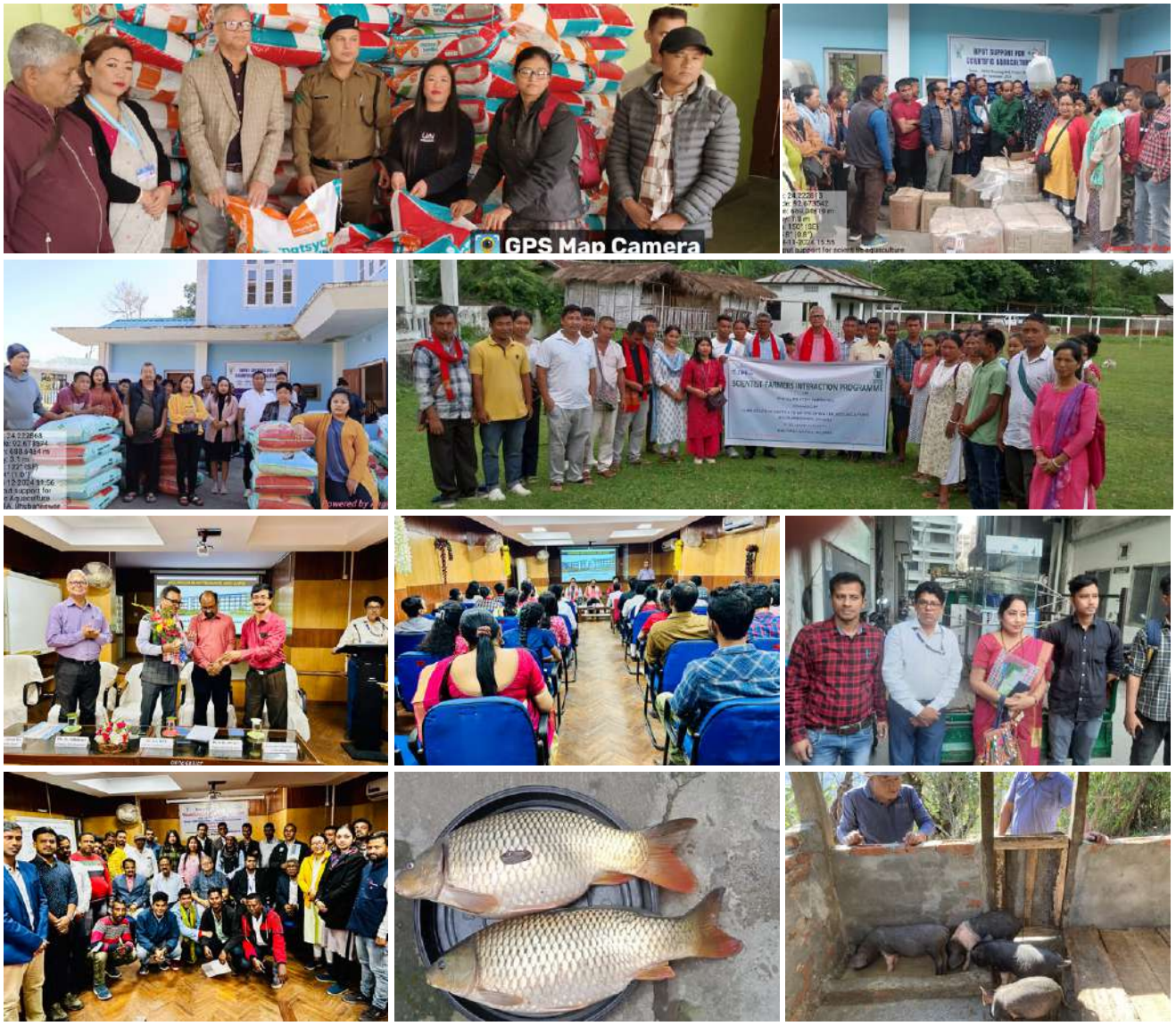
Specialized training programs were conducted across seven North-Eastern States of India involving a total of 855 participants (72.4% male, 27.6% female). The benefiareis were from Assam (320), Arunachal Pradesh (170), Sikkim (130), Tripura (85), Mizoram (50), Meghalaya (40), and Nagaland (30). These initiatives effectively disseminated scientific knowledge and practical applications on diverse topics including integrated fish farming, scientific freshwater aquaculture, ornamental fish breeding and culture,

aquarium maintenance, biofloc technology, recirculating aquaculture systems, small indigenous fish species cultivation, and fish health management.

Input distribution

In order to ensure wider dissemination of technologies, aquaculture and allied inputs like fish seed, feed and feed ingredient & lime were distributed among 1,060 beneficiaries across these states. Based on the baseline survey and local requirements, the appropriate inputs were chosen for distribution like Amur carp in Arunachal Pradesh, Sikkim, and Mizoram; Indian Major Carps in South Tripura; pengba and rohu in Manipur. Integrated farming systems were promoted through pig-fish integration in Karbi Anglong, Assam and Kohima, Nagaland. Sixty aquarium units were distributed to schools in Assam, Tripura, and Nagaland to create awareness about aquarium hobbying, while water testing kits provided to 80 beneficiaries in Aizawl to support scientific management practices.

In addition, need based aquaculture technology demonstration programmes were



A pair of adult Amur carps harvested from pond

Four piglets provided to each farmer

also undertaken in four NE states, benefiting 640 individuals, including 119 women. The focus area was mainly on location specific technologies like fish-cum-pig farming in Nagaland and Assam, composite fish culture in Assam and Tripura, and carp polyculture with pengba in Manipur.

Scheduled Tribe Component (STC) Scheme

Scheduled Tribe Component Scheme is being operated in five tribal-dominated districts of Odisha and one district of Tamil Nadu. All the activities under this scheme are being implemented through a project entitled "Ensuring livelihood security through aquaculture based integrated approaches and value chain development of tribal populations in India".

Several developmental activities were taken up during 2024 under four sub-projects:

- Implementation of aquaculture based integrated farming development for livelihood security of tribal populations in Gajapati and Rayagada districts, Odisha.

- Development of value chain of freshwater aquaculture among tribal communities in Nabarangpur & Kalahandi districts, Odisha

- Livelihood improvement of tribal communities through introduction of improved fish varieties and other technological intervention in the Mayurbhanj District of Odisha.

- Livelihood development of scheduled tribe communities in Coimbatore region of Tamil Nadu through aquaculture and allied intervention strategies.

In 2024, the institute actively engaged in awareness programs, workshops, and exposure visits under STC to promote aquaculture practices among tribal communities. A total of 588 beneficiaries, including 542 women, participated in these initiatives across Odisha and Tamil Nadu. Key activities included training on fish health management, feed preparation, and pond management, along with exposure visits for tribal self-help groups (SHGs) to enhance their knowledge of sustainable aquaculture practices.

Additionally, input distribution programs were conducted across Odisha, Chhattisgarh, and Karnataka, benefiting 918 tribal farmers. These programs focused on providing essential resources such as fish seed, feed, and training on hatchery management, scientific fish farming, and sanitary measures for pond aquaculture. The initiative emphasized empowering tribal communities by equipping them with technical knowledge and inputs for sustainable fish farming.

ICAR-CIFA also demonstrated the feed formulations such as 'CIFA Carp Grower' and 'CIFA Carp Starter' in Chhattisgarh's Narayanpur district, benefiting 124 farmers. In Odisha's Kalahandi district, technologies like Jayanti Rohu, CIFAX, L-Check, and M-Check were introduced to 81 farmers, including 27 women. These demonstrations aimed to enhance productivity and disease management in aquaculture, further supporting livelihood development in tribal areas.

Scheduled Caste Sub-Plan (SCSP) Scheme

- Scheduled caste sub-plan (SCSP) scheme is being operated in project mode with following seven sub-projects.

- Economic empowerment and capacity building of rural SC farm families of West Bengal through technological intervention in fish farming

- Sensitization of SC beneficiaries from Karnataka state to scientific aquaculture practices and income generation for sustainable livelihood

- Upliftment of SC farmers through modern scientific aquaculture practices in Punjab and Rajasthan States under SCSP Programme

- Upliftment of SC fisher community through integrated advanced aquaculture practices in Andhra Pradesh and Telangana States

- Entrepreneurship development in catfish farming technologies for socio-economic upliftment of scheduled caste community in Odisha State
- Livelihood development of SC farmers through fish seed village and Integrated fish farming in Puri and Kandhamal district of Odisha.

- Rural Livelihood Improvement and Empowerment of Women through Aquaculture

The consolidated work done during the year is as follows:

Capacity development

Thirty-nine training programs/ workshops/ skill development sessions were conducted under SCSP scheme in Andhra Pradesh, Punjab, Rajasthan, Karnataka, West Bengal, and Odisha, benefiting 3,833 participants. These programs covered scientific fish farming, integrated aquaculture, ornamental fish culture, fish feed preparation, and disease management, providing practical skills and knowledge to fish farmers and entrepreneurs from SC communities. In Odisha, 20 training programs with 2,042 beneficiaries focused on carp seed production, feed preparation, and pond management. Kisan melas and exhibitions attracted 1,340 participants, including 760 women SC farmers. Workshops in Andhra Pradesh and Karnataka reached out to 183 participants on improved fish farming methods, while programs in Punjab and Rajasthan engaged 130 beneficiaries in ornamental fish farming and fish seed distribution. West Bengal hosted two scientist-farmer meetings with 138 participants, introducing them to the recent technologies in scientific aquaculture techniques.

Technology demonstration

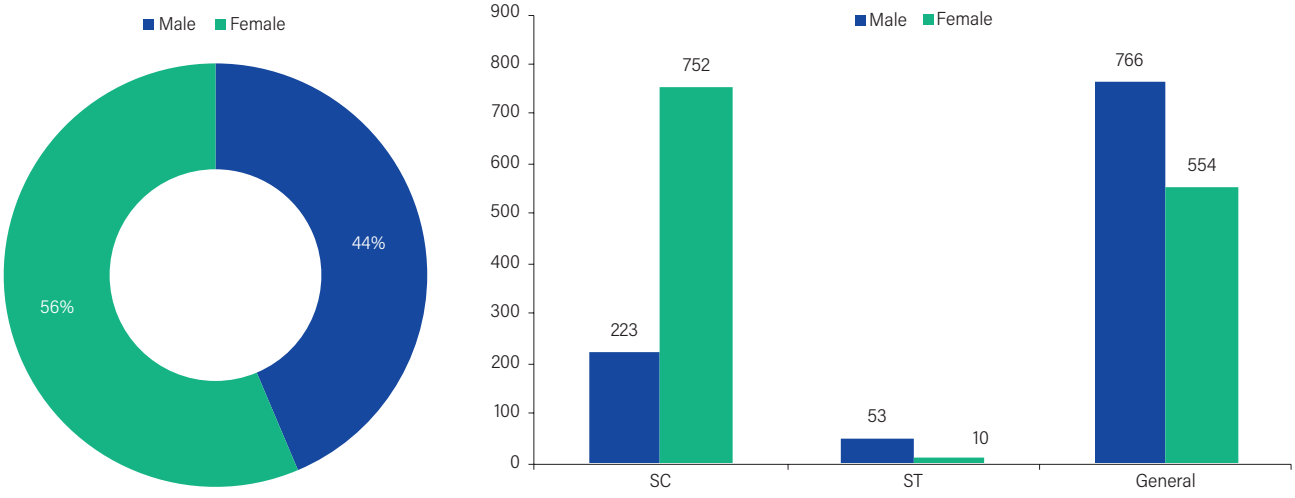
The institute demonstrated the improved aquaculture technologies to 4,168 farmers, focusing on grow-out carp culture and ornamental fish farming. Grow-out carp culture was introduced in Andhra Pradesh (106), Karnataka (30), West Bengal (138), and Odisha (3,767 across 12 districts), with training on scientific fish culture, disease prevention, and water quality. Ornamental fish farming demonstrations in Punjab and Andhra Pradesh benefited 117 farmers, covering breeding, species selection, and market opportunities. These initiatives helped farmers improve productivity and explore new aquaculture ventures.

9 Krishi Vigyan Kendra

In alignment with its mandate, KVK-Khordha, ICAR-CIFA, Bhubaneswar successfully conducted 65 training programs covering various disciplines, including Crop Production, Horticulture, Animal Science, Fisheries, and Home Science. These initiatives benefited 2,358 participants, including practicing farmers, farmwomen, rural youth, and extension functionaries.

Table 27. Details of Training Programmes conducted

Sl. No	Category	Number of trainings	Duration (days)	No of participants
	Practicing Farmers/ Farmwomen	51	1	1924
	Rural Youth	5	5	120
	Extension Functionaries	3	3	35
	Sponsored Trainings	6	3	279
	Total	65	12	2358



Participation of male and female in training programmes

On Farm Trials (OFT) conducted

Varietal evaluation of CR Dhan 801 and 802 during kharif season

Paddy growers in the district were experiencing production losses due to climatic variations, primarily drought conditions. To address the challenge, KVK conducted field evaluations of the climate-resilient rice varieties CR Dhan 801 and CR Dhan 802, developed by ICAR-NRRI, Cuttack. The trials were carried out across seven locations in Khordha district, covering 2.0 hectares during the Kharif season of 2024. Their performance was assessed in comparison to the local paddy variety, Pooja. Results showed that the yield of CR Dhan 801 and CR Dhan 802 was 46.90 and 43.20 q/ha respectively. CR Dhan 801 demonstrated a significantly higher yield, producing 20.5% more than the local variety Pooja, which recorded a yield of 38.9 q/ha.

Assessment of INM in sweet corn

Sweet corn farmers often use an imbalanced fertilizer ratio of NPK 135:80:45 kg/ha, resulting in lower yields and reduced profitability. To address this issue, an evaluation was conducted using two fertilizer treatments-50% RDF (NPK 120:60:60 kg/ha) and 100% RDF (NPK 120:60:60 kg/ha)-both supplemented with

Zinc Sulphate at 25 kg/ha to assess their impact on productivity and returns. This balanced nutrient management approach resulted in a 25.5% higher yield compared to the farmers' practice, highlighting its effectiveness in enhancing productivity and profitability.

Assessment of fertilizer management in yard long bean

Farmers face the challenge of low yields in yard-long bean cultivation due to imbalanced fertilizer application, typically at an NPK ratio of 85:110:30 kg/ha. To address this, soil test-based fertilizer applications were evaluated, including two treatments: one with 50:75:50 kg NPK/ha supplemented with bio-fertilizers (*Rhizobium* & PSB) at 5 kg, and another with 40:60:50 kg NPK/ha. The results showed that the treatment with 50:75:50 kg NPK/ha and bio-fertilizers led to an average pod weight of 21.82g and a significantly higher yield of 98.04 q/ha, demonstrating its effectiveness in enhancing productivity.

Assessment of GI catla spawns in farmers' pond

The performance of 'Genetically Improved GI catla,' developed by ICAR-CIFA, was evaluated in farmers' ponds during 2024. GI catla and locally bred catla were stocked separately and reared for 15 days in six different ponds to assess their growth and performance under field conditions. The result indicated a higher survival rate of 41.4% in GI catla over the normal catla. Similarly, the average length was 31 mm and 21 mm, respectively for GI catla and local bred catla. The demonstrated benefits of this superior strain, including higher growth and survival rates, encouraged its adoption among the farmers.

Intercropping of minor carp in carp polyculture system

The incorporation of minor carps in the carp polyculture system was evaluated in six farmers' ponds. Fry of *Puntius gonionotus* was stocked @ 20% of the stocking density of Indian Major Carps (8000/ha). After six months of culture, an average weight of 340g was recorded for *P. gonionotus*. Further, this approach led to an 8.4% increase in yield and an improved benefit-cost (BC) ratio of 2.26, compared to 2.14 in the polyculture of IMC alone.

Effect of chelated minerals supplement on milk yield of crossbred Jersey cows

Farmers' practice of feeding Jersey cows with concentrate feed and paddy straw often results in low milk yield. Supplementing with 50 g/day of chelated minerals increased milk production by 18% compared to the farmers' practice. Chelated minerals being more bioavailable enhanced nutrient absorption, improving milk yield.

Performance of paddy straw mushroom using crumpled paddy straw

To utilize crumpled paddy straw, a technology was tested through an OFT, comparing it with the farmers' practice across seven fields using the OSM-11 variety and the tray method. The study found that paddy straw mushrooms grown

Paddy straw mushroom OSM-11

on crumpled straw from pedal threshers yielded 600g/bed (15% biological efficiency, BC ratio 1.33), while those using straw from combined harvesters yielded 550g/bed (13.75% efficiency, BC ratio 1.22).

Front Line Demonstrations (FLD) conducted

Demonstration of Paddy variety RNR 15048 (Telangana Sona) in farmers' field

To promote and enhance income from paddy cultivation, paddy variety RNR 15048 (Telangana Sona) was demonstrated at 25 farmers field in Khordha district during Kharif, 2024. The variety has a low glycemic index (<50%), fine grain quality, and blast resistance. Its production was compared with the local variety Bina, yielding 46.9 q/ha (9.8% higher than Bina). The average net income and BC ratio were Rs. 78,150/ha, 3.0 and Rs 45,178, 2.2 for Telangana Sona and local variety Bina, respectively.

Paddy var. Bina

Paddy var. RNR 15048

Demonstration of Ragi & Value addition training

To promote the Millet Mission, KVK demonstrated the high-yielding ragi variety 'Arjun' (100–110 days) across five locations with 25 farmers in Khordha. Using 80:40:40 kg NPK/ha and 30×22.5 cm spacing, 'Arjun' outperformed the local variety VL-Mandua 376, yielding 41.5% higher. Ten women SHGs were provided training in finger millet value addition, producing ready-to-eat products. Arjun variety millet flour (100 g) contained 66.82 g carbohydrates, 7.23 g protein, 11.06 g fiber, 362 mg calcium, and 4.6 mg iron. The SHGs earned Rs. 3,500 from 60 kg millet, promoting productivity, food security, and livelihoods.

Finger Millet Var. Arjun

Demonstration of scientific fish culture in community ponds

Scientific fish culture was demonstrated in three community ponds (3.8 ha) with

scheduled caste women SHGs in Khordha. With training and inputs, yields improved to 3.914 t/ha (BC ratio 2.58) from 2.418 t/ha (BC ratio 2.11). The groups gained insights into scientific management, institutional linkages, and higher income.

Demonstration of Amur carp in carp polyculture system

Amur carp was partially replaced with mrigal in a 30:40:15:15 ratio (catla: rohu: mrigal: amur) instead of the farmers' 30:40:30 ratio (catla: rohu: mrigal) at a stocking density of 8000/ha. The 15% replacement increased production by 12.12% over the IMC-only practice.

Paddy straw mushroom (OSM-11) cultivation

OSM-11, a high-yielding mushroom variety, developed by AICRP Mushroom Unit, OUAT, was demonstrated through front line demonstration. The trials were conducted across ten farm women's fields in Bhagabatipur, Bhubaneswar, Dhanahara, and Guapur villages of Balipatna Block, Khordha. Paddy straw was treated with 1% $CaCO_3$, resulting in a higher yield of 1.1 kg/bed with 15.71% biological efficiency. OSM-11 showed pinhead formation in 10 days and had a 25-day crop cycle, outperforming the local variety with a BC ratio of 1.88.

Vermicompost production

To promote proper waste utilization, a skill development training program on vermicompost production was conducted under the front-line demonstration. Essential inputs such as Silpaulin vermicomposting beds (12×4×2 ft) and *Eisenia foetida* earthworms were provided to five women self-help groups (30

members) in Dhanahara and Majhihara villages of Balipatna block, Khordha. The initiative resulted in an average vermicompost yield of 7.0 q/bed per cycle, with a conversion period of 75 days and a BC ratio of 4.66 per unit.

RAWE program for students

Five B.Sc. (Agriculture) students from SOA University, Bhubaneswar, had undergone Rural Awareness Work Experience (RAWE) Program at KVK, ICAR-CIFA for 3 months from 9 September to 9 November 2024. The

students were exposed to the major problems and issues in agriculture and allied sectors in different villages and formulated need-based solution(s) in their action plans. Practical exposure to different scientific management practices were demonstrated at KVK during this period.

Table 28. Different Programmes organized by KVK, Khordha

Sl. No.	Programme Title	Date	No. of beneficiaries	
1	Farmer-Scientist Interaction and Agricultural Farm Implements Distribution	07 Mar 2024	62	
2	Training-cum-Exposure Visit on Nano-fertilizers, organic farming, fish culture, and mushroom cultivation, promoting sustainable practices	18-20 Mar 2024	40	
3	Training-cum-Input Distribution Programme on Integrated Farming System (IFS) models, and a demonstration on Agri-drone use in agriculture and aquaculture (under SCSP Scheme)	31 July 2024	28	
4	Awareness Program on PM-KUSUM (solar energy adoption in agriculture to reduce dependency on non-renewable energy sources and minimize carbon emissions)	30 Sept 2024	33	
5	World Food Day 2024: Promoting Sustainable Food Security	16 Oct 2024	72	

10 Library and Information Systems

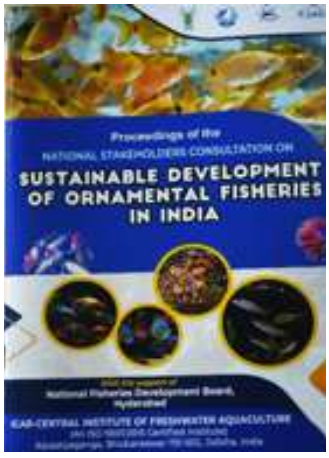
ICAR-CIFA is home to a well-equipped library, the Hiralal Chaudhuri Library, and an e-resource center that offers a rich collection of reference books and journals across a wide range of fields, including Fisheries, Freshwater Aquaculture, Physiology, Nutrition, Aquatic Health, Environmental science, Biotechnology, Genetics, Bioinformatics, Socio-economics, and Extension. These resources serve the needs of scientists, research scholars, personnel from other research organizations, academicians, university students, and various other stakeholders

Library Collection

The Hiralal Chaudhuri Library has an extensive collection of approximately 7,485 reference books, 2,900 journal back volumes, newsletters, reports, and various other publications. Each year, the library's holdings are expanded with the acquisition of new books and subscriptions to both national and international journals. Additionally, the library has been designated as an FAO depository, housing a valuable collection of FAO publications related to fisheries and allied agricultural sciences.

CeRA (Consortium of e-Resources on Agriculture)

The library has established online access to the Consortium for Electronic Resources in Agriculture (CeRA), which includes over 100 international and national journals focused on fisheries and aquaculture. Library users extensively utilize CeRA through the J-Gate platform, one of the largest discovery services globally, catering to agricultural



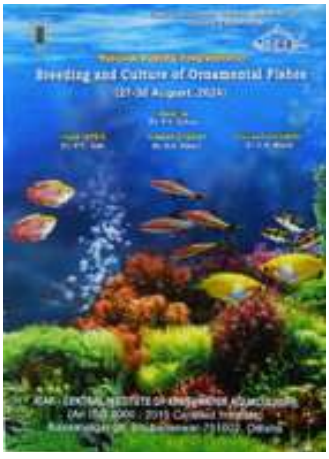
researchers across the country. The platform features a user-friendly interface, allowing easy search, browsing, and access to relevant content. Its advanced search options let users refine queries based on keywords, authors, publication dates, and journals. Through CeRA, users can access 1,174 e-books on agriculture and related fields, along with more than 2,900 e-journals. It also offers 80 e-books on fish and fisheries, 17 e-book series, and journals published by major publishers such as Elsevier, Wiley, Springer, and Taylor & Francis. Additionally, the Indiastatagri database is available through CeRA. Beyond this, the library provides Document Delivery Services to various institutions, including State Agricultural Universities (SAUs) under the National Agricultural Research System (NARS), sending key articles to both internal and external researchers.

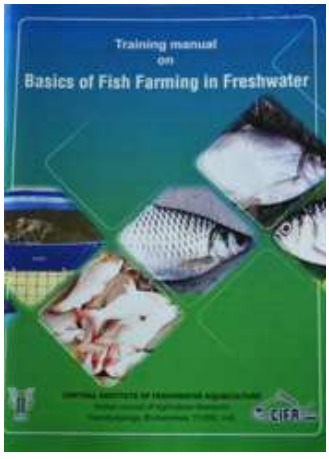
MyLOFT WebApp

MyLOFT, which stands for 'My Library on Fingertips,' is an application designed for accessing, organizing, and sharing digital content and e-resources subscribed to by the library. ICAR-CIFA has subscribed to MyLOFT to provide remote access to e-resources available through CeRA.

Anti-plagiarism service

The library also provides the service for checking the plagiarism of scientific articles of the institute staff prior to publishing in various journals. The iThenticate software of 'Turnitin'



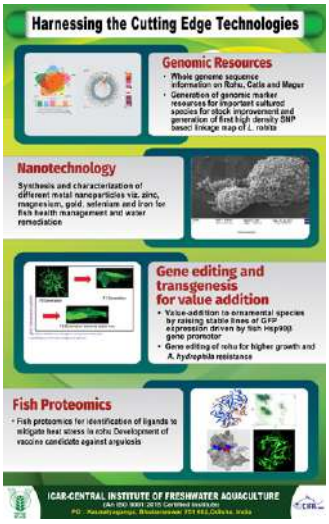


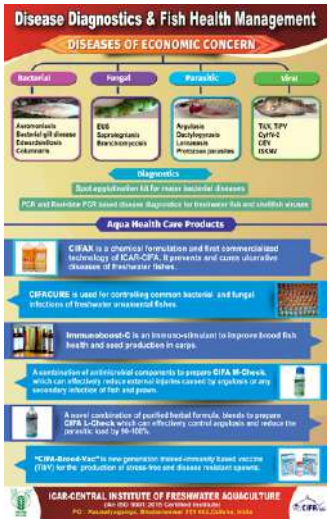
is subscribed for anti-plagiarism services by the institute.

CIFA in Media

All major research breakthrough/ scientific activity/success stories and the events of the institute etc. were duly covered in both electronic and print media. The media presence of the institute has increased manifold and invariably all-important news is also posted in ICAR website beside ICAR-CIFA website. Additionally, news articles related to CIFA are meticulously archived and compiled annually under the title 'CIFA in Media.'

ICAR-CIFA received Appreciation certificate for Best CeRA usages for Eastern Region among ICAR Institutes (2023) during CeRA Regional Workshop on 13 September 2024 held at Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal. Also received the Plaque and Appreciation certificate for Highest Online Hits on J-Gate Discovery Platform among ICAR Institutes for Eastern Region





11 Publications

Research Articles

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12 Awards and Recognitions

The AICRP on PEASEM Centre at ICAR-CIFA, Bhubaneswar had been conferred with Runner Up Best Centre Award-2024 at the XX Annual Workshop of AICRP on PEASEM held at SKUAST-K, Srinagar, Jammu and Kashmir during 14-16 October 2024 for overall achievements of the centre in Application of Plastic Engineering in Agriculture.


All India Coordinated Research Project on
Plastic Engineering in Agriculture Structure and Environment Management
ICAR-Central Institute of Post-Harvest Engineering & Technology, Ludhiana

Runner Up Best Centre Award -2024

presented to

ICAR-CIFA, Bhubaneswar

in the XX Annual Workshop of AICRP on PEASEM held at SKUAST-K, Srinagar during October 14-16, 2024 in recognition of overall achievements of the centre in Application of Plastic Engineering in Agriculture

(Rakesh Sharda)
PC(PEASEM)

(S.N. Jha)
DDG(Agril. Engg.)

ICAR-CIFA bagged 'Best Stall Award' in the '3rd Acharya Prafulla Chandra Roy Smarak Vigyan Mela O Pradarshani' in Kolkata during 26-29 December 2024.

The "CIFA-Amrit Catla" technology received national recognition as one of the prominent technologies at the 96th ICAR Foundation and Technology Day on 16 July 2024

Dr B. N. Paul and Dr K. C. Das, Principal Scientists received 'Fellow Award' from Animal Nutrition Society of India during ANSICON-2024 Conference held in Chennai during 23-25 January 2024.

Dr A. Paul, Scientist received Asian Fisheries Society Young Scientist Award in 13th Indian Fisheries & Aquaculture Forum held in Kolkata during 23-25 February 2024.

Dr A. Paul, Scientist has been conferred with prestigious Dr. C. V. Kulkarni Young Scientist Award 2024 on 6 June 2024 from ICAR-CIFE, Mumbai.

Dr P. K. Sahoo, Director, ICAR-CIFA was awarded Distinguished Scientist Award in the 6th International Conference on "Agri Vision-2024: Agriculture for Sustainable Future" at ICAR-NRRI, Cuttack held during 19-21 January 2024.

Dr J. K. Sundaray, Principal Scientist and Head, FGBD was honoured with the Padma Shri (Dr) Ajay Parida Lifetime Achievement Award in the 6th International Conference on "Agri Vision-2024: Agriculture for Sustainable Future" at ICAR-NRRI, Cuttack held during 19-21 January 2024.

Dr B. C. Mohapatra, Principal Scientist received Life Time Achievement Award from ZSI, Gaya, Bihar in the 35th All India Congress of Zoology and International Conference in Bilaspur, Chhattisgarh during 5-7 June 2024.

Dr Harapriya Nayak, Senior Scientist and Head, KVK, Khordha received the 1st prize for oral presentation in the International conference on 'Building small holder climate resilience for achieving sustainable food systems' at OUAT, Bhubaneswar during 17-19 September 2024.

Dr Harapriya Nayak, Senior Scientist and Head, KVK, Khordha received 2nd prize in oral presentation in 3rd International Conference on 'Climate smart nutri-sensitive integrated farming system for gender equitable sustainable agriculture prospects and challenges' at ICAR-CIWA, Bhubaneswar during 6-8 November, 2024.

Table 35. Student Guidance

Sl. No.	Name of the Student	Course (PG/PhD)	Name of the Guide	Dissertation/Thesis Title	Name of the University/ College/Institute
1	Ms. Tanisha Nayak	M.F. Sc.	Dr B. R. Pillai	Comparative evaluation of individual rearing versus group rearing on growth, survival and maturation of broodstock of genetically improved freshwater prawn 'CIFA-GI Scampi®'	College of Fisheries (OUAT) Rangailunda, Berhampur
2	Ms. Swapna Behera	Ph.D.	Dr P. C. Das	Evaluation of growth and production performance of *Ompok bimaculatus* (Bloch, 1794) in biofloc system	Fisheries College and Research Institute, Thoothukudi, TNJFU, Tamil Nadu
3	Ms. Subhasrita Nayak	M.F. Sc.	Dr P. C. Das	Physio-metabolic responses of *Catla catla* against Ammonia toxicity	College of Fisheries (OUAT) Rangailunda, Berhampur
4	Ms. Pralipta Priyanjali Panda	M.F.Sc.	Dr B. C. Mohapatra	Productivity evaluation of plant and fish biomass in floating raft aquaponics system in cement cistern	College of Fisheries (OUAT) Rangailunda, Berhampur
5	Ms. Kabyasree Bala	M.F. Sc.	Dr R. N. Mandal	Production of live fish food organisms with fertilizers and manures in different environmental conditions	West Bengal University of Animal and Fishery Science, Kolkata
6	Mr. Sajan D.	M.F. Sc.	Dr J. K. Sundaray	Expression profiling of the genes associated with PUFA biosynthesis and immune system in *Channa striata* (Bloch, 1793),	ICAR -CIFE, Mumbai
7	Ms. Latasha Bhuyan	M. Sc.	Dr L. Sahoo	Genetic Characterization of Odisha stock of *Anabas testudineus*	School of Biotechnology, KIIT University
8	Mr. Uday Kr Udit	Ph.D.	Dr Samiran Nandi	Visceral and subcutaneous fat accumulation and its implication on gonad maturation in brood female catla, (*Catla catla*, Ham.)	ICAR-CIFE, Mumbai
9	Mr. Arabinda Tung	M.F. Sc	Dr Samiran Nandi	Characterization of early maturing females of rohu (*Labeo rohita*)	College of Fisheries, Rangailunda, OUAT
10	Mr. K. Anantharaja	Ph.D.	Dr P. Routray	Production performance of *Hypselobarbus pulchellus* (Day, 1870) in biofloc based seed rearing system	ICAR-CIFE, Mumbai
11	Ms. Rakhi Kumari	Ph.D.	Dr K.N. Mohanta	Ontogeny of gastrointestinal tract and digestive enzymes during larval development and subsequent responses to diets in striped murrel, *Channa striata* (Bloch,1793) larvae	ICAR-CIFE, Mumbai
12	Ms. P.C. Nandanpawar	Ph.D.	Dr P. Das	Identification of genes associated with it performance traits in selectively bred 'Jayanti' rohu, *Labeo rohita* (Hamilton, 1822)	ICAR-CIFE, Mumbai
13	Mrs Mamata Mahapatra	Ph.D.	Dr S. S. Giri	Influence of dietary lipids and micronutrients on omega-3 fatty acids biosynthesis and tissue deposition in rohu, *Labeo rohita* (Hamilton, 1822)	Utkal University, Bhubaneswar
14	Ms. Sonali Parida	Ph.D.	Dr P. K. Sahoo	Cloning and molecular characterization of few antioxidant defence genes of rohu, *Labeo rohita* (Hamilton)	Utkal University, Bhubaneswar
15	Ms. Suchismita Nayak	Ph.D.	Dr P. Routray	Ecology, spawning and culture possibilities of *Amblypharyngodon mola*	Utkal University, Bhubaneswar

13 Human Resource Development

Table 36. Training undergone by the staff members of the Institute

Scientific Staff

Sl. No	Name of the Staff	Name of the Training	Duration	Organized by
	Dr D. Panda	Uploading of employees on iGOT Karmayogi platform	26 Sept 2024	Online
	Dr B. R. Pillai	Vigilance Perspectives for ICAR Officers	6-8 Nov 2024	ICAR-NAARM Hyderabad
	Dr P. K. Sahoo Dr D. Panda	On-boarding of all employees of ICAR-Institutes/HQs on iGOT Karmayogi platform	12 Dec 2024	Online

Technical staff

	Mr Sisir Mohanty	Data Carpentry and AI/ML Tools for Libraries	1-5 Jul 2024	IIM, Kolkata
	Mr Sisir Mohanty	J-Gate@CeRA for eastern region	13 Sept 2024	BCKV, Mohanpur, West Bengal

Table 37. Participation of Scientists/ Technical Officers in Workshops/ Seminars/ Symposia/ Conferences/ Meetings

Events	Venue	Duration	Participant(s)
National workshop on 'Ecosystem services in agricultural landscape of Himalayan region of India',	ICAR-ATARI, Zone-VI, Guwahati, Assam	11-12 Jan 2024	Dr S. Adhikari
17th Annual General Meeting & National Seminar in 'Current Trends in Sustainable and Profitable Aquaculture', CuTSPA-2024	West Bengal University of Animal and Fishery Sciences, Kolkata	12 Jan 2024	Dr B. N. Paul
Meeting with startups in the Fisheries and Aquaculture Sector	Department of Fisheries, Govt. of India, New Delhi	12 Jan 2024	Dr P. K. Sahoo Dr N. K. Barik
SRIJAN: Empowering ZTMCs/ ITMUs of ICAR Institutes	NASC, Pusa, New Delhi	17-19 Jan 2024	Dr Rajesh Kumar
8th Meeting of Central Standing Committee (CSC) of PMMSY	Department of Fisheries, Govt. of India, New Delhi	19 Jan 2024	Dr S. S. Giri
81st APICOL Board of Directors Meeting	APICOL, Bhubaneswar	22 Jan 2024	Dr P. K. Sahoo
20th Biennial International Conference of ANSICON-2024 on Sustainable Animal Nutrition for Global Health and production: Innovations and directions	Madras Veterinary Collage, Chennai	23-25 Jan 2024	Dr S. S. Giri Dr Ashis Saha
Meeting of ICAR-Fisheries Institute on Research Programme: Mutual Learning and Collaborations	ICAR-CIFE, Mumbai	1 Feb 2024	Dr P. K. Sahoo
Institute Technology Management (ITMC) meeting of ICAR-IIWM	ICAR-IIWM, Bhubaneswar	1 Feb 2024	Dr Rajesh Kumar
Seminar on Immunology, Biodiversity, Aquaculture & Aquatic toxicology	Aacharya Nagarjuna University, Guntur	2-3 Feb 2024	Dr Ramesh Rathod Dr A. K. Chaudhari

Events	Venue	Duration	Participant(s)
Workshop on "Establishment of Carp Fish Brood Bank in Himachal Pradesh"	Department of Fisheries, Bilaspur, Himachal Pradesh	7 Feb 2024	Dr P. K. Sahoo Dr J. K. Sundaray Dr S. Nandi Dr K. Murmu Mr Avinash Rasal
Launching programme of Research and Entrepreneurship Park	IIT, Bhubaneswar	11 Feb 2024	Dr N. K. Barik
Celebration of the conferment of Bharata Ratna to Late Prof. M S Swaminathan	ICAR (Virtual Mode)	13 Feb 2024	All Staff members
28th meeting of the ICAR Regional Committee for Zone VIII	National Institute of Ocean Technology, Chennai	16 Feb 2024	Dr G. Barlaya
13th Indian Fisheries & Aquaculture Forum (IFAF)	Kolkata	23-25 Feb 2024	Director, ICAR-CIFA along with scientists and technical officers
VCs and Director's Conference	NASC, New Delhi	26-27 Feb 2024	Dr P. K. Sahoo
31st West Bengal State Science and Technology Congress-2024	Kolkata Science City, Kolkata	29 Feb 2024	Dr S. Adhikari
Methodological Workshop for the NASF project entitled "Agripreneurship for Sustainable Agricultural Development: Technological and Institutional Innovations and Strategies"	NAARM, Hyderabad	20-21 Mar 2024	Dr N. K. Barik
Entrepreneurship and Empowerment in Aqua Industry	Andhra Chambers of Commerce, Vijayawada Chapter	27 Mar 2024	Dr Ramesh Rathod
IBSC meeting of IIT, Bhubaneswar	IIT, Bhubaneswar	2 April 2024	Dr P. K. Sahoo
IP and the SDGs: Building Our Common Future with Innovation and Creativity	PPVFR, New Delhi (virtual)	26 April 2024	Dr Rajesh Kumar
Lecture and interaction for all Official language officers of Bhubaneswar City (Cyber security and you)	RBI, Bhubaneswar	9 May 2024	Dr D. K. Verma
Meeting on New scheme on PMMKSSY	DoF, Govt. of India (Virtual)	10 May 2024	Dr P. K. Sahoo Dr H. K. De Mr S. N. Sahoo Dr U. L. Mohanty
NFDB-PMMKSSY Adoption of Aqua Crop Insurance Meeting	DoF, Govt. of India	21 May 2024	Dr P. K. Sahoo Dr N. K. Barik
Launching workshop of All Indian Network project on "Antimicrobial resistance for fisheries and livestock"	NASC, New Delhi	22 May 2024	Dr P. Swain
NAAS 31st GB Meeting and Foundation Day Programme on the theme "A Roadmap for Second Blue Revolution"	ICAR, New Delhi	4-5 June 2024	Dr P. K. Sahoo Dr S. Ferosekhan
35th All India Congress of Zoology & International Conference "Impact of Climate Change with Special Reference to Challenges and Approached in Applied Zoology, Biodiversity, Conservation, Food and Health Security"	Zoological Society of India, Gaya and GGV (Central University), Bilaspur, Chhattisgarh	5-7 June 2024	Dr. B. C. Mohapatra
Commodity presentation of meeting of Animal Science Division Chaired by DG, ICAR	ICAR, New Delhi	10 June 2024	Dr P. K. Sahoo
Expert to Assessment Committee for CAS of ARS scientist under Veterinary microbiology	ICAR-CIBA	01 July 2024	Dr P. K. Sahoo
World Zoonosis Day	School of Veterinary and Animal Sciences, CUTM, Gajapati	06 July 2024	Dr P. Swain
ICAR Foundation & Technology Day	ICAR, New Delhi	15-16 July 2024	Dr P. K. Sahoo Dr K. Murmu
1st Meeting of Expert Committee to evaluate the present status of the Nucleus Breeding Centres in Freshwater Aquaculture	DoF, GoI, New Delhi (Virtual)	16 July 2024	Dr B. R. Pillai

Events	Venue	Duration	Participant(s)
National Conference on "Stepping up agricultural research and education for next generation researchers perspectives"	ICAR-IIRR, Hyderabad	29-30 July 2024	Dr P. Routray
National Space Day, 2024	CIFNET, Visakhapatnam	06 & 09 Aug 2024	Dr P. K. Sahoo Mr S. K. Mohanty
Gender Responsive Seed Systems and Promoting Women Entrepreneurship	Krushi Bhawan, Bhubaneswar	07 Aug 2024	Dr B. C. Mohapatra
Release of 109 varieties of crops by Hon'ble Prime Minister	ICAR, New Delhi	11 Aug 2024	Director and all staff members of ICAR-CIFA and KVK
Stakeholder consultation meeting on Fisheries- FAO-GEF-8 Project on "Transforming Andhra Pradesh aquaculture to a sustainable, reduced footprint and climate resilient food system"	Commissioner of Fisheries, AP.	13 Aug 2024	Dr B. R. Pillai Dr Ramesh Rathod
Interactive meeting for Innovative Projects with ICAR Fisheries Research Institutes with CE, NFDB	NFDB, Hyderabad	13 Aug 2024	Dr P. K. Sahoo
Meeting on Production and Processing Clusters in the Fisheries Sector	DoF, GoI, New Delhi (Virtual)	14 Aug 2024	Dr B. R. Pillai
National Symposium and Workshop on Clinical Proteomics (NSWCP-2024)	ILS, Bhubaneswar	20 Aug 2024	Dr J. Mohanty Mr Mohan R. Badhe
XXVII Meeting of ICAR Regional Committee (Zone II)	ICAR-NRRI, Cuttack	23 Aug 2024	Dr P. K. Sahoo Dr H. K. De
Webinar on "Aquatic Health"	Asian Fisheries Society (Virtual)	26 Aug 2024	Dr P. K. Sahoo
Annual Zonal Workshop for the KVKs under ATARI, at OUAT, KVK, Puri	ATARI, Kolkata	27 Aug 024	Dr P. K. Sahoo
Stakeholders Consultation on Fisheries export promotion with focus on shrimp farming and export value chain	DoF, GoI through NFDB (virtual)	06 Sept 2024	Mrs Rakhi Kumari Dr U. L. Mohanty
4th Anniversary meeting of the PMMSY project	Sushma Swaraj Bhavan, New Delhi	11 Sept 2024	Dr B. R. Pillai Dr U. L. Mohanty
2nd International Conference & Exhibition on Sustainable fisheries & aquatic resource management: life below water" (SFARM – 2024)	Science City Auditorium, Kolkata	12-14 Sept 2024	Dr B. N. Paul Dr F. Hoque Mr. A. Das
International Conference on Building small holder climate resilient for achieving sustainable food system	OUAT, Bhubaneswar	17-19 Sept 2024	Dr H. Nayak Dr U. L. Mohanty
Meeting on Cluster development at Hazaribagh, Madurai & Lakshadweep	DoF, GoI, New Delhi (Virtual)	18 Sept 2024	Dr P. K. Sahoo Dr P. C. Das Dr B. R. Pillai Dr S. Saurabh Dr I. Sivaraman Mrs E. M. Chhandaprajnadarsini
Meeting on implementation of voluntary carbon market (VCM) in fisheries sector	DoF, GoI, New Delhi (Virtual)	18 Sept 2024	Dr P. C. Das
Meeting on fish and shrimp feed manufacturers	DoF, GoI, New Delhi (Virtual)	19 Sept 2024	Dr S. S. Giri
Meeting to review the progress of projects approved under CSS Scheme	DoF, GoI, New Delhi (Virtual)	23 Sept 2024	Dr P. K. Sahoo Dr Bindu R. Pillai
National Conference on Blue revolution for sustainable fisheries development	KSTA, Bengaluru	25-27 Sept 2024	Dr P. K. Sahoo Dr G. Barlaya Dr T. N. Vinay Dr Satheesha Dr C. H. Raghavendra
Meeting for uploading of employees on iGOT Karmayogi platform	Virtual	26 Sept 2024	Dr D. Panda
National seminar on "Emerging Trends & Prospects in Biotechnology"	Utkal University, Bhubaneswar	27-28 Sept 2024	Dr A. Saha

Events	Venue	Duration	Participant(s)
XX Annual Workshop of ICAR-AICRP on Plastic Engineering in Agriculture Structures & Environment Management	SKUAST, Srinagar, J&K	14-16 Oct 2024	Dr B. C. Mohapatra
NACA-FAO meeting	FAO (virtual)	15 Oct 2024	Dr P. K. Sahoo
Ornamental fisheries cluster at Madurai	DoF, GoI, New Delhi (Virtual)	16 Oct 2024	Dr C. K. Misra
Meeting on Drone demonstration chaired by Hon'ble Minister Shri Rajiv Ranjan Singh	DoF, GoI, New Delhi (Virtual)	19 Oct 2024	Dr P. K. Sahoo Dr H. K. De Dr U. L. Mohanty
Virtual workshop/meeting on Cyber Security	Dept. of Fisheries, Govt. of India	22 Oct 2024	Dr P. K. Sahoo
VIROCON-2024	Gwalior, MP	11-13 Nov 2024	Dr A. Paul
26th Mid-term review meeting of RCM-III	ICAR RC for NEH, Meghalaya, (hybrid)	12 Nov 2024	Dr P. K. Sahoo Dr S. Adhikari
27th Meeting of RCM-IV	ICAR-IIVR, Varanasi (online)	14 Nov, 2024	Dr P. K. Sahoo Dr D. Panda
International Hands-on Workshop on "Utilizing microbiome and genomic resources for understanding and mitigating antimicrobial resistance in one health context"	FAO Reference Centre for AMR & AB, Nitte University, Mangalore	18-22 Nov 2024	Mr S. N. Sahoo
Workshop on 'Perspectives, Opportunities and Challenges in Fisheries Sciences in a Changing Climate: A Workshop for Emerging Scientists'	KSNUAHS, Shivamogga, Karnataka	19-23 Nov 2024	Dr A. Satheesha Dr T. N. Vinay
World Fisheries Day celebration	New Delhi	21 Nov 2024	Dr P. K. Sahoo
APICOL Board of Directors Meeting	Bhubaneswar	25 Nov 2024	Dr P. K. Sahoo
The XXXII Annual Conference of Society of Animal Physiologists of India (SAPI)	ICAR-CIRC, Meerut, U. P.	27-29 Nov 2024	Dr A. Saha
1st Meeting of the Expert Committee for PVS Pathway in aquatic animals	DoF, Govt. of India (virtual)	6 Dec 2024	Dr P. K. Sahoo
Consultation meeting with State Fisheries Department and Fish Farmers for Aquapark Establishment.	DoF, Govt. of Bihar	09-13 Dec 2024	Dr P. K. Sahoo Dr P. C. Das Dr D. Panda
One-day workshop and awareness meet on 'Genetically Improved fish and shellfish varieties for sustainable freshwater aquaculture development and enhancing farmer's income'	Fisheries Research Station, Undi, Bhimavaram, Andhra Pradesh	10 Dec 2024	Dr B. R. Pillai Dr K. Murmu
Consultation meeting with State Fisheries Department and fish Farmers for Aquapark establishment	Himachal Pradesh	16-19 Dec 2024	Dr P. C. Das Dr D. Panda Er. P. B. Bhakat
Meeting for Analyzing and Recommending the feasibility for establishing a "New University for Veterinary and Fishery Science" in Odisha	OUAT, Bhubaneswar	17 Dec 2024	Dr P. K. Sahoo
Aquapark Agency selection committee meeting	Office of the Commissioner of Fisheries, Vijayawada, A. P	17 Dec 2024	Dr Ramesh Rathod
National Conference on Digital Agriculture jointly organized by ICAR-NAAS-ICRISAT	ICAR, New Delhi	17-18 Dec 2024	Dr H. S. Swain
Launching of FPO Acceleration Program "Agri Gativardhan 1.0"	ICAR-NAARM, Hyderabad	19 Dec 2024	Dr Ramesh Rathod
Policy round table meeting on "Advancing Inclusive Agriculture Transformation in Odisha"	Bhubaneswar	20 Dec 2024	Dr B. R. Pillai

14 Distinguished Visitors

Shri Rajiv Ranjan Singh, Hon'ble Union Minister of Fisheries, Animal Husbandry & Dairying and Panchayati Raj, and Shri George Kurian, Hon'ble Union Minister of State for Fisheries, Animal Husbandry & Dairying and Minority Affairs, visited ICAR-CIFA on 12 September, 2024.

Prof. S. P. Singh Baghel, Hon'ble Union Minister of State for Fisheries, Animal Husbandry & Dairying and Panchayati Raj, Govt. of India visited the Institute and farm facilities and reviewed its research activities on 16 June 2024.

Dr. Mukesh Mahaling, Hon'ble Minister for Health & Family Welfare, PA, E & IT, Govt. of Odisha visited the Institute and witnessed the "Direct telecast on PM Kisan" programme organized jointly by the Institute and KVK, Khordha on 18 June 2024.

Shri Gabriel D. Wangsu, Hon'ble Minister of Agriculture, Horticulture, Animal Husbandry & Veterinary, Dairy Development & Fisheries, Food & Civil supply, Legal, Metrology & Consumer Affairs, Govt. of Arunachal Pradesh visited the Institute on 27 June 2024.

The Press Information Bureau (PIB) team from New Delhi visited the Institute to witness the Viksit Bharat Sankalp Yatra on 11 January 2024 and participated in the interaction meeting with the Director and scientists of ICAR-CIFA.

Dr. B.P. Mohanty, ADG (Inland Fisheries) visited RRC-Rahara and Kalyani FS on 15 January 2024.

Director, Department of Fisheries, Govt. of Jharkhand visited the Institute on 22 January 2024 and interacted with the Director.

Director, Department of Fisheries, Govt. of Himachal Pradesh visited the Institute on 11 March 2024 and discussed with the Director and scientists for transfer of ICAR-CIFA technologies.

Director, ICAR-CTCRI, Thiruvananthapuram along with Head, Regional Centre, CTCRI, Bhubaneswar and team visited ICAR-CIFA on 23 April 2024 and interacted with the Director and Heads of Divisions.

Team from World Bank along with Mr. T. Dola Shankar, Commissioner of Fisheries, Govt. of Andhra Pradesh visited RRC, Vijayawada on 9 December, 2024.

FAO Committee comprising of Dr. C.M. Muralidharan, Shri Vishnu Bhat, Dr. Jasmeet Kaur, Dr. Seema Bhatt, Dr. K. Neena, Dr. Neelkanth Mishra visited RRC of ICAR-CIFA, Vijayawada on 14 August 2024 as a part of the project "Transforming AP aquaculture to a sustainable, reduced footprint and climate resilient food system".

Dr. Himanshu Pathak, Secretary (DARE) & DG (ICAR); Dr J.K. Jena, DDG (Fy.Sc.), Dr R. C. Agrawal, DDG (Ag. Edn.), ICAR visited the Institute and its farm on 13 July 2024.

Dr. (Mrs.) Dhriti Banerjee, Director, Zoological Survey of India (ZSI), Kolkata on the eve of Annual Day of the Institute on 1 April, 2024.

15 Flagship Schemes of Govt. of India

Mera Gaon Mera Gaurav

In 2024, ICAR-CIFA conducted five programs under the Mera Gaon Mera Gaurav initiative in Odisha's Khordha, Dhenkanal, Jagatsinghpur, and Keonjhar districts. A team of scientists from diverse backgrounds provided guidance on scientific fish farming and other enterprises to approximately 300 farmers and farmwomen. Key topics included the application of lime and feed in fish ponds, the importance of water testing, and periodic monitoring for optimal fish health. The scientist-farmer interface facilitated direct knowledge transfer and practical advice. Additionally, the program distributed extension materials in Barijanga (Khordha), Tarava, Sankueli (Dhenkanal), Demal (Kendrapara), Mangalpur (Jagatsinghpur), and Sarasakola (Keonjhar) to support knowledge and capacity building.

Swachh Bharat

The ICAR-CIFA along with its RRCs launched the "Swachhata Hi Seva" campaign on 17 September 2024, with aim to promote cleanliness, sustainability, and environmental awareness across institutions, schools, and villages. It began with a cleanliness pledge and a symbolic "Swachhata Run" and cycle rally covering 2.5 km involving villagers, students and staff. Marking the "Ek Ped Maa Ke Naam" initiative, 150 saplings of wood apple, mango, and arecanut trees, were planted to create a greener campus. Additionally, competitions for drawing, essay, and debate were conducted among the students in

schools and colleges of the nearby villages to promote cleanliness and sustainability. Events like "Swachhata Samvad" in Kaushalyapur village and recycling workshops at Chakradhara Institute of Rehabilitation Sciences, Bilipada were organised to educate participants on waste bio- and non-biodegradable management. A mural with 1,000 plastic bottle caps was displayed to highlight the importance of Reduce, Reuse, Recycle. The campaign culminated in a felicitation program for sanitation workers and the celebration of Swachh Bharat Divas on 2nd October. Gracing the occasion, Chief Guest Dr. Sundara Narayana Patro, President, Odisha Environmental Society praised ICAR-CIFA's efforts in fostering environmental conservation and sustainability involving villagers and students, the young mass of the society.

Swachhata Pakhwada

ICAR-CIFA successfully completed its two-week-long Swachhata Pakhwada under the Swachh Bharat Mission from December 16 to 31, 2024. The campaign brought together local communities, students, farmers, and staff for activities promoting cleanliness, waste management, afforestation, and sustainable practices. It began with a Swachhata Pledge on December 16, followed by awareness campaigns at Dhauli Hill and the Dhauli Shanti Stupa. On December 17, ICAR-CIFA collaborated with KVK Khordha to demonstrate waste-to-wealth technologies like vermicomposting to over 20 participants. The campaign continued with large-scale cleaning drives at ICAR-CIFA headquarters, waste segregation initiatives, and clearing outdated records on December 18-19. Afforestation efforts took place on December 20, with plantation drives across multiple centers, including Bhubaneswar and Kalyani. Further, cleaning drives and signature campaigns were held at various locations, such as Laxminarayanpur and Kairi village, promoting sustainable practices among locals. The campaign also celebrated Kisan Diwas on December 23 by honoring progressive farmers and promoting organic farming, with a focus on women's involvement in biofloc aquaculture. Additional activities included essay and drawing competitions, wastewater recycling demonstrations, composting workshops, and a mega plogging event. The campaign culminated in a community cleanup on December 30 at Pubasasan village, led by local women. ICAR-CIFA's Director, Dr. P.K. Sahoo, concluded the event on December 31, reinforcing the institute's commitment to the Swachh Bharat Mission and environmental responsibility.

16 Promotion of Official Language

Rajbhasha Quarterly Workshops

ICAR-CIFA organized quarterly Hindi workshops and events in 2024 to promote the use of the Official Language. A Hindi workshop on "Implementation of Artificial Intelligence based translation and writing tools for official language Hindi proficiency" was organized on 19 March 2024. On this occasion, Mr. Avinash Das, Librarian, Institute of Hotel Management, Catering Technology and Applied Nutrition, Bhubaneswar graced the occasion as Chief Guest. He discussed in detail the common errors in Hindi in official work and their solutions.

On June 28, a workshop on "Constitutional Provisions and Various Apps for Implementing Official Language" was held. Mrs. Namita Kar, Senior Translation Officer, explained the use of Android-based apps for Hindi implementation in Central Government offices. Scientists, technical officers, and administrative staff actively participated. From 13 to 27 September 2024, ICAR-CIFA celebrated Hindi Fortnight, inaugurated by Director Dr. P.K. Sahoo. Various competitions, including Hindi debate, essay writing, speech, and poetry recitation, were conducted. The closing ceremony on September 27 featured a Kavi Sammelan, with eminent poets mesmerizing the

audience. Winners of the competitions were felicitated. On 23 September, a workshop on the "Inspection and Importance of the Parliamentary Official Language Committee" was conducted. Shri H.L. Meena, CAO, discussed the committee's role in monitoring Hindi usage in government institutions and urged employees to use Hindi in official work. On 9 December, the last quarterly workshop on "New Tools and Techniques for Hindi in Office Work" featured Shri V. Ganesh Kumar from ICAR-NRRI, Cuttack, who emphasized on using apps for Hindi implementation. The event concluded with a vote of thanks by Dr. D.K. Verma.

Review of hindi implementation by Sub-Committee of Parliament on Official Language

On 23 October 2024, the Thirteenth Sub-Committee of Parliament on Official Language inspected ICAR-CIFA, Bhubaneswar. Chaired by Shri Ujjwal Raman Singh, the members in the meeting included MPs, committee officials, and representatives from ICAR Hqs. and ICAR-CIFA. The team reviewed implementation of Hindi within the institute, with committee members offering suggestions for improvement. The Chairman directed ICAR-CIFA to submit a progress report to the committee within three months.

Other activities

- 'A word a day' in bilingual was displayed on the electronic display board every day.
- The letters received in Hindi were replied in Hindi.

Publications in Hindi:

- Three training manuals were prepared for the farmers from Bihar, Chhattisgarh and Jharkhand.
- Fifteen leaflets on different ICAR-CIFA technologies.
- Annual Report 2023 in Hindi
- All the four issues of CIFA Newsletter
- The Hindi magazine of the Institute 'Neelitima' 2024 (No. 14)

17 Budget 2023-2024

Table 38. Provision from the ICAR (2024-2025)

Expenditure as of 31.12.2024 (Rs. in lakhs)

Sl. No.	Sub-head	Govt. grant (01.01.2024-31.03.2024)	Exp. out of Govt. grant (01.01.2024-31.03.2024)	Govt. grant (01.04.2024-31.12.2024)	Exp. out of Govt. grant (01.04.2024-31.12.2024)
1	2	3	4	5	6
1.	Capital Exp.				
a)	Land	-	-	-	-
b)	Building	39.78	39.78	508.31	236.27
c)	Equipment	13.12	13.12	265.71	189.39
d)	Furniture/Fixture	3.09	3.09	14.93	18.24
e)	Info. Tech.	5.02	5.02	20.30	26.63
f)	Vehicle/Vessels	5.25	5.25	0.00	
g)	Library Books	0.00	0.00	12.01	16.01
h)	Others	0.00	0.00	0.00	
2.	Revenue Exp.	0.00	0.00	0.00	
a)	Estt. Charges	823.05	823.05	2786.14	2771.92
b)	Wages	0.00	0.00	0.00	
c)	OTA	0.00	0.00	0.00	
d)	Pension & Other Retirement benefits	110.42	110.42	250.00	241.75
3.	Loans & Advances	0.00	0.00	0.00	
4.	TA	6.37	6.37	41.25	31.96
5.	Other Charges	0.00	0.00	0.00	
a)	Res. Expenses	31.50	31.50	150.00	152.96
b)	Operational Expenses	156.75	156.75	487.50	497.40
c)	Admn. Expenses	115.36	115.36	465.75	429.08
d)	Misc. Expenses	9.47	9.47	50.25	45.49
6.	HRD	0.56	0.56	6.00	1.30
7.	NEH (capital + revenue)	20.00	20.00	157.50	135.07
8.	STC (capital + revenue)	18.75	18.75	86.25	78.81
9.	SCSP (capital + revenue)	37.50	37.50	206.25	182.45
	TOTAL	**1395.97**	**1395.97**	**5508.14**	**5054.73**

18 Personnel (as on 31.12.2024)

Director

Dr P. K. Sahoo

Head of Division

Dr S. S. Giri
Dr P. C. Das
Dr J. K. Sundaray
Dr M. Samanta

Principal Scientist

Dr S. S. Mishra
Dr S. K. Swain
Dr S. Adhikari
Dr (Mrs.) Bindu R. Pillai
Dr G. S. Saha
Dr P. Swain
Dr S. K. Sahoo
Dr Samiran Nandi
Dr P. Routray
Dr B. C. Mohapatra
Dr J. Mohanty
Dr B. N. Paul
Dr H. K. Barman
Dr S. Mohanty
Dr K. C. Das
Dr H. K. De
Sri P. K. Meher
Dr R. N. Mandal
Dr Ashis Saha
Dr Satyanarayan Sethi
Dr Gangadhar Barlaya
Dr Chandra Kanta Misra
Dr Khuntia Murmu
Dr N. K. Barik
Dr Shailesh Saurabh
Dr Rajesh Kumar

Senior Scientist

Dr Lakshman Sahoo
Dr Ramesh Rathod
Dr B. S. Anand Kumar
Dr D. Panda
Dr Subhas Sarkar
Dr Pankaj Kumar Tiwari
Dr S. Ferosekhan
Dr Satheesha Avunje

Scientist

Sri A. S. Mahapatra
Dr (Mrs) Rakhi Kumari
Dr Ajit Keshav Chaudhary
Dr Nitish Ku. Chandan
Sri Arabinda Das
Dr Siddaiah G. M.
Dr Uday Kumar Udit
Mrs. Snatashree Mohanty
Dr Rakesh Das
Dr (Mrs.) P. C. Nandanpawar
Dr Mukesh Ku. Bairwa
Dr I. Sivaraman
Sri Badhe Mohan Ramesh
Sri Ajmal Hussan
Dr (Mrs.) Puspha Choudhary
Sri Avinash R. Rasal
Dr (Mrs.) E. M. Chhandaprajnadarsini
Mrs. Husne Banu
Sri Satyanarayan Sahoo
Sri Jackson Debbarma
Dr (Mrs.) Farhana Hoque
Dr Himansu Sekhar Swain
Dr Anirban Paul
Dr (Mrs.) Chinmayee Muduli
Dr T.N. Vinay

Senior Scientist & Head, KVK

Dr (Mrs) Harapriya Nayak

Chief Technical Officer

Sri Surendra Singh (KVK)
Dr P. R. Sahoo (KVK)
Mrs. Sukanti Behera (KVK)
Dr D. K. Verma
Dr (Mrs) U. L. Mohanty
Sri D. P. Rath

Asst. Chief Technical Officer

Dr Bibhudatta Mishra
Sri S. K. Mohanty
Er. P. B. Bhakat
Sri Santosh Ku. Nayak

Technical Officer

Sri Sovan Sahoo
Sri Aruna Ku. Behera
Sri Dukhia Majhi
Dr C. H. Raghavandra
Sri Aurobinda Patra (Compounder)
Sri Bhagabat Ch. Das (Mike Operator)

Senior Technical Assistant

Sri Affcer Mohamad (Powertiller Operator)

Technical Assistant

Sri Sriman Anarpit Das
Sri Jayanta Swain
Sri Pramod Ku. Sahoo
Sri Srinivasulu Gudipudi

Technician

Sri Rajesh Kumar
Sri Aman Kumar Singh

Driver

Sri Trinath Behura (Sr. Tech. Assistant)
Sri K. C. Das (Sr. Tech. Assistant)
Sri S. C. Panda (Tech. Asst.)
Sri D. Pradhan (Tech. Asst.) (KVK)
Sri S. P. Behera (Tech. Asst.) (KVK)

Chief Administrative Officer

Sri H. L. Meena

Administrative Officer

Sri Sujan Show

Finance and Accounts Officer

Sri S. S. Mohapatra
Sri Yashwant Sorte

Private Secretary

Ms. Singa Soren

Assistant Administrative Officers

Sri Birabar Amanta
Sri A. K. Prusty
Sri Jitendranath Jena
Sri T. K. Mishra
Sri Manoj Ku. Mohapatra
Sri Niranjan Behera

Assistant

Sri Loknath Senapati
Sri Swamiji Sen
Sri S. K. Rath
Sri Sukhendu Biswas
Sri Arijit Panda
Sri Mrigank Shubham
Ms. Anjali Pandey
Sri Abinash Swain
Sri Ankush Kumar
Sri Angad Chaudhary
Sri Pancham Ku. Gupta
Sri Mridul Barshilia
Sri Abhishek Sharma
Sri Chetan Lehkra
Sri Deepak Kumar (KVK)

Upper Division Clerk

Sri Prakash Ch. Parida
Sri Pradiumna Behera
Sri Manas Ku. Muduli

Lower Division Clerk

Sri Bhikari Charan Bhoi
Sri Dusmanta Ku Sahu
Sri Bikram Kishore Kahali
Sri Simanchal Behera

Skilled Support Staff

Sri T. Muthyullayya (absconded)
Sri Siddaraju
Sri Saroj Kumar Parida
Sri Sarat Ch. Barik
Ms. Manju Singh
Sri Gopal Ch. Mohapatra
Sri Gouriguru Sibananda Bhuyan
Sri Baikuntha Nayak
Sri Manoj Kumar Jena (KVK)
Sri Budhia Behera (KVK)
Sri Bauri Bandhu Pradhan
Sri Aruna Kumar Muduli
Sri Tanay Balav Barik
Sri Prasanna Ku. Behera
Ms. Kiron Oraon
Sri Sanatan Pradhan
Sri B. K. Deo
Sri Sarat Ch. Barik (E)
Sri Mahendra Behera
Sri J. K. Palai
Sri Kalandi Charan Biswal
Sri Baja Muduli
Sri P. K. Mohapatra
Sri Rabindra Nath Biswal
Sri Tapan Kumar Routray
Sri Basanta Kumar Mallick
Smt. Bilasi Nayak
Sri Goutam Mallick
Sri Babuli Samal
Sri Krushna Chandra Sethy
Sri Nabin Jena
Sri Dwarika Nath Nayak
Sri Kalandi Behera
Sri Birabara Mallick
Sri Debendra Bhoi
Sri Abhiram Behera
Sri Pramoda Khatua
Sri Anadi Charan Bhoi
Sri Sridhar Bhoi
Sri Girish Ch. Upadhyay
Smt. Mungli Sardar

19 List of Approved On-going Projects

Table 39. Institute-based projects

Aquaculture Production and Environment Division

Sl. No.	Institute Project Code	Project title	Duration	Project personnel (PI/Co-PIs)
1	I-108	Inducing sterility in carps and tilapia using different biochemical agents	01.04.2020 – 31.03.2024	P. Routray (PI) K. C. Das D. K. Verma (Associate)
2	I-110	Development of protocol for organic fish farming: A sustainable production approach in freshwater ecosystems	01.04.2020 – 31.03.2024	S. N. Sethi (PI) P. C. Das P. K. Tiwari S. N. Sahoo
3	I-119	Optimization of freshwater pearl mussel culture technology through dietary and environmental intervention for greater adoptability to the farming communities	01.04.2021 – 31.03.2024	S. Saurabh (PI) Rajesh Kumar P. K. Tiwari E. M. Chhandaprajnadarsini
4	I-120	Ecological engineering in pond aquaculture for intensive fish production system	01.04.2021 – 31.03.2024	S. Sarkar (PI) P. K. Tiwari D. Panda
5	I-125	Effect of ionic composition of water on egg hatching and larval rearing of selected air breathing fishes	01.04.2022-31.03.2025	P. K. Tiwari (PI) Subhas Sarkar Rajesh Kumar S. Ferosekhan (up to July 2024) V. Bhaskara Rao (Associate) up to April 2024
6	I-137	Standardisation of mass scale seed production and grow-out culture technologies of *Clarias dussumieri*	01.04.2023 – 31.03.2026	S. Ferosekhan (PI up to July 2024) S. K. Sahoo (PI) S. S. Giri P. K. Tiwari S. N. Sahoo
7	I-138	Studies on the effect of selected environmental stressors (Ammonia and pH) on Indian major carps and exploring their mitigation measures	01.04.2023 – 31.03.2026	H. S. Swain (PI) P. C. Das Rakhi Kumari Husne Banu
8	I-139	Hormonal intervention for improving reproductive fitness and breeding efficiency of male striped murrel *Channa striata* under captivity	01.04.2023 – 31.03.2026	Rajesh Kumar (PI) S. Nandi J. Debbarma M. K. Bairwa

Sl. No.	Institute Project Code	Project title	Duration	Project personnel (PI/Co-PIs)
9	I-148	Protocol development for seed production of *Lamellidens marginalis* (Lamarch, 1819)	01.04.2024–31.03.2027	E. M. Chandaprajnadarsini (PI) S. Saurabh B. R. Pillai P. K. Tiwari Rakhi Kumari C. Muduli
10	I-149	Identification of suitable plant pigment sources for coloration improvement of commercially important ornamental fishes (Koi carp and Rosy barb)	01.04.2024–31.03.2027	C. K. Mishra (PI) S. K. Swain N. K. Chandan
11	I-150	Development of mass scale freshwater live food production systems for larval rearing of selected fish species	01.04.2024–31.03.2027	S. N. Sethi (PI) C. K. Misra E. M. Chandaprajnadarsini
12	I-156	AICRP on Plastic Engineering in Agriculture Structure and Environment Management Centre at ICAR-CIFA Sub-project (A): Design and development of transportation system for different stages of freshwater fish and shellfish Sub-project (B): Design and Development of floating raft aquaponics for Freshwater Ponds Sub-project (C): Design and development of Plastic Based Cascade Aerators / Vertical Aeration Towers for Freshwater Aquaculture Ponds	01.04.2024–31.03.2027	B. C. Mohapatra (PI) P. C. Das D. Panda P. K. Tiwari H. S. Swain
13	I-159	Network project on Ornamental fish breeding and culture (NPOFBC) CIFA Component: Breeding and culture of freshwater ornamental fishes, *Trichogaster chuna* and *Dawkinsia assimilis* Lead Institute: ICAR-CMFRI	01.04.2021 – 31.03.2025	S. K. Swain (PI) M. K. Bairwa C. K. Misra
14	I-160	Network programme on Precision Agriculture (NePPA) (ICAR-CIFA: as Fisheries Lead Institute and collaborating Institutes: ICAR-CIFRI & ICAR-CIFE)	Oct, 2021 – Mar 2026	S. K. Swain (PI) P. C. Das C. K. Misra I. Sivaraman S. Ferosekhan (up to July 2024) H. S. Swain R. N. Sahoo (ICAR-IARI) Nirmal Kumar (ICAR-NBSSLUP); P. K. Sahoo (Associate)
15	I-162	National Agriculture Innovation Foundation (NAIF)–Component-I	Phase-II (Oct 2017- Mar 2025	Rajesh Kumar (PI) N. K. Barik

Fish Genetics and Biotechnology Division

Sl. No..	Project Code	Project title	Duration	PI/Co-PIs
1	I-113	Identification of SNPs linked to body weight trait in genetically improved rohu, 'Jayanti'	1.4.2020 – 31.3.2024	P. Das (PI) (up to Feb 2024) P. C. Nandanpawar L. Sahoo K. Murmu
2	I-124	Level and pattern of genetic variabilities in carp hatcheries of Odisha	1.4.2021 – 31.3.2024	C. K. Misra (PI) P. K. Meher K. Murmu A. Hussan
3	I-127	To study the cross-talk between brain and gut microbes during different reproductive cycles for efficient seed production of commercially important food fish catla (*Catla catla*)	1.4.2022-31.3.2025	J. K. Sundaray (PI) S. Mohanty L. Sahoo U. K. Udit A. Rasal

Sl. No..	Project Code	Project title	Duration	PI/Co-PIs
4	I-128	Selective breeding of rohu (*Labeo rohita*) for higher growth and disease resistance against *A. hydrophila* and selective breeding of catla (*C. Catla*) for growth trait	1.4.2022-31.3.2025	K. Murmu (PI) L. Sahoo Anirban Paul C. K. Misra A. Rasal J. K. Swain (Associate)
5	I-129	Population genetic evaluation of Indian populations of climbing perch *Anabas testudineus* and striped murrel *Channa striata*	1.4.2022-31.3.2025	L. Sahoo (PI) P. Das (up to Feb 2024) Rajesh Kumar J. Debbarma P. C. Nandanpawar
6	I-130	Mitigation of heat stress in freshwater fish *Labeo rohita* through bioactive peptides and nutritional intervention (Ham. 1822)	1.4.2022-31.3.2025	M. R. Badhe (PI) J. Mohanty P. C. Nandanpawar A. Paul
7	I-131	Genetic characterization of rohu (*Labeo rohita*) brooder exhibiting variation in breeding window	1.4.2022-31.3.2025	P. K. Meher (PI) S. Nandi H. K. Barman U. K. Udit R. Rathod A. K. Chaudhari
8	I-143	Genome editing in aquaculture	1.4.2024 – 31.3.2026	P. K. Sahoo (Project Coordinator) H. K. Barman (PI) J. K. Sundaray A. Saha K. Murmu S. Mohanty A. Rasal A. Paul
9	I-151	Functional genomics of *CAST* and *AMPD* encoding genes and their implications on body growth in *Labeo rohita*	01.4.2024–31.03.2027	P. C. Nandanpawar (PI) K. Murmu M. R. Badhe A. Rasal

Fish Health Management Division

Sl. No.	Project Code	Project title	Duration	PI/Co-PIs
1	I-132	Application of natural, herbal and microbial preparations in fish disease and environment management in freshwater aquaculture system		
2	I-132(A)	Evaluation of selected natural products and plant-based preparations for their antimicrobial and insecticidal properties and use in fish disease management	1.4.2022-31.3.2025	S. S. Mishra (PI) P. Swain P. Choudhary S. N. Sahoo S. Mohanty C. Muduli B. S. Anand Kumar R. Rathod F. Hoque
3	I-132(B)	Development and evaluation of probiotic preparations for fish immunity and production enhancement in freshwater aquaculture	1.4.2022-31.3.2025	S. P. Mohanty (PI) S. S. Giri S. Mohanty
4	I-142	Exploring immunomodulating properties of immunostimulants and probiotic bacterial consortium during seed rearing of *Channa striata* and *Heteropneustes fossilis* for enhancing survival and immune status	1.4.2023 – 31.3.2026	P. Choudhary (PI) G. M. Siddaiah C. Muduli J. Debbarma
5	I-152	Development of mutant constructs through in-frame deletion mutation approaches to generate live attenuated vaccines against bacterial fish pathogen *Aeromonas veronii*	01.4.2024–31.03.2027	R. Das (PI) M. Samanta

Sl. No.	Project Code	Project title	Duration	PI/Co-PIs
6	I-157	All India Network Project on fish health	July 2015 – June, 2025	S. S. Mishra (PI) P. Choudhary P. Swain S. N. Sahoo R. Rathod A. K. Chaudhari
7	I-158	Network program on assessment of antimicrobial resistance (AMR) in microorganisms associated with fisheries and aquaculture in India	Jan 2018 –March 2025	S. S. Mishra (PI) P. Swain S. N. Sahoo R. Rathod

Fish Nutrition and Physiology Division

Sl. No.	Project Code	Project title	Duration	PI/Co-PIs
1	I-114	Utilisation of insect larval meal as protein source in the diet of *Channa striata* and *Anabas testudineus* production system	1.4.2020 – 31.3.2024	G. M. Siddaiah (PI) Rajesh Kumar Rakhi Kumari
2	I-115	Effect of dietary micronutrients supplementation on gonadal development of Indian major carp and catfish	1.4.2020 – 31.3.2025	A. Saha (PI) S. S. Giri S. K. Sahoo S. Ferosekhan (up to July 2024) G. M. Siddaiah (up to Mar 2024)
3	I-123	Study on the effect of change in dietary protein concentration on product quality in grow out carp culture	1.4.2021 – 31.3.2025	K. C. Das (PI) N. K. Chandan
4	I-141	Development of feed and feeding strategy for *Channa striata* larvae	1.4.2023 – 31.3.2026	Rakhi Kumari (PI) K. C. Das Rajesh Kumar L. Sahoo G. M. Siddaiah N. K. Chandan K. N. Mohanta (ICAR-CIFE)
5	I-153	Development and evaluation of alternate feed resources for production performance of *Pangasianodon hypophthalmus* and Indian major carps	01.4.2024–31.03.2027	G. M. Siddaiah (PI) Rakhi Kumari N. K. Chandan
6	I-154	Dietary intervention to improve ω-3 fatty acid content in IMC fillet	01.4.2024–31.03.2027	N. K. Chandan (PI) A. Saha

Social Science Section

Sl. No.	Project Code	Project title	Duration	PI/Co-PIs
1	I-117	Development of index for measuring women's empowerment in aquaculture	1.4.2020 – 31.3.2024	H. K. De (PI) G. S. Saha A. S. Mahapatra U. L. Mohanty (Associate) D. P. Rath (Associate)
2	I-118	Farmers' producers' organization in freshwater Aquaculture- a critical assessment	1.4.2020 – 31.3.2024	G. S. Saha (PI) H. K. De A. S. Mahapatra G. Sreenivasulu (Associate)
3	I-133	Creating a Geo-spatial decision support system for evidence-based aquaculture development planning	1.4.2022-31.3.2025	I. Sivaraman (PI) H. K. De A. S. Mahapatra G. S. Saha V. Patil (XIM Univ.)
4	I-155	Development of clientele management system for feedback collection and training effectiveness assessment	01.4.2024–31.03.2027	A. S. Mahapatra (PI) G. S. Saha H. K. De

Sl. No.	Project Code	Project title	Duration	PI/Co-PIs
5	I-161	Agri-Business Incubation (ABI) program at ICAR-CIFA	Mar 2015–Continuing	N. K. Barik (PI) Rajesh Kumar

RRC, Vijayawada

Sl. No.	Project Code	Project title	Duration	PI/Co-PIs
1	I-126	Standardisation of breeding and rearing protocol for Red-bellied pacu, *Piaractus brachypomus*	1.4.2022-31.3.2025	R. Rathod (PI) A. K. Chaudhary G. M. Siddaiah

RRC, Rahara

Sl. No.	Project Code	Project title	Duration	PI/Co-PIs
1	I-121	Breeding, seed rearing and culture of barred spiny eel, *Macrognathus pancalus* (Hamilton, 1822)	1.4.2021 – 31.3.2024	S. Adhikari (PI) R. N. Mandal B. N. Paul A. Das F. Hoque A. Hussan
2	I-147	Captive Broodstock Development of Indian Shad, *Tenualosa ilisha*	01.4.2024–31.03.2027	A. Das (PI) S. Adhikari A. Hussan R. N. Mandal B. N. Paul F. Hoque S. Sarkar S. Nandi

RRC, Bengaluru

Sl. No.	Project Code	Project title	Duration	PI/Co-PIs
1	I-122	Production performance of peninsular carps in biofloc based seed rearing system	1.4.2021 – 31.3.2025	G. Barlaya (PI) Hemaprasanth (up to July 2024) B. S. Ananda Kumar C. H. Raghavendra (Associate)
2	I-140	Species diversification in peninsular aquaculture: Evaluation of aquaculture potential of *Hypselobarbus kolus* and *Labeo kontius*	1.4.2023 – 31.3.2026	Hemaprasanth (PI) (upto July 2024) G. Barlaya (PI) B. S. Ananda Kumar T. N. Vinay C. H. Raghavendra (Associate)
3	I-144	Genetic characterization of *Barbodes carnaticus, Hypselobarbus pulchellus* and *H. kolus* using mitochondrial DNA markers	01.4.2024–31.03.2027	T. N. Vinaya (PI) A. Satheesha
4	I-145	Establishing larval rearing protocol of peninsular fish using live food organisms	01.4.2024–31.03.2027	A. Satheesha (PI) T. N. Vinaya

RRC, Bathinda

Sl. No.	Project Code	Project title	Duration	PI/Co-PIs
1	I-146	Development of advanced fingerling production protocol of striped catfish, *Pangasianodon hypophthalmus* during winter season in Northern India	01.4.2024–31.03.2027	M. K. Bairwa (PI)

Specially Assisted Central Scheme

North-Eastern Hill (NEH)

Sl. No.	Project Code	Project title	Duration	PI/Co-PIs
1	I-134-A	Development of Fisheries in Assam along with livelihood of the people	1.4.2022-31.3.2025	S. Adhikari (PI) S. K. Swain B. C. Mohapatra N. K. Barik C. K. Misra A. Das U. K. Udit
2	I-134-B	Livelihood development for fish farmers in Nagaland through diversified aquaculture	1.4.2022-31.3.2025	R. N. Mandal (PI) S. K. Swain S. Adhikari G. S. Saha A. Hussan

Scheduled Caste Sub-Plan (SCSP)

Sl. No.	Project Code	Project title	Duration	PI/Co-PIs
1	I-135	Strengthening Livelihood of Scheduled Caste Farmers through Freshwater Aquaculture		H. K. De (Coordinator) A. Saha (Co-coordinator)
2	I-135-A	Upliftment of SC Fisher community through Integrated Advanced Aquaculture Practices in Andhra Pradesh and Telangana States	1.4.2022-31.3.2025	R. Rathod (PI) A. K. Chaudhari
3	I-135-B	Sensitization of SC beneficiaries from Karnataka state to Scientific Aquaculture Practices (SAP) and income generation for sustainable livelihood	1.4.2022-31.3.2025	G Barlaya (PI) B. S. Ananda Kumar
4	I-135-C	Upliftment of SC farmers through Modern Scientific Aquaculture Practices in Punjab and Rajasthan States	1.4.2022-31.3.2025	M. K. Bairwa (PI) A. K. Chaudhari (up to July 2024) C. K. Misra
5	I-135-D	Entrepreneurship development in catfish farming technologies for Socio-economic upliftment of Schedule Caste community in Odisha State	1.4.2022-31.3.2025	S. Ferosekhan (PI) S. N. Sethi (PI) (w.e.f. Aug 2024) S. K. Sahoo S. S. Giri G. M. Siddaiah P. K. Tiwari P. C. Nandanpawar I. Sivaraman
6	I-135-E	Livelihood development of SC farmers through fish seed village and integrated fish farming in Puri and Kandhamal district of Odisha	1.4.2022-31.3.2025	S. N. Sethi (PI) P. Choudhary J. Debbarma D. P. Rath (Associate) S. K. Mohanty (Associate)
7	I-135-F	Economic empowerment and capacity building of rural SC farm families of West Bengal state through technological intervention in fish farming	1.4.2022-31.3.2025	A. Das (PI) R. N. Mandal A. Hussan F. Hoque S. Adhikari B. N. Paul S. S. Giri
8	I-135-G	Rural livelihood improvement and empowerment of women through aquaculture	1.4.2022-31.3.2025	A. Saha (PI) S. S. Giri H. K. Barman M. Samanta C. K. Misra A. S. Mahapatra U. K. Udit N. K. Chandan

Scheduled Tribe Component (STC)

Sl. No.	Project Code	Project title	Duration	PI/Co-PIs
1	I-136	Ensuring livelihood security through aquaculture based integrated approaches and value chain development of tribal population in India		K. C. Das (Coordinator) R. Das (Co-coordinator)
2	I-136-A	Development of value chain of freshwater aquaculture among tribal communities in Nabarangpur and Kalahandi districts of Odisha	1.4.2022-31.3.2025	N. K. Barik (PI) K. C. Das S. Saurabh P. Routray S. S. Mishra D. K. Verma (Associate)
3	I-136-B	Livelihood improvement of tribal communities through introduction of improved fish varieties and other technological intervention in the Mayurbhanj district of Odisha	1.4.2022-31.3.2025	K. Murmu (PI) P. Swain S. K. Sahoo J. K. Sundaray L. Sahoo
4	I-136-C	Implementation of Aquaculture based integrated farming development for livelihood security of tribal populations in Gajapati and Rayagada districts, Odisha	1.4.2022-31.3.2025	S. S. Mishra (PI) P. Routray S. K. Sahoo K. C. Das S. N. Sahoo U. K. Udit B. Mishra (Associate) D. P. Rath (Associate) S. K. Mohanty (Associate)
5	I-136-D	Livelihood development of schedule tribe communities in Coimbatore region of Tamil Nadu through aquaculture and allied intervention strategies	1.4.2022-31.3.2025	T. N. Vinay (PI) B. Gangadhar B. S. Ananda Kumar C. H. Raghavendra (Associate)

Table 40. Externally funded projects

Aquaculture Production and Environment Division

Sl. No	Project code	Title	Funding Agency	Duration	PI/Co-PIs
1	E-03	AICRP on Plastic Engineering in Agriculture Structure and Environment Management Centre at ICAR-CIFA Sub-project (b): Development of user friendly biofloc fish rearing facility Sub-project (c): Design and development of transportable scampi seed production system	ICAR	April 2021 – Mar 2024	B. C. Mohapatra (PI) N. K. Chandan B. R. Pillai S. K. Swain D. Panda
2	E-132	Development of Bio-floc based technology (BFT) for production of freshwater fish and demonstration for peri-urban fish farmers and rural youth	RKVY, Govt. of Odisha	April 2021 – Mar 2024	P. C. Das (PI) S. N. Sethi S. Sarkar Rakhi Kumari P. Choudhary S. Ferosekhan (up to July 2024) H. S. Swain
3	E-134	Scaling up of Genetic Improvement Programme of Freshwater Prawn *Macrobrachium rosenbergii* (Scampi)	PMMSY, DoF, GoI	Feb 2021 – Mar 2025	B. R. Pillai (PI) D. Panda P. K. Sahoo R. Rathod F. Hoque B. Mishra (Associate) S. Sahu (Associate) P. B. Bhakat (Associate)

Sl. No	Project code	Title	Funding Agency	Duration	PI/Co-PIs
4	E-136	Strengthening quality freshwater fish seed supply chain through 'Cluster seed villages' approach in Odisha	PMMSY, DoF, GoI	Mar 2021 – Mar 2025	P. C. Das (PI) S. K. Sahoo H. K. De S. Sarkar H. S. Swain
5	E-160	Evaluation and refinement of biofloc based new age farming technology through effective microbial management, recirculation and input optimization for sustainable intensification across different aquaculture system	NASF, ICAR	June 2023 – May 2026	P. C. Das (CCPI) S. K. Sahoo Rajesh Kumar S. Ferosekhan (upto July 2024) H. S. Swain Husne Banu
6	E-166	Expanding breeding window of IMC (*Labeo catla*) for year-round seed availability	NASF, ICAR	March 2024 – Feb 2027	P. Routray (PI) S. Nandi P. K. Meher K. C. Das U. K. Udit Asamanja Chattoraj (CCPI)
7	E-126	Development of sustainable aquaculture practices through life cycle analysis (LCA) of selected aquaculture production systems and performance evaluation of improved varieties of carps and freshwater prawn	WorldFish	Jan 2019-Mar 2024	B. R. Pillai (PI) K. D. Mahapatra (up to 28-02-2023) P. C. Das D. Panda H. K. De B. S. Giri K. Murmu A. Rasal P. K. Tiwari H. S. Swain (from December 2022) S. Sarkar B. Mishra S. Sahu
8	E-171	WorldFish and ICAR-CGIAR-W3 research project on "Studies on carbon sequestration potential of freshwater carps and catfish production system and inbreeding effect on production potential of improved rohu (Jayanti) and CIFA-GI Scampi"	WorldFish	Jan 2024 – Dec 2028	P. K. Sahoo (PI) J. K. Sundaray P. C. Das B. R. Pillai K. Murmu D. Panda P. K. Tiwari H. S. Swain A. Paul A. Rasal

Consultancy Service

Sl. No	Project code	Title	Funding Agency	Duration	PI/Co-PIs
1	E-154 (CS)	Breeding, seed production and culture of striped murrel, *Channa striata* in Tamil Nadu	DoF, Govt. of Tamil Nadu	Dec 2022 – Dec 2025	Rajesh Kumar (PI) J. Debbarma S. Ferosekhan (up to July 2024)
2	E-168 (CS)	Livelihood development through ornamental aquaculture for enhancing climate resilience of vulnerable coastal communities in 4 coastal districts of Odisha (Ganjam, Puri, Kendrapara and Balasore)	ECRICC, Govt. of Odisha	July 2024 -July 2025	C. K. Misra (PI) S. K. Swain P. K. Tiwari P. B. Bhakat

Contract Research

Sl. No	Project code	Title	Funding Agency	Duration	PI/Co-PIs
1	E-163 (CR)	Evaluation of efficacy of OxyFeed™ Blue in improving water quality and growth performance of Indian major carps in grow out culture	M/s Aqua Ecosystem Pvt. Ltd., Raipur	Dec 2023 – Jan 2025	P. K. Tiwari (PI) P. C. Das H. S. Swain H. Banu

Fish Genetics and Biotechnology Division

Sl. No	Project code	Title	Funding Agency	Duration	PI/Co-PIs
1	E-133	Investigation of key transcripts and regulatory network associated with reproductive biology and medicinal value of striped murrel (*Channa striata*) using Omics approaches	DBT-CABIN, Phase-III	Oct 2020 – Mar 2025	J. K. Sundaray (PI) L. Sahoo Rajesh Kumar J. Debbarma
2	E-137	Development of vaccines against Tilapia lake virus (TiLV) and Cyprinid herpesvirus-2 of fish in Indian aquaculture system	DBT, GoI	Mar 2021- Mar 2025	J. Mohanty (PI) P. K. Sahoo A. Paul
3	E-140	Studies on the bioactive properties of small peptides from protein hydrolysates of fish waste using biotechnological tools and suitable incorporation into bacterial/animal cell culture media for better growth	Science and Technology Dept., Govt. of Odisha (Lead Institute: MSCB University, Odisha)	Jan 2022 – Jan 2025	J. Mohanty (CCPI) M. R. Badhe
4	E-145	Genome wide association studies in giant freshwater prawn, *Macrobrachium rosenbergii*: Linkage mapping and QTL identification (NASF)	NASF, ICAR	Sept 2022 – Aug 2025	L. Sahoo (PI) B. R. Pillai D. Panda P. C. Nandanpawar
5	E-146	Evaluation of efficacy of novel vaccine candidate against argulosis in carps: understanding mechanism of protection and its field evaluation	CRP on Vaccines and Diagnostics	April 2022 – Mar 2025	J. Mohanty (PI) P. K. Sahoo M. R. Badhe
6	E-158	CRP on Genomics: Whole genome sequencing and generation of allied genome resources for *Macrobrachium rosenbergii* and *Labeo fimbriatus*	ICAR-CRP (Lead Institute: ICAR-NBFGR)	May 2023-2026	P. K. Sahoo (Coordinator) S. Nandi (PI) L. Sahoo P. C. Nandanpawar B. R. Pillai D. Panda
7	E-164	Elucidation of molecular mechanism of captive reproduction of *Clarias dussumieri* and derive relevant molecular cues for successful induced spawning of male *Clarias magur*	NASF, ICAR (Lead Institute: ICAR-CIFE)	Mar 2024 – Feb 2027	J. K. Sundaray (CCPI)
8	E-167	Establishment of Biotech-KISAN hub at DBT-ILS, Bhubaneswar for carrying out activities in tribal districts of Odisha	DBT, GoI	Feb 2022 – Feb 2025	J. K. Sundaray (CCPI)

DST-SERB NPD Fellowship

Sl. No	Title	Funding Agency	Duration	Post Doc Scholar	Mentor Scientist
1	Exploring transgenerational effects of polystyrene microplastics in zebra fish (*Danio rerio*) through integrative analysis of metabolomics	DST-SERB (NPDF)	April 2024 – March 2026	Dola Roy	J. K. Sundaray

Fish Health Management Division

Sl. No	Title	Funding Agency	Duration	Post Doc Scholar	Mentor Scientist
1	E-86	National Surveillance programme on aquatic animal diseases (Phase-II)	PMMSY (Lead Instt. : ICAR-NBFGR)	Phase-II: Apr 2022 – Mar 2025)	A. Paul (PI) P. K. Sahoo S. Mohanty
2	E-138	Deciphering the role of NLRs, TLRs and RLRs-signal transduction pathways in *Labeo rohita* brood female in enhancing broadly acting material innate immunity for the prevention of infection and mortality of larvae	DBT, GoI	Mar 2021 – Dec 2024	M. Samanta (PI) A. Saha
3	E-148	Harmonized One health Trans-Species Transmission of Antibiotics Resistance: Community Level Inter-host transmission of Carbapenemase-producing *Escherichia coli* among humans, animals and environment (HOTSTAR-CLIC)	ICMR, New Delhi	April 2023 – Jun 2024	S. S. Mishra (PI) P. Swain S. N. Sahoo
4	E-162	Prospects of employing 'Paraprobiotics' as an alternate means of vaccination in freshwater fish culture practices	Science and Technology, Dept., Govt. of Odisha	Oct 2023 – Oct 2026	S. P. Mohanty (PI)
5	E-165	Standardization of sustainable medicinal leech farming technology and development of SoP for its storage, transportation and therapeutic application	Central Council for Research in Ayurvedic Sciences, Ministry of Ayush, GoI)	March 2024 – March 2027	A. Paul (PI) P. K. Sahoo S. Mohanty

Consultancy Service

Sl. No	Title	Funding Agency	Duration	Post Doc Scholar	Mentor Scientist
1	E-169	Laboratory testing of the immunogenicity, toxicity and efficacy of the *Aeromonas hydrophila* attenuated vaccine with Indian Immunological Ltd	Indian Immunological Ltd., Hyderabad	Jun 2024 –Mar 2025	P. Swain S. S. Mishra P. Choudhary C. Muduli

DST Inspire Fellow

	Title	Funding Agency	Duration	Inspire Fellow	Mentor Scientist
1	Molecular cloning and functional characterization of septin genes in rohu, *Labeo rohita* (Hamilton)	DST Inspire Fellow Scheme	Feb 2022- Jan 2027	Lopamudra Parida	P. K. Sahoo

Fish Nutrition and Physiology Division

Sl. No	Project code	Title	Funding agency	Duration	PI/Co-PIs
1	E-150	Omega-3 fatty acid enriched edible algal biomass as feed supplements	DBT, GoI (Lead Institute: CSIR-NIIST)	Mar 2023 – Mar 2026	K. C. Das (PI) Rakhi Kumari
2	E-170	Elucidating the role of phoenixin and its receptor signaling pathways on gonadal maturation of freshwater carp	ANRF, SERB, GoI	July 2024 – July 2027	A. Saha (PI) M. Samanta

Sl. No	Title	Funding Agency	Duration	Ph.D. Fellow	Mentor Scientist
1	Maximising consumers' health benefits from farmed fish through nutritional programming of fish feed	UNESCO-TWAS-DBT Sandwich PhD scholarship	Dec 2022 – Jun 2024	Ms. Ibukun Esther Awoyemi, University of Ibadan, Nigeria	S. S. Giri

Social Science Section

Sl. No	Project code	Title	Funding agency	Duration	PI/Co-PIs
1	E-105	Promoting Improved Agriculture and allied Sector Technologies in Khordha district through Farmer FIRST Approach	ICAR	April 2016–March 2025	H. K. De (PI) G. S. Saha A. S. Mahapatra I. Sivaraman J. Debbarma Husne Banu D. P. Rath (Associate)
2	E-143	Economic empowerment of SC fish farmers through capacity building in two aspirational districts – Dhenkanal and Kandhamal, Odisha	DST, GoI	April 2022 – Mar 2025	H. K. De (PI) S. K. Swain C. K. Misra S. N. Sethi U. L. Mohanty (Associate) S. Gudipudi (Associate)
3	E-144	ICAR-CIFA Outreach of Matsya Setu	NFDB, Hyderabad	April 2022 -June 2024	I. Sivaraman (PI) A. S. Mahapatra H. K. De B. R. Pillai A. Rasal
4	E-147	Strategic planning and database development for ornamental fisheries value chain upgradation in India	PMMSY, DoF, GoI	April 2023 – April 2024	I. Sivaraman (PI) S. K. Swain C. K. Misra H. K. De M. K. Bairwa
5	E-149	Impact assessment of freshwater aquaculture technologies under Network project "Production system, agri-business and institutions" Component-I: Impact assessment of agricultural technology	NIAP (Lead Institute: ICAR-CMFRI)	April 2022 – March 2026	N. K. Barik P. Routray
6	E-151	Farm Based S&T interventions for socio-economic development in the aspirational district of Nabarangpur, Odisha	RKVY, Govt. of Odisha	July 2019 – March 2024	N. K. Barik (PI) S. S. Mishra Rajesh Kumar K. Murmu
7	E-152	Establishment of incubation center for micro enterprises in freshwater aquaculture for Odisha	RKVY, Govt. of Odisha	April 2018 – March 2024	N. K. Barik P. Swain P. Routray K. C. Das
8	E-159	Agripreneurship for sustainable agricultural development: Technological and institutional innovations and strategies	NASF (Lead Centre: ICAR-NAARM)	June 2023 – May 2026	N. K. Barik (CCPI)
9	E-161	Preference, consumption pattern and future demand for fish and fishery product in India	NFDB	July 2023 – Dec 2024	I. Sivaraman (PI) H. K. De G. S. Saha

RRC, Rahara

Sl. No.	Project code	Title	Funding agency	Duration	PI/Co-PIs
1	E-135	Captive breeding of hilsa, *Tenualosa ilisha*: Phase-II	NASF, ICAR (Lead Institute: ICAR-CIFRI)	Feb 2021 – Feb 2024	S. Adhikari (CCPI) A. Das S. Nandi

20 Superannuations and Appointments

Superannuation

- Dr. P. Das, Pr. Scientist on 29.02.2024
- Shri C. M. Rao, SSS on 30.04.2024
- Dr. B. K. Banja, CTO (T-9), KVK, Khordha on 31.05.2024
- Shri Debabrata Sahoo, Security Officer on 30.06.2024
- Smt. Golap Bhanja, AAO on 31.07.2024
- Dr. Hemaprasanth, Pr. Scientist. & SIC, RRC, Bengaluru on 31.07.2024

Appointments

Administrative & Finance

- Shri Yashwant Sorte, Finance & Accounts Officer w.e.f. 30.12.2024
- Shri Sujan Show, Administrative Officer w.e.f. 22.04.2024
- Shri Deepak Kumar, Assistant at KVK Khordha w.e.f. 04.09.2024
- Shri Abinash Swain, Assistant w.e.f. 05.09.2024
- Shri Angad Chaudhary, Assistant w.e.f. 06.09.2024
- Shri Mridul Barshilia, Assistant w.e.f. 18.09.2024
- Shri Mrigank Shubham, Assistant w.e.f. 27.09.2024
- Ms. Anjali Pandey, Assistant w.e.f. 07.10.2024
- Shri Ankush Kumar, Assistant w.e.f. 14.10.2024
- Shri Pancham Kumar Gupta, Assistant w.e.f. 17.10.2024
- Shri Abhishek Sharma, Assistant w.e.f. 18.10.2024
- Shri Chetan Lehkra, Assistant w.e.f. 06.11.2024

Technical

- Shri Rajesh Kumar, Technician (T-1) w.e.f. 06.05.2024
- Shri Aman Kumar Singh, Technician (T-1) w.e.f. 09.05.2024
- Shri Vinod Kumar Meena, Technician (T-1) 27.06.2024-11.07.2024

Promotion

- Dr. Rajesh Kumar, Sr. Scientist promoted to the post of Principal Scientist w.e.f.07.01.2023.
- Dr. Shailesh Saurabh, Sr. Scientist promoted to the post of Principal Scientist w.e.f. 07.01.2023.
- Shri Durga Prasad Rath, ACTO promoted to the post Chief Technical Officer (T-9) w.e.f. 12.10.2022.
- Shri Santosh Ku. Nayak, STO promoted to the post Asst. Chief Technical Officer (T-7-8) w.e.f. 01.01.2022
- Shri Niranjan Behera, Assistant promoted to the post of Assistant Administrative Officer w.e.f. 02.09.2024
- Shri Arijit Panda, UDC promoted to the post of Assistant w.e.f. 27.11.2024
- Shri Manas Kumar Muduli, LDC promoted to the post of UDC w.e.f 27.11.2024
- Shri Pradiumna Behera, LDC promoted to the post UDC w.e.f. 27.11.2024

Transfer/joining

- Dr. Satheesha Avunje, Sr. Scientist transferred from ICAR-CIBA, Chennai and joined at RRC of ICAR-CIFA, Bengaluru on 01.01.2024.
- Shri Prakash Kumar Behera, Technical Officer (T-5) transferred from ICAR-CIFA, Bhubaneswar w.e.f. 31.01.2024 to ICAR-CIFE
- Shri Bhaskara Rao Vazragiri, Tech. Asst. (T-3) transferred from ICAR-CIFA, Bhubaneswar w.e.f. 22.04.2024 to ICAR-CIRCOT.

21 Women Empowerment

International Women's Day

ICAR-CIFA and KVK, Khordha jointly organized a workshop on "Women Empowerment through Aquaculture" on 8 March 2024 to celebrate International Women's Day. Forty farm women from six SHGs attended the programme. Dr. Bindu R. Pillai welcomed guests and highlighted the institute's women-centric initiatives. Chief Guest Mrs. Bijayini Singh (OPS), DSP, Odisha State Commission for Women, encouraged women's social and economic participation. Special Guest Ms. Linkan Subudhi emphasized digital empowerment for a safer society. Guest of Honour Dr. K.D. Mahapatra stressed on economic independence of women for their empowerment. Director (I/C) Dr. S.S. Giri outlined ICAR-CIFA's women empowerment programs. On the eve of International Women's' Day, the institute organized a workshop cum training on "Advanced Entrepreneurship Development for Women in Agriculture" where 30 women entrepreneurs participated.

International Day of Rural Women (Mahila Kisan Diwas)

ICAR-CIFA, KVK Khordha, and Darbar Sahitya Sansad celebrated Mahila Kisan Diwas on 15 October 2024 at Balipatna, Khordha. Chief Guest Dr. Pradip Dey emphasized on role and importance of rural women's perseverance. Mango saplings were distributed, and 50 farm women from nine SHGs participated in this empowerment-focused event.

Women in Agriculture Day

ICAR-CIFA organized "Women in Agriculture Day" on 4 December 2024 at different locations through SCSP Scheme. On this occasion, an Awareness-cum-Training Programme on "Scientific Aquaculture" was organised at Rajendrapur village in the Bhandaripokhari block of Bhadrak district, Odisha. Over 200 beneficiaries, including around 160 women farmers took part. A fish harvest Mela was organised at Phiringia, Kandhamal.

Large number of beneficiaries, including Women Self-Help Groups (WSHGs), fish farmers, various stakeholders, NGOs, Mission Shakti members, and government officials participated in the programme. This day was also observed at Raigurubasudeipur, Balianta, Khordha. Sixty farmwomen from Raigurubasudeipur and Nagapur villages of Balianta block attended the programme.

Women Friendly Technology

Freshwater Pearl Farming: Unlocking Opportunities for Women

Freshwater pearl farming is one of the emerging women friendly technologies with immense potential for promoting women entrepreneurship. The technology is gaining importance due to operational easiness, employment generation and higher economic returns. With its relatively low environmental impact and significant socio-economic benefits, it can empower women in rural and semi-urban areas, especially in regions where natural resources like water bodies are abundant. The economic viability of freshwater pearl farming is evident in its profitability, lightweight and non-perishable final products which have good demand in the domestic as well as export market all over the world. Recognizing its potential, ICAR-CIFA has developed this technology and disseminated it through conducting various capacities building programme for wider adoption. The farming practice is easy to adopt and aligns well with the physical abilities and general aptitude of rural womenfolk. There is only marginal need for investment capital and diminutive demand on the labour time. The aquaculture activities can be pursued in convenient leisure time without detriment to their normal vocation and domestic chores. Moreover, this technology is associated with several ancillary activities like pearl mussel collection, nucleus preparation, surgical implantation and providing pre & post-operative care, all of which offer women opportunities to participate and earn their livelihood. The surgical implantation is only the challenging, labour intensive and time consuming activities while other activities can be done through little monitoring. Farmers can do freshwater pearl farming in tanks having aeration facility as well as in well managed pond as monoculture or composite fish culture systems. Many women trained under ICAR-CIFA have ventured into this sector, exemplifying successful entrepreneurship.

22 ICAR-CIFA in Print Media

Boost for farmers: 'Amrit Catla' fish variety launched at CIFA

FIELD TRIALS SHOW THAT THE IMPROVED 'CATLA' CAN REACH AN AVERAGE WEIGHT OF 1.8 KG IN ONE YEAR, COMPARED TO 1.2 KG FOR LOCAL STRAINS

Union Minister Rajiv Ranjan Singh also unveiled Rangeen Machhli app, a digital platform for the ornamental fisheries sector

ICAR-CIFA inks pact with Himachal govt

POST NEWS NETWORK

Bhubaneswar, June 9: Two Memorandums of Understanding (MoUs) were signed between ICAR-Central Institute of Freshwater Aquaculture (ICAR-CIFA) and the department of Fisheries, Government of Himachal Pradesh, for a collaborative effort towards establishing units for 'Jayanti Rohu' and 'Improved Catla breed', as well as introducing CIFAB-ROOD, a specialised broodstock diet for carp fish.

On the occasion, ICAR-CIFA organised a workshop on aquaculture initiatives.

ICAR-CIFA principal scientists K Murmu elucidated on genetically improved carp fish breeds for enhanced productivity and income generation and S Nandi provided insights into carp broodstock diet, underscoring its importance in aquaculture.

ICAR-CIFAcelebrated Kisan Diwas as a part of SwachhataPakhwada

भाकृअनुप-सीफा में हास्य कवि सम्मेलन आयोजित

नवभारत

Odisha Patrika - 02 Apr 2024 - 02/srp4
epaper.navabharat.news

भाकृअनुप-सीफा ने वार्षिक दिवस समारोह के साथ मनाया

Dr. U. S. Gautam DDG, Agricultural Extension inaugurates Kisan Mela-cum-Exhibition at ICAR-CIFA

DG ICAR inaugurates Smart Pond

Lays foundation for Genome editing facility in fish

STATESMAN NEWS SERVICE

BHUBANESWAR, 13 JULY:

EISURE
The Statesman Sun, 14 July 2024
https://epaper.thestatesman.com/c/75440685

FISH FEEDS DISTRIBUTED TO FLOOD AFFECTED FISH FARMERS OF MANIPUR

admin January 24, 2025 0 Comments

Asem Bhakta, Special Correspondent North East

Imphal: The Department of Fishery, Government of Manipur in collaboration with the ICAR- Central Institute of Freshwater Aquaculture (ICAR-CIFA), Bhubaneshwar has distributed about 20 tonnes of fish feeds to around 200 flood affected fish farmers of Manipur today at the office complex of the Directorate of Fisheries, Manipur at Lamphelpat under the ICAR-CIFA NEH Outreach Programme. The Director of Fisheries, Manipur, H. Balkrisna Singh along with the fisheries

Union Minister Baghel visits ICAR-CIFA

POST NEWS NETWORK

Bhubaneswar, June 16: Union Minister of State, Fisheries, Animal Husbandry and Dairying, SP Singh Baghel reviewed freshwater aquaculture research activities being carried out by ICAR-Central Institute of Freshwater Aquaculture (CIFA) here, Sunday.

On the occasion, the minister planted a tree sapling on the institute premises and visited CIFA farm facilities.

ICAR-CIFA director PK Sahoo, welcomed the minister and presented an action plan for next 100 days of the institution. Sahoo also briefed him about the ongoing research activities and the 'Vision 2047'.

Baghel appreciated the efforts by the institution in rearing more than 23 different fish varieties, like genetically improved 'Jayanti' Rohu, Catla, Scampi, minor Carps, different breeds of Catfish, Murrel, Anabas and Pearl Mussel. He also reviewed different aquaculture practices, such as pond culture, Biofloc and Aquaponics. Different gadgets, feed formulations and therapeutics developed by the institute were also exhibited.

The minister reviewed the work progress of central schemes on animal husbandry and fisheries operated in the state. Officials from the Fisheries and Animal Resources Development department attended the review meeting.

Baghel laid emphasis on transfer of advanced technologies to the farming community and stressed the need for more research on farming practices which will play a significant role in making India a developed country in agriculture.

Plantation drive by ICAR-CIFA

ARINDAM GANGULY, OP

Bhubaneswar, June 6: The ICAR-Central Institute of Freshwater Aquaculture (ICAR-CIFA) celebrated World Environment Day (WED) and organised a tree plantation programme on its campus, recently.

This year's WED theme, 'Land restoration, desertification, and drought resilience' which underlines the critical need to heal the land, combat desertification, and strengthen mankind's re-

ಮತ್ಸ್ಯಸಾಗುಲೊ ಮೆಳಕುವಲತೊನೆ ಲಾಭಾಲು

DUMANI MAIL
Bhubaneswar
Wednesday, 19, June, 2024

TWIN CIT

KVK-Khordha & ICAR-CIFA, Kausalyaganga organised live streaming of PM-KISAN Samman Nidhi Programme

Bhubaneswar: Krishi Vigyan Kendra, Khordha in collaboration with ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar organised the live streaming of PM-KISAN Samman Nidhi programme on 18 June, 2024.

Hon'ble Prime Minister Shri Narendra Modi released the 17th instalment of the PM-KISAN scheme at Varanasi in which more

worker. Dr. Mukesh Mahaling, Hon'ble Cabinet Minister for Pattanayak, MLA, Pipili, Puri and Mr. Babu Singh, MLA,

state government for the farming community. Dr. P.K Sahoo, Director, ICAR-Central Institute of Freshwater Aquaculture (CIFA), Bhubaneswar welcome the Hon'ble Cabinet Minister and Members of Legislative Assembly and briefed PM-KISAN Scheme to the farmers and farmwomen present on the event.

Dr.Haraprivia Nayak,

ಒಳನಾಡು ಜಲ ಕೃಷಿ ತರಬೇತಿ

ಚಿಕ್ಕಬಳ್ಳಾಪುರ : ಕೇಂದ್ರೀಯ ಸಿಹಿನೀರು ಜಲಕೃಷಿ ಸಂಸ್ಥೆ, ಪ್ರಾದೇಶಿಕ ಸಂಶೋಧನಾ ಕೇಂದ್ರ, ಬೆಂಗಳೂರು ಇವರು ಮೀನುಗಾರಿಕಾ ಇಲಾಖೆಯ ಸಹಯೋಗದೊಂದಿಗೆ ಚಿಕ್ಕಬಳ್ಳಾಪುರದ ಆಮಾನಿಕೆರೆ ಪರಿಸರದಲ್ಲಿ ಒಳನಾಡಿನ ಜಲಕೃಷಿಯ ಬಗ್ಗೆ ತರಬೇತಿಯನ್ನು ನಡೆಸಿದರು. ಕೇಂದ್ರದ

ಯ, ಡಾ. ಆನಂದ ಕುಮಾರ್, ಡಾ. ಸತೀಶ, ಎ. ಹಾಗೂ ಇಲಾಖೆಯ

23 Special Report

Simultaneous General Election (SGE-2024) was held in Odisha during 13 May to 1 June 2024 in four phases. Personnel from the institute were assigned different duties such as polling officers, presiding officers, micro-observers in polling and home voting, and also in counting the ballots for Puri, Khordha and Jagatsinghpur districts. The staff were rigorously trained for free and fair conduct of SGE-2024.

ICAR-Central Institute of Freshwater Aquaculture

Kausalyaganga, Bhubaneswar-751 002, Odisha, India
Tel.:(0674) 2465421, Fax : (0674) 2465407
Email : Director.cifa@Icar.gov.in
Www.cifa.nic.in