ANNUAL REPORT 2024

भा.कृ.अनु.प. - केंद्रीय खारा जलजीव पालन अनुसंधान संस्थान

ICAR-CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE

Front cover: The image displays a blue swimmer crab, *Portunus reticulatus*, positioned atop a bed of brackishwater seaweed, *Gracilaria salicornia*. The presence of the crab signifies ICAR-CIBA's success in the seed production of the blue swimmer crab *Portunus reticulatus*, in brackishwater for the first time, a crucial step in aquaculture. Concurrently, the abundant seaweed highlights the successful demonstration of Gracilaria salicornia farming in brackishwater environments, indicating advancements in sustainable aquaculture practices that integrate both crustacean and algal cultivation.

Back cover: Images depicting the complete early developmental stages of *Portunus reticulatus* would typically showcase a sequence of distinct larval forms, illustrating the remarkable transformation from a microscopic, planktonic larva to a benthic, crab-like juvenile instar.

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(भारतीय कृषि अनुसंधान परिषद)

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ICAR - CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE

ISO 9001 : 2015
(Indian Council of Agricultural Research)
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Published by

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ISSN 0976-5336 © Central Institute of Brackishwater Aquaculture 2024

Citation: CIBA, 2024. Annual Report 2024.
Central Institute of Brackishwater Aquaculture, Chennai. 288 p.

Layout, Design & Printing:
Aparna Graphic Arts, Chennai

Contents

PREFACE

ICAR- Central Institute of Brackishwater Aquaculture (ICAR-CIBA), has continued concentrating on the research and development in the niche area of brackishwater aquaculture in India. The objective is to be technologically innovative for improving aquaculture practices, which are resilient to challenges, farmer's income and thus, enhancing affordable and healthy seafood production, which helps improving nutritional security of both consumers and producers. The brackishwater aquaculture sector has consistently contributed over INR 45,000 crores in foreign exchange through export of shrimp, which is one of the single largest commodities supplied to the world food basket. This is nothing less than a hub of seafood responsible for the nutritional security of globe. With the strong conviction that solution to the problems that Indian aquaculture faces, are to be found within the country through a path of self-reliance, ICAR-CIBA has pursued scientific research in this direction. The shrimp culture faces uncertain international prices, rising feed and input costs, diseases, environmental concerns and land-use conflicts. Besides this it is important that productivity per unit area increases and more diversified species technologies are available. In this direction, ICAR-CIBA successfully demonstrated super intensive shrimp farming system, which is suitable to Indian farming conditions and can improve the revenues, through input use efficiency (FCR 1.1 to 1.2) and increased productivity upto 45 tons per ha per crop, over 5 times of the conventional system yields. The system minimises environment risks, integrates smart farming technologies, automation and the efficiency transform into over 30% lower cost of production. The institute demonstrated the system to the industry experts during 8th cycle of harvest with an encouraging response from the stakeholders, in the presence of Hon'ble Minister of State for Minority Affairs and Fisheries, Animal Husbandry & Dairying, Shri George Kurien jee and the technology was inaugurated by Hon'ble Union Cabinet Minister of Fisheries, Animal Husbandry and Dairying and Minister of Panchayati Raj, Shri Rajeev Ranjan Singh ji on 12th February 2025. The time has come that when Indian farmers will be able to adapt super-intensive farming with lower disease risks. The diversification technologies with other shrimp, crustaceans and finfish species are also on the horizon to address the global competitive edge of the country. One of the important aspects is the research on developing genetically improved indigenous Indian white shrimp and a nuclear breeding centre is in advanced stage of completion through PMMSY support. The development of indigenous broodstock of white shrimp will help the country lower its dependence on the import of broodstock of white leg shrimp.

The species and system diversification efforts occupy a focussed space in the institute's long-term action plan. The country needs to bring systematic aquaculture of high-valued species other than shrimp such as crabs, seabass to unlock the still hidden commercial value. The crabs have a vast export potential and needs the culture practices which environmental neutral and are not dependent upon the wild populations for critical inputs seed and feed. The ICAR-CIBA has not only significantly improved hatchery recovery of cablets of two species of mud crab and species of blue swimming crab, but has got encouraging results with the formulated feed use. In nutshell, ICAR-CIBA is working towards crab culture, which does not focus upon fattening the wild collected juveniles but is systematically cultured. For seabass and other finfish such as milk fish and pearlspot, ICAR-CIBA has demonstrated end to end technology and hatcheries in private sector are established based on the designs and technology supported by the institute. The vaccination against viral necrosis virus in seabass broodstock is a new milestone achieved by the institute. During the year, ICAR-CIBA has developed and commercialised the indigenous shrimp larval feeds, which is import substitute and can help reducing cost of shrimp seed. In the area of shrimp feed, a new feed formulation was developed, named as *Chingudi*^{plus} and is commercialised. The progress in addressing

the deadly EHP disease in shrimp has been widely accepted with commercial production of EHP CURA I, based on the institute's technology. Field level diagnostic kits are in advanced stage of development which will help empowering the farmers and disease management. The association with the new network project like ornamental fishes, will help the institute in finding new opportunities for the institute. ICAR-CIBA has initiated a new program on Genome Editing for improving the production traits in priority species.

ICAR-CIBA, during the year has worked with the industry through consultancy services, initiated collaborative research programmes in the areas like shrimp crop insurance, brackishwater seaweed culture and signed several MoU's for transfer of technology generating about 100.04 lakhs as revenue in addition to the revenue of 300.00 lakhs earned through sale of technologies and products. It is matter of pride that ICAR-CIBA achieved National Accreditation Board for Testing and Calibration Laboratories (NABL) accreditation, in the field of aquaculture feed testing in addition to existing pathogen testing.

ICAR-CIBA has continued its technical support to complement for the fulfilment of vision of Department of Fisheries, National Fisheries Development Board, Coastal Aquaculture Authority, Marine Product Export Development Authority through positive interactions. I express my gratitude to Hon'ble Secretary (DARE) and Director General, ICAR for his overwhelming support and able guidance. My special thanks to Dr J.K. Jena, Deputy Director General (Fisheries Science), ICAR for his continuous support, guidance and direct involvement in all our research and administrative activities. I also thank our Assistant Director General (Marine Fishereis), Dr S. Ghosh for his timely help in many of the aspects.
I also express my sincere gratitude to all the scientists and members of SMD in fisheries Science, particularly to mention about Dr. Prem Kumar and Dr Yasmin Basade for their great support in many of our activities.

Our sincere thanks to all the farmers, stake holders, state government officials and officials from other research organizations, who all have helped and collaborated along with us to achieve the success. I also thank to all the Heads of the Divisions, Scientists-in-Charge, Head of Regional Research Centres, Officer in charge and all the scientists, technical officers and administrative staff of the institute who all have put their consistent effort towards the development of this institute.

I thank and appreciate all the members of the Institute annual report 2024 committee for their efforts as editorial board members to bring this document.

Dr Kuldeep K. Lal
Director, ICAR-CIBA, Chennai

कार्यकारी सारांश

पर्लस्पॉट, *इट्रोप्लस सुराटेन्सिस* के लिए प्री-ग्रोआउट पालन प्रथाओं का अनुकूलन

आकार अनुसार छँटाई और अलग पालन द्वारा पर्लस्पॉट (*इट्रोप्लस सुराटेन्सिस*) की खेती को अनुकूलित करने से वृद्धि में उल्लेखनीय सुधार होता है। जहाँ बड़ी मछलियाँ सबसे अधिक दैनिक वजन वृद्धि दर्शाती हैं, वहीं मध्यम और छोटी मछलियाँ तुलनात्मक या बेहतर वजन वृद्धि प्रतिशत और विशिष्ट वृद्धि दर प्रदर्शित करती हैं, जिससे सामाजिक पदानुक्रम प्रभावों पर विजय प्राप्त होती है और इस उच्च-मूल्य वाली प्रजाति के समग्र विकास में वृद्धि होती है।

आकार ग्रेडिंग के माध्यम से पर्लस्पॉट के विकास में बढ़ोत्तरी

पर्लस्पॉट को छोटे (प्रारंभिक 19.4-19.6%), मध्यम (52.6-53.7%), और बड़े (26.8-27.6%) वर्गों में बांटने के बाद 100-135 दिनों तक (प्री-ग्रोआउट) और 108-173 दिनों (ग्रोआउट) तक तीनों वर्गों को अलग-अलग पालन-पोषण करने पर, मत्स्य आबादी में उल्लेखनीय सुधार हुआ है। इसके परिणामस्वरूप बड़ी मछलियों के अनुपात में उल्लेखनीय वृद्धि हुई (सेट 1 में 40.6% और सेट 2 में 38.6%) और छोटी मछलियों में उल्लेखनीय कमी आई (सेट 1 में 9.8% और सेट 2 में 12.6%), जिससे किसानों को निरंतर और उच्च आय प्राप्त हुई।

तालाब-आधारित पिंजरा संवर्धन में पर्लस्पॉट, इट्रोप्लस सुराटेन्सिस की वृद्धि विशेषताएँ

पर्लस्पॉट उप-वयस्कों को 500 मछलियां/पिंजरा (50 मछली/घन मीटर) की दर से तालाब-आधारित पिंजरों में संग्रहीत करने पर संवर्धन प्रक्रिया ने 173 दिनों में महत्वपूर्ण वृद्धि अंतर प्रदर्शित किया : बड़े आकार की मछलियों (प्रारंभिक 74.06 ग्राम) का वजन

बढ़कर 204.8 ग्राम तक पहुँच गया, जो मध्यम आकार की मछलियों (प्रारंभिक 48.13 ग्राम) के 179.7 ग्राम और मिश्रित समूहों (प्रारंभिक 48.5 ग्राम) के 145.1 ग्राम से बेहतर प्रदर्शन था। बड़े आकार के पिंजरों में इस दौरन 100% उत्तरजीविता और 11.0 किग्रा/घन मीटर की उच्च उत्पादकता दर्ज किया गया, यह बड़े पैमाने पर उत्पादन के लिए एक आर्थिक रूप से टिकाऊ विधि साबित हुई।

हापा-आधारित प्रणाली में बंगाल येलोफिन ब्रीम (*एकेंथोपेग्रस डेटनिया*) के बीज मछलियों का आउटडोर नर्सरी पालन

एक आउटडोर हापा-आधारित नर्सरी प्रणाली में, हैचरी में उत्पादित बंगाल येलोफिन ब्रीम (*एकेंथोपेग्रस डेटनिया*) के बीज मछलियों को 50 नग/घन मीटर संग्रहण घनत्व पर प्रभावी ढंग से पाला गया, जिससे दो महीनों में शुरुआती 1.0 ± 0.02 ग्राम से 6.8 ± 1.16 ग्राम तक औसत वजन वृद्धि प्राप्त हुई। शूटर घटना को रोकने और उत्तरजीविता में सुधार के लिए नियमित साप्ताहिक ग्रेडिंग को महत्वपूर्ण माना गया।

काकद्वीप अनुसंधान केंद्र में शून्य-इनपुट कृषि-बागवानी-मुर्गी पालन प्रणाली का मूल्यांकन

काकद्वीप अनुसंधान केंद्र में एक शून्य-इनपुट एकीकृत जलजीव-बागवानी-मुर्गी पालन प्रणाली का मूल्यांकन किया जा रहा है। इस प्रणाली में *मिस्टस गुलियो*, मिल्कफिश, पर्लस्पॉट, तिलापिया, टेड मुलेट और पेनियस मोनोडॉन जैसी प्रजातियों का 1 नग/घन मीटर की दर से और केवल चूने के प्रयोग (200 किग्रा/हेक्टेयर भंडारण-पूर्व, तत्पश्चात साप्ताहिक तौर पर 30 किग्रा/हेक्टेयर) के साथ भंडारण कर प्रणाली का मूल्यांकन किया जा रहा है। इस प्रणाली का मूल्यांकन वाणिज्यिक चारा प्रणालियों के विरूद्ध किया जा रहा है ताकि "काम करते हुए सीखें और कमाएँ" (एलईडब्ल्यू) कार्यक्रम के माध्यम से 18 अनुसूचित जाति के किसान परिवारों के लिए एक लागत-प्रभावी और टिकाऊ खारे पानी की जलीय कृषि मॉडल का निरूपण किया जा सके।

ग्रो-आउट के लिए विकास अवरुद्ध टेड मुलेट

टेड मुलेट (*लिज़ा टेड*) की अंगुलिकाओं (प्रारंभिक 3.8 ± 1.1 ग्राम) को 80 और 100 मछली/घन मीटर (T1 और T2) के घनत्व पर 11 महीने तक पिंजरों में संग्रहीत कर किए गए एक परीक्षण की तुलना 20 मछली/घन मीटर की दर से कंट्रोल पालन के साथ करने पर उच्च उत्तरजीविता दर (कंट्रोल में 100%, T1 में 91.67%) और अंतिम औसत शारीरिक भार 53.23 ग्राम (कंट्रोल), 47.38 ग्राम (T1), और 51.23 ग्राम (T2) प्राप्त हुआ, जिससे पूर्वी भारत में सतत ग्रो-आउट पालन की संभावना प्रदर्शित हुई।

स्काइला ओलिवेसिया का ग्रोआउट पालन

नर्सरी में पालित *स्काइला ओलिवेसिया* केकड़ों को 0.5 नग/वर्ग मीटर की दर से 150 दिनों तक ग्रोआउट पालन करने पर, नरों ने 210 ± 34 ग्राम तक की अनुकूल वृद्धि दर्शायी, जबकि मादाओं का वजन 80 दिनों के भीतर 80-120 ग्राम तक पहुँच गया; महत्वपूर्ण बात यह है कि सूत्रबद्ध आहार खिलाए गए और ट्रैश फिश खिलाए गए केकड़ों के बीच वृद्धि में कोई महत्वपूर्ण अंतर नहीं था, जो कृत्रिम आहार के प्रति अनुकूलनशीलता और ट्रैश फिश पर निर्भरता कम होने की संभावना को दर्शाता है।

भारतीय सफेद झींगों की घनत्व-निर्भर वृद्धि

भारतीय सफेद झींगों (*पीनियस इंडिकस*) के तरूण झींगों (प्रारंभिक वजन ~0.89 ग्राम) के साथ 150-दिवसीय शीतकालीन प्रयोग में घनत्व-निर्भर वृद्धि निरूपित हुई। 0.3 नग/लीटर (T1) की दर से संग्रहीत झींगों की वृद्धि 7.67 ग्राम तक पहुँच गई, जो 0.5 नग/लीटर (T2) से संग्रहीत झींगों की तुलना में बेहतर थी, जो 90 दिनों के बाद 6.91 ग्राम तक पहुँच गए।

मल्टी-पॉलीकल्चर और पारंपरिक पॉलीकल्चर की तुलना में बेहतर

240 दिवसीय तुलनात्मक प्रयोग ने निरूपण किया कि पिंजरों में सीबास एवं पर्लस्पॉट, तैरते हुए बक्सों में मड क्रैब, और खुले तालाब में मिल्कफिश और पर्लस्पॉट से मल्टी-पॉलीकल्चर मॉडल से पारंपरिक पारंपरिक पॉलीकल्चर (106.9 किलोग्राम पर्लस्पॉट, 312.6 किलोग्राम मिल्कफिश) की तुलना में कुल उपज (जैसे, 348 किलोग्राम सीबास, 203.8 किलोग्राम पिंजरे में पर्लस्पॉट, 87.6 किलोग्राम खुले में पर्लस्पॉट, 288 किलोग्राम मिल्कफिश, 224.5 किलोग्राम मड क्रैब) काफ़ी अधिक प्राप्त हुई, जिससे किसानों को बढ़ी हुई और नियमित आय प्राप्त हुई।

मानसून में *पीनियस इंडिकस* झींगा का उच्च घनत्व वाली खेती

मानसून के दौरान अधस्तर लगे तालाबों (128 दिनों तक 80 झींगा/वर्ग मीटर की दर से) में भारतीय सफेद झींगों (*पीनियस इंडिकस*) की उच्च घनत्व वाली खेती से 8.15 से 8.8 टन/हेक्टेयर की उपज प्राप्त हुई, जिसमें 98.3% उत्तरजीविता दर और 11.8-12.2 ग्राम का औसत वजन रहा, जो भारी वर्षा के बावजूद आर्थिक रूप से व्यवहार्य साबित हुआ।

अर्ध-गहन खेती में भारतीय सफेद झींगों की वृद्धि

मिट्टी के तालाब में भारतीय सफेद झींगों (*पीनियस इंडिकस*) की अर्ध-गहन खेती से 138 दिनों में 14.02 ग्राम का औसत शारीरिक भार प्राप्त हुआ, जिसमें प्रभावकारी 97.6% उत्तरजीविता, 1.75 FCR और 4.45 टन/हेक्टेयर की उच्च उत्पादकता प्राप्त हुई, जो उत्कृष्ट वृद्धि और अनुकूल कृषि परिस्थितियों को दर्शाता है।

तालाबों में *पी. इंडिकस* पोस्ट-लार्वा वृद्धि

अधस्तर लगे तालाबों में 3 नग/वर्ग मीटर की दर से संग्रहीत बंद-प्रजनन से उत्पन्न *पीनियस इंडिकस* पोस्ट-लार्वा ने 120 दिनों के भीतर 16.5 ग्राम (नर) और 22.0 ग्राम (मादा) का औसत शारीरिक भार प्राप्त किया, जिसमें 20% मादाओं में जननग्रंथि विकास देखा गया, जिससे सफल वृद्धि और प्रारंभिक प्रजनन क्षमता प्रदर्शित हुई।

एकीकृत समुद्री शैवाल एवं झींगों का एकीकृत नर्सरी व्यवहार्य साबित हुई

खाद्य समुद्री शैवाल (*अल्वा लैक्टुका*) की खेती (प्रारंभिक 5 किग्रा से 12.5 किग्रा तक एकत्रित बायोमास) को 100 वर्ग मीटर के तालाबों में *पीनियस इंडिकस* नर्सरी पालन के साथ एकीकृत करने से झींगा वृद्धि (उपचार: 0.941 ± 0.08 ग्राम बनाम कंट्रोल : 0.928 ± 0.07 ग्राम) या उत्तरजीविता (उपचार : 95.2% बनाम कंट्रोल : 94.5%) पर कोई प्रतिकूल प्रभाव नहीं पड़ता है, जिससे समुद्री शैवाल से अतिरिक्त आय का स्रोत प्राप्त होता है।

अति-गहन परिशुद्धता एवं प्राकृतिक झींगा पालन (SIPNSF)

हमारी अग्रणी अति-गहन परिशुद्धता एवं प्राकृतिक झींगा पालन (एसआईपीएनएसएफ) प्रणाली ने 90-104 दिनों में *पीनियस वन्नामेय* के 12 चक्रों के साथ 3.47 – 4.97 किग्रा/घन मीटर (34.7 – 49.7 टन/हेक्टेयर) की उल्लेखनीय उत्पादकता प्राप्त की, जिससे न्यूनतम इनपुट उपयोग के माध्यम से असाधारण फ़ीड रूपांतरण अनुपात (0.97 – 1.23) और उत्तरजीविता दर (86.5% – 98.8%) का निरूपण हुआ, जिससे यह एक टिकाऊ और स्केलेबल "फार्म-टू-फोर्क" मॉडल बन गया।

किण्वित बायोफ्लॉक *पी. वन्नामेय* का प्रदर्शन

45 दिवसीय अध्ययन से पता चला है कि किण्वित बायोफ्लॉक (एफबी) ने *पी. वन्नामेय* की वृद्धि (गैर-किण्वित कंट्रोल में 9.7 ग्राम ± 1.6 बनाम 7.99 ग्राम ± 1.47), उत्तरजीविता (97.2% ± 2.5 बनाम 81.6% ± 1.66), प्रतिरक्षा और लाभकारी जीन अभिव्यक्ति में उल्लेखनीय वृद्धि हुई।

पी. वन्नामेय पोस्ट-लार्वल ट्रेस मिनरल ऑप्टिमाइज़ेशन

60 दिवसीय परीक्षण में सामान्य और बायोफ्लॉक संवर्धन प्रणालियों में *पी. वन्नामेय* पोस्ट-लार्वा पर $ZnSO_4$ की विभिन्न सांद्रताओं (2, 4, 6, और 8 पीपीएम) के प्रभाव का मूल्यांकन किया जा रहा है। प्रारंभिक अवलोकनों से पता चलता है कि 24-48 घंटों के भीतर कोई तनाव या मृत्यु दर नहीं देखी गई, क्योंकि शोधकर्ता विकास दर और समग्र झींगा स्वास्थ्य की निगरानी कर रहे हैं।

ट्रेस मिनरल्स और प्रोबायोटिक प्रभावकारिता

इन-विट्रो प्रयोगों में यह मूल्यांकन किया जा रहा है कि ट्रेस मिनरल्स ($ZnSO_4$ 100 ppm, $CuCl_2$ 50 ppm, $MnCl_2$ 50 ppm, मिश्रित लवण 200 ppm) की विभिन्न सांद्रताएँ मिश्रित प्रोबायोटिक उपभेदों की कोशिका व्यवहार्यता और प्रसार को कैसे प्रभावित करती हैं, जिनका उपयोग जलीय जीवों के स्वास्थ्य और उत्पादकता को बढ़ाने के लिए बायो-फ्लोक उत्पादन में किया जाता है।

पर्लस्पॉट के लिए बायोफ्लॉक में कार्बन स्रोत के रूप में डकवीड

इट्रोप्लस सुराटेन्सिस (*पर्लस्पॉट*) के लिए बायोफ्लोक प्रणालियों में कार्बन स्रोत के रूप में ठोस-अवस्था किण्वित और अकिण्वित लेम्ना प्रजाति (डकवीड) की तुलना करने वाले 90-दिवसीय अध्ययन से पता चला कि किण्वित आहार (5.33 ± 0.25 ग्राम ABW) ने नियंत्रित झींगा आहार (5.42 ± 0.15 ग्राम ABW) के समान प्रदर्शन किया, जो वर्तमान औसत शारीरिक भार में अकिण्वित डकवीड आहार (4.64 ± 24 ग्राम ABW) से काफी बेहतर प्रदर्शन करता है।

बायोफ्लोक ने झींगा नर्सरी पालन को बेहतर बनाया

बायोफ्लोक तकनीक ने भारतीय सफेद झींगा (*पीनियस इंडिकस*) के नर्सरी पालन में उल्लेखनीय सुधार किया है, जिससे 15 डीओसी (बायोफ्लोक में 0.47 ग्राम) द्वारा नियंत्रण टैंकों में 0.34 ग्राम की तुलना में 1.25 ग्राम का अंतिम औसत शारीरिक भार प्राप्त हुआ और कम विब्रियो गणना के साथ बेहतर जल गुणवत्ता बनाए रखी गई।

प्रोबायोटिक्स द्वारा बायोफ्लॉक झींगा संवर्धन का अनुकूलन

पीनियस वन्नामेय संवर्धन (200/m3 स्टॉकिंग घनत्व) के लिए बायोफ्लोक और बायोफ्लॉक+पेरिफाइटन प्रणालियों में प्रोबायोटिक्स (जैसे, *बैसिलस सबटिलिस*) को शामिल करने से वृद्धि, जल गुणवत्ता, फैटी एसिड और अमीनो एसिड प्रोफाइल, और सूक्ष्मजीव विविधता में उल्लेखनीय वृद्धि हुई, जिससे समग्र प्रदर्शन में सुधार हुआ।

ग्रे मुलेट के लिए बायोफ्लॉक कार्बन स्रोत

चावल की भूसी ने बायोफ्लोक प्रणालियों में ग्रे मुलेट (*मुगिल सेफेलस*) की वृद्धि को उल्लेखनीय रूप से बढ़ाया, जिससे 40 दिनों में 7.6 ग्राम मछली प्राप्त हुई, जबकि नियंत्रण में यह 4.1 ग्राम थी। साथ ही, इससे जल की गुणवत्ता में सुधार हुआ और TAN का स्तर कम हुआ।

मिल्कफिश के लिए बायोफ्लॉक प्रबंधन

एक चालू प्रयोग में मिल्कफिश (*चानोस चानोस*) की वृद्धि, जल गुणवत्ता और बायोफ्लोक प्रणालियों में प्रतिरक्षा प्रतिक्रियाओं पर दो आहार व्यवस्थाओं (25% और 30% प्रोटीन) के साथ सूक्ष्मजीव प्रबंधन और एक

पुनःपरिसंचरण मॉडल के प्रभावों का मूल्यांकन किया जा रहा है।

बायोफ्लोक प्रणालियों में झींगा पालन

उच्च घनत्व वाले बायोफ्लॉक पालन प्रणालियों में, CIBAFLOC (T1) ने 46 दिनों के बाद *पीनियस वन्नामेय* (6.8 ± 0.24 ग्राम) और *पीनियस इंडिकस* (6.2 ± 0.4 ग्राम) दोनों के औसत शारीरिक भार में उल्लेखनीय सुधार किया, जो नियंत्रण (5.9 ± 0.2 ग्राम) से बेहतर प्रदर्शन था, जबकि जल की गुणवत्ता और सूक्ष्मजीव भार को अनुकूलतम बनाए रखा।

पीनियस वन्नामेय के लिए बायोफ्लॉक इनोकुलम

पीनियस वन्नामेय बायोफ्लॉक प्रणालियों में, CIBAFLOC + पेरिफाइटिक सब्सट्रेट (BFT3) इनोकुलम ने उच्चतम औसत शारीरिक भार (24.22 ± 0.24 ग्राम बनाम नियंत्रण 13.8 ± 0.52 ग्राम 100 DOC पर) और बेहतर प्रतिरक्षा प्रतिक्रिया (*वी. पैराहेमोलिटिकस* चुनौती के बाद 41% मृत्यु दर बनाम नियंत्रण में 86%) प्रदान की, जो वृद्धि और रोग प्रतिरोधक क्षमता में सुधार करने में इसकी प्रभावकारिता को दर्शाता है।

हाइपनिया मस्किफॉर्मिस की खेती का अनुकूलन

नियंत्रित प्रयोगों ने *हाइपनिया मस्किफॉर्मिस* की खेती के लिए अनुकूलतम परिस्थितियों की पहचान की: 25 ग्राम प्रति लीटर की लवणता, 50-100 ग्राम के बीच प्रारंभिक बायोमास घनत्व, और 0.5 मीटर की जल गहराई ने विशिष्ट वृद्धि दर में उल्लेखनीय वृद्धि की, जिससे व्यावसायिक उत्पादन के लिए महत्वपूर्ण जानकारी प्राप्त हुई।

गेलिडिएला एसेरोसा की खेती का अनुकूलन

लाल समुद्री शैवाल *गेलिडिएला एसेरोसा* पर किए गए शोध में 30 पीपीटी लवणता पर इष्टतम वृद्धि (1.77% प्रतिदिन का SGR), 75 ग्राम प्रारंभिक बायोमास के साथ उच्चतम बायोमास (मोनोलाइन प्रणालियों के लिए 525-700 ग्राम/मी अनुशंसित), और बेहतर प्रकाश प्रवेश के कारण कम गहराई (0.25-0.5 मीटर) पर बेहतर वृद्धि पाई गई।

ग्रेसिलेरिया सैलिकोर्निया बीजाणु निर्गमन

ग्रेसिलेरिया सैलिकोर्निया पर किए गए एक अध्ययन में बीजाणु निर्गमन पर लवणता के प्रभाव की जाँच की गई, जिसमें पाया गया कि बीजाणु अंकुरण, जो थैलस कली निर्माण द्वारा दर्शाया गया था, केवल नियंत्रण समूह में 28 पीपीटी लवणता पर हुआ, न कि 21-दिवसीय अवलोकन अवधि के दौरान कम लवणता की स्थितियों (5 पीपीटी और 10 पीपीटी) में।

खाराजलीय सीवीड (समुद्री शैवाल) की खेती पर व्यावहारिक प्रशिक्षण

आईसीएआर-सीबा के मुत्तुकाडु प्रायोगिक केंद्र (एमईएस) में चेंगलपट्टू जिले के कोट्टईकाडु गाँव की दस मछुआरिनों के लिए खारे पानी में समुद्री शैवाल की खेती पर एक दिवसीय प्रशिक्षण कार्यक्रम आयोजित किया गया। 14 अगस्त, 2024 को मत्स्य पालन विभाग, तमिलनाडु के सहयोग से आयोजित इस कार्यक्रम में सैद्धांतिक ज्ञान को व्यावहारिक कौशल के साथ जोड़ा गया, जिसमें राफ्ट-आधारित ट्यूबलाइन खेती भी शामिल थी, ताकि तटीय समुदायों को स्थायी जलीय कृषि के माध्यम से आर्थिक रूप से सशक्त बनाया जा सके।

ग्रेसिलेरिया कॉर्टिकाटा के लिए पोषक तत्व आवश्यकताएँ

लाल समुद्री शैवाल *ग्रेसिलेरिया कॉर्टिकाटा* की भूमि-आधारित खेती पर किए गए एक अध्ययन में पाया गया कि इष्टतम नाइट्रेट और फॉस्फेट की आवश्यकता लवणता के साथ बदलता है। 100 µM नाइट्रेट और 8 µM फॉस्फेट से 25 ppt पर 3.64% दैनिक बायोमास वृद्धि प्राप्त होती है, जबकि 50 µM नाइट्रेट और 8 µM फॉस्फेट से 35 ppt पर पर्याप्त वृद्धि होती है, जिससे वर्ष भर उत्पादन प्राप्त होता है।

एआई-संचालित झींगा आहार से वृद्धि में बढ़ोत्तरी

एक 60 दिवसीय परीक्षण से पता चला है कि *लिटोपेनियस वन्नामेय* झींगा के लिए एआई-संचालित स्वचालित आहार प्रणालियों ने वृद्धि में उल्लेखनीय बढोत्तरी की है, जिसके परिणामस्वरूप झींगा की लंबाई 8.2-10 सेमी और वजन 8.5-9.2 ग्राम तक पहुँच गया, जो मैन्युअल आहार से बेहतर प्रदर्शन करता है। हालाँकि उच्च गंदलापन/टर्बिडिटी कैमरे की प्रभावशीलता को प्रभावित कर सकता है, जबकि एक साथ लगे IoT-आधारित सिस्टम ने पानी की गुणवत्ता की प्रभावी निगरानी की।

महाराष्ट्र में उत्तरदायी जलीय कृषि के विस्तार हेतु संभावित क्षेत्रों का भू-स्थानिक मानचित्रण

महाराष्ट्र के तटीय जिलों में अनुत्पादक/बंजर भूमि से जलीय कृषि के विस्तार हेतु संभावित क्षेत्रों की पहचान की गई है। यह पहचान संसाधन विशेषताओं और पर्यावरणीय नियमों के आधार पर, भू-स्थानिक तकनीकों और जमीनी सच्चाई विश्लेषण का उपयोग करके की गई है। अध्ययन से पता चला है कि जलीय कृषि के तत्काल विकास के लिए संभावित क्षेत्र उपलब्ध हैं, जिनमें 300% तक विस्तार की क्षमता है।

सेंटिनल 2 डेटा स्पेक्ट्रल इंडेक्स और एक रैंडम फ़ॉरेस्ट (आरएफ) मॉडल का उपयोग करना

गूगल अर्थ इंजन (GEE) के अंतर्गत रैंडम फ़ॉरेस्ट (RF) मॉडल का उपयोग करते हुए, विश्लेषण लवणता से प्रभावित भूमि पर केंद्रित था। इन भूखण्डों को पाँच अलग-अलग समूहों में वर्गीकृत किया गया है, जो गैर-लवणीय से लेकर अत्यधिक लवणीय तक हैं। इस मॉडल में अन्य क्षेत्रों में

वैकल्पिक उद्देश्यों के लिए लवणता प्रभावित भूखण्डों की पहचान और मापन हेतु अनुप्रयोग की क्षमता है। रैंडम फारेस्ट मॉडल का उपयोग करके लवणता प्रभावित भूमियों का आकलन किया गया है।

एशियाई सीबास में त्वरित नरत्व का प्रेरण

अवयस्क एशियाई सीबास (आयु: 17-19 महीने; औसत शारीरिक भार: 750-1000 ग्राम; प्रति उपचार N=15 मछलियाँ) को नर अवस्था को लम्बा करने के लिए तीन महीने की अवधि में GnRHa और 17α-मिथाइलटेस्टोस्टेरोन (प्रत्येक हार्मोन का 50µg प्रति किलोग्राम शारीरिक भार) का संयोजन दिया गया। उपचारित मछलियों में तीसरे इंजेक्शन के बाद, उपचारित मछलियों में अनुपचारित की तुलना में, मिल्ट का रिलीज देखा गया। ये परिणाम एशियाई सीबास में शीघ्र वृषण विकास की संभावना का संकेत देते हैं।

अल्ट्रासाउंड इमेजिंग का उपयोग करके एशियाई सीबास की यौन परिपक्वता का अध्ययन

ICAR-CIBA में एक अध्ययन में वन्य एशियाई सीबास की यौन परिपक्वता का आकलन करने के लिए गैर-आक्रामक अल्ट्रासाउंड इमेजिंग का सफलतापूर्वक उपयोग किया गया। इस तकनीक ने अल्ट्रासाउंड (कैलिपर फ़ंक्शन) और वास्तविक गोनाड माप के बीच एक मजबूत सहसंबंध दिखाया, जिसमें नर और मादा में विभिन्न गोनाडल चरणों के लिए अलग-अलग इमेजिंग पैटर्न थे। यह एशियाई सीबास में लिंग और प्रजनन स्थिति निर्धारित करने के लिए अल्ट्रासाउंड को एक विश्वसनीय उपकरण के रूप में पुष्टि करता है।

एशियाई सीबास (*लेटेस कैल्केरिफ़र*) में डीप लर्निंग-आधारित अल्ट्रासाउंड इमेजिंग का उपयोग करके लिंग निर्धारण और अंडकोशिका मापन

इस अध्ययन में पहली बार एशियाई सीबास के लिंग और अंडकोशिका आकार का गैर-आक्रामक निर्धारण करने के लिए डीप लर्निंग को अल्ट्रासाउंड इमेजिंग के साथ एकीकृत किया गया। परीक्षण किए गए विभिन्न मॉडलों में, रेसनेट ने लिंग वर्गीकरण में सबसे अधिक सटीकता प्राप्त की, जबकि रिज और लैस्सो रिग्रेशन मॉडल ने वास्तविक मापों के 10% औसत निरपेक्ष त्रुटि के साथ अंडकोशिका व्यास का प्रभावी ढंग से अनुमान लगाया। ये परिणाम एआई-संचालित अल्ट्रासाउंड विश्लेषण का उपयोग करके एशियाई सीबास में प्रजनन आकलन को स्वचालित करने की क्षमता को उजागर करते हैं।

एशियाई सीबास भ्रूणों में कोशिका विभाजन की प्रगति पर तापमान का प्रभाव

एशियाई सीबास भ्रूणों को उपानुकूलतम तापमान (25-26°से) पर रखने से कोशिका विभाजन में देरी हुई। प्रारंभिक आँकड़े पहले विभाजन (क्लिवेज) में लगभग 6 मिनट और आठ-कोशिका चरण में 2 मिनट की देरी दर्शाते हैं, जिससे भ्रूणों में गाइड आरएनए माइक्रोइंजेक्शन की अवधि (विंडो) बढ़ जाती है।

मैंग्रोव रेड स्नैपर, *लुटजानस अर्जेंटीमाकुलैटस* की प्रजनक मछलियों को उचित संगरोध, टीकाकरण और कैप्टिव प्रणाली के अंतर्गत टैगिंग द्वारा सुदृढ़ीकरण

वीएनएन वैक्सीन से टीकाकरण की गई कुल 60 मैंग्रोव रेड स्नैपर मछलियों को आरसीसी टैंकों और मिट्टी के तालाबों में रखा गया और निगरानी के लिए टैग की गई। मार्च से अक्टूबर तक कैप्टिव परिपक्वता देखी गई और इस पूरी अवधि में परिपक्व मादाओं की तुलना में स्त्रावी नर मछलियों की उच्चतर मौजूदगी देखी गई।

मैंग्रोव रेड स्नैपर के बड़े पैमाने पर बीज उत्पादन हेतु प्रजनन और लार्वा पालन प्रोटोकॉल का मानकीकरण

मैंग्रोव रेड स्नैपर के चार प्रजनन परीक्षण किए गए, जिनमें से तीन परीक्षणों में सफलतापूर्वक अंडजनन हुआ। रोटिफ़र्स, कोपेपोड्स और सिलिअट्स जैसे विभिन्न जीवंत आहार के उपयोग से 15 दिनों तक लार्वा पालन सफलतापूर्वक किया गया।

ग्रे मुलेट, *मुगिल सेफालस* के प्रजनकों का सुदृढ़ीकरण और प्रजनन परीक्षण

वीएनएन वैक्सीन से टीकाकरण की गई और ब्रूडस्टॉक विकास के लिए टैग की गई कुल 90 ग्रे मुलेट मछलियों को सूत्रबद्ध गुटिका आहार दिया गया। सितंबर 2024 की शुरुआत से परिपक्वता देखी गई और प्रजनन विकास को बढ़ाने के लिए चयनित नर और मादाओं में हार्मोन प्रत्यारोपण किया गया। उन्नत अंडकोशिका विकास वाली मादाओं का उपयोग करके तीन प्रेरित प्रजनन परीक्षण किए गए, जिसके परिणामस्वरूप दो मामलों में स्वतः ही अंडजनन हुआ, हालाँकि अंडे निषेचित नहीं थे।

पश्चिमी तट पर ग्रे मुलेट, *मुगिल सेफालस* की परिपक्वता मूल्यांकन और प्रेरित अंडजनन

सीबा एनजीआरसी माटवाड फार्म, नवसारी, गुजरात में परिपक्वता मूल्यांकन और प्रजनन परीक्षण के लिए मिट्टी के तालाबों में स्थापित पिंजरों में वयस्क ग्रे मुलेट का रखरखाव किया गया। नवंबर के तीसरे और चौथे सप्ताह में, बायोप्सी सैम्पलिंग के दौरान, 5 मत्स्य शुक्र स्त्रावी नर (0.97-1.34 किग्रा) और 10 परिपक्व मादा (1.56-2.4 किग्रा) प्राप्त किए गए, मादा मछलियों की अंडकोशिका व्यास 500-550 माइक्रोमीटर था। 5000 लीटर के एक गोलाकार टैंक में स्थापित मलमल के कपड़े के हापा में दो प्रजनन सेटों को रखा गया और वाणिज्यिक GnRHa सूत्रण से प्रेरित किया गया। हालाँकि, किसी भी परीक्षणों में कोई अंडजनन (स्पॉनिंग) नहीं देखी गई।

नई चयनित आबादी से मिल्कफिश का हैचरी बीज उत्पादन

अप्रैल 2024 के दौरान तालाब में पालित मिल्कफिश प्रजनकों को प्रजनन टैंकों में डालने से प्रजनन क्षमता में सुधार हुआ, प्रजनकों में बेहतर विकास हुआ और वे परिपक्वता तक पहुँच गए। तीन सफल प्रजननों से 0.35 मिलियन निषेचित अंडे और 0.2 मिलियन लार्वा प्राप्त हुए, जिसके परिणामस्वरूप तमिलनाडु, गुजरात और पश्चिम बंगाल के किसानों और उद्यमियों को 37,000 पोनों का वितरण किया गया, इन मत्स्य बीजों की बिक्री से 1,96,330 रुपयों का राजस्व प्राप्त हुआ।

रैबिट फिश *सिगानस जावस* ब्रूडस्टॉक और उप-वयस्क संग्रह

रैबिट फिश (*सिगानस जावस*) के किशोर और उप-वयस्क, जिनका वजन 50 ग्राम से 1.2 किलोग्राम तक है, विभिन्न तटीय स्थानों से एकत्र किए गए और मानक उपचारों का उपयोग करके संगरोधित किए गए। मछलियों को खुले तालाब-आधारित पिंजरों में सूत्रबद्ध आहार के साथ पाला जा रहा है और उनकी वृद्धि और जननांगो की परिपक्वता की नियमित अंतराल पर निगरानी की जा रही है।

एकत्रित वन्य *सिगानस जावस* का जननांग परिपक्वता मूल्यांकन

विभिन्न लैंडिंग केंद्रों से मासिक तौर पर 400-600 ग्राम तक की रैबिट फिश (*सिगानस जावस*) एकत्रित की गईं, और ऊतकीय तकनीकों का उपयोग करके परिपक्वता चरणों का आकलन करने के लिए उनके जननांगों का विश्लेषण किया गया। अध्ययन से ज्ञात हुआ कि जननांग विकास 200 ग्राम से स्पष्ट होता है, जिसमें 400-500 ग्राम परिपक्वता मूल्यांकन के लिए उपयुक्त है और वन्य मछलियों में जून से अक्टूबर तक संभावित प्रजनन काल का संकेत मिलता है।

सिगनस जावस में जननांग परिपक्वता में तेजी लाने में हार्मोन पेलेट प्रत्यारोपण का प्रभाव

सिगानस जावस में जननांग विकास पर सेक्स हार्मोन के प्रभाव का अध्ययन करने के लिए, नर और मादा में क्रमशः 17α-मिथाइल टेस्टोस्टेरॉन और LHRH प्रत्यारोपित किया गया। हार्मोन प्रत्यारोपित मादाओं में अंडकोशिका व्यास में वृद्धि और एस्ट्राडियोल का स्तर गैर-प्रत्यारोपित और वन्य रूप से एकत्रित की गई मछलियों की तुलना में बढ़ा हुआ देखा गया, जो बढ़ी हुई जननांग परिपक्वता का संकेत देता है, जबकि नरों में कोई महत्वपूर्ण अंतर नहीं देखा गया।

सिगानस लिनिएट्स में अंडजनन के लिए हार्मोनल प्रेरण

जुलाई 2024 में LHRH हार्मोन के उपयोग से रैबिट फिश *सिगानस लिनिएट्स* (800-950 ग्राम) को नियंत्रित हैचरी स्थितियों में और दो अंडजनन प्रेरण परीक्षणों के अधीन किया गया। परिपक्व जननांगों वाले प्रजनकों का चयन करने के बावजूद, अंडजनन नहीं हुआ, संभवतः उच्च जल तापमान (30°से.) के कारण, जो अक्टूबर 2023 में दर्ज सफल अंडजनन से 3°से. अधिक था।

आरएएस में टेड मुलेट (*एल. टेड*) की वर्ष भर की परिपक्वता स्थिति

पश्चिम बंगाल में पारंपरिक रूप से संवर्धित एक उच्च-मांग वाली शाकाहारी प्रजाति, टेड मुलेट (*लिज़ा टेड*), की वर्ष भर की परिपक्वता का अध्ययन करने के लिए बंद स्थितियों के अंतर्गत आरएएस के साथ आरसीसी टैंकों में रखा गया। परिपक्वता की शुरुआत मार्च में देखी गई, जिसमें अप्रैल से अगस्त तक अंडकोशिका का प्रगतिशील विकास और मई से जुलाई के बीच नर शुक्राणुजनन देखा गया, जो दर्शाता है कि प्रारंभिक विकास 10-14 पीपीटी लवणता पर होता है, जबकि अंतिम मादा परिपक्वता के लिए 15 पीपीटी से अधिक स्तर की आवश्यकता होती है।

बंगाल येलोफिन सीब्रीम (*एकेंथोपेग्रस डेटनिया*) के भ्रूण विकास और लार्वा उत्तरजीविता पर लवणता और तापमान का प्रभाव

स्पारिड प्रजातियों में अंडों के ऊष्मायन और प्रारंभिक लार्वा विकास के लिए अनुकूलतम लवणता और तापमान निर्धारित करने हेतु एक अध्ययन किया गया। परिणामों से पता चला कि लवणता और तापमान में वृद्धि के साथ ऊष्मायन समय कम होता गया, और 25-30 पीपीटी लवणता और 22°C तापमान पर सबसे अधिक स्फुटन दर (97%) और भ्रूण उत्तरजीविता देखी गई। यद्यपि लवणता और तापमान ने स्फुटन दर, जर्दी थैली के आयतन और तेल की बूंदों के आयतन को महत्वपूर्ण रूप से प्रभावित किया, लेकिन नोटोकॉर्ड की लंबाई पर कोई महत्वपूर्ण प्रभाव नहीं देखा गया।

मुगिलोगोबियस टाइग्रिनस के लिए कैप्टिव परिपक्वता और प्रजनन रणनीतियाँ

मुगिलोगोबियस टाइग्रिनस, एक कठोर गोबी प्रजाति, जिसे हाल ही में मुट्टुकाडु बैकवाटर्स में पहली बार दर्ज किया गया है, ने सजावटी खारे पानी के जलीय कृषि के लिए प्रबल क्षमता दर्शायी है। लार्वा संक्रमण के लिए विकसित एक मानकीकृत प्रोटोकॉल के साथ, कैप्टिव परिपक्वता, प्रजनन और लार्वा पालन को सफलतापूर्वक प्राप्त किया गया। इस प्रजाति की आकर्षक विशेषताएँ और अनुकूलनशीलता इसे नैनो और सामुदायिक एक्वेरियम के लिए एक आशाजनक उम्मीदवार बनाती हैं।

खारा जलीय सजावटी गोबी, *मंगारीनस वाटररौसी* का प्रजनन और भ्रूण विकास

मंगारीनस वाटररौसी ने सफल कैप्टिव परिपक्वता, प्रजनन और लार्वा पालन के साथ, सजावटी खारा जलीय कृषि के लिए प्रबल क्षमता प्रदर्शित की है। भ्रूण और लार्वा विकास के लिए मानकीकृत प्रोटोकॉल, प्रजनन व्यवहार और लैंगिक द्विरूपता के विस्तृत अवलोकनों के

साथ, बड़े पैमाने पर तरूण मछलियों के उत्पादन और टिकाऊ उद्योग द्वारा सतत रूप से अपनाने का समर्थन करते हैं।

मुत्तुकाडु ज्वारनदमुख से प्राप्त खारा जलीय पिस्टल श्रिम्प, अल्फियस प्रजाति के प्रारंभिक जीवन चरण

मुत्तुकाडु ज्वारनदमुख से प्राप्त खारा जलीय पिस्टल श्रिम्प, जिसे अस्थायी रूप से *अल्फियस* प्रजाति के रूप में पहचान की गई है, के प्रजनन जीव विज्ञान को समझने में उल्लेखनीय प्रगति हुई है। यह प्रजाति नॉप्लियस अवस्था को पार कर अद्वितीय लार्वा विकास प्रदर्शित करती है और प्रारंभिक अवस्था में मज़बूत लचीलापन दर्शाती है जहां लार्वा हैचिंग के चार दिन बाद तक जीवित रहते हैं। विभिन्न जीवंत आहारों के साथ प्रारंभिक परीक्षण भविष्य में जलीय कृषि की संभावनाओं का समर्थन करते हैं, जबकि प्रजातियों की पुष्टि और प्रजनन अनुकूलन के लिए आगे के अध्ययनों की आवश्यकता है।

मुत्तुकाडु बैकवाटर्स की गोबी : सजावटी मत्स्य पालन की विविधता और संभावनाएँ

मुत्तुकाडु ज्वारनदमुखी प्रणाली में एक मत्स्यविज्ञान संबंधी सर्वेक्षण में सोलह से अधिक गोबी प्रजातियों की पहचान की गई, जिनमें से कई अपने जीवंत रंगों और अनूठी आकृति विज्ञान के कारण अत्यधिक सजावटी महत्व रखती हैं। भारतीय तट पर कुछ प्रजातियों को हाल ही में दर्ज किया गया है, जिससे इस क्षेत्र के पारिस्थितिक महत्व और स्थायी सजावटी जलीय कृषि को बढ़ावा देने तथा वन्य आबादी पर दबाव कम करने के लिए ब्रूडस्टॉक विकास और कैप्टिव प्रजनन की आवश्यकता को बल मिलता है।

किसानों की भागीदारी से खुले जल निकायों में सिल्वर मूनी, *मोनोडैक्टीलस अर्जेन्टियस* का ब्रूडस्टॉक विकास

बड़े पैमाने पर प्रजनन के लिए सिल्वर मूनी के ब्रूडस्टॉक विकसित करने हेतु, सीबा ने तमिलनाडु के कडलूर चिन्ना कुप्पम और कोलाथुर में खुले जल निकायों में पिंजरों का उपयोग करते हुए एक किसान-सहभागिता कार्यक्रम शुरू किया। वन्य रूप से पकड़े गए लगभग 500 किशोरों को आर्टेमिया और स्किड मील के साथ सीबा द्वारा सूत्रबद्ध आहार के उपयोग से पाला गया, जिसके परिणामस्वरूप उनका वजन 50-60 ग्राम तक बढ़ गया और पाँच महीने बाद नर नर दिखाई देने लगे।

नाइट गोबी (*स्टिग्मैटोगोबियस सदानुंडियो*) में भ्रूण विकास के दौरान लवणता का प्रभाव

नाइट गोबी (*स्टिग्मैटोगोबियस सदानुंडियो*), भारतीय सुंदरबन की एक देशी ज्वारनदमुखी प्रजाति, जिसका सजावटी व्यापारिक महत्व है, का विभिन्न लवणता स्थितियों में कैप्टिव अवस्था में सफलतापूर्वक प्रजनन किया गया। सभी लवणता स्थितियों में प्रजनन हुआ, लेकिन अनुकूलतम हैचिंग (98.83%) और उत्तरजीविता (99.12%) 3 पीपीटी पर देखी गई, जो दर्शाता है कि कम लवणता (0-3 पीपीटी) कैप्टिव प्रजनन और बीज उत्पादन के लिए आदर्श है।

विविध क्रस्टेशियन प्रजातियों की जलीय कृषि क्षमता का मूल्यांकन: *पीनियस जैपोनिकस, स्काइला* प्रजाति और सजावटी क्रस्टेशियन

खारा जलीय केकड़े, *पोर्टुनस रेटिकुलैटस* ने हैचरी और नर्सरी चरणों में सफल प्रजनन चक्रों और कम नरभक्षण के साथ उच्च जीवित रहने की दर प्रदर्शित की। अनुकूलतम पालन पद्धतियों की पहचान की गई, जिससे व्यावसायिक खेती का मार्ग प्रशस्त हुआ। *मेटापीनियस मोनोसेरोस* (भूरे झींगे) के लिए स्वतः परपोषी पालन प्रणालियाँ सबसे प्रभावी साबित हुईं, जिससे उच्च भंडारण घनत्व पर भी बेहतर वृद्धि और उत्तरजीविता क्षमता प्राप्त हुई। यह स्थान-विशिष्ट खेती के विकास के लिए एक मजबूत विधि प्रदान करता है। कुरुमा झींगे पर किए गए अध्ययनों ने बाहरी, प्राकृतिक रूप से प्रकाशित इकाइयों में बेहतर वृद्धि और उत्तरजीविता क्षमता दर्शायी।

आर्टेमिया बायोमास उत्पादन

टैंक आधारित आर्टेमिया बायोमास उत्पादन को विभिन्न परिस्थितियों में अनुकूलित किया गया। यह सिद्ध हो चुका है कि आर्टेमिया बायोमास झींगे का एक महत्वपूर्ण परिपक्वता आहार है, और इसका उपयोग हार्मोनल पूरकता के साधन के रूप में किया जा सकता है।

हार्मोनल/पर्यावरणीय एवं आहार संबंधी दृष्टिकोणों के माध्यम से कुरुमा झींगा, *पीनियस जैपोनिकस* फॉर्म II का कैप्टिव ब्रूडस्टॉक विकास और प्रेरित परिपक्वता तकनीकें

पीनियस जैपोनिकस के प्रजनन जीव विज्ञान से पता चला है कि विभिन्न स्थानों से वन्य रूप से पकड़े गए ब्रूडस्टॉक में विविध परिपक्वता अवस्थाएँ (स्पेंट एण्ड मेटेड फिमेल का उच्च प्रतिशत) पाई गईं और उन्होंने रेतीले तल वाले वास-स्थलों को प्राथमिकता दी, जिसके परिणामस्वरूप सीबा में एक विशेष रेत-आधारित पुनर्चक्रण ब्रूडस्टॉक प्रणाली का विकास हुआ, जिसमें कैप्टिव परिपक्वता को समर्थन देने के लिए अनुकूलित आहार व्यवस्था और जल गुणवत्ता प्रबंधन शामिल है।

मुत्तुकाडु ज्वारनदमुख से प्राप्त खारा जलीय पिस्टल श्रिम्प, *अल्फियस* प्रजाति के प्रारंभिक जीवन चरण

आईसीएआर-सीबा ने मुत्तुकाडु ज्वारनदमुख से प्राप्त खारा जलीय पिस्टल श्रिम्प (अल्फियस प्रजाति) के प्रजनन जीव विज्ञान को समझने में महत्वपूर्ण प्रगति की है। उन्होंने इसके अनूठे लार्वा विकास का अवलोकन किया है जो नौप्ली चरण को दरकिनार कर देता है और प्रारंभिक चरण में इसके जीवित रहने की संभावना को

दर्शाता है। साथ ही, संभावित जलीय कृषि अनुप्रयोगों के लिए इसके विकास को अनुकूलित करने के उद्देश्य से चल रहे आहार परीक्षणों का भी अध्ययन किया जा रहा है।

पहचान स्थलों के साथ ब्रूडस्टॉक एकत्रित राज्य

झींगा घरेलूकरण कार्यक्रम और आनुवंशिक लक्षण-वर्णन के लिए एक मजबूत आधारभूत जनसंख्या स्थापित करने हेतु, भारत के पूर्वी तट (पुरी, काकीनाडा, चेन्नई, कन्याकुमारी, क्विलोन) में ब्रूडस्टॉक खरीद केंद्र स्थापित किए गए हैं, जिनका विस्तार पश्चिमी तट और अंडमान एवं निकोबार द्वीप समूह तक करने की योजना है, साथ ही रोगग्रस्त झींगों के प्रवेश को रोकने के लिए पूर्व-प्राथमिक संगरोध सुविधाओं का विकास भी किया जा रहा है।

टैंक प्रणाली में *पीनियस इंडिकस* का कैप्टिव ब्रूडस्टॉक विकास

पीनियस इंडिकस ब्रूडस्टॉक विकास पर एक अध्ययन में, तालाब में पाले गए पालतू ब्रूडस्टॉक (कैप्टिव- GN4) ने एचडीपीई टैंक प्रणालियों में 390 दिनों के संवर्धन के बाद वन्य ब्रूडस्टॉक (जंगली पीढ़ी GN1) की तुलना में उल्लेखनीय रूप से बेहतर प्रदर्शन किया, जिसमें बेहतर वृद्धि दर (मादा : 36.14 ग्राम बनाम 31.57 ग्राम; नर : 29.27 ग्राम बनाम 22.77 ग्राम), उच्च उत्तरजीविता दर (90% बनाम 70%), और विशेष रूप से, बिना आइस्टाल्क एब्लेशन मादाओं में 30% डिम्बग्रंथि विकास देखा गया, जिससे 25 पीपीटी पर सफल प्रजनन और लार्वा उत्पादन संभव हुआ।

पीनियस इंडिकस में कृत्रिम गर्भाधान (एआई) परीक्षण

झींगा के लिए कृत्रिम गर्भाधान (एआई) प्रोटोकॉल के अनुकूलन में उल्लेखनीय प्रगति हुई है। 23 परीक्षणों में 65% स्पॉनिंग सफलता दर प्राप्त हुई है। इसके लिए नर शुक्राणुकोशों वाली नई मादाओं में सावधानीपूर्वक कृत्रिम गर्भाधान किया गया है। प्रजनन क्षमता बढ़ाने और चयनात्मक प्रजनन कार्यक्रमों को समर्थन देने के लिए अक्सर आइस्टाल्क एब्लेशन और तनाव-मुक्त संचालन का उपयोग किया जाता है।

लार्वा पालन तकनीक में सुधार:

पीनियस इंडिकस के लिए पारंपरिक लार्वा पालन प्रणाली (सीएलआरएस) की संशोधित लार्वा पालन प्रणाली (एमएलआरएस) के साथ तुलना करने पर एक प्रयोग से पता चला कि एमएलआरएस, जिसमें इन-सीटू सूक्ष्म शैवाल उत्पादन शामिल है, ने बाहरी शैवाल पर निर्भर पारंपरिक तरीकों की तुलना में जीवाणु संदूषण को कम करके, प्रारंभिक कृत्रिम फ़ीड के बिना बेहतर जल गुणवत्ता बनाए रखकर और जल विनिमय से लार्वा तनाव को कम करके लार्वा के अस्तित्व में उल्लेखनीय सुधार किया।

मिट्टी के तालाबों और एचडीपीई टैंकों में संवर्धित वन्य *पीनियस इंडिकस* लार्वा का उपयोग करके ब्रूडस्टॉक का विकास

विकास और प्रजनन क्षमता का मूल्यांकन करने के लिए, वन्य स्रोतों से प्राप्त रोगाणु-मुक्त पीनियस इंडिकस ब्रूडस्टॉक को परिपक्वता टैंकों में विशेष फ़ीड पर पाला गया, जबकि उनके हैचरी-उत्पादित पोस्ट-लार्वा को मिट्टी के तालाबों और एचडीपीई टैंकों में अलग-अलग घनत्वों पर संवर्धित किया गया, और इन वयस्क झींगों का निरंतर पालन ब्रूडस्टॉक विकास के लिए किया गया।

काकद्वीप अनुसंधान केंद्र में *स्काइला ओलिवेसिया* के प्रजनन परीक्षण

केआरसी में मड क्रैब *स्काइला ओलिवेसिया* का प्रजनन परीक्षण किया गया। अपरिपक्व केकड़े तैरते हुए बक्सों में सफलतापूर्वक परिपक्व हुए और 5±1 पीपीटी की लवणता पर अंडों का विकास देखा गया। हालाँकि, आरएएस प्रणाली में आंख की ठंडी विलोपन आईस्टॉक एब्लेशन द्वारा 35 दिनों के बाद 21 पीपीटी पर स्पॉनिंग प्रेरित हुई।

झींगा प्रक्षेत्रों में तालाबों की आयु बढ़ने का मृदा और जलीय गुणवत्ता, उत्पादकता और रोग घटनाओं पर प्रभाव

नागपट्टिनम, पट्टुकोट्टई और नेल्लोर जिलों में अलग-अलग आयु के झींगा पालन तालाबों की जाँच से पता चला है कि तालाबों की उम्र बढ़ने से मिट्टी की थकान, मिट्टी की गुणवत्ता के साथ-साथ झींगा उत्पादन को भी प्रभावित होती है। 10 से कम, 10-20 और 20 से अधिक वर्षों वाले तालाबों में मछली पालन के समय से लेकर कटाई तक कार्बनिक कार्बन की मात्रा में वृद्धि हुई। तीनों समूहों में से, नागपट्टिनम में रोग का प्रसार कम था।

अंतर्स्थलीय लवणीय क्षेत्रों में जलीय कृषि के लिए मृदा एवं जल विशेषताएँ

पंजाब, हरियाणा और राजस्थान के अंतर्स्थलीय लवणीय क्षेत्रों में जल एवं मृदा के नमूनों के अभिलक्षणन से मृदा नमूनों में पोटेशियम की कमी दर्ज की गई। जल नमूनों में लवणता 7 से 18 पीपीटी और कुल क्षारीयता CaCO3 के रूप में 185 से 565 पीपीएम के बीच थी।

अमोनिया और नाइट्राइट के शमन पर लाभकारी बैक्टीरिया संघ का प्रभाव

स्फिंगोबैक्टीरियम प्रजाति और *ज़ोबेलेला डेनिट्रिफ़िकेंस* ने व्यक्तिगत रूप से और उनके संयोजन से खारे जल में नाइट्राइट नाइट्रोजन को काफी कम कर दिया, लेकिन कुल अमोनिया नाइट्रोजन को नहीं।

जल और मृदा में फॉर्मेलिन और ऑक्सालिनिक अम्ल का फोटोडिग्रेडेशन

जल में फॉर्मेलिन के अपघटन पर किए

गए अध्ययन में कम लवणता और उच्च pH पर सूर्य के प्रकाश में 0.51 दिनों की अर्धायु के साथ तीव्र अपघटन देखा गया, जिसका औसत तापमान, तीव्रता और प्रकाश-अवधि क्रमशः लगभग 33.5°C, 57,000 लक्स और 12 घंटे 25 मिनट थी। दोमट रेतीली मृदा की तुलना में भारी बनावट वाली मृदा में फॉर्मेलिन और ऑक्सालिनिक अम्ल में त्वरित अपघटन था।

शैवाल में फ्लोरफेनिकॉल की विषाक्तता और पर्यावरणीय सुरक्षा

फ्लोरफेनिकॉल (एफएफसी) के 0, 2, 4, 8, 16 और 32 पीपीएम खुराक के संपर्क में 96 घंटे तक आने से समुद्री शैवाल, *क्लोरेला मैरिना* की वृद्धि मंदता के साथ-साथ क्लोरोफिल की मात्रा में कमी देखी गई, और सुपरऑक्साइड डिसम्यूटेज और ग्लूटाथियोन के स्तर में 16 पीपीएम तक में वृद्धि देखी गई, और फिर 32 पीपीएम पर तेजी से कमी आई। 4-16 पीपीएम पर 96 घंटे तक एफएफसी का घातक संपर्क भी सुरक्षित था।

जल मापदंडों के मापन हेतु IoT उपकरण

टाइटेनियम हाउसिंग सामग्री से बने विशेष रूप से डिज़ाइन किए गए औद्योगिक सेंसर, जो अत्यधिक गंदले वातावरण में भी कार्य करने में सक्षम हैं, एक संशोधित एक्का बॉय के एक पीसीबी बोर्ड पर एम्बेडेड हैं, और सेंसर युक्त एक्कासेंस को जलीय कृषि तालाबों में जल मापदंडों की निरंतर ऑनलाइन निगरानी के लिए कैलिब्रेट किया गया है। लाइव जल मापदंडों तक पहुँचने और किसानों को स्थान-विशिष्ट एवं व्यक्तिगत सलाह देने के लिए डैशबोर्ड एप्लिकेशन और मोबाइल फ़ोन आधारित परामर्श प्रणाली विकसित की गई।

ग्राफीन और पॉलीएनिलाइन-आधारित स्क्रीन-मुद्रित स्वदेशी pH सेंसर

दो-इलेक्ट्रोड प्रणाली के लिए pH सेंसर स्टेंसिल मॉडल मुद्रित किए गए और GRAPHTEC 2D फ्लैटबेड कटिंग प्लॉटर की सहायता से लचीली पॉलीएथिलीन टेरेफ्थेलेट शीट पर उत्कीर्ण किए गए। व्यावसायिक स्क्रीन-मुद्रित इलेक्ट्रोड पर pH-संवेदन सामग्री के रूप में पॉलीएनिलिन-आधारित PANI पाउडर और स्याही का उपयोग किया गया। 5-12 pH रेंज पर सेंसरों के अंशांकन ने ग्राफीन-आधारित सेंसर की तुलना में PANI-आधारित pH सेंसरों के साथ बेहतर रैखिकता प्रदर्शित की।

जलवायु परिवर्तन के कारण खारे जलीय कृषि का जोखिम मूल्यांकन

IPCC के AR5 के अनुसार, तटीय जिलों को जोखिम (20%), भेद्यता (40%), ऐतिहासिक खतरे (20%), और भविष्य के खतरे (20%) के भारित सूचकांकों के आधार पर अति उच्च, उच्च, मध्यम, निम्न और अति निम्न श्रेणियों में वर्गीकृत किया गया था। पूर्वी तट के जिले पश्चिमी तट की तुलना में अधिक जोखिम में थे।

मत्स्य पालन में जलवायु जोखिम और अनुकूलन की समीक्षा

एक व्यापक व्यवस्थित साहित्य समीक्षा में वेब ऑफ साइंस और स्कोपस डेटाबेस में क्रमशः झींगा और भारतीय मेजर कार्प पर केंद्रित 65 और 37 शोध लेखों की पहचान की गई, जो जलवायु जोखिम और प्रभावों तथा अनुकूलन रणनीतियों के लिए थे।

लू और अत्यधिक वर्षा के दौरान पी. मोनोडॉन की वृद्धि विशेषताएँ

दक्षिण गुजरात के व्यावसायिक फार्मों से प्राप्त *पी. मोनोडॉन* के वृद्धि आँकड़ों से पता चला है कि लू और भारी वर्षा के दौरान औसत दैनिक वृद्धि दर और साप्ताहिक वृद्धि दर सामान्य ग्रीष्म और मानसून ऋतुओं की तुलना में काफी कम रही।

चक्रवात से प्रेरित अत्यधिक भारी वर्षा और बाढ़ का झींगा जलीय कृषि पर प्रभाव

दिसंबर 2023 में मिचाउंग नामक भीषण चक्रवाती तूफान और उसके बाद आई बाढ़ के कारण हुई अत्यधिक भारी वर्षा ने बुनियादी ढाँचे और तालाबों के बाँधों को नुकसान पहुँचाया, जिससे तालाब जलमग्न हो गए और आंध्र प्रदेश के गुडूर में झींगा जलीय कृषि क्षेत्र को भारी नुकसान हुआ। *पी. मोनोडॉन* प्रक्षेत्रों में जल की गुणवत्ता में गिरावट और प्रतिरक्षा मापदंडों में परिवर्तन देखा गया।

पी.मोनोडॉन में प्रतिरक्षा मापदंडों में परिवर्तन और सफेद धब्बा रोग की घटनाओं पर वर्षा पैटर्न की परिवर्तनशीलता का प्रभाव

भारी वर्षा और डब्ल्यूएसएसवी की चुनौती के संपर्क में आने वाले *पी.मोनोडॉन* में फिनोल ऑक्सीडाइज़ और सुपरऑक्साइड डिसम्यूटेस में परिवर्तन देखे गए। छोटी समय अवधि के भीतर भारी वर्षा के तनाव के प्रभाव ने डब्ल्यूएसएसवी के कारण झींगा मृत्यु दर को बढ़ा दिया।

तापमान नियंत्रित इनडोर आरएएस प्रणाली में पर्लस्पॉट का उन्नत प्रजनन और बीज उत्पादन

नवंबर से जनवरी के दौरान 32-33 डिग्री सेल्सियस के जलीय तापमान पर बनाए गए प्रोटोटाइप तापमान-नियंत्रित इनडोर आरएएस प्रणाली में, जब जल का तापमान 25 डिग्री सेल्सियस तक गिर जाता है, पर्लस्पॉट के 36 स्पॉनिंग देखे गए, जिनमें 2500 अंडों की औसत प्रजनन क्षमता और 82% की औसत हैचिंग देखी गई। हापा की सुविधा में नियंत्रित मछलियों में कोई स्पॉनिंग नहीं देखी गई।

खारा जलीय कृषि के लिए मिल्कफिश एक आशाजनक जलवायु-प्रतिरोधी प्रजाति

मानसून-पूर्व, मानसून और मानसून-पश्चात की अवधियों के दौरान मिट्टी के तालाबों में मिल्कफिश का विकास प्रदर्शन, जहाँ अत्यधिक भारी वर्षा, उसके बाद बाढ़ और हवा के तापमान में उतार-चढ़ाव के कारण लवणता 0

पीपीटी से 32 पीपीटी के बीच उतार-चढ़ाव करती रही, ने मिल्कफिश को तटीय और अंतर्स्थलीय क्षेत्रों में उच्च वृद्धि दर, तापमान और लवण सहनशीलता के साथ एक उपयुक्त जलवायु-प्रतिरोधी प्रजाति के रूप में सिद्ध किया।

पी. वन्नामेय में अजैविक तापमान स्ट्रैस सहनशीलता के लिए सूक्ष्मजीव मध्यस्थता वाली ठोस-अवस्था किण्वित पादप प्रोटीन स्रोतों का प्रभाव।

बैसिलस और *सैकरोमाइसिस* द्वारा मध्यस्थता वाले ठोस-अवस्था किण्वित पादप प्रोटीन अवयवों के माध्यम से पी. वन्नामेय के आहार में बदलाव से 32°C पर बेहतर उत्तरजीविता और अधिक वजन वृद्धि देखी गई। 32°C पर झींगा में प्रोटियोबैक्टीरिया, *फिमिकुलेट्स* के इष्टतम अनुपात के परिणामस्वरूप कार्यात्मक पोषक तत्वों की पूर्ति करके तापमान तनाव में बेहतर सुधार हुआ।

विभिन्न लवणताओं पर मीथेन को कम करने में मीथेनोट्रोफिक बैक्टीरिया की दक्षता

खारे जल प्रणालियों के तलछट के नमूनों से पृथक किए गए समृद्ध मीथेनोट्रोफिक बैक्टीरिया के तीन प्रजातियों, अर्थात् *मिथाइलोबैसिलस फ्लैगेलेट्स, मिथाइलोफैगा थायोऑक्सीडांस* और *मिथाइलओवरसैटिलिस डिसिपुलोरम,* में फैले हुए थे और 24 घंटे बाद मीथेन में 76.29% और 89.62% की कमी देखी गई।

झींगा और मछली फार्मों में रोग की व्यापकता

तमिलनाडु, गुजरात और पश्चिम बंगाल के 145 झींगा फार्मों और पश्चिम बंगाल के दो मछली फार्मों में किए गए रोग निगरानी से पता चला कि *साइटोन्यूक्लियोस्पोरा हेपेटोपेनाई* (EHP) का प्रचलन सबसे अधिक पाया गया, इसके बाद व्हेनझोउ वायरस 8 (WzSV8) और व्हाइट स्पॉट सिंड्रोम वायरस (WSSV) का स्थान रहा। इससे पता चलता है कि झींगा फार्मों में EHP एक महत्वपूर्ण रोगजनक है, जो देश में अत्यधिक प्रचलित है और पूरे वर्ष मौजूद रहता है।

WSSV संक्रमित झींगों में कोशिकाद्रव्यी मुक्त Ca^{2+} विश्लेषण

नियंत्रण नमूनों की तुलना में, WSSV संक्रमित समूहों में सभी समय बिंदुओं पर उच्च तापमान पर हीमोसाइटिक कोशिकाद्रव्यी मुक्त कैल्शियम (Cf-Ca2+) सांद्रता का उच्च स्तर देखा गया। 30°C और 27°C की तुलना में 33°C पर WSSV की प्रतिकृति कम हो गई। WSSV वायरल कण की 101 से 106 प्रतियों के साथ इंजेक्शन लगाए गए, झींगों में 24 घंटे में महत्वपूर्ण अंतर के साथ कुल हीमोसाइट संख्या में कमी देखी गई। संक्रमित समूह में गिल ऊतक में प्रतिरक्षा जीन SOD और प्रोफेनोलऑक्सीडेज जीन अपरेगुलेटेड पाए गए। WSSV का पता लगाने के लिए तीव्र न्यूक्लिक अम्ल निष्कर्षण विकसित किया गया है, जहाँ केवल दो मिनट में पूर्ण न्यूक्लिक अम्ल निष्कर्षण किया जा सकता है।

विब्रियो हार्वेई में विषाणु मार्करों का विभेदन

विषाणु मार्करों के लिए 132 वी. हार्वेई उपभेदों के इन सिलिको अभिलक्षणन से संकेत मिलता है कि टाइप I, टाइप II, टाइप III, टाइप V और टाइप VI स्राव तंत्र विभिन्न विषों के उत्पादन में प्रमुख भूमिका निभाते हैं। *वी. हार्वेई* को अप्रकाशित माना जा सकता है, जो TCBS अगर पर पीली कॉलोनी बनाता है। श्वेत मल (WFS) नमूनों के विश्लेषण में वी. पैराहेमोलिटिकस की प्रबलता देखी गई, जिससे संकेत मिलता है कि WFS में *वी. पैराहेमोलिटिकस* की संभावित भूमिका है।

कीटाणुनाशकों का उपयोग करके विब्रियोसिस का नियंत्रण

विब्रियोसिस को 2 पीपीएम पर बीकेसी, 10 पीपीएम पर पोटेशियम परमैंगनेट, 20 पीपीएम पर फॉर्मेलिन और 80 पीपीएम पर आयोडोफोर द्वारा नियंत्रित किया जा सकता है।

पीनियस वन्नामेय पर भूरे सीवीड का प्रभाव

एस्कोफिलम नोडोसम ने *पीनियस वन्नामेय* में वृद्धि क्षमता और रोग प्रतिरोधक क्षमता बढ़ाने के लिए आहार पूरक के रूप में अपार क्षमता दिखाई। अध्ययन किए गए नए सिंबायोटिक फॉर्मूलेशन ने प्रोबायोटिक्स और प्रीबायोटिक्स के पूरक लाभों को प्रभावी ढंग से एकीकृत किया, प्रतिरक्षा में सुधार, तनाव सहनशीलता में वृद्धि और बेहतर वृद्धि क्षमता को बढ़ावा दिया।

झींगा और जलीय नमूनों में एंटीबायोटिक प्रतिरोध

रोगाणुरोधी प्रतिरोध अध्ययनों से पता चला है कि *स्टैफिलोकोकस* प्रजाति पेनिसिलिन और ई. कोली आइसोलेट्स के प्रति अधिक प्रतिरोधी थी, और सेफोटैक्सिम के लिए अधिकतम प्रतिरोध देखा गया। इसी प्रकार, विब्रियो प्रजाति के लिए, एम्पीसिलीन के लिए अधिकतम प्रतिरोध देखा गया।

मड क्रैब के हेपेटोपैन्क्रियास में EHP बीजाणुओं का कोई प्रसार नहीं

स्काइला सेर्राटा और *एस. ओलिवेसिया* में बहु-खुराक चुनौती प्रयोग से HP ऊतकों में EHP बीजाणुओं का कोई प्रसार नहीं देखा गया।

ईएचपी के विरुद्ध रोगनिरोध

सिलीमारिन व्युत्पन्न, झींगा में ईएचपी संक्रमण के विरुद्ध लगभग 0.02% और उससे अधिक यकृत-रक्षक पाया गया है।

ईएचपी क्यूरा का क्षेत्रीय मूल्यांकन

सीबा ईएचपी क्यूरा-I उत्पाद, फाइटोकेमिकल और पोषण पूरकों के संयोजन का तमिलनाडु, आंध्र प्रदेश, पंजाब, पश्चिम बंगाल और गुजरात के 169.5 हेक्टेयर के 74 फार्मों में क्षेत्रीय मूल्यांकन किया गया है, जिससे ईएचपी

भार में उल्लेखनीय कमी आई है और झींगों की प्रतिरक्षा और वृद्धि में सुधार हुआ है।

एरोमोनास वेरोनी एशियाई सीबास की मृत्यु का कारण

एरोमोनास वेरोनी, सीबास जलीय कृषि में एक उभरता हुआ रोगजनक पाया गया है और यह सेप्सिस, अल्सर और सामूहिक मृत्यु का कारण बन सकता है। यकृत, गुर्दे और प्लीहा से आठ जीवाणुओं के 16SrDNA अनुक्रमण द्वारा फोटोबैक्टीरियम डैमसेले की पहचान की गई, जिसकी बाद में फोटोबैक्टीरियम डैमसेले के लिए विशिष्ट कैप्सूलर पॉलीसैकेराइड जीन (CPS) पर आधारित पीसीआर द्वारा पुष्टि की गई।

एशियाई सीबास में मृत्यु दर का कारण बनने वाले प्रमुख परजीवी रोग

सीबास मछली से पहचाने गए प्रमुख परजीवी वर्गों में परजीवी सिलिअट्स (*क्रिप्टोकैरियन इरिटेंस*), डाइनोफ्लैजेलेट्स (*एमाइलोडिनियम ओसेलेटम, ट्राइकोडिना* एसपीपी.), मोनोजीनियन गिल फ्लूक (*डिप्लेक्टेनम एसपीपी.*), और परजीवी क्रस्टेशियन (*आर्गुलस* एसपीपी.) शामिल हैं। इनमें से, सी. इरिटेंस और *ए. ओसेलेटम* सीबास हैचरी में तीव्र प्रकोप से जुड़े थे, जिसके कारण नैदानिक शुरुआत के 7 से 10 दिनों के भीतर गंभीर सामूहिक मृत्यु दर (90-100%) हुई, विशेष रूप से खारे पानी की प्रणालियों में ब्रूड स्टॉक और लार्वा चरणों को प्रभावित किया। *एमाइलोडिनियम* से संक्रमित मछली को ठीक करने के लिए सबसे अच्छा उपचार 0.15 मिलीग्राम/लीटर $CuSO_4$ (निरंतर स्नान) था, जिसमें 86% उत्तरजीविता दर थी, इसके बाद 10वें दिन 84% जीवित रहने की दर के साथ ताजे पानी में विटामिन सी दिया गया। खुराक और उपचार की अवधि मछली की प्रजातियों, उनके आकार, पर्यावरणीय मापदंडों आदि के साथ भिन्न हो सकती है। भारतीय जलीय कृषि में जलीय पशु रोगों के कारण होने वाली कुल आर्थिक हानि की गणना करने के लिए एक मॉडल फ्रेमवर्क ELDA विकसित की गई है।

EXECUTIVE SUMMARY

Optimizing Pre-Growout Farming Practices for Pearlspot, *Etroplus suratensis*

Optimizing pearlspot (*Etroplus suratensis*) farming by size-sorting and separate rearing significantly improves growth. While large fish show the highest daily weight gain, medium and small fish exhibit comparable or superior weight gain percentage and specific growth rate, overcoming social hierarchy effects and enhancing overall growth for this high-value species.

Enhanced Pearlspot Growth Through Size Grading

Size grading pearlspot into small (initial 19.4-19.6%), medium (52.6-53.7%), and large (26.8-27.6%) classes, followed by separate rearing for 100-135 days (pre-growout) and 108-173 days (growout), significantly improved the population structure. This resulted in a notable increase in the proportion of large fish (to 40.6% in Set 1 and 38.6% in Set 2) and a significant reduction in small fish (to 9.8% in Set 1 and 12.6% in Set 2), offering continuous and higher farmer income.

Growth Characteristics of Pearlspot, *Etroplus suratensis*, in Pond-Based Cage Culture

Pond-based cage culture of pearlspot, stocked at 500 fish/cage (50 fish/m^3) with sub-adults,

demonstrated significant growth differences over 173 days: large-sized fish (initial 74.06g) reached 204.8g, outperforming medium (initial 48.13g) at 179.7g and mixed groups (initial 48.5g) at 145.1g, with 100% survival and a high productivity of 11.0 kg/m3 in large-sized cages, proving it an economically sustainable method for large-scale production.

Outdoor Nursery Rearing of Bengal Yellowfin Bream (*Acanthopagrus datnia*) Fry in Hapa-Based System

An outdoor hapa-based nursery system effectively reared hatchery-produced Bengal Yellowfin Bream juveniles (*Acanthopagrus datnia*) at a 50 no./m^3 stocking density, achieving an average weight gain from an initial 1.0 ± 0.02 g to 6.8 ± 1.16 g in two months, with regular weekly grading deemed crucial to prevent shooter occurrence and improve survival.

Evaluation of Zero-Input Agri-horti-poultry System at Kakdwip Research Centre

A zero-input integrated aqua-horti-poultry system at Kakdwip Research Centre, stocking species like *Mystus gulio*, Milkfish, Pearlspot, Tilapia, Tade Mullet, and *Penaeus monodon* at 1 individual/m^3 with only lime application (200 kg/ha pre-stocking, then 30 kg/ha weekly), is being evaluated against commercial feed systems to demonstrate a cost-effective and sustainable brackishwater aquaculture model for 18 SC farmer families via a "Learning and Earning While Working" (LEW) program.

Stunting Tade Mullet for Grow-out

A trial on stunting Tade mullet (*Liza tade*) fingerlings (initial 3.8 ± 1.1g) in cages for 11 months at densities of 80 and 100 fish/m^3 (T1 & T2) compared to a control at 20 fish/m^3 yielded high survival rates (100% in control, 91.67% in T1) and final average body weights of 53.23g (Control), 47.38g (T1), and 51.23g (T2), showcasing potential for sustainable grow-out culture in Eastern India.

Growout of *Scylla olivacea*

In a 150-day growout of nursery-reared *Scylla olivacea* at 0.5 crabs/m^2, males showed consistent growth to 210 ± 34g, while females reached 80-120g within 80 days; importantly, there was no significant difference in growth between crabs fed formulated feed and trash fish, indicating adaptability to artificial diets and potential for reduced trash fish dependency.

Density-Dependent Growth of Indian White Shrimp

A 150-day winter experiment with Indian white shrimp (*Penaeus indicus*) juveniles (initial ~0.89g) demonstrated density-dependent growth, with those stocked at 0.3 nos/L (T1) reaching 7.67g, outperforming those at 0.5 nos/L (T2) which reached 6.91g after 90 days.

Multi-Polyculture Outperforms Polyculture

A 240-day comparative experiment demonstrated that a multi-polyculture model combining seabass and pearlspot in cages, mud crabs in floating boxes, and open-pond milkfish and pearlspot, yielded significantly higher total harvests (e.g., 348 kg seabass, 203.8 kg caged pearlspot, 87.6 kg open pearlspot, 288 kg milkfish, 224.5 kg mud crabs) compared to traditional polyculture (106.9 kg pearlspot, 312.6 kg milkfish), providing farmers with increased and regular income.

High-Density *Penaeus indicus* Farming in Monsoon

High-density farming of Indian white shrimp (*Penaeus indicus*) during monsoon in lined ponds (stocked at 80 shrimp/m^2 for 128 days) yielded 8.15 to 8.8 tonnes/ha with 98.3% survival and average weights of 11.8-12.2g, proving economically viable despite heavy rainfall.

Growth of Indian White Shrimp in Semi-Intensive Farming

Semi-intensive farming of Indian white shrimp (*Penaeus indicus*) in an earthen pond at 35 PL/m^2 yielded a 14.02g average body weight in 138 days, with an impressive 97.6% survival, 1.75 FCR, and a high productivity of 4.45 tonnes/ha, demonstrating excellent growth and favorable farming conditions.

P. indicus Post-Larvae Growth in Ponds

Captive-bred *Penaeus indicus* post-larvae, stocked at 3 nos./m^2 in lined ponds, achieved average body weights of 16.5g (males) and 22.0g (females) within 120 days, with 20% of females showing gonad development, demonstrating successful growth and initial reproductive performance.

Integrated Seaweed-Shrimp Nursery Proves Feasible

Integrating edible seaweed (*Ulva lactuca*) cultivation (initial 5 kg to 12.5 kg harvested biomass) with *Penaeus indicus* nursery rearing in 100m^2 ponds shows no adverse effects on shrimp growth (treatment: 0.941 ± 0.08g vs. control: 0.928 ± 0.07g) or survival (treatment: 95.2% vs. control: 94.5%), providing an additional income source from seaweed.

Super-Intensive Precision and Natural Shrimp Farming (SIPNSF)

Our pioneering Super-Intensive Precision and Natural Shrimp Farming (SIPNSF) system achieved remarkable productivity of 3.47 – 4.97 kg/m^3 (34.7 – 49.7 tons/ha) with 12 cycles of *Penaeus vannamei* in 90-104 days, demonstrating exceptional feed conversion ratios (0.97 - 1.23) and survival rates (86.5% – 98.8%) through minimal input use, making it a sustainable and scalable "farm-to-fork" model.

Fermented Biofloc Boosts *P. vannamei* Performance

A 45-day study showed fermented biofloc (FB) significantly enhanced *P. vannamei* growth (9.7g ± 1.6 vs. 7.99g ± 1.47 in unfermented control), survival (97.2% ± 2.5 vs. 81.6% ± 1.66), immunity, and beneficial gene expression.

P. vannamei Post-Larval Trace Mineral Optimization

A 60-day trial in progress is evaluating the impact of varying $ZnSO_4$ concentrations (2, 4, 6, and 8 ppm) on *P. vannamei* post-larvae in normal and biofloc culture systems, with initial observations showing no stress or mortality within 24-48 hours, as researchers monitor growth rates and overall shrimp health.

Trace Minerals & Probiotic Efficacy

In-vitro experiments are evaluating how various concentrations of trace minerals ($ZnSO_4$ 100 ppm, $CuCl_2$ 50 ppm, $MnCl_2$ 50 ppm, mixed salts 200 ppm) impact the cell viability and proliferation of mixed probiotic strains, which are then used to generate bio-floc to enhance aquatic organism health and productivity.

Duckweed as Carbon Source in Biofloc for Pearlspot

A 90-day study comparing solid-state fermented and unfermented *Lemna* spp. (duckweed) as a carbon source in biofloc systems for *Etroplus suratensis* (pearlspot) revealed that fermented feed (5.33 ± 0.25g ABW) performed comparably to control shrimp feed (5.42 ± 0.15g ABW), significantly outperforming unfermented duckweed feed (4.64 ± 24g ABW) in current average body weight.

Biofloc Enhances Shrimp Nursery Rearing

Biofloc technology significantly improved the nursery rearing of Indian white shrimp (*Penaeus indicus*), achieving a final average body weight of 1.25g compared to 0.34g in control tanks by 15 DOC (0.47g in biofloc) and maintaining better water quality with low *Vibrio* counts.

Probiotics Optimize Biofloc Shrimp Culture

Incorporating probiotics (e.g., *Bacillus subtilis*) into biofloc and biofloc+periphyton systems for *Penaeus vannamei* culture (200/m^3 stocking density) significantly enhanced growth, water quality, fatty acid and amino acid profiles, and microbial diversity, leading to improved overall performance.

Biofloc Carbon Sources for Grey Mullet

Rice bran significantly enhanced grey mullet (*Mugil cephalus*) growth in biofloc systems, yielding 7.6g fish in 40 days, compared to 4.1g in controls, while improving water quality and reducing TAN levels.

Biofloc Management for Milkfish

An ongoing experiment is evaluating the effects of microbial management and a recirculatory model with two dietary regimes (25% and 30% protein) on milkfish (*Chanos chanos*) growth, water quality, and immune responses in biofloc systems.

Shrimp Grow-Out in Biofloc Systems

In high-density biofloc grow-out systems, CIBAFLOC (T1) significantly improved average body weight for both *Penaeus vannamei* (6.8 ± 0.24g) and *Penaeus indicus* (6.2 ± 0.4g) after 46 days, outperforming controls (5.9 ± 0.2g) while maintaining optimal water quality and microbial load.

Biofloc Inoculum for *Penaeus vannamei*

In *Penaeus vannamei* biofloc systems, the CIBAFLOC + periphytic substrate (BFT3) inoculum yielded the highest average body weight (24.22 ± 0.24g vs. control 13.8 ± 0.52g at 100 DOC) and superior immune response (41% mortality post *V. parahemolyticus* challenge vs. 86% in control), indicating its efficacy in improving growth and disease resistance.

Optimizing *Hypnea musciformis* Cultivation

Controlled experiments identified optimal conditions for *Hypnea musciformis* cultivation: a salinity of 25 g L^{-1}, initial biomass densities between 50-100g, and a water depth of 0.5m significantly enhanced specific growth rates, providing crucial insights for commercial production.

Optimizing *Gelidiella acerosa* Farming

Research on red seaweed *Gelidiella acerosa* found optimal growth (SGR of 1.77% per day at 30 ppt salinity, highest biomass with 75g initial biomass (recommending 525-700g/m for monoline systems), and superior growth at shallower depths (0.25-0.5m) due to better light penetration.

Gracilaria salicornia Spore Release

A study on *Gracilaria salicornia* investigated the effect of salinity on spore release, observing that spore germination, indicated by thallus bud formation, occurred only in the control group at 28 ppt salinity, and not in reduced salinity conditions (5 ppt and 10 ppt) during a 21-day observation period.

Hands-on Training on Brackishwater Seaweed Farming

A one-day training program on brackishwater seaweed farming was conducted at the Muttukadu Experimental Station (MES), ICAR-CIBA, for ten fisherwomen from Kottaikadu village, Chengalpattu district. The program, held

on August 14th, 2024, in collaboration with the Department of Fisheries, Tamil Nadu, combined theoretical knowledge with practical skills, including raft-based tubeline cultivation, to empower coastal communities economically through sustainable aquaculture.

Nutrient Requirements for *Gracilaria corticata*

A study on land-based cultivation of red seaweed *Gracilaria corticata* found optimal nitrate and phosphate requirements varied with salinity, with 100 µM nitrate and 8 µM phosphate yielding a 3.64% daily biomass increase at 25 ppt, while 50 µM nitrate and 8 µM phosphate sufficed at 35 ppt, informing year-round production.

AI-Powered Shrimp Feeding Enhances Growth

A 60-day trial demonstrated that AI-powered automated feeding systems for *Litopenaeus vannamei* shrimp significantly enhanced growth, leading to shrimp reaching 8.2-10 cm in length and 8.5-9.2 grams in weight, outperforming manual feeding, though high turbidity can affect camera effectiveness, while an accompanying IoT-based system effectively monitored water quality.

Geospatial mapping of potential zones for expanding responsible aquaculture in Maharashtra

Potential areas for the expansion of aquaculture have been identified from unproductive/ waste lands in the coastal districts of Maharashtra. This identification was based on resource characteristics and environmental regulations, utilizing geospatial techniques and ground truth analysis. The study revealed that there are potential zones available for the immediate development of aquaculture, with the capacity to expand by 300%.

Assessment of salt affected lands using Random forest model

Utilizing Sentinel 2 data spectral indices and a Random Forest (RF) model within Google Earth Engine, the analysis focused on lands impacted by salinity. These lands have been categorized into five distinct groups, spanning from non-saline to extremely saline. This model has the potential for application in other areas to identify and measure salt-affected lands for alternative purposes.

Induction of early maleness in Asian seabass

Sub-adult Asian seabass (age: 17–19 months; average body weight: 750–1000 g; N = 15 fish per treatment) were administered a combination of GnRHa and 17α-methyltestosterone (50 µg of each hormone per kg body weight) over a three-month period to prolong the male phase. Milt release was observed after the third injection in treated fish compared to the untreated controls. These results suggest the potential for early testicular development in Asian seabass.

Studies on the sexual maturation of Asian seabass using ultrasound imaging

A study at ICAR – CIBA successfully used non- invasive ultrasound imaging to assess the sexual maturity of wild- Caught Asia seabass. The Technique showed a strong corelation between ultrasound (calliper Function) and actual gonad measurements, with distinct imaging patterns for different gonadal stages in males and females. This confirms ultrasound as a reliable tool for determining gender and reproductive status in Asian sea bass.

Sex determination and Oocyte measurement using Deep learning-based ultrasound imagining in Asian seabass *Lates calcarifer*

The study integrated deep learning with ultrasound imaging to non -invasively determine the sex and oocyte size of Asian seabass for the first time. Among various models tested, ResNet achieved the highest accuracy in sex classification, while ridge and lasso regression models effectively predicted oocyte diameters with mean absolute error 10% of actual measurements. These results highlight the potential for automating reproductive assessments in Asian sea bass using AI- driven ultrasound analysis.

Effect of temperature on the progression of cell division in Asian seabass embryos

Maintenance of Asian seabass embryos at suboptimal temperatures (25–26 °C) resulted in delayed cell division. Preliminary data indicate a delay of approximately 6 minutes in the first cleavage and a 2-minute delay in the eight-cell stage, thereby extending the window for guide RNA microinjection into the embryos.

Strengthening the broodstock fishes of Mangrove red snapper, *Lutjanus argentimaculatus* with proper quarantine, vaccination and tagging under captive system

A total of 60 mangrove red snapper were maintained in RCC tanks and earthen ponds, vaccinated with VNN vaccine, and tagged for monitoring. Captive maturation was observed from March to October, with a higher occurrence of oozing males compared to mature females throughout the period.

Standardization the breeding and larval rearing protocols for mass scale seed production of Mangrove red snapper

Four breeding trails of Mangrove red snapper performed, out of which, three trails successfully spawned. Larval rearing conducted up to 15 days successfully using different live feeds such as rotifers, copepods and ciliates.

Broodstock strengthening and breeding trials of grey mullet, *Mugil cephalus*

A total of 90 grey mullet fishes were maintained on formulated pellet feed, vaccinated with VNN vaccine, and tagged for broodstock development. Maturation was observed from early September 2024, and hormone implantation was carried out in selected males and females to enhance reproductive development. Three induced breeding trials were conducted using females with advanced oocyte development, resulting in spontaneous spawning in two cases, though the eggs were unfertilized.

Maturity assessment and induced spawning trials for grey mullet, *Mugil cepahalus* at West Coast

Adult grey mullets were maintained in cages installed in earthen ponds for maturational assessment and breeding trial at CIBA NGRC Mawtad Farm, Navsari Gujarat. In the third and fourth week of November, 5 milt oozing males (0.97-1.34 kg) and 10 mature females (1.56–2.4 kg) with oocyte diameter (500-550 µm) were obtained during biopsy sampling. Two breeding sets were stocked in muslin cloth hapa installed in a 5000 L circular tank and induced with commercial GnRHa formulations. However, no spawning was observed in all the trials.

Hatchery seed production of milkfish from newly recruited populations

The induction of new pond-reared milkfish brooders into breeding tanks in April 2024 enhanced spawning performance, with brooders showing significant growth and reaching maturity. Three successful spawnings yielded 0.35 million fertilized eggs and 0.2 million larvae, resulting in the distribution of 37,000 fry to farmers and entrepreneurs across Tamil Nadu, Gujarat, and West Bengal, generating a revenue of ₹1,96,330 from seed sales.

Rabbit fish *Siganus javus* broodstock & Sub adult collection

Juveniles and sub-adults of rabbit fish (*Siganus javus*), ranging from 50 g to 1.2 kg, were collected from various coastal locations and quarantined using standard treatments. The fishes are being reared in open pond-based cages with formulated feed, and their growth and gonadal maturity are being monitored at regular intervals.

Gonadal maturity assessment studies with wild collected *Siganus javus*

Rabbit fish (*Siganus javus*) ranging from 400–600 g were collected monthly from various landing centers, and their gonads were analyzed to assess maturity stages using histological techniques. The study revealed that gonadal development is evident from 200 g onwards, with 400–500 g being ideal for maturity assessment, and indicated a probable breeding season from June to October in the wild.

Impact of hormone pellets implantation in accelerating gonadal maturity in *Siganus javus*

To study the effect of sex hormones on gonad development in *Siganus javus*, males and females were implanted with 17α-methyl testosterone and LHRH, respectively. Hormone-implanted females showed increased oocyte diameter and elevated estradiol levels compared to non-implanted and wild-caught fishes, indicating enhanced gonadal maturation, while no significant differences were observed in males.

Hormonal induction for spawning in *Siganus lineatus*

Rabbit fish Siganus lineatus (800–950 g) were maintained under controlled hatchery conditions and subjected to two spawning induction trials in July 2024 using LHRH hormone. Despite selecting brooders with mature gonads, no spawning occurred, possibly due to elevated water temperature (30°C), which was 3°C higher than the successful spawning recorded in October 2023.

Year-round maturation status of Tade mullet (*L. tade*) in RAS

Tade mullet (*Liza tade*), a high-demand herbivorous species traditionally cultured in West Bengal, was maintained in RCC tanks with RAS to study year-round maturation in captivity. Maturation onset was observed in March, with progressive oocyte development from April to August and spermiating males between May and July, indicating that while initial development occurs at 10–14 ppt salinity, levels above 15 ppt are likely needed for final female maturation.

Influence of salinity and temperature on embryonic development and larval survival of Bengal yellowfin seabream (*Acanthopagrus datnia*)

A study was conducted to determine the optimal salinity and

temperature for egg incubation and early larval development in sparid species. Results showed that incubation time decreased with increasing salinity and temperature, with the highest hatch rate (97%) and embryo survival observed at 25–30 ppt salinity and 22 °C. While salinity and temperature significantly influenced hatch rates, yolk sac volume, and oil droplet volume, no significant effect was observed on notochord length.

Captive maturation and breeding strategies for *Mugilogobius tigrinus*

Mugilogobius tigrinus, a hardy goby species recently recorded for the first time in Muttukadu backwaters, has shown strong potential for ornamental brackishwater aquaculture. Successful captive maturation, breeding, and larval rearing were achieved, with a standardized protocol developed for larval transition. The species' attractive features and adaptability make it a promising candidate for nano and community aquariums.

Breeding and embryonic development of the brackishwater ornamental Goby, *Mangarinus waterousi*

Mangarinus waterrousi has demonstrated strong potential for ornamental brackishwater aquaculture, with successful captive maturation, breeding, and larval rearing. Standardized protocols for embryonic and larval development, along with detailed observations of reproductive behavior and sexual dimorphism, support large-scale juvenile production and sustainable industry adoption.

Early Life Stages of a brackishwater pistol shrimp, *Alpheus* sp. from Muttukadu Estuary

Significant progress has been made in understanding the breeding biology of a brackishwater pistol shrimp, tentatively identified as *Alpheus* sp., from the Muttukadu estuary. The species exhibits unique larval development, bypassing the nauplius stage and showing strong early-stage resilience, with larvae surviving up to four days post-hatch. Initial trials with various live feeds support future aquaculture potential, while further studies are needed for species confirmation and breeding optimization.

Gobies of Muttukadu Backwaters: Diversity and potential for ornamental fish culture

An ichthyological survey in the Muttukadu estuarine system identified over sixteen goby species, including several with high ornamental value due to their vibrant colors and unique morphology. Some species were newly recorded along the Indian coast, emphasizing the region's ecological importance and the need for broodstock development and captive breeding to support sustainable ornamental aquaculture and reduce pressure on wild populations.

Broodstock development of silver moony, *Monodactylus argenteus* in open water body with farmers participation

To develop broodstock of silver moony for large-scale breeding, CIBA initiated a farmer-participatory program using open water cages at Kadaloor Chinna Kuppam and Kolathur, Tamil Nadu. Around 500 wild-caught juveniles were reared using CIBA-formulated feed along with Artemia and squid meal, resulting in growth to 50–60 grams and the appearance of milting males after five months.

Effect of Salinity during embryonic development in Knight Goby (*Stigmatogobius sadanundio*)

The knight goby (*Stigmatogobius sadanundio*), a native estuarine species from the Indian Sundarbans with ornamental trade value, was successfully bred in captivity under varying salinity conditions. Spawning occurred across all salinities, but optimal hatching (98.83%) and survival (99.12%) were observed at 3 ppt, indicating that low salinity (0–3 ppt) is ideal for captive breeding and seed production.

Evaluation of aquaculture potential of diversified crustacean species: *Penaeus japonicus, Scylla* spp and ornamental crustaceans

Brackishwater crab, P*ortunus reticulatus* demonstrated high survival rates in hatchery and nursery phases, with successful breeding cycles and low cannibalism. Optimal rearing practices were identified, paving the way for commercial cultivation. Auto heterotrophic rearing systems proved most effective for *Metapenaeus monoceros* (Brown Shrimp) , yielding superior growth and survival even at high stocking densities. This offers a robust method for developing location-specific farming. Studies on Kuruma shrimp showed better growth and survival in outdoor, naturally lit units.

Artemia biomass production

Tank based Artemia biomass production was optimized across various conditions. It is proved that Artemia biomass is a vital maturation diet of shrimp, and it could be used as a vehicle for hormonal supplementation.

Captive broodstock development and induced maturation techniques of kuruma shrimp, *Penaeus japonicus* Form II through hormonal/ environmental & dietary approaches

Reproductive biology of Penaeus japonicus revealed that wild-caught broodstock

from various locations exhibited diverse maturation stages (with a high percentage of spent and mated females) and preferred sandy bottom habitats, leading to the development of a specialized sand-based recirculatory broodstock system at CIBA with optimized feeding regimes and water quality management to support captive maturation.

Broodstock collected states with identification sites

To establish a robust baseline population for a shrimp domestication program and genetic characterization, broodstock procurement centers have been set up across India's east coast (Puri, Kakinada, Chennai, Kanyakumari, Quilon), with plans to expand to the west coast and Andaman and Nicobar Islands, alongside the development of pre-primary quarantine facilities to prevent the introduction of diseased shrimp.

Captive broodstock development of *Penaeus indicus* in tank system

In a study on Penaeus indicus broodstock development, pond-reared domesticated broodstock (Captive-GN4) significantly outperformed wild broodstock (Wild Generation GN1) in HDPE tank systems by 390 days of culture, showing superior growth rates (females: 36.14g vs. 31.57g; males: 29.27g vs. 22.77g), higher survival rates (90% vs. 70%), and notably, 30% ovarian development in females without eyestalk ablation, enabling successful breeding and larval production at 25 ppt.

Artificial Insemination (AI) Trials in *Penaeus indicus*

Significant progress made in optimizing artificial insemination (AI) protocols for shrimp, achieving a 65% spawning success rate in 23 trials by carefully performing AI on newly molted females with male spermatophores, often employing eyestalk ablation and stress-free handling to enhance reproductive efficiency and support selective breeding programs.

Improvement in Larval Rearing Technology:

An experiment comparing Conventional Larval Rearing Systems (CLRS) with a Modified Larval Rearing System (MLRS) for Penaeus indicus revealed that the MLRS, which incorporates in-situ microalgae production, significantly improved larval survival by reducing bacterial contamination, maintaining better water quality without early artificial feeds, and minimizing larval stress from water exchange, compared to traditional methods relying on external algae.

Broodstock development using wild *Penaeus indicus* larvae cultured in earthen ponds and HDPE tanks

To evaluate growth and reproductive performance, pathogen-free *Penaeus indicus* broodstock, originating from wild sources, were reared on specialized feeds in maturation tanks, while their hatchery-produced post-larvae were cultured in earthen ponds and HDPE tanks at varying densities, with the ongoing rearing of these adult shrimp for continued broodstock development.

Breeding trials of *Scylla olivacea* at Kakdwip Research Centre

A breeding trial for the mud crab *Scylla olivacea* was carried out at the KRC. Immature crabs matured successfully in floating boxes and egg development was observed at 5±1 ppt salinity. However, in RAS system eyestalk ablation induced spawning at 21 ppt after 35 days

Effect of pond ageing on soil and water quality, productivity and disease occurrence in shrimp farms

Investigations in shrimp culture ponds of varying age at Nagapattinam, Pattukkottai and Nellore Districts revealed that soil fatigueness by the pond ageing affects soil quality as well as shrimp production. Organic carbon content increased in <10, 10-20 and > 20-year ponds from stocking time to the harvest. Among the three clusters disease prevalence was low in Nagapattinam.

Soil and water characteristics for aquaculture in inland saline areas

Characterization of water and soil samples in inland saline regions of Punjab, Haryana and Rajasthan registered a deficiency of potassium in soil samples. Water samples had a salinity range of 7 to 18 ppt, and total alkalinity between 185 and 565 ppm as $CaCO_3$.

Effect of beneficial bacteria consortia on mitigation of ammonia and nitrite

Sphingobacterium spp., and *Zobellella denitrificans* individually and their combination reduced nitrite nitrogen significantly but not total ammonia nitrogen in brackishwater.

Photodegradation of formalin and oxalinic acid in water and soil

The study on the degradation of formalin in water showed rapid degradation at low salinity and high pH with a half-life of 0.51 days under sun light with the mean temperature, intensity and photoperiod of about 33.5°C, 57,000 lux and 12 hours 25 min respectively. The degradation of formalin and oxalinic acid was rapid in heavy texture soil compared to loamy sand soil.

Toxicity and environmental safety of florfenicol in algae

96-hours of exposure to Florfenicol (FFC) at 0, 2, 4, 8, 16, and 32 ppm doses showed a decrease in chlorophyll

content in tandem with a growth retardation of marine algae, *Chlorella marina,* and increased levels of superoxide dismutase and glutathione up to 16 ppm and then sharply decreased at 32 ppm. Acute exposure of FFC for 96 hours at 4–16 ppm was safe.

IoT devices for measurement of water parameters

Specifically designed industrial sensors with titanium housing material, capable of functioning in highly turbid conditions, embedded on a PCB board in a modified aqua buoy, and the AquaSense with sensors were calibrated for continuous online water parameters monitoring in aquaculture ponds. Dashboard application and mobile phone based advisory system were developed to access the live water parameters and for location specific and personalized advisories to farmers.

Graphene and polyaniline--based screen-printed indigenous pH sensors

The pH sensor stencil models were printed for the two-electrode system and engraved from flexible polyethylene terephthalate sheets with a GRAPHTEC 2D flatbed cutting plotter. Polyaniline based PANI powder and ink were employed as pH-sensing materials on the commercial screen-printed electrodes. The calibration of the sensors at 5-12 pH range demonstrated better linearity with PANI-based pH sensors compared to the graphene-based sensor.

Risk assessment of brackishwater aquaculture to climate change

The coastal districts were categorised under very high, high, medium, low, and very low based on the weighted indices of exposure (20%), vulnerability (40%), historical hazard (20%), and future hazard (20%) as per AR5 of IPCC. The districts on the East Coast were at higher risk than the West Coast.

Review on climatic risks and adaptations in culture fisheries

A comprehensive systematic literature review identified 65 and 37 research articles in the Web of Science and Scopus databases focused on shrimp and major Indian carp, respectively for climatic risks and impacts, and adaptation strategies.

Growth characteristics of *P. monodon* during periods of heat wave and extreme rainfall

Growth data of *P. monodon* from commercial farms in south Gujarat indicated significantly lower average daily growth rate and weekly growth rate during heatwave and periods of heavy rainfall compared to normal summer and monsoon seasons.

Impact of cyclone-induced extremely heavy rainfall and flood on shrimp aquaculture

The extremely heavy rainfall due to MICHAUNG severe cyclonic storm and subsequent flood during December 2023 damaged the infrastructure and pond bunds, led to the inundation of ponds amounting to a huge loss to the shrimp aquaculture sector in Gudur, Andhra Pradesh. A deterioration in water quality and changes in immune parameters were observed in *P. monodon* farms.

Impact of rainfall pattern variability on changes immune parameters and incidence of white spot disease in *P. monodon*

Changes in phenol oxidise and superoxide dismutase were noticed in *P. monodon* exposed to the varying heavy rainfall and challenge with WSSV. The impact of heavy rainfall stress within a short span accelerated the shrimp mortality due to WSSV.

Enhanced breeding and seed production of Pearlspot in temperature controlled indoor RAS system

Thirty-six spawnings of Pearlspot were observed with average fecundity of 2500 eggs and average hatching of 82% in prototype temperature-controlled indoor RAS system maintained at water temperature of 32-33°C during November to January when the water temperature goes down as low as 25°C. No spawning was observed in control with fishes in hapas facility.

Milkfish a promising climate resilient species for brackishwater aquaculture

The growth performance of Milkfish in the earthen pond during pre-monsoon, monsoon and post monsoon periods where salinity fluctuated between 0 ppt to 32 ppt as a result of very heavy rainfall followed by flooding, and varying air temperatures proved Milkfish as a suitable climate-resilient species in coastal and inland areas with higher growth rate, temperature and salinity tolerance.

Effect of microbial mediated solid-state fermented plant protein sources for abiotic temperature stress tolerance in *P. vannamei*

Dietary manipulation of *P. vannamei* diets through *Bacillus* and *Saccharomyces* mediated solid-state fermented plant protein ingredients showed better survival and higher weight gain at 32°C. The optimum proportion of *Proteobacteria*, *Fimiculates* in shrimp at 32°C resulted in better amelioration of the temperature stress by supplementing the functional nutrients.

Efficiency of methanotrophic bacteria in mitigating methane at different salinities

The enriched methanotrophic bacteria isolated from sediment

samples of brackishwater systems were spread across three genera viz., *Methylobacillus flagellates, Methylophaga thiooxydans,* and *Methyloversatilis discipulorum,* and showed 76.29% & 89.62% reduction of methane after 24 hrs.

Disease prevalence in shrimp and fish farms

Disease surveillance carried out in 145 shrimp farms in Tamil Nadu, Gujarat and West Bengal and two fish farms in West Bengal revealed the prevalence of *Ecytonucleospora hepatopenaei* (EHP) found to be highest, followed by Whenzhou virus 8 (WzSV8), and White Spot Syndrome Virus (WSSV). This shows that EHP is an important pathogen in shrimp farms, highly prevalent in the country and is present throughout the year.

Cytoplasmic free Ca^{2+} analysis in WSSV infected shrimp

Elevated levels of hemocytic cytoplasmic free calcium (Cf-Ca^{2+}) concentration in higher temperatures at all time points in WSSV infected groups was observed when compared to control samples. Replication of WSSV decreased at 33°C when compared to 30°C and 27°C. The shrimp injected with 101 to106 copy no. of WSSV viral particle showed reduced total haemocyte count with significant difference at 24 hours. The immune genes SOD and Prophenoloxidase gene found to be upregulated in infected group in gill tissue. Rapid nucleic acid extraction has been developed for detection of WSSV where in complete nucleic acid extraction in just two minutes.

Differentiating virulence markers in *Vibrio harveyi*

in silico characterization of 132 V. harveyi strains for virulence markers indicated that type I, type II, Type III, type V and type VI secretion system plays major role in production of various toxins. *V. harveyi* could be concluded as non-luminescent, forms yellow colony on TCBS agar. Dominance of *V. parahaemolyticus* was seen in analysis of white feacal (WFS) samples indicated that possible role of V. parahaemolyticus in WFS.

Control of Vibriosis using disinfectants

Vibriosis could be controlled by BKC at 2 ppm, potassium permanganate at 10 ppm, formalin at 20ppm and Iodophor at 80 ppm.

Effect of brown seaweed on *Penaeus vannamei*

Ascophyllum nodosum showed great potential as a dietary supplement to enhance growth performance and disease resistance in *Penaeus vannamei*. Novel synbiotic formulation studied had effectively integrates the complementary advantages of probiotics and prebiotics, promoted immune improvement, enhanced stress tolerance, and better growth performance.

Antibiotic resistance detected in shrimp and water samples

Antimicrobial resistance studies indicated that *Staphylococcus* sp were more resistance to Penicillin, *E. coli* isolates, maximum resistance observed for Cefotaxime. Similarly, for *Vibrio* sp., maximum resistance was observed for Ampicillin.

No proliferation of EHP spores in mud crab hepatopancreas

Multiple-dose challenge experiment in *Scylla serrata* and *S. olivacea* revealed no proliferation of EHP spores in HP tissues.

Prophylactics against EHP

Silymarin derivative found to be a hepato-protectant at about 0.02% and above against EHP infection in shrimp.

Field evaluation of EHP cura

CIBA EHP cura - I product, combination of phytochemical and nutritional supplements has been field evaluated in 74 farms of 169.5 ha in Tamil Nadu, Andhra Pradesh, Punjab, West Bengal and Gujarat has significantly reduced the EHP load and improved the shrimp immunity and growth.

Aeromonas veronii causing mortality of Asian seabass

Aeromonas veronii found to be an emerging pathogen in seabass aquaculture and can cause sepsis, ulcer and mass mortality. 16SrDNA sequencing of eight bacterial isolates from liver, kidney, and spleen was identified as *Photobacterium damselae* was later confirmed by PCR based on capsular polysaccharide gene (CPS) specific to *Photobacterium damselae*.

Major parasitic diseases causing mortalities in Asian seabass

The key parasitic taxa identified from seabass fish includes parasitic ciliates (*Cryptocaryon irritans*), dinoflagellates (*Amyloodinium Ocellatum, Trichodina* spp., monogenean gill flukes (*Diplectanum* spp.), and parasitic crustaceans (*Argulus* spp.). Among these, *C. irritans* and *A. ocellatum* were associated with acute outbreaks in seabass hatcheries, leading to severe mass mortalities (90–100%) within 7 to 10 days of clinical onset, particularly affecting brood stock and larval stages in brackishwater systems. The best treatment for recovering fish infested with *Amyloodinium* was 0.15mg/L $CuSO_4$ (continuous bath) with 86% survival rate followed by fresh water with Vitamin C recording 84% on 10th day. The dose and duration of treatment may vary with fish species, their size, environmental parameters etc. A model framework ELDA was developed to calculate total economic loss due to

aquatic animal diseases to Indian aquaculture.

Enhanced Paddy Production with *Plankton*^{Plus}

Foliar application of *Plankton*^{Plus} significantly increased paddy yield (highest at 10%) and key growth parameters (tillers, panicles, plant height), while also reducing the need for chemical fertilizers and eliminating pesticide use in field trials in Tamil Nadu.

Plankton^{Plus} Boosts Carp Culture in Sunderban

Application of CIBA *Plankton*^{Plus} in low-saline carp culture increased *Catla catla* average body weight to 451.43 g and Labeo rohita to 450.09 g, resulting in a highest yield of 3,119.86 kg/ha with a 20 ppm dosage, demonstrating its potential for enhancing Indian Major Carp growth and yield for ST communities.

Plankton^{Plus} for Feed Reduction in Carp Culture

Ongoing trials are assessing the use of *Plankton*^{Plus} at 20 and 40 ppm in carp culture with reduced formulated feed levels (80% and 60%) compared to 100% feed, aiming to determine its potential to lower feed requirements while maintaining productivity for tribal farming families.

Cost-Effective Shrimp Farming with *Plankton*^{Plus} and *Chingudi*^{Plus}

A demonstration of shrimp farming using *Plankton*^{Plus} and *Chingudi*^{Plus} feed achieved comparable shrimp weights (28.21 ± 1.25 g) to commercial practices but significantly reduced the FCR (1.26 vs. 1.57) and production cost (₹162 vs. ₹234), leading to a higher cost-benefit ratio of 2.33 vs. 1.55.

Microbial Monitoring in *Penaeus vannamei* Culture

Microbial monitoring during *Penaeus vannamei* culture revealed that while total heterotrophic bacteria levels were similar, the total Vibrio (TV) count was significantly higher in commercial feed groups compared to those using *Plankton*^{Plus} and *Chingudi*^{Plus} (3.607 ± 0.127a Log10 CFU/ml vs. 4.275 ± 0.112b Log10 CFU/ml in haemolymph), suggesting improved shrimp health.

Enhanced Rapeseed Meal in *P. vannamei* Feed

Solid-state fermentation of rapeseed meal with *Bacillus subtilis* and *Saccharomyces cerevisiae* allows for up to 7.5% inclusion in *P. vannamei* grow-out feeds, improving growth by increasing limiting amino acids (lysine by 19.66%, methionine by 17.18%) and significantly reducing anti-nutritional factors (phytic acid by 47.69%, tannin by 46.59%, glucosinolates by 43.76 mg/100g).

Fermented Groundnut Oil Cake for *P. vannamei*

Fermenting groundnut oil cake with *Bacillus subtilis* and *Saccharomyces cerevisiae* enables its inclusion up to 7.5% in *P. vannamei* feed (compared to 5% for raw), attributed to a significant reduction in anti-nutritional factors like saponins (from 732.20 to 347.35 mg/100g), phytic acid (from 1028.31 to 438.87 mg/100g), and tannin (from 1734.95 to 545.82 mg/100g)

Mud Crab Digestive Enzyme Ontogeny

Research on mud crab (*Scylla serrata*) larvae revealed that key digestive enzymes like trypsin, chymotrypsin, and amylase generally peak in activity at Zoea V (15 dph) and decrease at the megalopa stage (20 dph), suggesting this period is optimal for developing easily digestible artificial feeds.

Probiotic Impact on *Penaeus vannamei* Gut Microbiome

Dietary supplementation of single and multiple-strain probiotics (e.g., *Pediococcus pentosaceus, Lactiplantibacillus plantarum*) in Pacific Whiteleg Shrimp (*Penaeus vannamei*) significantly modulated and enriched beneficial gut microbiome signatures, increasing the abundance of families like *Oxalobacteraceae* and *Bacillaceae,* especially with higher doses of multiple-strain probiotics

Fermented Rapeseed Meal in *P. vannamei* Feed

Fermented rapeseed meal (RSM) can effectively replace 10-15% of soybean meal in *Penaeus vannamei* grow-out feeds, improving limiting amino acids and reducing anti-nutritional factors.

Programmed Feeding for Super-Intensive Shrimp Farming

Implementing programmed feeding protocols with automated feeders in super-intensive shrimp farming, where feed is dispensed unequally based on shrimp activity and withheld overnight, achieved a better feed conversion ratio (1.13 vs. 1.21) compared to equal distribution, enhancing resource efficiency.

Value-Added Products from Milkfish

Utilizing a fish meat picking machine and accessories, milkfish (400-500g) yielded 37% minced meat, successfully processed into deep-fried patties and fingers that maintained good taste after freezing, demonstrating potential for value-added product development.

Utility of Invasive Charru Mussel

Analysis of the invasive Charru mussel (*Mytella strigata*) revealed a meat yield of less than 20% with nutritional composition (e.g., 9.25% crude protein, 0.95% crude fat), indicating its shell's primary utility as a calcium carbonate source rather than a significant aquafeed ingredient.

Shrimp Grow-out Feed Innovation

A newly formulated shrimp grow-out feed achieved excellent results in precision and intensive natural farming, demonstrating a low FCR range of 0.97-1.16 and high survival rates of 87-98%.

Shrimp Larval Feed Enhancement

A new shrimp larval feed incorporating Black Soldier Fly (BSF) meal improved feed acceptability without significantly impacting survival or average body length at PL10, and a black/brown colored larval feed was also successfully developed by optimizing pigment inclusion.

Arrowroot as Aquafeed Ingredient

Initial analysis of five arrowroot varieties showed minor nutritional variation, confirming its potential as a good energy source and viable alternative to maize and wheat in aquafeeds.

Yam Bean as Aquafeed Ingredient

Analysis of six yam bean samples revealed consistent high available carbohydrate content, indicating its strong potential as an alternative to maize and wheat in aquafeeds.

Tubers as Alternative Feed Ingredients

Nutrient analysis of diversified tubers and their by-products, including sweet potato haulms and weevil-infested sweet potatoes, revealed their potential as alternative feed ingredients: sweet potato vines and cassava leaves offer moderate protein and energy for herbivorous fish, while tuber chips and weevil-infested sweet potatoes are excellent energy sources capable of replacing maize and wheat.

Silkworm Pupae Meal for *P. vannamei*

In a 60-day feeding trial, defatted silkworm pupae meal at 2.5% and whole silkworm pupae meal at all tested levels (2.0%, 4.0%, 6.0%) performed as well as or better than the control diet, highlighting their potential as effective feed ingredients for *P. vannamei*.

Yeast-Fermented Sunflower Oil Cake for Milkfish

Yeast fermentation of sunflower oil cake significantly improved its inclusion levels in milkfish (*Chanos chanos*) feed, with the 7.5% fermented diet yielding the highest weight gain (276.56 ± 5.07%) compared to the lowest with 12.5% unfermented cake (170.64 ± 7.12%), attributed to a reduction in anti-nutritional factors like saponins (from 641.52 to 207.01 mg/100g DMB).

Black Soldier Fly Larval Meal in Shrimp Diet

A 45-day feeding trial showed that black soldier fly (BSF) larval meal can replace fish meal in tiger shrimp (*Penaeus monodon*) diets up to 6% inclusion without negatively impacting growth or survival, with the 3% BSF group (BSF3) achieving the highest weight gain percentage (320.12%), comparable to the control.

Mass Culture of Small-Sized Live Feeds

ICAR-CIBA successfully established a mass culture facility for seven copepod species and one ciliate species (*Euplotes* sp.), utilizing *Nannochloropsis oculata* and mixed microalgae for enrichment, and standardized a filtration system to harvest small nauplii (<100 µ) and ciliates (38-47 µ), crucial for enhancing finfish larval survival, especially for species requiring live feeds smaller than 70 microns.

Onuphis kovala: Potential Aquaculture Feed

The marine polychaete worm, *Onuphis kovala,* identified through 16S rRNA gene analysis, demonstrated promising culture performance, achieving a biomass of 126g with 90% survival (0.70g ABW) and 960g with 80% survival (0.60g ABW) in 120 days under different feeding regimes, and its biochemical composition (11.29% crude protein, 0.83% fat) highlights its potential as a sustainable feed resource for aquaculture.

Screening for Animal Meat Contamination in Shrimp Feed

Comparative genomic analyses of cattle, buffalo, sheep, goat, pig, chicken, duck, and quail whole genomes identified unique genic regions for each species, providing a foundation for developing simple DNA-based screening methods to detect unethical animal meat contamination in shrimp feed formulations.

Whole genome assembly of goldlined seabream (*Rhabdosargus sarba*)

A highly contiguous and chromosome-scale genome of assembly length, 764.6 Mb has been generated for *R. sarba* in 32 scaffolds with N50 of 33.9 Mb using long-read and linked-read sequence data.

Chromosome-scale genome assembly for *Siganus javus:*

The genome assembly generated for *S. javus* is of 563.9 Mb length in 210 scaffolds with N50 length of 23.94 Mb. The genome is predicted to contain 16.63% repeat elements and was assessed to be 96.6% complete.

Deleterious cSNP variations in shrimp

About 11 and 6 non-synonymous SNP variations in *P. vannamei* and *P. indicus,* respectively were predicted as having effect on protein function and stability using in silico approaches.

Metabolic changes in *P. indicus* under salinity stress and varying lipid levels in diet

The molecular mechanisms playing a role in amelioration of salinity stress during feeding of high-lipid diets have been delineated in Penaeus indicus using RNAseq approach.

PPI networks significant for WSSV infection in shrimp

Using orthology- and domain-based in silico approaches, we have documented that there were only 14 WSSV proteins that showed interaction with shrimp proteins which may be crucial during WSSV infection in shrimp.

Molecular mechanisms regulating salinity stress in pearl spot, *Etroplus suratensis*

Based on the gene expression profiles, a lncRNA with possible cis-regulation on the functioning of inositol monophosphatase 1 gene is identified as playing important role in osmoregulation of salinity-stressed Pearlspot fish.

Molecular mechanisms linked to pearlspot fish adapted to freshwater

Using RNA sequence data, it is inferred that Pearlspot fish modulates the pathways and processes related to ion transport, energy metabolism, amino acid metabolism, antioxidation, hormonal control, cellular permeability and cytoskeletal remodelling for their adaptation in freshwater.

Markers to screen animal meat contamination in shrimp feed

Extensive comparative genomics analyses resulted in identification of unique genic-regions of cattle, buffalo, sheep, goat, pig, chicken, duck and quail. These would help in development of strategies to identify their meat in shrimp feeds.

Impact of Indigenous Feed Technology (*Vanami*^{Plus})

An estimated reduction in Feed Conversion Ratio (FCR) of 0.10 among adopters, as determined by the Propensity Score Matching (PSM) method, confirms that adopting feed technology significantly reduces FCR. Farmers' experience, age, crop duration, feed price, and FCR are significant determinants of feed-technology adoption, as identified by a Tobit model.

Shrimp crop insurance product development

Five shrimp crop insurance products have been developed with the technical assistance of ICAR-CIBA by the following companies: Oriental Insurance Company Ltd., Agricultural Insurance Company Ltd., Digisafe Private Limited, TATA AIG, and New India Assurance Company Ltd.

Status of Milkfish Fry Collection in Gulf of Mannar

Annual milkfish fry collection of 3–4.5 million in Gulf of Mannar was revealed through a survey at Mandapam Island. The Major milkfish nursery grounds include Rameswaram Island (Pamban, Chinnapalam creek), Pillaimadam lagoon, Panaikulam creek, Valinokkam, Erwadi, Sethukarai, Thirupullani, Kunthukal beach, Karaiyur, Thangachimadam, Ariyaman beach, Thiruppalaikudi, and Uppur. Establishing hatcheries in Tamil Nadu can enhance seed supply, benefit farmers and fry collectors, and promote sustainable milkfish culture

Introduction

Aquaculture, cultivation of fish, crustaceans, mollusks and seaweeds, evolved almost thousand years ago as an activity with goals similar to the terrestrial agriculture and animal husbandry. This simple but elegant food production system originated in Asia in many ways it resembled the dynamics of natural ecosystem. However, the goal of aquaculture has been partially shifted from a high-quality nutrient supplier for the local community to the supplier of high-valued export-oriented crops. Shrimp aquaculture in the tropical countries is the paradigmatic example of this transformation. It has been regarded as one of the success stories of modern aquaculture. Within a short span of time, shrimp aquaculture has achieved sufficient sophistication in reproduction, larval rearing, grow-out, post-harvest technology and marketing. Perhaps it is one of the long-lived aquaculture enterprises, and pioneering effort in the coastal/brackishwater aquaculture. At this context many developing nations provided more focus to aquaculture research and development.

In order to provide a greater focus in priority areas of fisheries research, Council reoriented and restructured the fisheries research during the sixth five-year plan period. Recognizing the importance of high valued brackishwater aquaculture crops (mainly penaeid shrimps), Council established Central Institute of Brackishwater Aquaculture in 1987 by merging three research centers of Central Inland Fisheries Research Institute (CIFRI): Madras, Puri and Kakdwip, and one research center of Central Marine Fisheries Research Institute (CMFRI):Narakkal. The headquarters of the institute is at Chennai, Tamil Nadu with an experimental station at Muttukkadu, about 30 km from Chennai and research centers at Kakdwip, (West Bengal), and Navsari (Gujarat). A second experimental facility, Kovalam (near Muttukadu), that spread about 64 acres has been added recently as an expansion of experimental farming infrastructure.The main campus of the institute is in Chennai, in five-acre land. The building complex comprises 14 advanced research laboratories, administrative wings, library, wet laboratory and guest house. Since the inception this institute serves as a nodal agency for the brackishwater aquaculture development in the country. The institute has established itself as an organization of international repute and has been in the forefront for development of brackishwater aquaculture sector. The core research and policy support given by CIBA in the last two and half decades has brought in many laurels and wide acclaim to the institution.

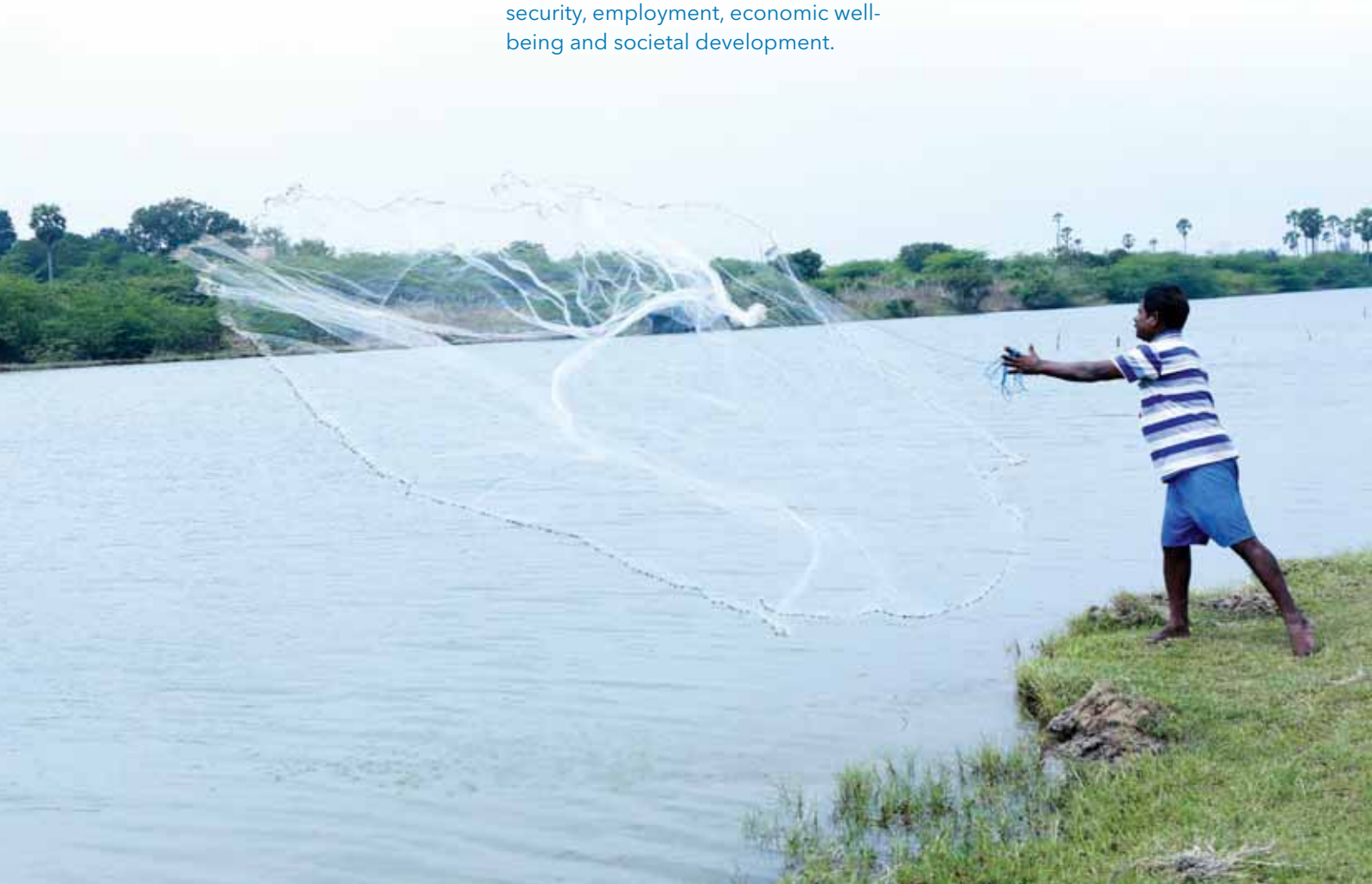
During the last year ICAR-CIBA has addressed several research and technological issues to develop a sustainable brackishwater aquaculture system, and to improve the livelihood of coastal communities. Diversification of species and system has been remained to be the focus of research programs of the institute. While CIBA has played a major role in the introduction of exotic *Penaeus vannamei* to India, considering the issue of vannamei aquaculture, presently the institute has been focusing on the development of genetically improved stock of native Indian penaeid, *P. indicus*. During the current year, the initial steps for establishing nuclear breeding center, quarantine facilities, nursery, pre grow out and grow out facilities have been completed.

Vision

CIBA envisages its role as one of the world's foremost scientific research institute in brackishwater aquaculture through the pursuit of excellence in research and innovation that contribute modernization and development of sustainable brackishwater aquaculture in the country.

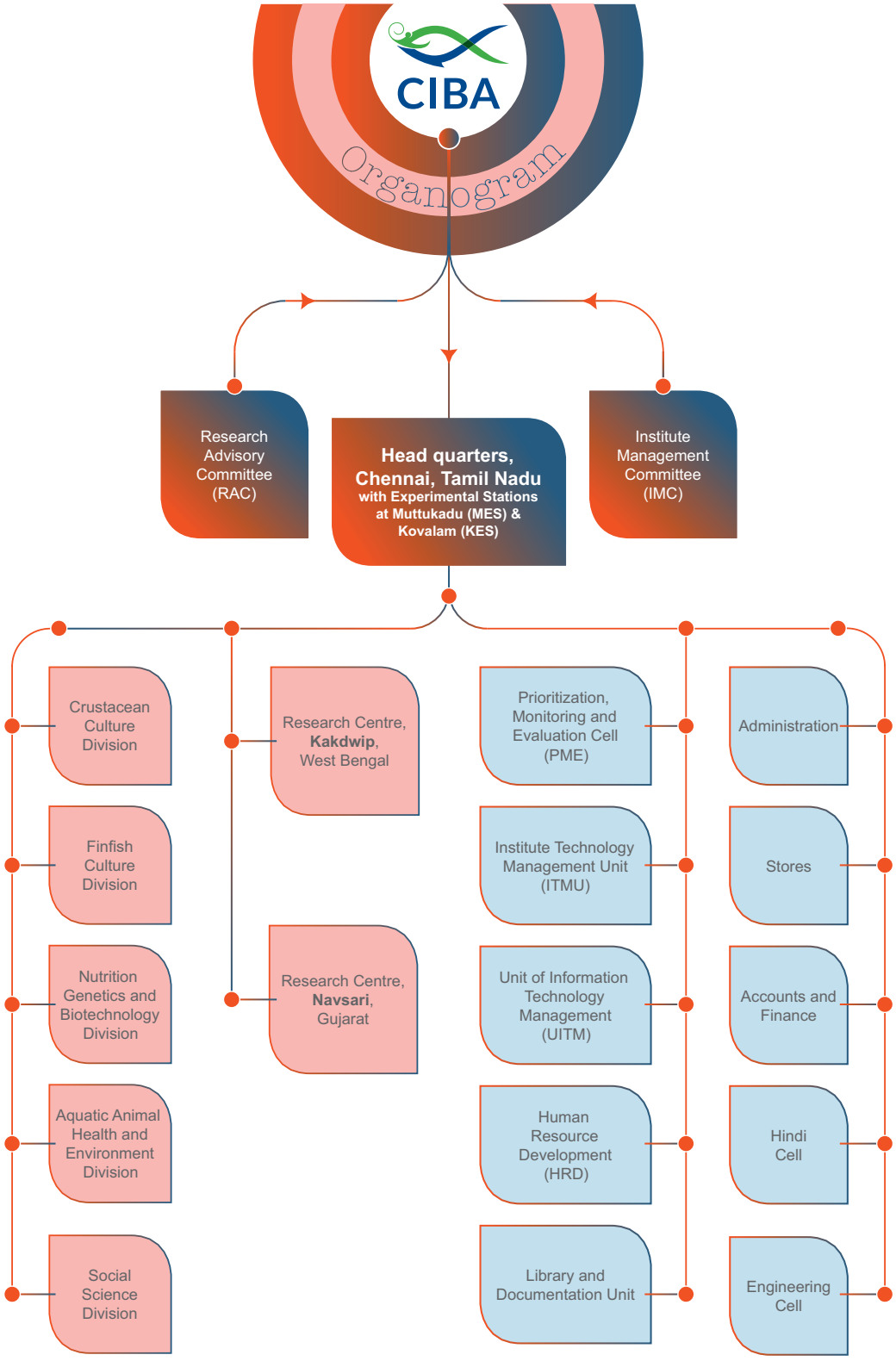
Mission

Our mission is to realize this vision through basic and applied research, and providing technological backstopping suitable for Indian conditions for the development of sustainable brackishwater aquaculture, which would provide much needed food, nutritional security, employment, economic well-being and societal development.



Mandate

- Basic, strategic and applied research for techno-economically viable and sustainable culture systems for finfish and shellfish in brackishwater.
- Species and systems diversification in brackishwater aquaculture.
- Act as a repository of information on brackishwater fishery resources with a systematic database.
- Human resource development, capacity building and skill development through training, education and extension.


CIBA
Organogram
Research Advisory Committee (RAC)
Head quarters, Chennai, Tamil Nadu
with Experimental Stations at Muttukadu (MES) & Kovalam (KES)
Institute Management Committee (IMC)
Crustacean Culture Division
Finfish Culture Division
Nutrition Genetics and Biotechnology Division
Aquatic Animal Health and Environment Division
Social Science Division
Research Centre, Kakdwip, West Bengal
Research Centre, Navsari, Gujarat
Prioritization, Monitoring and Evaluation Cell (PME)
Institute Technology Management Unit (ITMU)
Unit of Information Technology Management (UITM)
Human Resource Development (HRD)
Library and Documentation Unit
Administration
Stores
Accounts and Finance
Hindi Cell
Engineering Cell

UNIFIED BUDGET 2024

The Budget & Expenditure under Non-Plan & Plan for the financial year 2024 of ICAR-CIBA

S.No.	Sub-Head	RE 2024-25	Expenditure upto 31.12.2024
Grants for creation of Capital Assets (CAPITAL)			
1	Works		
	i. Office building	480.00	155.28
2	Equipments	357.44	183.94
3	Information Technonogy	35.00	7.31
4	Library Books and Journals	2.00	0.97
5	Vehicles & Vessels	36.56	16.45
6	Furniture & Fixtures	15.00	15.14
7	TSP	10.00	3.76
8	SCSP	25.00	3.31
	Total Capital (Grants for creation of Capital Assets)	**961.00**	**386.16**
	Grants in Aid - Salaries (Revenue)		
Estabilishment Expenses			
1	(A) Salaries		
	i. Establishment charges	2880.00	2390.79
	Total -Establishment Expenses (Grants in Aid-Salaries)	**2880.00**	**2390.79**
	Grants in Aid - General (Revenue)		
	Pension & Other Retirement Benefits	3010.00	2469.96
1	Traveling Allowance		
	(A) Domestic TA/Transfer TA	60.00	55.88
	(B) Forign TA		
	Total - Travelling Allowances	**60.00**	**55.88**
2	Research & Operational Expenses		
	(A) Research Expenses	240.00	199.86
	(B) Operational Expenses	230.00	186.48
	Total - Res. & Operational Exp.	**470.00**	**386.34**
3	Administrative Expenses		
	(A) Infrastructure	250.00	228.95
	(B) Communication	3.00	1.35
	(C) Repairs & Maintenance		
	i. Equipments, Vehicles & others	50.00	40.75
	ii. Office building	100.00	89.48
	iii. Residential building		
	iv. Minor Works	60.00	57.52
	(D) Others (excluding TA)	245.00	235.83
	Total - Administrative Expenses	**708.00**	**653.88**
4	Miscellaneous Expenses		
	A. HRD	15.00	7.59
	B. Other Item (Fellowships, Scholarships etc.)		
	C. Publicity & exhibitions	10.00	6.05
	D. Guest House - Maintenance	5.00	4.5
	Total - Miscellaneous Expenses	**30.00**	**18.14**
5	TSP	125.00	92.01
6	SCSP	200.00	161.58
	Total Revenue (Grants in Aid-salaries + Grants in Aid - General)	7483.00	6228.58
	Grand Total (Capital + Revenue)	**8444.00**	**6614.74**
AINP on Fish Health Project		**250.00**	**174.80**
Grand Total		**8694.00**	**6789.54**

GRAND TOTAL

8694.00

6789.54

Cadre Strength Of CIBA

Cadre Strength of CIBA

Position	Sanctioned	Filled	Vacant
Director (R.M.P)	1	1	0
HOD	4	4	0
HoRs	1	1	0
Principal Scientist	2	0	2
Sr. Scientist	14	7	7
Scientist	52	46	6
Technical Officers/ Technical Assistant	31	18	13
Chief Administrative Officer	1	1	0
Senior Administrative Officer	1	0	1
Administrative Officer	1	1	0
CFAO/Dy. Director Finance	1	0	1
Senior Finance & Accounts Officer	1	1	0
Assistant Finance & Accounts Officer	1	1	0
Assistant Administrative Officer	4	3	1
Principal Private Secretary	1	0	1
Private Secretary	2	1	1
Personal Assistant	3	2	1
Assistant	13	9	4
Upper Division Clerk (UDC)	5	3	2
Lower Division Clerk (LDC)	6	3	3
Skilled Support Staff (SSS)	30	8	22
TOTAL	**175**	**109**	**66**

Position	Sanctioned	Filled	Vacant
DIRECTOR	1	1	0
SCIENTISTS (HOD/HORs/PS/Sr.Sci./Sci)	73	58	15
TECHNICAL	31	18	13
ADMINISTRATION	40	24	16
SSS	30	8	22
TOTAL	**175**	**109**	**66**

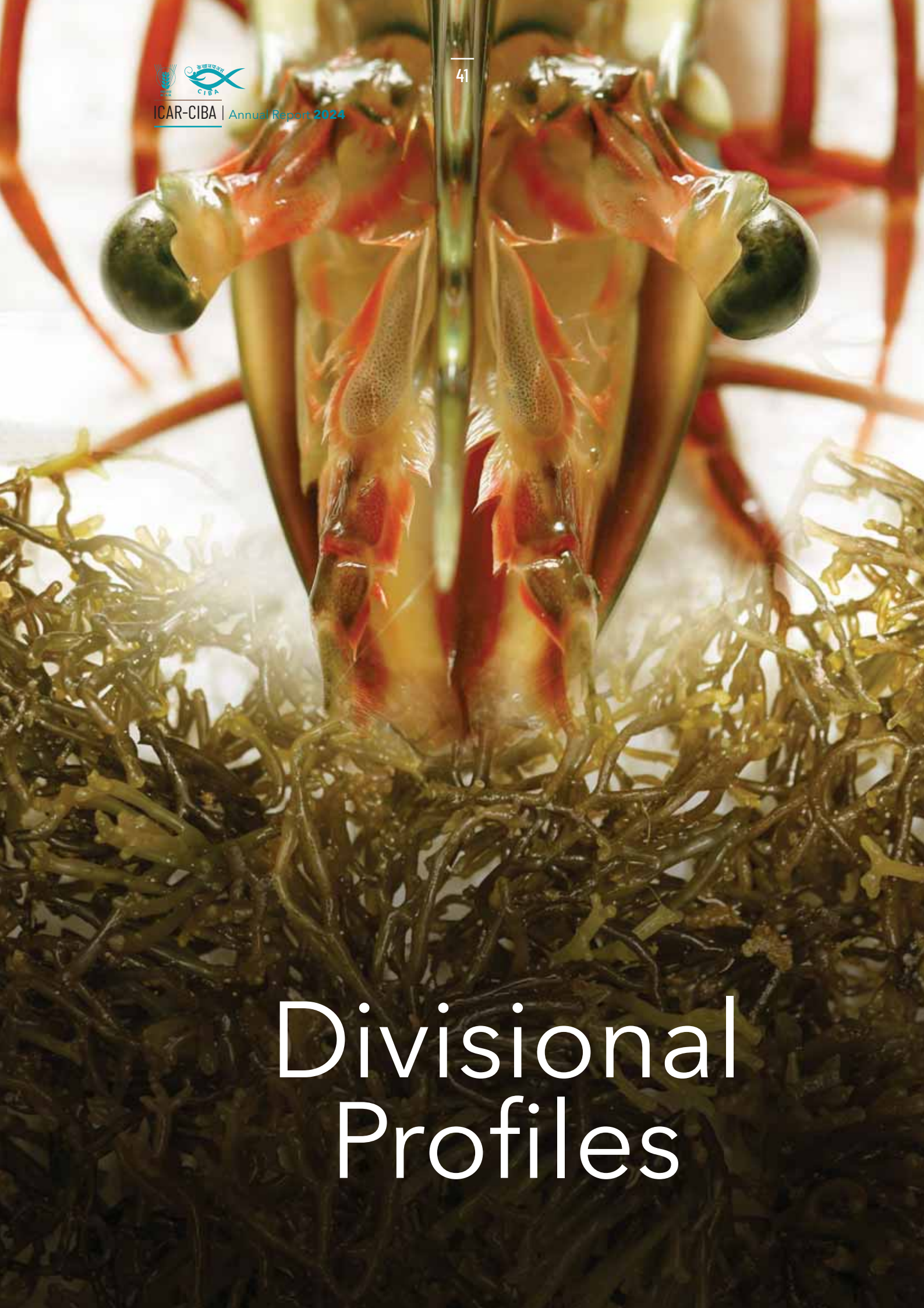
Research Projects

S.No		Project Title	Principal Investigator
Crustacean Culture Division (CCD)			
Institute funded projects			
1.	FISHCIBASIL 202300100152	Evaluation of aquaculture potential of diversified crustacean species: *Penaeus japonicus, Scylla* spp and ornamental crustaceans.	Balasubramanian C. P.
2.	FISHCIBASIL 202300200153	Amelioration of soil and water under different geographical regions for sustainable aquaculture production.	Saraswathy R.
3.	FISHCIBASIL 202300300154	Captive broodstock development and induced maturation techniques of kuruma shrimp, *Penaeus japonicus* Form II through hormonal/ environmental & dietary approaches.	Shyne Anand
Externally funded projects			
4.	FISHCIBASOL 202201000127	Demonstration of viable farming protocols for indigenous brackish water seaweed species for income generation among coastal folks.	Nila Rekha P.
5.	FISHCIBASOL 202200200119	Development of indigenous shrimp (Indian white shrimp) aquaculture: Genetic improvement Program of *Penaeus indicus*, Phase – I.	Akshya Panigrahi
6.	FISHCIBASOL 202300100133	Biofortification of trace elements in biofloc based aquaculture –microbial mediated approach for value added healthy shrimp and fish production.	Akshya Panigrahi
7.	FISHCIBASOL 202300200134	Development and demonstration of artificial intelligence based precision aquaculture technologies.	Nila Rekha P.
8.	FISHCIBASOL 202300800140	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.	Akshya Panigrahi
9.	FISHCIBASOL 202300200135	Geospatial mapping of potential zones for expanding responsible aquaculture in Maharashtra.	M. Jayanthi
Finfish Culture Division (FCD)			
Institute funded projects			
10	FISHCIBASIL 202300400155	Upscaling the breeding and seed production of grey mullet (*Mugil cephalus*) and Magrove Red snapper (*Lutjanus argentimaculatus).*	Kailasam M.
11	FISHCIBASIL 202300500156	Characterizing and developing the indigenous fish cell lines to prove stemness and proliferation in seafood cell culture.	Makesh M.
12	FISHCIBASIL 202300600157	Application of assisted reproductive techniques in breeding programmes for Lates calcarifer.	Sherly Tomy.
13	FISHCIBASIL 202300700158	Broodstock development and captive maturation of Streaked spine foot Siganus javus & S. lineatus.	Jayakumar R.
14	FISHCIBASIL 202300800159	Optimization of larval rearing protocol and mass scale seed production of Goldlined Seabream Rhabdosargus sarba.	Senthil Murugan T.
15	FISHCIBASIL 202300900160	Development of base population for selective breeding on growth in pearlspot.	Sivamani B.
16	FISHCIBASIL 202301000161	Reliable seed production of brackishwater finfishes Seabass (*Lates calcarifer*), Milkfish (*Chanos chanos*) Mono angel (*Monodactylus argenteus*) and Scat (*Scatophagus argus*).	Subburaj R.
Externally funded projects			
17	FISHCIBASOL 201800700099	Development of brackishwater aquariculture through optimisation of captive breeding protocols of potential and emerging ornamental fish species, technology transfer and livelihood generation.	Kailasam M.
18	FISHCIBASOL 202201100128	Development of recombinant microalgae expressing Nervous necrosis virus capsid protein for vaccinating finfish against viral nervous necrosis (CRP on Vaccines and Diagnostics).	Makesh M.
19	FISHCIBASOL 202300200136	AINP on Ornamental Fish Breeding and Culture.	Shri. Dani Thomas
20	FISHCIBASOL 202300200137	Genome editing approaches for improving growth and reproductive performance of Asian seabass (*Lates calcarifer*) and Indian white shrimp (*Penaeus indicus*).	Sherly Tomy.

S.No		Project Title	Principal Investigator
Aquatic Animal Health and Environment Division (AAHED)			
Institute funded projects			
21	FISHCIBASIL 202301100162	Genotyping and virulence analysis of white spot syndrome virus.	Shashi Shekhar M.
22	FISHCIBASIL 202301200163	Evaluation of stress mediated immunological and physiological response in brackishwater candidate species by flowcytometry.	Shashi Shekhar M.
23	FISHCIBASIL 202301300164	Application of gene editing technologies (CRISPR/Cas) for disease diagnosis.	Poornima M.
24	FISHCIBASIL 202301400165	Interaction of *Enterocytozoon hepatopenaei* (EHP) and Vibrio spp. in disease outcome and their therapeutics.	Ananda Raja R.
25	FISHCIBASIL 202301500166	Aquaculture pond ageing on soil, water quality and crop productivity in shrimp culture ponds.	Kumararaja P.
26	FISHCIBASIL 202301600167	Fish diseases and their management with special reference to Amyloodinium ocellatum and other parasites.	Vidya Rajendran
27	FISHCIBASIL 202301700168	Field evaluation of *Enterocytozoon hepatopenaei* (EHP) therepeutic CIBA EHP cura I.	Sathish Kumar T.
Externally funded project			
28	FISHCIBASOL 202200700124	National Surveillance Programme for Aquatic Animal Diseases (NSPAAD) - 2. National Referral Laboratory for Brackishwater Fish Diseases.	Subhendu Kumar Otta
29	FISHCIBASOL 201800400096	Indian Network for Fisheries and Animals Antimicrobial Resistance (INFAAR).	Subhendu Kumar Otta
30	FISHCIBASOL 202000200105	All India Network project on fish health.	Patil PK.
31	FISHCIBASOL 202201400131	Development of molecular diagnostics for differentiation of pathogenic and non-pathogenic Vibrio species in aquaculture.	Sujeet Kumar
32	FISHCIBASOL 202200600123	National Surveillance Programme for Aquatic Animal Diseases (NSPAAD) - 1. National Surveillance Programme for Aquatic Animal Diseases in Tamil Nadu.	Ezhil Praveena P.
33	FISHCIBACOP 201100100057	National Innovations in Climate Resilient Agriculture (NICRA) - Developing sustainable adaptive and mitigation strategies for climate smart brackishwater aquaculture.	Muralidhar M.
34	FISHCIBASOL 202201200129	Development of probiotics and immunostimulants for shrimp.	Patil PK.
35	FISHCIBASOL 202201500132	Development of point of care diagnostics for the detection of major shrimp pathogens WSSV and EHP.	Sathish Kumar T.
36	FISHCIBASOL 202200300120	Novel approaches for disease-free health certification in finfish and development of high health shrimp for sustainable aquaculture.	Subhendu Kumar Otta
37	FISHCIBASOL 202201300130	Development of microalgae based improved delivery method for control of shrimp White Spot Syndrome Virus (WSSV) in culture ponds.	Subhendu Kumar Otta
38	FISHCIBACOL 202100800116	Precision brackishwater aquaculture using Machine Intelligence.	Muralidhar M.
39	FISHCIBASIL 202301100162	Genome sequencing and its application for Brackishwater Aquaculture.	Shashi Shekhar M.
40	FISHCIBASOL 202300200138	IoT based water and soil health monitoring systems with affordable indigenous sensors for intensive aquaculture.	Muralidhar M.

S.No		Project Title	Principal Investigator
Nutrition, Genetics & Biotechnology Division			
Institute funded projects			
41	FISHCIBASIL 202301800169	Identification and evaluation of diversified feed ingredients for their utility in shrimp and fish feeds for sustainability.	Ambasankar K.
42	FISHCIBASIL 202301900170	Development, testing and demonstration of newer feeds and feed management strategies.	Ambasankar K.
43	FISHCIBASIL 202302000171	Collection and breeding of wild marine polycheat worms.	Kannappan S.
44	FISHCIBASIL 202302100172	Production and management of live feeds for use in aquaculture.	Kumaraguru Vasagam K. P.
45	FISHCIBASIL 202302200173	Molecular approaches for solutions directed towards the management of diseases and feed for aquaculture species.	Vinaya Kumar Katneni
Externally funded projects			
46	FISHCIBASOL 202000300106	Investigations on dietary alterations in shrimp for abiotic stresses using nutrigenomics approach.	Ashok Kumar J.
47	FISHCIBASOL 202300600138	Atlas of Climate Adaptation in South Asian Agriculture.	Ashok Kumar J.
48	FISHCIBASOL 202000100104	Whole genome sequencing of brackishwater aquaculture candidate species and development of genomic resources.	Vinaya Kumar Katneni
49	FISHCIBASOL 202100200110	Development of grow-out technology for mass culture of sand and muddy polychaete worms and assessment of their seasonal nutritional profiling for use in shell and finfish hatcheries.	Kannappan S.
50	FISHCIBASOL 202100400112	Solid state fermentation technology for development of cost effective customized plant protein products as fishmeal alternate for shrimp feed.	Syama Dayal J.
51	FISHCIBASOL 202100500113	Unravelling signatures of growth and salinity adaptation in Etroplus surentensis through omics approaches.	Vinaya Kumar Katneni
52	FISHCIBASOL 202300400136	New age shrimp rearing system for precise use of land, water and feed.	Kumaraguru Vasagam K. P.
53	FISHCIBASOL 202300700139	Unravelling signatures of dietary protein sparing and fibre tolerance in Penaeus vannamei for development of cost effective feeds through omics approaches.	Syama Dayal J.
Social Science Division			
Institute Funded Project			
54	FISHCIBASIL 202302300174	Demonstrations of ICAR-CIBA nursery and grow-out technologies for livelihood upliftment and skill development of SC and tribal communities of coastal Odisha.	Ravisankar T.
55	FISHCIBASIL 202302400175	Economic Analysis in brackishwater aquaculture production marketing and trade sectors.	Sairam C. V.
56	ISHCIBASIL 202302500176	Brackishwater Aquaculture Technologies Integrated with Agro-Based Technologies for Livelihood Development of Communities.	Shanthi B.
57	FISHCIBASOL 202300200139	Livelihood analysis on gender participation in aquaculture sectors and impact of environmental changes and challenges faced by coastal families.	Shanthi B.
58	FISHCIBASIL 202302600177	Brackishwater aquaculture led integrated livelihood development for the coastal SC families in Mayiladuthurai district of Tamil Nadu.	Kumaran M.
59	FISHCIBASIL 202302700178	Diversification of farming activities for alternate sustainable livelihood of fisherfolk in Tamil Nadu and Karnataka.	Geetha R.

S.No		Project Title	Principal Investigator
Externally funded projects			
60	FISHCIBASOL 202200100118	Promotion of Integrated Multi-trophic Aquaculture (IMTA) Technology for income generation and optimum use of bio-resources.	Deboral Vimala
61	FISHCIBACOL 202200500122	Production Systems, Agribusiness and Institutions - Component 1 : Impact of Agricultural Technology.	Geetha R.
62	FISHCIBASOL 202300500137	Development and pilot scale implementation of crop insurance solution for sustainable shrimp farming.	Ravisankar T.
63	FISHCIBASOL 202200400121	Establishment of DBT Rural Bioresources Complex at Ramanathapuram District, Tamil Nadu.	Mahalakshmi P.
64	FISHCIBASOL 202300200140	Front line demonstration on mudcrab and blue swimmer crab in polyculture and monoculture systems	Mahalakshmi P.
Kakdwip Research Centre (KRC)			
Institute funded projects			
65	FISHCIBASIL 202302800179	Demonstration and dissemination of brackishwater aquaculture technologies for livelihood development of SC and ST communities of Sundarban.	Debasis De
66	FISHCIBASIL 20230290180	Field validation and economic evaluation of effectiveness of *Plankton* ^{Plus} in agriculture, horticulture and aquaculture for livelihood improvement of SC and ST communities of India.	Debasis De
67	FISHCIBASIL 202303000181	Captive breeding and seed production of candidate brackishwater species of eastern region of India.	Debasis De
68	FISHCIBASIL 202303100182	Development and demonstration of sustainable and economically viable brackishwater aquaculture models for Eastern region of India.	Sanjoy Das
		Externally funded project	
69	FISHCIBASOL 202100100109	Captive Breeding of Hilsa, Tenualosa ilisha: Phase II	Debasis De
Navsari Gujarat Research Centre (NGRC)			
Institute funded project			
70	FISHCIBASIL 202303200183	Development of sustainable and cost-effective brackishwater farming technologies for shellfish and finfish in the western region.	Akshya Panigrahi
71	FISHCIBASIL 202303300184	Demonstrations of brackishwater aquaculture technologies for livelihood upliftment and skill development of tribal communities of Western region	Pankaj Amrut Patil
72	FISHCIBASIL 202303400185	Livelihood enhancement and skill development of SC communities in Gujarat through demonstration of brackishwater aquaculture technologies	Jose Antony
Externally funded project			
73	FISHCIBASOL 202100900117	Pilot Project on cage culture of Asian seabass, *Lates calcarifer* and *Pearlspot Etroplus* suratensis in brackishwater creeks as an alternate livelihood for coastal fisher folks of southern Gujarat.	Pankaj Amrut Patil



Divisional Profiles

Crustacean Culture Division

Crustaceans are the most traded and valuable seafood commodity. The evolution of crustacean farming, particularly Indian shrimp farming, from an embryonic industry of 1980 to today's mature and sophisticated industry has been spectacular. Crustacean culture Division of CIBA is one of the pioneering divisions that focus on sustainable crustacean aquaculture. The division is mandated to develop focused research and development in order to improve knowledge and technologies needed for increasing the efficiency of production of currently farmed crustaceans, and increasing the number of species farmed and diversifying the farming system for sustainable brackishwater aquaculture We constantly renew and refine our technologies to deliver technology-backstopping and services based on the latest scientific knowledge. The division provides high quality research, training, knowledge partnership programmes and consultancy on brackishwater crustacean farming. The stake holders of research outputs of the division include farmers, entrepreneurs, regulatory agencies industrialists, young professionals and students. For the last thirty seven years, this division has contributed and led the way in advancing crustacean aquaculture in India. The division works on captive maturation, induced maturation, issues in larval rearing, growth physiology, stock improvement and various aquaculture production systems from monoculture to integrated multi-trophic aquaculture systems. The major focuses are: how high quality stockable seeds are produced; how reproduction is controlled at organismic and functional level, and how efficiently can manage the crustacean husbandry by using science based management strategies. The division has been actively collaborated with various national and international agencies. The division has well established research hatcheries, wet laboratory facilities, sophisticated advanced laboratories and grow-out production systems. The multi-disciplinary team of the division includes crustacean biologists, farming system researchers, biotechnologists, and aquaculture engineers.

Finfish Culture Division

The division is actively engaged in developing comprehensive practices for captive breeding, larval rearing, nursery management, and grow out culture of candidate brackishwater finfish species. These include Asian seabass (Lates calarifer), Mangrove red snapper (Lutjanus argentimaculatus), Milkfish (Chanos chanos), Grey mullet (Mugil cephalus), golden-lined spine foot rabbitfish (Siganus lineatus), Goldlined Seabream (Rhabdosargus sarba), Pearlspot (Etroplus suratensis), as well as ornamental finfish species like Silver moony (Monodactylus argentimaculatus), spotted scat (Scatophagus argus), among others. The division plays a crucial role in enhancing species diversification in brackishwater aquaculture to effectively utilize the brackishwater resources by adopting different farming systems such as cage culture, pen culture, IMTA and RAS based rearing systems. The division is also associating closely with the stakeholders/farmers and provides technical guidance to establish fish hatcheries, nursery rearing and farming systems on consultancy basis. Furthermore, it conducts tailored training programs/ interaction meets to address the specific needs of stakeholders.

Nutrition, Genetics & Biotechnology Division

Nutrition, Genetics and Biotechnology Division of Central Institute of Brackishwater Aquaculture is the pioneer in Aquaculture Nutrition research in India. Feed being the major and critical input in aquaculture considerable thrust was given to feed development programmes. The division has developed cost-effective, environmentally sustainable, efficient, and indigenous feed processing technologies for the brackishwater aquaculture candidate shell and finfish species for their all-life stages. Functional feeds for broodstock, larvae, and specialty feeds to address the niche markets are also being developed by the division. The division is having complete nutritional data base of various feed resources available in India and this helped in use of novel feed ingredients and custom made feed formulations. The division has carried out extensive research on fishmeal replacement by using customized enzyme mixtures and solid state fermentation technology. The focussed research programmes implemented by the division lead to the development and commercialisation of several feed technologies in the country to benefit the small and medium scale farmers. Currently, the division is focusing on sustainable and functional feeds and nutrigenomic applications for improving the efficiency of feed.

In Genetics and Biotechnology, the division focused on genetic characterization of candidate aquaculture species, development and utility of markers and genes for improving economic traits. Whole genome of Penaeus indicus, Mugil cephalus and Lutjanus argentimaculatus were sequenced and assembled. Pathogens like Vibrio campbelli and Vibrio parahaemolyticus genomes were completely sequenced and assembled. The division is having in–house capability for bioinformatics and developed a bioinformatics tool 'Missing Regions Finder' (MRF) which rapidly tabulates and depicts complete and partial missing CDS in a query genome when compared to a reference genome. Division also developed first open-access SNP search database 'dbVAST' for shrimp. The division is actively involved in Population genetics and genetic improvement programme of P. indicus.

Aquatic Animal Health And Environment Division

Aquatic Animal Health and Environment Division constitutes multi-disciplinary expertise in Biotechnology, Parasitology, Microbiology, Pathology, Fish health and Soil chemistry/ fertility. The division is engaged in surveillance for aquatic animal diseases, development of diagnostics, prophylactics and therapeutics. In addition, the division is also involved in various research aspects of climate change impacts on aquaculture production systems, soil health and water management. The division has developed and commercialised many products related to disease diagnosis and therapeutics and soil and water quality parameter analysis kits for aquaculture industry. The division has a state of art NABL accredited disease diagnostic laboratory which offers service to aquaculture farmers for timely detection and screening of pathogens which helps to maintain the best management practice and biosecurity protocols required for sustainable brackishwater aquaculture production. With an aim towards capacity building and skill development, the division also undertakes suitable and regular training programmes, demonstrations and consultancy programmes for the aquaculture farmers and stakeholders.

Social Science Division

Aquaculture extension and policy interventions buttress need-based technology development and sustainability of aquaculture sector. The research and extension activities of the division aim to develop system specific pragmatic extension approach/strategy and good practices intend to improve the knowledge and skill capacities of the end users and facilitate forward and backward linkages that would contribute for the increased aquaculture production, income and societal development. Similarly, techno-socio-economic assessment of aquaculture systems, feedback on technologies and their impact at the micro and macro levels, market and trade analyses are given due thrust which contribute for evolving appropriate policy advisories for refinements in aquaculture planning, regulation and supportive mechanisms for sustainable development of the sector. The social science research also give adequate focus on "reaching the unreached" viz., small scale aquaculture farmers, socio economically vulnerable communities and entrepreneurs through front-line extension, Information and Communication Technology (ICT) applications and outreach programmes.

Kakdwip Research Centre

The Kakdwip Research Centre (KRC), one of the oldest research centres of ICAR-CIBA, is located in Kakdwip, West Bengal, between two tributaries of the sacred river Ganga, in the natural scenic grandeur of Sundarban (21° 51′ 28.8″ N, 88° 11′ 1.9″). The Kakdwip Research Centre (KRC) was established in 1968 as a brackishwater experimental fish farm under the Central Inland Fisheries Research Institute (CIFRI), Barrackpore. It was then transferred to the ICAR-Central Institute of Brackishwater Aquaculture (CIBA), Chennai, on April 1, 1987, to promote research and offer technological support to the country's developing brackishwater aquaculture industry. The KRC is well connected to the rest of the country via road, rail, and air. Netaji Subhash Chandra Bose International Airport in Kolkata is 130 kilometres from the centre and can be reached by road NH 117 or by local suburban train via the Namkhana-Sealdah route. The centre has cutting-edge farm facilities, and well-equipped laboratories to meet the demands of brackishwater aquaculture research, training (HRD), outreach, and demonstration. The centre now has Head of Regional Centre with 6 scientists, 1 technical officer, and 1 support staff to administer the centre's research activities. KRC covers a total of 17 hectares, which includes a bheri. The office building, library, seminar hall and laboratories are all placed in the same block at the centre's

entrance. The centre also features a visitor accommodation facility, the Hilsa trainees' hostel, as well as well-maintained quarters for in-house scientists and personnel. The farm facilities are separated into three sectors: A, B, and C, each having its own set of earthen ponds used for diverse research purposes. The wet lab complex includes three experimental yards including one hatchery unit, an indoor and outdoor live feed unit. The centre also has state of art feed mill facilities equipped for preparing sinking and floating pellet feed for experiments and demonstrations on farmers' fields. The center's recent additions include a farm sale counter called "The Kiosk" for selling farm product, as well as a recreation area with indoor games and a badminton court. The centre has various farming technology and goods to its name. Biosecured zero water exchange shrimp farming, polyculture technique for brackishwater fishes, breeding and seed production of Hilsa, Yellowfin bream, Mystus gulio, and products such as Plankton plus, Horti plus, and Poly plus are among the most notable.

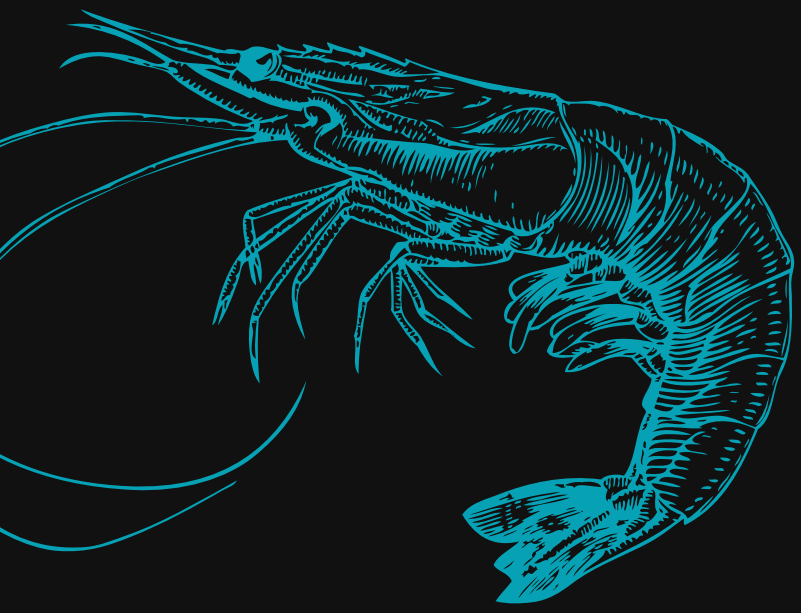
Nasari-Gujarat Research Centre

Navsari Gujarat Research Centre (NGRC) is the regional station of ICAR-CIBA on the Indian West coast, strategically located in the South Gujarat region, which has developed as one of the most intensive shrimp farming hubs in the country. The centre is located in the Navsari district of Gujarat, 30 km south of Surat city, within the Navsari Agricultural University campus at Eru Char Rastha. The centre also has an experimental station with a 10 ha brackishwater research farm, situated on the Dandi heritage road, in Matwad village, 4 km west of the historical Dandi village that played a key role in the Indian freedom struggle. The centre was established in 2018 to carry out cutting-edge research on frontier areas of brackishwater aquaculture. The centre mainly focuses on developing location-specific farming and breeding technologies for the Gujarat coast, field testing of CIBA technologies before disseminating to the farming community, capacity building, and livelihood enhancement activities for aqua farmers, coastal, tribal, and economically weaker communities. Cage-based community spawning of pearlspot, Etroplus suratensis, and a simple and cost-effective recirculatory system for large-scale seed production have been developed at the centre. The technology is found suitable for small homestead ponds and women SHGs where 20,000 fries can be easily produced in a month. The technology overcomes several key constraints in broodstock maintenance and spawning of the species. On the industry front, the centre has successfully demonstrated the commercial farming of Indian white shrimp (Penaeus indicus), whiteleg shrimp (P. vannamei), and the giant tiger prawn (P. monodon).

Research Highlights

01

BRACKISHWATER PRODUCTION SYSTEM

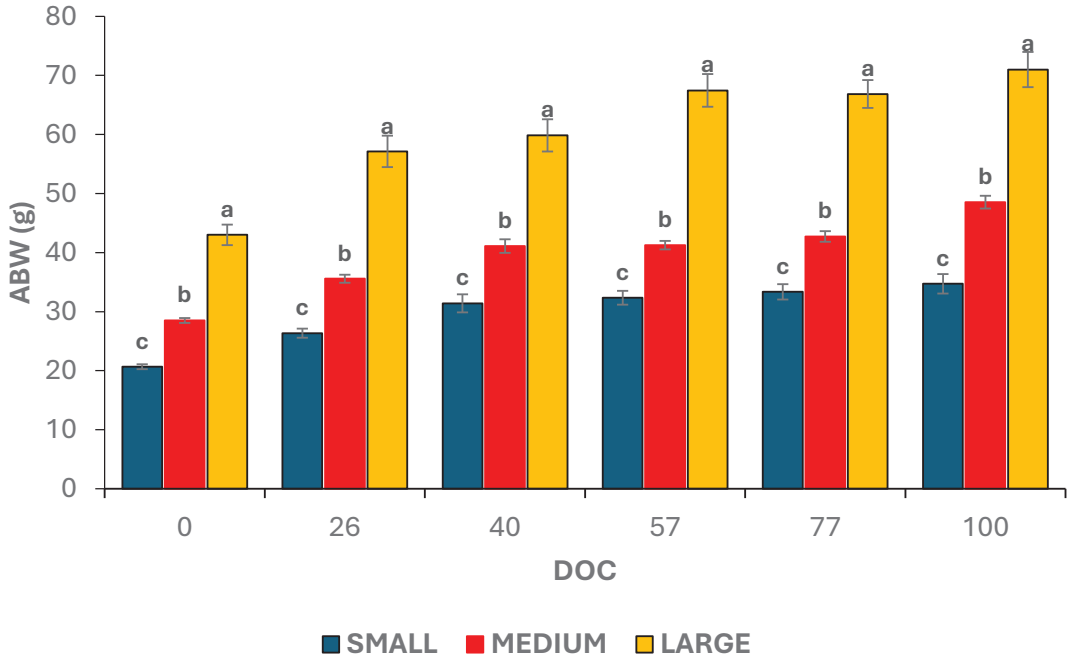


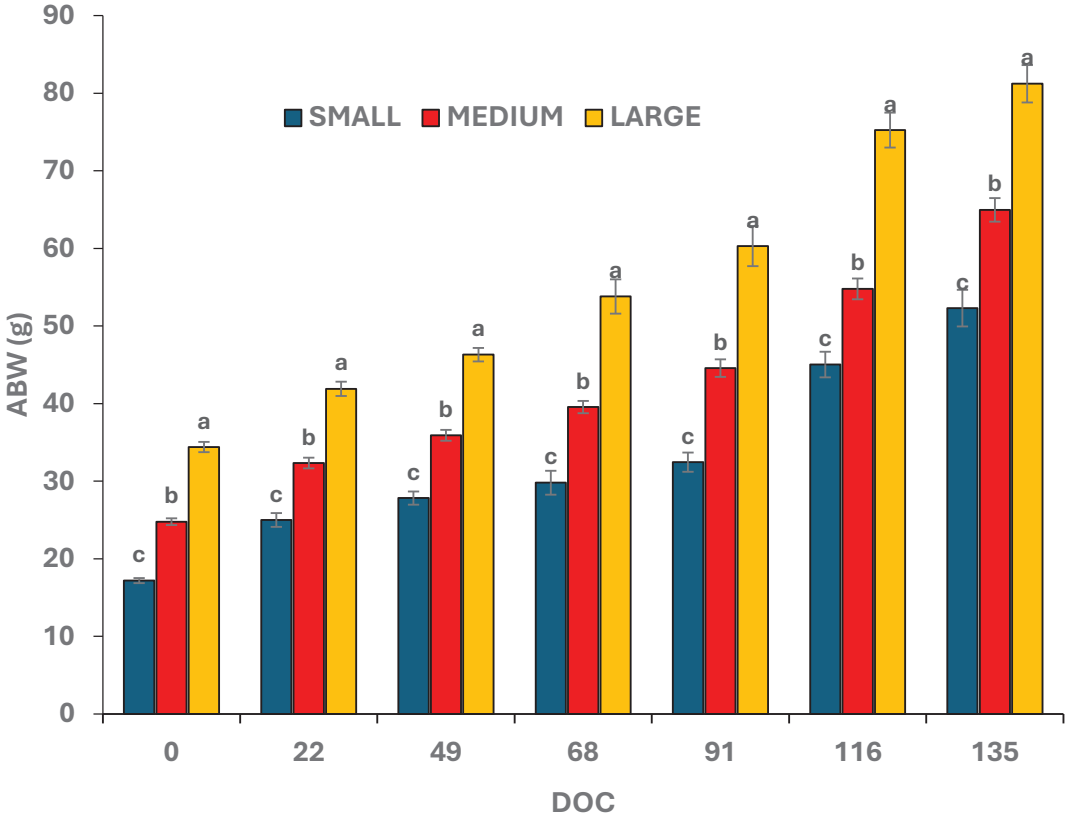
BRACKISHWATER PRODUCTION SYSTEM

Optimizing the pre growout farming practices for pearlspot, *Etroplus suratensis*

Pearlspot is a high-value brackishwater finfish species, although its large-scale farming is limited by poor growth rate. Experimental trials were conducted to optimize its farming practices in the earthen ponds. Pearlspot fry nursery reared for 117 days (4000 nos, TL: 2.5-3.5 cm) were size sorted depending on their body weight into two sets (Set 1 & 2) consisting of three size classes viz., small (S), medium (M), and large (L). The size classes were subsequently reared separately in 2 m x 2 m x 1.75 m hapas installed in an earthen pond at 400 nos./hapa (100 nos./m^3). The mean body weight of fish was significantly different ($p<0.05$) for all three size classes across sampling intervals for both sets. The size class 'Large' resulted in the highest mean body weight followed by 'Medium' and 'Small'. The daily weight gain (DWG; g/day) was significantly higher ($p<0.05$) for fishes of size class L in both sets (S1 & S2) whereas DWG was similar for size classes M and S at certain sampling intervals. However, the WG (%) and SGR were significantly higher for fishes of size classes M and S at most sampling intervals or at times similar to fishes belonging to the large group in both sets. The higher growth rate observed in fishes of size classes M and S is due to a part of the population attaining higher body weight similar to the 3rd and 4th quartile of large-sized fish. The trial indicates the social hierarchy in pearlspot fish and size grading followed by separate rearing improves the growth of small and medium-sized fish.

Pre-growout rearing of size sorted pearlspot juveniles (Large, medium and small groups) in hapas installed in earthen pond

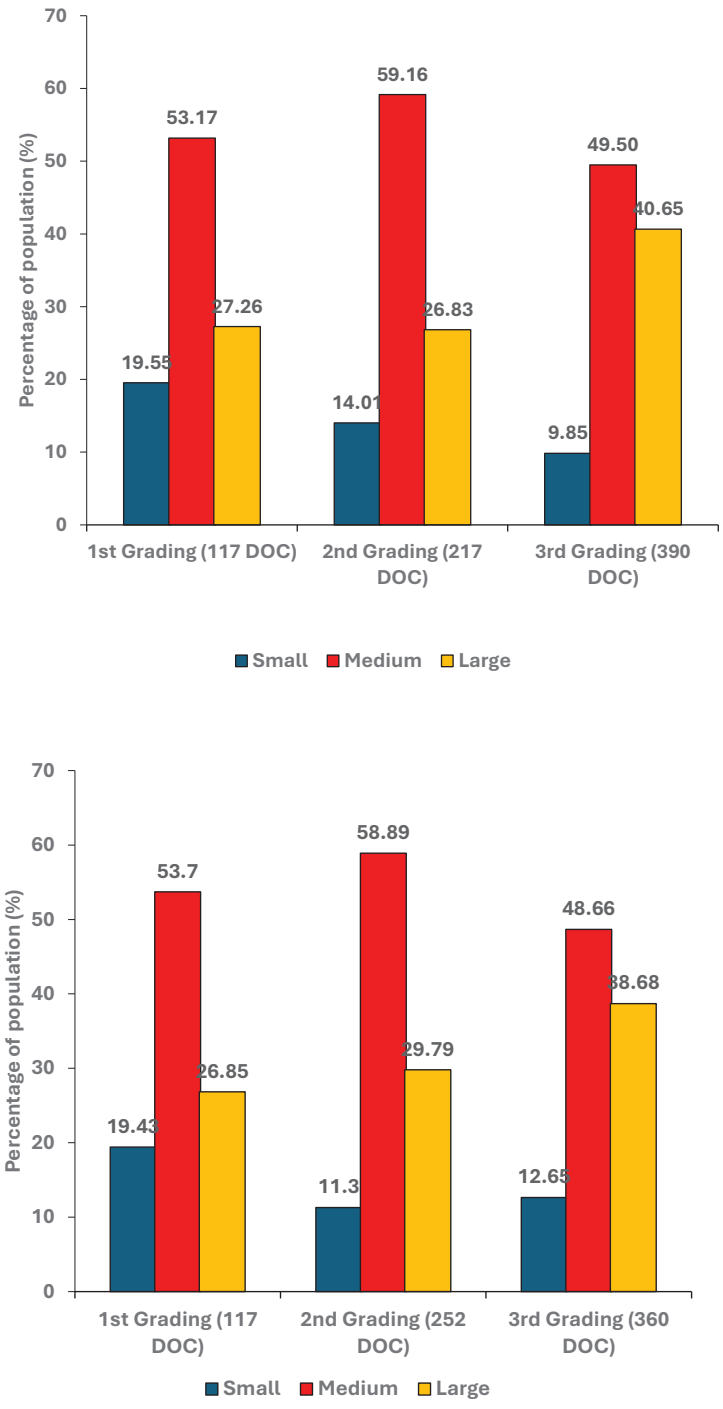




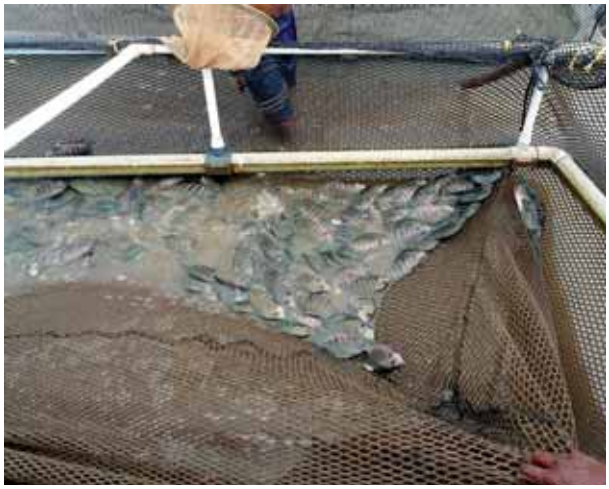
Mean body weight of pearlspot fish of different size classes across sampling intervals for Set 1 (a) and Set 2 (b) reared for 100 days and 135 days respectively

Size grading improves the growth rate and population structure of pearlspot in cages

Grading of pearlspot fish to three size classes viz., small, medium, and large, based on their body weights followed by separate rearing was evaluated as a strategy to (a) segregate fast growing fish that achieves marketable sizes within short periods and (b) improve growth of small and medium sized fish. Pearlspot fry reared in two sets (Set 1 & 2) was size sorted at the end of 117 days of nursery rearing (nursery phase). This resulted in identical proportions of small (19.4-19.6%), medium (52.6-53.7%), and large (26.8-27.6%) individuals in both sets. The size sorted fishes were further reared separately in hapas (400 nos./hapa) for 100 days in the case of set 1 and 135 days for set 2, before the 2nd size grading (pre-growout phase). The proportion of small fish reduced from 19% to 14% and proportion of medium fish increased from 53% to 59% in the case of set 1. In set 2, the percentage of smaller fish reduced from 19% to 11% and that of medium sized fish increased from 53% to 58%. The proportion of large sized fish did not vary significantly, post the 1st grading for both sets. Following this, size sorted fishes from set 1 was stocked to cages (5m x 2m x 2m) as large, medium, and mixed (combination of S, M, and L) at 500 nos./cage and fishes from set 2 were further reared separately in hapas as small, medium, and large at 200 nos./hapa (growout phase). The fishes were subjected to final size sampling after 173 days and 108 days for set 1 and set 2 respectively to determine the population structure. The proportion of large, medium, and small fish changed to 40.6%, 49.5% and 9.8% respectively in set 1 and 38.6%, 48.6% and 12.6% respectively for set 2. The proportion of large sized fish increased significantly post the 2nd size grading, whereas the proportion of small sized fish reduced significantly. The trial clearly demonstrated the benefits of size grading in improving the population structure of pearlspot fish and adoption of the technique can help farmers to obtain continuous and larger income.



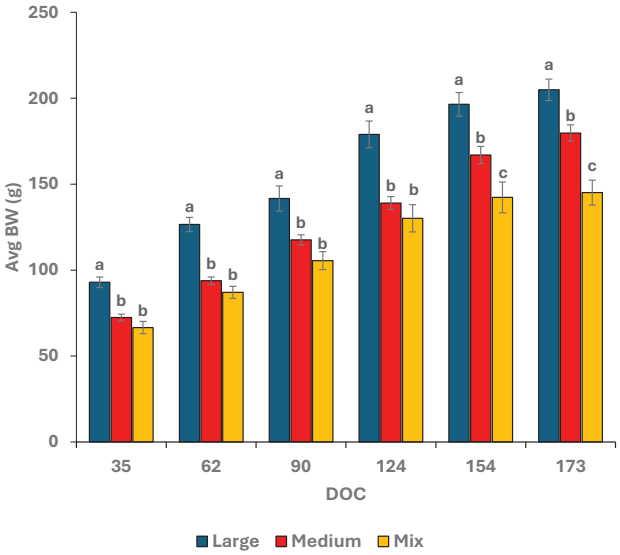
Proportion of small, medium, and large individuals in pearlspot population during the 1st, 2nd and 3rd grading for set 1(a) and set 2(b) during nursery, pre-growout and growout phase.



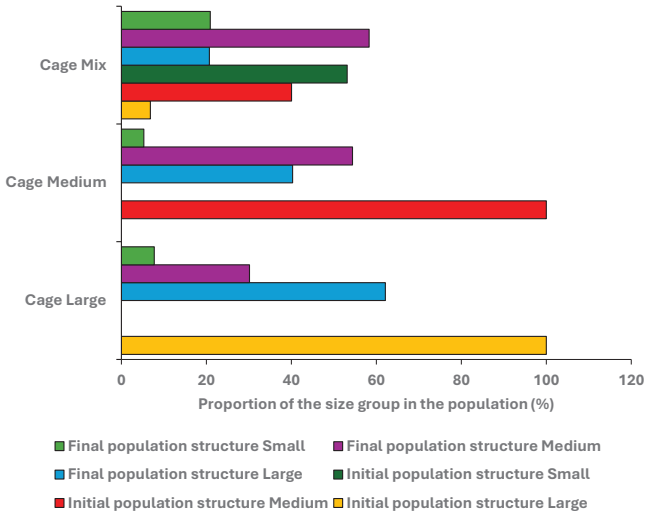
Final sampling of marketable size pearlspot reared in pond-based cages

Growth characteristics of pearlspot, *Etroplus suratensis* in pond-based cage culture

Natural breeding of pearlspot in brackishwater ponds affects the growth of the animals as feed would be used for reproduction rather than somatic growth, thus affecting its productivity. An alternative to this issue is the pond-based cage culture of the species at high densities. Cage culture of pearlspot sub adult fish, obtained from pre-growout operations, was carried out in 5 m x 2m x 2m cages installed in a pond at 500 nos./cage (50 nos./m3). Size sorted sub adult fish of average body weight, 74.06 g (large), 48.13 (medium) and 48.5 (mixed: combination of small, medium, and large) were stocked in the cages. The final body weight at the end of 173 days was significantly different ($p<0.05$) between large (204.8g), medium (179.7g) and mixed cages (145.1g). Survival rate was 100% in all the cages and the cage with large sized individuals resulted in total biomass of 110.6 kg and productivity of 11.0 Kg/m^3 within a 6-month rearing period. The production characteristics obtained during the pond-based cage culture is economically sustainable for



Mean body weight of fishes in large, medium, and mixed cages during the 173 days growout trial in pond-based cages



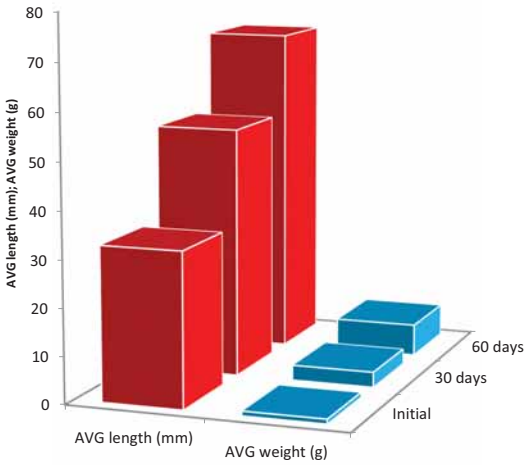
Proportion of small, medium, and large individuals in different cages at the time of stocking and at the end of 173 days culture

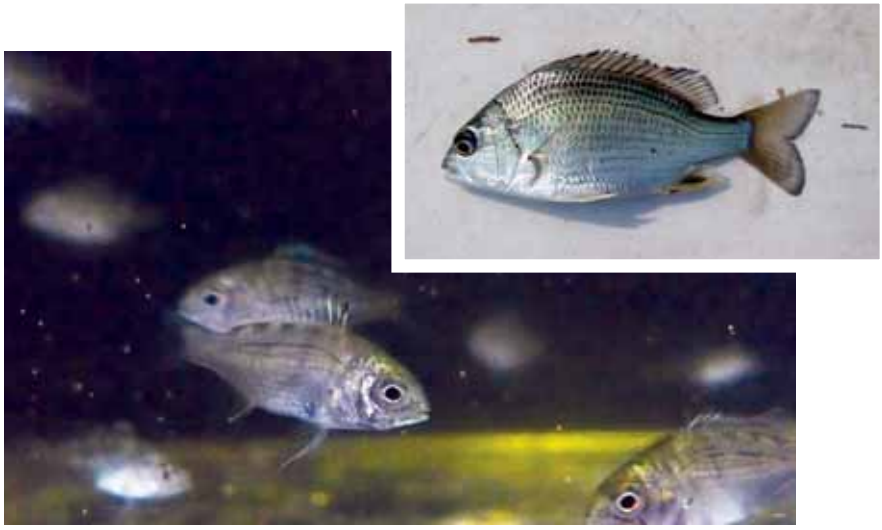
large scale production of pearlspot. The SGR and WG (%) was occasionally, significantly higher in the medium size group as few individuals attained body weight similar to fish in the large size group. However, the daily weight gain was higher for large sized fish. Overall, pond-base cage culture is a promising technology for farming of pearlspot.

Pond-based cage culture of size sorted pearlspot fish in cages of size 5 m x 2 m 2 m installed in earthen pond

Outdoor nursery rearing of Bengal yellowfin bream (*Acanthopagrus datnia*) fry in hapa based system

An outdoor nursery rearing trial was conducted with hatchery produced Bengal Yellowfin Seabream larvae to develop complete package of practices for seed production Weaned Bengal yellowfin bream juveniles, of 45 days old were acclimatized to 7 ppt salinity and shifted to hapa based nursery systems. Stocking density was maintained at 50 no/ m^3 in 2X1X1 m hapa. Initial length and body weight was 32.8 ± 0.05 mm and 1.0 ± 0.02 g. Feeding was done with formulated feed of CP 30 % at the rate of 5 % body weight twice a day. After two months of nursery rearing fishes gained average weight 6.8 ± 1.16 g. The occurrence of shooters were observed during the nursery phase that can result in low survival, necessitating the need for grading during this phase.





Growth of hatchery produced Bengal bream, fry (a) and juveniles (b) after 60 days of rearing

ICAR-Central Institute of Brackishwater Aquaculture has successfully achieved the first-ever captive spawning and larval production of Bengal yellowfin seabream (*Acanthopagrus datnia*) at KRC, West Bengal

Bengal yellowfin seabream (*Acanthopagrus datnia*) belongs to the sparidae family, majorly distributed in the Bay of Bengal region and has high demand and market price (₹ 300 to 400/ kg) owing to its white tender meat. Quality seed availability hindered the aquaculture expansion and till now it is only grown traditionally in Bheries of West Bengal. Hence, broodstock development and trials on induced spawning were carried out in the Recirculation Aquaculture System (RAS) facility at Kakdwip Research Centre of ICAR-CIBA. Animals were successfully bred, and 30000 larvae were produced. Globally this is the first report on captive spawning and larval production of Bengal yellowfin seabream (*A. datnia*). This achievement marks a significant milestone for hatchery-based seed production of Bengal yellowfin seabream in India leading to new opportunities for aquaculture in the near future through species diversification in the country.

Evaluation of zero input Agri-horti-poultry system at Kakdwip Research Centre:

A zero-input integrated aqua-horti-poultry system was developed at Kakdwip Research Centre of ICAR- CIBA farm to demonstrate cost effective sustainable brackishwater aquaculture farming which requires no supplementary feed or fertilizers. The performance of this system was compared with control ponds using commercial feed. The gross profit margin ratio of this system was compared to that of traditional brackishwater polyculture integrated farming, which relies on supplementary feed. This system, involved species such as Long whiskers catfish, Milkfish, Pearlspot, Tilapia, Tade Mullet, and tiger shrimp, stocked at 1 individual of each species per square meter. Lime ($CaCO_3$) was applied at 200 kg/ha 15 days and at 30 Kg/ha on weekly basis post stocking. The trial is currently ongoing for the last two months and data will be compared at the end of the trial.

Production of stunted fingerlings for better growth and productivity of mullets in polyculture models

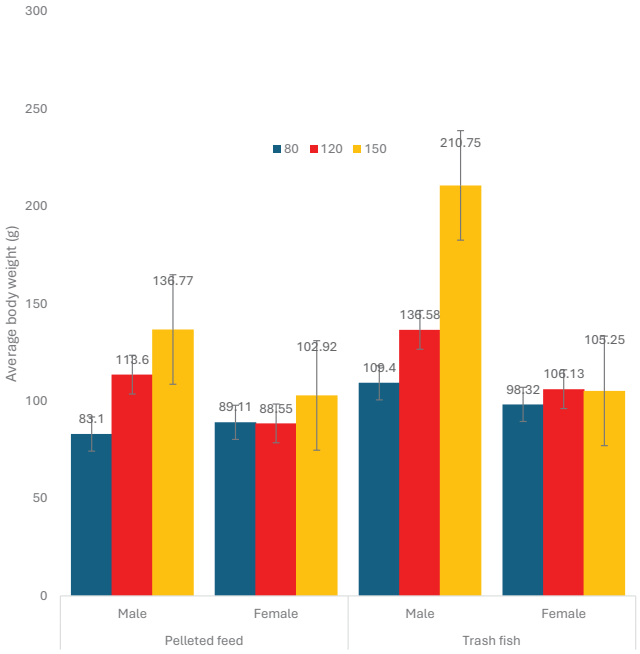
Tade mullet (*Liza tade*) is a regionally important mullet species in eastern India that naturally occurs in Sundarbans. It is widely cultured in both brackish and freshwater mono and polyculture fish ponds. It has high-quality flesh, superior growth, wide salinity and temperature tolerances, and an omnivorous feeding habit. It also has a good consumer preference in the domestic market where it fetches ₹ 300 – 500/kg. Traditionally, extensive polyculture farming is being practiced by farmers in bheries to culture tade mullet. To develop a sustainable aquaculture models for eastern region of India, a trial

Stunted fingerlings of Tade mullet after 11 months of stunting in cages

on stunted tade mullet juvenile production and its effect on subsequent growout culture was performed in 3 m x 3 m x 1.2 m *L. tade* fingerlings (ABW: 3.8 ± 1.1 g) were procured and stocked at two different stocking densities of 80 (T1) and 100 (T2) no/m^3. 20 no/m^3 stocking density was adopted for control group. Fishes were fed using Poly Plus feed (Crude Protein 25 %) @ 1 % body weight. After 11 months of rearing in cages, survival percentage was significantly higher (100 %) in Control what happened to T2? they might have missed its survival rate. adding a line to conclude would have bee fine as there is not much of a variation among the three.

Growout comparison of nursery reared *Scylla olivacea* using formulated feed and trash fish

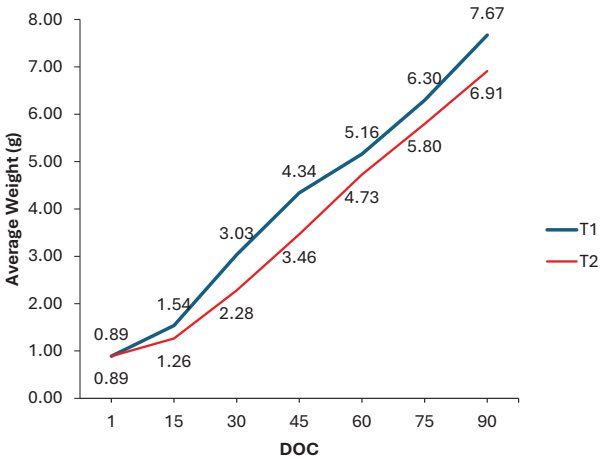
Nursery reared, *Scylla olivacea* crablets of size 20-25 g body weight was stocked at a density of 0.5/m^2 in earthen ponds and was reared on pelleted feed and trash fish for studying the growth potential for 150 days. Crabs attained a body weight in the size range of 80-90 gm at 80 days of culture in both the experimental groups and significant difference was not observed. Body weight of the female crabs stayed in the range of 80-120 gm at the end of 150 days in both treatment groups. However, the body weight of the males was showing constant growth in both the experimental groups, with peak growth of 210±34 g during 150 days of culture. There was no significant difference in Growth pattern between the crabs reared with trash fish and pelleted feed. This shows that the crabs can be easily adapted to the artificial feed and dependence on the trash fish can be reduced. Female crabs attaining a size of 80-120gm within a period of 80 days is beneficial and can act in future as a supply chain to the box based fattening system. Due to the burrowing behavior, the recovery of the crabss for final survival estimation was poor, which is a major bottleneck in the pond-based farming of the species.



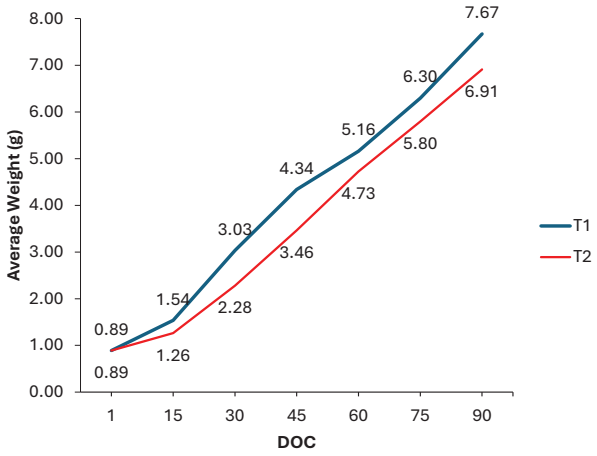
Growth of male and female *Scylla olivacea* in earthen ponds reared on trash fish and pelleted feed.

Density dependent growth performance of Indian white shrimp, *Penaeus indicus* during the winter season

A 150-day experiment was undertaken to evaluate the density dependent growth performance of Indian white shrimp, *Penaeus indicus* during the winter season (Sep, 2024-Feb, 2025). *P. indicus* juveniles (~0.89 g) were stocked at two densities viz., 0.3 nos L^{-1} (T1) and 0.5 nos L^{-1} (T2), in indoor circular tanks (18 tonne) and reared in brackishwater of salinity 15 ppt. The shrimp were fed using 38% crude protein feed, four times a day according to their body weight. To ensure optimal water quality, water exchange



Growth performance of *Penaeus indicus* stocked at two different stocking densities in indoor circular tanks during the winter season



Mean water temperature (°C) during the 90 days experiment in winter season

Indoor farming of *P. indicus* during the winter season

was performed on daily basis. At the end of 90 DOC, shrimp attained an average body weight of 7.67 and 6.91 g in T1 and T2, respectively. The culture is currently under progress and shrimp will be harvested in February, 2025.

Comparative evaluation of multi-polyculture and polyculture farming

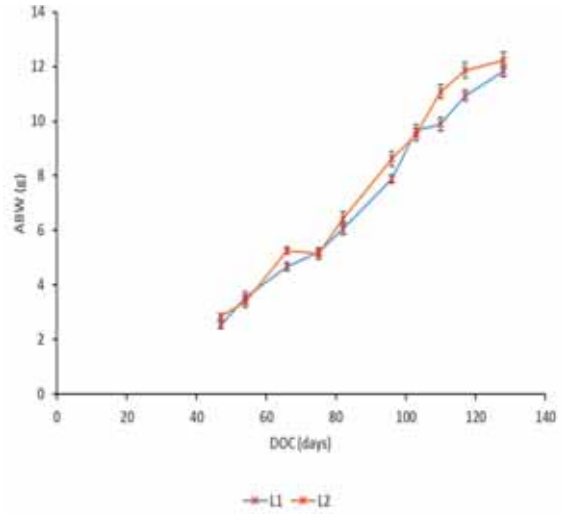
A 240 days experiment was undertaken to compare the growth performance of fish in two polyculture systems viz., (a) multi-polyculture model comprising of seabass and pearlspot culture in pond-based cages, mud crab farming in floating boxes and polyculture of milkfish and pearlspot in open space and (b) polyculture model consisting of traditional mixed culture of milkfish and pearlspot. Seabass was fed with 45% CP feed whereas milkfish and pearlspot fingerlings were fed 32% CP feed according to biomass twice daily. Crabs were fed trash fish once in two days. In the case of multi-polyculture, 348 kg seabass and 203.8 kg pearlspot were harvested from cages; and an additional 87.6 kg pearlspot,

Indian white shrimp harvest from earthen pond at the end of 138 DOC

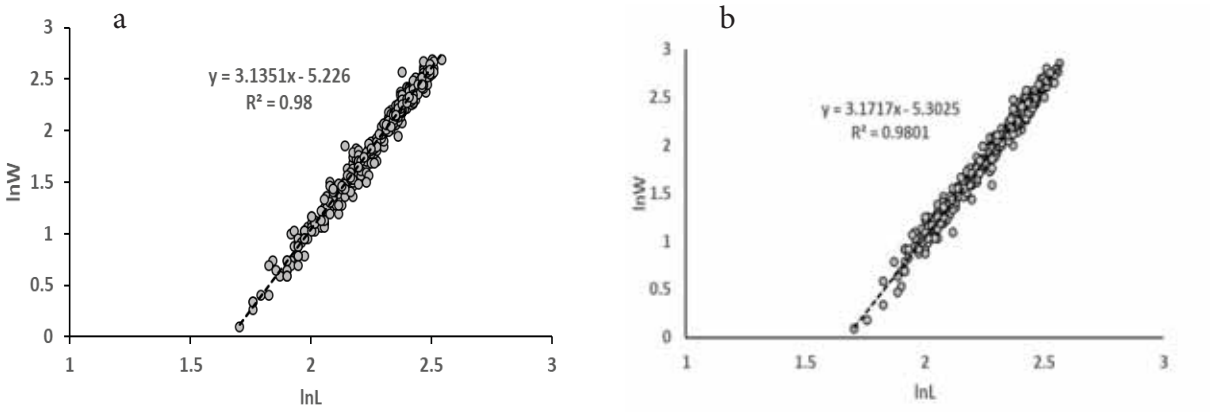
288 kg milkfish and 224.5 kg mud crabs were harvested from the open space outside the cages. Whereas, in the conventional polyculture system, 106.9 kg of pearlspot and 312.6 kg of milkfish were harvested. The results revealed that farmers can obtain more income at regular intervals by adopting multi-polyculture farming.

High density farming trials for Indian white shrimp, *Penaeus indicus* in lined ponds at Navsari, Gujarat during the monsoon season

High density rearing of Indian white shrimp, *Penaeus indicus* was attempted during the monsoon season in two, 0.1 ha (1000m^2) lined ponds (L1 & L2) at NGRC of CIBA farm in Navsari, Gujarat. The PL were stocked in the month of July at 80 nos./m^2 and harvested after 128 days of culture. Shrimp attained an average body weight of 11.8 g and 12.2 g in ponds L1 and L2 respectively. The yield, FCR and productivity in ponds L1 and L2 were 879 Kg and 815 Kg, 1.36 and 1.47, 8.8 tonnes/ha and 8.15 tonnes/ha respectively. The average survival rate observed in both ponds was around 98.3%. The length weight relationship of shrimp in both ponds depicted a positive allometric growth pattern and the relative condition factor of shrimp in the ponds (Kn=1.0003, >1.0), indicated good growing conditions in the pond despite heavy rainfall. Shrimp attained an average body weight of 10 g only by around 110 DOC. High stocking densities coupled with heavy rain fall may have affected growth rate of the shrimp. However, the productivity of *P. indicus* during the monsoon season remained economically viable.



Growth characteristics of *P. indicus* during high density rearing in lined ponds for 128 days

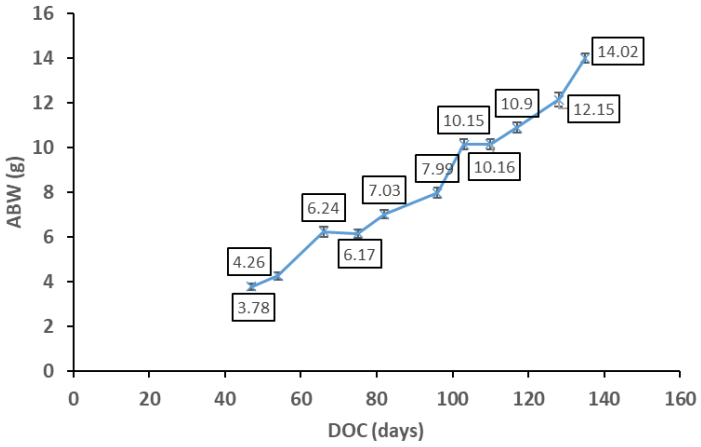


Length-weight relationship of *P. indicus* in lined pond (a) L1, W=0.005375 $L^{3.13512}$, (R2=0.98,p<0.05) and (b) L2, W=0.004979 $L^{3.171717}$, R2=0.98, p<0.05)

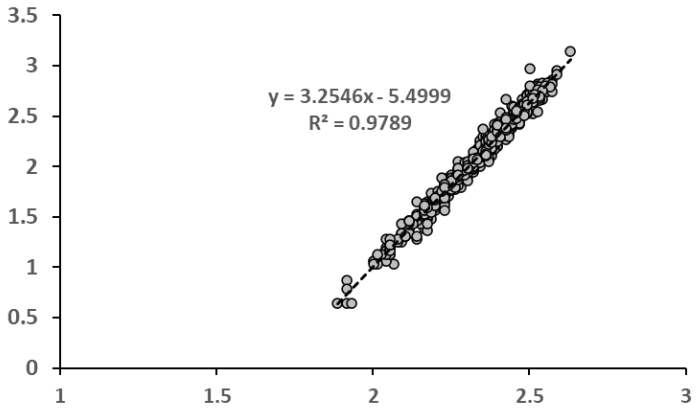
Indian white shrimp, *Penaeus indicus* harvested from HDPE lined ponds at NGRC of CIBA, Navsari, Gujarat

Growth characteristics of Indian white shrimp, *Penaeus indicus* during semi-intensive farming in earthen pond

Semi intensive farming of Indian white shrimp, *P. indicus* was carried out in an earthen pond of 1 acre (4000m^2) area at Navsari, Gujarat. Seed (PL7-8) was stocked at a density of 35 nos./ m^2 (1.4 lakh seed) and reared for 138 days. The shrimp attained an ABW of 10 g by 100 DOC and 14.02 g by 138 DOC. The FCR and survival rate observed during the growout trial was 1.75 and 97.6% respectively. At the end of 138 days, 1782 Kg of shrimp was harvested, resulting in a productivity of 4.45 tonnes/ ha. The ADG and WGR observed during the trial was 0.10 g/day and 0.71 g/week respectively. The length-weight relationship during the trial viz., W=0.004087 L$^{3.254612}$, (R2=0.97, p<0.05, n=530), indicated a positive allometric growth pattern. The Fulton's, allometric and relative condition factors of the shrimp during the trial were 0.7436, 0.4096 and 1.0023 respectively and suggested good growing conditions for shrimp during the trial.



Growth characteristics of *P. indicus* during 138 days semi-intensive farming in earthen pond



Length-weight relationship of *P. indicus* in earthen pond L1, W=0.004087 L3.254612, (R2=0.97, p<0.05)

Indian white shrimp harvest from earthen pond at the end of 138 DOC

Growth performance of post-larvae of captive-reared *P. indicus* brooders in lined ponds

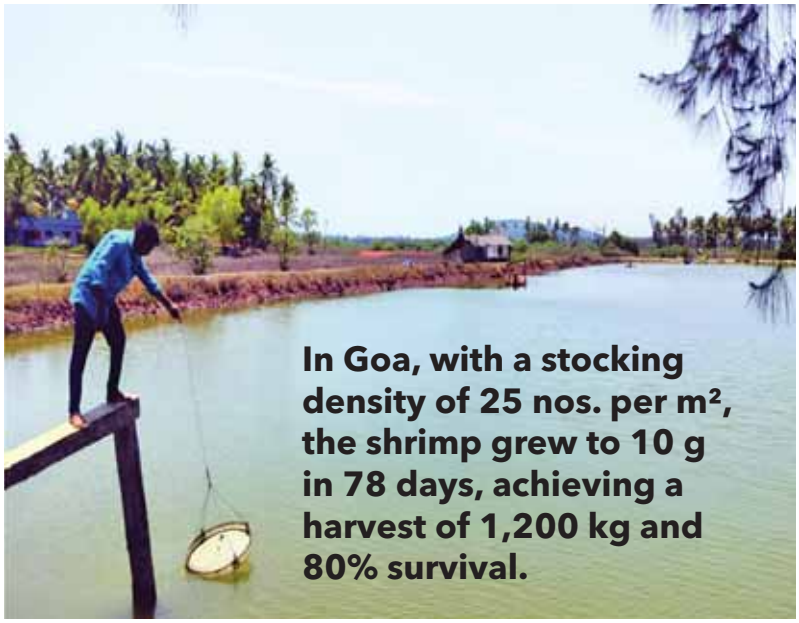
To understand the growth and reproductive performance of *Penaeus indicus* Post Larvae (PL) obtained from captive wild broodstock, an experiment was conducted in lined pond. The nursery-reared post-larvae ((45 days old) were stocked at the rate of 3 nos. per m^3 in lined ponds at MES. At the end of 120 days, the male and female brooders attained an average body weight of 16.5g and 22.0g respectively. About 20% of the females recorded initiation of gonad development and onset of vitellogenesis.

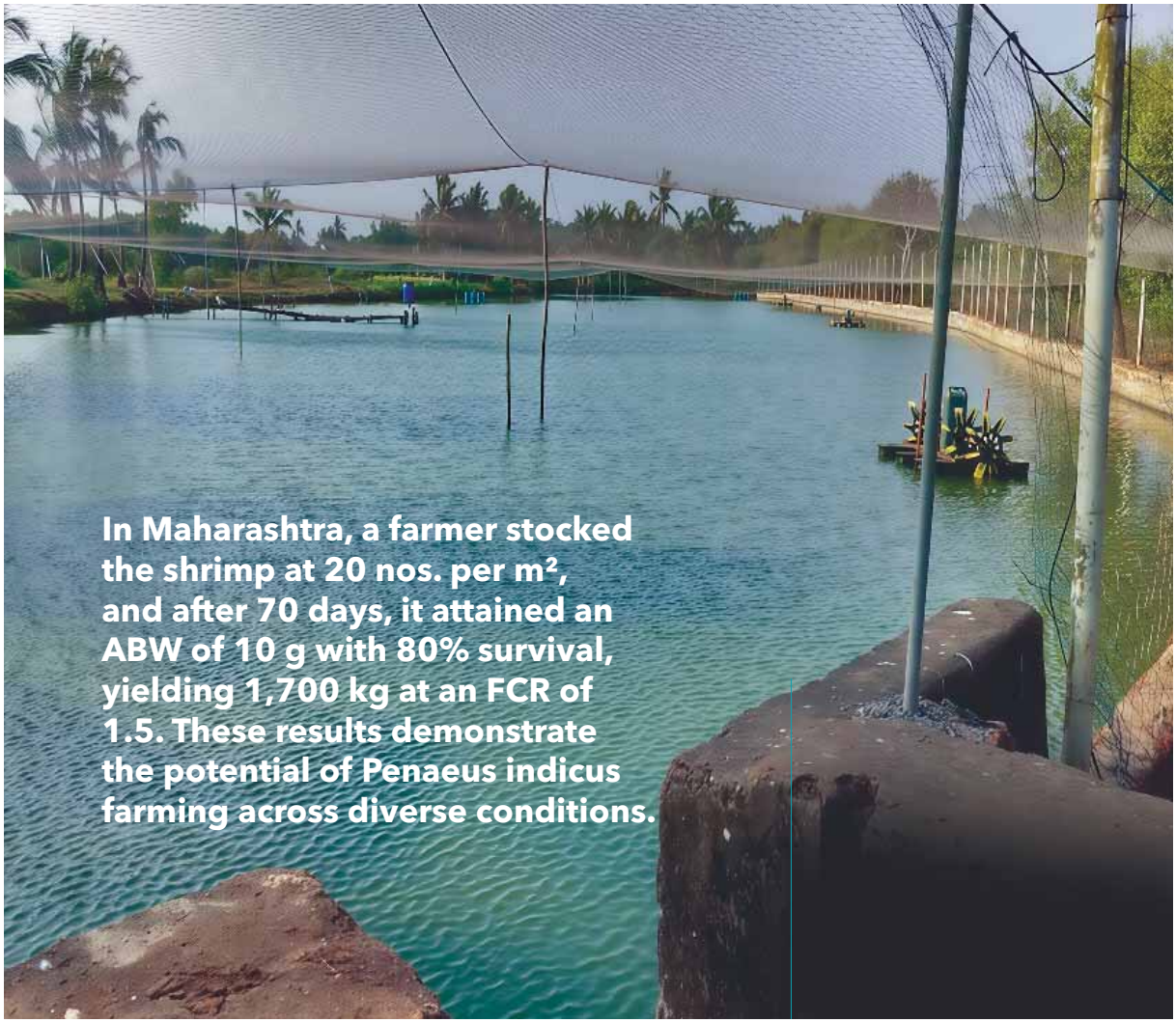
S. No.	States	Total Post larvae (PL)
1	Tamil Nadu	70,000
2	Andhra Pradesh	6,18,000
3	Odisha	3,39,000
4	West Bengal	1,30,000
5	Kerala	2,10,000
6	Goa	2,10,000
7	Maharashtra	9,30,000
TOTAL		**25,07,000**

In Tamil Nadu (Vedaranyam), with a stocking density of 10 shrimp per m^2, the shrimp grew to 20 gm in 150 days, achieving a harvest of 700 kg. In Karnataka (Honnavar), *Penaeus indicus* shrimp reached 8.5 gm in 77 days with a stocking density of 15 shrimp per m^2.

Farming demonstration of Indian white shrimp

Broodstocks collected across different locations are screened for OIE listed pathogens and good quality desease free broodstock were transferred to maturation section. The broodstocks were fed with specific pathogen free (SPF) frozen feeds such as, polychaete, krill, squid and CIBA formulated maturation pellet feed @ 15% of the body weight. Fully matured and stage-IV broodstocks were used for seed production to achieve the good quality and healthy post larvae. Twenty-five lakhs and seven thousand *Penaeus indicus* shrimp seeds were distributed to shrimp farmers across various coastal states in India to evaluate their production potential under field conditions.





In Gujarat (Navsari), the shrimp in earthen ponds reached an ABW of 4.5 g after 54 days at stocking density of 30 nos. per m^2, while those in HDPE-lined ponds reached 2.5 g at stocking density of 50 nos. per m^2.

Sustainable Integration of Edible Seaweed (*Ulva lactuca*) Cultivation with *Penaeus indicus* Nursery Rearing: A Feasibility Study

An experiment was conducted to evaluate the cultivation of *U. lactuca* with *P. indicus* nursery rearing, to assess its potential and profitable approach to aquaculture. The study was carried out for 30-days in two 100m² ponds, one with *U. lactuca* cultivated on PVC rafts, and the control pond without seaweed *P. indicus* PL was stocked in both treatment and control tanks at 100 nos./m². *U. lactuca* was initially stocked at 5 kg and showed substantial growth, reaching a harvested biomass of 12.5 kg. The results indicated that shrimp in the treatment pond attained a slightly higher mean body weight of 0.941 ± 0.08g compared to 0.928 ± 0.07g in the control pond, with survival rate at 95.2% in the treatment pond and 94.5% in the control pond. These findings demonstrate that integrating *U. lactuca* with shrimp nursery systems doesn't adversely affect shrimp growth or survival while offering an additional source of income through seaweed biomass.

Production performance of super-intensive precision and natural shrimp farming (SIPNSF)

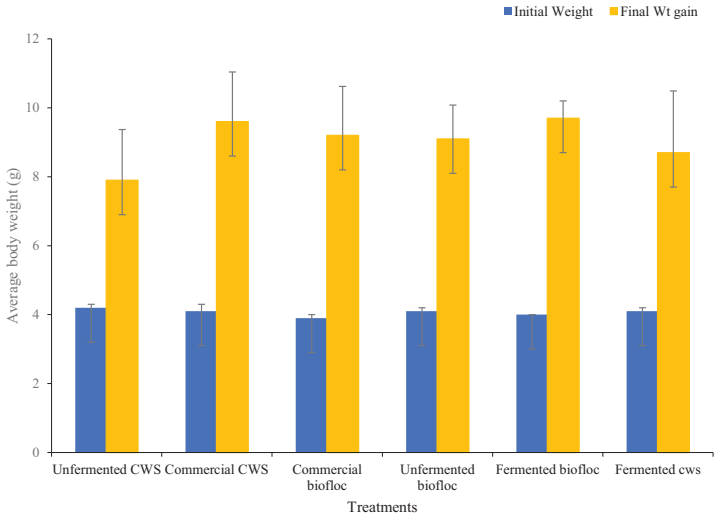
In the face of evolving climate challenges, the shrimp aquaculture sector must embrace innovation and technology to ensure resilience and sustainability. A sustainable approach gaining attention involves enhancing shrimp productivity by utilizing co-cultured microbes, algae, copepods, planktonic organisms, and associated biofloc (microcosm). To align with this vision, we have developed a pioneering next generation farming system, with high stocking density and precise use of input resources such as water, feed and energy. We did several cycles of farming with stocking density ranging from 70-240 shrimps/ m^3. In the last one year, we have completed 12 cycles of shrimp production trials with *Penaeus vannamei* seeds. Each farming cycle ranged between 90 to 104 days. We achieved a productivity of 3.47 – 4.97 kg per m^3, which is equivalent of 34.7 – 49.7 tons per ha. The highlights of this farming system were the minimal use of inputs such as feed, aeration, and water, resulting in a better feed conversion ratio (FCR) between 0.97 - 1.23 and survival between 86.5% – 98.8%. This success indicates that the system could serve as a scalable model for monthly shrimp stocking and harvesting, promoting domestic market growth and offering fresh shrimp to consumers at affordable prices under the direct "farm to fork" concept. On the farmers side it will reduce reliance on export markets. In this win-win model, where farmers benefit from increased revenue and consumers enjoy access to fresh, high-quality shrimp.

Study on the effect of fermented and non-fermented microbial consortium in biofloc culture system

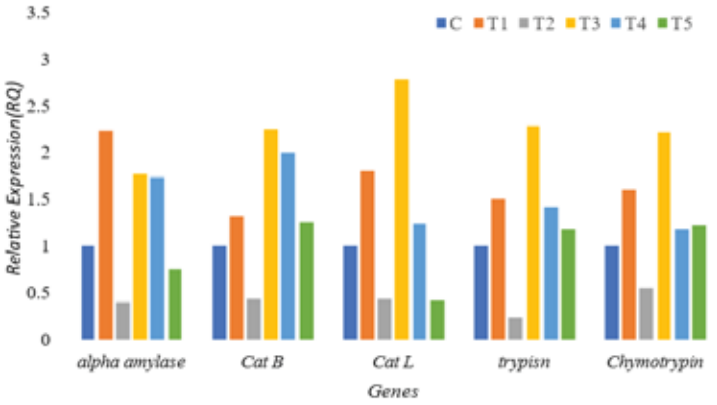
A 45-day experiment was conducted to evaluate the effects of a microbial consortium fermented by a solid-state fermentor on the growth, survival, immunological parameters, and gene expression of immune and digestive-related genes in *P. vannamei*. The results showed significantly higher growth (9.7g ± 1.6) in the FB-treated group, followed by CB (9.5g ± 1.42), UFB (9.21g ± 0.98), FCW (9.15g ± 1.79), CCW (8.70g ± 1.44), and UFCW (7.99g ± 1.47). Survival rate was also higher in the FB group (97.2% ± 2.5) compared to the control (81.6% ± 1.66). Immunological parameters such as prophenoloxidase, lysozyme, and superoxide dismutase activity were significantly higher in the FB group. Additionally, relative gene expression of digestive and immune genes (trypsin, chymotrypsin, amylase, cathepsin B, cathepsin L, lysozyme, and myostatin) was upregulated in the FB group. In conclusion, the fermented biofloc improved growth, immunity, and immunomodulation in *P. vannamei*.

Trace mineral optimization of *P. vannamei* (Post larval) in a normal and bio floc culture system- in progress

A 60-day trial was conducted to optimize the concentration of $ZnSO_4$ supplementation in biofloc system for *P. vannamei* post-larvae. Varying concentrations



Average body weight (Mean ± SD) for different treatments during the study period



Comparative mRNA expression levels of digestive genes in the gut samples of shrimp reared in biofloc and clear water system with fermented and unfermented microbial consortium in comparison to that of the control.

of $ZnSO_4$ (2 ppm, 4 ppm, 6 ppm, and 8 ppm) was added to tanks containing 30 PL, to study the effects of the supplementation on animal behavior and survival rates. After 24 to 48 hours of continuous activity and behavior monitoring, the experiment showed no indications of stress or mortality in the post-larval shrimp. Throughout the trial, growth rates, proper water exchange, constant feed timing, water quality management, and the general health of the shrimp were monitored. The experiment is currently in progress.

In-vitro experimental evaluation of trace minerals supplementation in the mixed probiotic strains

An in vitro experimental model was carried out using $ZnSO_4$ (100 PPM), $CuCl_2$ (50 PPM), $MnCl_2$ (50 PPM), mixed salts (200 PPM), BFT, and positive and negative control groups to evaluate the effects of these compounds on cell viability and proliferation of the microbial consortium. The results indicated significant differences in cellular responses, suggesting that the presence of these metals may influence biochemical pathways essential for cell growth. These trace mineral-enriched strains

were used to generate bio-floc with molasses. After inoculation, the samples were incubated at 33°C for 24 hr-56 hr at 120 rpm to ensure adequate mixing and oxygenation. Samples were collected at different time intervals (0 hr, 6 hr, 12 hr, 18 hr, 24 hr) and stored at 4°C for subsequent analysis. The growth of the strains was confirmed by plating them onto ZMA agar plates and incubating them at 33°C for 24-48 hours. Colonies were then counted and characterized to assess their diversity and dominance within the samples. The samples were processed for the ICP analysis to quantify the quantification of trace minerals in the sample.

Comparison of solid state fermented and unfermented *Lemna* spp. (Duckweed) as a carbon source in biofloc system for rearing *Etroplus suratensis*

A 90-days study was conducted to investigate the efficiency of *Lemna* spp. (Duckweed) as a substitute ingredient and a carbon source under fermented and unfermented conditions on *Etroplus suratensis* in biofloc based rearing system. An experiment with 4 treatments; F1- Unfermented feed, F2- Unfermented duckweed feed, F3- Fermented feed, F4- Fermented duckweed feed and as F5- control-C the reference feed was used. *Etroplus suratensis* fingerlings of ABW 1.43 ± 0.2 were stocked @ 20 nos. per 1000L microcosm tank with biofloc conditions developed using CIBAFLOC consortium. The ongoing experiment has significant growth in all treatments, with 5.01 ± 0.24g as the current ABW. In the recent sampling, shrimp feed (F5) and fermented feed (F3) are performing the best with not much significant difference in ABW between the two treatments (i.e. Average weight 5.42 ±0.15 and 5.33 ± 0.25g respectively), followed by Unfermented duckweed feed(F2) at 4.64 ± 24 g average body weight.

Nursery rearing of Indian white shrimp *Penaeus indicus* in Biofloc culture technology

Biofloc technology for maintaining high water quality for shrimp production was evaluated. *Penaeus indicus* were cultivated using 3000 PLs per 20,000-litre tank over 30 days. The water quality was maintained by manipulating the C:N ratio in the culture system. During the nursery trail no water was exchanged, only refilling after syphoning off waste. Total vibrio colonies were reported low in biofloc system, and better water quality was observed average body weight for biofloc and control tanks was 0.47g and 0.34g at 15 DOC, and 1.25g and 1.21g at 30 DOC demonstrating a significant difference between control and biofloc (cibafloc)-treated.

Elucidating the mode of action of probiotics in biofloc based shrimp culture of *Penaeus vannamei*

The experiment was conducted to evaluate the effect of probiotics in biofloc based shrimp culture. C0 – Without probiotic, biofloc & periphyton PERI0 – Periphyton alone, BFT0 – Biofloc without probiotic, BFTP – Biofloc with probiotic, BPT0 – Biofloc + periphyton without probiotic, BPTP – Biofloc + periphyton with Probiotic. Biofloc consortium was prepared using *Bacillus subtilis, Lactobacillus rhamnosus, Saccharomyces cerevisiae* (5.4 X 106 cfu/ml). The stocking density was 200/ m^3. The carbon source including millet, wheat flour, molasses was used for maintaining C:N ratio of 15:1. The result revealed that BFTP and BPTP was showing a better result on growth, water quality, fatty acid as well as amino acid and the metagenomic analysis revealed that higher number of diversified bacterial community was reported in BPTP and BFTP than other groups. The plankton studies showed that cyanobacteria, rotifers, copepods, and nematodes are dominating in BFTP and BPTP group than other treatments whereas diatoms are observed in the control.

Effect of various carbon sources in biofloc-based culture of fin fish grey mullet

INITIAL SAMPLING

RECENT SAMPLING

Average body weight of the mullet *Mugil cephalus* in different carbon source in biofloc system

(*Mugil cephalus*) for growth, water quality, and immune responses

To study the effect of various carbon source in biofloc based fin fish culture of grey mullet (*Mugil cephalus*) for growth, water quality, and immune responses. The treatments include Control (C0 (without carbon and biofloc), Molasses (MLC), Rice bran (RBC), Wheat flour (WFC), Sugar (SGC). Mugil cephalus fingerlings were stocked in tanks at 70/m^3; Grow-out: 30/m3 CN ratio – 15:1. The result revealed that the fish fry at the DOC 40, reached 7.6g in RBC, followed by WFC 7.1g, MLC 6.3g, SGC 6.1g and Control 4.1g. The TAN level was significantly ($P<0.05$) decreased in biofloc treatments compared to control. Moreover, the water quality was improved in biofloc treatments than control groups.

Refinement of biofloc based new age farming technology through effective microbial management and recirculatory model with two dietary feeding regime of fin fish milk fish (*Chanos chanos*) for growth, water quality, and immune responses

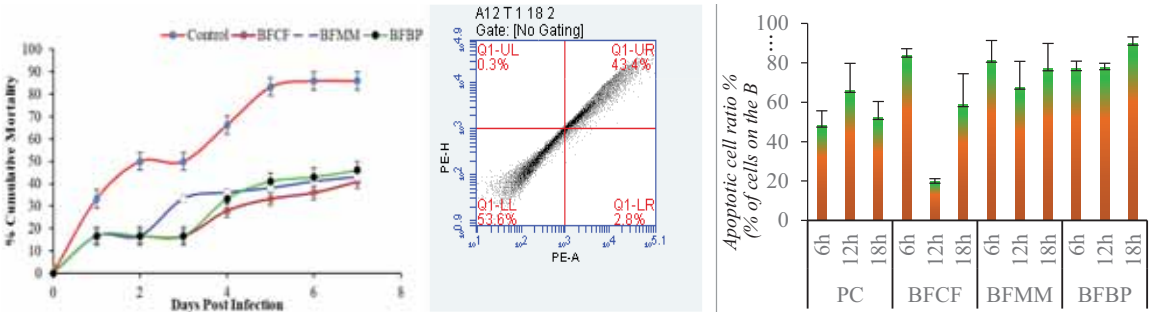
To study the effect of microbial management and recirculatory model with two dietary feeding regime of fin fish milk fish *Chanos chanos* for growth, water quality, and immune responses. The treatments include Control Diet 25% (C025 (without carbon and biofloc), Biofloc 25%; (BFT25) Control Diet (C030 (without carbon and biofloc), Biofloc 30%; (BFT30) and Milk Fish – Stocking density 20/m3; CN ratio – 15:1. The experiment was initiated and it's in progress.

Biofloc experiment for comparing the *P. vannamei* and *P. indicus* in grow-out system

An experiment in a biofloc system with high stocking density aimed to evaluate growth, water quality, microbial dynamics, and immune responses in shrimp. Treatments included a control (C0), T1 (CIBAFLOC), T2 (seaweed and carbon fermentation), and T3 (CIBAFLOC + periphytic substrate), for both *P. vannamei* and *P. indicus*. Shrimp were stocked in 15-ton tanks at 3000 no's/m^3 of PL 12, in triplicate. After 46 days, results showed the higher ABW for *P. vannamei* in T1 (6.8 ± 0.24g) and for *P. indicus* in T1 (6.2 ± 0.4g), compared to the control (5.9 ± 0.2g). The water quality parameters and microbial load is maintained for optimal condition. The experiment continues to further assess digestive enzymes and immune responses.

Comparison of various inoculum for generation biofloc in terms of growth indices, water quality, microbial dynamics, and immune responses in *Penaeus vannamei*

An experiment was started with four treatments in triplicate (i.e. control (C0), BFT1 (CIBAFLOC), BFT2 (seaweed and carbon fermentation) and BFT3 (CIBAFLOC + periphytic substrate). In this experiment, 200 juvenile *P. vannamei* per cubic meter were stocked for an experiment for 100 DOC. The present study revealed

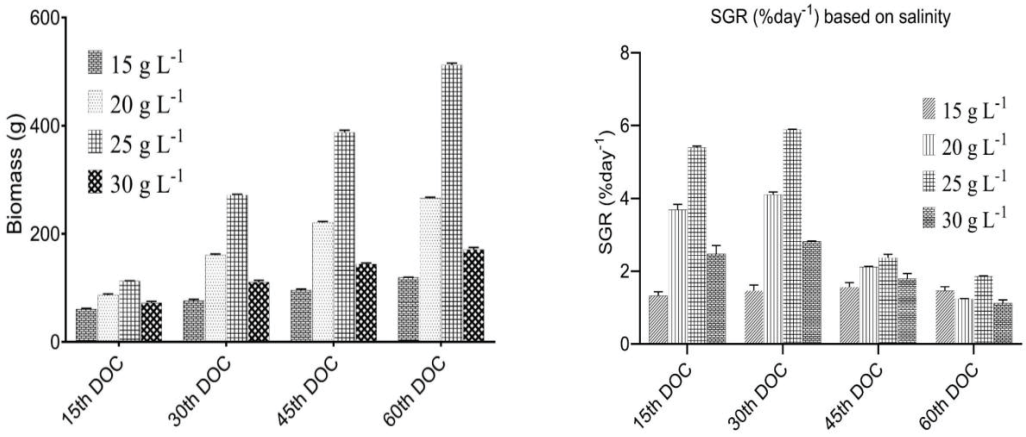


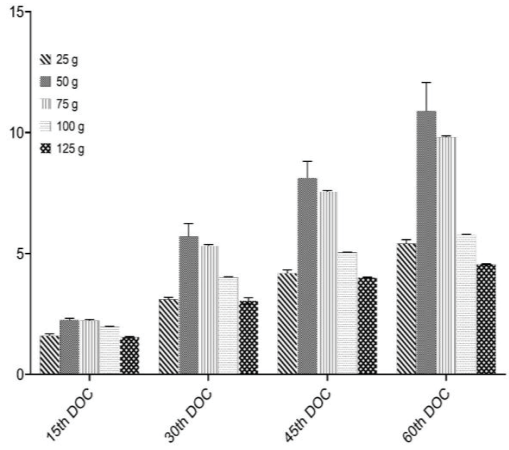
Biofloc reared shrimps challenged against *V. parahemolyticus* and flowcytometric analysis of percentage activity of Apoptotic cell ratio of haemocytes of *P. vannamei* reared in biofloc and challenged against *V. parahemolyticus* after 6, 12, 18h exposure.

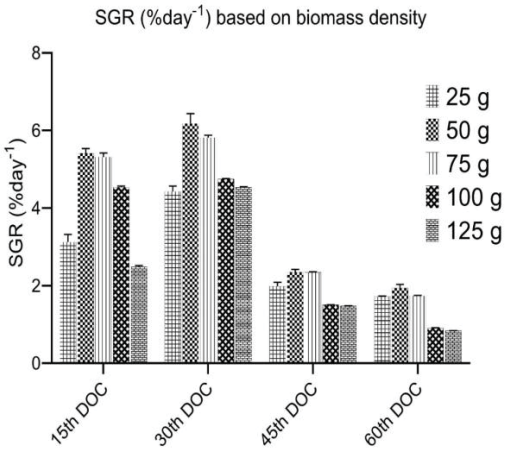
that significantly higher ABW in BFT3 (24.22±0.24g) followed by BFT2 (22.56±0.34) and BFT1 (23.12±0.24g) as compared to control (13.8 ±0.52g) in DOC 100. Shrimps grown under the experimental condition was challenged against V. parahemolyticus (1.1 × 10^4 CFU/ml); the results revealed 86 % cumulative mortality in 72 hrs. Whereas in treatments BFT3- 41% BFT2- 43% and BFT3 with 46% was recorded 7 days post infection. Overall, better growth, water quality, proximate, mineral composition and immune response was observed in BFT2 followed by BFT1. The results were significantly different in the treatments and control at ($p<0.05$).

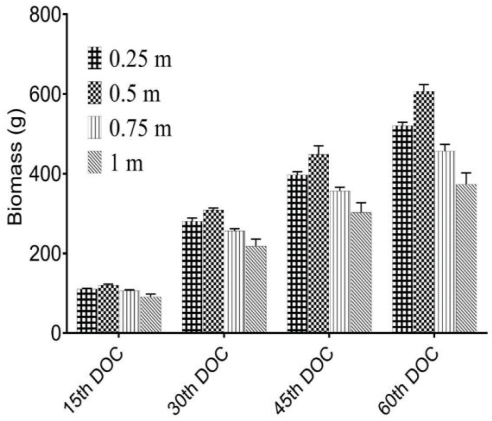
Development of aquaculture of red seaweed, *Hypnea musciformis*

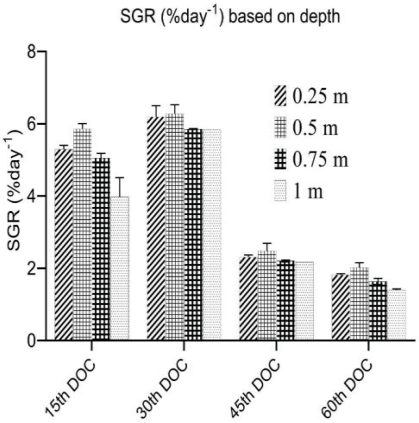
Hypnea musciformis is ecologically valuable and economically significant due to its carrageenan content, although its commercial cultivation is still nascent. A controlled experiment was conducted to ascertain the effects of salinity (Trial 1), biomass density (Trial 2) and water depth (Trial 3) on the growth and yield of *H. musciformis*. The growth response of *H. musciformis* was assessed under different salinity levels (20, 25, and 30 g L^{-1}). Seaweeds cultivated at a salinity of 25 g L^{-1} exhibited a significantly higher specific growth rate, highlighting the species' preference for moderate salinity conditions. A Completely Randomized Design (CRD) experiment evaluated the impact of varying initial biomass densities (25, 50, 75, 100, and 125g) on the specific growth rate of *H. musciformis*. The highest specific growth rates were observed at biomass densities of 50, 75 and 100g, indicating an optimal range for cultivation initiation. Various water depths (0.25m to 1m) were tested to identify the optimal depth range for *H. musciformis* cultivation. Findings revealed that 0.5m provided the highest SGR, followed by 0.25m, with deeper levels (0.75m and 1m) showing a declining growth. These results emphasized the need for precise control of salinity, biomass and depth to enhance *H. musciformis* productivity.





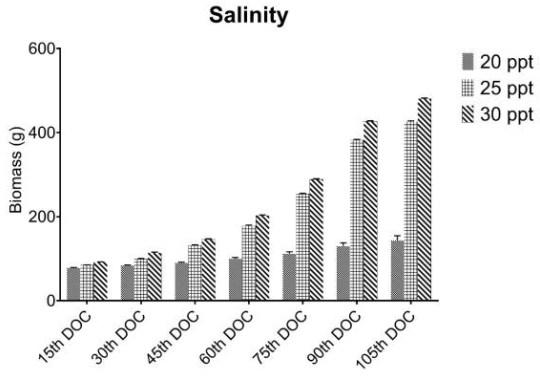




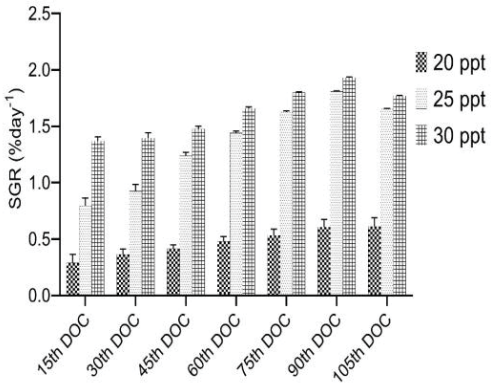


Development of farming practices of red seaweed *Gelidiella acerosa*

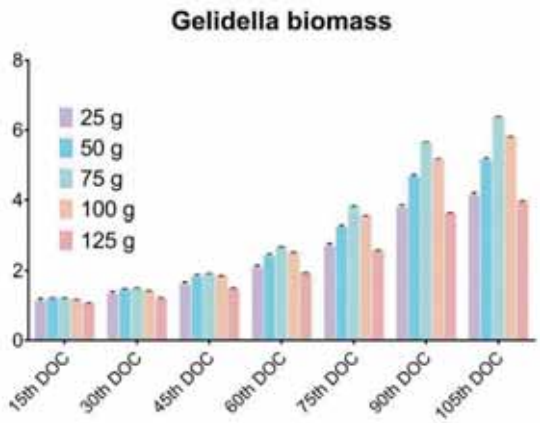
A completely randomized design (CRD) experiment was conducted to determine the optimal salinity for *G. acerosa* cultivation using 75g biomass per treatment. The study tested 20 ppt, 25 ppt and 30 ppt salinity levels, each in triplicate. Results showed that the 30 ppt salinity yielded the highest growth rate, suggesting the optimal salinity lies between 25-30 ppt. Specifically, the 25 ppt salinity level had an SGR of 1.65% d^{-1} on the 105th day of culture (DOC), while the 30 ppt salinity level had an SGR of 1.77% d^{-1}. Another CRD experiment tested various biomass levels (25g, 50g, 75g, 100g, 125g), showing that 75g biomass yielded the highest biomass accrual and SGR, followed by 100g. For the monoline system, the recommended biomass range per meter is 525g to 700g to promote healthy growth. In another CRD experiment, *G. acerosa* was cultivated at depths from 0.25 to 1.25m to ascertain the optimal depth. Results indicated significantly higher growth at shallower depths (0.25 and 0.5 meters) due to enhanced light penetration, which is for maximizing biomass yield.



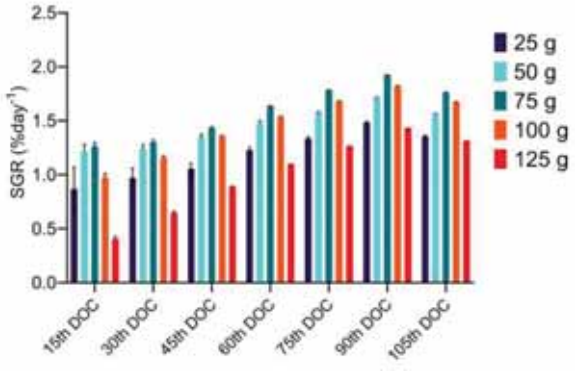
G. acerosa biomass densities at various salinity



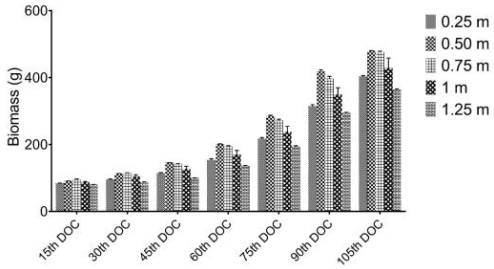
G. acerosa : SGR based on different salinity



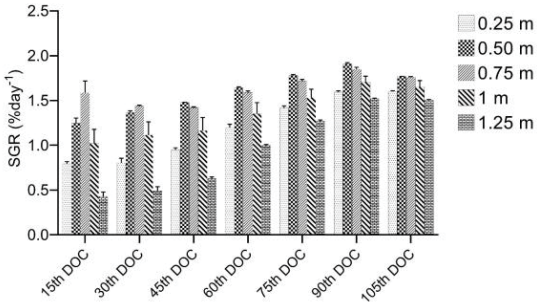
G. acerosa biomass accrual at various densities



SGR based on different biomass densities



G. acerosa: biomass at various depth



SGR at various depths

Culture trial of *G. salicornia* in fish pond

A culture trial of *G. salicornia* was carried out in a fish pond using the monotube line net method. The initial stocking density was 0.5 kg vertically (6 units) and 0.85 kg horizontally (6 units). After 15 days, the biomass increased to 1.5 kg and 3.5 kg with a Specific Growth Rate (SGR) of 7.32% and 9.44%, respectively. By the 30th day, the biomass further increased to 1.9 kg and 5.16 kg with an SGR of 4.45% and 6.01%, respectively. On the 45th day, the biomass density reached approximately 2.95 kg and 8.61 kg, with SGRs of 3.94% and 5.15%, respectively.

Spore Culture of *G. salicornia*

Specimens of the red seaweed *G. salicornia* were harvested from aquaculture ponds and carefully prepared by rinsing to eliminate contaminants and drying with sterile tissue paper. Subsamples were allocated to three groups: a control group at 28 ppt salinity, and two experimental groups at 5 ppt and 10 ppt salinity, respectively. The study hypothesized that reduced salinity stimulates spore release from the G. salicornia thallus. A 21-day observation period was conducted, during which particulate matter released from the seaweed was collected and analysed microscopically to identify and quantify spores. The spores were inoculated into Provasoli's Enriched Seawater (PES) medium to assess germination potential over 15 days. Germination, indicated by thallus bud formation, was observed only in the control group, not in the reduced salinity conditions. These buds were then examined under a stereo microscope for detailed morphological analysis and documentation.

5.1 Hands on training on brackishwater seaweed farming for coastal fisher women

A one-day training program on brackishwater seaweed farming was held at

Culture trial of *G. salicornia* in fish Pond

the Muttukadu Experimental Station (MES), ICAR-CIBA on August 14th, 2024, for ten beneficiaries from Kottaikadu village, Chengalpattu district. Conducted in collaboration with the Department of Fisheries, Tamil Nadu, the program blended theoretical knowledge and practical skills. Dr. P. Nila Rekha, Principal Scientist, Crustacean Culture Division (CCD), highlighted the ecological and economic importance of brackishwater seaweeds, emphasizing their roles in carbon sequestration, nutrient bioremediation, and as a sustainable food source. A practical session, led by Shri R. Aravind, Scientist, CCD, and research scholars (Shri R. Nishan Raja and Shri S. Aravind Kumar), demonstrated raft-based tubeline cultivation a scalable technique for growing seaweed on longlines suspended from rafts. Participants learned about species selection, seeding, maintenance and harvesting techniques. This initiative aims to develop a thriving seaweed cultivation sector in Tamil Nadu, supporting sustainable aquaculture and empowering coastal communities economically.

Nutrient requirement evaluation of red seaweed, *Gracilaria corticata* at two different salinities

Gracilaria corticata is a red macroalgae found in lower mid littoral zone and intertidal pools of coastal waters, including estuaries towards the high tide mark. Land based cultivation of the seaweed provides the opportunity to produce seaweed throughout the year. In this regard, a study was conducted to evaluate the optimum nitrate and phosphate requirement of *G. corticata* at two different salinities (20 ppt and 35 ppt). For each salinity, certain combinations of three nitrate levels (25, 50, 100 µM) and four phosphate levels (4, 8, 16, 40 µM) were tested. Under different nutrient conditions and salinity, varying growth rates (SGR ranging from 0.16 to 5.2%/day), pigments quantities (PE ranging from 480 to 1331µg/g, PC ranging from 155 to 507 µg/g, total chl 134 to 230 µg/g) and nutrient uptake were observed. When 100 µM nitrate and 8 µM phosphate were added to 25 ppt of water, the biomass increased by 3.64% per day; however, 50 µM nitrate and 8 µM phosphate was sufficient to produce the same biomass at 35 ppt. Increasing the phosphate concentration to 40 µM or decreasing the nitrate concentration to 25 µM resulted in deterioration of biomass. The findings reported in this study would be useful for the land-based production of *G. corticata*.

AI based *Penaeus vannamei* feeding system culture trial and demonstration

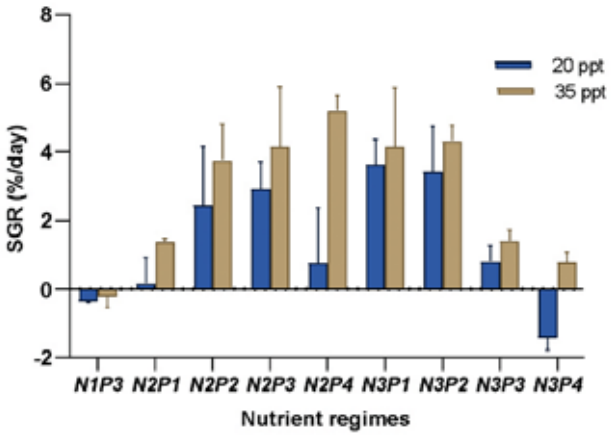
AI-powered shrimp feeders are transforming aquaculture by optimizing feeding practices. These systems utilize sensors, cameras, and AI to monitor shrimp behaviour, water quality, and environmental conditions, ensuring precise feed delivery. Trials have demonstrated the effectiveness of these systems in enhancing *Penaeus vannamei* shrimp growth. In a 60-day trial, automated AI feeding resulted in significant growth, with shrimp reaching lengths of 8.2 to 10 cm and weights of 8.5 to 9.2 grams. Further study showed that growth rate was highest at AI based auto feeder compared to manual feeding. However, high turbidity in larger tanks can hinder the cameras' effectiveness. An IoT-based water quality monitoring system, tested in a 500-liter tank, effectively tracked dissolved oxygen, pH, and ammonia levels, enabling real-time interventions to maintain optimal water quality. These advancements showcase the potential of AI and IoT to improve efficiency, productivity, and sustainability in shrimp farming.

Geospatial mapping of potential zones for expanding responsible aquaculture in Maharashtra

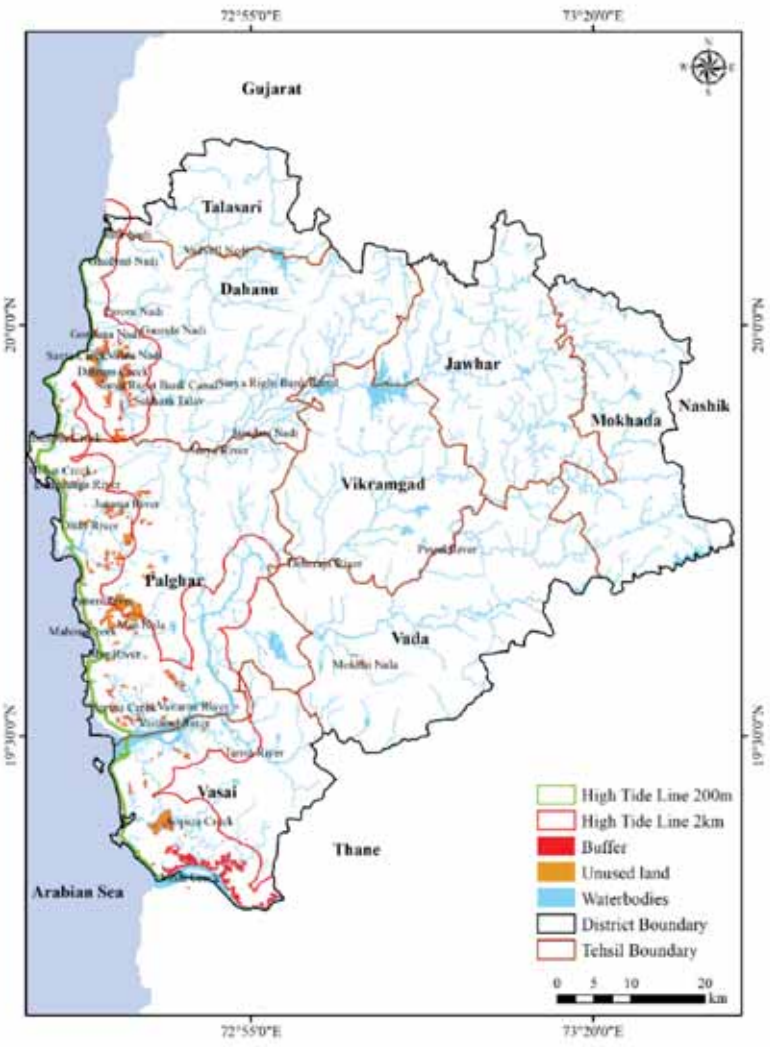
Responsible aquaculture is developing ecologically efficient, environmentally friendly and socially acceptable farming practices to satisfy and maintain the quality of land and water resources. The unplanned aquaculture growth has been accompanied by many environmental concerns. Hence, the project was carried out with the funding support of the Department of Fisheries, Government of Maharashtra to identify potential zones for aquaculture from unproductive lands based on resource characteristics and environmental regulations. All waterbodies such as creeks and estuaries were mapped in Palghar, Sindhudurg, Raigad, Ratnagiri, and Thane Districts. The major land classes were agriculture, mangroves, buildings, mudflats, saltpans, abandoned saltpans, scrub or unproductive lands, forest areas and sandy areas. The water quality influencing aquaculture and the soil quality from unproductive lands were assessed. Geospatial analysis was carried out to integrate the land available, CAA regulations such as removal of restricted areas, buffer zone between resources with water and soil characteristics. The potential zones suitable for expanding aquaculture were delineated for Palghar and Raigod Districts. The mapping of potential areas for aquaculture in other districts are in progress.

Assessment of salt affected lands using Random forest model

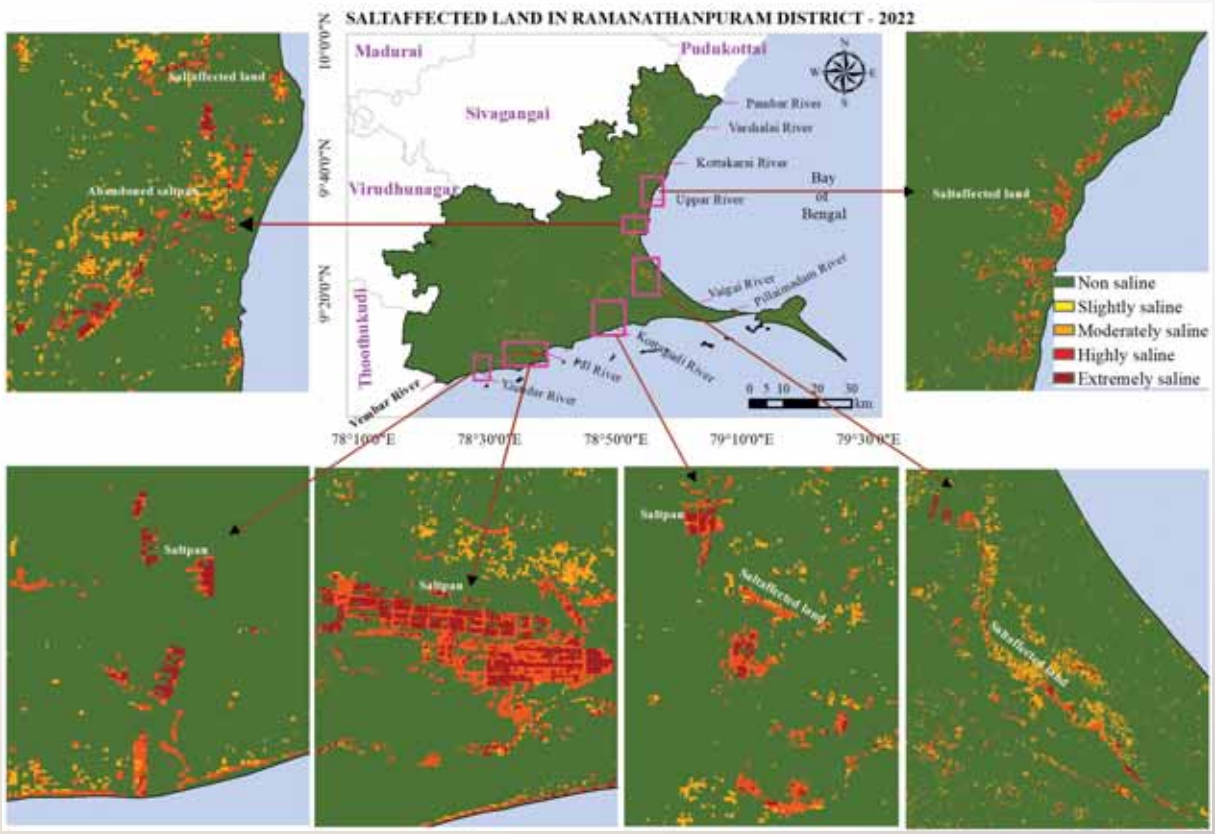
The assessment of salt affected lands and their salinity levels helps to get the location, level of salinity, and extent. The present study focused on assessing salt-affected land in Ramanathapuram District using Sentinel-2 satellite imagery and a Random Forest (RF) model implemented in Google Earth Engine (GEE) cloud based platform. The research utilized soil samples from 350 locations, with 230 samples collected between March and May 2024 for Electrical Conductivity (EC) analysis to determine soil salinity. The EC values were classified into non-saline, slightly saline, moderately saline, highly saline, and extremely saline categories. To analyze the salt-affected land, several spectral indices of vegetation and soil salinity, including NDVI, EVI, SAVI, and CRSI, were computed using Sentinel-2's 10-meter spatial resolution bands. The RF model was trained with 70% of the soil samples, while the remaining 30% were used for validation. The results revealed the spatial extent of non-saline, slightly saline, moderately saline, highly saline, and extremely saline zones.



Specific growth rate (SGR) of *Gracilaria corticata* in nine nutritional treatments under two different salinities



Potential areas for expanding aquaculture in Palghar District of Maharashtra



Salt affected lands in Ramanathapuram District of Tamil Nadu

02

REPRODUCTION, BREEDING & LARVAL REARING

REPRODUCTION, BREEDING & LARVAL REARING

Induction of early maleness in Asian seabass

Development of functional male and female broodstock in shorter timeframe can help reduce the high resource demands associated with brooder maintenance in hatcheries. Sub-adults of Asian seabass (Age:17-19 months old, average body weight (ABW): 750-1000 g, total length: 31-42 cm) were treated either with hormone pellet containing GnRHa and 17-alpha methyltestosterone (50µg of each hormone /kg body weight) for extension of male phase or with hormone pellet containing GnRHa and estradiol for early sex conversion to females (50µg of each hormone/kg body weight) at monthly intervals. The fish were maintained in a 10-ton RAS with a salinity of 29-31 ppt. Eight fish among the MT treated group were noticed with oozing milt after third dose of injection compared to the untreated controls suggesting early male development in seabass. No signs of ovarian development were visible in E2 treated fish. Additionally, thirty seabass (TL: 44 cm, ABW: 1.4 Kg) were stocked in four HDPE (4 m x 2m x 2m) cages to induce early maleness in pond water condition.

Matured male seabass (tl< 30 cm) with devedeveloped testis

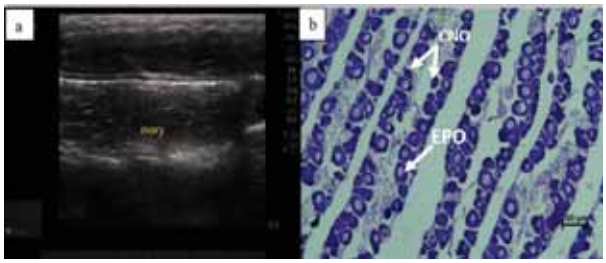


Oozing milt from male seabass (tl< 30 cm)

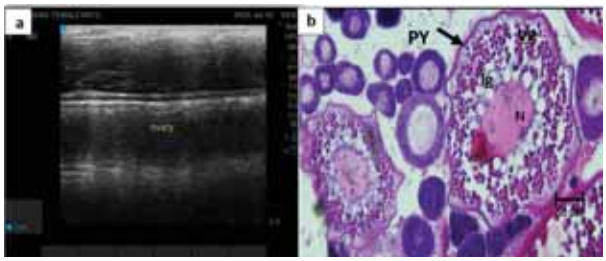

Seabass stocked in pond based HDPE cages for induction of early sex-change

Studies on the sexual maturation of Asian seabass using ultrasound imaging

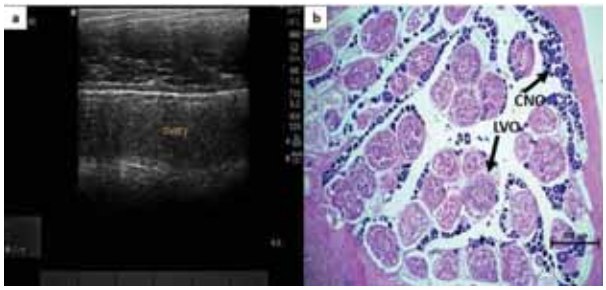
A study was conducted to assess the sexual maturity of Asian seabass using ultrasound imaging, a non-invasive and non-lethal technique to determine gender and gonadal stages. Wild-caught seabass maintained at the ICAR-CIBA hatchery were scanned using a SonoSite Edge II ultrasound (6–13 MHz). Fish were anesthetized and cannulated for sex identification prior to scanning. Total length and weight were recorded, and scanning was done using the "Small Parts" exam mode (depth: 2.8–4.4 cm, gain: 80–90%). The fish were placed on damp towels, and ultrasonic gel was applied. The probe was positioned along the abdominal surface to detect gonads. Gonadal length and width were measured using a ruler and the ultrasound's caliper function. A strong correlation was found between real and ultrasound-measured gonad dimensions (length: $R^2 = 0.9926$; width: $R^2 = 0.9909$). Ultrasound images were recorded, and corresponding gonads were preserved for histology. Ripe-stage female gonads appeared dark grey with a heterogeneous texture due to visible oocytes, while primary oocyte stage gonads lacked this pattern. Male gonads in the ripe stage showed distinct echogenicity compared to ovaries. Ultrasound imaging proved to be a reliable tool for identifying sexual maturity in Asian seabass.



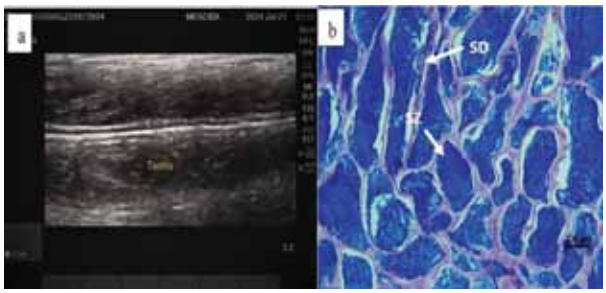
a. Ultrasonographic image of female Asian sea bass gonad in primary oocyte stage, b. corresponding histological section of gonad in primary oocyte stage.EPO- Early Perinucleolar oocyteCNO- Chromatin nucleolar oocyte. Scale bar-100µm



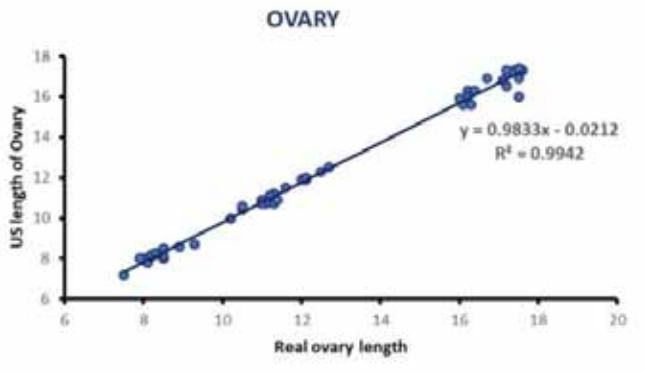
a. Ultrasound image of female Asian sea bass gonad in pre vitellogenic stage, b. Corresponding histological image.PY - Primary yolk oocyte, yg -Yolk granules, lg - lipid globule, N - Nucleus. Scale bar- 50µm



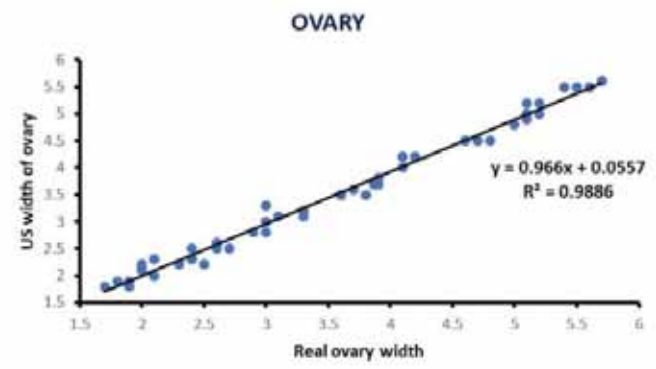
a. Ultrasound image of female Asian sea bass gonad in ripe stage, b. Corresponding histological image.LVO - Late vitellogenic oocyte, CNO- Chromatin nucleolar stage. Scale bar- 500µm



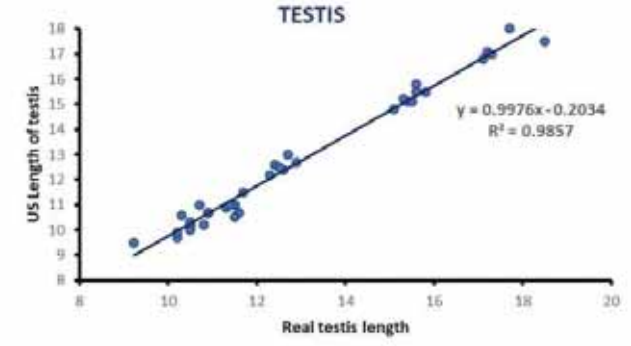
a. Ultrasonographic image of male sea bass gonad in ripe stage, b. corresponding histological image.SD- Spermatids, SZ- Spermatozoa. Scale bar- 100µm



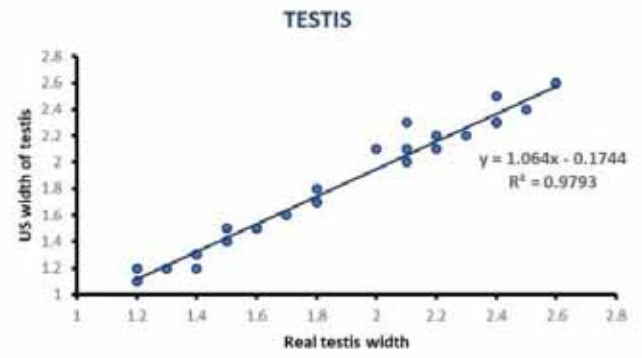
Linear relationship between ultrasound determined ovary length and real ovary length



Linear relationship between ultrasound determined ovary width and real ovary width



Linear relationship between ultrasound determined testis length and real testis length length



Linear relationship between ultrasound determined testis width and real testis width

Sex determination and oocyte measurement using deep learning-based ultrasound imagining in Asian seabass, *Lates calcarifer*

The present study aims to employ deep learning in conjugation with ultrasound studies as a non-invasive tool to determine the sex of Asian seabass and accurately measure the oocyte range of female seabass gonads, for the first time. Ultrasound images of both male and female Asian seabass were done. Multiple views of the same fish were taken at different points in the scan, resulting in 26 images for males and 35 images for females. These images were then augmented by rotation and by changing the brightness to obtain 426 images, 213 images each for male and female.

Sex prediction involves classification into one of two classes (i.e. male, female). In the discussion that follows, N_{ij} is used to denote the number of examples (images) belonging to class i and classified as belonging to class j; so, for example N_{MF} denotes the number of male examples incorrectly classified as female examples. The following metrics have been used to evaluate performance of the models:

1. Precision for class j which is calculated as $P_j = \frac{N_{jj}}{(N_{ij} + N_{jj})}$

2. Recall for class j which is calculated as $R_j = \frac{N_{jj}}{(N_{ji} + N_{jj})}$

3. F1-score for class j is $F_j = \frac{N_{jj}}{\frac{1}{P_j} + \frac{1}{P_j}}$

Different deep learning models were used for sex prediction from ultrasound images like VGG16, DenseNet and ResNet. The study found that ResNet outperforms all models, possibly due to its widespread use. DenseNet-121 outperforms DenseNet-201 and DenseNet-161 due to fewer parameters in the fully connected layer, allowing better generalizability for smaller datasets, while DenseNet-201 performs worse. Prediction of Oocyte diameter were also done using regression models. Ridge regression and lasso regression were used for predicting the minimum and maximum oocyte measurements respectively.

To evaluate the regression models' performance, the following metrics have been used:

1. The absolute loss (or absolute error) between predicted values (y) and true values (y) computed asy- y.

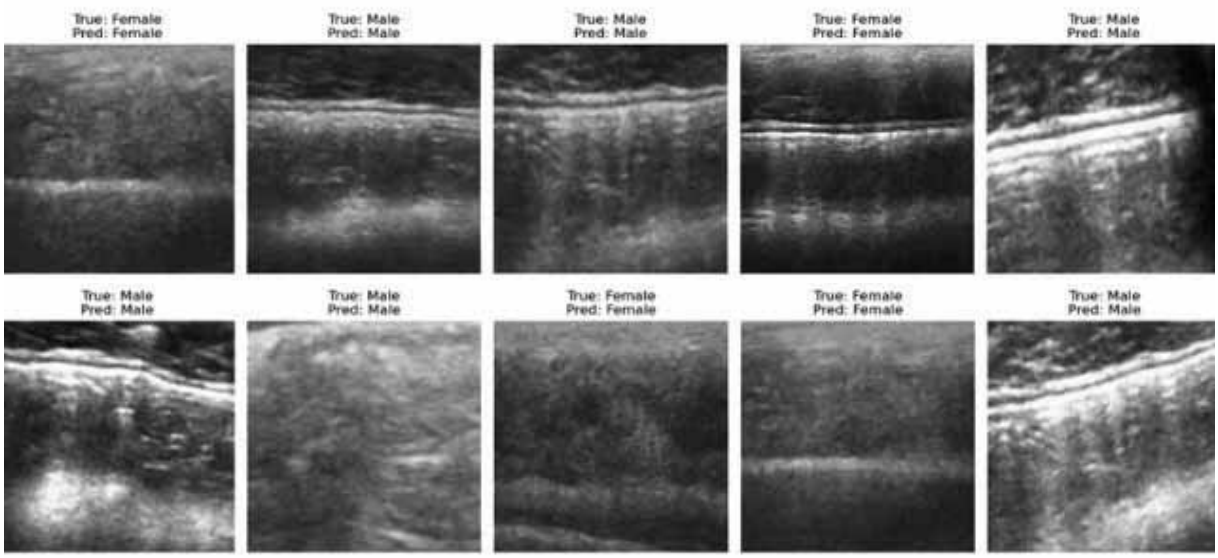
2. The Mean Absolute Loss (MAE) which is mean of absolute losses across all n examples, computed as

$$\text{Mcan Absolute Loss (MAE)} = \frac{1}{n}\sum_{i=1}^{n}|y_{jj} - y_{jj}|$$

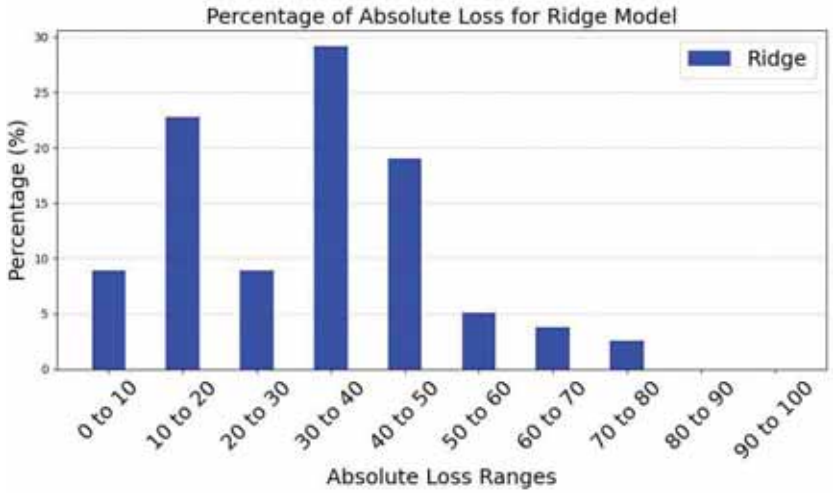
The MAE for minimum oocyte diameter was found to be 32.29 µm, and MAE for maximum oocyte diameter was found to be 23.35 µm, which is less than 10% of actual oocyte diameter (381 to 544 µm) measured under microscope using NIS- element imagining software. The good classification performance by deep learning models suggests that there is good scope for automation of sex prediction and oocyte measurement of Asian seabass.

Model	Precision		Recall		fl-score		Accuracy
	Female	Male	Female	Male	Female	Male	
VGG16	0.98	0.98	0.98	0.98	0.98	0.98	0.98
DenseNet-121	0.98	0.98	0.98	0.98	0.98	0.98	0.98
DenseNet-161	0.98	0.98	0.98	0.98	0.98	0.98	0.98
DenseNet-201	0.98	0.98	0.98	0.98	0.98	0.98	0.98
ResNet	0.98	0.98	0.98	0.98	0.98	0.98	0.98

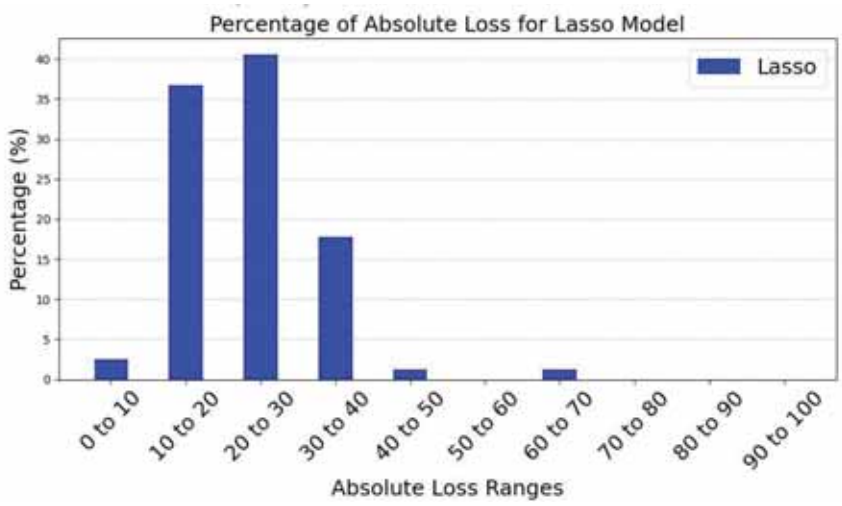
Sex classification performance for different models



Original and predicted classes for ultrasound images of gonads



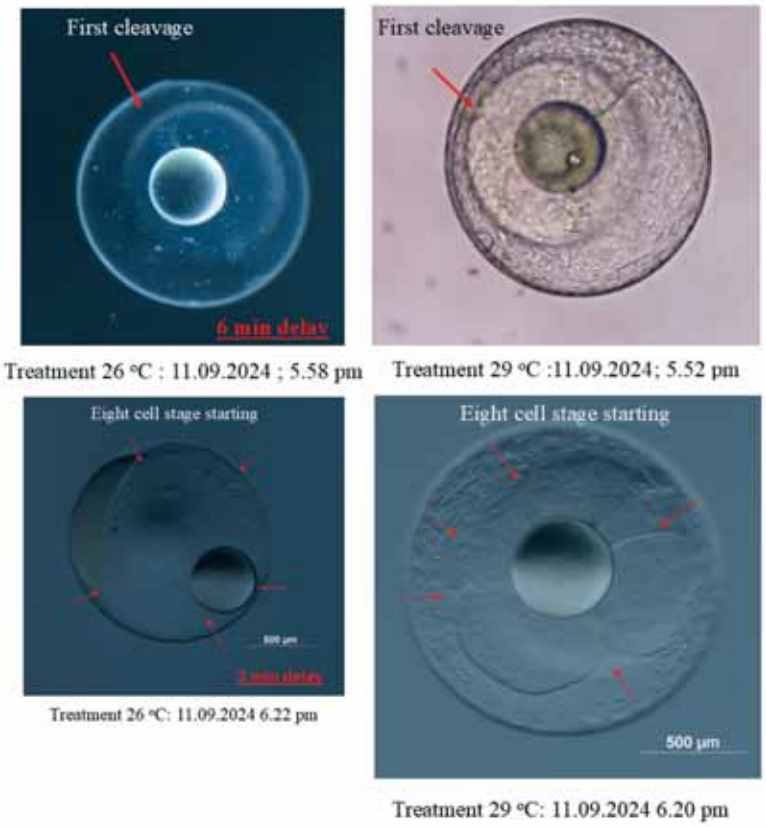
Histogram plot of absolute loss for minimum oocyte diameter using ridge regression



Histogram plot of absolute loss for maximum oocyte diameter using lasso regression

Effect of temperature on the progression of cell division in Asian seabass embryos

This study investigated the impact of temperature manipulation on the timing of the first cell division in Asian seabass embryos, aiming to create a longer window for microinjection during genome editing. Standardized protocols were developed for incubating fertilized eggs at suboptimal temperatures of 25-26°C in a cooling incubator. The results showed a 6-minute delay in the first cleavage and a 2-minute delay at the eight-cell stage in embryos incubated at 26 °C, compared to those incubated at 29°C (hatchery conditions). These findings suggest that lowering incubation temperature can extend the duration of the single-cell stage, thereby providing additional time for microinjection of guide RNA into seabass embryos.



Delay in cell division in Asian seabass embryos maintained at sub-optimal temperature

Strengthening the broodstock fishes of mangrove red snapper, *Lutjanus argentimaculatus* with proper quarantine, vaccination and tagging under captive system

A total of 60 fishes of mangrove red snapper are being maintained in the RCC tank and earthen ponds. All the fishes were vaccinated with VNN vaccine to protect them from infection of noda virus. After vaccination, the fishes were tagged and maintained to attain captive maturation. Matured

Results of the mangrove red snapper breeding trials

Larval parameters	1st Batch	2nd Batch	3rd Batch
Mean oocyte (µm)	570	460	520
Fertilized eggs (µm)	854	824	832
Newly hatched larval size (mm)	2.5	2.3	2.5
Yolk volume (µm)	586	578	582
Oil globule volume (µm)	325	321	322
Larval rearing period (dph)	12	8	11

Captive reared broodstock of mangrove red snapper

fishes observed from March to October and oozing males were dominant compared to mature females in all the months.

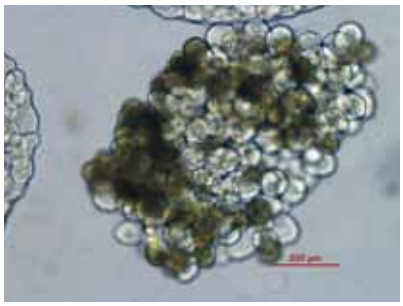
To standardize the breeding and larval rearing protocols for mass scale seed production of Mangrove red snapper

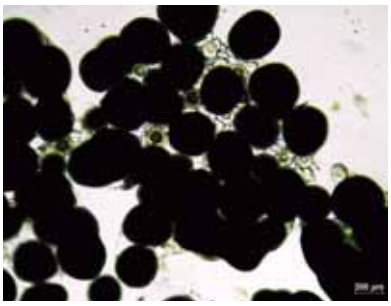
Four breeding trails of Mangrove red snapper performed, out of which, three trails successfully spawned. Larval rearing conducted up to 15 days successfully using different live feeds such as rotifers, copepods and ciliates.

Broodstock strengthening and breeding trials of grey mullet, *Mugil cephalus*

A total of 90 grey mullet fishes in the size range from 550g to 1.750kg are being maintained by feeding with formulated pellet feed. These fishes were vaccinated with VNN vaccine and after tagging, released in the broodstock tanks for the maintenance. Maturation of the fishes noticed from the first week of September 2024 with the presence of primary oocytes and reached maximum of 384µm during third week of October 2024. Ten females and 10 males were treated with hormone implantation (combination of LHRHa & 17 α methyl testosterone) from September. Implanted fishes (4 nos) indicated with presence of developed oocytes in the range from 476 to 520 µm and the non-implanted fishes (5 nos) had oocytes in the size range of 402 to 506 µm. However, 12 oozing males could be observed together with equal numbers in control and treated fishes. Fishes observed with above 500 µm were selected for induced breeding experiments along with the oozing males. A total of three induced breeding experiments conducted by selecting the females had oocyte diameters of 525 µm, 520 µm and 502 µm. They were injected with HCG hormone @ 17000 IU/kg and and after 24 hrs LHRHa hormone administered@ 200 µg/kg body weight. After 24 hrs of second injection, two set spawned spontaneously, however, the eggs were unfertilized.

Maturity assessment and induced spawning trials for grey mullet, *Mugil cepahalus* at West Coast

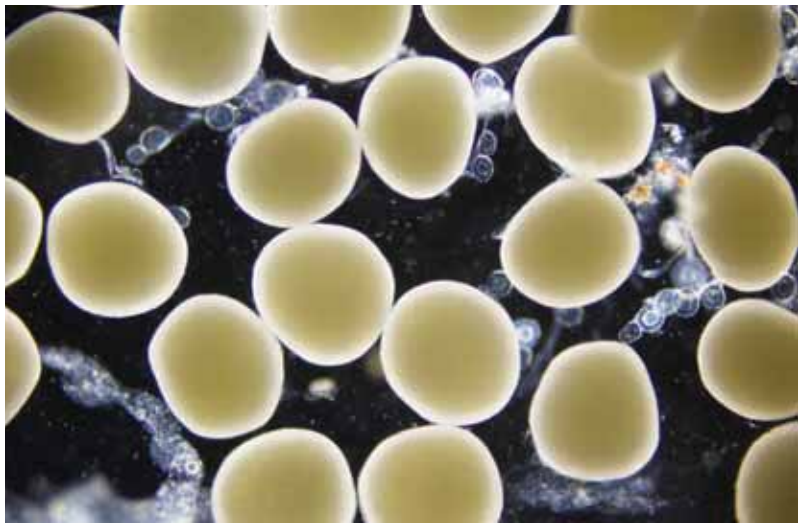




Captive reared broodstock of grey mullet with eggs showing different maturity stages

Grey mullet broodstock and assessment of maturity

A total of 60 adult grey mullet (0.97-2.4 kg) were maintained in cages (4 x 4 x 2 m) @ 15 nos./ cages in an earthen pond for carrying out captive spawning trials. The fish were fed with 6-7 mm artificial feed (CP: 47 %, CF: 10%). A total of 5 milt oozing males (0.97-1.34 kg) and 10 mature females (1.56–2.4 kg; Oocyte diameter: 500-550 µm) were obtained in the third and fourth week of November during routine assessment of maturity. Females with oocyte diameter 524-544 µm were selected for the captive spawning trials. Two sets of spawning trials with a sex ratio (female:male) of 1:2 and 1:3 were attempted by stocking the



Mature eggs (>544 µm) of grey mullet, *Mugil cephalus*

Milkfish broodstocks with new recruits

broodfish in a muslin cloth hapa (3 x 2 x 1 m) installed in a 5000 L circular tank (33 ppt salinity). HCG was used in the first trial for induction of final maturation and spawning in one trial. In the 2nd trial, OVAFISH (5000-10000 IU GnRH) was injected to female at 1-2 ml/kg and male at 0.5 -1 ml/Kg after 24 hrs of a conditioning dose (0.1 ml/Kg). No spawning was observed in both the trials.

Hatchery seed production of milkfish from newly recruited populations

Total 46 milkfish broodstock (Average body weight: 6.6 kg,

Hatchery produced milkfish fingerlings

total biomass: 303 kg) from Chennai and Kakinada group were maintained equally in two 100t RCC tanks. Thirteen new stocks (Chennai, ABW 3.0 kg, tl. 82 cm) recruited this year. Second line broodstocks (n=30, 2.5 kg, TL: 77 cm) are maintained in pond as future brood stock. Among two groups, population 2 (tank no 3) has showed significantly higher maturation (90.47 %) compared to population 1 (tank no 2-61.90%). A total of 03 spawning (01 dribbling, 02 major spawning) was observed during April to May -2024 resulted 0.35 million fertilized eggs and 0.2 million larvae. Total 37000 milkfish fry has been distributed among farmers and entrepreneurs from Tamil Nadu, Gujarat and West Bengal. Total revenue generated from seed sale is Rs. 196330.

Rabbit fish *Siganus javus* broodstock & Sub adult collection

Juveniles and sub adults of rabbit fish *Siganus javus* with the size ranging of 50 gm -1.2 kg size were collected from fishermen of Kovalam, Kolathur, Pulicat, Tuticorin and Mandapam operating trawl/hook & line and trap net fishery. These fishes were quarantined by treating with $KmNO_4$ (10 ppm), formalin (100 ppm), Chloroquine phosphate (3-5 ppm), copper sulphate (0.5 ppm) and are reared in the open pond-based cages and fed with formulated feed. Growth parameters and gonadal maturity are evaluated at periodic intervals.

Gonadal maturity assessment studies with wild collected *Siganus javus*

Rabbit fish *Siganus javus* weighing in the size range of 400 - 600 gm were collected from fish landing centres at Pulicat, Kanathur, Semmanchery and Kovalam at monthly intervals. The gonads of these fishes were dissected and gonadal maturity was assessed. Gonad tissues were observed under light microscope and part of the samples were fixed in neutral buffered formalin and histological sections were made and stained with haematoxylin and eosin stains. Stained sections were photo micro graphed to assess the maturity stages in relation with seasons. Male, female sex ratio of the collected specimens was observed as 6:4 (for each 10


Holding of collected fishes in PVC cages @ Pulicat


Loading in transport carrier


Shifting to baot with tank and oxygen cylinder

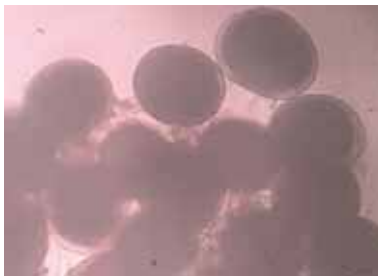

Prophylatic treatment with KmNo4 @MES

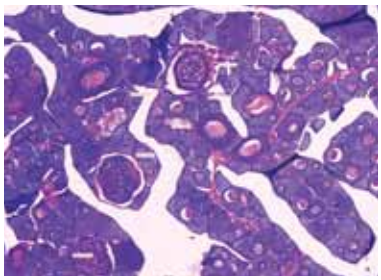

Transportation in boat


Rearing in HDPE lined ponds @ MES


Intra ovarian oocyte(>150µm)


Intra ovarian oocyte(>250µm)


Intra ovarian oocyte(>450µm)


Histology of gonad showing different stages of oocyte development

samples). Developmental stages in gonads are differentiable from 200 grams onwards, however 400 -500 gm size was ideal for observing the stages. Progress of gonadal maturity was observed from March to October and there after spent females landed. This indicates that the probable breeding season falls between June to October in the wild.

Impact of hormone pellets implantation in accelerating gonadal maturity in *Siganus javus*

To assess the effect of sex hormones on gonad development was examined by implanting female and male rabbit fish *Siganus javus* with LHRH and 17α methyl testosterone (MT) hormone pellets, respectively, at a dose of 50 µg/kg body weight. Serum samples from both hormone-implanted and non-implanted fish were analysed for 17α-estradiol and testosterone levels using ELISA. The results indicated that E_2 levels varied between 0.3-0.8 ng/ml in females and 0.2-0.4 ng/ml in males and the T levels ranged between 1-2 ng/ml in both the sexes. Cannulation biopsy of implanted fish had larger oocyte diameter (120 -328 µm) compared to the non-implanted fish (120 -214 µm). Progress of oocyte maturation in wild caught fishes was recorded as 95 µm to 140 µm during the similar period. Estradiol levels were higher in females, while testosterone levels were elevated in males, supporting stimulatory role of sex steroids on fish maturation. No significant differences were observed between hormone-implanted and non-implanted males.

Progress of oocyte development in *Siganus javus*

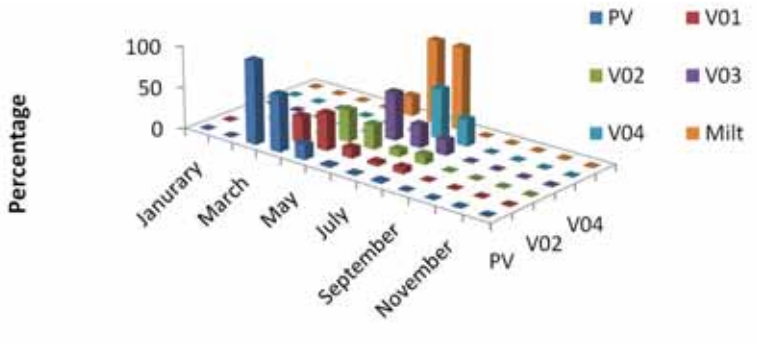
	0 day	15th day	30th day	45th day	60th day
LHRH implanted	120 µm	176 µm	268 µm	294 µm	328 µm
Without hormone implant	120 µm	145 µm	182 µm	192 µm	214 µm

Hormonal induction for spawning in *Siganus lineatus*

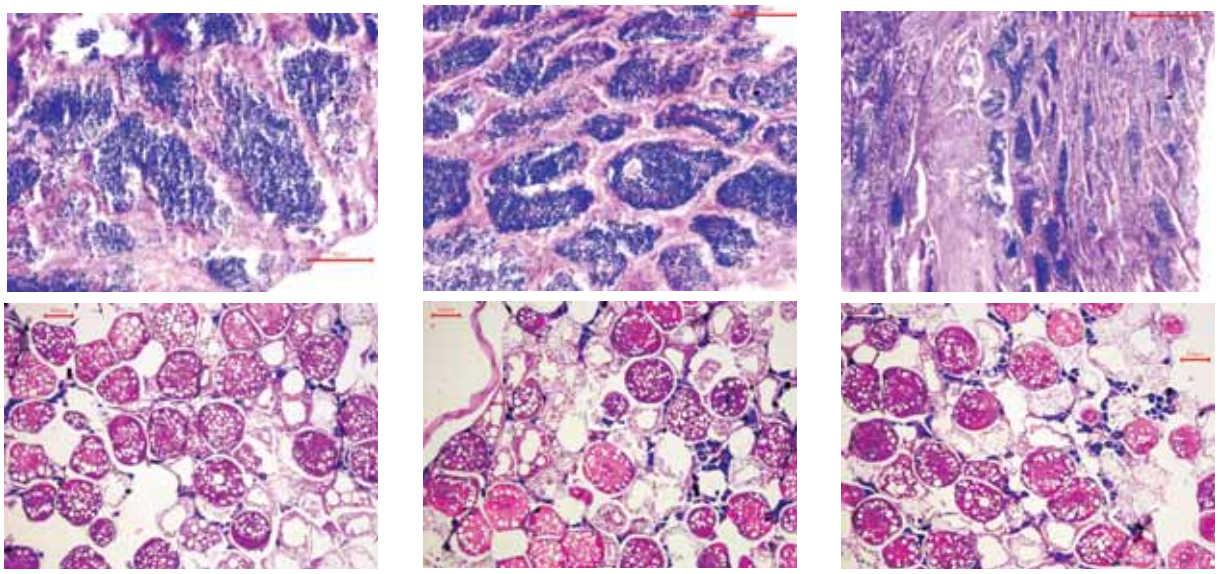
Rabbit fish *Siganus lineatus* weighing 800-950 grams size range are being maintained under controlled water quality parameters and broodstock diet in the hatchery facility. Two spawning inductions were carried out (during July 2024) in *Siganus lineatus* (one female and two males) female having intra ovarian oocyte diameter above 450µm and male having oozing milt were induced with LHRH @ 100 µg/kg body weight for female and 50 µg/kg body weight for male. No spawning occurred even after 48 hours of post induction. A second dose was administered, but the fish did not respond. Water temperature was 30°C, which was about 3°C higher than the spawning achieved during October 2023.

Year round maturation status of Tade mullet (*L. tade*) in RAS

Tade mullet (*Liza tade*) is a brackish water species cultured under traditional polyculture farming systems in West Bengal, India. It is an herbivore species with good demand in the domestic market. Broodstock of +1 year age group has been maintained in circular RCC tank connected with an RAS to observe the year round maturation profile in captivity. Onset of maturation was observed in March when previtellogenic stages were observed in ovarian biopsies. The vitellogenic stages from cortical alveolus stage (V01), Lipid vesicle stage (V02), Yolk granule stage (V03) and advanced vitellogenic stage (V04) was observed from month of April to August. Spermiating males were observed during the months of May – July.



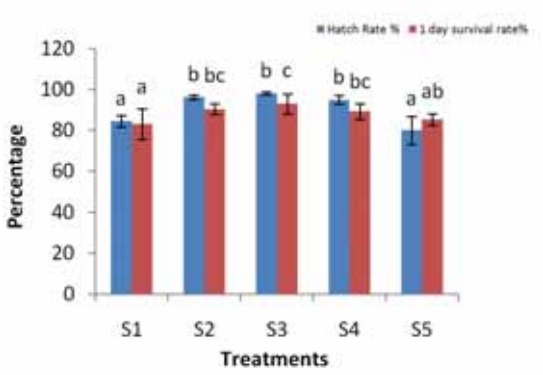
Microscopic observation of gonad development of *Liza tade* during May – July

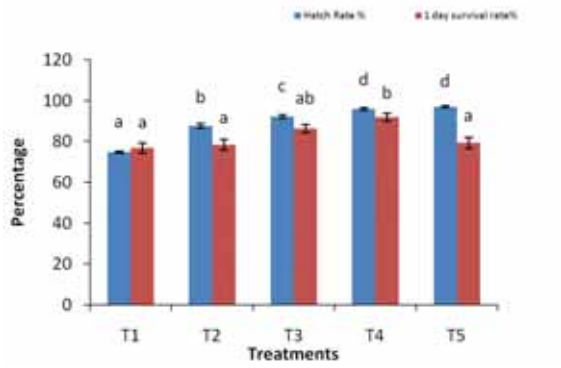


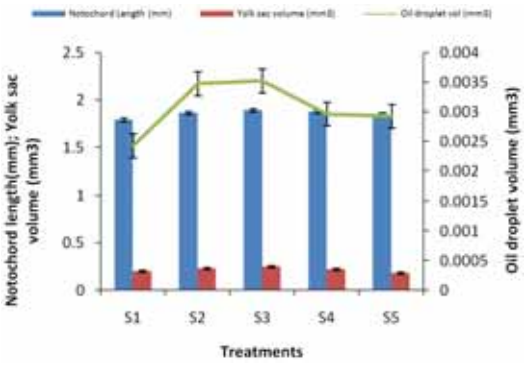
The above study indicated that oocyte development of Tade mullet may occur in prevailing brackishwater salinity at KRC (10 – 14 ppt), however salinity >15 ppt is required to achieve final maturation by the females.

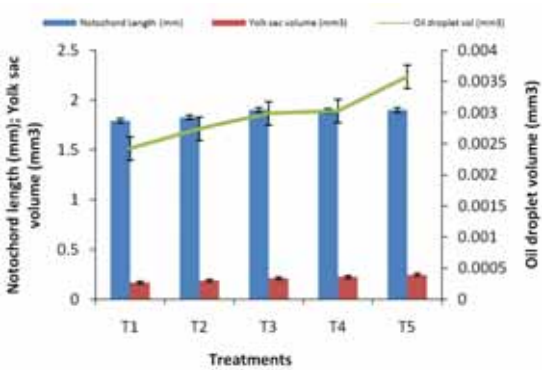
Influence of salinity and temperature on embryonic development and larval survival of Bengal yellowfin seabream (*Acanthopagrus datnia*)

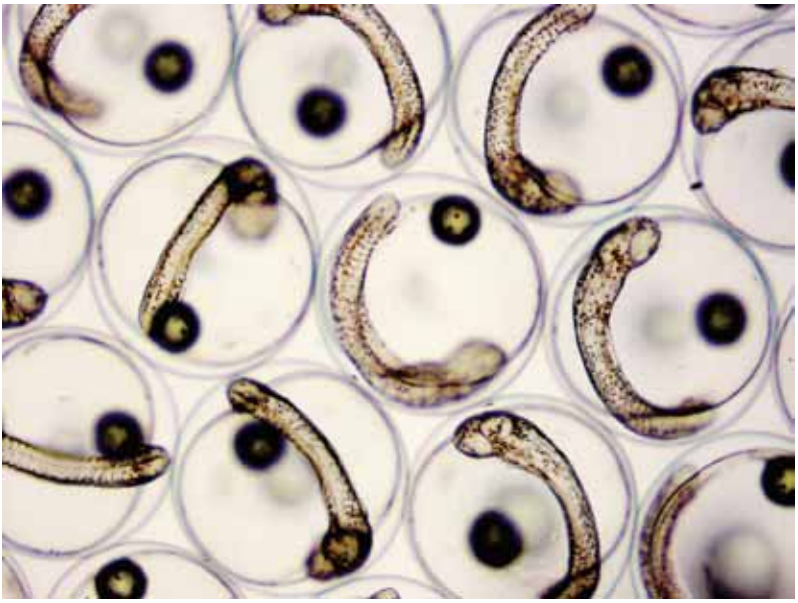
Abiotic factors like salinity and temperature plays an important role during embryonic development and early larval development in many sparid species. Total five salinities (20 (S1), 25 (S2), 27 (S3), 30 (S4), 35 (S5) ppt) and temperature (14 (T1), 16 (T2), 18 (T3), 20 (T4), 22 (T5) °C) was studied to find optimum levels of both factors for egg incubation. In this study inverse relationship was found between abiotic factors (salinity, temperature) and incubation time for fertilized eggs. Incubation time was significantly short (18 and 14 hours respectively) when fertilized eggs were incubated at 25 ppt salinity and 22 °C temperature. The number of viable embryos at hatch was dependent of salinity and temperature. The highest significant proportion of hatch rate was observed in the salinity range of 25 – 30 ppt in treatments 25, 27, and 30 ppt whereas significantly ($P \leq 0.05$) highest hatch percentage of 97 ± 0.5 was observed at 22 °C in treatment 5. 24 hour survival rate was significantly highest (93 ± 3.1) in 27 ppt whereas 91.87 ± 2.05 survival percentage were observed in replicates at 20 °C. There were no significant ($P > 0.05$) difference observed of salinity and temperature on Notochord length which were almost similar in all the replicates. Yolk sac volumes were significantly lowest at 20 ppt salinity and highest at 27 ppt. There were no significant difference between the Oil droplet volumes in 14 and 16 °C. Significantly highest ODV were found when temperature was 22 °C.











Developing embryo and hatching in Bengal bream

ORNAMENTAL

Captive Maturation and Breeding Strategies for *Mugilogobius tigrinus*

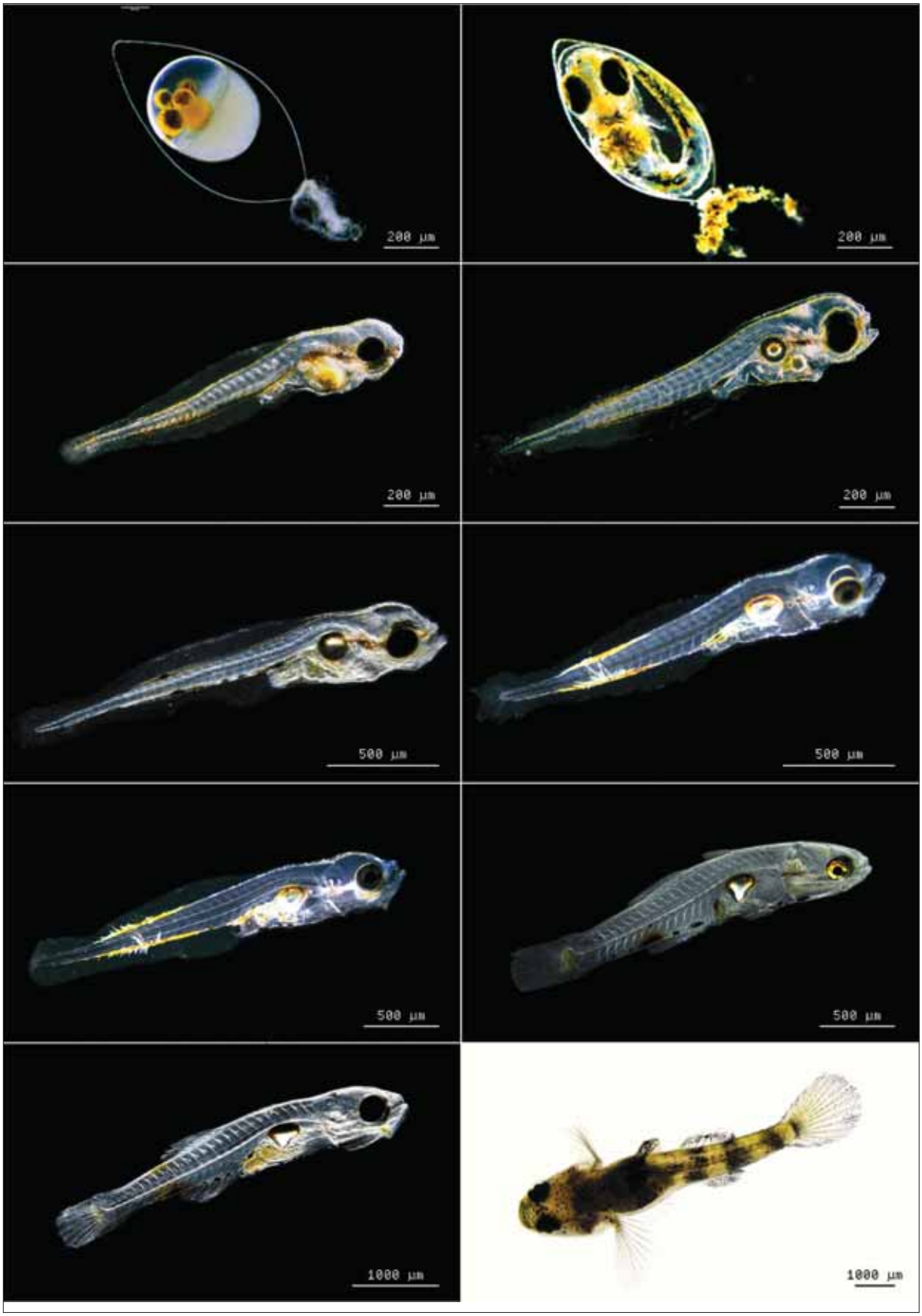
Mugilogobius tigrinus, a small goby species, inhabits the Eastern Indian Ocean and Western Central Pacific, with recent sightings in Andhra Pradesh, Tamil Nadu, Kerala, and the Andaman and Nicobar Islands. This study reports its first capture in the Muttukadu backwaters and highlights significant advancements in its aquaculture. Known for its hardiness, *M. tigrinus* shows promise as an ornamental species for community and nano tanks. Captive maturation, breeding, and larval rearing were achieved successfully in captivity.

Broodstock were fed live feeds, such as artemia and polychaetes, along with commercial pellets. Sexual dimorphism was noted, with males displaying elongated dorsal spines and vibrant colors, while females appeared more rounded. Males exhibited courtship behaviors, guarding and aerating eggs post-spawning. Each spawn produced 150–250 elliptical, stalked eggs, with hatching occurring within 72–96 hours in salinity ranges of 18–30 ppt.

A standardized larval rearing protocol was established, transitioning from ciliates and copepodites to rotifers. This study underscores the species' potential for ornamental brackish aquaculture, advocating further research to support its industry adoption.

Mugilogobius tigrinus adult

Mugilogobius tigrinus breeding group

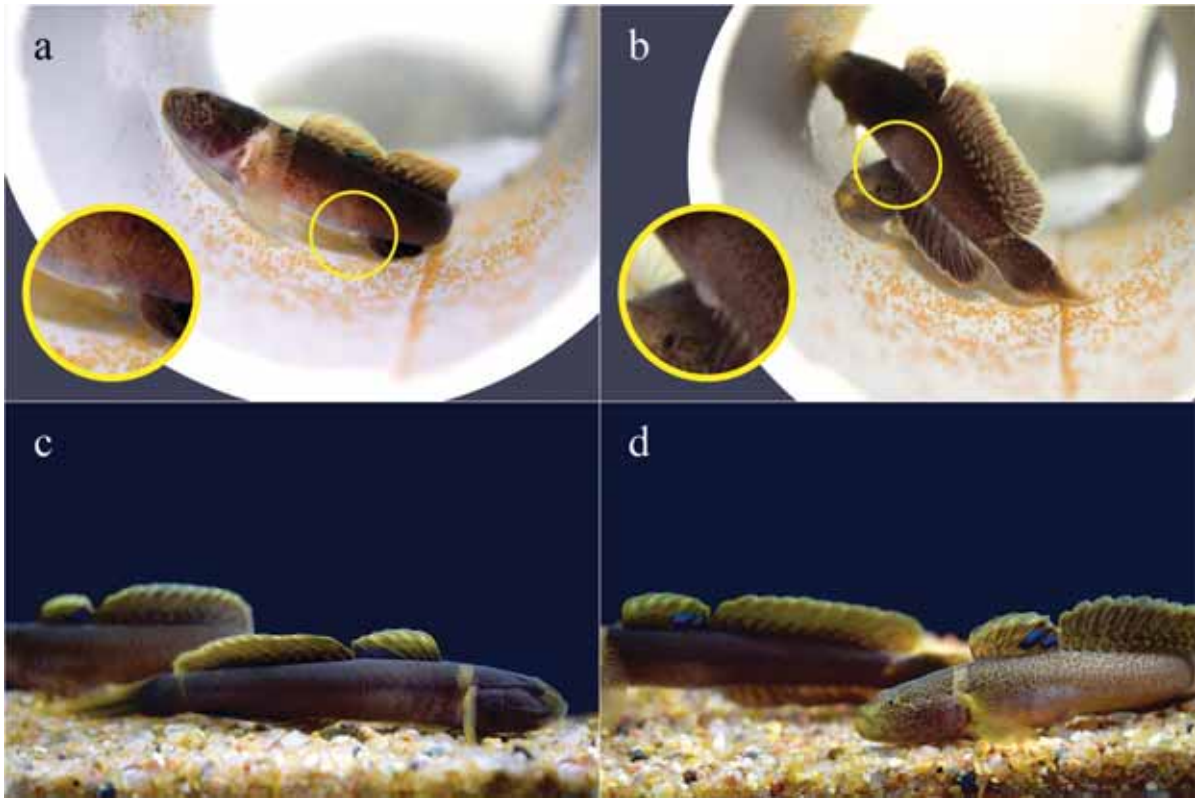


Embryonic development to larval metamorphosis of *Mugilogobius tigrinus*

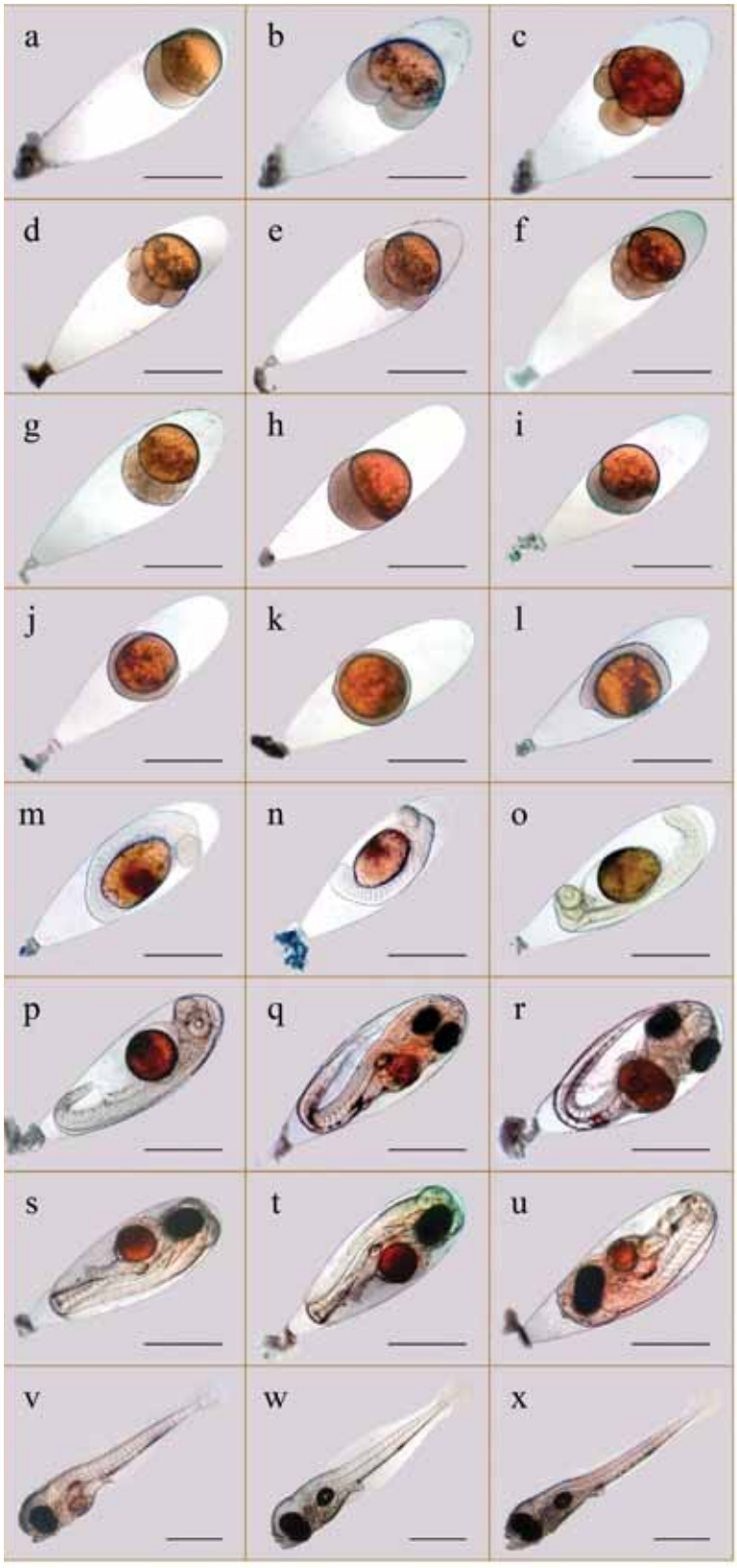
Breeding and embryonic development of the brackishwater ornamental Goby, *Mangarinus waterousi*

Mangarinus waterrousi demonstrates strong potential for ornamental aquaculture, with successful captive maturation, breeding, and larval rearing achieved through controlled experiments. Comprehensive documentation of its embryonic development revealed key stages from fertilization to hatching. Each spawning event produced 1150 ± 120 eggs, with intervals averaging 14.35 ± 1.73 days. The polylecithal eggs, oval to pear-shaped, measured 1.336 ± 0.04 mm in length and 0.38 ± 0.09 mm in width, featuring an adhesive end and vibrant yellow-orange coloration that turned silvery-orange by day two. Spawning occurred early in the morning, with hatching after 90.13 ± 0.15 hours of incubation.

A standardized larval rearing protocol optimized feed types, schedules, and water quality, ensuring high survival rates and robust growth, facilitating large-scale juvenile production. Sexual dimorphism was evident, with distinct male and female traits aiding broodstock management. Observations of unique courtship and spawning behaviors further enriched understanding of its reproductive biology. This study positions *M. waterrousi* as a viable candidate for sustainable brackishwater aquaculture, supported by established breeding protocols and insights into its biology.



Sexual dimorphism in *M. waterousi* (a) Male pointed papillae (b) Blunt female papillae (c) Male exhibiting intense brown coloration (d) Female displaying a dusky brown shade with scribbling patterns.

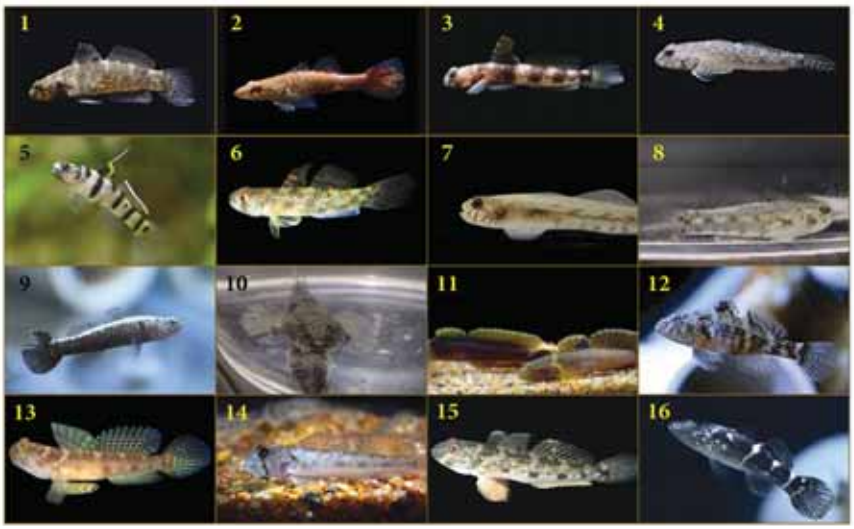


Stages of embryonic development of *M. waterousi* from the (a): single cell stage, (b): Two cell stage (c): four cell stage, (d): eight cell stage, (e): sixteen cell stage, (f): thirty two cell stage, (g): sixty four cell stage, (h): morula, (i): gastrula, (j):germ ring disappearance, (k): epiboly, (l): Neurula, (m):Notochord formation, (n): Kupfer's vesicle appearance, (o): Body turnover, (p): Heart formation, (q): Otolith formation, (r): blood circulation, (s): Pectoral fin bud formation, (t): Opercular movements, (u): pelvic fin bud formation (v): 0 dph, (w): 2 dph, (x): 6dph. Scale depicted in the picture is about 500µm.

Early Life Stages of a brackishwater pistol shrimp, *Alpheus* sp. from Muttukadu Estuary

Significant progress has been made in understanding the breeding biology of a brackishwater pistol shrimp collected from the Muttukadu estuary in Chennai. This species, tentatively identified as *Alpheus* sp., exhibits a unique larval development process. The pistol shrimp larvae hatch at an unusually large size, allowing them to bypass the first larval stage (nauplii) entirely and enter directly into the second stage, which is typical to some of the species belonging to this genus. This second stage (zoea), lasting about one day, is critical for enabling the shrimp to transition from a sessile to stalked eyes. The subsequent third and final larval stage lasts 2-3 days and involves further morphological changes. Notably, the larvae have demonstrated survival up to four days after hatching, indicating remarkable resilience in their early life stages. To optimize their growth and survival rates, various feeding strategies have been tried for the larvae. These trials involve feeding them with different food

1. *Bathygobius fuscus*
2. *Butis butis*
3. *Yongeichthys viganensis*
4. *Favonigobius reichei*
5. *Mugilogobius tigrinus*
6. *Pseudogobius melanosticta*
7. *Eugnathogobius mindora*
8. *Pseudogobius minimus*
9. *Eleotris fusca*
10. *Psammogobius biocellatus*
11. *Mangarinus waterousi*
12. *Butis koilomatodon*
13. *Cryptocentrus fasciatus*
14. *Oligolepis acutipennis*
15. *Acentrogobius audax*
16. *Ophiocara porocephala*



sources, including rotifers, copepod nauplii, and artemia nauplii. Identifying the optimal diet will be crucial for future efforts to breed and conserve this shrimp species. The research on *Alpheus* sp. from Muttukadu estuary not only contributes to our understanding of its reproductive biology but also sets the groundwork for potential aquariculture applications. Continued monitoring and further studies will be essential for identifying this species accurately and enhancing breeding success in controlled environments.

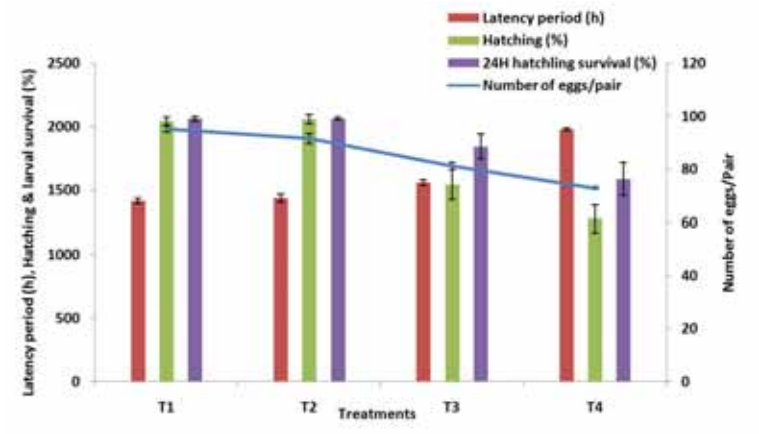
Gobies of Muttukadu Backwaters: Diversity and Ornamental Significance

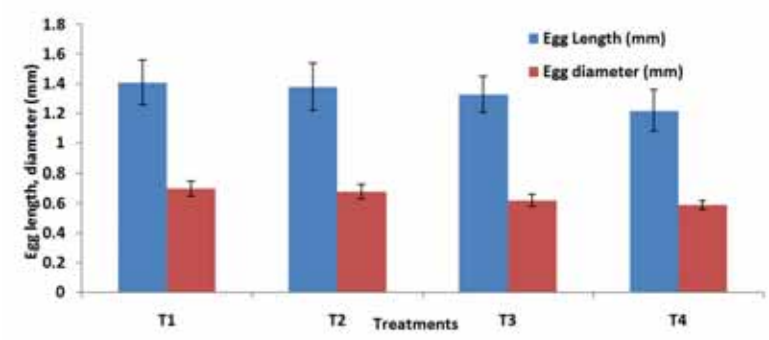
An ichthyological survey conducted in the Muttukadu estuarine system, recognized as a rich biodiversity hotspot and a critical habitat for gobiid species, revealed remarkable findings. Over sixteen goby species were identified and documented. Notably, several of these species possess significant ornamental potential, characterized by unique morphologies and vibrant coloration, making them highly desirable in the ornamental trade. Some species were newly recorded along the Indian coast, highlighting the ecological significance of this estuarine system. To promote sustainable utilization, the development of broodstock and captive breeding programs for these gobies is imperative, as it reduces dependence on wild stocks. Moreover, the identification of novel candidate species through biodiversity assessments could expand the ornamental aquaculture sector, boosting local economies while contributing to conservation and sustainable fisheries management.

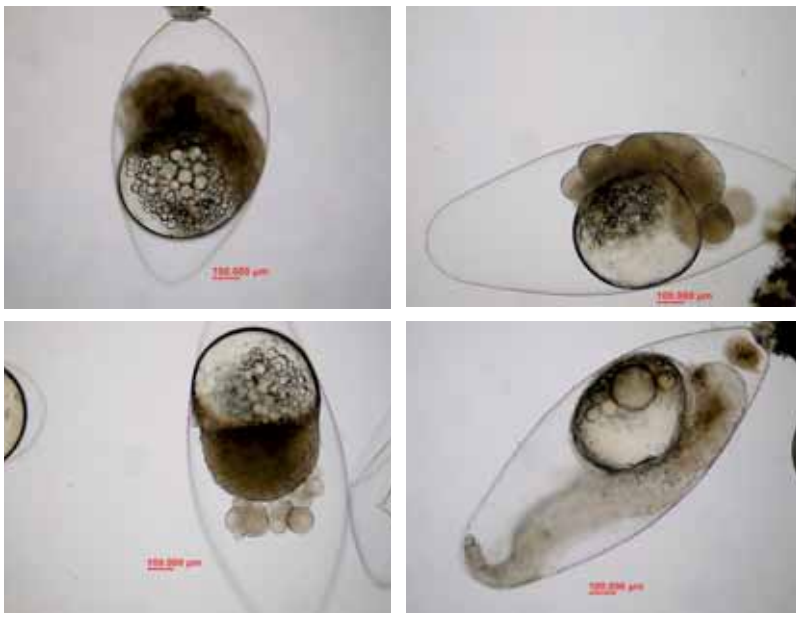
Cage culture of silver moony for broodstock development at farmers site

Broodstock development of silver moony, *Monodactylus argenteus* in open water body with farmers participation

To develop broodstock of silver moony for mass-scale breeding, CIBA initiated a broodstock development program in open water bodies with farmer participation. Wild-caught juveniles, ranging in size from 10 to 15 grams, were collected and stocked at two







Deformity during embryonic development in 9 ppt salinity of Knight Goby

farmer sites: Kadaloor Chinna Kuppam and Kolathur, Tamil Nadu. Approximately 500 fish were stocked across these locations, with rearing carried out in small and medium-sized cages. Feeding was done using CIBA-formulated feed, supplemented with Artemia biomass and squid meal to promote broodstock development. After a five-month culture period, the fish grew to a size of 50–60 grams, and milting males were observed.

Effect of Salinity during embryonic development in Knight Goby (*Stigmatogobius sadanundio*)

The knight goby (*Stigmatogobius sadanundio*) is a promising estuarine species native to the Indian Sundarbans and is internationally traded. It is omnivorous, readily accepts formulated feed, and is compatible with other species in captivity. A total of 108 adults (ABL: 5.1 ± 1.24 cm) were collected and reared in FRP tanks (500 L) on a 30% CP diet. Sexual dimorphism appeared after four months. Spawning and embryonic development were studied at salinities of 0 (T1), 3 (T2), 6 (T3), and 9 ppt (T4) with 1:3 female-to-male ratios. Spawning occurred in all treatments with 1500–2000 eggs per female. Egg sizes were similar across treatments. Latency was shortest in T1 (68 h) and longest in T4 (95 h). Highest hatching (98.83%) and survival (99.12%) were in T2, while T4 showed the lowest results and deformities (5.12%). The study suggests 0–3 ppt salinity is optimal for captive breeding and seed production.

Evaluation of aquaculture potential of diversified crustacean species: *Penaeus japonicus*, *Scylla* spp. and ornamental crustaceans

Several native crustaceans including ornamental decapods have been identified as possible aquaculture species. This

project is aimed to evaluate the aquaculture traits and to develop hatchery and culture technologies for these candidate species.

Portunus reticulatus: Female crabs weighing between 180 g and 320 g, collected from the Chennai, Chengalpattu, and Puducherry coastal belt, exhibited fecundity ranging from 0.3 to 1 million eggs per spawning. Six successful breeding cycles were conducted at salinity levels between 15 and 32 ppt, yielding 60,000 to 1.2 lakh megalopa per cycle with a survival rate of 40% to 66.6%, underscoring the species' potential for brackishwater aquaculture.

The larval cycle from zoea 1 (Z1) to megalopa spanned approximately 13 days, progressing through four zoeal stages, each lasting 3–4 days. During the Z1 to Z2 stages, larvae were fed with rotifers (*Brachionus plicatilis*), transitioning to newly hatched *Artemia nauplii* (5–8 nauplii per larva) for Z2 to Z3, supplemented by a 30% water exchange to enhance moulting. From the megalopa stage onward, chopped clam meat was introduced as feed, and third-day megalopa were transferred to hapa-based or lined pond nurseries equipped with hideouts to improve survival rates. Survival from the megalopa to the crab instar stage ranged from 62% to 82%, with significantly reduced cannibalism compared to other species such as *Scylla serrata* and *S. olivacea*. Substrate preference experiments revealed better survival on sandy bottoms, although crablet collection posed operational challenges. Brackishwater seaweeds such as *Gracilaria salicornia* and *Acanthophora* sp. served as effective natural hideouts, further enhancing survival during the nursery phase.

This study establishes *P. reticulatus* as a viable candidate for brackishwater aquaculture, with promising outcomes in larval survival and nursery rearing practices. Ongoing field trials at farmer ponds using specialized CIBA feeds aim to optimize grow-out conditions and assess the economic feasibility of large-scale cultivation, paving the way for sustainable aquaculture practices for this species.

Metapenaeus monoceros: Brown shrimp, *Metapenaeus monoceros,* has been identified as one of the potential candidate species for the diversification of penaeid shrimp aquaculture. Although this species has been the major component of the traditional shrimp culture system in India and in many Asian countries, the culture technique of this species is yet to be optimized. This study was aimed to optimize the rearing system and stocking density for M. monoceros grow-out cultures. A 50-day experiment was carried out with hatchery-produced *M. monoceros* (3.92 ± 0.04g), using the rearing system as the first factor (clear water (CW), biofloc (B) and auto heterotrophic system (AH) and stocking density as the second factor (30 and 60 shrimp/m3) resulting in six treatments (CW30, CW60, B30, B60, AH30, AH60). At the end of the trial, the highest body weight (g) ($P<0.05$) was recorded in the auto heterotrophic treatments (AH30:7.71 ± 0.17 g; AH60: 7.6±0.33 g), followed by the biofloc treatments (B30:7.25 ± 0.002 g; B60: 7.24 ± 0.18 g). Similarly, the highest survival (%) was recorded in auto heterotrophic treatments (AH30: 100; AH60: 96.29±1.85) followed by biofloc-based treatment (B30: 96.29±3.7; B60: 94.44±5.55%). The digestive enzyme, proximate composition, water quality parameters, microbiological analysis, and plankton diversity varied among the treatments. The study revealed that brown shrimp can be reared up to 60 shrimp/m^3 stocking density in auto heterotrophic rearing system compared to conventional culture practices. As brown shrimps are resilient species with strong local demand, the culture techniques demonstrated here can directly be applied to the development of location-specific farming in various coastal regions of India

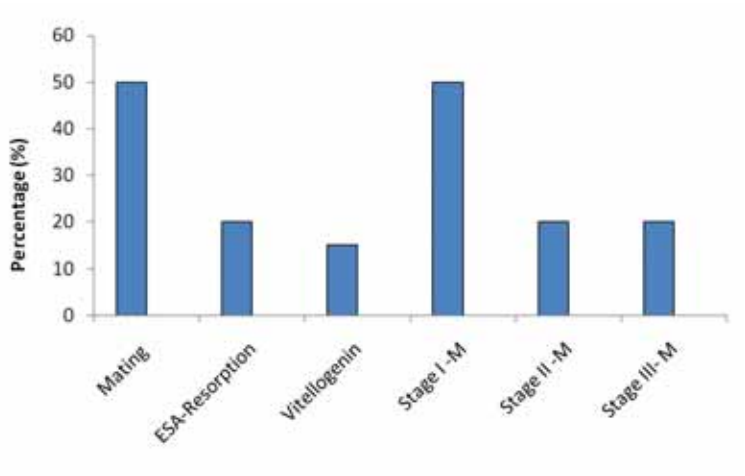
Penaeus japonicus: To popularize Kuruma shrimp, *Penaeus (Marsupenaeus) japonicus* Form II, as a part of the diversification of shrimp farming across India, seed production and growth performance studies were conducted. In experiment I, the reproductive performance of Kuruma shrimp was studied in captive system. In experiment II, a 75-day growth performance study was carried out in 2 × 2 factorial design with and without sandy bottom (S) as the first factor and outdoor units having natural light (O) and indoor units with restricted light (I) as the second factor resulting in four treatments: O+S, O-S, I+S and I-S. The seed production trial recorded an average survival of nauplius to post larvae (PL) 36 ± 12%. In experiment II, the PL (0.02 ± 0.01 g) was stocked at 300 PL m−3 to study the effect of sandy bottom and light intensity on growth performance. Results indicated that the highest final body weight (0.63 ± 0.05 g) and survival (80 ± 2.0 %) were registered in outdoor units without (O-S) and with sandy bottom (O+S), respectively. Although no difference ($p > 0.05$) in body weights were recorded among the treatments, the Kuruma shrimps reared under indoor units with restricted light intensity had lower ($p < 0.05$) survival (43–45%).

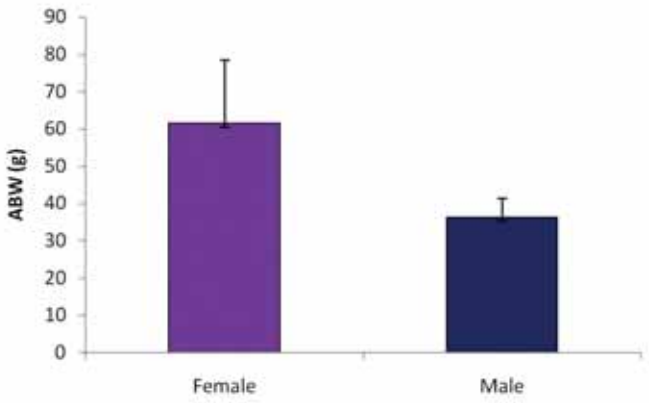
Artemia biomass production: Artemia biomass production in a controlled biosecure system can be popularised in inland or coastal areas where accessibility to saltpan is limited. Against this background, four sets of experiments were executed to optimize different management regimes in Artemia biomass production, and to explore its role as a maturation diet for Indian white shrimp, *Penaeus indicus*. In experiment, I, Artemia biomass production was carried out in autotrophic (microalgae, TA), heterotrophic (TH), and

mixotrophic (TMX) rearing systems for 18 days. Experiment II was conducted to evaluate Artemia biomass production under diverse salinity regimes (10, 15, 20, 30, 40, and 50 ppt), and in experiment III, the effect of varying stocking densities of Artemia (300, 600, 1200, and 1800 nos L^{-1}) in production was attempted. In experiment IV, the role of adult Artemia (live, frozen, and hormone-enriched) as a maturation diet for *P. indicus* (36.40 ± 0.3 g) was explored, and the sex steroid profile of adult Artemia was compared with other fresh maturation feeds (polychaete, clam, and squid).

Captive broodstock development and induced maturation techniques of kuruma shrimp, *Penaeus japonicus* Form II through hormonal/ environmental & dietary approaches

Reproductive biology of Kuruma shrimp, *Penaeus japonicus* Form II brooders were collected from Vizhinjam, Chennai and Pazhaverkadu for the study period and captive stock carried out. Out of 200 brooders collected from Vizhinjam during June-August male and female brooders had an average weight of 29.71 (18-97 g) and 40 (25-80 g) size. The wild collected male population were 32% Matured (IV), and 55% in maturing white (II) stage. The wild caught female brooders were 100 % spent with 505 of the brooders were in mated stages. The sub adult brooders were collected from Pazhaverkadu Lake (21 ppt) for captivity rearing. Out of 55





number of sub adults collected 2:1 female male ratio. The male and female sub adult body weight ranged between 8-25 g and 9-27.5 g respectively. Out of the sub adult collected 58% male were immature stage and 42% was maturing stage. All the sub adult female were in immature stage of gonad development and 45% population were in mated stage. In Tamil nadu brooders were mainly collected from Chennai, Kalpakkam during August to December period. Above 75 brooders were collected from Chennai coast with male and female with average body weight of 35 (15-64 g) and 80 g (30-120g) respectively. Majority of the female brooder were above 8 g size and were in spent stage. Captive broodstock performance reveled female brooders were 50% in mated and 155 of population were in vitellogenin stage. In male brooders 50% male were in stage 1, 20% in stage 2 and 20% in stage 3 broodstock development stage.

As kuruma shrimp brooders preferred sandy bottom habitat, a sand based recirculatory broodstock unit with *in situ* bio filtration units with water exchange capacity minimum 10 percentages in a month was developed for captive broodstock development of kuruma shrimp. Water quality and microbial parameter are well maintained in the maturation units. Dietary approaches for gonad maturation through enriched supplemented feeds and formulated feed (ICAR-CIBA) are well accepted by the brooders and brooders nocturnal feeding regime management is optimized.

ESTABLISHMENT OF PILOT SCALE NUCLEUS BREEDING CENTRE FOR QUALITY SEED PRODUCTION AND DOMESTICATION

The preliminary estimate for the entire Genetic Improvement Program (GIP) unit consisting of the quarantine units, pilot scale NBC (Nuclear Breeding Centre), nursery system, pre-grow-out and grow-out system along with reservoir and treatment systems is completed. Series of discussion with CPWD and consultant engineers were organized to arrive at the optimum design criteria within the allotted budget. However, there is a considerable price escalation, due to variation in the Goods and Services Tax (GST) and cost index of CPWD. After all our effort to keep the estimated cost within the allotted budget, there is a need for extra money (2.28 Crores) to compensate for the GST difference and cost index. The ministry is requested to sanction the extra amount for which the response obtained was very positive.

All the necessary clearances for water pipeline from sea to the GIP facility are obtained and initiated the work.

Broodstock collected states with identification sites and collected months, 2024

Sampling State	Collection site	September	October	November	December
Andhra Pradesh	Kakinada				
Andhra Pradesh	Visakhapat-nam				
Goa	Goa				
Karnataka	Mangaluru				
Kerala	Kochi				
Maharashtra	Ratnagiri				
Odisha	Puri				
Tamil Nadu	Chennai				
Tamil Nadu	Kanyakumari				
Tamil Nadu	Pazhayar				
West Bengal	Digha				

Larval parameters	1st Batch	2nd Batch	3rd Batch
Mean oocyte (µm)	570	460	520
Fertilized eggs (µm)	854	824	832
Newly hatched larval size (mm)	2.5	2.3	2.5
Yolk volume (µm)	586	578	582
Oil globule volume (µm)	325	321	322
Larval rearing period (dph)	12	8	11

BROODSTOCK COLLECTED STATES WITH IDENTIFICATION SITES

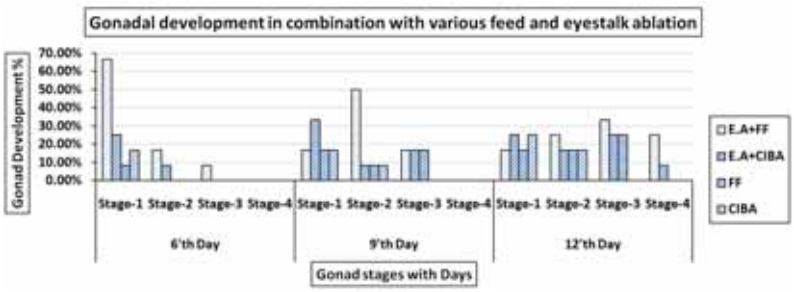
Broodstock procurement centres across the coast at Puri (Odisha), Kakinada (AP), Chennai (TN), Kanyakumari (TN), Quilon (KR) and started collecting broodstock for the genetic characterization through SNP genotyping. Further, we need to develop contact points in the West Coast (Mangalore and Goa), Andaman and Nicobar Islands for establishing a robust baseline population for initiating the domestication program. We also need to develop required pre-primary quarantine facilities at the procurement sites to avoid any diseased shrimp coming to the GIP center.

CIBA maturation feed *vs* various frozen feed for Indian white shrimp to enhance the gonadal development

To achieve gonadal development of *P. indicus* female broodstock shrimp using ICAR-CIBA formulated feed, we employed about 36 females in 500 litres of FRB tanks with 3 females and one male used in each treatment with triplicate. We employed two distinct techniques, eyestalk ablation and non-eyestalk ablation with various feeds.

Total experiment consists of four groups: a) Eyestalk Ablation + Frozen Feed (EA + FF), b) Eyestalk Ablation + CIBA maturation feed (EA + CIBA), c) Non-eyestalk ablation + Frozen feed (FF) and d) Non-eyestalk ablation + CIBA maturation feed (CIBA).

In a 12-day trials, it was observed that feed would result in 25% of the animals reaching stage-4, however, 8.33% of the animals in the eyestalk with frozen feed and eyestalk with CIBA feed actually reached stage-4. In the frozen feed 25% of subjects without eyestalk ablation achieved stage-3 and 16.67% reached stage 2 with CIBA feed, respectively.

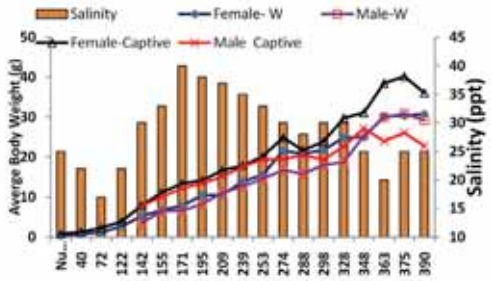


Gonadal development with respective feeds.

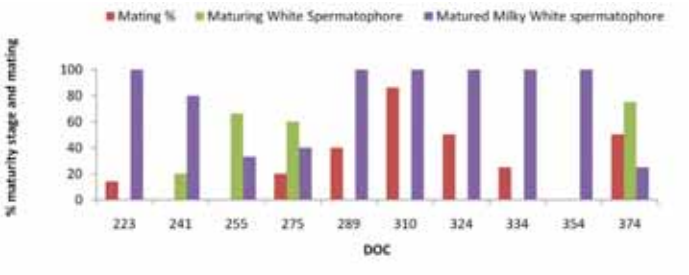
Captive broodstock development of *Penaeus indicus* in tank system

Captive broodstock development of *P. indicus* was carried out in HDPE tank system. The post larvae (Wild Generation GN1) produced from wild broodstock (G0) was compared with pond-reared domesticated broodstock (Captive - GN4). The nursery-reared (30 DOC) post-larvae were stocked in 20-ton outdoor-based HDPE tanks at the varied salinity from 17 to 45 ppt.

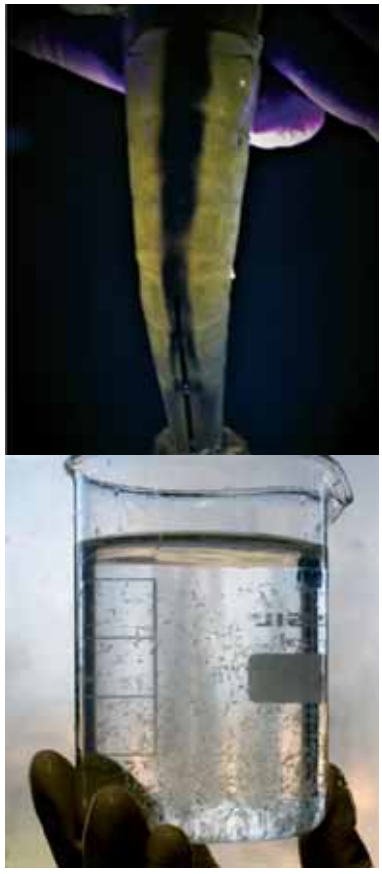
By 390 DOC, female and male captive-reared stocks attained 36.14± 6.25g (23.42 - 48.72g) and 29.27 ± 3.86g (25.1-29.27g), respectively compared to 31.57 ± 5.92g (22.85-52.14g) and 22.77 ± (12.32-36.41g) attained by wild GN-1. At the end of the trail, 30% of the captive GN4 females recorded ovarian development without eyestalk ablation compared to 18.9% ovarian



Growth performance of PL of *P. indicus* produced wild brooders (Wild GN-1) and Pond reared broodstock (Captive GN 4) in tank-based system



Percentage of maturity stage during captive development



Captive-reared *P. indicus* brooder and post-larvae.

development in GN-1. Survival was 90% (captive-GN4) and 70% (wildGN-1). Successful breeding and larval production in tank system without eye stalk ablation at 25 ppt.

Artificial Insemination (AI) trials in *Penaeus indicus*

Artificial insemination technique is a key in shrimp culture aimed in improving the reproductive efficiency and genetic selection. It enables controlled breeding which is extremely useful in the production of specific traits in improving hatchery outcomes to support selective breeding programs.

Artificial insemination was performed on newly moulted mature females which were inseminated with a male spermatophore when the thelycum is soft. The spermatophore-implanted female was released to the maturation tank and close monitoring of the developments of eggs. In this period, total 23 artificial inseminations were conducted. From these, 15 were successfully spawned and the success rate was 65%.

Insertion of spermatophore in female thelycum; extraction of spermatophore

The AI methodology involved eyestalk ablation with stress-free handling of the broodstocks with improved fertility results. Results reveal considerable progress on optimizing the AI protocol in terms of success spawning.

Improvement in larval rearing technology

Experiment conducted to evaluate the efficacy of feeding on microalgae revealed better survival during larval rearing. *P. indicus* larval production tried with 2 different feeding strategies at Nauplius and protozoea of Penaeus indicus larval stages. Used like Conventional Larval Rearing System (CLRS) and Modified Larval Rearing System (MLRS).

Two different feeding strategies with % of survival in *P. indicus* larval rearing system CRS- Conventional Rearing System; MRS- Modified Rearing System

CLRS VS MLRS:

Conventional Rearing System	Modified Rearing System
• Algae feeding daily as per Larval density and feeding strategy adopted. • Outside algae feeding may increase bacterial load which may reduce the survival. • Artificial feeds from protozoea which may reduce the water quality. • The algal density and quality depend on the outdoor algal production. • Depends on outdoor algae, in this have more chances to enter contaminants like protozoans and other phytoplankton species to larval rearing tank. Which may reduce of larval survival. • Water exchange requires earlier stages, which may go larval was stress.	• Before larvae stocking adding pure culture of microalgae • *In Situ* algal product nauplii will be reducing bacterial contamination and increase % of survival. • In *In-situ* algal system, not adding artificial feed until Mysis stage and this keep the water quality better. • The algal density and quality depend on sunlight & nutrients which controlled relatively. • Pure colony of micro algal culture adding without any contamination like protozoan's and other phytoplankton. • Water exchange started from mysis 3 or Post larvae-1, in these less chances of larval stress and increases % of survival.

Broodstock development using wild *Penaeus indicus* larvae cultured in earthen ponds and HDPE tanks

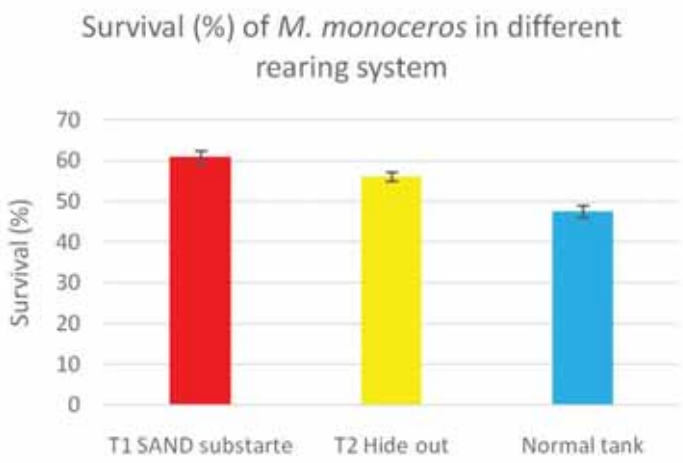
To evaluate the growth and reproductive performance of post-larvae reared from wild broodstock, pathogen-free broodstock screened for OIE-listed pathogens were stocked in maturation tanks and fed SPF frozen feed and CIBA-formulated maturation feed at 15% of body weight. Hatchery-produced post-larvae (PL12) were stocked at 10 nos. per m² in earthen ponds and 20 nos. per m² in HDPE tanks.

Shrimp were transferred to maturation tanks upon reaching an average size of over 22 gm, at 150 days of culture for pond-reared shrimp and 190 days for HDPE tank reared shrimp. For broodstock development, 300 shrimp from earthen ponds and 80 from HDPE tanks were stocked in maturation tanks. The rearing process for pond and HDPE tank grown adult shrimp for broodstock development is ongoing.

Breeding trials of *Scylla olivacea* at Kakdwip Research Centre

Scylla olivacea is a major mud crab species of the Sunderbans contributing towards the brackishwater fisheries and aquaculture. Developing seed production technique is prerequisite for large scale production of *Scylla olivacea* seed for supporting the emerging crab culture activities. In this background, breeding trial of *Scylla olivacea* was taken up at KRC centre. Immature mud crabs of carapace width (mm) 85.93 ± 2.47 and average body weight 144 ± 1.86 g was stocked in floating boxes and reared on trash fish for 40-45 days for maturation. Further, representative samples were analyzed for gonadal development by examining carapace and abdominal flap joint. Developing eggs with ovadiameter of 301.64±12.1 µm was observed and this development was achieved in a salinity of 5±1ppt. Females with advanced maturity stages were selected and transferred to indoor broodstock facility with RAS system. The salinity was increased gradually to 21ppt in the RAS system and Eyestalk ablation was performed and spawning was observed after 35 days post eye stalk ablation. Egg development in the berried crabs were not observed after spawning.

Maturing stage ovary in female box reared *Scylla olivacea*.

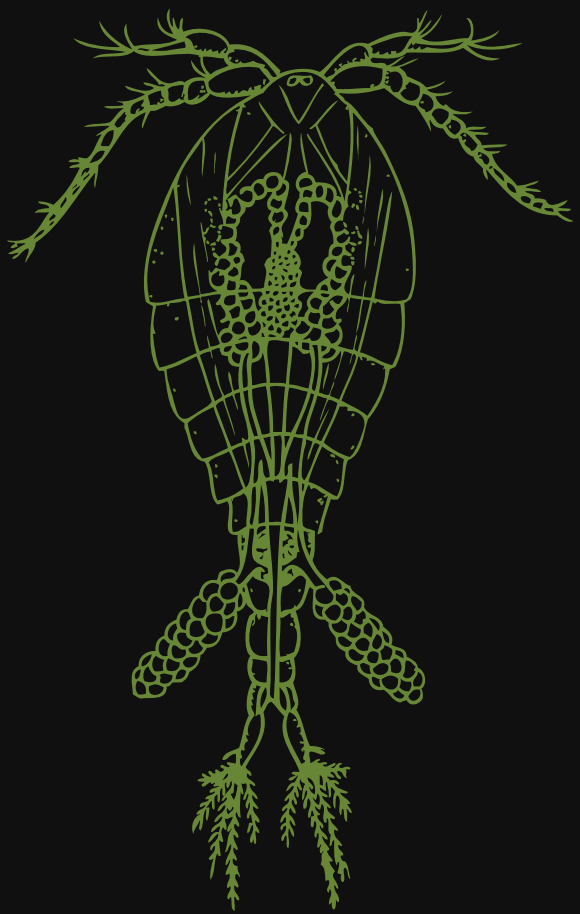


Survival of *M. monoceros* in different rearing systems

Broodstock development and captive maturation trials on *Metapenaeus monoceros*

M. monoceros is a major penaied species contributing to the bhery fisheries and also considered as a local delicacy in West Bengal fetching upto ₹500/ kg during festival seasons. To study the captive maturation and seed production potential of this species, different experiments were conducted. Adult males (10-11.5cm length, 10-11g weight) and females (11-12cm length, 12-13g weight) were collected from the wild for the study. The effect of three types of tank bottom substrate was analyzed for assessing the survival during indoor rearing. Tank bottom with sand bed (T1), with hide out provision (T2) and normal tank (T3) was setup in a RAS system at 21ppt salinity (n=25). Shrimps were fed with pellet feed during the experimental period (Salinity 23 ± 2ppt). Higer survival of 60.75 ± 1.61 was observed in (T1) tank with sand substrate and provision of hide out (56.11 ± 1.09) (T2) which was significantly higher. To further improve this a second experiment was conducted to study the effect of different diet (T1-Normal shrimp feed, T2-Commercial maturation feed, T3- Squid meat+clam+shrimp feed) on molting and maturation. Shrimps fed with combination of pellet feed and live feed (T3) exhibited higher survival (76 ± 2 %) and percentage of molting (17.5 ± 1.5%). Survival after eyestalk ablation was poor and no gonadal development was observed during the study.

03 NUTRITION AND FEED TECHNOLOGY




CIBA

NUTRITION AND FEED TECHNOLOGY

Field validation of use of *Plankton*^{Plus} for enhanced production of paddy

Trials were carried out to enhance paddy production through the foliar spray of *Plankton*^{Plus}. Three field demonstrations took place in the Tiruvallur and Chengalpattu districts of Tamil Nadu. These demonstrations were conducted on farmers' fields in collaboration with the Murugappa Chettyar Research Centre (MCRC), Chennai. In the initial trial in the Chengalpattu district, 2%, 4%, and 6% foliar sprays were administered three times, with a control field receiving no *Plankton*^{Plus}. The results showed a significant increase in the number of tillers, panicles, and plant height with the 4% and 6% applications compared to the 2% application and the control. The trial in the Tiruvallur district included three treatments: a control with conventional farming practices, *Plankton*^{Plus} 5% involving two applications of 5% *Plankton*^{Plus} (v/v) alongside conventional practices, and *Plankton*^{Plus} 6% with two applications of 6% *Plankton*^{Plus} (v/v) also alongside conventional practices. The results indicated a reduction in the need for ammonium sulfate fertilizer during the panicle initiation stage in *Plankton*^{Plus} treated fields. No significant difference in yield was observed among the treatments. Additionally, no pest incidence was reported in *Plankton*^{Plus} treated fields, eliminating the need for pesticides. In a third trial in the Tiruvallur district, 0%, 5%, 8%, and 10% foliar applications were tested. The results showed a significant increase in yield, with the highest yield observed in the 10% foliar application of *Plankton*^{Plus}. These findings suggest that *Plankton*^{Plus} has the potential to enhance paddy production, reduce the need for synthetic inputs and pesticides, and promote more sustainable agricultural practices.

Evaluation of potential use of *Plankton*^{Plus} in carp culture involving farmers of ST communities in Sunderban

Experiments were conducted on the application of CIBA-*Plankton*^{Plus} in low-saline carp culture as a sustainable livelihood option for tribal communities in Mousuni Island, South 24 Parganas, West Bengal. Eighteen earthen ponds (200-1000 m^2) of economically disadvantaged farmer families were selected

for the study. The experiment included six treatments: Control (Mustard Oil Cake@200 kg/ha + Farm Yard Manure@1.5 t/ha) and five varying dosages of CIBA-*Plankton*^{Plus} (T1: MOC+FYM+20 ppm, T2: 20 ppm, T3: 40 ppm, T4: 60 ppm, T5: 80 ppm without other inputs). Ponds were stocked with Indian Major Carps (IMC), including *Catla catla* and *Labeo rohita*, at 1 fish/m² with an average initial body weight of 111.11g and 33.33g respectively at a ratio of 1:1 (*catla*:rohu) and fed a cost-effective formulated feed (@2% of their body weight) supplied by ICAR-CIBA. After a 210-day culture period, Catla catla exhibited the highest average body weight (451.43 g) under T1 followed by T2, T3,T5, Control,T4 with avg. body weight of 384.29 g, 297.59 g, 289.87 g, 278.17 g and 267.6 g respectively., while Labeo rohita achieved maximum growth (450.09 g) in T2 followed by T3, T1, T5, Control, T4 with avg. body weight of 427.79 g, 398.6 g, 295.73 g, 283.97 g and 26.73 g respectively. The highest yield (3,119.86 kg/ha) was recorded in T2, proving the potential use of CIBA- *Plankton*^{Plus} to enhance growth and yield of IMC in low-saline conditions.

Plankton^{plus} for feed reduction in carp culture

To study the potential use of *Plankton*^{Plus} in reducing feed requirements in carp culture, 15 tribal farming families with homestead ponds (250–1250 m²) were selected and effect of *Plankton*^{Plus} @20 and 40 ppm with different levels of formulated feed were assessed. The study included Control (100% feed with no *Plankton*^{Plus}), T-1 (100% feed + 20 ppm *Plankton*^{Plus}), T-2 (100% feed + 40 ppm *Plankton*^{Plus}), T-3 (80% feed + 20 ppm *Plankton*^{Plus}), T-4 (80% feed + 40 ppm *Plankton*^{Plus}), T-5 (60% feed + 20 ppm *Plankton*^{Plus}), and T-6 (60% feed + 40 ppm *Plankton*^{Plus}). The ponds were dried and treated with lime @200 kg/ha before filling with water. After filling, *Plankton*^{Plus} (40% of the total requirement) was applied, except in the control ponds, to boost plankton production. Indian major carp (*rohu* & *catla*) were stocked @ 1 no./sqm at a ratio of 1:1. Water quality testing and plankton density and diversity were estimated at 15-day intervals. The demonstration is in progress.

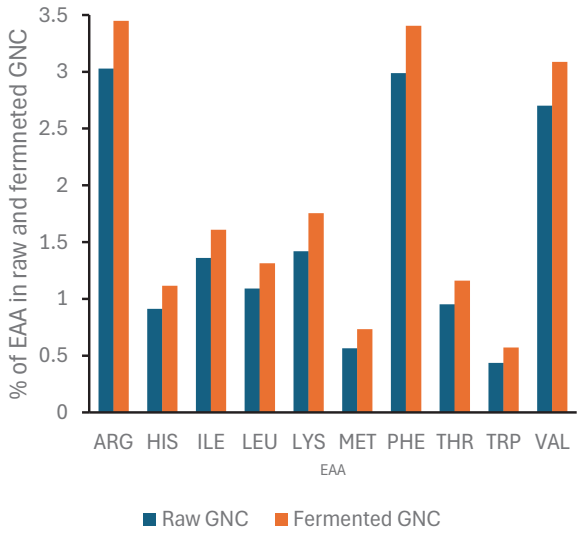
Demonstration of cost-effective shrimp farming using *Plankton*^{Plus} and *Chingudi*^{Plus} feed:

A shrimp farming demonstration was organized at KRC for capacity building among the beneficiaries for familiarizing the use of *Plankton*^{Plus} and *Chingudi*^{Plus} feed. *Plankton*^{Plus} is a Plankton booster developed by CIBA and *Chingudi*^{Plus} is a newly developed low cost shrimp feed for farming. The demonstration was carried out as two treatments, T1- with *Plankton*^{Plus} application and use of *Chingudi*^{Plus} feed and T2- commercial shrimp feed and conventional rearing practice. The earthen ponds six numbers with varying sizes were selected for the culture and each treatment was carried out in 0.5 ha area. In the T1 experimental group, the initial fertilization and subsequent phytoplankton density was maintained using the application of *Plankton*^{Plus}. In T2- the initial pond fertilization was carried out using, organic juice application and mineral supplements were provided periodically as per the conventional shrimp farming practice followed by the farmers of the area. *P. vannamei*, PL-8 was stocked into the ponds at a density of 60/m^2 and feeding was conducted as per the standard feeding schedule followed in farming of *P. vannamei*. After 112 days, shrimps in T1 and T2 attained a body weight of 28.21 ± 1.25 g and 25.61 ± 0.58 g respectively without any significant difference between both the groups. Average survival of 80% was observed irrespective of the treatment groups. The average FCR was significantly lower (1.26) in the T1 group where the combination of *Plankton*^{Plus} and *Chingudi*^{Plus} was used for rearing the shrimps compared to 1.57 in T2. The average cost of production while using *Plankton*^{Plus} and *Chingudi*^{Plus} was ₹ 162 compared to ₹ 234 with commercial shrimp feed. The reduction in cost of production resulted in a higher margin with the cost benefit ratio of 2.33 compared to 1.55 in T1. The combined use of low cost shrimp feed *Chingudi*^{Plus} and plankton booster *Plankton*^{Plus} can help the farmers reduce the cost of production of shrimp and improve the farmers income.

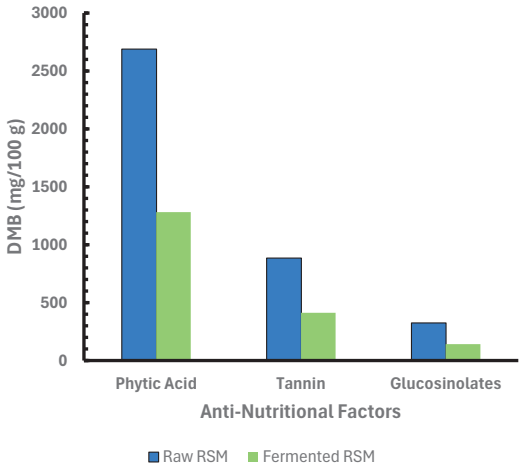
Microbial monitoring during the culture of *Penaeus vannamei* using *Plankton*^{plus} and *Chingudi*^{plus}:

Culture of *Penaeus vannamei* was done using two different treatment T1-using *Plankton*^{Plus} and *Chingudi*^{plus} and T2-using commercial pelleted feed. Total heterotrophic bacteria (THB) and total *Vibrio* (TV) were monitored on DOC 0, 30, 60, 75, 90 and 112 (day of harvest). No significant difference in the level of THB and TV was observed during culture except on DOC 60, when the level of TV was significantly ($p < 0.05$) higher in T2 as compared to T1.

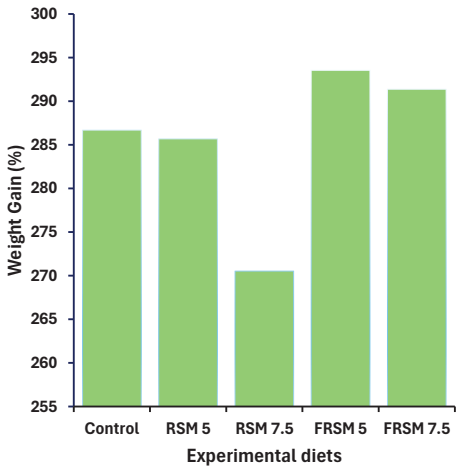
The TV level in haemolymph was checked at the end of culture in the cultured shrimp and it was observed that TV level in haemolymph was significantly ($p < 0.05$) higher in T2 (4.275 ± 0.112^{b} Log_{10} CFU/ml) as compared to T1 (3.607 ± 0.127^{a} Log_{10} CFU/ml).



Effect of fermentation of rapeseed meal (RSM) with *Bacillus* and yeast on Essential Amino Acid contents



Effect of fermentation of rapeseed meal (RSM) with *Bacillus* and yeast on Anti-Nutr



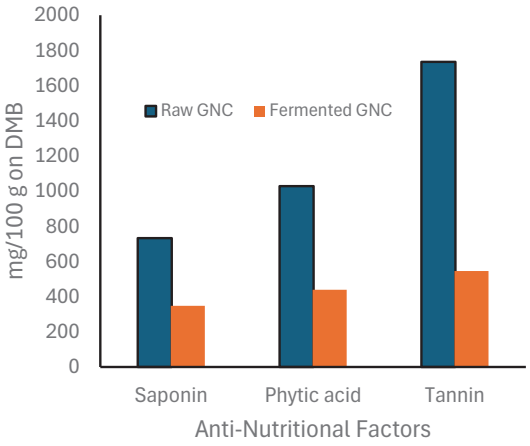
Effect of inclusion of raw and fermented RSM in *P. vannamei* on WG (%)

Effect of Solid-State Fermentation of Rapeseed meal with *Bacillus subtilis* and *Saccharomyces cerevisiae* on growth and nutrient utilization in *P. vannamei*

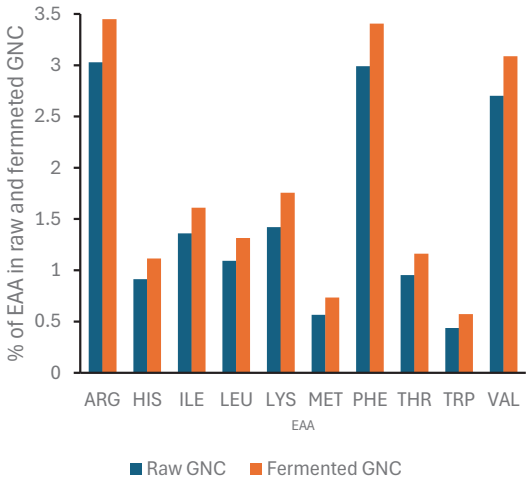
In order to increase the inclusion level of the rapeseed meal (RSM), it is fermented with Bacillus subtlis and Saccharomyces cerevisiae in the pilot scale fermenter. Experimental diets were prepared by incorporating different levels of raw and fermented rapeseed meal. Growth trial results indicated that fermented RSM can be included up to 7.5% in the grow-out feeds of *P. vannamei* and fermentation has improved the growth with *Bacillus* and yeast due to the improvement of limiting amino acids (lysine, methionine and methionine by 19.66, 17.18 and 10.91%, respectively) and decrease of anti-nutritional factors (phytic acid, tannin and glucosinolates by 47.69, 46.59 and 43.76 mg/100g, respectively).

Effect of fermentation of ground nut oil cake with combination of *Bacillus subtilis* and *Saccharomyces cerevisiae* on growth and nutrient utilization in *P. vannamei*

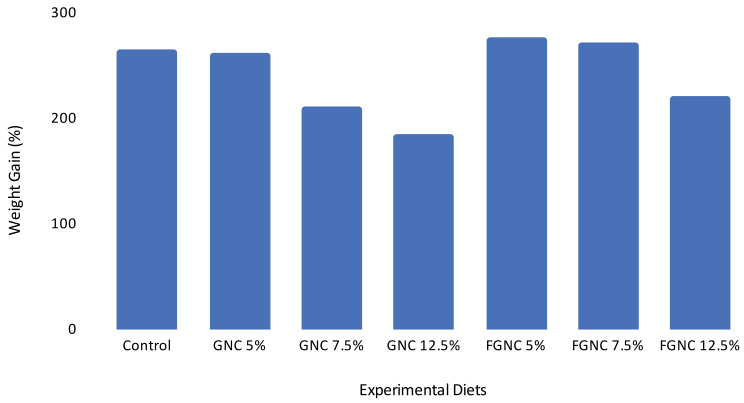
Ground nut oil cake was fermented with probiotic bacteria *Bacillus subtilis* and



Effect of fermentation of Ground nut oil cake on Anti-Nutritional Factors



Effect of fermentation of Ground nut oil cake on Amino acids

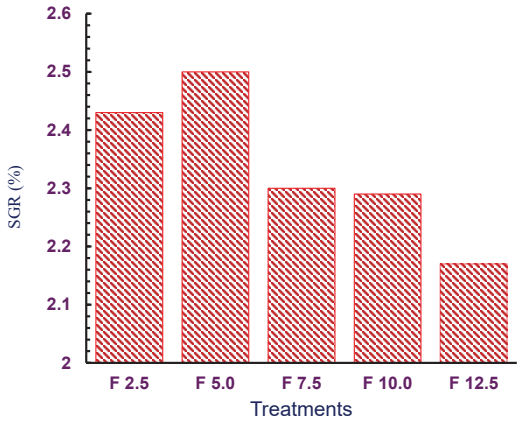


Effect of Fermentation of Ground nut oil cake on Weight gain (%) in *P. vannamei*

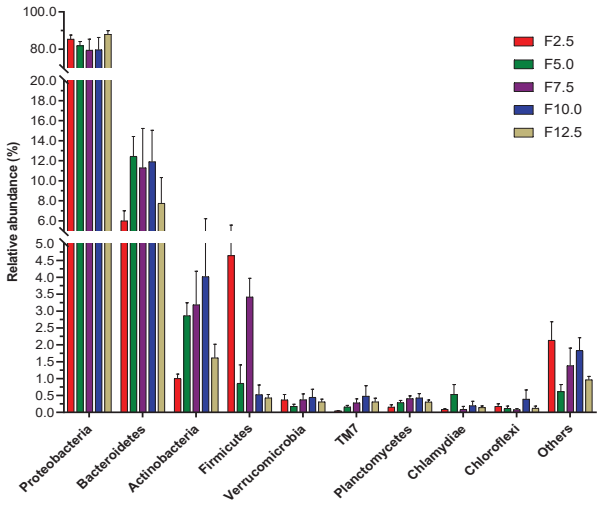
Effect of Crude Fibre in *P. vannamei* on growth and gut microbiome

In the present study, the effect of crude fibre level is tested at five levels viz., 2.5, 5, 7.5, 10 and 12.5% levels, in order understand the fibre tolerance of *P. vannamei*. The results have indicated that up to 5% of dietary crude fibre, the results of weight gain are non-significant but above 10% reduction is highly significant. With the increase of crude fibre up to 10% the proportion of Bacteroidetes and Actinobacteria increased which will help the host animal by supplementing cellulose and fibre digesting enzymes.

Saccharomyces cerevisiae at 60-65% moisture for three days. For optimization of the inclusion level in shrimp feed, seven test feeds having 0, 5.0, 7.5 and 12.5% levels of raw and fermented GNC were prepared by replacing fishmeal. The results indicated that fermented GNC can be included up to 7.5% whereas raw GNC could be included up to 5% in *P. vannamei*. The enhanced inclusion level of fermented GNC can be attributed to reduction of saponins, phytic acid, and tannin (mg/100 g DMB) from 732.20, 1028.31, 1734.95 to 347.35, 438.87 and 545.82, respectively.



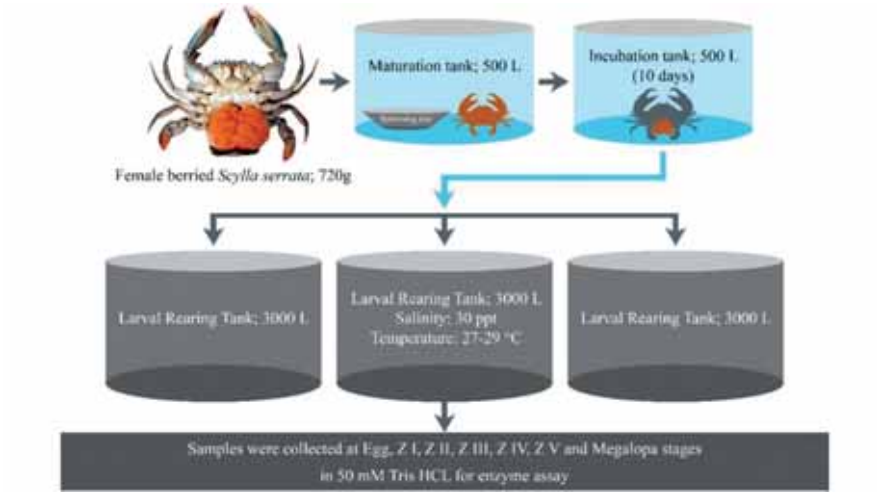
Growth performance of *Penaeus vannamei* fed with different levels of crude fibre



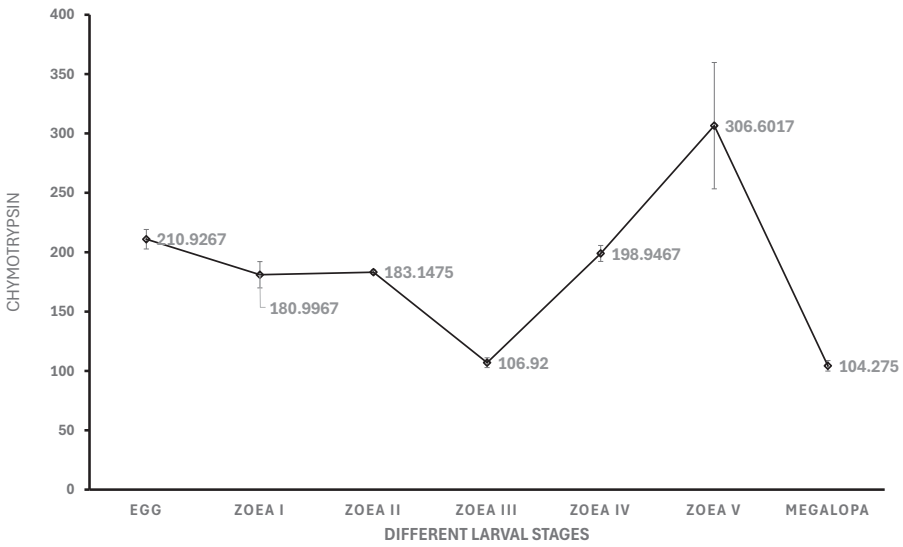
The effect of crude fibre level on gut microbiome in *P. vannamei*

Elucidate the ontogeny of digestive enzyme of mud crab larvae

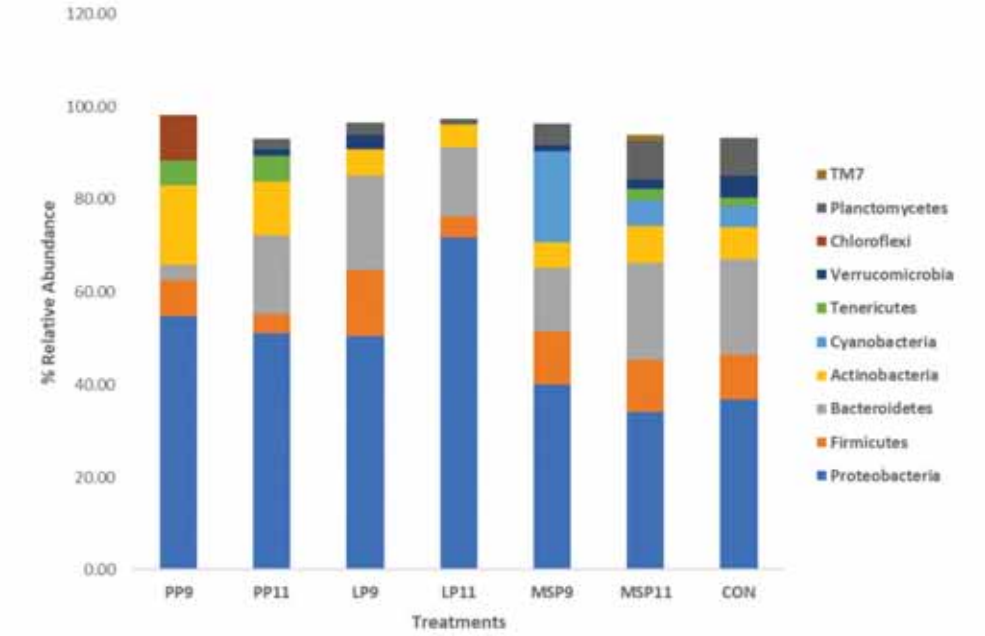
The present study was undertaken with the main objective of elucidating the critical larval nutritional elements. In this context, we assessed the activity profile of key digestive enzymes viz., trypsin, chymotrypsin, leucine aminopeptidase, lipase, amylase and alkaline phosphatase during the early ontogeny of mud crab, *Scylla serrata*. Eggs were collected before 3 days of



Schematic representation of the mud crab breeding / hatchery conditions and experimental design (colours in the diagram indicates the original tank colours)



Ontogeny of the total activity of chymotrypsin in crab larvae from zoea to megalopa stage. Enzyme activity is expressed as U g-1 tissue (mean ± SD; N=6). Different superscript letters at different time points indicate statistically significant differences (one-way ANOVA; P<0.05)



Relative abundance of gut bacterial phyla in *P. vannamei* fed with functional probiotic feed. Only the phyla with relative abundance of >1% are shown in the figure.

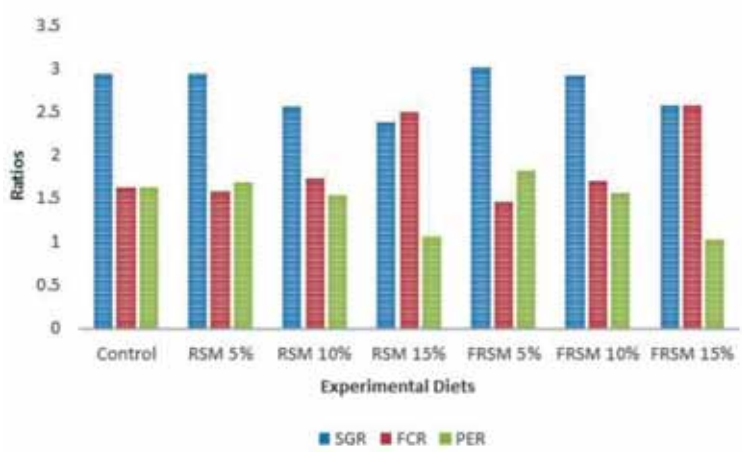
hatching from the berried mud crab. Larvae were collected from three larval rearing tanks on 2dph (zoea I), 6dph (zoea II), 9dph (zoea III), 12dph (zoea IV), 15dph (zoea V) and 20 dph (megalopa) to examine the active profile of the digestive enzymes. The sampling time was uniformly scheduled in the morning at 7:00 am before feeding, which helps minimise the contribution of exogenous enzymes from undigested feed in the gut of the larvae. With respect to protein digestion, the activity of pancreatic enzymes trypsin and chymotrypsin, and intestinal brush border leucine aminopeptidase showed peaks at 15 dph (Zoea V) and low at 20dph (Megalopa). Similar bimodal peaks were observed for amylase activities, with peak at Zoea V and Followed by decreasing at megalopa stage. Whereas in the case of lipase, high activity levels were observed at Zoea II, and megalopa. Overall, as most of the enzymes were found to have peak activities at Zoea V and low activity observed at Megalopa stage this period can be potentially considered as the developmental window for developing artificial feeds in hatcheries which can easily digestible by the larvae.

Effect of functional diet containing single and multiple strain probiotic, on the gut microbiome signatures in the Pacific White leg shrimp, *Penaeus vannamei*

The present objective was to analyze gut microbiome of the shrimp after dietary supplementation of probiotic. Six basal diets with probiotic functional feed viz., *Pediococcus pentosaceus* 109 and 1011 CFU/ Kg of feed (PP9 & PP11); *Lactiplantibacillus plantarum* 10^9 and 10^{11} CFU/ Kg of feed (LP9 & LP11); Multiple strain probiotics (*P. pentosaceus, L. plantarum, Lactococcus lactis, Enterococcus faecium, E. durans, E. hirae*) 10^9 and 10^{11} CFU/ Kg of feed (MSP 9 & MSP11); and control (CON) diet prepared and experiment was conducted in *P. vannamei*. Proteobacteria have been demonstrated to be the most prevalent phylum in the gut microbiome with LP11. Further, Firmicutes is predominant in the LP9 and Actinobacteria in the PP9. Alpha diversity indices, observed OTUs and Fisher alpha were significantly high ($p \leq 0.05$) in the multiple strain probiotic with high dose. Beta diversity indices, principal coordinate analysis depicted distinct bacterial community profile in PP11 & MSP11. The beneficial core microbiome families *Oxalobacteraceae, Flavobacteriaceae, Cellulomonadaceae, Rhodobacteraceae, Pseudomonadaceae* and *Bacillaceae* were predominant in the probiotic diet supplementation treatments. *Ralstonia, Tenacibaculum Demequina,* and *Paracoccus* were unique and prevalent genus in probiotic diet supplemented treatments. It was found that probiotic supplementation resulted in the modulation, alteration and enrichment of the gut microbiome signatures with relative abundance of healthy beneficial bacterial communities in *P. vannamei*.

Fermented Rapeseed meal as replacer of soybean meal in *P. vannamei*

Fish meal and soybean meal are the major protein sources in shrimp feed. In the present study the effect of other plant protein source, RSM has been tested as replacer for those major protein sources. The nutritional quality of RSM has been improved by solid-state fermentation by using *Bacillus subtilis* and *Saccharomyces cerevisiae* in the pilot scale fermenter. Experimental diets were prepared by incorporating different levels of raw and fermented rapeseed meal by replacing soybean meal at 0, 5, 10 and 15% levels. Growth trial results indicated that fermented rape seed can be included up to 10-15% in the grow-out feeds of *P. vannamei* by replacing soybean meal. This positive effect is attributed to due to the improvement of limiting amino acids and decrease of anti-nutritional factors.



Effect of raw and fermented rapeseed meal inclusion on SGR, FCR, and PER in *Penaeus vannamei*

Programmed feeding protocols with automated feeders in super-intensive shrimp farming

automatic feeders are promoted in Indian shrimp farming for their benefits, including improved efficiency, sustainability, and profitability. However, adoption remains limited due to farmers' skepticism and the varying pros and cons of available models. In super-intensive systems, automatic feeders help maintain water quality by preventing overfeeding and reducing feed waste.

In our farming experiments, two different feed dispensing protocols were tested. In the first method, the daily feed ration was divided equally into six feeding intervals, distributed evenly throughout the 24-hour cycle. The feed quantity and timing remained consistent across day and night. In the second method, the daily ration was divided unequally and programmed based on the active feeding behavior of the shrimp. More feed was dispensed during peak

Programmed Feeding Protocols with Automated Feeders

feeding times, and no feed was provided from midnight to late morning to account for oxygen levels in the system. Across trials lasting 90 to 120 days, the second method (programmed feeding) achieved a better feed conversion ratio (FCR) of 1.13 compared to 1.21 with the first method. However, there were no significant differences in survival rates or other growth indices between the two feeding protocols. These findings highlight the resource efficiency of automatic feeders in super-intensive shrimp farming systems. By reducing feed waste and maintaining water quality, automatic feeders contribute to the sustainability and economic viability of intensiveshrimp farming operations.

Development of value-added products from milk fish

Fish meat picking machine with the accessories of Descaler, Beheader, Mincer, & Patty maker (Rs: 17.3 lakhs) were procured for development of value-added products from Brackishwater fish.

About 22 Kg of milk fish (400-500g size) was dressed, beheaded, and got 8.2 Kg of minced meat (37% yield). 1.15 Kg of minced meat was mixed with 650 gm of masala and final weight was obtained as 1.80 Kg and made into pattys of 40 gm size using pattys forming machine. Then the pattys were deep-fat fried in oil, about 45 pieces could get from 1.8 Kg material. It was tasty as per the sensory evaluation. The fish patty's (2 Kg) were frozen for 2 days at -18°C, then they were deep fat fried, the taste was good as per sensory evaluation. The patty's (2 Kg) cut into 2 cm finger size and frozen at -18°C for one day, and then deep fat fried the taste was good as per sensory evaluation.

Fish patty forming machine (1000-1500 nos/hr)

Meat mincer (100kg /hr), 14 a

Milk fish fingers, 14 b

Milk fish pattys, 14 c

a-c Development of value-added products from milk fish

a Whole *Mytella strigata*

b Shells of the *Mytella strigata*

a & b Invasive Charru mussel *Mytella strigata*

Studies to explore the utility of invasive Charru mussel

Charru mussels (*Mytella strigata*) are invasive species and the it has become a major menace in the coastal waters of North Chennai. In this connection as per the request from state department of fisheries a study was undertaken to collect the samples and explore the possibilities for use in aqua feed. The analysis revealed that it contains 84.2, 9.25, 4.2, 0.95, 1.79 and 0.18 % of Moisture, crude protein, NFE, Crude fat, Ash and crude fiber respectively. The meat yield was less than 20% and the shell contains predominantly calcium carbonate and the only way it can be used is as a source of calcium carbonate

Testing and Demonstration of Newer Feeds:

Shrimp Grow out Feed

A formulated feed for precision and intensive natural farming of shrimp has been developed and tested, showing consistent results of improved attractability, palatability, growth and FCR. This feed formula has been finalised as the standard

a-c Optimization of color and buoyancy of larval feed

feed for precision and intensive natural farming. The FCR obtained among the sequential demonstration ranged from 0.97-1.16 with 87-98% survival.

Shrimp Larval Feed

A shrimp Larval feed containing BSF meal was prepared by including it in the diet of standard CIBA shrimp larval feed and the effect of including BSF meal in the larval feed was studied. The results indicated that there was improvement in the feed acceptability and there was no significant difference in survival and ABL at PL10.

There was a requirement to have a black or brown coloured larval feed. In this pursuit various pigments have been screened and its optimal level of inclusion for better colour was standardised.

Screening of alternate resources for its potential application in aqua feed

Arrowroot, is a minor tuber crop that grows well in tropical climates is a staple food in developing countries including India and is also used in feed

Arrowroot samples collected for nutrient analysis

Proximate composition of arrowroot samples

Sample ID/ Parameter	1	2	3	4	5
Moisture	79.52	82.41	75.54	77.22	81.83
Crude protein	15.41	13.30	12.90	16.25	10.44
Ether extract	3.33	7.38	7.66	3.42	4.72
Total ash	7.29	7.10	7.75	6.75	7.15
Acid insoluble ash	2.29	2.02	2.27	1.83	1.89
Fibre	4.82	6.21	6.10	5.18	4.50
NFE	69.15	66.01	65.59	68.40	73.19

and industrial sectors. A study was made in association with ICAR-CTCRI for the potential application of arrowroot in aqua feeds. Five samples (varieties) of arrowroot have been collected and the average nutrient content is given below. The results revealed that there was minor variation among the five different varieties and the results inferred that it is good source of energy and has got the potential alternate to maize and wheat and it can be explored.

Yam bean

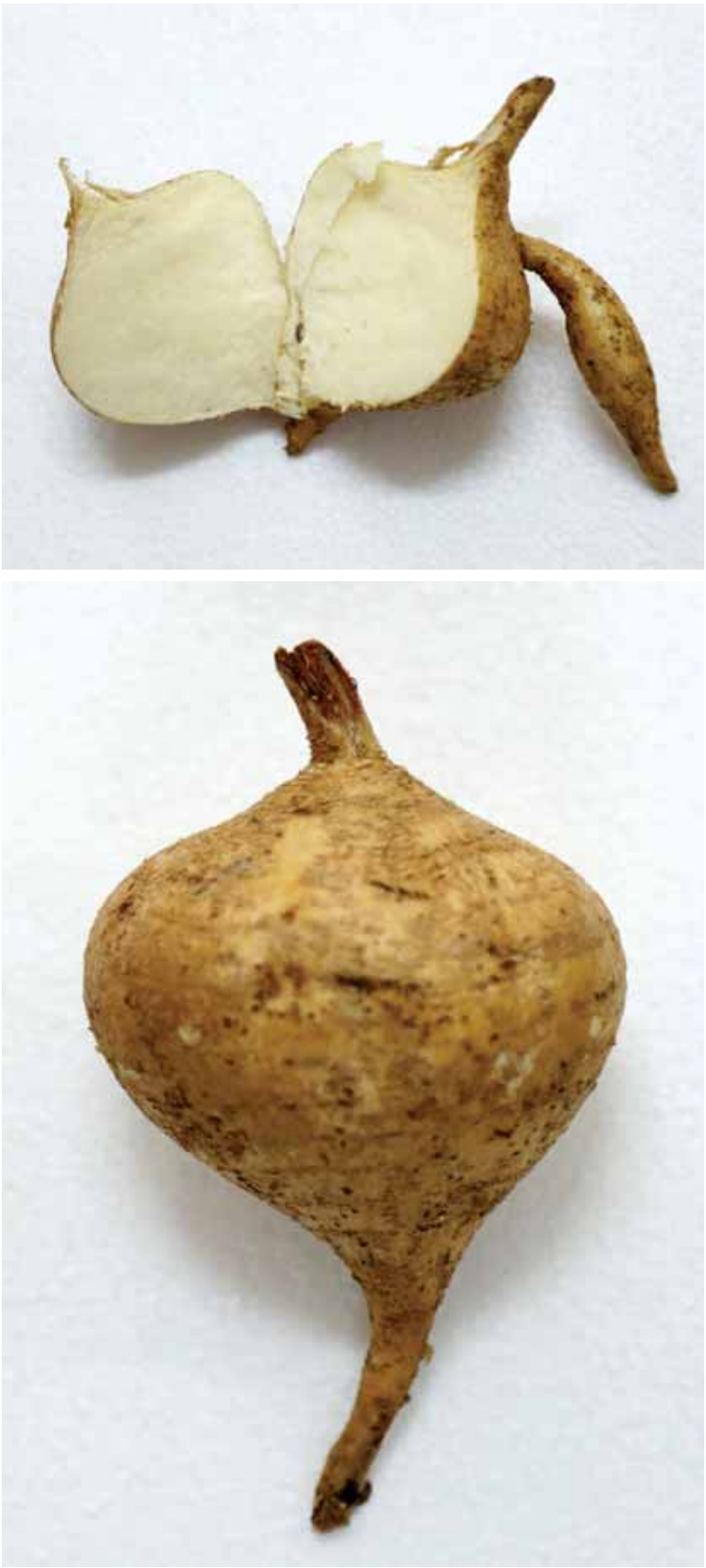
Yam Bean is a minor tuber crop that is part of the Leguminoceae family. The root of the yam bean is edible and can be eaten raw or cooked. It is sweet, crisp, and juicy. Six different samples have been collected. and the average nutrient content is given below. The results revealed that there was not much variation among the samples and the results inferred that it has got higher available carbohydrate. This has got the potential alternate to maize and wheat and it can be explored.

Nutrient	Average (%)
Moisture	65.20 ±0.89
Crude protein	4.72±0.02
Ether extract	0.511±0.04
Total ash	3.85±0.10
Acid insoluble ash	1.20±0.21
Fibre	3.29±0.04
NFE	87.63±0.95

Table 2. Proximate composition of arrowroot samples

Diversified tubers and its by-products as an alternate resources of feed ingredient

Sweet potato haulms, cassava leaves, tuber chips,



The root of the yam bean

weevil infested sweet potato and kishan tuber has been received from CTCRI and subjected for nutrient analysis. The results are given below. The vine of sweet potato and leaves of cassava has moderate protein and energy and it can be used as an alternate to rice bran in the herbivorous fishes. The byprodct, tuber chips and sweet potato and weevil infested sweet potato also has been screened and the results revealed that it is a very good source of energy having higher available carbohydrates and has got the potential to replace the energy sources like maize and wheat.

Nutrient (%) / Sample	Sweet potato halums	Cassava Leaves	Tuber Chips	Weevil infested sweet potato	Kishan Tuber
Moisture	7.85	7.17	12.41	8.44	10.2
Crude protein	15.48	15.61	1.88	4.67	4.54
Ether extract	2.45	3.84	0.63	1.63	1.56
Total ash	13.7	11.03	2.61	3.15	2.22
Acid insoluble ash	2.26	2.62	0.54	0.62	0.57
Crude Fibre	24.53	29.74	2.32	3.66	3.14
NFE	35.99	32.61	80.15	78.45	78.34

Proximate composition of diversified tubers and its by-products

Alternate resource for feed ingredient, sweet potato halums

Effect of dietary inclusion of defatted (pro) and whole (Omega) insect meal (Silkworm Pupae) on growth and survival of *P. vannamei*

A collaborative cum consultancy research has been undertaken with M/s. Loopworm in exploring the potential of silkworm pupae meal in the diet of shrimp, *P. vannamei*. Two types of meal viz., defatted (Pro) and whole (Omega) obtained from Loopworm has been analysed for its nutrient composition and a feeding experiment was carried out by including defatted meal at 2.5,5.0 and 7.5% and at 2.0,4.0 and 6.0% of wholemeal. The standard diet containing 36.0% CP and 5.8% Lipid was used as control. The effect of whole and defatted silk worm pupae meal on growth and nutrient utilisation was carried out in a 60 days feeding trial and the results revealed that the best performance was observed in group fed with 2.5% defatted silkworm pupae meal and whole meal containing diets at all the levels also performed on par or better than the control. These results indicated the utility of the silkworm pupae meal in the diet of *P. vannamei*.

Effect of dietary inclusion of defatted (pro) and whole (Omega) silkworm pupae meal on growth performance and survival of *Penaeus vannamei*

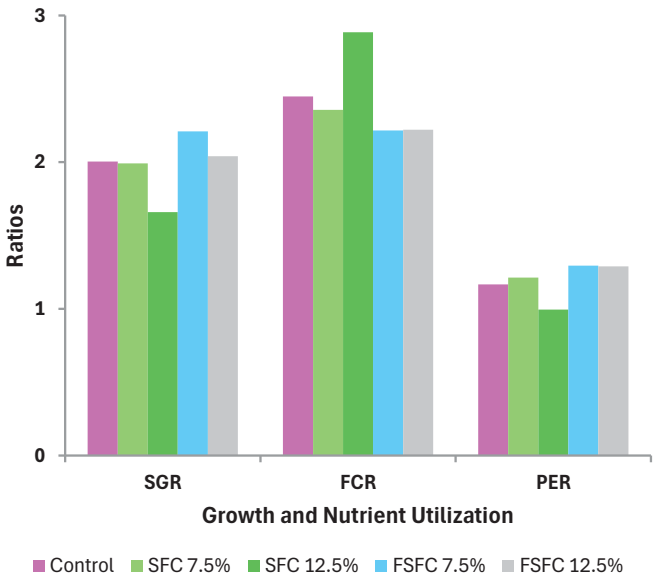
	FBW (g)	WG (g)	Survival (%)*	FI	FCR
1Control	17.57^{ab}±0.54	14.22^{ab}±0.45	88.89±10.18	19.62^{a}±0.54	1.38^{bc}±0.04
2Pro 2.5	20.45^{e}±0.52	17.04^{e}±0.58	93.33±0.00	22.65^{c}±0.44	1.33^{a}±0.02
3Pro 5.0	17.68^{ab}±0.51	14.32^{ab}±0.57	91.11±3.85	19.85^{a}±0.75	1.39^{bc}±0.01
4Pro7.5	17.01^{a}±0.17	13.74^{a}±0.11	91.11±3.85	19.56^{a}±0.44	1.42^{c}±0.02
5Ome2	18.36^{bc}±0.33	15.09^{bc}±0.31	97.78±3.85	20.73^{ab}±0.65	1.37^{ab}±0.01
6Ome4	19.46^{d}±0.43	16.14^{dc}±0.44	97.78±3.85	21.79^{bc}±0.90	1.35^{ab}±0.02
7Ome6	18.87^{cd}±0.30	15.51^{cd}±0.32	95.55±3.85	21.10^{abc}±0.74	1.36^{ab}±0.02

Effect of yeast fermentation of sunflower oil cake on growth and nutrient utilization in Milkfish, *Chanos chanos*

Sunflower oil cake (SFC) was fermented with yeast, Saccharomyces cerevisiae at 60-65% moisture for three days. For optimization of the inclusion level in milkfish feed, five test feeds having 0, 7.5 and 12.5% levels of raw and yeast fermented SFC were prepared by replacing other plant protein ingredients. A 60-day feeding trial was conducted in the juveniles of milkfish (6.37 ± 0.30 g) to evaluate the effect of inclusion of raw and fermented SFC at 7.5 and 12.5% levels on growth, nutrient utilization of Milkfish, Chanos chanos. Weight gain (%) was significantly highest in fish fed with 7.5% Fermented SFC diet (276.56 ±5.07) whereas lowest weight gain (%) was observed in fish fed on 12.5% unfermented SFC diet (170.64 ± 7.12). The results indicated that yeast fermented SFC can be included up to 12.5% whereas raw SFC could be included up to 7.5% in C. chanos. The enhanced inclusion level of fermented SFC can be attributed to reduction of saponins (mg/100 g DMB) and hemicellulose (% on DMB) from 641.52± 39.57& 16.27±0.44 to 207.01±18.99 & 12.69±0.59, respectively.

Effects of black soldier fly larval meal inclusion in the diet of black tiger shrimp

In recent times, insect meal (IM) has emerged as a sustainable protein source showing promising results. It not

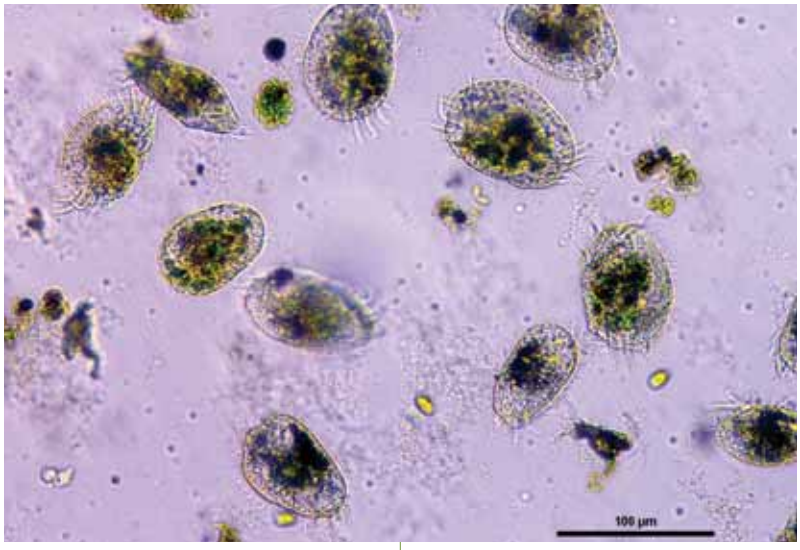


Effect of raw and fermented Sunflower oil cake inclusion on SGR, FCR, and PER in Milkfish

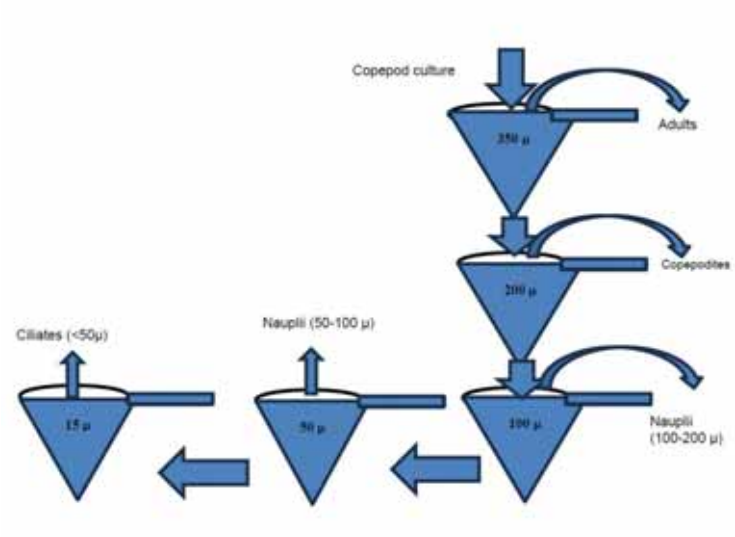
only has a high protein content but is also rich in lipids, vitamins, and minerals. The composition of IM closely matches the dietary requirements of shrimp and fish, making it a potential resource as an alternate ingredient to fish meal in aqua feeds. Against this backdrop, a 45-day feeding trial was conducted to investigate the effects of black soldier fly (BSF) larval meal as fish meal replacer in the diet of tiger shrimp (*P. monodon*). Five experimental diets were prepared (isoproteic 380 g kg^{-1} and isolipidic 100 g kg-1) with varying levels of BSF meal that included 0% (BSF0), 3% (BSF_3), 6% (BSF_6), 9% (BSF_9), and 12% (BSF_{12}). Shrimp post larvae (with an initial body weight of 0.4 ± 0.02 g) were stocked at 30 animals each, in fiberglass reinforced plastic (FRP) tank of capacity 100 L which were arranged in completely randomized design (CRD) where, each diet was fed to triplicate groups. At the end of the feeding trial, there were no significant differences in the growth performance between the groups fed with BSF_3 and the control (BSF_0). The BSF_3 group showed the highest weight gain percentage (320.12%). Both the control and BSF3 diet-fed groups exhibited similar average weight gain (AWG), specific growth rate (SGR), and daily weight gain (DWG), with no significant differences ($p > 0.05$). In conclusion, this study suggests that BSF larval meal is having the potential to replace fish meal in *P. monodon* diets up to an inclusion level of 6% without negatively impacting growth and survival. The optimal inclusion level of BSF meal for *P. monodon* diets ranges from 3.73 to 5.13%, as indicated by broken line regression analysis of various growth parameters.

Mass culture of small-sized live feeds for enhancing finfish larval survival

Larval rearing of marine and brackishwater finfish poses significant challenges in hatchery production, particularly for species with small mouth gapes that require live food organisms smaller than 70 microns during their critical developmental



Copepod nauplii and ciliates harvested from mass culture system.



Filtration system for copepods and ciliates

phases. To address this, ICAR-CIBA isolated potential species of copepods and ciliates and established a dedicated mass culture facility. The facility supports the cultivation of seven copepod species (*Oithona dissimilis, Tisbe tenera, Pseudodiaptomus annandalei, Parvocalanus* sp., *Dioithona rigida, Euterpina* sp., *Apocyclops* sp.) and one ciliate species (*Euplotes* sp). These zooplankton are cultured on a diet of *Nannochloropsis oculata* and enriched with mixed microalgae to enhance their nutritional value. Additionally, a filtration system was standardized to harvest small-sized nauplii (<100 µ) and marine protozoan ciliates (*Euplotes* sp, 38–47 µ), ensuring the availability of appropriately sized live feed for larval rearing.

Culture performance and biochemical composition of *Onuphis kovala*: a potential feed resource for sustainable aquaculture

the marine sand-dwelling polychaete worm, *Onuphis kovala*, was identified from the Kovalam seashore through 16S rRNA gene analysis, amplifying a 600 bp sequence using the 16SarL and 16SONU-R primers. Juveniles (0.2 ± 0.01 g; 6.2 ± 0.1 cm) were cultured in fiberglass reinforced plastic (FRP) tanks under two experimental conditions over a 120-day period. In the first trial, 200 juveniles were fed CIBA shrimp feed (30% of BW) at salinity levels of 20-28 ppt, pH 7.4-8.0, and a temperature of 25°C. This trial achieved a biomass of 126 g with 90% survival and an average body weight (ABW) of 0.70 g. In the second trial, 2000 juveniles were fed the same shrimp feed (15% of BW) supplemented with microalgae (*Chaetoceros calcitrans*, 10^6 cfu/ml, 40 ml/day). Under similar conditions (20-25 ppt salinity, pH 7.6-8.0, and 25°C), the biomass increased to 960 g with 80% survival and an ABW of 0.60 g. Biochemical composition analysis of *Onuphis kovala* revealed 81.77% moisture, 11.29% crude protein, 0.83% fat, 0.20% crude fiber, 2.89% carbohydrates, and 3.01% ash. These results highlight the potential of *O. kovala* as a valuable feed resource for sustainable aquaculture practices.

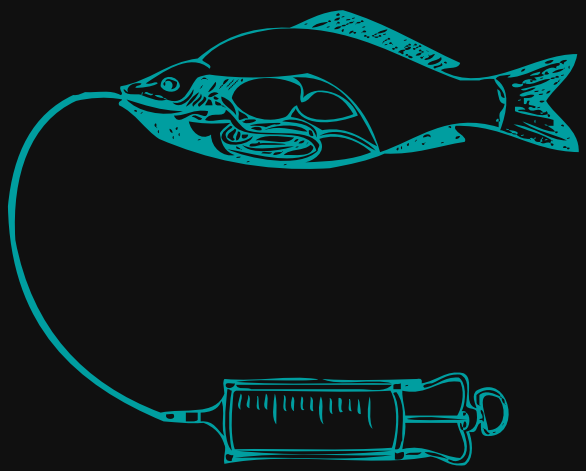
Number of unique genic-regions identified in eight species.

Sl. No.	Species	No. of unique genic-regions
1	Cattle	26
2	Buffalo	5
3	Goat	10
4	Sheep	11
5	Pig	1094
6	Chicken	1321
7	Duck	1849
8	Quail	474

Markers to screen animal meat contamination in shrimp feed

Shrimp feed formulations generally use plant-based ingredients and fishmeal to accommodate protein. Recent times, there are concerns about unethical usage of animal meat in shrimp feed preparations. In this context, availability of simple DNA-based screening methods to identify the adulteration of commonly available animal meat in shrimp feed becomes handy. We have performed extensive comparative genomic analyses with whole genomes of cattle, buffalo, sheep, goat, pig, chicken, duck and quail to identify the unique genic-regions of each species. The approach initially involved the comparison of gene set of a species with every other species to identify unique genes. Then, the unique genes of a species were mapped to the whole genome of every other species to confirm the species-specific nature of unique genes. The study identified few genic-regions unique to each of eight species. The analyses would be followed with designing of screening methods based on unique genic-regions.

04 AQUATIC ANIMAL HEALTH



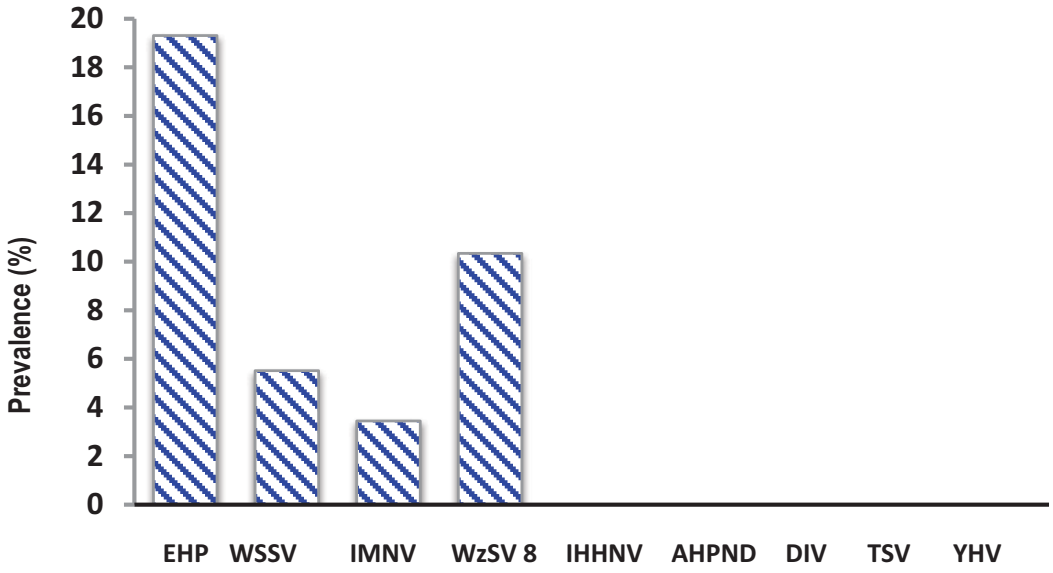
AQUATIC ANIMAL HEALTH

Disease prevalence in shrimp and fish farms

Disease surveillance was carried out in 145 shrimp farms in Tamil Nadu (N=59), Gujarat (N=81) and West Bengal (N=5) and two fish farms in West Bengal. Pathogens like IHHNV, AHPND, TSV, YHV and DIV were found to be negative from these farms. However, EHP, WSSV, IMNV and Whenzhou8 (WzSV8) pathogens were found to be positive. The prevalence of EHP was found to be highest and 28 farms were found positive, 15 farms were positive for WzSV8, eight farms positive for WSSV and five farms gave positive for IMNV. The prevalence rate of EHP is found to be 19% and WzSV8 is found to be 10%. This clearly shows that EHP is an important pathogen in shrimp farms, highly prevalent in the country and is present throughout the year. Disease investigation carried out in two fish farms of West Bengal state revealed one farm positive for Tilapia Lake Virus (TiLV). Hepatopancreatic microspordiasis (EHP) is found to be highly prevalent in the country and is seen throughout the culture period.

Cytoplasmic free Ca^{2+} concentration in WSSV-infected *Penaeus indicus* by flowcytometry analysis

Many host cell defence mechanisms and apoptosis are associated with increased intracellular Ca^{2+} concentration. In invertebrates maintaining intracellular Ca^{2+} concentration is very crucial for promoting immune response by the host organism against infective agents through the immune signalling process. Hemocytic cytoplasmic free calcium (Cf-Ca^{2+}) in shrimp hemolymph samples was quantified using a flow cytometer and probe Fluo-3/Acetoxymethyl

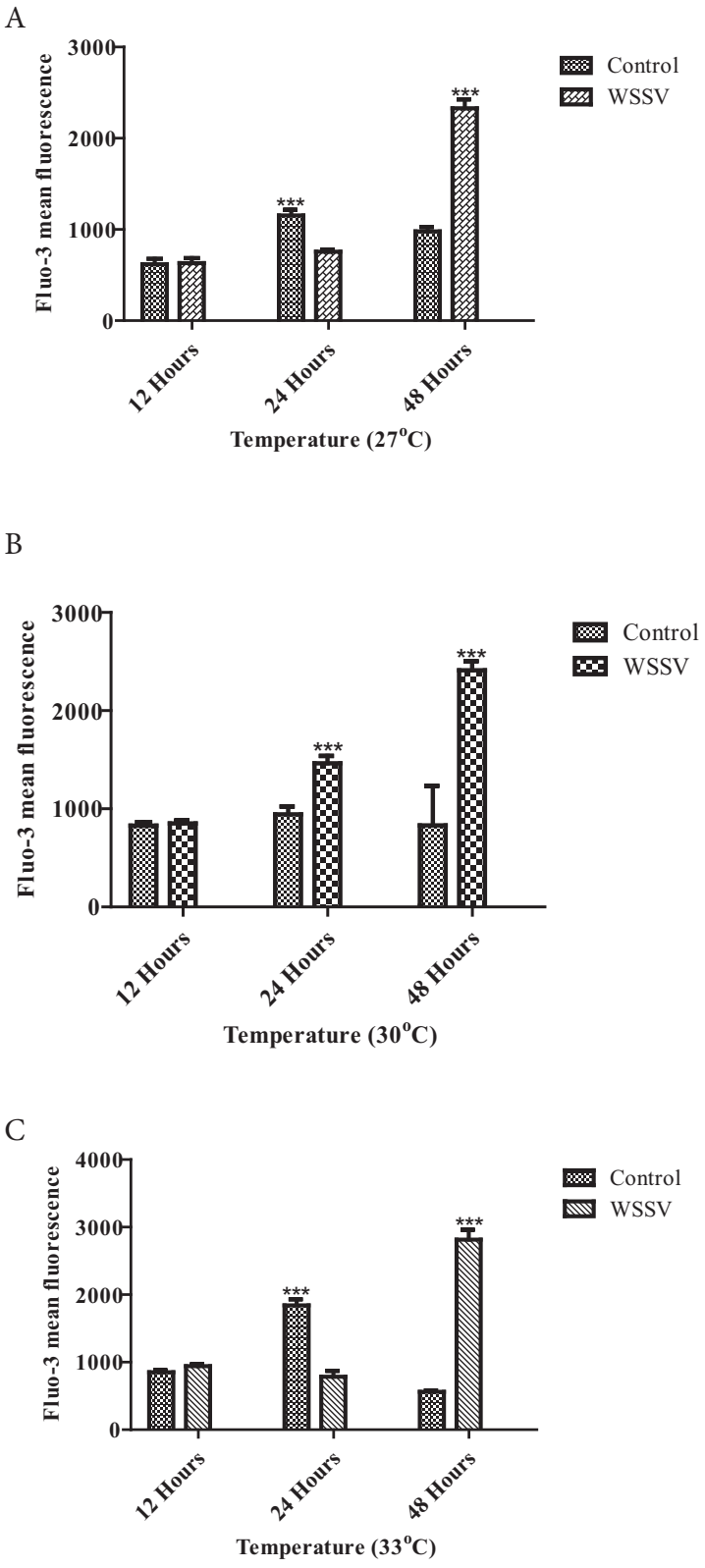


Disease prevalence in shrimp farms

ester (Fluo-3/AM). Haemolymph from each of the six shrimp replicates was incubated with 20 µL of 10 µM fluo-3/AM and fluorescence events (10,000) from the cell suspensions were examined using flow cytometry, and the mean fluorescence of fluo-3 was used to express the Cf-Ca^{2+} concentration. Present study shows elevated Cf-Ca^{2+} concentration in higher temperatures at all time points. Cf-Ca^{2+} concentration in WSSV infected groups shows the highest percentage of 57.91%, 65.55% and 80.10% at 48 hpi at 27°C, 30°C and 33°C respectively when compared to control samples (Fig)

Impact of temperature on the virus replication in WSSV-infected Indian white shrimp (*Penaeus indicus*)

The shrimps were acclimatized to three temperature conditions of 27°C, 30°C and 33°C and WSSV challenge experiment was carried out. The shrimp samples were collected at different time points viz., 12 hpi, 24 hpi, 48 hpi and used for quantitative real-time PCR (qPCR) analysis. Nested PCR results confirmed that all WSSV-injected animals had an infection during the period of the experiment, and no PCR amplification was observed in control samples. qPCR results showed WSSV copy numbers gradually increased in WSSV infected shrimps at 27°C (2.31, 3.08, and 4.95-folds) and 30°C (2.57, 3.61, and 4.86 folds) temperatures at 12, 24, and 48 hpi, respectively. The shrimps exposed to higher temperatures (33°C) which showed a 2.05-folds in WSSV copy numbers at 12 hpi, decreased to 1.79-folds at 24 hpi and 1.67-folds at 48 hpi. The study reveals that replication of



Cf-Ca^{2+} estimation in the hemocytes of control and WSSV-infected shrimps across different time and temperature points (A) 27°C (B) 30°C (C) 33°C

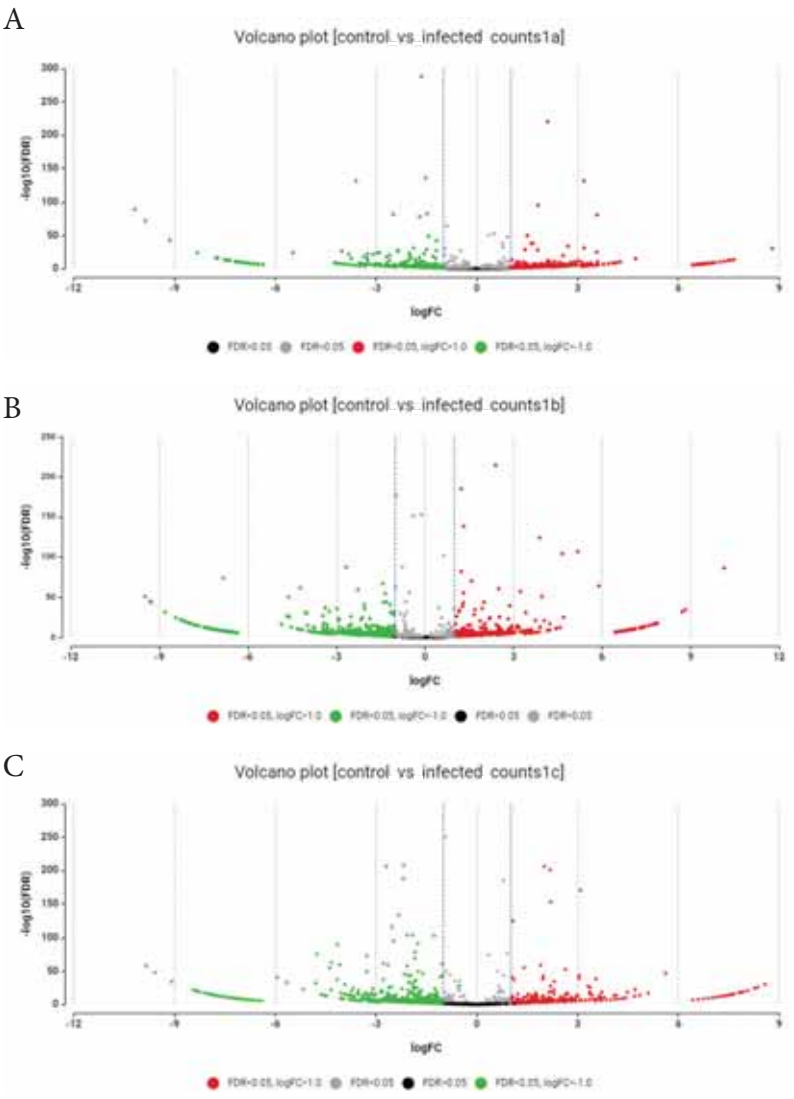
WSSV decreased at 33°C when compared to 30°C and 27°C. Flow cytometry was used to analyse the immunological response of WSSV-infected shrimp, *P. indicus* exposed to different temperatures.

Transcriptome analysis of WSSV-infected Indian white shrimp (*Penaeus indicus*) exposed to temperature variations

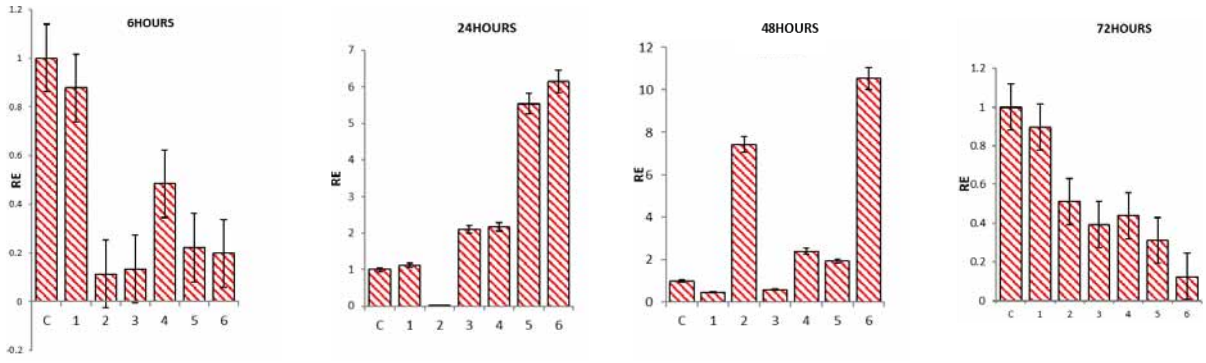
The gill tissue samples collected from shrimps (*Penaeus indicus*) acclimatized to three temperature conditions of 27°C, 30°C and challenged with WSSV were analyzed for transcriptome profile at three time points of 12 hpi, 24 hpi and 48 hpi. The transcriptome data of shrimps exposed to 33°C at 12 hpi, on analysis resulted in a total of 846 differentially expressed genes (DEGs) with 421 up-regulated and 425 down-regulated genes. Shrimp samples collected at 24 hpi, showed 854 DEGs with 420 up-regulated and 434 down-regulated genes. About 1291 DEGs were identified at 48 hpi with 662 up-regulated and 629 down-regulated genes against control samples.

Role of immune genes during WSSV disease pathogenesis

An experiment was conducted in *Penaeus vannamei* (N=315 grouped into seven) to evaluate the virulence of viral copy number in causing pathogenesis. The shrimp were injected with different WSSV copy numbers (10^1, 10^2, 10^3, 10^4, 10^5 and 10^6) and control group with PBS, they were observed for changes at 6, 24, 48 and 72 hrs. WSSV viral

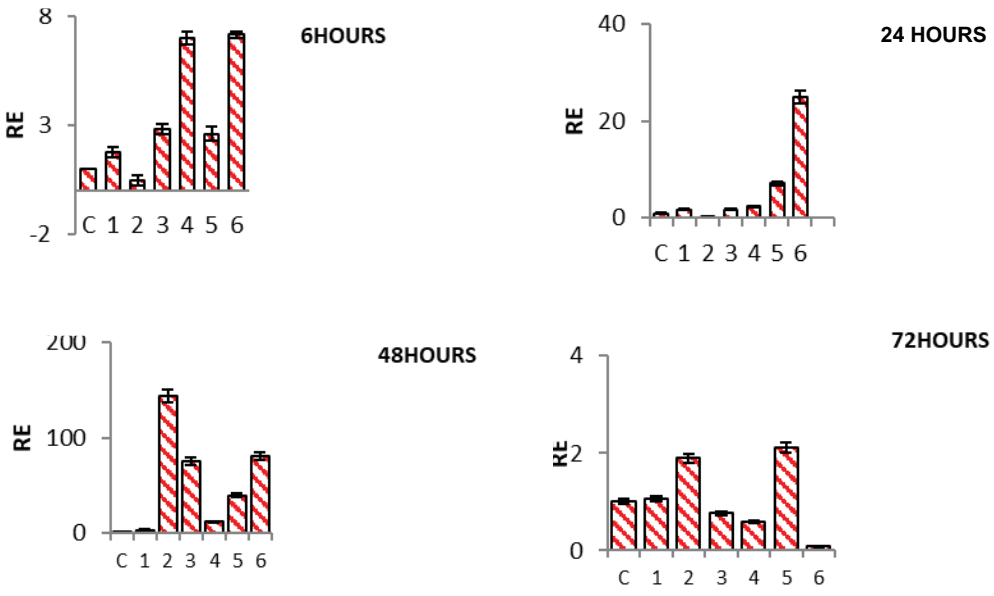


Transcriptome analysis of WSSV-infected Indian white shrimp (Penaeus indicus) exposed at 33°C temperature variations (A) 12 hpi, (B) 24 hpi (C) 48 hpi .



SOD concentration during various time intervals of WSSV infection with various WSSV copy number

copy number. The group injected with 10^5 and 10^6 copy no. of WSSV viral particle gave first step positive while the other groups gave second step positive by PCR at 24 hours and at 48 hours post infection. By 72 hours all the groups gave first step positive amplification by PCR in all the groups. The total haemocyte count was found reduced in all the infected groups with significant difference at 24 hours when compared to that of control, indicates thechanges in immune response of shrimp infected with WSSV. Mortality was observed from 48 hrs onwards in groups injected with 10^4 viral copy no. and above, group with lesser than 10^4 viral copy numbers did not showed mortality until 72 hours of infection.



Expression of Prophenol oxidase during various time interval of infection with various WSSV copy numbers

Immune genes such as SOD and prophenoloxidase, during the infection due to various copy number of the pathogen was estimated in the gill tissue. The SOD concentration in gill tissue during various time intervals of infection was estimated and it was found to be varying during various time interval of infection. However, as disease progressed the level found to be decreasing with higher copy number (10^5 and 10^6) at initial 6 hours interval and reaching the highest level at 24 and 48 hour with subsequent decrease at 72 hours.

Similarly Prophenoloxidase gene expression was studied in gill tissue (Fig) during various time intervals,from 6 to 48 hours of infection and it was found that higher the copy number of viral infection the expression of PRO is found to be higher than control,however on 72 hours of infection the expression was found to be low on 10^6 copy number of WSSV infected group as majority of the shrimp immune system were weakened that makes it difficult for them to defend itself against infection.

WSSV VP28 Primers

WSSV envelope protein VP28 primers were designed and amplified by PCR with WSSV positive DNA samples. pASapI vector and VP28 gene were isolated and restricted with restriction enzymes and ligated. Positive clones (pASapI+VP28) were obtained. Nucleotide sequence of VP28 was checked by DNA sequencing and plasmid was designed as pASapI-vp28. Through bioinformatics approach, codon optimization as per *Chlamydomonas reinhardtii* codons was developed so as to get effective expression in the microalgae. Codon optimised VP28 was also cloned to pASapI vector. Positive clones were initially verified by PCR and then through sequencing. Culture of *C. reinhardtii* was standardised through media optimization.

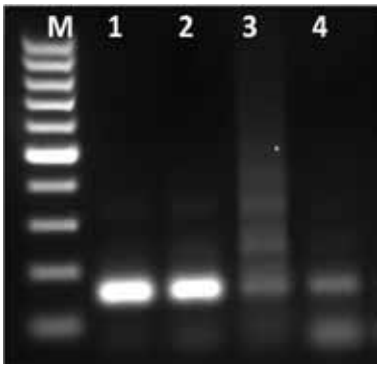
Following glass bead and electroporation, transformation of the clones, pASapI+VP28 and pASapI+OP-VP28, were attempted to transform to *C. reinhardtii.* Colonies were grown in the incubator and subsequently screened for positive clones. It has not been possible so far to obtain positive clones by either of the methods.

Field-Portable, user-friendly and rapid paper-based nucleic acid extraction method for application in point of need diagnostics

In resource-limited settings instrument-free method for rapid nucleic acid extraction has been developed for downward application to detect White Spot Syndrome Virus (WSSV). This innovative filter paper disc-based technique utilizes custom-designed reagents and can complete nucleic acid extraction in just two minutes, followed by amplification of the target sequence using standard PCR. The detection limit for WSSV was found to be 10^2 copies/µl. In addition, with this method 100% sensitivity and specificity were achieved when testing disease outbreak samples in the figure. Recombinant plasmid standards for quantification of RPA assay were established and detection sensitivity determined was 10^1copies/µl. Further this paper based NA extraction method is being enhanced by integrating the RPA protocol with CRISPR CAS12a, enabling visual detection without the need for specialized equipment which aims to facilitate the point-of-need diagnosis of WSSV, is currently under progress.

Differentiating virulence

Field-Portable, user-friendly and rapid filter paper disc based nucleic acid extraction method



Detection of WSSV using a filter paper disc method for DNA extraction by nested PCR. M – 100bp Marker Lane 1-2: First step positive sample used as template Lane 3-4: Second step positive sample used as template

markers in *Vibrio harveyi* and its possible role in pathogenicity

V. harveyi is a major pathogen in shrimp and fishes. Despite extensive efforts, understanding on virulence markers differentiating level of pathogenicity is lacking. Therefore, 132 strains of *V. harveyi* were characterized (*in silico*) for virulence markers. The analysis indicated that Type I, Type II, Type III, Type V and Type VI secretion system plays major role in production of various toxins. They are chromosomal in origin and mostly conserved. However, strain wise variation was observed in conjugation plasmid system, virB T4SS system, and few of the toxins and siderophore receptors.

Luminescence behaviour

and sucrose fermentation in *Vibrio harveyi*

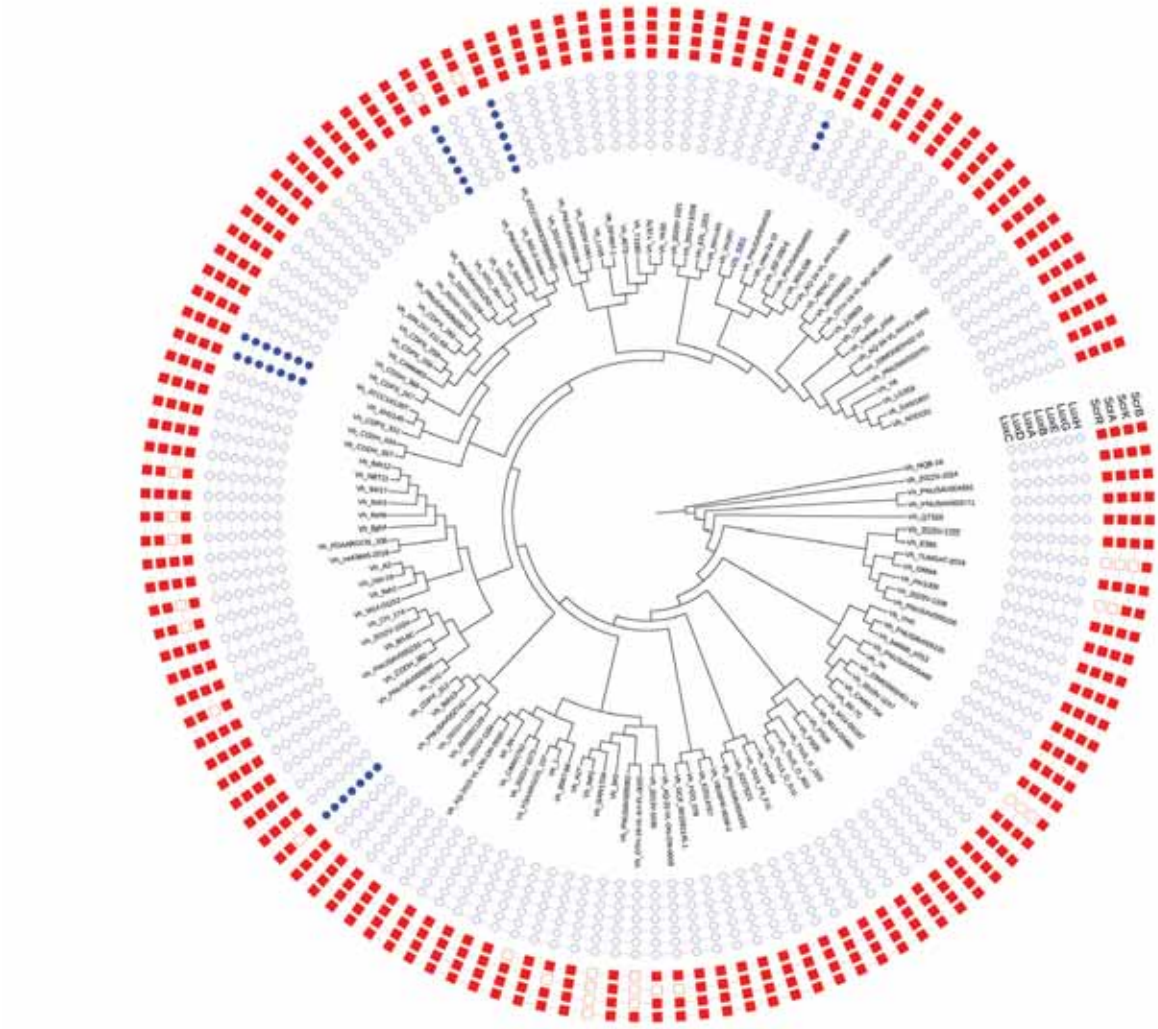
V. harveyi is a major pathogen in shrimp and fishes. It has been widely reported as luminescent, sucrose non-fermenter bacterium (green colony on TCBS agar). However, in view of extensive misidentification there is a need to revisit its key phenotypic markers. Therefore, luminescence operon luxCDABEGH and sucrose operon scrRAKB were mapped in 132 *V. harveyi* strains from NCBI database and further phenotypically characterized in 14 CIBA strains. Contrary to the widely published reports only five out of 146 strains carried luminescence operon and except one strain all carried either functional scrRAKB operon or partial operon, suggesting as sucrose fermenter (yellow colony on TCBS agar). The present study underscores the need for extensive characterization of a bacterial isolate before concluding as *V. harveyi*. Further, *V. harveyi* could be concluded as non-luminescent, forms yellow colony on TCBS agar.

Role of *Vibrio* spp in white feces syndrome

White feces syndrome (WFS) has emerged as major problem in shrimp aquaculture. There are reports about role of *Vibrio* species either independently or in combination with EHP in causing WFS. To investigate their role, 53 hepatopancreas and fecal samples were quantified for several Vibrio species using in-house developed quantitative real time PCR. The analysis indicated that 40 out of 53 samples had dominance of *V. parahaemolyticus*. However, none of the samples had dominance of other important pathogens like *V. harveyi* or *V. campbellii*. These studies suggest the possible role of *V. parahaemolyticus* in WFS.

Control of vibriosis using disinfectants

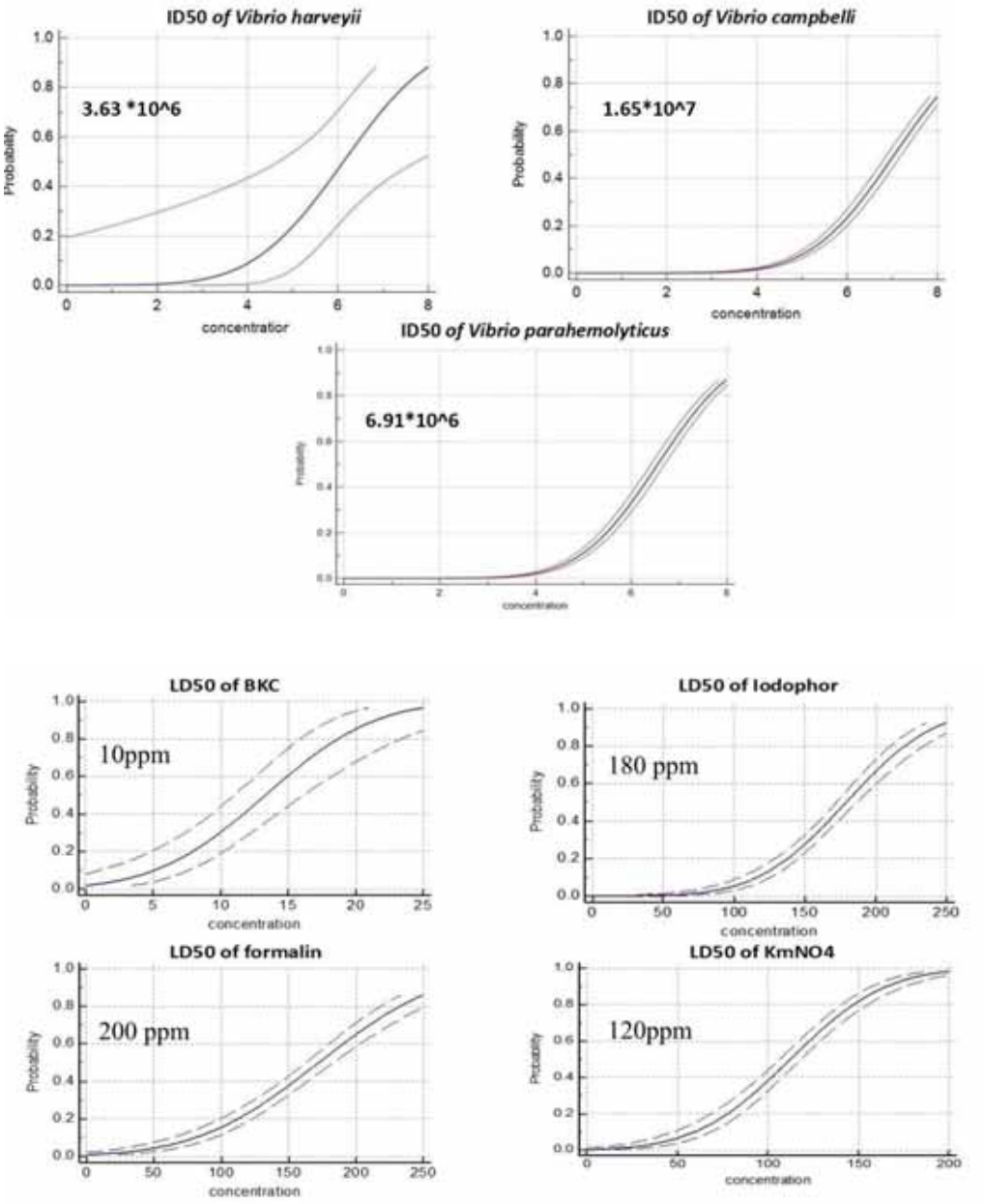
The effect of common disinfectants used in aquaculture namely benzalkonium chloride (BKC), potassium permanganate, iodophor and formaldehyde especially targeting shrimp vibriosis pathogens belonging



Distribution of luminescence gene and sucrose operon in *Vibrio harveyi*

to the genus *Vibrio* (*V. harveyi, V. campbelli and V. parahaemolyticus*) was evaluated. The MIC was determined BKC (1 ppm), Potassium permanganate (5 ppm), Formaldehyde (10 ppm) and Iodophor (40 ppm). *In vitro* antibacterial activity was assessed by using qualitative suspension test to determine the effective concentration for BKC (2 ppm), formaldehyde (20 ppm), $KMnO_4$ (10 ppm) and Iodophor (80 ppm). The in vivo efficacy was evaluated by challenging PL10 (post larvae) with disinfectant at no observed effect concentration (NOEC) against median infective dose (ID50) of three species of *Vibrio* determined from infectivity test. Acute toxicity test (LD50, lethal dose) was done for all disinfectants in vivo with *P. vannamei* observing 50% mortality rates following OECD (guideline No.203). BKC was effective at 2ppm, potassium permanganate at 10ppm, formalin at 20ppm and Iodophor at 80 ppm. Organic load more than 2% showed the most decrease in efficacy of all disinfectants and a contact time of 20 min was optimum for BKC and formaldehyde while potassium permanganate and iodophor were effective within 30 min.

Further, based on the lethal dose and infectivity dose, a challenge study was carried outby inoculating post larvae shrimp with the ID_{50} dose followed by



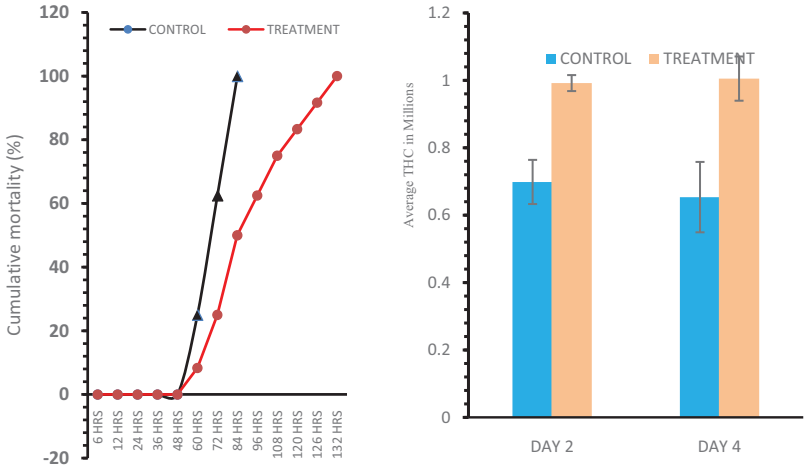
ID50 of three important vibrio species (*Vibrio harveyii, V. campbelli, V. parahemolyticus*)

treatment with disinfectant doses range below LD_{50}. The effective dose was calculated using statistical probit analysis based on mortality observed during 96 h. Although, mortality was improved, formalin and potassium permanganate reduced oxygen levels and should be used with caution of oxidative stress at higher concentrations.

Brown seaweed, *Ascophyllum nodosum* effect on *Penaeus vannamei*

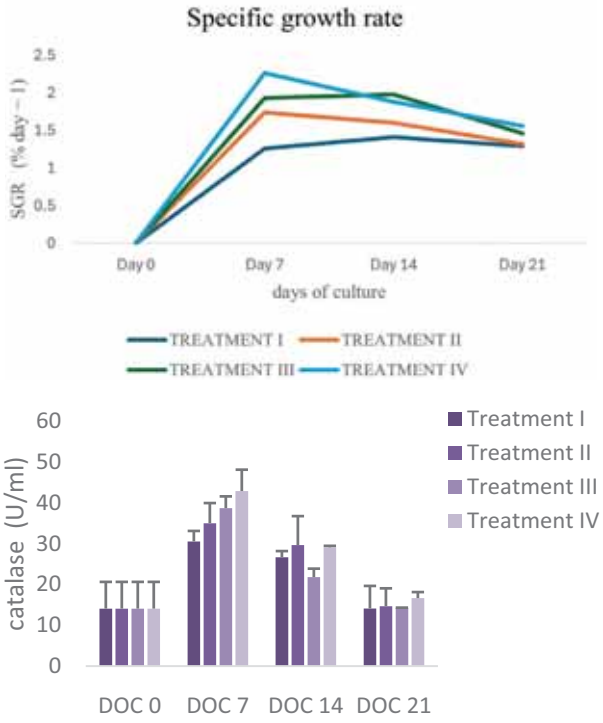
Effect of brown seaweed, *A. nodosum*, as an immunostimulant feed additive for *P. vannamei*, to enhance growth performance and disease resistance against White Spot Syndrome Virus (WSSV) was evaluated. A treatment diet supplemented with *A. nodosum* at 37 mg/kg were fed to shrimps (initial body weight of 3.0 ± 0.25 g) for 28 days and challenged with WSSV (10^5copies) via intramuscular injection on 14th and 28th day. The treatment group demonstrated significant improvements in growth parameters, including specific growth rate (SGR) and feed conversion ratio (FCR), along with enhanced antioxidant activity compared to the control group. Additionally, the treatment group exhibited lower mortality rates and higher haemocyte counts under WSSV challenge, indicating the immunomodulatory potential of the brown seaweed. In conclusion, *Ascophyllum nodosum* shows great potential as a dietary supplement to enhance growth performance and disease resistance in *P. vannamei*.

A novel synbiotic formulation for improved immunity and growth of *Penaeus vannamei*



Graph depicting the immunomodulatory potential of the brown seaweed

The application of substances like probiotics, prebiotics, nutritional supplements, etc. has been an effective strategy for improving disease resistance and growth in shrimp aquaculture. The present study evaluates the efficacy of a novel synbiotic formulation (*Bacillus* sp., yeast, and microalgae) in enhancing the growth and immune enhancement in Pacific white shrimp. Four diet combinations: control (Treatment I), probiotic microbes (Treatment II), microalgae (Treatment III), and synbiotic (probiotic + microalgae) (Treatment IV) were fed 3 times a day at 4% of the body weight of experimental shrimps (initial body weight of 3.0 ± 0.15 g) for 7 consecutive days. A novel synbiotic formulation demonstrated a significant

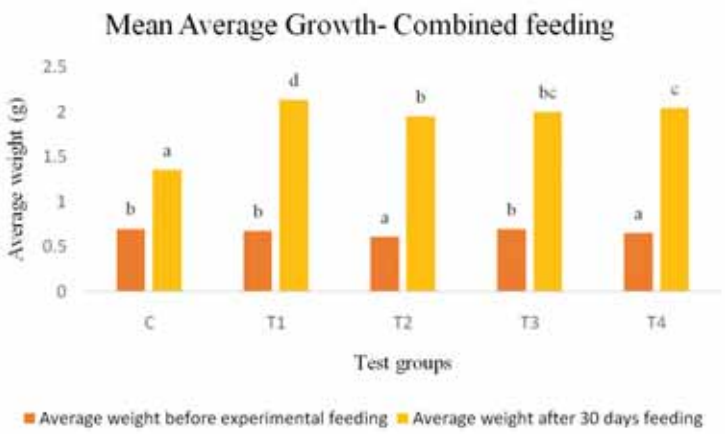


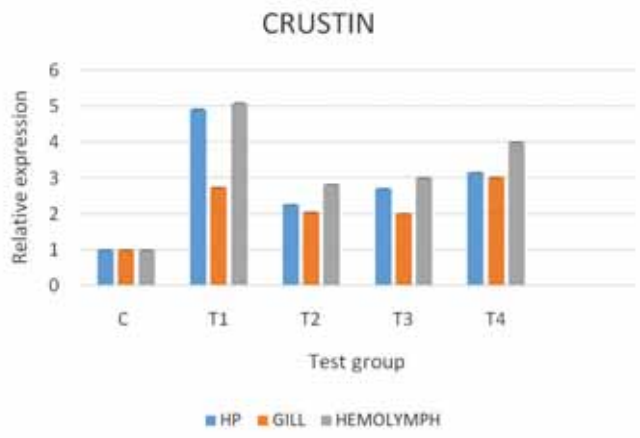
Specific growth rate of *P. vannamei* fed with four diets combinations, control (Treatment I), probiotic microbes (Treatment II), microalgae (Treatment III), and synbiotic (probiotic + microalgae) (Treatment IV).

enhancement in the immune response, antioxidant activity, and growth performance of shrimps compared to groups provided either probiotics alone or microalgae supplementation. Shrimps fed with treatment IV showed significantly higher ($P < 0.05$) expression of immune-related genes, including prophenoloxidase, lysozyme, peroxinectin, crustin, and heat shock protein 70 (HSP 70), alongside antioxidant-related genes such as superoxide dismutase (SOD) and catalase, in both the intestine and hepatopancreas. This enhanced gene expression is indicative of an improved immune defence mechanism and oxidative stress mitigation. Enhanced growth parameters, including average body weight and specific growth rate (SGR), were observed, underscoring the growth promoting effect. The findings indicate that this novel synbiotic formulation effectively integrates the complementary advantages of probiotics and prebiotics, promoting immune improvement, enhanced stress tolerance, and better growth performance.

Probiotics and prebiotics combination provides better growth and health status to Pacific white shrimp, *Penaeus vannamei*

Disease is one of the major hurdles for shrimp aquaculture practice and due to under developed immune system, immunomodulators are important components for shrimp protection from diseases. In one experiment, different combinations of immunomodulators (Probiotic -*Bacillus subtilis*, prebiotic – inulin and immunostimulant – beta glucan) were given (Control, T1 – Probiotic + prebiotic, T2-prebiotic + immunostimulant, T3-Probiotic + immunostimulant and T4 -prebiotic + probiotic + immunostimulant) in for a 30 days experimental period. While higher growth was observed in all the treatment groups, comparatively highest growth was noticed in probiotic and prebiotic combination (T1). When all the groups were challenged against shrimp white spot syndrome virus (WSSV), better survival was found in the same T1 group. Similarly, higher immune gene expression was also noticed in probiotic and prebiotic combination group compared to other combinations. This experiment indicated that probiotic and prebiotic





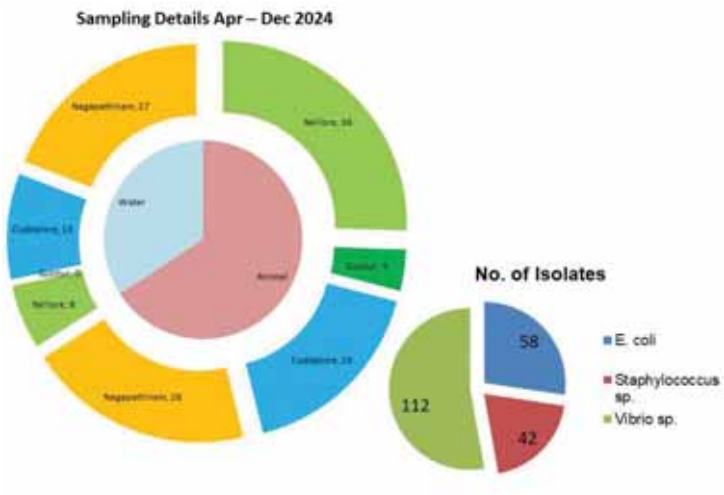
Graphical representing the effects of immunomodulators on P. vannamei

combination at appropriate dose will be helpful in improving growth and health status of shrimp in aquaculture practice.

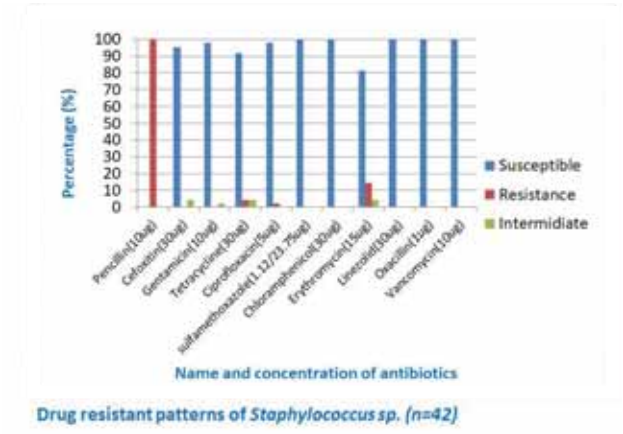
Antibiotic resistance detected in shrimp and water samples from shrimp culture ponds

Antimicrobial resistance in farmed shrimp was screened for the bacteria *E. coli, S. aureus,* and *Vibrio* species, including *Vibrio parahaemolyticus*. Samples (93 shrimp samples and 48 water samples) were collected from four different districts of two states Andhra Pradesh and Tamil Nadu. From these samples, a total number of 112 *Vibrio* sp, 58 *E.coli* and 42 *Staphylococcus* sp were isolated.

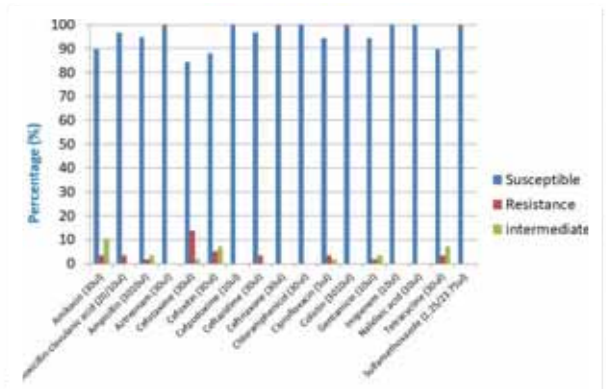
Staphylococcus sp were more resistance to Penicillin where all isolates were resistant to this antibiotic. Among the *E. coli isoates,* though maximum resistance was observed for Cefotaxime, only 15% isolates showed resistance. Similarly, for *Vibrio* sp., maximum resistance was observed for Ampicillin where more than 60% of isolates showed resistance.



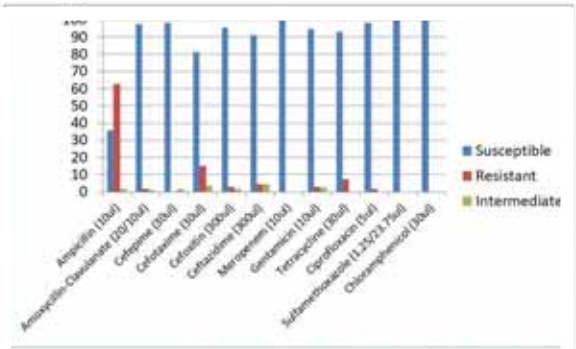
Details of animal and water samples collected from four district of Tamil Nadu and Andhra pradesh and number of bacterial isolates recovered during Apr - Dec 2024



Drug resistant patterns of *Staphylococcus sp. (n=42)*



Drug resistant patterns of *E.coli (n=58)*



Drug resistant patterns of *Vibrio sp. (n=112)*

Antimicrobials and their susceptibility testing results for recovered bacteral isolates

Pathobiology and the host range of *Enterocytozoon hepatopenaei* (EHP) infection in brackishwater aquaculture

Prevalence of *Enterocytozoon hepatopenaei* (EHP) in *Penaeus monodon* farms was found to be 30.6% with 94.7% at nested PCR positive of the forms screened. Multiple-dose challenge and susceptibility experiment in juveniles of *P. indicus*, *P. monodon* and *P. vannamei* revealed the highest EHP load in *P. vannamei* on 42nd day of post-challenge [dpc] followed by *P. monodon* on 35th dpc and the least EHP load in *P. indicus* during entire 42 days of experiment. Multiple-dose challenge and susceptibility study experiment in crab species (*Scylla serrata* and *S. olivacea*) with EHP revealed no establishment and/or no proliferation of EHP spores in HP tissues.

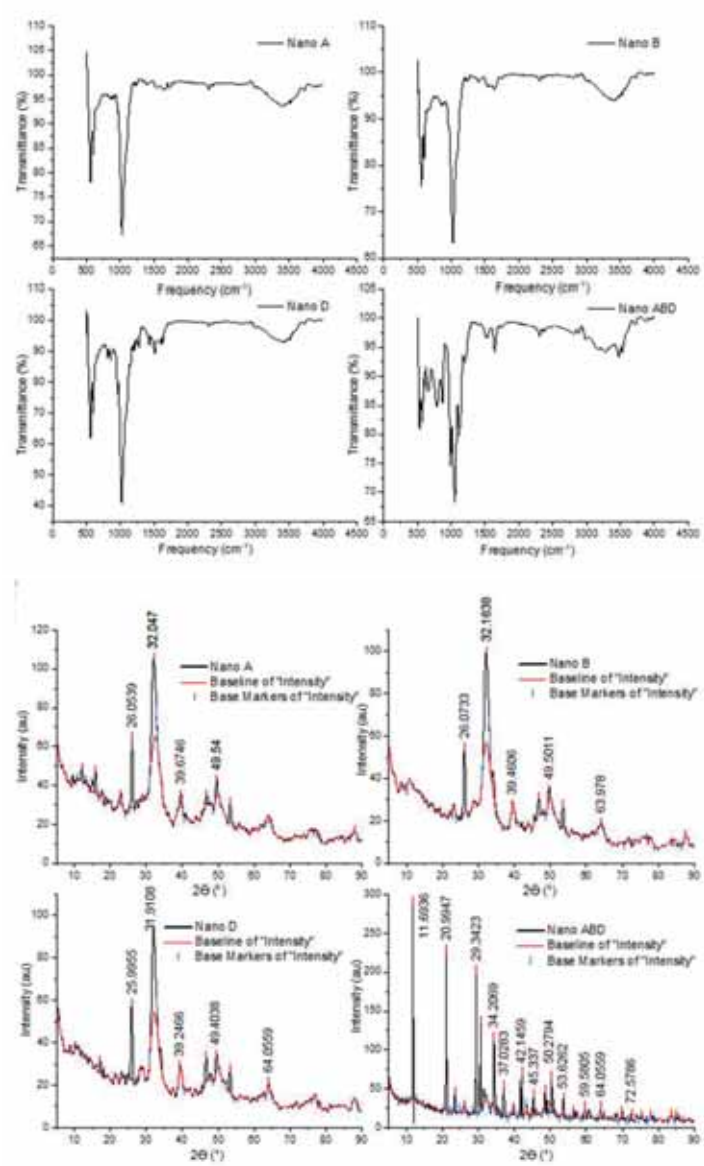
Prophylactics and therapeutics against *Ecytonucleospora hepatopenaei* (EHP) and *Vibrio* spp.

Safe and eco-friendly anti-microbial therapeutics are need of the hour against EHP and associated diseases in shrimp aquaculture. Three herbal nanoparticles with tissue recognition ligands were synthesised with the coupling efficiency between 96.36 and 99.64% and characterised by Fourier Transform Infrared Spectroscopy (FTIR), X-ray diffraction (XRD), zeta sizer and High-Resolution Scanning Transmission Electron Microscope (HRSTEM).

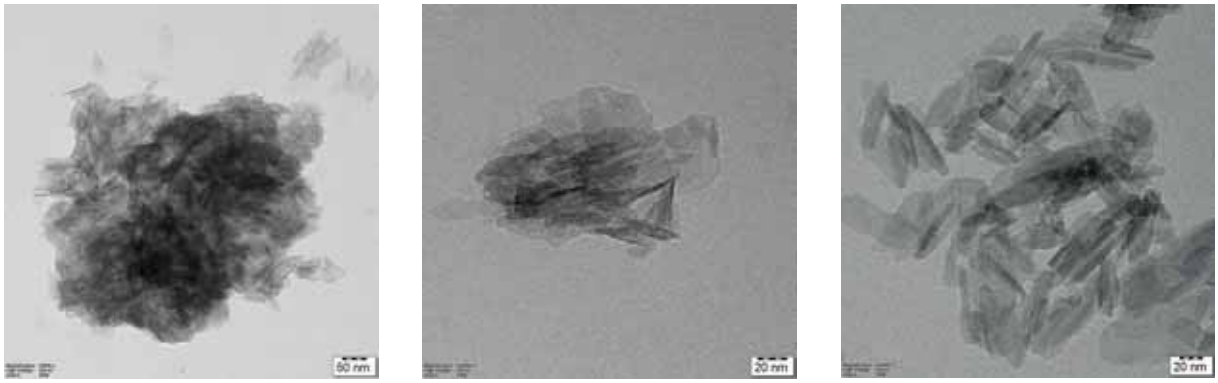
The compound A was tested in WFS affected *P. vannamei* juveniles and found effective on 5th day of exposure. Three herbal extracts (A, B, D & ABD) and their mixture were found to be effective against *V. parahaemolyticus*.

In another study, one essential oil and one active component were top coated with feed and found to inhibit EHP spore germination in challenged shrimp.

Silymarin derivative was found to be a hepatoprotectant at about 0.02% against EHP infection in shrimp. Silymarin derivative was supplemented in commercial shrimp feed as a prophylactic for EHP as an experimental feed trial with four treatment groups I, II, III, IV and control with silymarin derivative at 0.01%, 0.02%, 0.05%, 0.10% and 0.00% respectively and coated with soya based binder and stored in 4°C. The supplemented feed was fed to shrimps in all groups in duplicates for twenty days before challengeper os with *Enterocytozoon hepatopenaei* and observed for clinical signs and faecal matter collected for quantitative PCR and found EHP positive from five days post infection. There was no significant difference in the weight gain in the treatment and



FTIR image of herbal nanoparticles

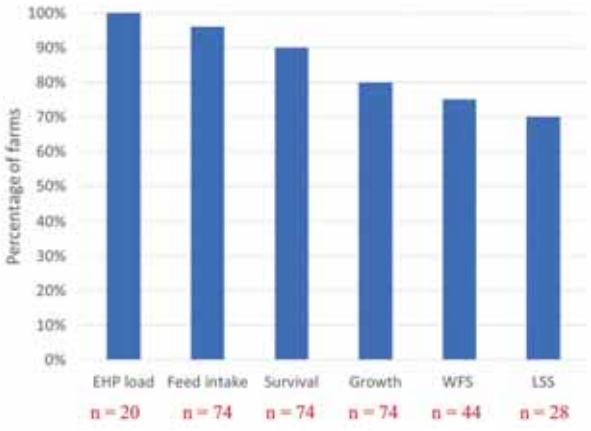


HRSTEM image of herbal nanoparticles

control group. The immune gene expression for lysozyme, SOD, penaeidin, prophenol oxidase and crustin were analyzed and histopathological study of all groups revealed that silymarin derivative was found to be a hepatoprotectant at about 0.02% and above against EHP infection in shrimp. An in silico SWPs and *P. vannamei* prophenoloxidase-activating peptidase (PPE) interaction study exhibited high energy interactions.

Field evaluation of *Ecytonucleospora hepatopenaei* (EHP) therepeutic CIBA EHP cura I

EHP (*Ecytonucleospora hepatopenaei*) the shrimp microsporidian poses a significant threat to the global shrimp aquaculture. EHP is the causative agent of the disease hepatopancreatic microsporidiasis (HPM). EHP is reported to be associated with size variation/ growth retardation and white feces syndrome (WFS). However, the studies on therapeutics and treatment against EHP are extremely limited. Recently, we developed a natural plant-based therapeutic 'CIBA EHP cura I' for the treatment of EHP. It is a combination of phytochemical and nutritional supplements which significantly reduced the EHP load and improved the shrimp immunity and growth. The product has been field evaluated in 74 farms of 169.5 ha in Tamil Nadu, Andhra Pradesh, Punjab, West Bengal and Gujarat. Around 5700 liters have been used for the field evaluation and a revenue of Rs 22,33450-/ has been generated.



Field evaluation of CIBA EHP Cura I in the shrimp farms of Tamil Nadu, Andhra Pradesh, Punjab, West Bengal and Gujarat, n- number of farms.

In field evaluation, 'CIBA EHP Cura I' found to significantly reduced the EHP load in all the farms tested and found to improve the feed intake (96% of farms), survival (90% of farms), growth (80% of farms)

and controlled the white feces syndrome (75% of farms) and loose shell syndrome (70% of farms). Also 'CIBA EHP Cura I' found to reduce the EHP load from ct value 21 (range 17-26) to 31 (28-32) and found to increase the average daily growth from 0.09 g (range 0.02 – 0.14) to 0.33 g (0.14 -0.42). In preliminary economic analysis the product found to increase the revenue 2.8 times (range 1.1 – 3.8) in the treatment ponds than the control affected ponds.

Aeromonas veronii causing mortality of Asian seabass (*Lates calcarifer*) cultured in fresh water environment

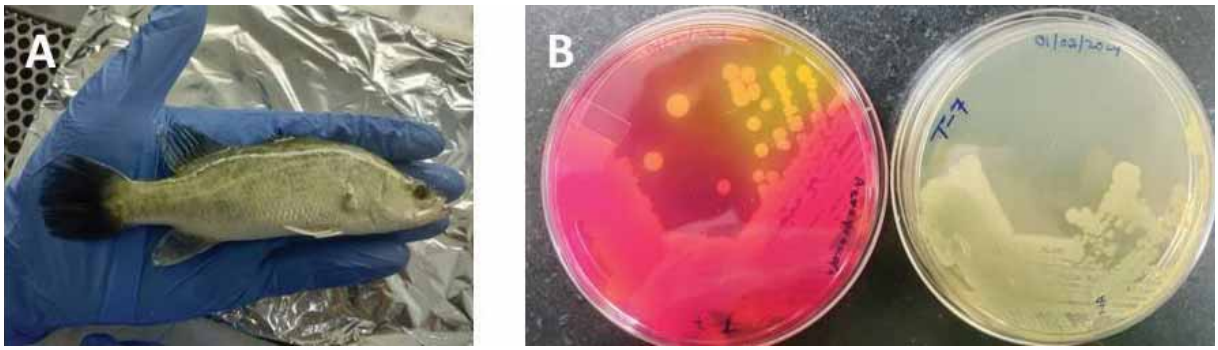
Juvenile Asian seabass (100–150 g) in freshwater farms reported with 5–10% daily mortality, symptoms including paleness, dullness, scale loss, and skin erosion. Comprehensive investigations revealed causative agent as *Aeromonas veronii*, a Gram-negative motile bacterium, in the heart blood of diseased fish which was later confirmed by16S rRNA sequencing revealed 98% similarity to *A. veronii* (KF413415). This emerging pathogen, known for causing sepsis, ulcer syndrome, and mass mortality in aquatic animals, poses significant risks in seabass aquaculture.

Isolation and identification of *Photobacterium damselae* from *Acanthopagrus datnia* (Bengal yellowfin seabream)

Bengal yellowfin seabream (*Acanthopagrusdatnia*) brooder fish mortality occurred during December to February, when temperature was between 20 to 25°C, an investigation was conducted. Gross signs included, hemorrhages on body, pale gills and internal organs, opaque eye and ascetic fluid accumulated in the abdomen. Histopathological observations revealed kidney had cellular infiltration in intra tubular area, vacuolization in tubular epithelium, separation of renal tubular epithelium from its basement membrane, and melanomacrophage aggregations. Spleen exhibited numerous melanomacrophage aggregations, granuloma and aggression of bacterial cells. Liver with lymphocytic aggression, dilated blood sinuses, necrosis, vacuolization of hepatic cells and granuloma. Eight bacterial isolates identified as *Photobacterium damselae* from liver, kidney, and spleen which was later confirmed by PCR based on capsular polysaccharide gene (CPS) specific to *Photobacterium damselae* as well as through 16SrDNA sequencing.

Major parasitic diseases causing mortalities in Asian seabass, *Lates calcarifer*

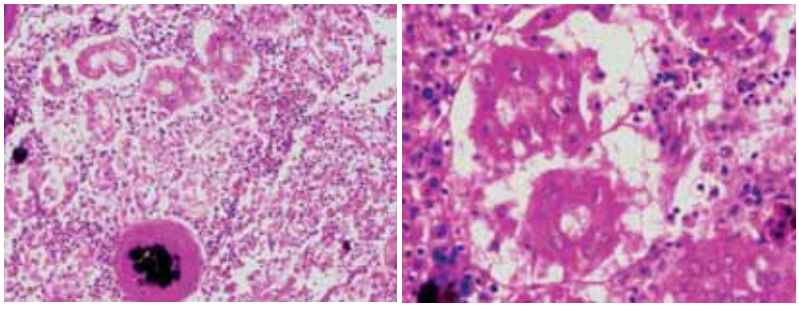
Asian seabass (*Lates calcarifer*) is a commercially important aquaculture species widely farmed in coastal ponds and brackishwater cage systems across India. However, its culture is significantly impacted by infectious diseases, particularly those caused by bacterial, viral, and parasitic agents. A total of 2,000 fish were sampled from 30 fish farms and cage culture units and three hatcheries between April 2023 and December 2024. The key parasitic taxa identified included parasitic ciliates (*Cryptocaryon irritans*), dinoflagellates (*Amyloodinium ocellatum*), *Trichodina* spp., monogenean gill flukes (*Diplectanum* spp.), and parasitic crustaceans (*Argulus* spp.). Additionally, several cases with unknown etiologies were recorded and are under further investigation. Among these, *C. irritans* and *A. ocellatum* were associated with acute outbreaks in hatcheries, leading to severe mass mortalities (90–100%) within 7 to 10 days of clinical onset, particularly affecting brood stock and larval stages in brackishwater systems. *Argulus* spp. was the most frequently encountered parasitic crustaceans in extensive freshwater farming systems of Asian seabass. However, their prevalence was notably reduced by the seasonal influx of brackishwater, which appeared to act as a natural control measure



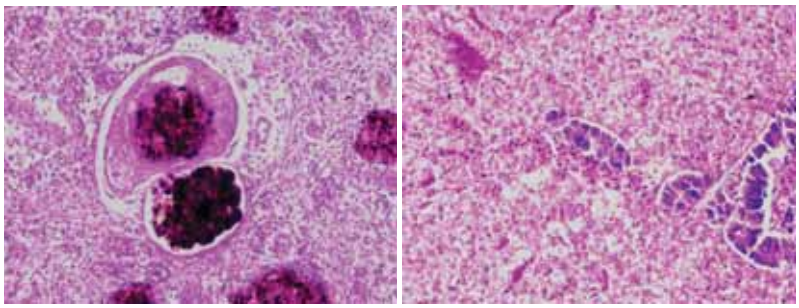
A. Infected Asian seabass symptoms of scale loss, and skin erosion, B. *Aeromonas veronii* on Aero pseudo selective medium

Haemorrhages on diseased Bengal yellowfin seabream

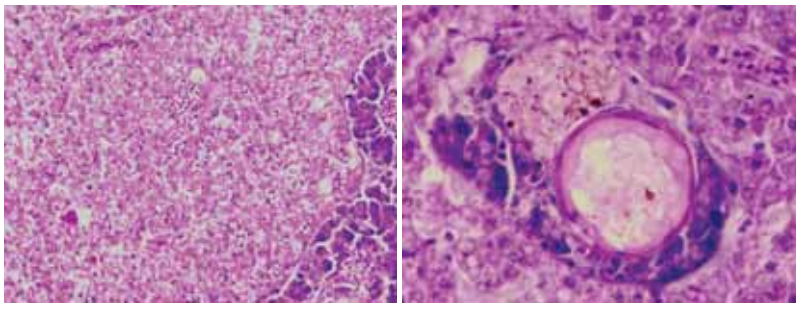
Kidney



Spleen



Liver

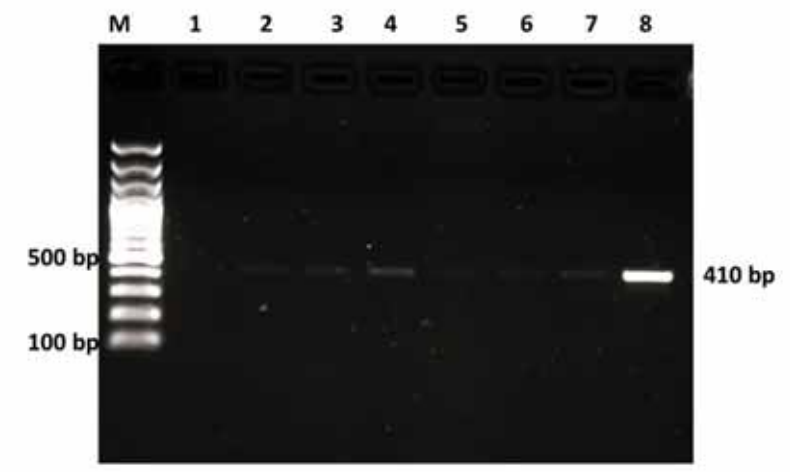


Micrographs of histological sections from diseased Bengal yellowfin seabream

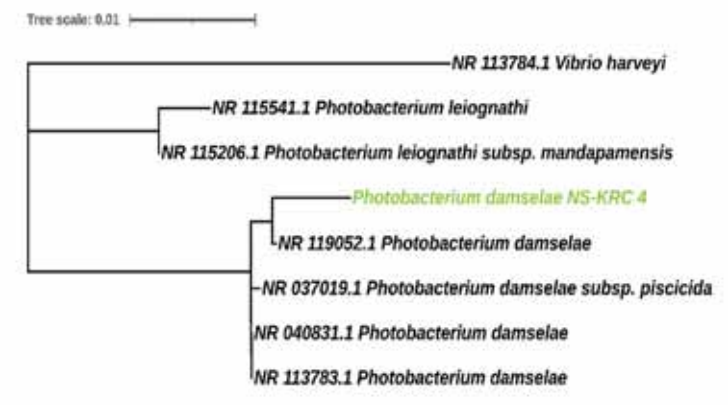
in surveyed farms. In contrast, infections caused by trichodinids and gill flukes (*Diplectanum* spp.) demonstrated a gradual build-up over a period of two weeks to several months. These parasites were responsible for chronic low-level mortality (<2–5% per day), particularly in rearing systems such as cages, raceways, and ponds, contributing to cumulative losses and reduced productivity.

Treatment strategies adopted for effective prevention of *Amyloodinium ocellatum* infestation in Asian seabass (*Lates calcarifer*)

Amyloodinium ocellatum is an obligatory protozoan parasite of marine and brackish-water fish, causing significant mortalities in fish hatcheries, cages, and farms. Effective control measures for *Amyloodinium* are still under development. The antiparasitic



Agarose gel electrophoresis of PCR product of capsular polysaccharide gene (CPS) (410 bp) specific to *Photobacterium damselae*.

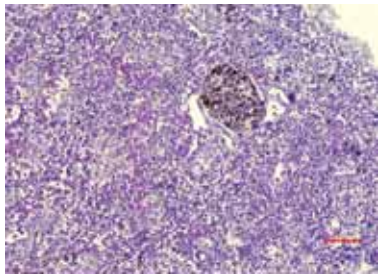


Phylogeny of *Photobacterium damselae* isolated from Bengal yellowfin seabream

effects of $CuSO_4$ (0.15 mg/L) in seawater, freshwater, and freshwater with Vitamin C (10 mg/L) were evaluated against *A. ocellatum* in Asian seabass (~10 g±2; 28 °C; 30 %). The fishes were then monitored for recovery and it was found that the best treatment for recovering fish infested with *Amyloodinium* was 0.15mg/L $CuSO_4$ (continuous bath) with 86% survival rate followed by fresh water with Vitamin C recording 84% on 10^{th} day. The study suggests the possible recovery of *Amyloodinium* infected Asian seabass; however, the dose and duration of treatment may vary with fish species, their size, environmental parameters etc.

Development of recombinant microalgae expressing Nervous necrosis virus capsid protein for vaccinating finfish against viral nervous necrosis

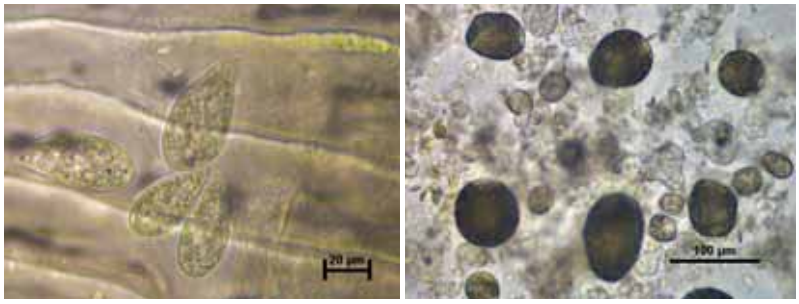
Asian seabass larvae are often affected by Viral nervous necrosis (VNN) caused by Nervous necrosis virus (NNV). To



H & E staining spleen showing Melanomacrophage centre (MMC) and necrosis

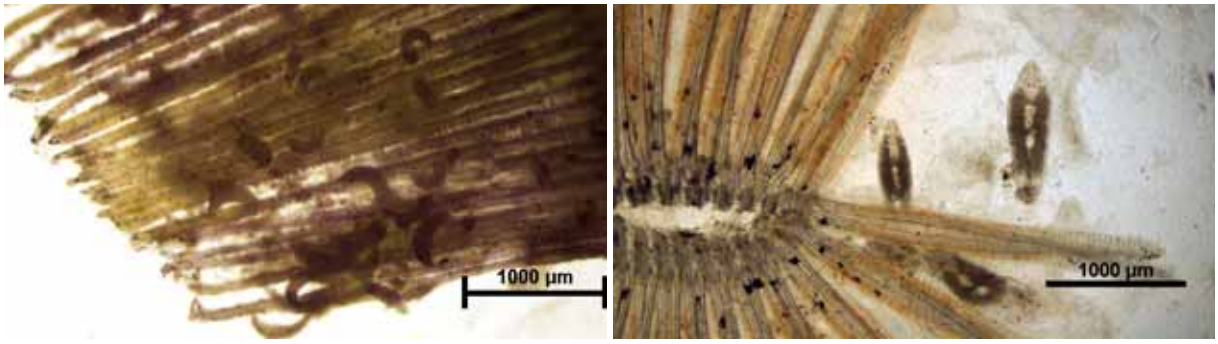
immunize larvae and juveniles, oral and immersion vaccines needs to be developed. Hence the expression of capsid protein gene of NNV in microalgae viz., *Chlamydomonas reinhardtii* was taken up. *C. reinhardtii* strain

CC-125 was transformed with recombinant plasmid, pChlamy_4 containing NNV capsid protein gene by glass bead aberration and electroporation methods. Colonies developing on the selective media were subcultured and screened by colony PCR. The presence of the zeocin antibiotic resistance gene was checked by PCR.

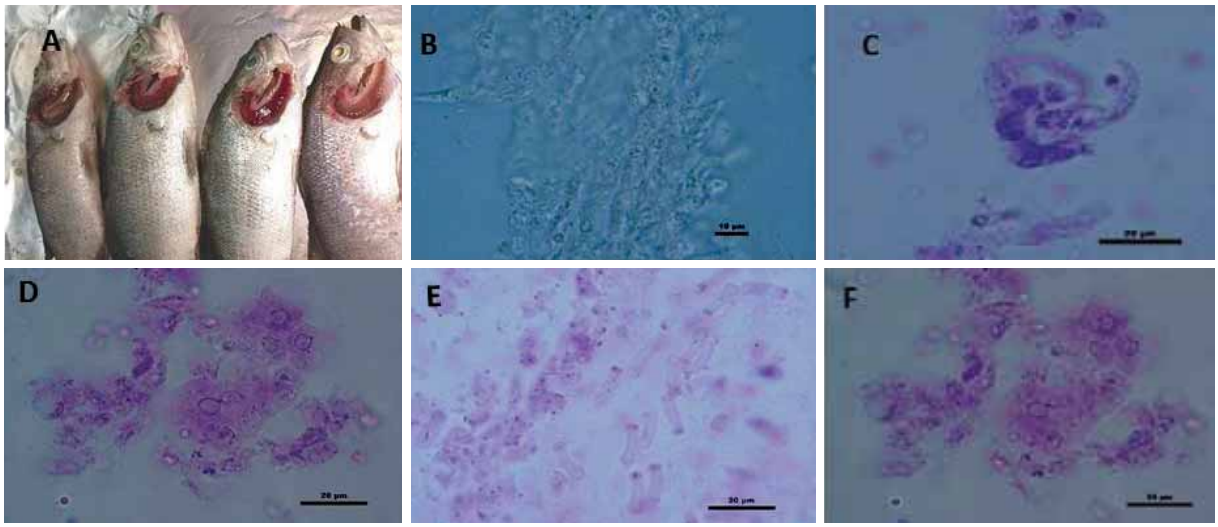


A. Parasitic ciliates (*Cryptocaryon irritans*-free living stages) and B.dinoflagellates (*Amyloodinium ocellatum*) causing mortalities in Asian seabass

Trichodinid spp. causing severe gill infection in Asian seabass, A. Individual Trichodinid, B. affected gill filament with fused secondary lamellae, *C. Severely* affected gills



Dactylogyrus spp. infestation in gills of juvenile Asian seabass



Asian seabass mortalities with unknown aetiologies. A. Dead Asian seabass with gill erosion; B. and C. Spindle shaped nucleated bodies under wet mount and stained with crystal violet; D,E and F different developing stages stained with crystal violet, scale bar -20 µm

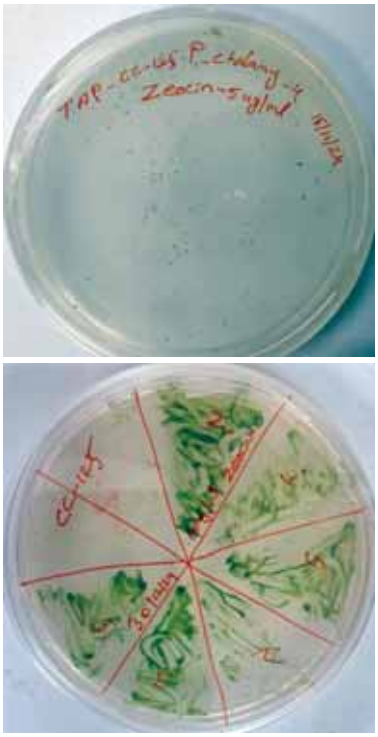
Characterizing and developing the indigenous fish cell lines to prove stemness and proliferation in seafood cell culture

Cultured meat which is produced by culturing animal cells in laboratory has several advantages such as being environment friendly, ethically acceptable, uses less water and land etc., has all the nutritional advantages of fish. With the aim of producing cultured Asian seabass meat primary cell culture of muscle cells were established. The cell line is being continuously passaged and has reached 78 passages. Cryopreservation was done at various passages. Molecular characterization of cytochrome oxidase subunit 1 (CO1) gene at various passages was carried out and confirmed that the developed muscle cell line belonged to Asian Sea bass, *Lates calcarifer*. Myogenic determination protein (MyoD) gene was expressed in the developed cell line at various passages confirmed that the developed cell line have stable expression of myoblast specific marker. Eight batches of myoblast differentiation have been done. Upon induction with differential medium myoblast differentiated into myotubules and myofibrils.

Aquatic animal health scoring

Diseases are one of the major limiting factors in achieving the potential production in aquaculture operations. Scoring the farm level aquatic animal health status is the key to improve the effectiveness of adopted BMPs in reducing the risk of diseases and its losses. A tool has been developed to assess biosecurity and provide benchmarks to evaluate farm performance, ensuring effective management and sustainability across diverse aquatic systems.

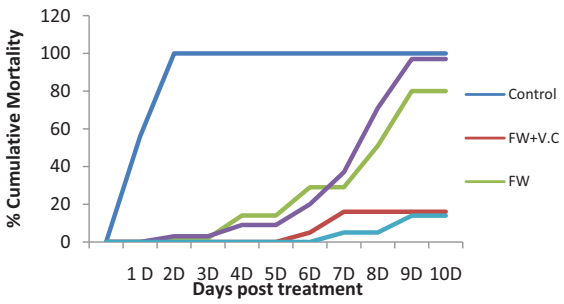
Major elements such as site selection and farm preparation, quarantine and health monitoring, management of stocking density, water source management etc. together creates an aquatic animal health framework which helps in minimizing the risk of disease spread and positive impact on farm health. Based on the literature review, a questionnaire framework has been designed with 75 important attributes for different fish farming ecosystems in the country. These attributes are grouped under various elements that consist of corresponding indicators aims to identify and resolve specific areas of concern by methodically evaluating the data collected, by applying statistical models.



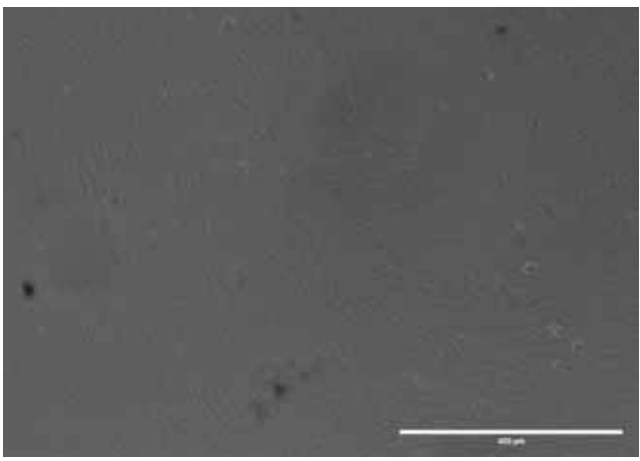
Transformed *Chlamydomonas reinhardtii* strain CC-125 on Zeocin TAP agar plates

Methodology framework Economic Loss due to Diseases in Aquaculture (ELDA)

A model framework ELDA was developed to calculate total economic loss due to aquatic animal diseases to Indian aquaculture. Stochastic frontier model and multinomial logit

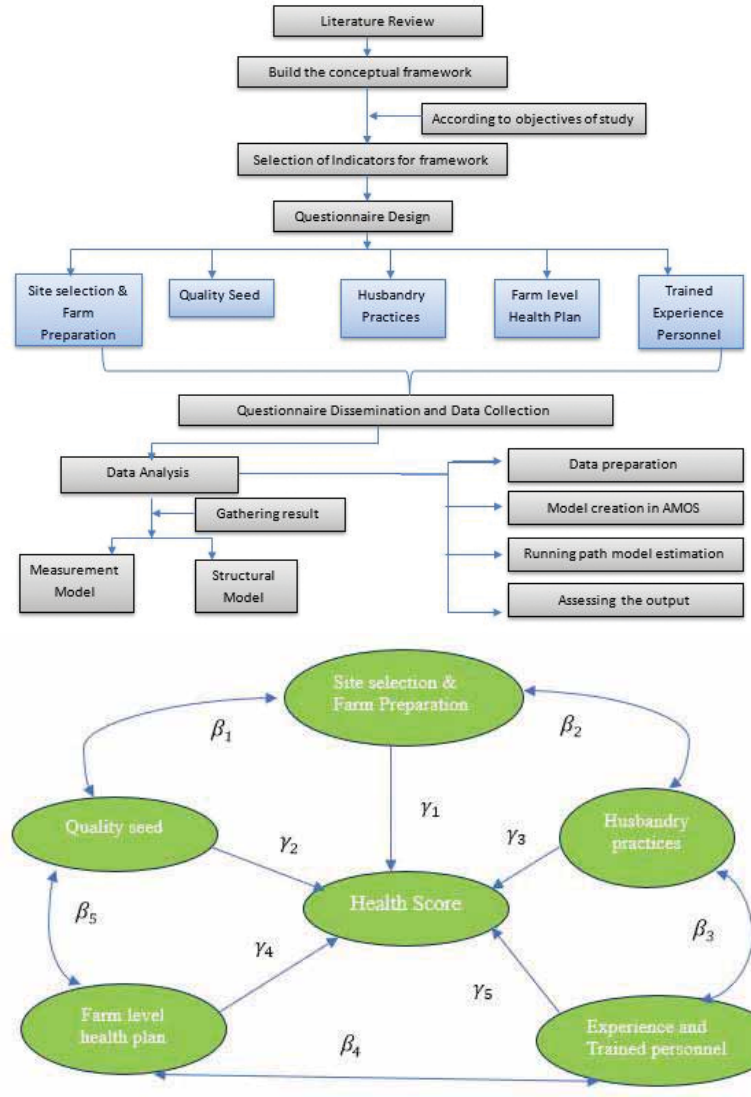


Percentage cumulative mortality of Asian seabass (*Lates calcarifer*) infected with *Amyloodiniumo cellatum* treated with freshwater with Vitamin C, freshwater, CuSO4 (0.15 mg/L -1day exposure), and CuSO4 (0.15 mg/L –continuous bath) until 10 day



Asian seabass muscle cell culture at 63rd passage

regression were used in ELDA model to identify technical inefficiency determinants and relative risk ratio, respectively. Economic burden of diseases on Indian aquaculture sector was estimated to be US$ 2.48 B which is 14.95% of annual aquaculture production value. The major contributors to the disease burden included production loss (23.90%), expenses on prophylactics (50.31%) and therapeutics (17.26%).



Flowchart describing the outline of study, a simple theoretical and hypothesized research model

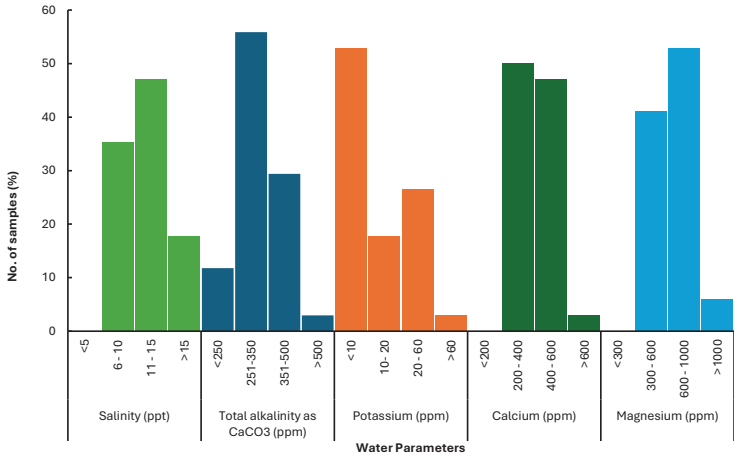
05

AQUACULTURE ENVIRONMENT

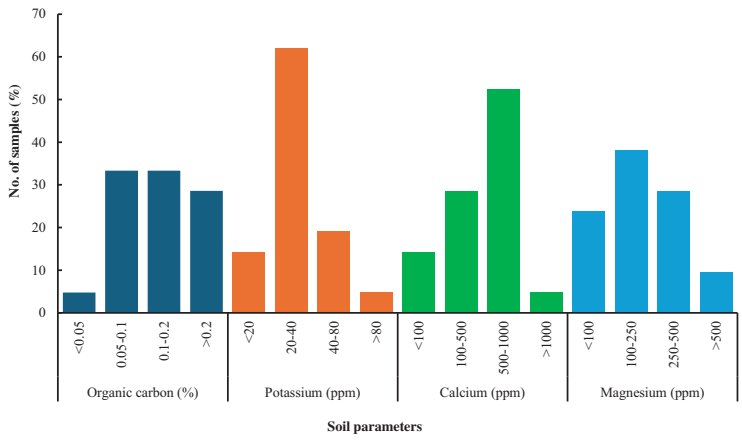
AQUACULTURE ENVIRONMENT

Soil and water characteristics of inland saline regions for aquaculture

Saline groundwaters of inland origin present an opportunity for the farmers to engage in shrimp farming. A survey was done with the tested questionnaire to collect the information on culture and management practices followed in the regions of Punjab, Haryana and Rajasthan, and water and soil samples were anlysed. Water salinity ranged between 7 and 18 ppt. The total alkalinity (ppm as $CaCO_3$) ranged between 185 and 565 in Rajasthan, and between 240 and 485 in Haryana and Punjab with more than 50 % of the samples falling between 250-350. Many samples were deficient in potassium and around 50% of the samples had optimum Mg:Ca ratio. Organic carbon content in soil ranged between 0.05 and 0.2%. Generally, soil calcium content was higher than or equal to magnesium content, and more than 50% of the samples were in in the range of 20-40 mg/kg potassium and 500-1000 mg/kg calcium.



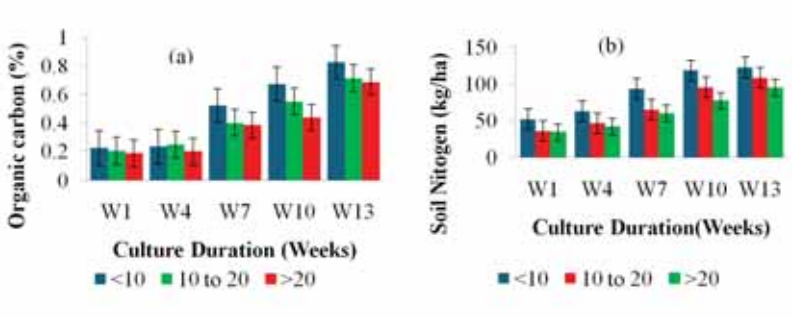
Variation in the water parameters in inland saline regions



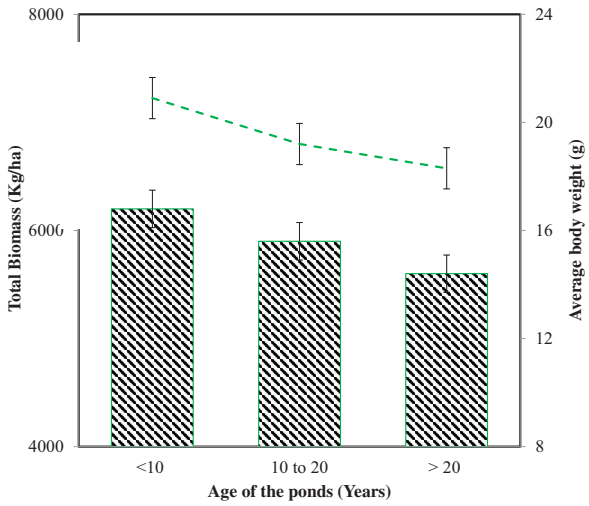
Variation in the soil parameters in inland saline regions

Soil and water quality, and productivity in shrimp culture ponds of varying age

Soil, water quality, and production parameters were monitored in shrimp culture ponds of varying age at Ananthapuram Village, Nellore District. There was no significant difference in soil pH and electrical conductivity values among the ponds varying in age. Organic carbon content and available nitrogen levels were found to be low in aged ponds and soil nutrient levels increased during the culture period. Organic carbon content increased by 37, 34 and 32% from stocking time to the time of harvest in <10, 10-20 and > 20-year ponds. Pond ageing significantly affected shrimp production (Fig 4). Average daily growth varied between 0.22, 0.20 and 0.19g and the total biomass varied from 6.2, 5.9 and 5.6 t/ha in <10, 10-20 and > 20-year ponds, respectively. The study reveals that soil fatigueness by the pond ageing affects soil quality as well as shrimp production.



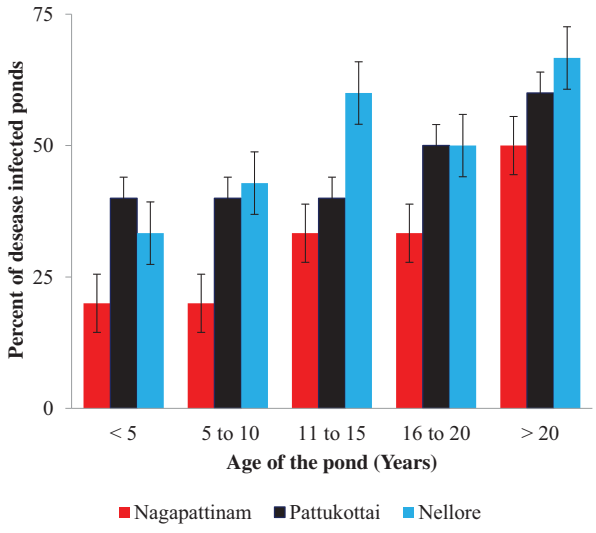
Organic carbon (a), and available nitrogen (b) content during the shrimp culture in different aged ponds



Shrimp biomass and production parameters of different aged ponds

Effect of pond ageing on disease occurrence in shrimp farms

To assess the effect of pond ageing on disease occurrence, primary data was collected from the ponds of varying age (<5, 5-10, 11-15, 16-20 and > 20 years) in farm clusters at Nagapattinam, Pattukkottai and Nellore Districts. Disease prevalence was found to be higher in aged ponds compared to ponds of less than 5 years. Around 50, 60 and 67% ponds of aged ponds (> 20 years) and 20, 40 and 33% ponds of < 5 years were disease infected in Nagapattinam, Pattukkottai and



Effect of aquaculture pond ageing on disease occurrence

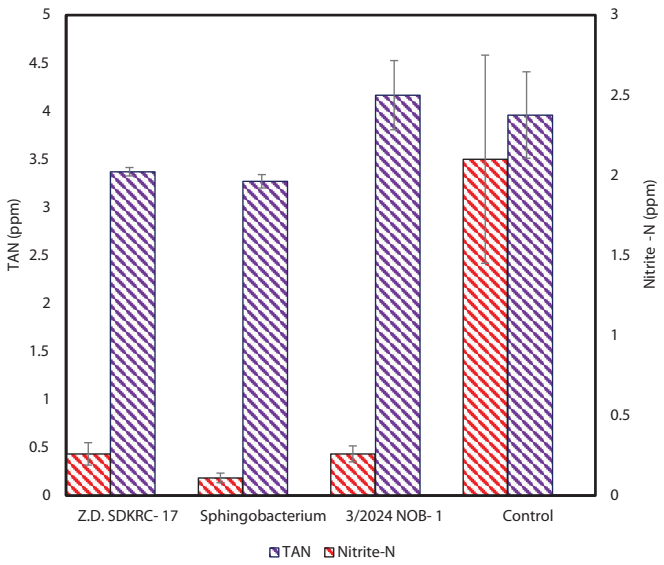
Nellore clusters, respectively. Among the three clusters disease prevalence was low in Nagapattinam. White faecal Syndrome (WFS) is a common disease in Nagapattinam and Pattukkottai clusters and White Spot is a major disease in Nellore cluster.

Effect of beneficial bacteria consortia on mitigation of ammonia and nitrite

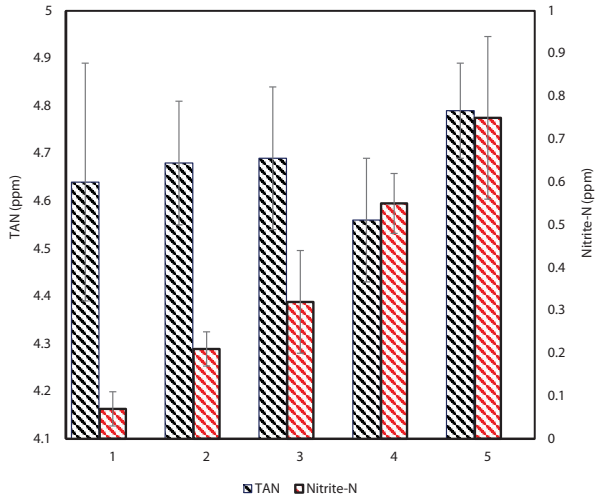
The effect of three different beneficial bacteria *Sphingobacterium* spp. SDKRC-13, *Zobellella denitrificans* SDKRC- 17 and 3/2024 SDNOB- 1 were checked for their efficacy to reduce total ammonia nitrogen (TAN) and nitrite nitrogen in brackishwater (Salinity: 7 ppt and pH 8). All the three isolates could reduce the level of nitrite-N significantly ($p < 0.05$) compared to control, and no significant reduction was observed in case of TAN. In another trial, different combination of bacteria (T1 = SDKRC-13 and SDKRC-17; T2 = SDKRC-13 and SDNOB-1; T3 = SDKRC-17 and SDNOB-1; T4= Combination of SDKRC-13, SDKRC-17 and SDNOB-1) were used to reduce TAN and nitrite-N in brackishwater (salinity 5 ppt and pH 7.8). It was observed that treatment T1 and T2 could reduce the level of nitrite-N significantly compared to control, with a higher reduction in T1. No significant reduction in TAN was observed in any of the treatment.

Photodegradation of formalin in water and soil

Formalin is used for bath treatment to control parasitic



Effect of individual bacterial isolates on removal of TAN and Nitrite-N

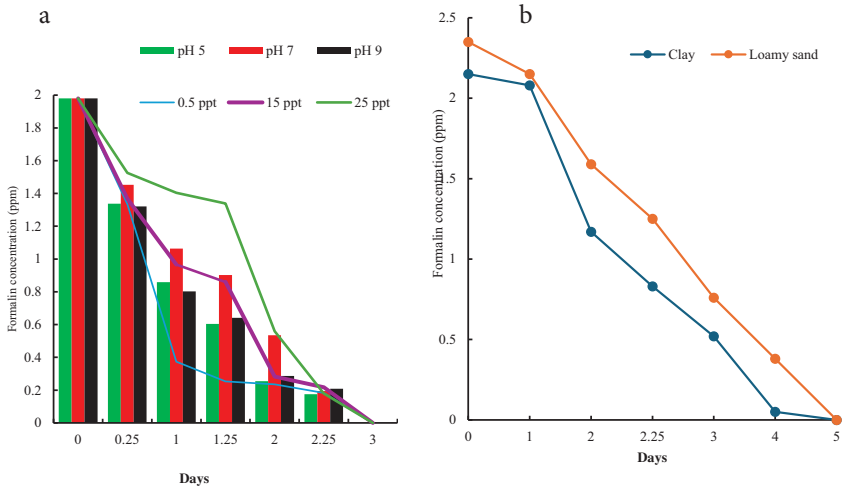


Effect of combination of bacterial isolates on removal of TAN and Nitrite-N

infections on the external surfaces (skin, fin, gills) of fish. The study on the degradation of formalin in water under different salinity and pH showed rapid degradation at low salinity (0.5 ppt) and high pH (9) with a half-life of 0.51 days under sun light with the mean temperature, intensity and photoperiod of about 33.5°C, 57,000 lux and 12 hours 25 min respectively. While comparing the degradation of formalin in different soils, it was rapid in heavy texture soil with the half-life of 1.5 days as compared to loamy sand soil. The degradation kinetics followed first-order reaction in both soil and water.

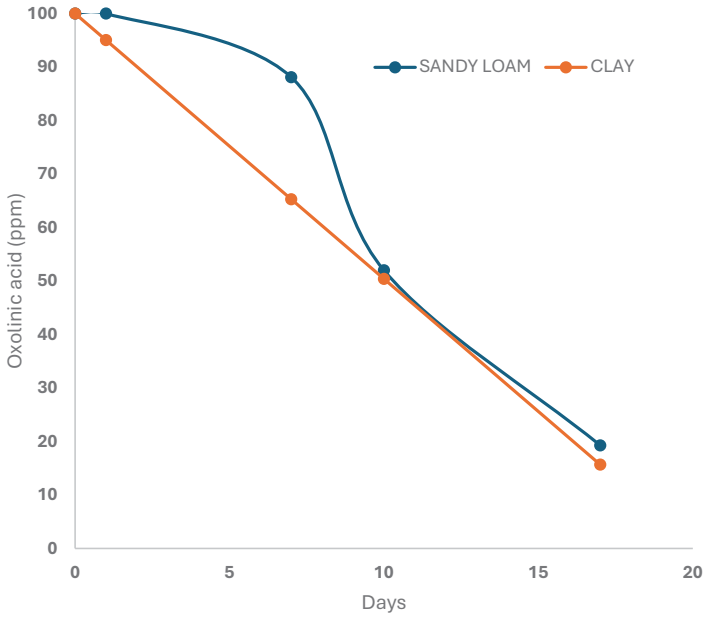
Degradation of oxalinic acid in soil

Oxalinic acid (OXO) is a quinolone antibiotic extensively used in aquaculture to combat bacterial infections. To understand the degradation of oxalinic acid in soil, 100 ppm

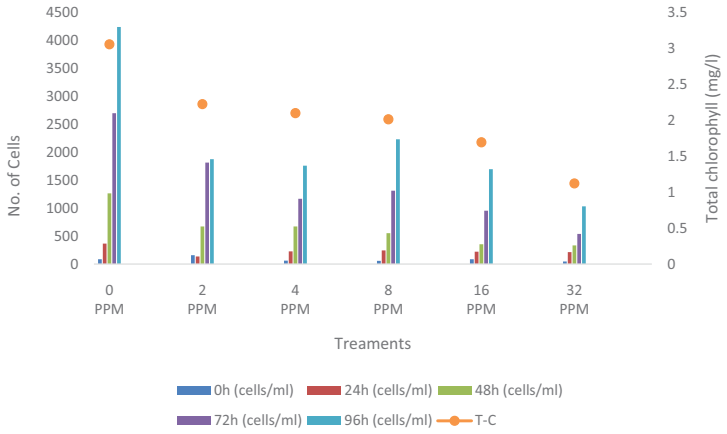


Degradation of formalin under varying (a) water pH, salinity and (b) soil texture

was spiked in sandy loam and clay soils and field capacity was maintained throughout the experiment. During the experiment, the temperature and light intensity varied from 30 to 36 °C and 3,156 to 121,300 lux (mean 36,973 lux). The photoperiod averaged 12 hours and 13 minutes. Oxalinic acid was estimated at periodic intervals using Liquid Chromatography Mass Spectrometry (LC-MS/MS). The data was incorporated into a kinetics model and further analysis was conducted using Computer Assisted Kinetic Evaluation (CAKE) software. Heavy texture clay soil exhibited slightly faster degradation rate with a half-life of 8.62 days compared to loamy sand at 10.3 days, attributed to higher organic matter content and more active molecular interactions present in clay. The results align best with first-order kinetics.



Oxolinic acid degradation in soil under sunlight



Growth inhibition of *Chlorella marina* cells and total chlorophyll content

Toxicity and environmental safety of florfenicol in copepod and algae

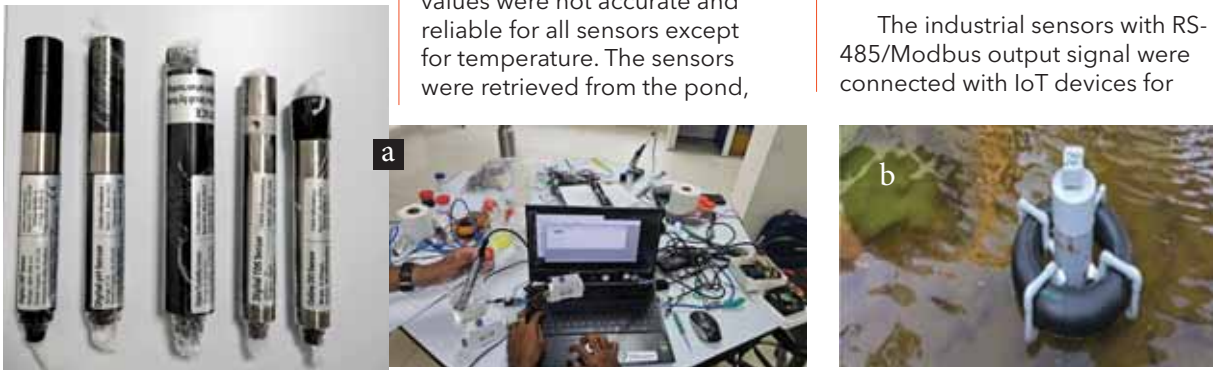
Florfenicol (FFC) is one of the most widely used antibiotics in aquaculture. To determine the residual concentration of FFC in the tropical aquatic environment and its impact on non-target organisms, FFC at doses of 0, 2, 4, 8, 16, and 32 ppm on the growth, chlorophyll content, photosynthetic pigmentation, antioxidant capacity, ingestion, and metabolism of copepods, *Apocyclops* sp., and marine alga, *Chlorella marina* were investigated. After 96 hours of exposure to FFC (2–32 ppm), the chlorophyll content decreased in tandem with a growth retardation of *C. marina*. The levels of reactive oxygen species, superoxide dismutase and glutathione increased up to 16 ppm and then sharply decreased at 32 ppm. At 32 ppm FFC, there was a noticeable decrease in the activity of malondialdehyde and catalase. The findings showed that acute exposure (96 hours) at 4–16 ppm was safe, and the suggested dosage of 10–15 mg/kg fish body weight is recommended in aquaculture without harming the environment.

Modified water buoy with industrial sensors for measurement of water parameters

The developed prototype water buoy embedded with low-cost commercial sensors for the continuous measurement of pH, temperature, dissolved oxygen (DO) and turbidity was ineffective as the measured values were not accurate and reliable for all sensors except for temperature. The sensors were retrieved from the pond, recalibrated, and retested under laboratory conditions. Despite multiple recalibration attempts, the problem persisted. This inconsistency in performance may be due to the clogging of sensors in high-turbidity pond waters or the adverse effects of elevated salinity levels. To address this issue, specifically designed industrial sensors with titanium housing material, more expensive than the previously purchased ones, and capable of functioning in highly turbid conditions were procured for continuous online monitoring. These sensors were calibrated as per the standard methods, and embedded on a PCB board in a modified aqua buoy and are currently under assessment for their performance and reliability.

IoT modules for real time monitoring of water parameters

The industrial sensors with RS-485/Modbus output signal were connected with IoT devices for

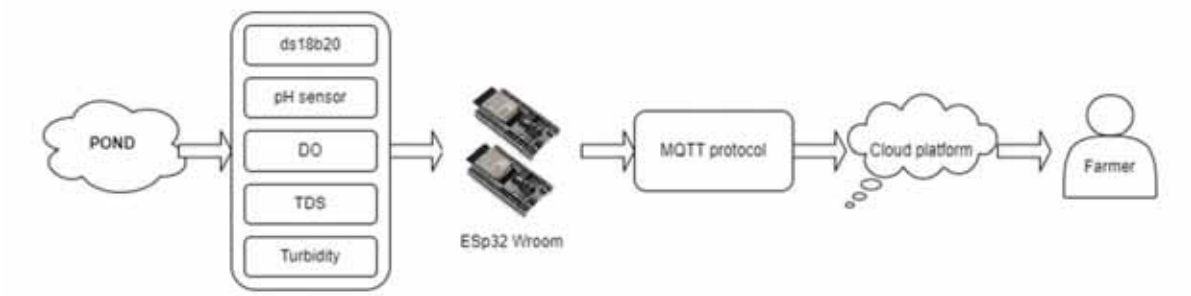


(a) Industrial grade sensors and their calibration (b) Modified aquabuoy with pH, DO and redox sensors

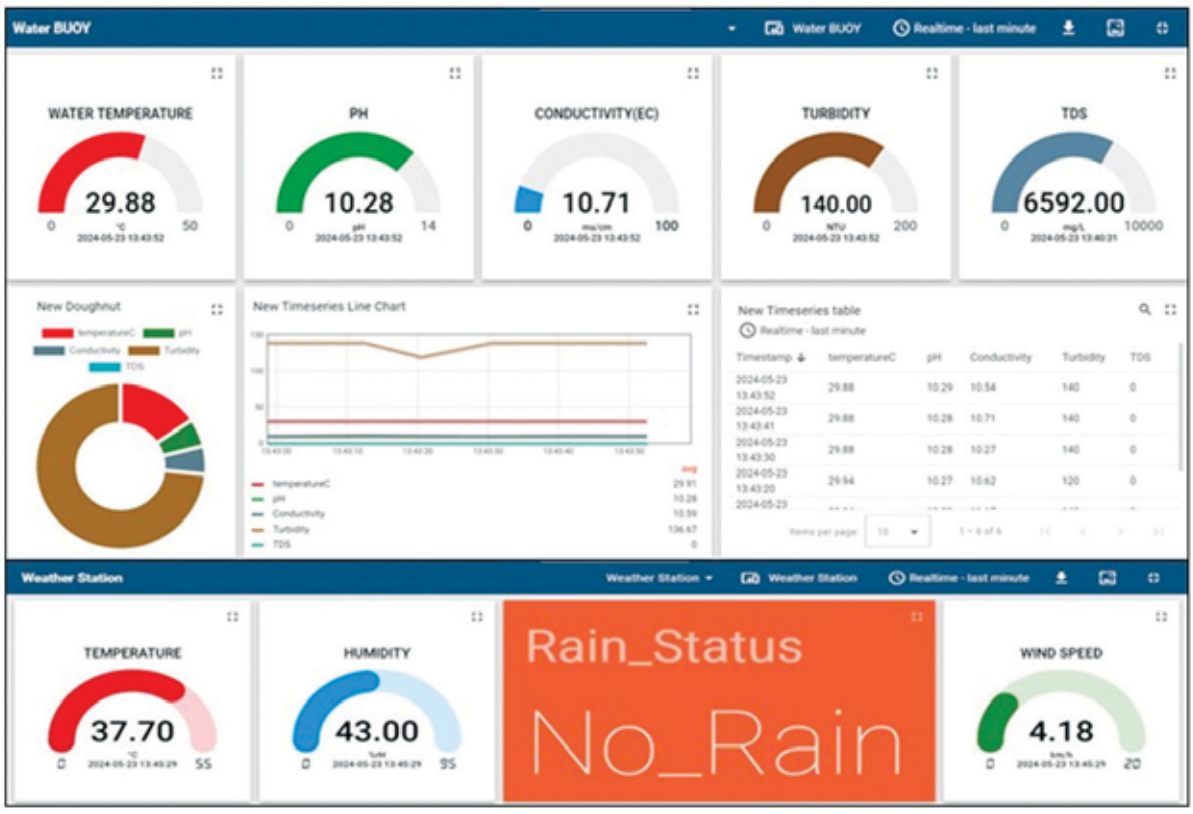
continuous monitoring of water parameters and alerts to shrimp aquaculture farmers. Devices and architecture were created to download the data in csv format file from water buoy and stored in public Ip server through MQTT approach. The collected raw data is calibrated in the server to improve the efficiency of the system. The big data can be subjected later for data analysis and data prediction processing. Mobile phone based advisory system was developed for location specific and personalized advisories to farmers. The dashboard application was designed to access the live water and weather parameters. Real-time based android application was developed to deliver alerts to the farmers.

AquaSense- IoT based aquaculture pond health management system

The AquaSense water quality monitoring system developed in association with



Modified water buoy working module



Android-based live dashboard to access the water and weather parameters

AquaSense water quality monitoring system

Sairam Engineering College, Chennai monitors the water quality parameters viz. pH, DO, salinity and temperature instantaneously and continuously at various locations in the pond and transfers the data via IoT to be displayed in the specifically developed mobile app, which helps the aqua farmers to take remedial action immediately to protect the culture and prevent economic losses. Rigorous testing and validation were done by comparing the results to standard methods to ensure the system's accuracy, reliability, and effectiveness.

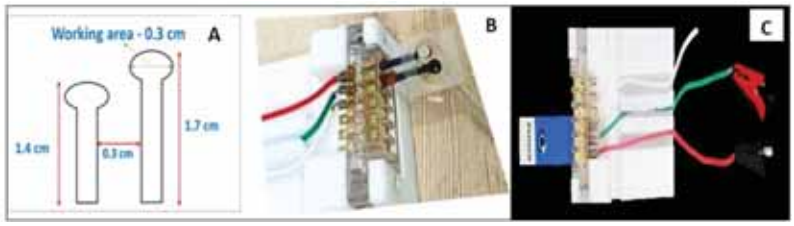
Development of graphene-based screen-printed indigenous pH sensor

Due to the inaccuracy, non-reliability, and cost of the commercial sensors, it is proposed to develop indigenous sensors to measure critical water parameters. The pH sensor model for the two-electrode system was created using CorelDRAW software and stencils for electrode printing were engraved from flexible polyethylene terephthalate (PET) sheets with a GRAPHTEC 2D flatbed cutting plotter. The printed electrodes were connected to PalmSens via an adaptor. The conductive graphene ink was applied to both the working and reference electrodes on PET substrate and then annealed at 60°C for 16 hours. Experiments were conducted in different volumes of pH solution at 5-12 pH range to check the reproducibility of the sensor. Each experiment was conducted multiple times with durations ranging from 20 to 1000 seconds and 60 seconds was optimized to achieve a stable potential range. The potential difference between Graphene-based electrode and reference electrode showed nonlinearity against time for various pH measurements.

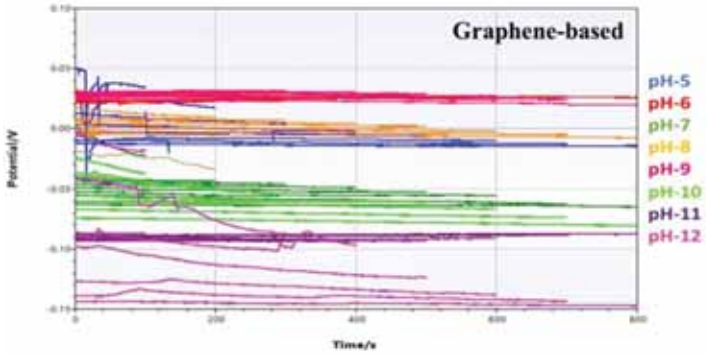
Development of indigenous pH sensors by polyaniline-based materials

Alternate approaches to indigenous pH sensor development using polyaniline-based materials were explored as the Graphene-based screen-printed electrodes showed nonlinearity in potential against time at various pH levels. The polyaniline (PANI) powder was synthesised in the laboratory by the oxidative polymerization method. 5 mg of PANI powder was dissolved in an organic solvent, dimethyl formamide (DMF). PANI ink was dispersed in an organic solvent, N-methyl-2-

pyrrolidone (NMP). The dissolved PANI powder and dispersed PANI ink were drop-cast on the commercial carbon screen-printed electrodes and dried for 120 minutes at room temperature. Both PANI powder and ink were employed as pH-sensing materials on the commercial screen-printed electrodes. Experiments conducted for calibration of the sensors in small (50 uL) and large (5 mL) volumes of pH solution at 5-12 pH range showed the linear potential range against time plots. The PANI-based pH sensors demonstrated better linearity compared to the graphene-based sensor.



(a) Electrode size and dimensions via screen printing approach, (b) Printed electrodes were connected to PalmSens via an adaptor (c)Calibration of pH sensor strip



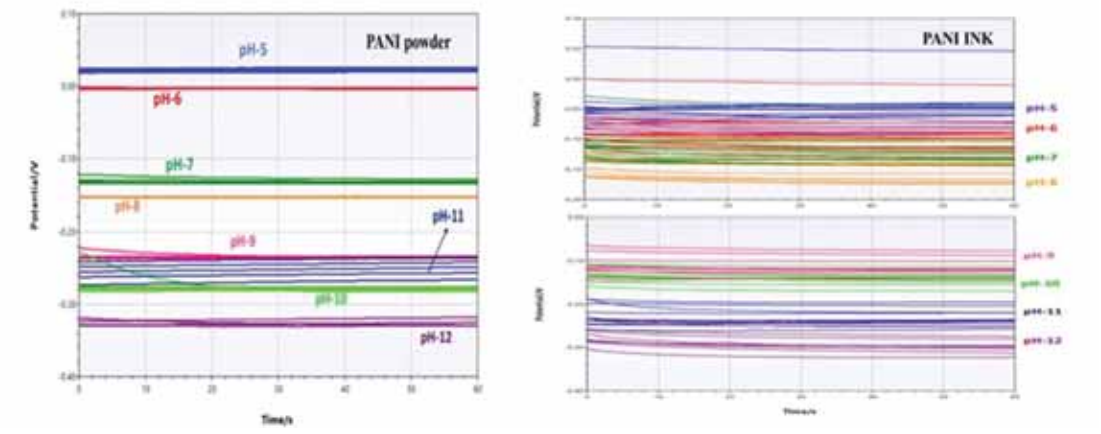
Potential against time graph for various pH measurements with graphene-based sensor

Risk assessment of brackishwater aquaculture to climate change

Coastal districts (n=51) primarily engaged in brackishwater aquaculture were assessed for their risk to climate change as per AR5 of IPCC. Based on the selected indicators districts were categorised: 3, 9, 23,14 and 2 districts under very high (VH), high, medium, low, and very low (VL) respectively for exposure; 3, 17, 15, 12 and 4 under VH, high, medium, low, and VL respectively for vulnerability; 2, 15, 17, 14 and 2 under VH, high, medium, low, and VL respectively for historical hazard; and for future hazard, 36 districts showed more unfavorable conditions, 9 moderately unfavourable, and 6 with no hazards. Risk was calculated using weighted indices of exposure (20%), vulnerability (40%), historical hazard (20%), and future hazard (20%). Overall, 2, 13, 20, 15 and 1 districts were under VH, high, medium, low, and VL risk respectively. The districts on the East Coast were at higher risk than the West Coast.

Systematic literature review on climatic risks and adaptations in culture fisheries

To identify key indicators of climatic risks and impacts and to document adaptation strategies in brackish and freshwater aquaculture across Southeast Asian countries, a comprehensive systematic literature review (SLR) was carried out. This review relied on a search string that included the terms climate, geography, and adaptations in the Web of Science and Scopus databases. After eliminating duplicate entries, 11,723 articles remained, and by applying subsequent filters, 65 and 37 research articles focused on shrimp and major Indian carp, respectively were identified. The most commonly recognised hazards were changes in rainfall patterns, floods, the number of hot summer days, drought, sea level rise, and cyclones. The impacts of these hazards on



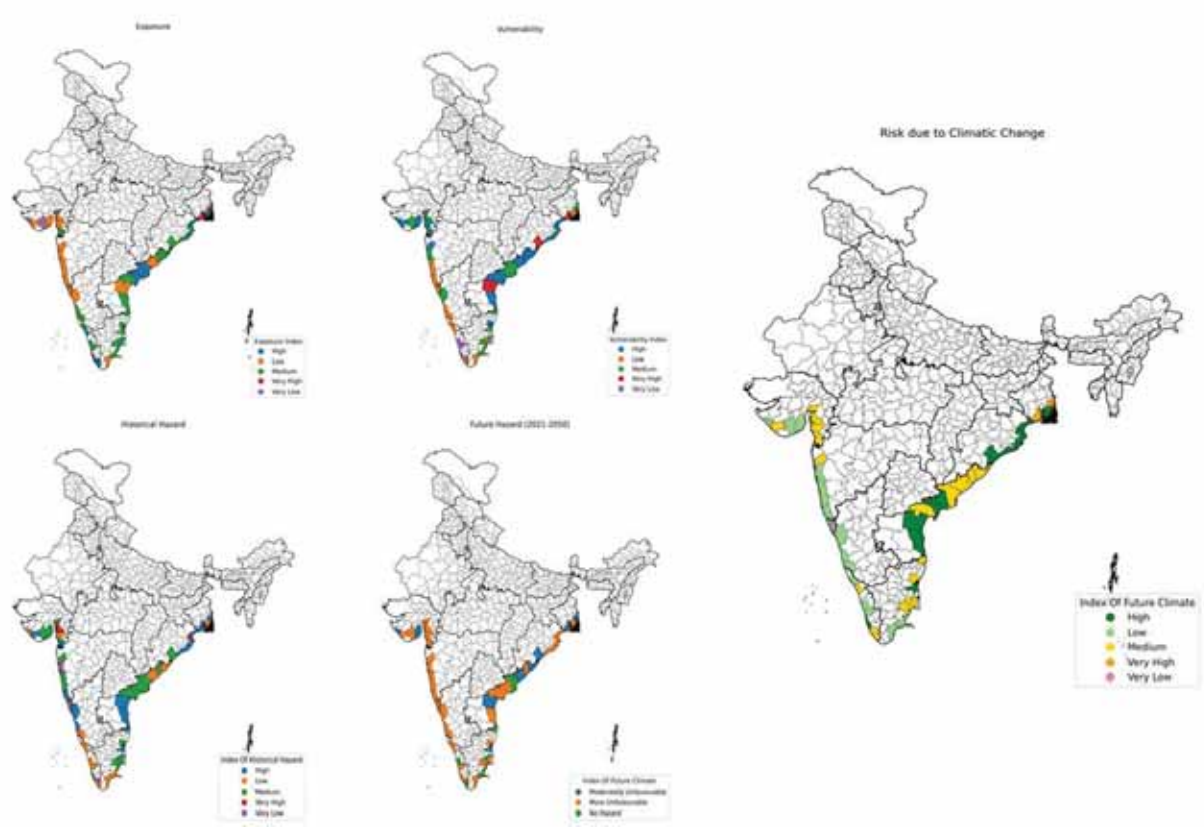
Potential against time for various pH measurements with PANI powder and ink based sensors

water quality, breeding, feeding, growth, disease, infrastructure damage, animal escape, and livelihoods, and adaptation measures related to culture systems (polyculture, IMTA, RAS, biofloc, aquaponics, and aqua-silviculture), selective breeding and species diversification, ponds upgradation, and water quality improvement were documented.

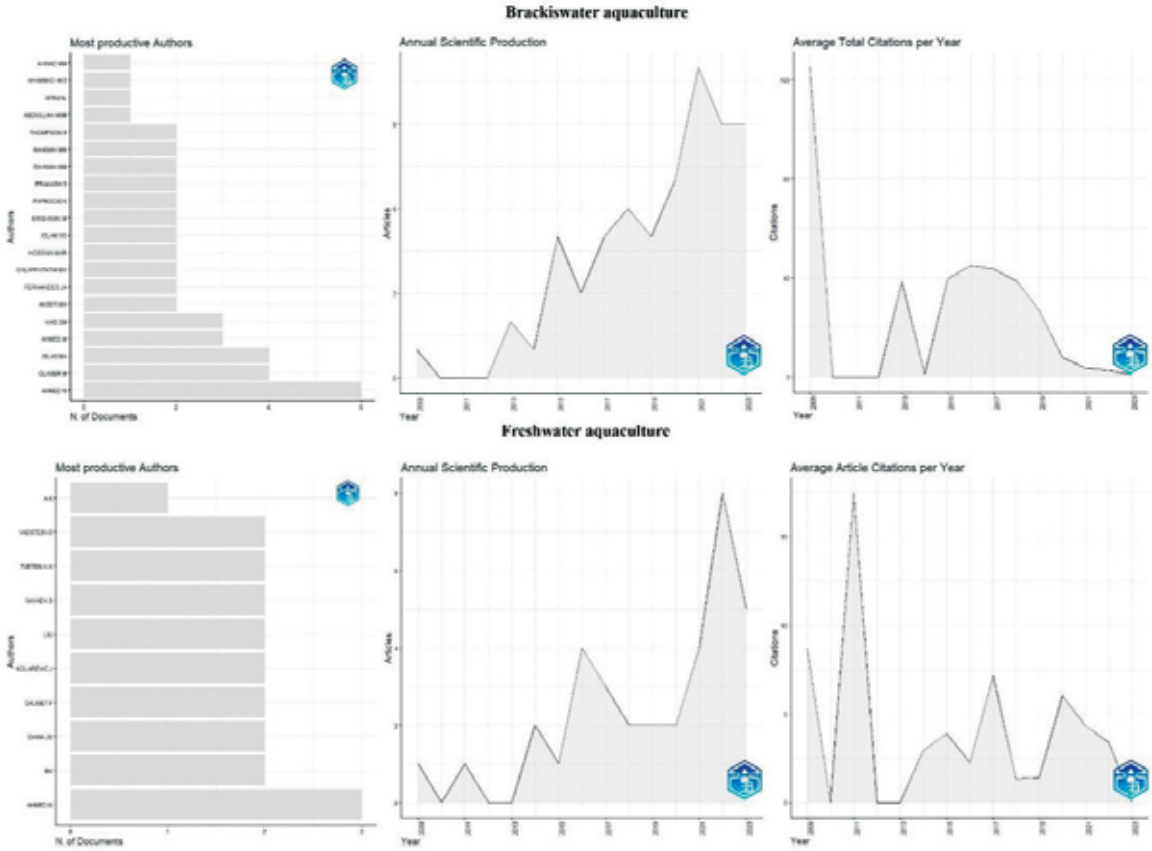
Growth characteristics of *Penaeus monodon* during periods of heat wave and extreme rainfall

as compared to normal summer and monsoon

The frequency of climate change-induced heatwave conditions and extremely heavy rainfall periods is increasing. Growth data of *P.monodon* from commercial farms in south Gujarat during periods of heatwave and normal summer (n=38), and extremely heavy rainfall and normal monsoon (n=42) indicated significantly ($p<0.05$) lower average daily growth rate (ADG: g/day) and weekly growth rate (WGR: g/week) during heatwave (0.34 g/day; 2.45g/week) compared to normal summer (0.43 g/day; 3.08 g/week) and a reduction in ADG and WGR during periods of heavy rainfall (0.32 g/day, 2.29 g/week) compared to normal monsoon (0.38 g/day and 2.72 g/week). The average air and pond water temperatures during heatwave (41.5±0.27°C and 34.6±0.13°C) were significantly higher ($p<0.05$) than normal summer (35.8±1.31°C; 32.8±0.13°C). The mean daily rainfall during extremely heavy rainfall and normal rainfall was 161.0±12.9 cm and 26.4±3.7 cm respectively. The impact of these extreme weather events on shrimp growth needs to be studied in detail.



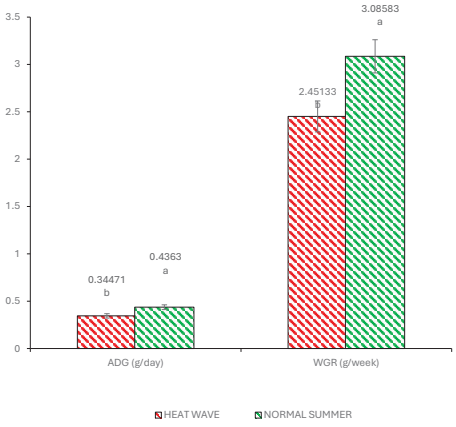
Districts under different categories for exposure, vulnerability, historical hazard, future hazard and overall risk



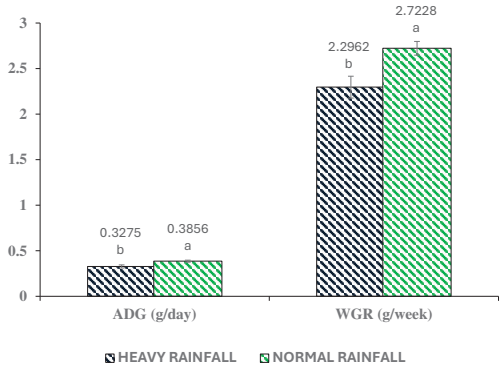
Bibliometric analysis for brackishwater and freshwater aquaculture

Impact of cyclone-induced extremely heavy rainfall and flood on shrimp aquaculture

The impacts of extremely heavy rainfall and subsequent floods on water quality and immune parameters were studied in shrimp farming areas of Gudur, Andhra Pradesh which were affected by the MICHAUNG severe cyclonic storm between 1st to 6th December 2023. The wind speed of 90-100 kmph damaged the infrastructure and pond bunds followed by 215 cm of rainfall within 24 hours led to the inundation of ponds amounting to a huge loss to the shrimp aquaculture sector. Heavy rainfall caused significant disruptions, particularly affecting the water quality parameters due to the influx of freshwater from the rainfall. Pond waters showed a decreasing trend in physiochemical parameters and minerals concentration during flood compared to pre (1-week before flood), and post flood (2 weeks after flood). *P.monodon*



ADG and WGR of *P. monodon* during heat wave conditions and normal summer in commercial shrimp farms (n=38)

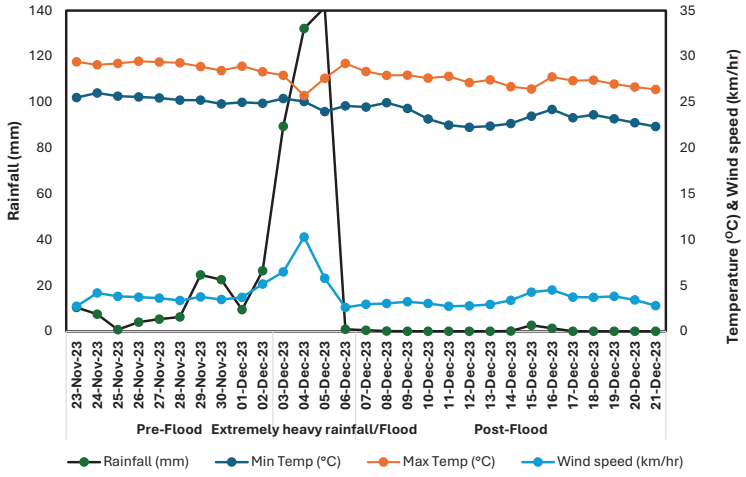


ADG & WGR of *P. monodon* during periods of extremely heavy rainfall and normal rainfall in commercial shrimp farms (n=42)

were under stress as evidenced by the values of immune parameters, phenoloxidase and superoxide dismutase during the flood compared to pre and post-flood.

Impact of rainfall pattern variability on changes immune parameters and incidence of white spot disease in *Penaeus monodon*

To understand the impact of heavy rainfall and its variability pattern on the changes in water quality, immune parameters and incidence of WSSV in *P. monodon*, three experiments were conducted using artificial rainwater and showers, and regulated the flow with water flow gauges (Expt-1: 0, 50, 100, 150, 200 and 250 mm in one day; Expt-2: 0, 100, 150, 200, 300, and 400 mm in three days; Expt-3: 0, 100, 150, 200, 300 and 400 mm in one week). After one day of each experiment, the animals were challenged with WSSV by oral administration, and the shrimp mortality was monitored on every day. Animals were under stress as evidenced by changes in immune parameters (phenol oxidise and superoxide dismutase) . Gradual mortality of shrimp in the treatments in less days compared to control indicated that the impact of heavy rainfall stress within a short span accelerated the shrimp mortality due to WSSV.

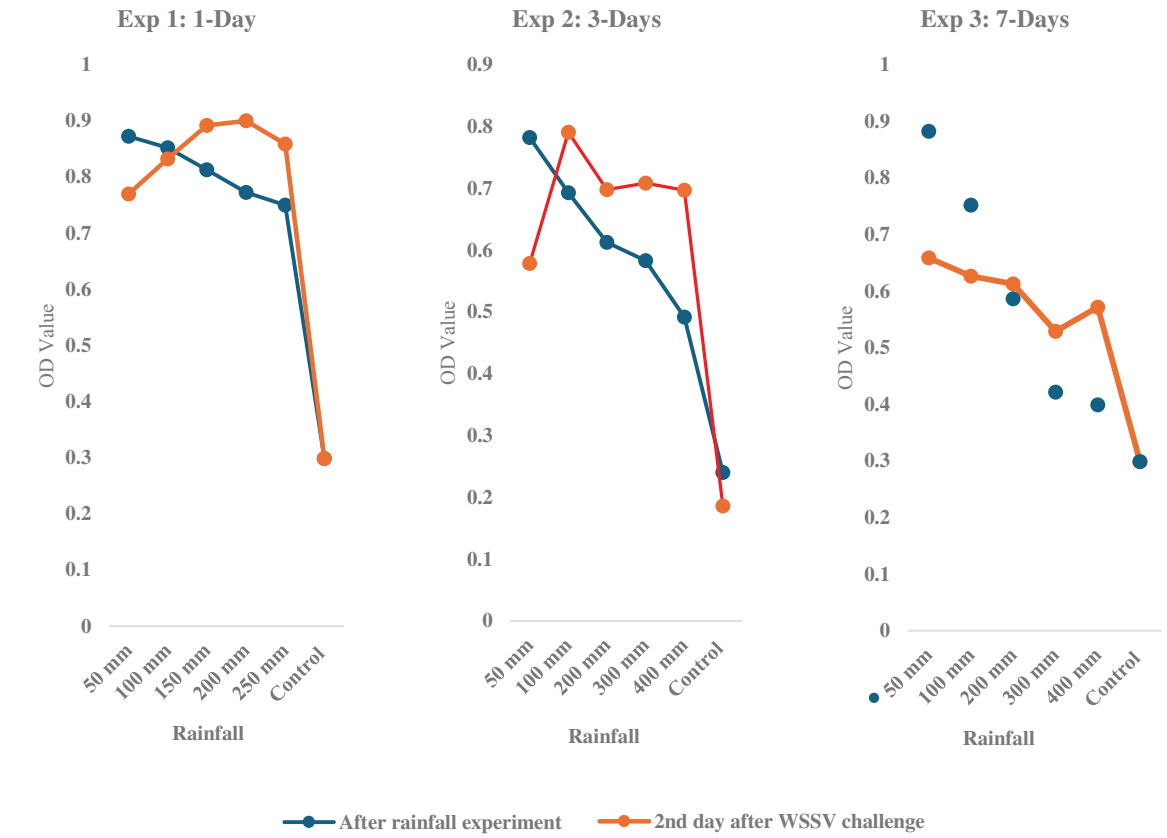


Changes in weather parameters during pre-flood, flood and post-flood in shrimp farming areas of Gudur, Andhra Pradesh

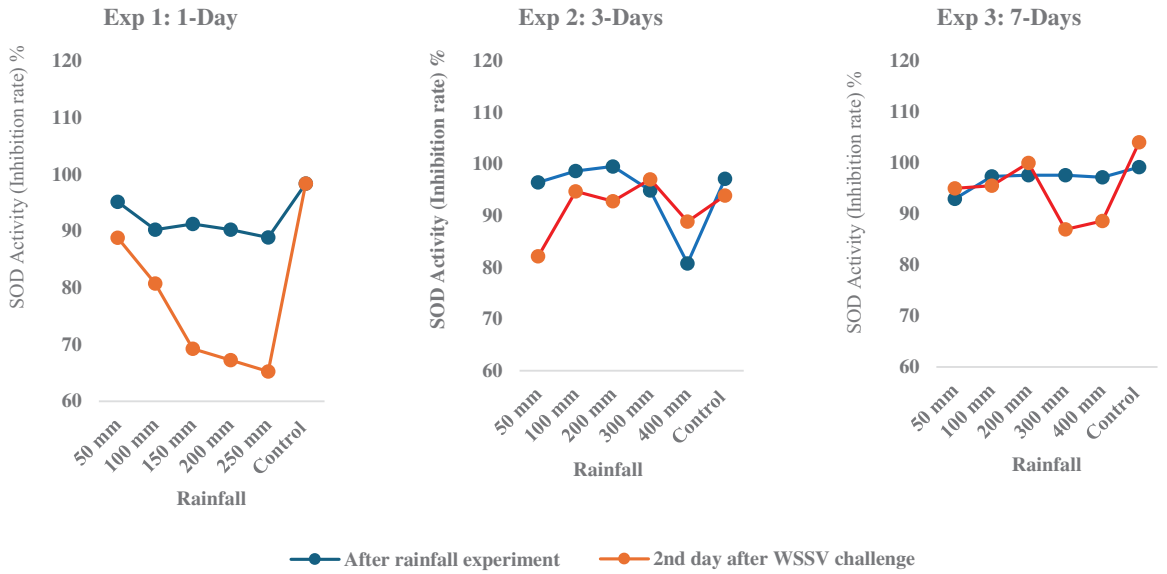
Enhanced breeding and seed production of Pearlspot (*Etroplus suratensis*) in temperature controlled indoor RAS system

In normal tank-based system poor spawning of Pearlspot was

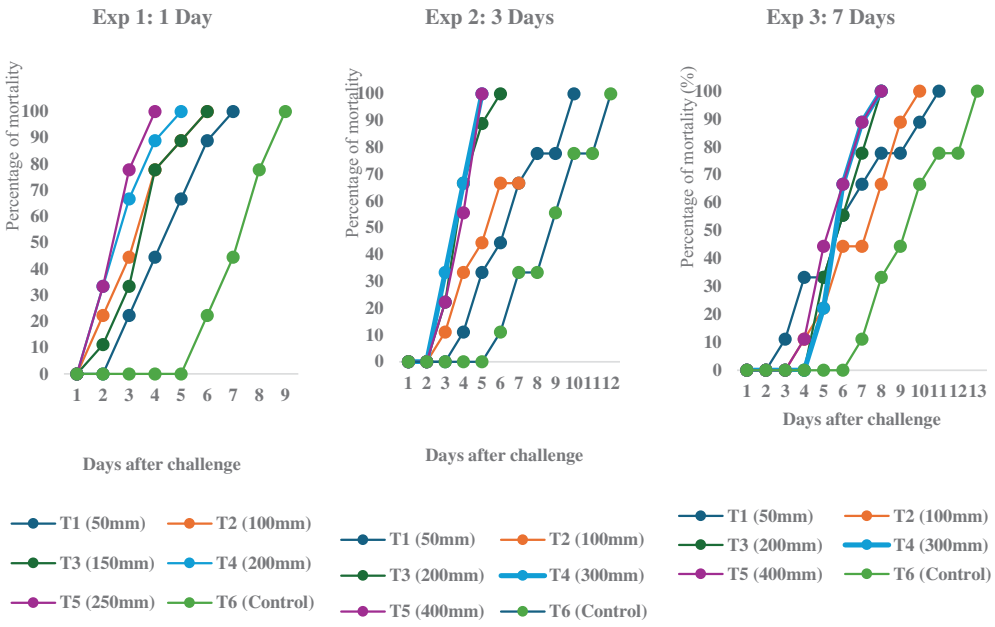
Inundation of shrimp culture ponds due to extremely heavy rainfall and flood



Changes in phenol oxidase activity in *P. monodon* after exposure to rainfall and challenge with WSSV



Changes in phenol oxidase activity in *P. monodon* after exposure to rainfall and challenge with WSSV

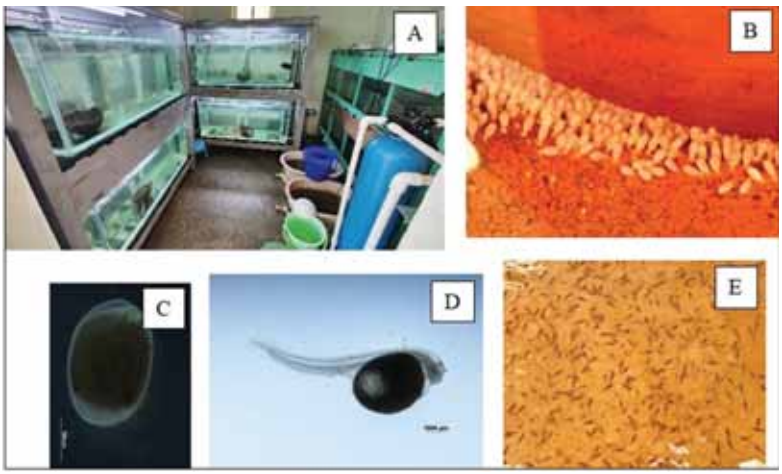


Mortality of *P. monodon* after exposure to rainfall variations and challenge with WSSV

noticed during November to January as the water temperature goes down as low as 25 °C. To overcome this issue a study was attempted to enhance the breeding and seed production of pearlspot in prototype temperature-controlled indoor RAS system with photo-thermal (14 L:10 D) control facility. In each tank eight brooders were stocked in equal sex ratio (150-220 g females, 78-140 g males) and water temperature of 32-33 °C was continuously maintained. In control with fishes in hapas in a pond (25-27 °C) with photo-period of 12 L:12 D, no spawning was observed. Thirty-six spawning were observed in four tanks @ three spawning/tank/month with average fecundity of 2500 eggs and average hatching of 82%. Larval rearing tanks were also maintained at the same temperature (32-33 °C). This environment controlled facility can help to achieve tank based year-round seed production of pearlspot.

Milkfish a promising climate resilient species for brackishwater aquaculture

Milkfish is one of the most promising climate-resilient species for aquaculture. The first trial of Milkfish farming was conducted in the earthen pond during pre-monsoon; monsoon and post monsoon periods where salinity fluctuated between 0 ppt to 32 ppt as a result of rainfall variation from 0 to 84 mm followed by flooding, and varying air temperatures. In the second trial, milkfish fingerlings (ABW: 17 g, tl. 11.7 cm) were stocked in higher density (3 no./m^2) in lined ponds and reared for one year to produce stunted yearlings (120.75 g, 23.56 cm tl), which were used in the second year to harness compensatory growth. Daily weight gain (2.33 g/day), SGR (1.5), and harvested biomass (5.5 tons/ha) of stunted yearlings were higher than non-stunted



Controlled seed production of pearlspot (*Etroplus surstensis*). A. Temeperature controlled RAS breeding facility. B. Attached eggs on substrate. C. Developing embryo (50 hpf). D. Newly hatched larvae (< 72 hpf). E. 35 dph early fry.

fingerlings (1.43 g/day, 1.34 & 4.78 tons/ha) . Milkfish can be a suitable climate-resilient species in coastal and inland areas with higher growth rate, temperature and salinity tolerance.

Effect of microbial mediated solid-state fermented plant protein sources for abiotic temperature stress tolerance in *P. vannamei*

Water temperature is a major abiotic stressor as it affects several physiological processes. It is hypothesized that dietary manipulation through *Bacillus* and *Saccharomyces* mediated solid-state fermented plant protein sources can ameliorate temperature stress to a certain extent. P.vannamei juveniles (6.5±0.4 g) were reared for 42 days in temperature-controlled glass tanks with RAS facility at two temperatures 28°C (Control) and 32°C (High) and fed with four iso-nitrogenous diets containing varying levels of fermented ingredients viz., control (Feed-1), unfermented plant protein mix (PPM) (Feed-2), fermented plant protein mix (FPPM) 7.5% (Feed-3), and FPPM 10% (Feed-4). Shrimp gut metagenomics results indicated that in control, phyla Proteobacteria dominated, but at 32°C Fimuculates were higher. The optimum proportion of Proteobacteria: Fimiculates in shrimp fed with Feed 3 at 32°C would have resulted in better amelioration of the temperature stress by supplementing the functional nutrients, and evidenced by better survival and higher weight gain.

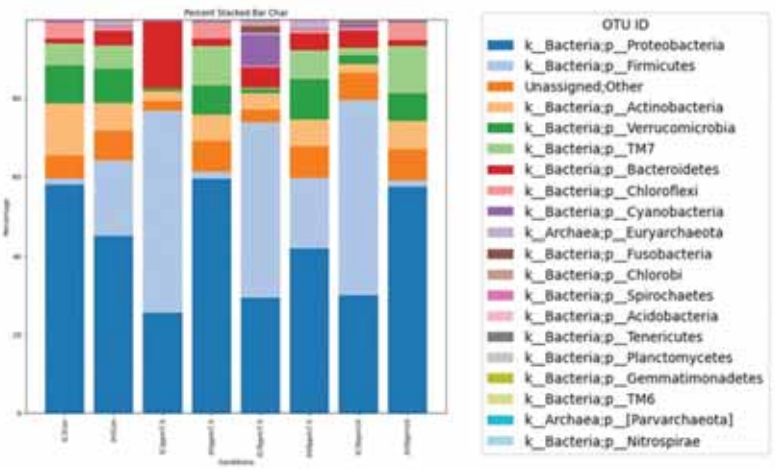
Efficiency of enriched methanotrophic communities from brackishwater systems in mitigating methane at different salinities

The strategies for the mitigation of methane are achieved by the methane-oxidizing bacteria, which aid in reducing the effects of global warming due to methane gas. The enriched methanotrophic bacteria were isolated and characterized from sediment samples (n=29) collected from brackishwater systems viz., shrimp culture ponds (n=16), crab culture ponds (n=3), bar mouth (n=3),

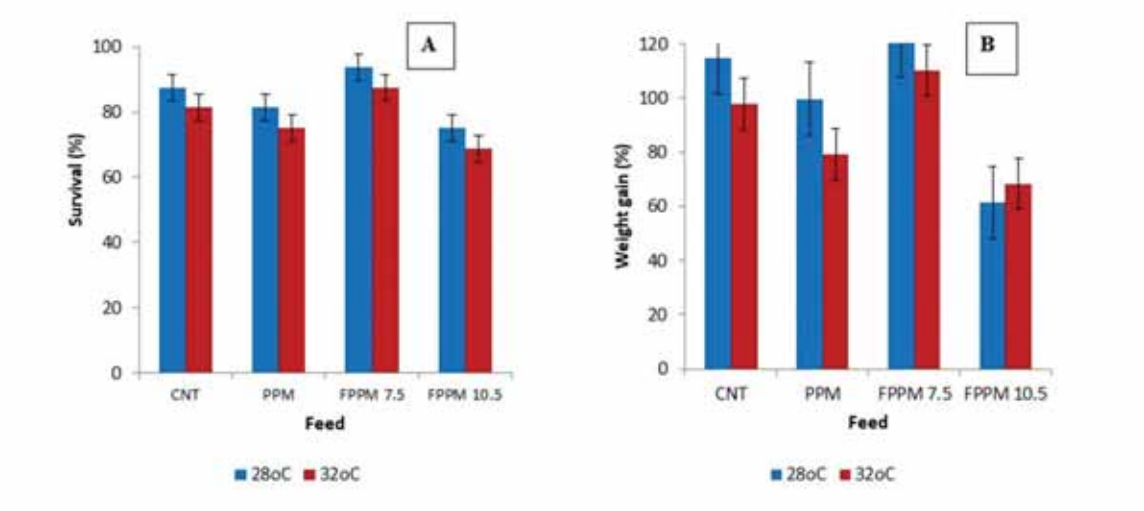
Weather and water parameters variation during Milkfish farming

Parameter	Pre-monsoon (July - Sept)	Monsoon (Oct to Dec)	Post-monsoon (Jan-Feb)
Min temp. (°C)	23.81 - 27.41 (25.36±0.74)	18.83 - 26.41 (24.21±1.67)	19.48 - 23.55 (21.80±0.96)
Max temp. (°C)	27.81 - 35.19 (31.92±1.59)	25.24 - 32.15 (28.51±1.36)	26.36 - 32.68 (28.76±1.34)
Rainfall (mm)	0 - 33.34 (5.01±6.02)	0 - 84.05 (11.78±18.61)	0 - 8.69 (0.55±1.59)
Wind speed (km/hr)	1.45- 5.02 (2.98±0.69)	1.04- 6.88 (2.85±1.24)	1.32- 4.73 (2.63±0.71)
Water salinity (ppt)	30 - 32 (27±0.69)	0 - 20 (14±1.5)	20 -32 (24±2.51)

Milkfish harvest from non-stunted and stunted fingerlings



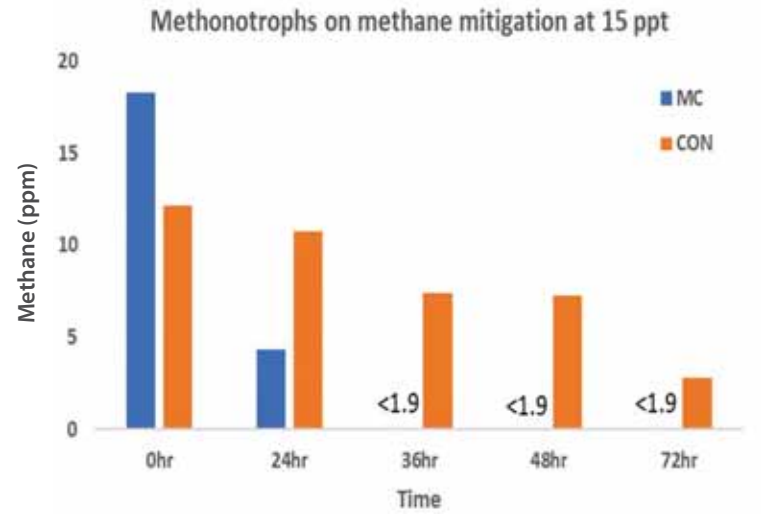
Effect of microbial-mediated solid-state fermented plant protein sources on gut metagenomics in *P. vannamei* reared at different water temperatures

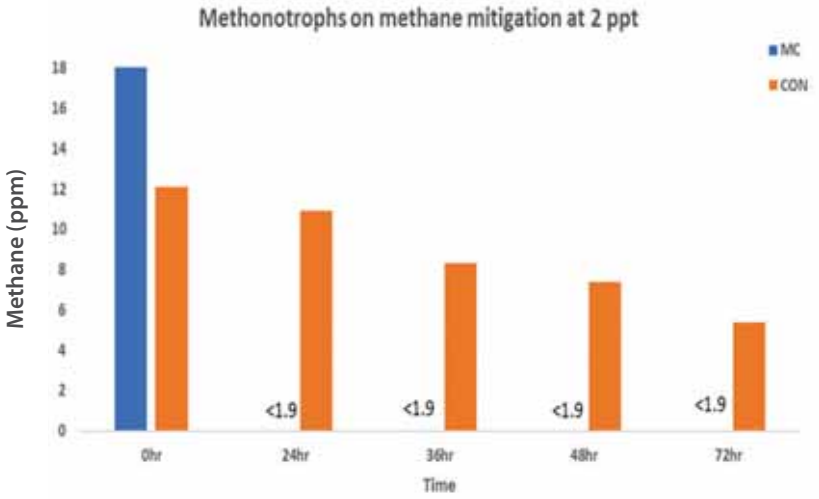


Effect of microbial-mediated solid-state fermented plant protein sources on A. Survival (%) and B. Weight gain (%) in *P.vannamei* reared at different water temperatures

lagoon (n=3) and estuary (n=4) from Tamil Nadu (n=18), Andhra Pradesh (n=7) and West Bengal (n=4). Methanotrophic isolates spread across three genera viz., *Methylobacillus flagellates, Methylophaga thiooxydans,* and *Methyloversatilis discipulorum* were identified and characterised. The methanotrophs consortia were evaluated for mitigation of methane at two salinities 2 and 15 ppt in a microcosm experiment. The methanotrophic microbial consortia showed 76.29% & 89.62% (<1.9ppm) reduction of methane when compared to control with 11.49%& 9.98% reduction after 24 hrs.

Microcosm experimental set up for GHG collection





Efficiency of methanotrophs consortia (MC) in decreasing methane gas at different salinities

06 GENETICS AND BIOTECHNOLOGY


Panasonic

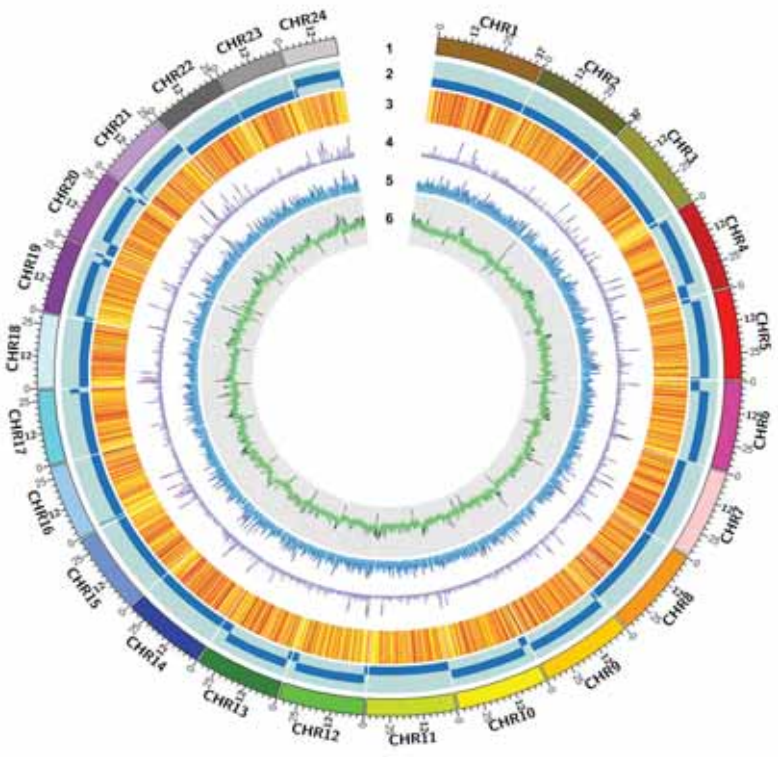
GENETICS AND BIOTECHNOLOGY

Whole genome assembly of gold-lined seabream (*Rhabdosargus sarba*)

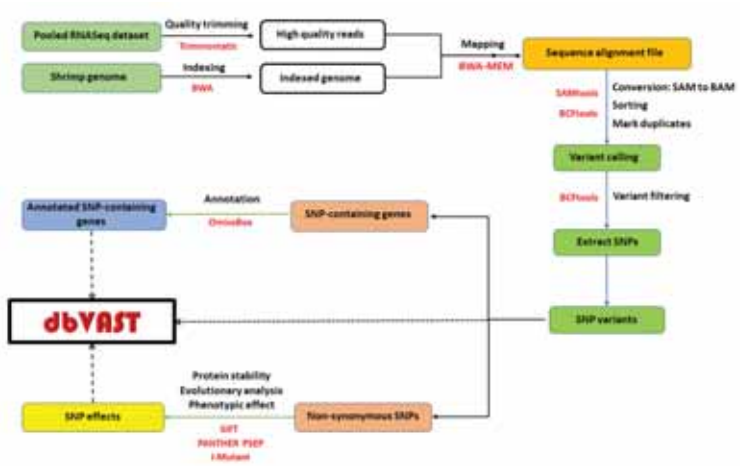
Goldlined seabream, *Rhabdosargus sarba*, is a sparid bream of aquaculture importance. Although, some aspects of the biology of this fish have been studied, there is no published information on the genome structure of this species. The aim of this study was, therefore, to decipher the whole genome of *R. sarba*. This information is an essential prerequisite to undertake any genetic improvement programmes of the species, which will ultimately lead to improved variety of fish with desirable traits. In this study, the genome assembly using PacBio long reads and Arima Hi-C linked reads resulted in a highly contiguous genome of 764.6 Mb length in 31 scaffolds with N50 value of 33.9 Mb. The genetic resources generated will have potential applications in the genomic selection programmes of *R. sarba*.

Chromosome-scale genome assembly for *Siganus javus*

The *Siganus javus* commonly known as java rabbit fish is found throughout the Indo-Pacific region. The java rabbit fish is a candidate brackishwater species where captive breeding is being standardized towards species diversification. Availability of genomic resources would facilitate better understanding of complex biology which ultimately leads to improvement of species. In this regard, the complete genome is generated for *S. javus* using 147 Gb of PacBio Sequel long reads and 495 million pairs of OmniC linked reads. The genome assembly is of 563.9



Goldlined seabream genome and its features (track 1 - 24 chromosomes; track 2: contigs; track 3: protein encoding genes; track 4 – genes supported by isosequencing data; track 5 – genes supported by RNAseq data; track 6 - GC content).



The workflow followed for identification of coding SNP variations in *P. vannamei* and *P. indicus*.

List of non-synonymous SNPs that were predicted as deleterious, having a probably damaging effect on the function of the protein and decrease the stability of the protein.

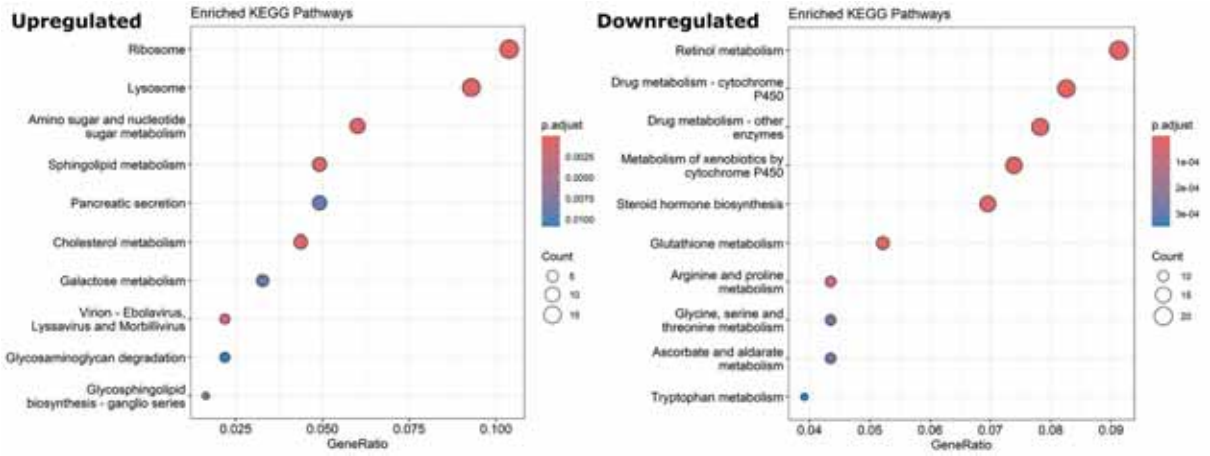
Protein ID	Protein Name	Amino acid substitution
Penaeus vannamei		
XP_027220069.1	venom carboxylesterase-6-like	R234K
XP_027218738.1	muscle M-line assembly protein unc-89-like isoform X1	P345T
XP_027208096.1	uncharacterized protein LOC113801866	V635G
XP_027231251.1	FGGY carbohydrate kinase domain-containing protein-like	R121Q
XP_027233098.1	uncharacterized protein LOC113824555	R240Q
XP_027234409.1	phosphoglycerate kinase-like	V158L
XP_027214706.1	uncharacterized protein LOC113807602 isoform X1	G100C
XP_027231189.1	carboxypeptidase B-like	I181T
XP_027233123.1	actin-related protein 10-like	Y249F
XP_027234052.1	long-chain fatty acid transport protein 4-like	F384C
XP_027232981.1	beta-galactosidase-1-like protein 2	G178R
Penaeus indicus		
Pi_Scaffold_103.11	phosphoenolpyruvate carboxykinase [GTP]	S174A
Pi_Scaffold_2.656	adenosine deaminase 2 isoform X1	V48M
Pi_Scaffold_265.8	peroxisomal biogenesis factor 19 isoform X1	L211F
Pi_Scaffold_36.73	pre-rRNA-processing protein TSR1 homolog	P615S
Pi_Scaffold_486.3	cytochrome P450 9e2-like	Y64H
Pi_Scaffold_6628.1	alpha-crystallin A chain	D62N

Mb length in 210 scaffolds with N50 length of 23.94 Mb. The genome is predicted to contain 16.63 % repeat elements and was assessed to be 96.6 % complete. About 98.62% of the assembly length is accounted in 24 scaffolds indicating the chromosome-scale nature of the genome assembly. The genome assembly would help in deciphering the phylogenetic relations and implementation of genetic improvement programs.

Deleterious cSNP variations in shrimp

Non-synonymous coding Single Nucleotide Polymorphism (SNP) variations can affect the function of the coded protein. Utilizing the publicly available RNA sequence datasets, we have documented the coding SNP variations in *Penaeus indicus* and *Penaeus vannamei* and studied their significance.

The study documented 7,511 and 2,571 non-synonymous SNP variations in *P. vannamei* and *P. indicus*, respectively. Based on the functional significance assessed using bioinformatics tools, there were 11 non-synonymous SNP variations in *P. vannamei* that were predicted as deleterious, predicted to have a probable damaging effect on protein function and predicted to decrease the stability of the coded protein. Similarly, for *P. indicus* there were 6 non-synonymous SNP variations that were predicted to have a deleterious effect and predicted to decrease protein stability. The documented deleterious SNPs have significance in breeding programs where they help to screen out the animals harboring deleterious SNPs.



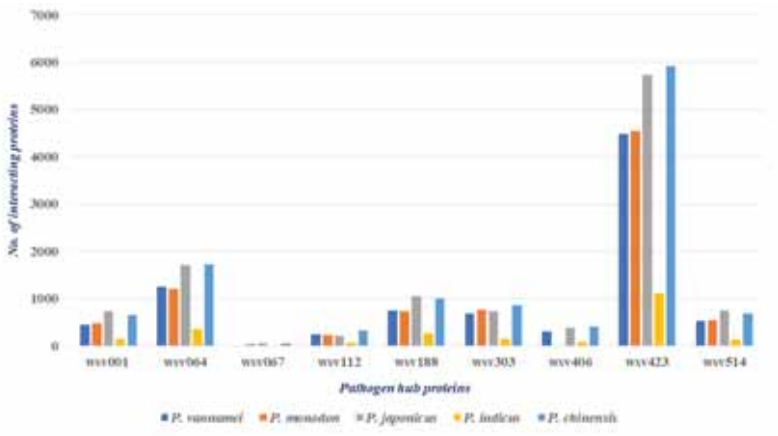
Enriched pathways in high-saline and high-lipid group (45 ppt, 7.7% lipid) against control conditions (28 ppt - 5.3 % lipid).

Metabolic changes in *P. indicus* under salinity stress and varying lipid levels in diet

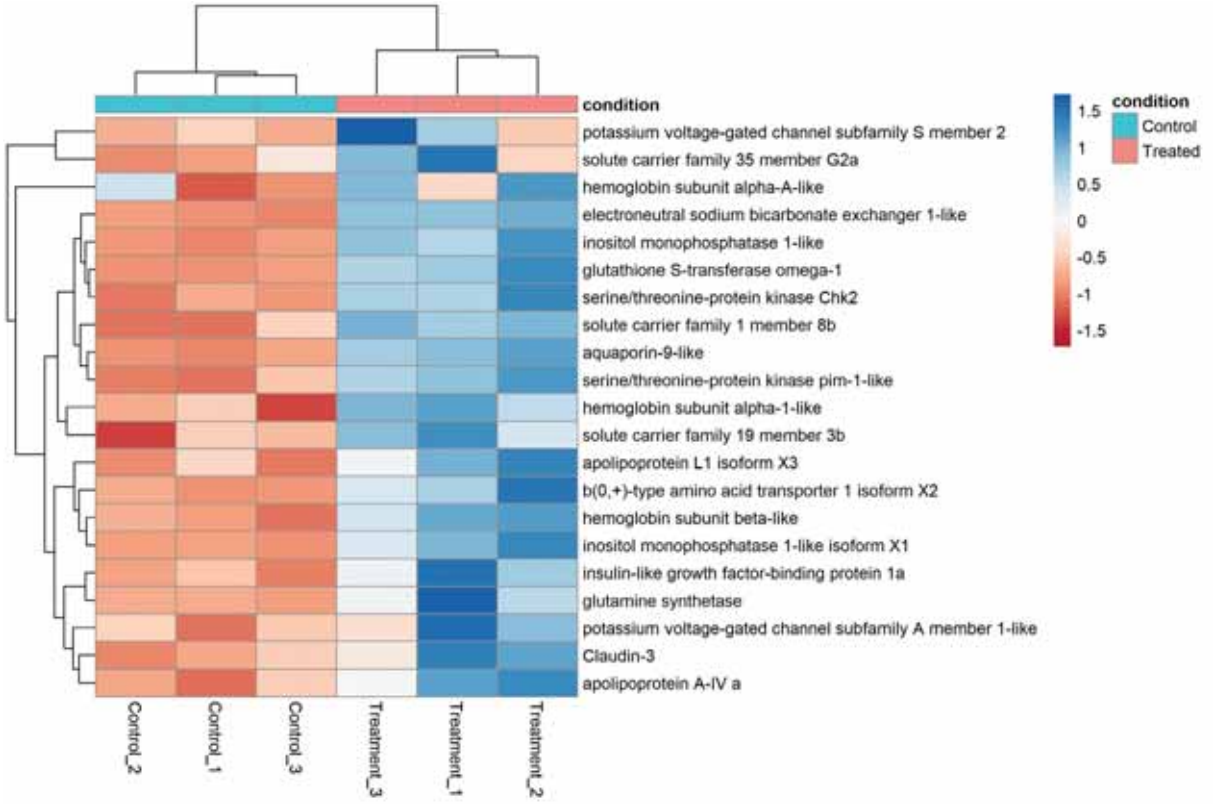
Molecular responses in *Penaeus indicus* under varying dietary lipid levels (5.3% and 7.7%) and salinity conditions (5 ppt, 28 ppt, and 45 ppt) were studied to understand the role of nutrition in stress resilience. The experiment was conducted in indoor flowthrough system for three weeks. Hepatopancreas tissue samples were collected from the animals and RNA-seq data was generated. Fastp, STAR and Deseq2 tools were used for quality control, read alignment to the reference and differential expression analysis respectively. Annotation of differential genes indicated association with lipid metabolism, oxidative stress, and energy production across salinity and dietary lipid conditions. Comparison of control salinity group with high and low salinities groups highlighted the stress responses like apoptosis, p53 signaling pathway, phagosome and proximal tubule bicarbonate reclamation. Whereas, comparison of high saline and high lipid diet condition with control salinity and diet, KEGG analyses revealed upregulation of sphingolipid metabolism, cholesterol metabolism and glycosphingolipid biosynthesis and downregulation of glutathione, arginine and proline and tryptophan metabolisms suggesting importance of lipids in high saline conditions and metabolic shift from amino acid metabolism as the amino acids act as organic osmolytes in high salinity stress. Study highlighted the alterations in metabolic responses due to changes in salinity conditions and diet supplementation.

PPI networks significant for WSSV infection in shrimp

The White Spot Syndrome Virus (WSSV) has been a major threat to penaeid shrimp farming. With the availability of genome information for shrimp and WSSV, it is now possible to characterize the host-pathogen protein interactions which will provide molecular insights underlying disease development and host defense response. We have analyzed the proteins of five shrimp species (*P. vannamei, P. indicus, P. monodon, P. japonicus* and *P. chinensis*) and the proteins of WSSV using orthology- and domain-based approaches to identify the host-pathogen protein interactions. Interestingly, a subset of only 14 WSSV proteins are found to be interacting with a wide range of host proteins of which nine of them are identified as hub-proteins with more interactions. The pathogen hub proteins are related to DNA replication and repair which are directly linked to WSSV survival.



The hub proteins of WSSV that are capable of interaction with shrimp proteins.



Important genes that displayed differential expression during salinity stress in gill tissue of Pearlspot fish.

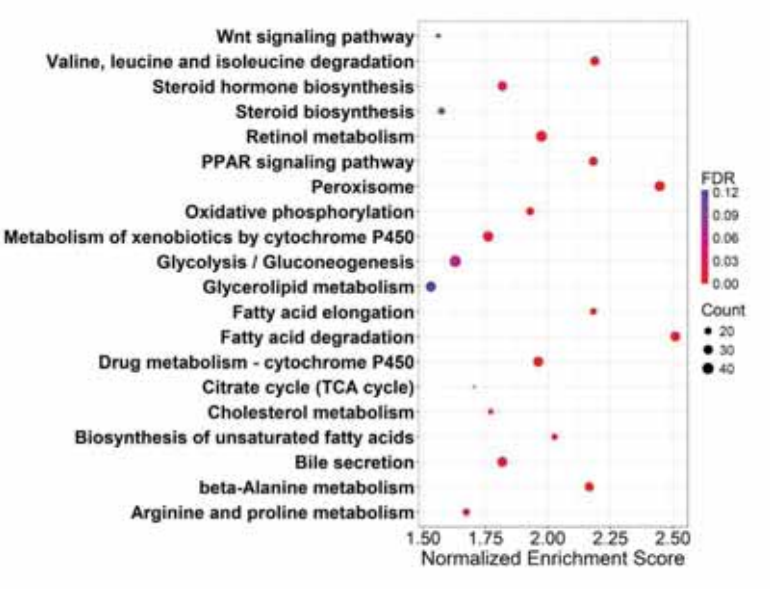
Molecular mechanisms regulating salinity stress in pearlspot fish

The Pearlspot fish, *Etroplus suratensis* is a euryhaline fish that display great adaptation to wide range of salinity. To document the molecular mechanisms that responds when fish is subjected to high-salinity stress, a stress experiment is conducted. Here, fish that were acclimated to 15 ppt salinity are shifted to 35 ppt salinity. Then at 3-, 6- and 12-hour post-stress, fish were sacrificed to generate RNA sequence data of gill tissue. The gene expression profiles indicated that few genes related to salinity acclimatization, energy metabolism and immunity like ion transporters (electroneutral sodium bicarbonate exchanger 1-like, potassium voltage-gated channel family proteins, aquaporin-9-like, and claudin-3) heat shock proteins, glutamine synthetase, inositol monophosphatase 1 and cathepsin K are differentially expressed at 3-hour post-stress. Further, a lncrna with cis-acting regulation on the functioning of inositol monophosphatase 1 gene is also identified as playing important role in osmoregulation of fish during salinity-stress conditions.

Molecular mechanisms linked to pearlspot fish adapted to freshwater

The Pearlspot is an herbivorous fish that displays great adaptation to salinity by surviving and breeding in freshwater to marine habitats. In order to understand the specific molecular mechanisms that are important for adaptation of Pearlspot fish to freshwater, the gene expression profiles (liver, gill and skin tissues) of fish collected from freshwater (Vellayani) and brackishwater (Parvathyputhanar)

habitats were compared. The results indicated that freshwater fish modulates the pathways and processes related to ion transport, energy metabolism, amino acid metabolism, antioxidation, hormonal control, cellular permeability and cytoskeletal remodelling for their adaptation in contrast to brackishwater fish. Further, 28 cis-acting and 13 trans-acting lncrna with specific gene regulation related to adaptation of Pearlspot to freshwater habitat have been documented.



The KEGG pathways that exhibited significant enrichment in liver tissue of fish living in freshwater in contrast to brackishwater.

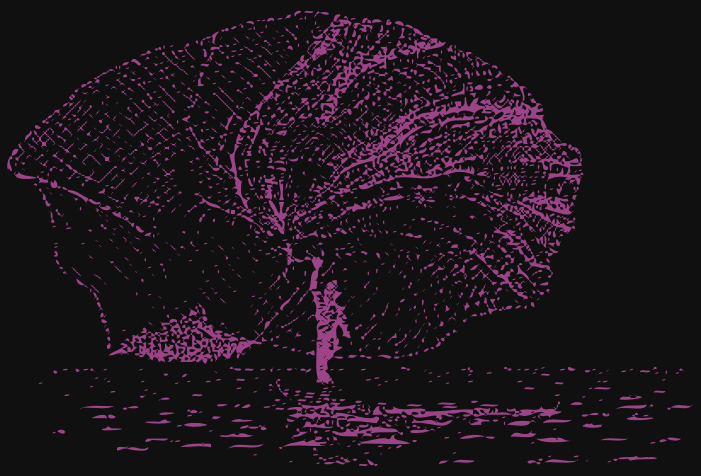
Markers to screen animal meat contamination in shrimp feed

Shrimp feed formulations generally use plant-based ingredients and fishmeal to accommodate protein. Recent times, there are concerns about unethical usage of animal meat in shrimp feed preparations. In this context, availability of simple DNA-based screening methods to identify the adulteration of commonly available animal meat in shrimp feed becomes handy. We have performed extensive comparative genomic analyses with whole genomes of cattle, buffalo, sheep, goat, pig, chicken, duck and quail to identify the unique genic-regions of each species. The approach initially involved the comparison of gene set of a species with every other species to identify unique genes. Then, the unique genes of a species are mapped to the whole genome of every other species to confirm the species-specific nature of unique genes. The study identified few genic-regions unique to each of eight species. The analyses would be followed with designing of screening methods based on unique genic-regions.

Number of unique genic-regions identified in eight species.

Sl. No.	Species	No. of unique genic-regions
1	Cattle	26
2	Buffalo	5
3	Goat	10
4	Sheep	11
5	Pig	1094
6	Chicken	1321
7	Duck	1849
8	Quail	474

07 SOCIAL SCIENCES & DEVELOPMENT

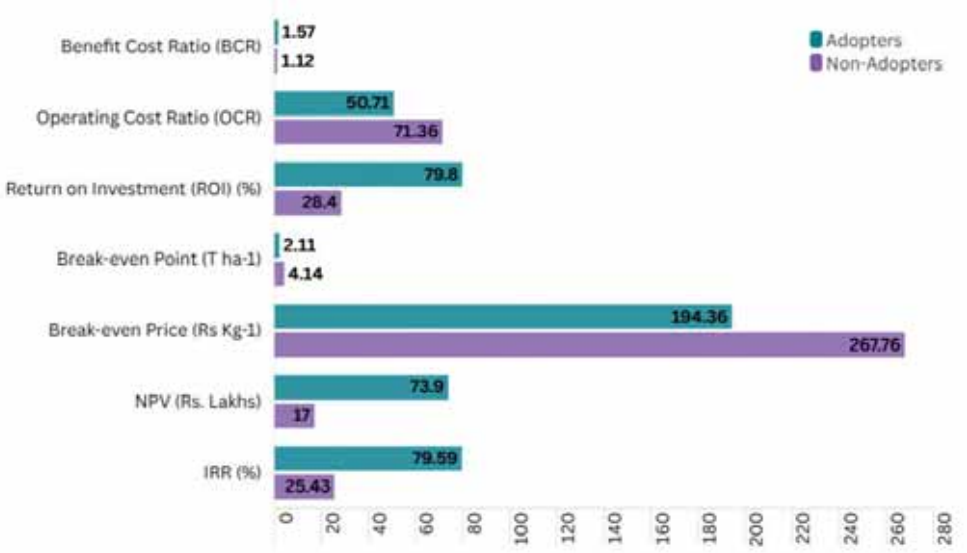



CIBA

SOCIAL SCIENCES & DEVELOPMENT

Methodology: Propensity Score Matching (PSM) for Estimating Impact of Feed Technology

The study was conducted to estimate the impact of indigenous feed technology (‘*Vanami* ^{Plus}) developed by ICAR-CIBA for shrimp farming, Data on cost and returns, production parameters, and socio-economic characteristics were collected in 2023 from major shrimp-producing states in India: Andhra Pradesh (AP) and inland saline areas (Punjab, Haryana, Rajasthan). The study included 87 adopters and 114 non-adopters. Biological parameters such as FCR (1.32) and biomass at harvest (8.49 t ha^{-1}) were superior among adopters compared to non-adopters. Adopters achieved higher gross (Rs 29.67 lakhs ha^{-1}) and net (Rs 13.17 lakhs ha^{-1}) incomes than non-adopters (Rs 23.03 lakhs ha^{-1}; Rs 5.10 lakhs ha^{-1}). Operational costs accounted for half of gross income for adopters, compared to 71.36% for non-adopters. Adopters also reached break-even earlier (2 t ha^{-1}) at a lower price (Rs 194 kg^{-1}) and showed better financial performance through BCR (1.57), NPV (Rs 73.9 lakhs), and IRR (79.6%). The Tobit model, with lower AIC, BIC, and a superior likelihood ratio, proved to be the best fit for the matched data, effectively identifying factors such as farmers’ experience, age, culture duration, feed price, and FCR as significant influencers of adoption. Using the PSM method, the Average Treatment Effect on Treated (ATT) estimated a FCR reduction of 0.10 among adopters by Nearest neighbor matching (NNM) . Radius matching further estimated an



Economic Indicators of feed technology adoption

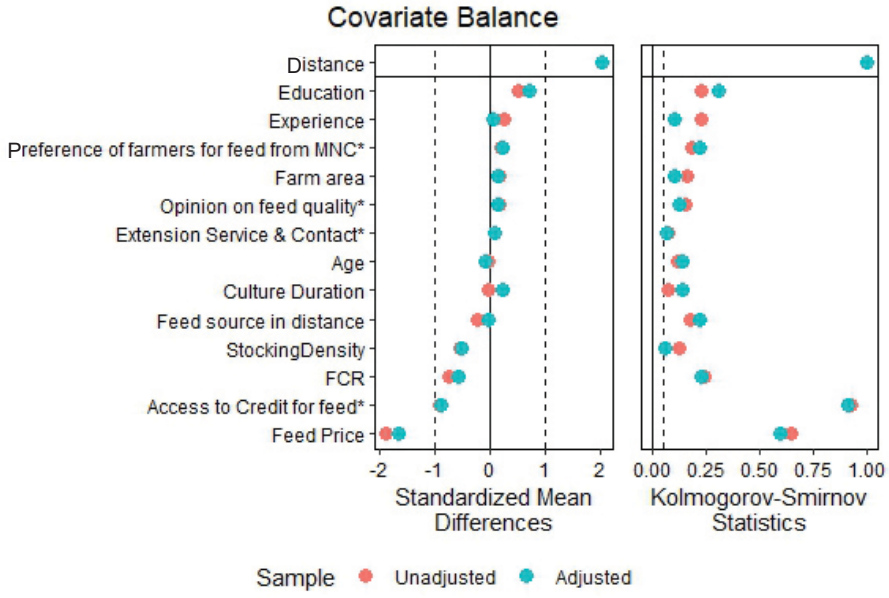
Factors influencing the adoption of feed technology

	Tobit			
	Marginal effect	**Std. Error**	**z value**	**Pr(>|z|**
Intercept	4.492	562.743	0.008	0.994
Age	0.019	0.004	4.343	0.000***
Education	0.063	0.034	1.868	0.062 .
Experience	-0.028	0.008	-3.410	0.001 ***
Stocking Density	0.010	0.006	1.733	0.083 .
Farm area	-0.002	0.001	-1.751	0.079 .
Culture duration	0.011	0.002	5.780	0.000 ***
Feed Source in distance	-0.001	0.001	-1.013	0.311
Feed price	-0.096	0.007	-0.007	0.000 ***
FCR	-0.515	0.200	-2.565	0.010 ***
Extension service	0.091	0.076	1.199	0.230
Opinion on feed Quality	0.190	0.104	1.824	0.068 .
Preference of farmers for feed from MNC	19.26	562.742	0.003	0.997
AIC	133.456			
BIC	177.683			
Log Likelihood Ratio test	-52.728			

FCR reduction of 0.17. Both methods confirmed that adopting feed technology significantly reduces FCR.

AI-Driven Energy Optimization and Production Forecasting for Sustainable Shrimp Farming

A study was carried out (N=60) in South 24 Paraganas, West Bengal (30 nos) and Nellore, Prakasam and Bapatla districts, Andhra Pradesh (30 nos) to analyze the energy use pattern in shrimp production for optimizing of energy use scenario and predication of shrimp production using AI techniques for sustainable shrimp farming. The total input energy used per ha for shrimp production is 738555.18 MJ and 354988.03 MJ for West Bengal and Andhra Pradesh respectively. High energy consumption in shrimp production is related to diesel (50.45%) in West Bengal and electricity (37.21%) in Andhra Pradesh. The energy ratio 0.99 (West Bengal) and 0.93 (Andhra Pradesh) is indicting



Propensity score matching using Nearest Neighbor Matching (NNM) method.

the inefficiency use of energy in shrimp production. The average energy productivity was 0.02 kg/MJ. The net energy is negative which is indicating energy is being lost. The results revealed that shrimp production in the study area was largely dependent on non-renewable energy. Energy use efficiency can be improved if crop yield increases or energy input consumption reduces.

Economic Analysis of Shrimp-Based Farming Systems in Nellore District, Andhra Pradesh

In 2024, a field survey was conducted in Sri Poti Sriramulu Nellore district of Andhra Pradesh with a sample size of N=25. The realized cost of production for 50 count shrimp was approximately Rs. 260/kg, while for 100 count, it was Rs. 210/kg. The realized Benefit-Cost Ratio (BCR) was 1.15, 1.23, and 1.32, corresponding to yield levels of 7.36 tonnes/ha, 8.25 tonnes/ha, and 9.6 tonnes/ha, respectively. Farmers engage in diversification by rearing finfish species such as Asian Seabass, achieving a net return of approximately Rs. 80,000–1,00,000/ha. Additionally, they further diversify their income by cultivating crops like paddy, with up to two cropping seasons per year in their fragmented farms.

Farmers do diversify their farming through cultivating crops like paddy in different fragments and realize a net return about Rs.45000/ha during Season 1 (July-September) and about Rs.55000/ha during Season 2 (October-December).

Product Development and pilot scale implementation of crop insurance solution for sustainable shrimp farming

Shrimp Monocrop	Yield level 1	Yield level 2	Yield level 3
Production	7.36 Tonnes/ha	8.25 tonnes/ha	9.6 tonnes/ha
Gross Cost (Rs)	1916120	2020250	2178200
Gross Return (Rs)	2208000	2475000	2880000
Net return (Rs)	291880	454750	701800
BCR	1.15	1.23	1.32
60% loss (Rs)	116752	181900	280720
80% loss (Rs)	58376	90950	140360

In 2024, significant efforts were made to promote shrimp crop insurance schemes, focusing on farmer education, stakeholder collaboration, and addressing the challenges of shrimp farming in India.

On January 23, 2024, ICAR-CIBA launched two shrimp crop insurance schemes in collaboration with Oriental Insurance Ltd. and Agriculture Insurance Company of India Limited (AIC). The inaugural interface meeting aimed to promote these policies among shrimp farmers, with participation from NFDB, ICAR-CIBA, insurance companies, and farmers. Around 80 farmers from Prakasam, Bapatla, Guntur, and Nellore districts attended the event, which was chaired by Shri Raghuram, Co-Vice Chairman of APSADA. Discussions highlighted the need for village-level group discussions, GST exemptions for shrimp insurance, and clarity on partial harvesting claims.

On January 27, 2024, a large-scale interface meeting was held in Veeravasaram, Bhimavaram, Andhra Pradesh, attracting 250 farmers. Chaired by APSADA Vice Chairman Shri B. Raghuram, the meeting featured speakers from ICAR-CIBA, state fisheries departments, and insurance companies. Key topics included disease prevalence, shrimp insurance coverage, and government support schemes. Farmers gained valuable insights into risk management in shrimp farming.

On February 1, 2024, a meeting at Zeal Aqua Pvt. Ltd. in Surat, Gujarat, brought together 65 farmers, fisheries officials, and insurance representatives. Discussions focused on eligibility criteria, coverage details, and claims processes. Dr. Ritesh Tandel emphasized the benefits of shrimp insurance and the need for collaboration with NABL-accredited laboratories for disease testing.

On February 2, 2024, another pilot scheme meeting was conducted in Bhat Village, Navsari, Gujarat, with 45 farmers in attendance. Discussions reiterated the key aspects of shrimp insurance and ICAR-CIBA's role in disease surveillance. Farmer feedback helped identify potential improvements in policy implementation.

Between February 19 and 23, 2024, ICAR-CIBA and ICAR-CIFE organized a certificate course in Chennai on risk management in shrimp farming. Inaugurated by Dr. C.N. Ravishankar, the program covered risk mitigation strategies, loss assessment, and case studies of successful shrimp insurance models. Participants gained in-depth knowledge and practical skills.

Weather-based insurance product released by Ministry

Certificate course on shrimp crop insurance and loss assessment at ICAR-CIFE, Mumbai

Technology transfer from ICAR-CIBA to TATA AIG on shrimp crop insurance

Launch of shrimp crop insurance product by Union Minister of Fisheries, Animal Husbandry and Dairying, Shri Parshottam Rupala

Insurance policies were issued to farmers in Andhra Pradesh and Tamil Nadu under AIC and OICL schemes, covering multiple ponds and enhancing financial security for shrimp farmers.

On April 13, 2024, ICAR-CIBA hosted a national consultative workshop on aquaculture insurance in Chennai in a hybrid format. The event featured 50 delegates, including officials from the Ministry of Fisheries, NFDB, the World Bank, and progressive farmers. Technical sessions focused on challenges and growth opportunities in aquaculture insurance, while field visits provided hands-on exposure to advanced aquaculture practices.

Between April 29 and May 3, 2024, another certificate course was conducted at ICAR-CIFE, Mumbai, attended by 22 participants. The program explored the economics of shrimp farming, climate-related risks, and insurance solutions. Expert-led sessions emphasized collaboration and technological advancements.

On May 3, 2024, ICAR-CIBA scientists interacted with farmers at Aqua Exchange in Vijayawada to discuss shrimp insurance challenges. Key topics included simplifying administrative procedures, increasing awareness, and designing region-specific insurance products.

On October 4, 2024, ICAR-CIBA partnered with TATA AIG at its Chennai headquarters to develop a customized insurance product addressing disease outbreaks and environmental risks. Plans were initiated for pilot projects in key shrimp farming clusters.

On October 8, 2024, Future Generali, with ICAR-CIBA's support, launched a weather-based insurance product designed for quick payouts in climate-related loss scenarios. Premiums and coverage were tailored to farmer needs.

Between October 24 and 25, 2024, a stakeholders' meeting on aquaculture insurance was held at ICAR-CIBA HQ in Chennai. Key discussions focused on GST exemptions, digital integration via the NFDP portal, and IRDAI-approved surveyors. Field visits enriched participants' understanding of aquaculture practices.

From June 15 to December 31, 2024, a field survey, supported by Digisafe Private Limited and InRisk, analyzed the economic aspects of shrimp farming in Andhra Pradesh. The study highlighted shrimp farming's profitability and reinforced the importance of insurance for economic stability.

On December 20, 2024, New India Insurance, with ICAR-CIBA's support, conducted a training program on shrimp farming practices and risk assessment. The program equipped participants with essential knowledge for insurance product implementation.

These comprehensive initiatives demonstrate a strong commitment to advancing shrimp crop insurance in India. By fostering collaborations, educating stakeholders, and addressing farmer concerns, these efforts lay the groundwork for a resilient and sustainable shrimp farming sector.

Status of Milkfish Fry Collection in Mandapam Islands of Gulf of Mannar, Tamil Nadu: Trade-off Between Sustainability and Livelihood

A baseline study conducted in June 2024 along the Mandapam coast of the Gulf of Mannar and Palk Bay assessed milkfish fry abundance in a 2 sq. km area from Chinnapalam to Dhanushkodi. Milkfish fry, essential for brackishwater aquaculture, are primarily collected from natural sources in India, with significant resources found in Tamil Nadu, Andhra Pradesh, Kerala, Karnataka, and Odisha. Tamil Nadu's Chinnapalam creek is a prominent fry collection site, yielding 3-4.5 million fry annually. Fry measuring 20-40 mm are abundant during March-April, while a secondary season occurs from October-November. Key nursery grounds include Pamban, Pillaimadam lagoon, Valinokkam, and Thangachimadam, among others. The Tamil Nadu Fisheries Department regulates fry collection and employs fishermen based on demand. Fry are sold to agents and farmers, with Matsyafed accounting for 60-70% of purchases. Around 12 families are directly involved in seasonal fry collection, earning Rs. 2-3 lakhs annually by collecting up to one lakh fry per family. The fry

Map showing milkfish fry collecting areas in Mandapam

Fisher marking the place of milkfish fry collection

are transported in plastic bags and stocked in ponds or cages for monoculture or polyculture. The potential annual milkfish fry resources on the east and west coasts of India are estimated to be between 200 million to 400 million. The study also examined socio-economic conditions and regulations affecting fry collectors. The rising demand for milkfish fry, limited natural seed availability, and habitat destruction highlight the need for hatcheries to ensure mass seed production. Improved handling, transportation, and nursery management practices are essential. Establishing hatcheries in Tamil Nadu can enhance seed supply, benefit farmers and fry collectors, and promote sustainable milkfish culture.

Export Performance of Indian Shrimp: Analysis for 2023-24

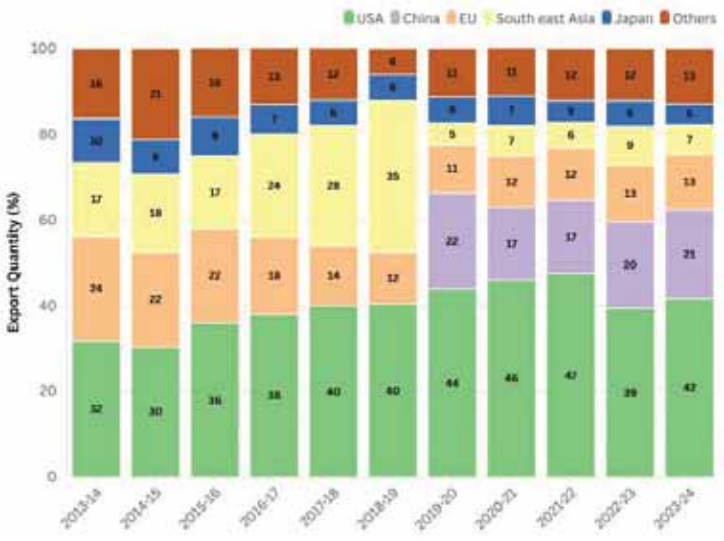
In 2023-24, India's seafood exports reached 1.78 million tonnes, earning USD 7.38 billion (₹60,523 crore), with shrimp playing a pivotal role. Farmed shrimp, valued at USD 4.8 billion, accounted for 71% of total seafood export earnings (₹40,000 crore), representing 40.19% of export volume (7.16 lakh tonnes). Vannamei shrimp dominated, contributing 92.7% of shrimp exports. The United States led as the largest market, importing 2.98 lakh tonnes (42% share), followed by China (1.48 lakh tonnes), the European Union (0.9 lakh tonnes), Southeast Asia (0.52 lakh tonnes), and Japan (0.36 lakh tonnes), reflecting the robust demand for Indian shrimp globally. Andhra Pradesh stands as the largest shrimp-producing state in India, contributing 70% of the nation's shrimp output. West Bengal and Gujarat also play significant roles in shrimp farming. The value of shrimp exports declined by 7.24% in Rupee terms and 10.95% in dollar terms compared to 2022-23. This decrease was primarily attributed to sluggish consumer demand, rising inflation in key markets like the USA and EU, and competitive pricing pressures caused by an oversupply of shrimp from competitor countries such as Ecuador.

From 2013-14 to 2023-24, India's shrimp export market witnessed significant shifts in the distribution of imports among its key trading partners. The United States remained the dominant importer of Indian shrimp, with its share reaching nearly 47% around 2021-22. However, this share declined to approximately 42% by 2023-24, while exports to China and Vietnam experienced substantial growth. In 2014, combined exports to these countries stood at 60,000 tons, surging to 200,000 tons by 2019-20. Overall, although the U.S. remained the top importer, its share in India's shrimp exports declined over the years. Meanwhile, the expansion of markets in China, Vietnam, and the EU reflected a diversification in India's shrimp export destinations between 2013-14 and 2023-24.

Extension

Front-line demonstration of Seabass (*Lates calcarifer*) nursery rearing

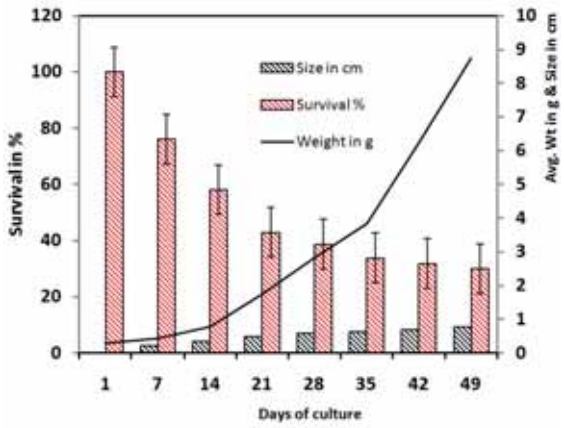
Front-line demonstration of Seabass (*Lates calcarifer*) nursery rearing in net cages in open waters (Uppanar River) was taken up with the participation of coastal scheduled class families as a livelihood development activity. A livelihood asset comprised of a pen size 60 x 15 m size and hapas (small net cages size 2mx1m) was established to take up seabass nursery rearing as a livelihood activity. Twenty pairs of hapa in two rows with two-meter space between each pair to ensure optimal water circulation were



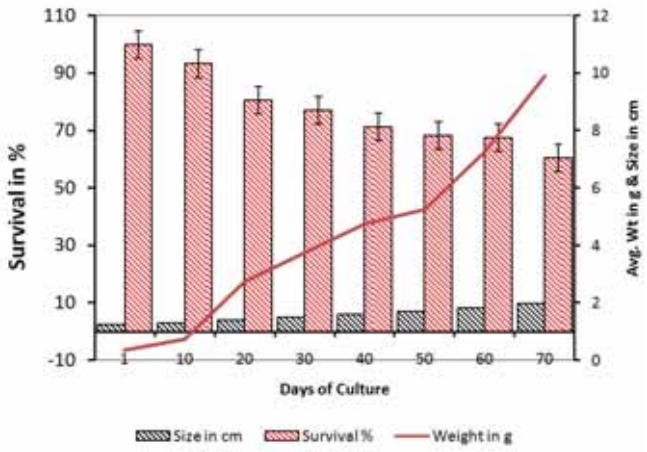
Performance of leading Shrimp Importers in India

Stocking of Seabass fry in hapas

Seabass Nursery Rearing (Cycle-I)



Seabass Nursery Rearing (Cycle-2)



Seabass Nursery Rearing (Cycle-I & II)

installed. The families especially women folk were given training on hapa handling, feeding, grading and handling of fish fry on learning by doing mode. Two cycles of nursery rearing were taken up and farming parameters are presented in the.

As farming innovation, PVC frames of 2ftx1.5ft were designed and placed in each hapa to prevent rapid run-off the fed given due to excessive water current in the waterbody. It helped the fish fingerlings to consume the feed fully, reducing feed wastage and improving overall feeding response. About 7000 and 10000 seabass frys were respectively distributed for rearing in the first and second cycles. The survival was 30% during the first cycle due to seed quality, improper grading and lack of experience. However, the group gained experience and improved the survival to 53% in the second crop. The nursery duration was 50-60 days and the beneficiary group harvested 7000 fingerlings of average size 9.5cm in both the cycles and sold them to the fish farmers at an average price of @ Rs.38 per fingerling. A sum of Rs. 2.6 lakhs was earned as income and the same was deposited in their group's bank account.

Establishment of DBT Rural Bio-Resource Complex at Ramanathapuram district, Tamil Nadu

ICAR-CIBA trains and empowers (240 beneficiaries) coastal communities of Mangadu, South Karaiyur and Olaikuda villages, Ramanathapuram, Tamil Nadu, in fish waste to value added products production technology. An impact analysis was undertaken for the assessment of perceptions and willingness-to-adopt (WTA) recycling of fish waste to value added products production technology for livelihood of coastal communities of Ramanathapuram district, Tamil Nadu. A total of 90 beneficiaries from Mangadu, South Karaiyur and Olaikuda villages were randomly selected for the study. A multivariate binary logit model was used to establish the factors affecting WTA responses because the responses are continuous and dichotomous in nature.

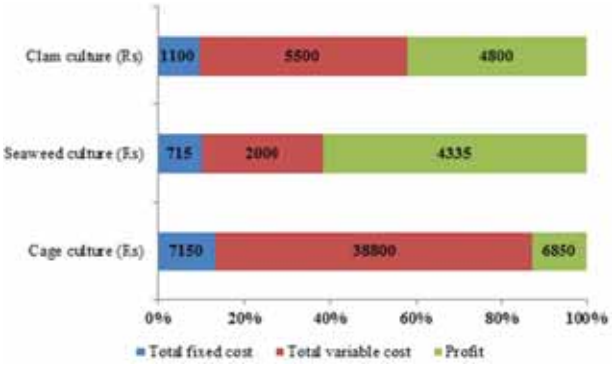
The WTA variable is dependent on other 17 independent variables of the respondent are depicted in. The average education level (5.33) was high. Overall, most of the respondents had primary or the other. Most of the respondents (60%) had attended training programme organized by the CIBA and Department of fisheries, Tamil Nadu. The average knowledge in fish waste to value added products activities (4.39) and participation in fish waste to value added products activities (5.63) were high. The results of the logistic regression model indicted that the overall predictive power of the model (80.2%) was quite high, while the significant Chi square (P<0.01) was indicative of the strength of the joint effect of the covariates on probability of WTA of recycling of fish waste to value added products production technology among the farmers in Ramanathapuram. The results also suggested that the decision to WTA of recycling of fish waste to value added products production technology is a function of education, access to aquaculture inputs, ownership, marketing behaviour, extension media contact, training exposure, knowledge in fish waste to value added products activities and participation in fish waste to value added products activities. Moreover, the Wald values of the model revealed that location of unit (6.934), knowledge in fish waste to value added products activities (8.084) and marketing behaviour (6.621) were three most important variables leading to WTA of recycling of fish waste to value added products production technology among the coastal communities in Ramanathapuram.

Logistic regression coefficients of the factors affecting willingness-to-adopt (WTA) of recycling of fish waste to value added products

Variables	Parameter estimate	Standard error	Wald	P value
Age	-0.038	0.028	2.012	0.132
Martial status	0.326	0.864	0.287	0.501
Education	0.013	0.027	3.689	0.059 *
Family Type	0.294	0.448	0.430	0.512
Family size	-0.034	0.031	2.464	0.109
Occupation	-0.101	0.228	0.231	0.610
Farming experience	0.105	0.167	0.269	0.467
Unit size	-0.068	0.030	2.554	0.101
Location of unit	0.314	0.134	6.934	0.007**
Access to inputs	0.164	0.004	4.580	0.031 **
Ownership	0.211	0.014	4.698	0.014 **
Marketing behaviour	0.321	0.109	6.621	0.009 ***
Family income	0.256	0.181	1.769	0.123
Extension media contact	0.025	0.038	3.594	0.054 *
Training exposure	0.151	0.002	3.579	0.043 **
Knowledge in fish waste to value added products activities	0.563	0.201	8.084	0.006 ***
Participation in fish waste to value added products activities	0.198	0.008	4.887	0.027 **
Constant	-1.794	2.234	0.704	0.439

*** P < 0.01; ** P < 0.05; * P < 0.10 ; -2 log likelihood = 168.76; chi-square is 47.25; Overall correct prediction 80.2%

IMTA Technology for Sustainable Income and



Cost and profit components in gross revenue of IMTA

Resource Optimization

The Department of Biotechnology (DBT), Government of India, sanctioned an externally funded project to ICAR-CIBA aimed at promoting Integrated Multi-Trophic Aquaculture (IMTA) for income generation and optimal utilization of bioresources. The project was operational from February 2022 to May 2024 in Ramanathapuram district, Tamil Nadu, which has been identified as an aspirational district by NITI Aayog. In the second phase of culture, Asian seabass (*Lates calcarifer*) was reared alongside seaweed (*Gracilaria salicornia*) and Asiatic hard clam (*Meretrix meretrix*) as extractive species in Karankadu village. The harvest yielded 132 kg of Asian seabass, 141 kg of seaweed, and 114 kg of clams. The Benefit-Cost (BC) ratio was 1.29, with a gross revenue of Rs. 71,250/- over seven months. Pellet feed was used during the culture period, accounting for 31% of the total cost. Among the cultured species, *Gracilaria salicornia* demonstrated the highest profit margin of 62%, making it a significant contributor to economic viability within the IMTA system. In contrast, Meretrix meretrix faced challenges due to high mortality on muddy bottoms. While feed and seed costs were substantial, community participation helped reduce labor expenses, enhancing the overall sustainability of the IMTA model.

Constraints faced by the fishers

Fishers encountered several constraints, which were categorized into six primary areas: technological, economic, extension, infrastructure, social, and environmental. The Garrett ranking method was used to prioritize these constraints based on recorded scores. Among technological constraints, the lack of location-specific technologies was ranked as the most significant issue, followed by the discontinuation of technologies. Economic constraints included the absence of nearby market facilities as the primary concern, with the lack of subsidies for fish culture ranked second. In terms of extension constraints, the unavailability of need-based training programs was identified as the most critical issue, followed by the lack of need-based information on diversification. Infrastructure-related challenges included the unavailability of fingerlings in nearby areas as the top concern, while the distance from research institutes was ranked second. Social constraints primarily involved a lack of cooperation among villagers, with conflicts in fishing areas being the next major issue. Lastly, environmental constraints were also prominent, with declining fish catch over time ranked as the most pressing issue, followed by the concern that riverine and estuarine sources are not perennial. These findings highlight the pressing challenges faced by fishers and emphasize the need for targeted interventions to address these constraints effectively.


Beneficiaries reaping the benefits of IMTA culture in Ramanatha Puram district of Tamil Nadu

08 SOCIETAL DEVELOPMENT PROGRAMMES

SOCIETAL DEVELOPMENT PROGRAMMES

Societal development programmes

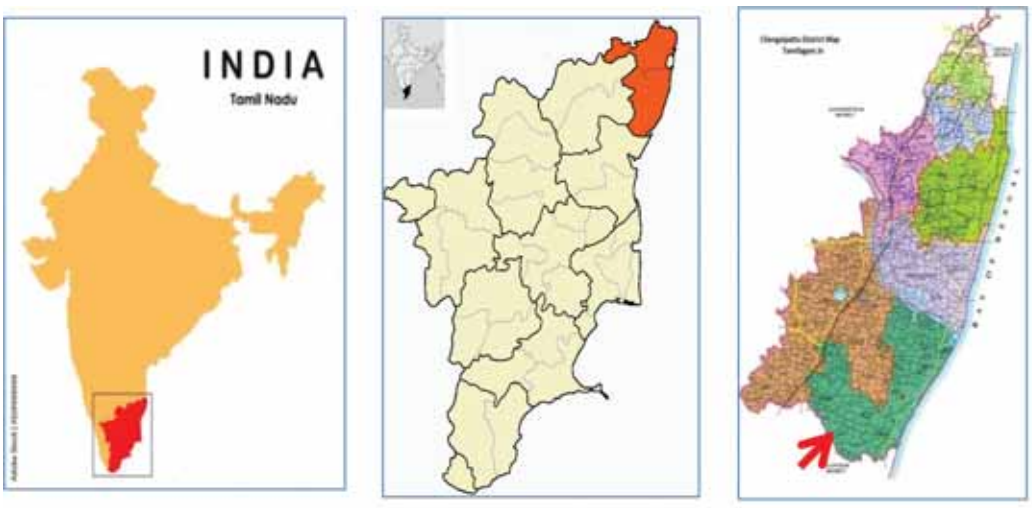
Aquaculture-based livelihood development models were demonstrated under the Scheduled Tribe Component (STC) and the Scheduled Caste Sub Plan (SCSP) programs to improve the socioeconomic conditions of SC/ST households in Tamil Nadu, Gujarat, Odisha, and West Bengal. The demonstrated models and the progress made are summarized below.

Livelihood Development Through Nursery Rearing of Asian Seabass: Popularization and widespread adoption of the Technology

As part of the societal development activities under the SCSP program, a baseline survey was conducted in Kottaikadu and Kolathur villages of Cheyyur Taluk, Chengalpattu district, Tamil Nadu to assess the socio-economic conditions of the community and to evaluate the potential impact of the SCSP program on improving their livelihoods. This survey provided valuable insights into the existing challenges and opportunities, enabling the program to be tailored effectively to the needs of the beneficiaries.

The program implemented in Kottaikadu and Kolathur villages of Cheyyur Taluk, Chengalpattu district, Tamil Nadu was aimed to improve the livelihoods of marginalized communities through innovative brackishwater aquaculture practices. Key initiatives included nursery rearing and cage culture of Asian seabass *Lates calcarifer*.

Nursery rearing: In Kottaikadu village, 40 hapas were installed, and 9,000 fry of Asian seabass (~2 cm) were stocked. The fry were fed three times a day to satiation with formulated feed. The fingerlings were harvested at an average size of 10 cm with FCR of 2.5. The harvest yielded only1,520 fingerlings due to poor water quality in creek and sold at ₹30–40/fingerling, generating a total income of ₹55,600. This activity was successfully managed by a group of 14 fisherwomen, showcasing their active participation and contribution to



Geographical Map depicting Kottaikadu and Kolathur Villages, Chengalpattu District, Tamil Nadu


Distribution of seabass fry for nursery rearing activity


Stocking of seabass fry by fisherwomen


Grading of seabass fry in hapas


Harvested fingerlings from hapas

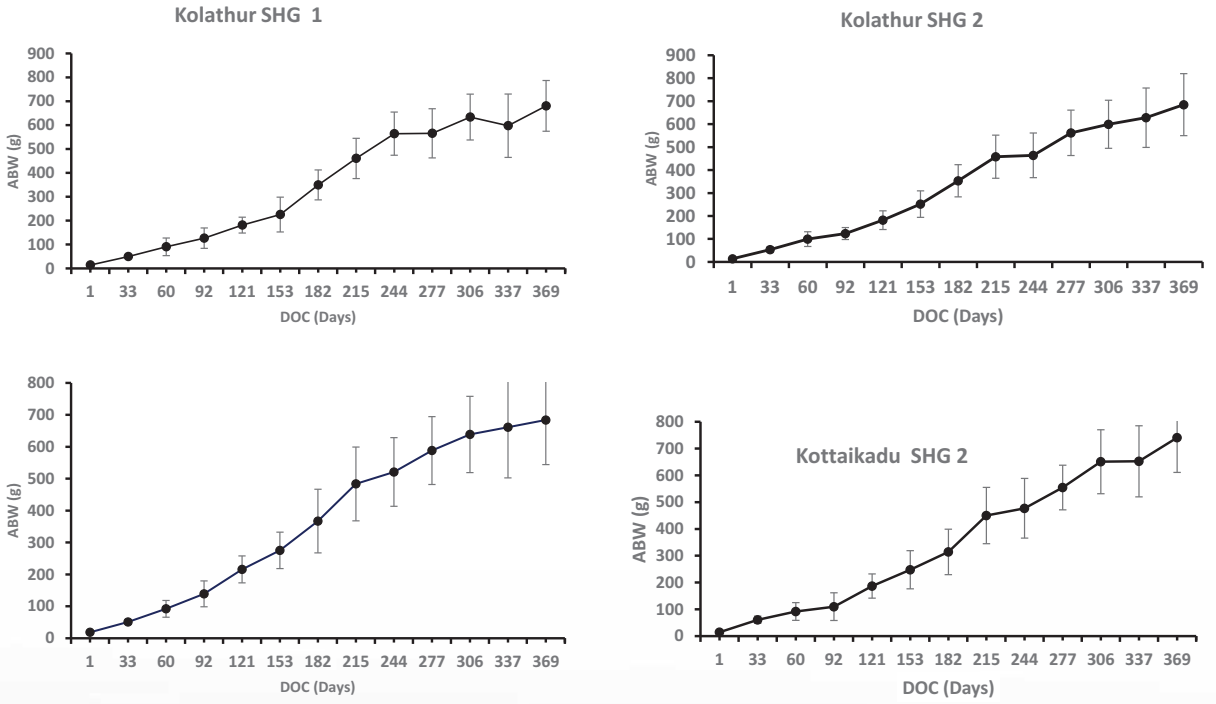
the initiative. In Kolathur village, 27 hapas were installed, and 5,000 Asian seabass fry were stocked. A partial harvest of 700 fingerlings generated an income of ₹28,000. The remaining stocks are being reared further to attain optimal size and market value for future harvests. This activity was carried out by a group of 8 fisherwomen. Regular monitoring of Asian seabass (*Lates calcarifer*) cages was conducted to maintain optimal water quality, ensure structural integrity, and promptly address fish health issues, thereby enhancing overall aquaculture productivity. This initiative provided a sustainable income source for the farmers and strengthened aquaculture practices in the region. This activity demonstrated the viability of seabass nursery rearing as a scalable livelihood model. Key challenges, such as water quality and health management were addressed through community training and technical support. Moving forward, the program was aimed to expand the scale of operations and to introduce growout farming techniques like cage culture and further support the economic empowerment of the participating communities. However, the Fengal Cyclone during December 2024 caused catastrophic damage to the nursery rearing activities in both villages. Strong winds and heavy rainfall led to the submersion of hapas, damage to crab fencing and heavy inflow of muddy rain water resulting in the loss of infrastructure and a significant quantity of the stocked fry.

Technology popularization: Empowering Communities Through Cage Culture of Asian Seabass

In Kottaikadu and Kolathur villages of Chengalpattu district, Tamil Nadu, cage culture of Asian seabass was initiated using four galvanized iron cages, each measuring 4m x 3m x 2.5m (24m^3). The project actively engaged four Self-Help Groups (SHGs), comprising 27 members from Kottaikadu and 12 members from Kolathur.

Growth Performance of Asian Seabass

The study monitored the average body weight (ABW) of Asian seabass cultured in four cages across Self-Help Groups



Growth pattern of Asian Seabass reared in cages by the SHGs during 2023-24

(SHGs) in Kottaikadu and Kolathur. The growth performance was recorded at different stages of culture to assess the progression of fish weight over time.

Success Stories and Feedback from SHG

These groups played a crucial role in cage culture operations, receiving training and contributing to the program's success. During 2023-24, each cage was stocked with 1,000 seabass fingerlings, averaging 10–12 cm in size (41.6 fingerlings/ m^3) and weighing 30 grams at stocking. The fish were fed formulated floating pellets twice daily, achieving a Feed Conversion Ratio (FCR) of 2.23. The cages were harvested in August 2024, yielding a biomass of 1,385 kg and generated an income of ₹4,44,000 to these beneficiaries. The success of these programs is evident from the positive feedback and the tangible economic benefits realized by the beneficiaries.

In continuation, during 2024-25, each cage was again stocked with 1,000 seabass fingerlings of 10–12 cm size. The fishes were fed twice a day with formulated floating pellet feed exclusively manufactured by the feed division of ICAR – CIBA. During December 2024, the fishes have reached an average size of 300 grams, with a size range of 200–500 grams. Regular sampling was conducted every 30 days to monitor growth and health. While the initiative has demonstrated significant potential for improving livelihoods, it faced severe challenges in December 2024 due to a devastating Fengal cyclone. Strong winds and heavy rainfall inflicted extensive damage to cage nets, submerging of the cages and leading to the loss of

Cage Monitoring in Kolathur

Net replacement in cage culture

Harvest of Asian Seabass from Cages at Kottaikadu

Revenue distribution to the beneficiaries

critical infrastructure as well as a significant portion of the stocked fish. Despite these challenges, the project proved resilient, generating significant income and establishing itself as a viable aquaculture model for the fisher folk.

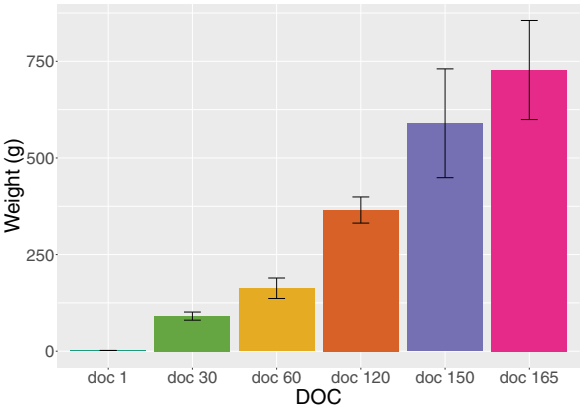
Front line demonstration on mud crab and blue swimmer crab in polyculture and monoculture systems

Front-line demonstrations on the farming of mud crab (*Scylla serrata*), milkfish (*Chanos chanos*), and shrimp (*Penaeus indicus*) were conducted in both monoculture and polyculture systems at Pattipulam, Chengalpattu, Tamil Nadu, under the SCSP program. In the monoculture system, mud crab grow-out farming was carried out in a 2,000 m² brackishwater earthen pond. Crab seeds, sourced from the ICAR-CIBA hatchery, were stocked at a density of 0.1 instars/m² (200 crabs). Over a 165-day culture period, salinity levels fluctuated between 3 and 22 ppt, demonstrating the system's adaptability to variable environmental conditions. The harvest yielded 112 kg of mud crabs, with an average body weight of 720 g and a survival rate of 52%. By marketing the crabs in size-graded categories directly to the Chindadripet market, the venture generated ₹1,73,250 in revenue.

In the polyculture system, milkfish was introduced at a stocking density of 0.3 individuals/m² alongside mud crabs. This approach yielded promising results, with milkfish reaching an average weight of 210 g and achieving a survival rate of 92%. The integration of milkfish provided additional income, generating ₹12,000 without compromising the growth of the mud crabs. This trial highlighted the potential of incorporating compatible species into mud crab ponds to enhance profitability and resource utilization. Another trial involved partitioning an earthen pond using HDPE sheets to

simultaneously farm mud crabs at 0.1 individuals/m² and shrimp at 10 individuals/m². The shrimp reached an average size of 12 g within 75 days, yielding an interim income of ₹3,000 from domestic market sales. This innovative approach demonstrated the viability of integrating shrimp into polyculture systems, offering farmers a strategy for economic diversification and short-term income generation.

The combined harvest of mud crabs, milkfish, and shrimp generated a total revenue of ₹1,88,250, significantly benefiting 15 farmers from Pattipulam village. Supported by ICAR-CIBA's scientific and technical expertise, this initiative underscores the potential of monoculture and polyculture systems in promoting sustainable aquaculture practices.



Average body weight of mud crabs at various stages of the culture period

Harvested mudcrab (*S. serrata*), Pattipulam, Chengalpattu , Tamil Nadu

Partial harvest of mud crab, Pattipulam, Chengalpattu, Tamil Nadu

Cheque Distribution to the beneficiaries, Pattipulam, Chengalpattu, Tamil Nadu

These models not only enhance coastal community livelihoods but also contribute to the development of environmentally resilient farming systems.

Brackishwater Aquaculture Technologies Integrated with Agro-Based Technologies for Livelihood Development of Communities

Base line survey among the beneficiaries of Kattur colony [20 SC], Laximipuram colony, Kattur Village, [20 ST] and Senjiamman village, Tiruvallur dt. [20 ST] was carried out. The feasibility of crab farming technology adoption among the selected ST beneficiaries is presented. Further, an exposure visit was conducted to familiarize participants with the brackishwater aquaculture technologies of ICAR-CIBA. The study was primarily aimed to

identify the gaps in technology adoption, motivate coastal ST and SC beneficiaries to adopt new practices by demonstrating their performance and profitability under field conditions, and dispel doubts, superstitions, and unfavorable attitudes toward these technologies.

More than 90% of farmers identified that the availability of the brackishwater source was the primary reason for adopting crab farming. In addition to this factor, community support for crab farming, the availability of water crabs in the local market, and access to trash fish were key determinants in the adoption of crab farming technology in both ST villages of Tiruvallur district.

Attitude of beneficiaries on technology adoption

A study was conducted to evaluate the attitude of ST and SC beneficiaries toward technology adoption by ranking the percentage of responses to identified factors.

Among the eleven factors, the women-friendly nature of the technologies, resource availability, enhanced family income, suitability of the technology for ST and SC women, and the simplicity of the technologies had the greatest influence on technology adoption (>90%). Other influential factors included improvements in self-confidence and financial independence.

Nursery rearing and pond-based cage culture of Asian seabass, *Lates calcarifer*

Nursery rearing and pond-based cage grow-out of Asian seabass (*Lates calcarifer*) were undertaken in Matwad village, Navsari as a livelihood activity for coastal SC communities under the SCSP program, following the 'Learning and Earning While Working (LEW)' model. Approximately 4,000 hatchery-raised seabass fry (2.0–2.5 cm) and 2,000 advanced fry (3–4 cm) were procured from Chennai and reared in hapas. The nursery rearing trial was conducted in 2.0 m × 2.0 m × 1.75 m hapas at a stocking density of 750 fry/hapa for smaller fry and 500 fry/hapa for larger fry. As the fish reached an average length of 10 cm, the density was reduced to 400 fingerlings per hapa. At the end of five months, an average survival rate of ~ 40% was

Factors that lead to the feasibility of crab farming technology adoption by the beneficiaries

S.No	Crab Fattening Technology	Tiruvallur dt.			
		Laximipuram, Kattur village		Senijiamman village	
		No	%	No	%
1	Availability of water source	45	90	47	94
2	Availability of crabs in the local markets	39	78	36	73
3	Trash fish availability (feed)	40	80	39	78
4	Market linkages for hardened crabs	37	75	42	83
5	Required water quality parameters	34	69	35	71
6	Community support for crab farming	44	88	45	90

Attitude of beneficiaries on technology adoption

S.No	Factors	Tiruvallur dt. N= 100 (%)		
		Laximipuram, Kattur Village	Kattur Colony	Senjiamman village
1.	This technology is well suited for women	92	89	82
2.	Technologies involved is very simple	90	92	89
3.	This technology seems to be a women friendly one	98	96	97
4.	It requires low investment	86	80	84
5.	The resources available in our village can be well used and augmented for this purpose	96	90	92
6.	Self-confidence was gained	88	82	87
7.	Skills can be improved	76	73	70
8.	Women could achieve better status	78	68	66
9.	Improved family income	93	88	87
10.	Change in attitude for better living	68	70	65
11.	Financial independence	85	83	84

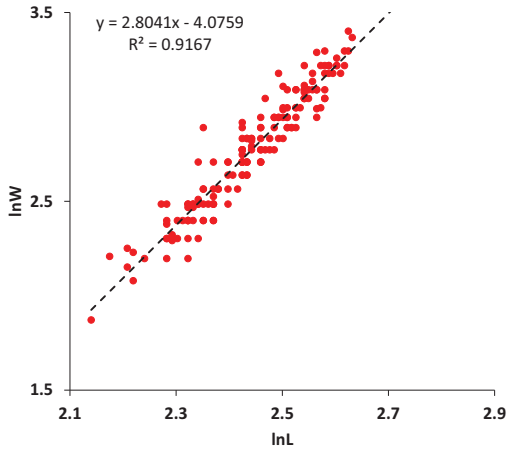
recorded, with fish categorized into size classes: XXL (TL >15 cm, ABW >60.0 g), XL (TL: 12.5–15.0 cm, ABW: 30–45 g), L (TL ~10 cm, ABW: 10–15 g), and M (TL ~7.5 cm, ABW: 6–8 g). The group of 21 members generated revenue of ₹10,680 through the sale of seabass fingerlings. Following the sale, the XXL, XL, and L size classes were transferred to two pond-based cages (5.0 m × 2.0 m × 2.0 m) for grow-out, with table-sized fish expected to be harvested after an additional six months of rearing.

Pond based cage culture of pearlspot, *Etroplus suratensis*

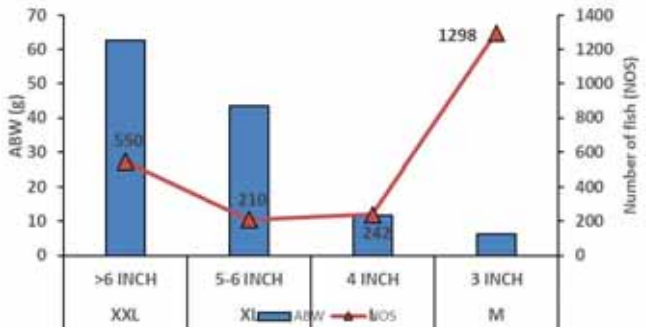
The farming of pearlspot (*Etroplus suratensis*) in pond-based cages was demonstrated as a livelihood model for coastal SC communities in Navsari under the SCSP program, following the 'Learning and Earning While Working (LEW)' model. The SC self-help group consisted of 18 members. Around 4,000 nursery reared pearl spot fry were reared in hapas to obtain juveniles with an average body weight (ABW) of 70.6±2.5 g. These juveniles were then further reared in rectangular PVC floating cages (5.0 m × 2.0 m × 1.75 m) with 30 mm mesh HDPE netting for pond-based grow-out rearing. The length-weight relationship of the fish during the grow-out phase was $W = 0.011386\ L^{3}.2853$ (R^2: 0.925), indicating a positive allometric growth pattern. Fulton's condition factor, allometric condition factor, and relative condition factor were 2.5711, 1.1466, and 1.007, respectively, signifying good growing conditions in pond-based cages. At the end of 154 days of culture (DOC), the fish attained a marketable size of 200 g. They were sold locally in a live condition based on customer demand. To date, the group has sold approximately 130 kg of fish, generating a total revenue of ₹48,235. An estimated 500 kg of fish biomass remains available for sale, which is expected to generate an additional revenue of ₹2.0 lakh in the coming months. Additionally, around 3,500 pearl spot fry are currently being nursery-reared in the same pond within hapas, ensuring a year-round income model for SC beneficiaries.

Integrated aqua-agri-poultry-goat farming in brackishwater pond as a livelihood model of tribal communities

An "Integrated Aqua-Agri-Poultry and Goat-Rearing Model Farm" was developed in April 2024 by the Navsari Gujarat Research to enhance the livelihood and nutritional security of tribal communities in Sultanpur Village, Navsari. NGRC-CIBA supported the tribal self-help group (SHG) by providing inputs such as net cages, cage frames, a water pump, fish seed, feed, vegetable and fruit tree saplings, goats, broiler chicks, and technical guidance on cage-based fish farming in the SHG pond. In 2024, tribal SHGs received additional support, including seabass fingerlings (2 inches, 19,000 nos.), pearl spot fingerlings (2–4 inches, 4,000 nos.), milkfish fingerlings (1 inch, 20,000 nos.), feed, bamboo, green shade nets, shed materials, and more. The SHG generated revenue of ₹4.92 lakh from the sale of fish fingerlings, poultry birds, vegetables, and other produce from the integrated farming unit.



Length weight relationship of seabass fry during the nursery rearing trial



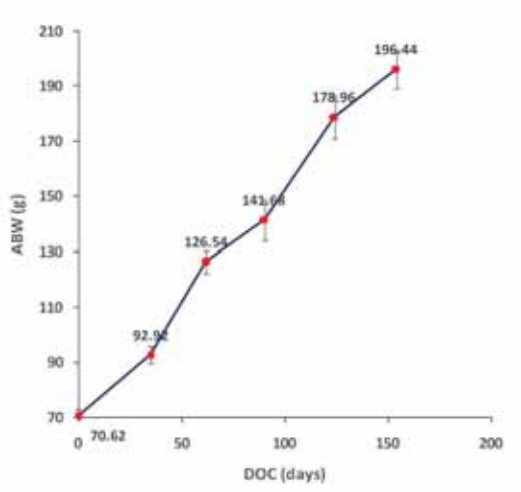
Average body weight and number of fishes under different size classes during the nursery rearing trial

Sale of seabass fingerlings by SC beneficiaries to other farmers, Navsari, Gujarat

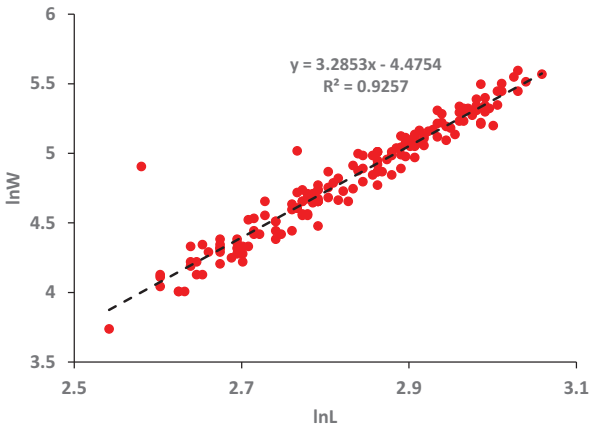
Sustainable livelihood approach through adoption of "Integrated Aqua-Agri-Poultry and Goat-rearing model in freshwater pond" by tribal SHG of Singod, Navsari.

The Navsari Gujarat Research Centre of ICAR-Central Institute of Brackishwater Aquaculture is demonstrating an "Integrated Aqua-Agri-Poultry and Goat-Rearing Model Farm in a Freshwater Pond" to enhance the livelihood and nutritional security of the 40-member Tribal Self-Help Group (SHG) *Singod Halpati Samaj Yuva Matsya Udhyog Juth* in Singod Village, Navsari, Gujarat. Since 2021, NGRC-CIBA has been supporting the tribal SHG by providing inputs such as net cages, cage frames, fish seed, feed, vegetable and fruit tree saplings, goats, and broiler chicks, along with technical guidance on cage-based fish farming in the village community pond. In 2023, tribal SHGs received additional support, including milkfish fingerlings (2,000 nos.), seabass and pearlspot feed (7 tonnes), poultry birds (500 nos.), poultry feed (1,500 kg), bamboo, green shade nets, and more. The SHG has achieved self-sufficiency, having purchased 5,000 *Catla* and *Rohu* seeds and 3 tonnes of feed in 2024 using their previous year's income. The tribal SHG of Singod Village, Navsari, has generated ₹6.6 lakh through the partial harvest and sale of

Seabass fingerlings (TL: 8-10 cm) produced during the nursery, Navsari, Gujarat



Average body weight of pearlspot juveniles at different intervals during the growout trial



Length-weight relationship of pearlspot juveniles during growout trial

Pond-based cage culture model for SC communities in Matwad, Navsari, Gujarat

Partail harvest and sale of pearlspot, Matwad, Navsari, Gujarat

fish (*Pangasius, Tilapia, Rohu,* and *Catla*) and poultry birds. The culture is ongoing, and the integrated aqua-agri-poultry and goat-rearing model farming system is expected to be fully harvested between April and May 2025.

Field validation trial on potential use of *Chigudi*^{Plus} and *Plankton*^{Plus} in shrimp farming

A field validation trial on the efficiency of the indigenous, cost-effective shrimp feed *Chigudi*^{Plus}, formulated by ICAR-CIBA, along with the plankton booster *Plankton*^{Plus}, developed by CIBA, was conducted in *Penaeus vannamei* culture. This trial was undertaken by the Budhakhali Sundari Scheduled Caste Fish Farmers Welfare Society, comprising 36 members at KRC, under the 'Learning and Earning While Working (LEW)' model as part of the SCSP program to build capacity among SC beneficiaries. *P. vannamei* post-larvae (PL-8) were stocked at a density of 60/m² and fed


Developed integrated Aqua-Agri-Poultry and Goat-rearing


Inputs distribution to SHGs model farm at tribal SHG brackishwater pond


Mud crab box farming, Sultanpur


Goat farming, Sultanpur


Poultry farming, Sultanpur


Vegetable farming on dykes, Sultanpur

Developed Integrated Aqua-Agri-Poultry and goat-rearing model at tribal SHG pond, Singod

Cage farming of freshwater seabass, pearlspot, Pangasius and tilapia in pond

Harvesting of fish at Tribal SHG IFF unit at Singod, Navsari, Gujarat

Chigudi^{Plus} feed according to the feeding schedule developed by CIBA. After 112 days of culture, the shrimp attained an average weight of 28.21 g, achieving a productivity of 13.93 t/ha with a feed conversion ratio (FCR) of 1.26. The beneficiaries earned a profit share of ₹15,84,992 from shrimp sales, demonstrating a significant improvement in their livelihood standards.

Field validation of use of *Plankton*^{Plus} for enhanced production of paddy

Trials were conducted to enhance paddy production using foliar sprays of *Plankton*^{Plus} in the Tiruvallur and Chengalpattu districts of Tamil Nadu, in collaboration with the Murugappa Chettyar Research Centre (MCRC), Chennai. In Chengalpattu, 2%, 4%, and 6% foliar sprays were administered thrice, with a control field receiving no *Plankton*^{Plus}. The 4% and 6% sprays significantly improved tiller count, panicle number, and plant height compared to the 2% spray and control. In

Tiruvallur, three treatments were tested: conventional practices as control, *Plankton*^{Plus} 5% with two applications, and *Plankton*^{Plus} 6% with two applications both combined with conventional practices. *Plankton*^{Plus} treatments reduced the need for ammonium sulfate during the panicle initiation stage, with no significant yield differences between treatments and also resulted in no pest incidence, eliminating pesticide use. A third trial in Tiruvallur tested 0%, 5%, 8%, and 10% foliar applications, with the highest yield observed at 10%. These findings highlighted the potential of *Plankton*^{Plus} to boost paddy production, reduce synthetic input reliance, and promote sustainable farming practices.

Application of *Plankton*^{Plus} for enhancing production of paddy, Tamil Nadu

Evaluation of potential use of *Plankton*^{Plus} in carp culture involving farmers of ST communities in Sunderban

Experiments were conducted to evaluate the application of CIBA-*Plankton*^{Plus} in low-saline carp culture as a sustainable livelihood option for tribal communities in Mousuni Island, South 24 Parganas, West Bengal. Eighteen earthen ponds (200–1000 m²) belonging to economically disadvantaged farmer families were selected for the study. Six treatments were tested: Control (Mustard Oil Cake @200 kg/ha + Farm Yard Manure @1.5 t/ha) and five dosages of CIBA-*Plankton*^{Plus} (T_1: MOC + FYM + 20 ppm, T_2: 20 ppm, T_3: 40 ppm, T_4: 60 ppm, T_5: 80 ppm without other inputs). The ponds were stocked with Indian Major Carps (IMC), specifically *Catla catla* and *Labeo rohita*, at a stocking density of 1 fish/m² with an initial average body weight of 111.11 g and 33.33 g, respectively, in a 1:1 ratio (*catla:rohu*). A cost-effective formulated feed, provided by ICAR-CIBA, was administered at 2% of the fishes' body weight. The highest yield of IMC was recorded in treatment T_2. The highest average body weight (ABW) was achieved by Rohu in T_3 and Catla in T_2, while T_2 recorded the highest density of phytoplankton and zooplankton. Beneficiaries earned ₹3,98,154 from fish sales in the demonstration ponds, significantly enhancing their livelihoods.

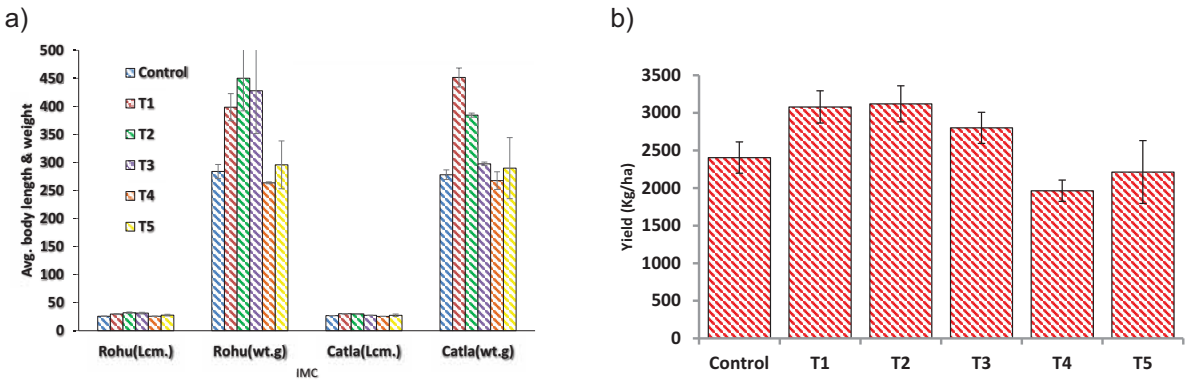
Field validation of use of *Plankton*^{Plus} for enhanced production in potato and vegetable cultivation involving farmers of SC communities

The experiment was conducted in 24 plots, each measuring 6 m² (3 m × 2 m), arranged in a factorial randomized block design (RBD) with eight treatments and three replications. The treatments included two factors: Factor A, the dose of *Plankton*^{Plus} at four levels (0%, 5%, 6%, and 7%), and Factor B, the level of inorganic fertilizer at two levels (100% RDF and 75% RDF), where 100% RDF represents the recommended

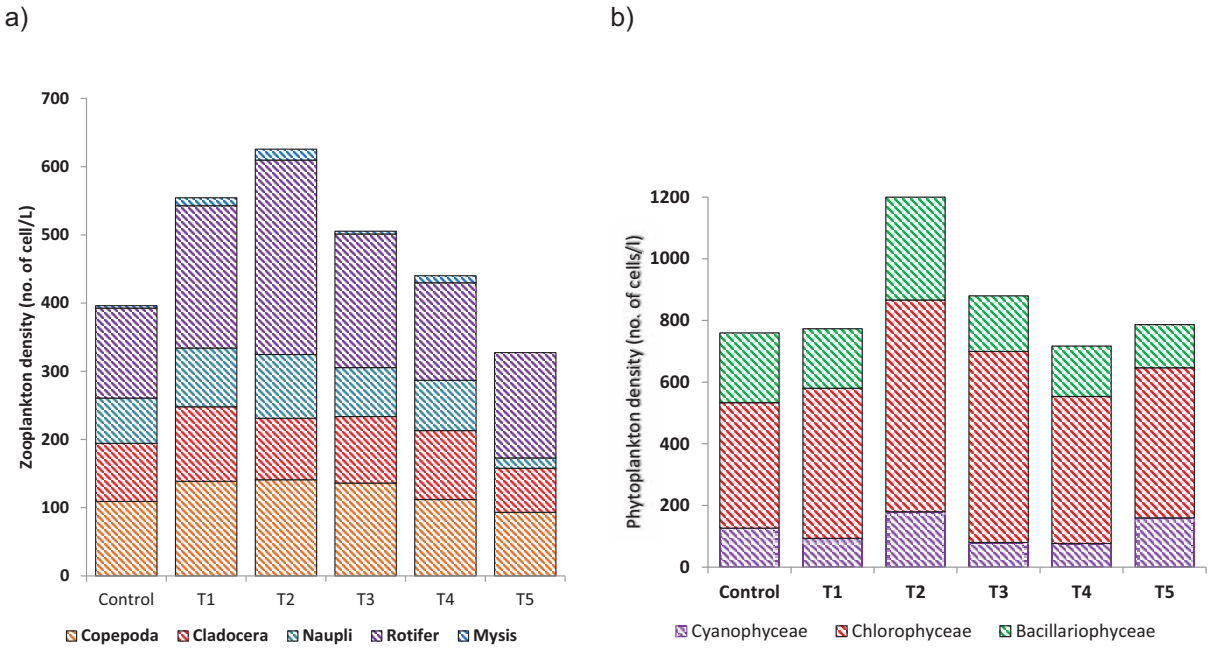

Harvested shrimp by the Budhakhali Sundari Scheduled Caste Fish Farmers Welfare Society, West Bengal

dose of fertilizer (150-100-100 $N\text{-}P_2O_5\text{-}K_2O$). Potato cultivation was carried out over 90 days, adhering to standard agronomic practices. Foliar application of *Plankton*^{Plus} at 5% showed a significant positive impact on potato yield at both levels of inorganic fertilizer, leading to a 7.29% to 9.5% yield increment compared to the control (no *Plankton*^{Plus} with full RDF). Notably, this yield improvement was achieved even with a 25% reduction in inorganic fertilizer application.

A study was conducted to evaluate the effect of *Plankton*^{Plus} on vegetable yields using a plot size of 3 m² (3 m × 1 m) for each crop. Two treatments were compared: T_1, which included the conventional package of practices with *Plankton*^{Plus}, and T_2, which followed the conventional package of practices without *Plankton*^{Plus}. Statistical analysis was performed using a paired t-test, and the results indicated a significant increase in vegetable yields with the application of *Plankton*^{Plus} (t-calculated = 2.961 > critical value = 2.365). The percentage yield increase under T_1 compared to T_2 was notable across all crops: German turnip (46.9%), cauliflower (22.3%), cabbage (26.2%), broccoli (14.3%), knol khol (39.8%), capsicum (19.6%), tomato (93.2%), and brinjal (22.5%). These findings confirmed the significant positive impact of *Plankton*^{Plus} on vegetable production.



Effect of different treatments on (a) yield of IMC and (b) growth performance of *Rohu* and *Catla*



Effect of different treatments on (a) Zooplankton and (b) phytoplankton density &diversity during culture

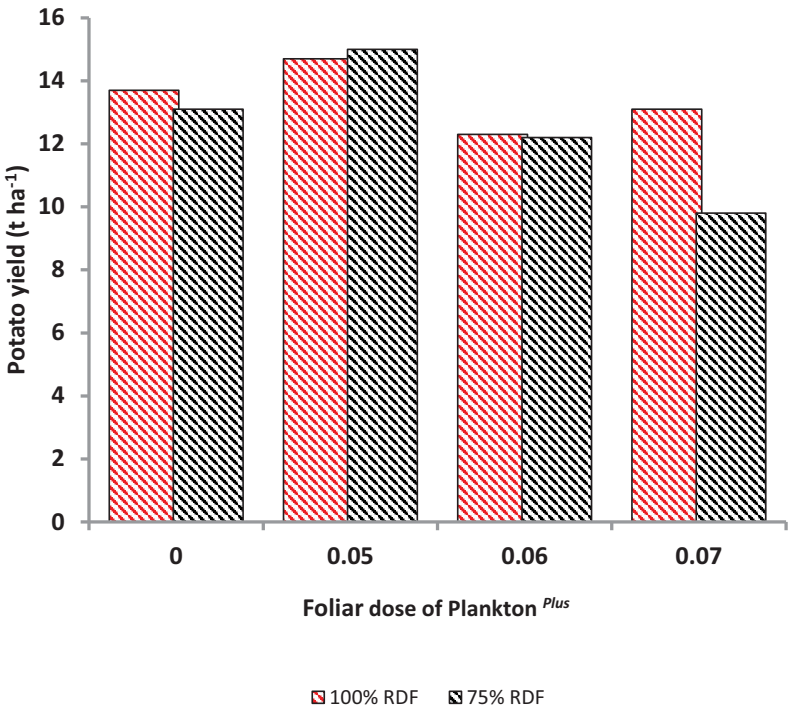
Demonstration of economically viable diversified finfish farming model

Under the institute's TSP program, diversified finfish farming–including Asian seabass, milkfish, grey mullet, and pearlspot–has been undertaken at the farm of beneficiary Mr. Jagabandhu Bar in Balasore District, Odisha. Inputs such as fish seed and feed were supplied to his farm in a phased manner. In previous years, around 10,000 milkfish seeds (priced at ₹8.00 each) were provided to Mr. Jagabandhu Bar. The milkfish fingerlings (5–8 cm TL) underwent a pre-grow-out phase for 60 days. After this period, juveniles (20–25 g / 12–15 cm TL) were stocked in an earthen pond along with grey mullets to implement a polyculture farming model. ICAR-CIBA also supplied 10,000 grey mullet seeds (priced at ₹4.95 each) along with the milkfish. Additionally, a total of 595 kg of nursery, pre-grow-out, and grow-out feed (0.8 mm to 3.0 mm size), worth ₹48,025, was supplied to support the farming activities. In September 2024, approximately 10,000 seabass and 5,000 pearlspot seeds were supplied for separate pond-based farming. In August 2024, an additional 4,300 kg of nursery and grow-out feed was provided to support all the mentioned farming activities. As of 330 days of culture (DOC), milkfish have reached an average size of 700 g, with an expected total production of 4.5 tonnes from multiple harvests. The estimated harvest size is projected to reach 1,000 g at 480 DOC. On August 7, 2024, scientists from CIBA conducted a farmer interaction meet with SC/ST farmers in Sahana village. Around 130 farmers participated in the event and witnessed the partial harvest of milkfish. To date, ₹2.24 lakh has been realized as net revenue and shared among the beneficiaries.

Livelihood Appraisal and Aquaculture-Based Intervention for Economic Upliftment in Mathaampattinam Village, Tamil Nadu

Mathaampattinam village in Sirkali taluk, Mayiladuthurai District, Tamil Nadu with 86 members of Scheduled Class community was selected for implementing the project. A baseline study was conducted in the village to understand their livelihood status. The data indicated that more than half of the active population was relatively young (< 40 years), majority of them were literate with primary to middle school level education and children were mostly matriculates employed as skilled workers like electrician, plumber etc. in nearby towns. All were non-vegetarian with a per capita seafood consumption of 18-20 kg per annum. Most of the houses are semi-pucca type, electrified and had gas connection but limited access to potable water and household toilet. The livelihood status of the beneficiaries indicated that none of them had land, most of them worked as agricultural labourers in the agricultural season and in the National Rural Employment Guarantee Programme popularly known as 100 day work. Majority of the women and several men were free for 15 days a month and willing to work.

The average family annual income was in the range of Rs.24,000-1,68,000 with an average monthly income of Rs.2000 to 14,000. The agricultural labour, skilled employment and 100 day work constituted 36%, 42% and 22% respectively of their annual income. In case of expenditure, expenses on food provisions, expenditure on social events, medical, transport, educational expenses, miscellaneous expenses constituted 36%, 26%, 16%, 10%, 9% and 2% respectively. None of them could



Effect of *Plankton*^{plus} on Potato Yield across different inorganic fertilization level

Partial harvest of milkfish

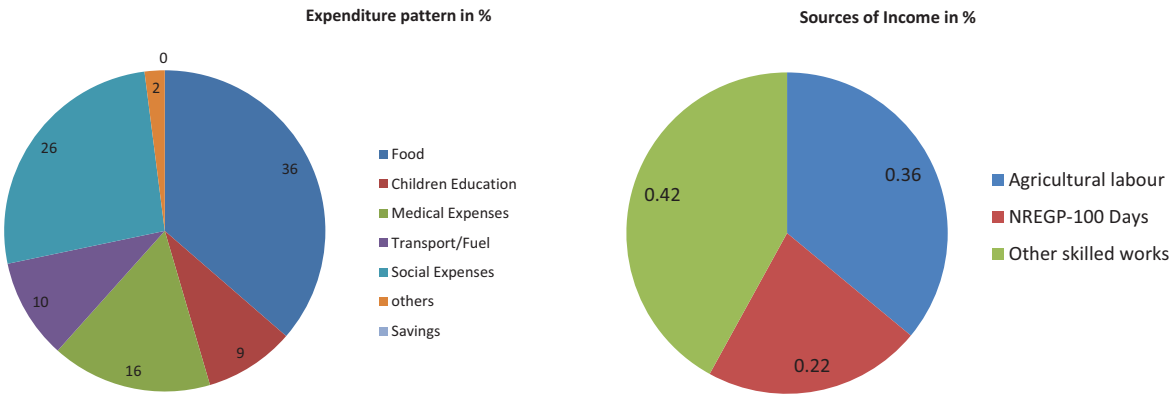
Farmers interaction meet, Sahana village, Balasore, Odisha

kept a portion of their income for saving, which testimony that their livelihoods are unstable. During the appraisal the villagers felt that aquaculture and poultry/goatery could be the better options for them as an additional livelihood activity.

The village has a brackishwater resource, Uppanar river flowing adjacent to the village with a depth of 2-3 m, salinity 15-28 ppt range with the bar mouth open for most of the time (9-10 months), hence, brackishwater aquaculture in the backwaters was an option for their livelihood improvement. Similarly, a small unit of poultry or goatery at their house backyard could provide them additional employment and income.

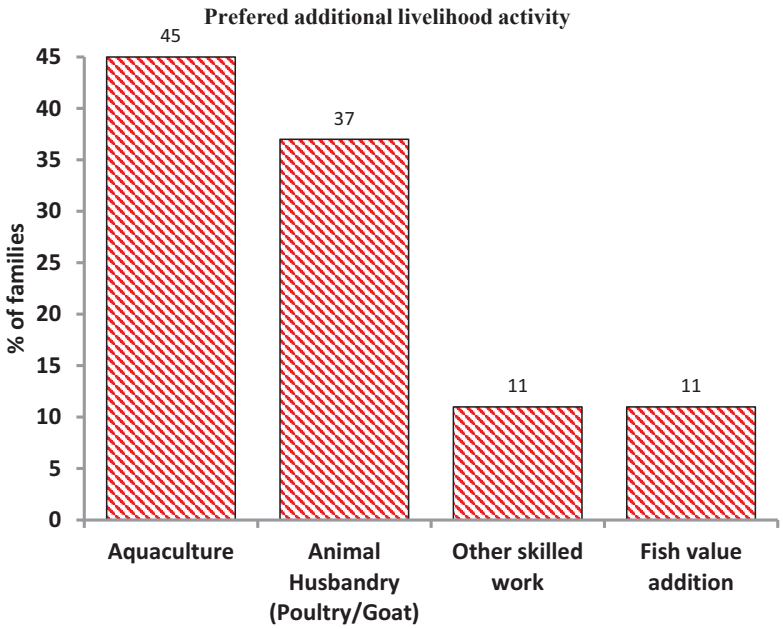


Base line study in the village.



Expenditure & Income pattern

ICAR-Central Institute of Brackishwater Aquaculture (ICAR-CIBA), Chennai and M.S. Swaminathan Research Foundation, Tamil Nadu signed a Memorandum of Understanding for collaborative technology validation and extension on 5th January, 2024 to enhance the livelihoods of resource-dependent communities including Scheduled Caste and Scheduled Tribes of the coastal districts. An exposure visit was arranged for the aquaculture beneficiaries in CIBA adopted village, Kottaikadu during 14-15th March, 2024.



Alternative livelihood activity

Human Resource Development (HRD) Training, Capacity Building and Skill Development

TRAINING PROGRAMS ATTENDED
Scientist Staff
Jan 2024- December 2024

S.No.	Name and designation of the Person	Programme Name	Venue	Duration	Organized by
1	Dr. J. Syama Dayal, Principal Scientist	Measurement Uncertainty	Delhi	28-29th February 2024	NITS Bureau
2	Mrs. Moumita Ash, Scientist	Use of remote sensing and GIS in assessing water quality indices, predicting shoreline changes and generating digital soil mapping.	Kolkata Regional Centre	4-6th March 2024	ICAR-NBSS&LUP, Kolkata
3	Dr. Riteshkumar Shantilal Tandel, Scientist	NABL Assessors Training Course on ISO/IEC 17025:2017	Chennai	11- 15th June 2024	NABL Assessors
4	Dr. J. Raymond Jani Angel, Senior Scientist	Agri-business Incubation	Hyderabad	3- 5th July 2024	ICAR -NAARM, Hyderabad
5	Ms. Moumita Ash, Scientist	Online Training Programme on "Multivariate Data Analysis Using R"	Hyderabad	22-26th July 2024	ICAR -NAARM, Hyderabad
6	Dr. P.S. Shyne Anand, Senior Scientist	Training programme (Online mode) on "Multivariate Data Analysis Using R"	Hyderabad	22-26th July 2024	ICAR- NAARM, Hyderabad
7	Dr. J. Raymond Jani Angel, Senior Scientist	Generative AI	Hyderabad	26-28th July 2024	ICAR -NAARM, Hyderabad
8	Dr. M. Makesh, Principal Scientist	National workshop on 3D Bio printing Technology	Chennai	21-23rd August 2024	Sathyabama Institute of Science and Technology, Chennai
9	Ms. Babita Mandal, Scientist	Genetic management of carp brood stock for quality seed production	Bhubaneswar	19-23rd August 2024	ICAR-CIFA, Bhubaneswar
10	Dr. P.S. Shyne Anand, Senior Scientist	Training programme on "CRISPR editing in fish"	Uttarakhand	27 August -02 September 2024	ICAR-DCFR, Bhimtal
11	Dr. C P Balasubramanian, Principal Scientist and HOD, CCD	"Orientation program for retiring Govt. Officials"	Hyderabad	Aug 29, 2024	ICAR-NAARM, Hyderabad
12	Dr. C V Sairam, Principal Scientist	Vigilance Perspectives for ICAR Officers	Hyderabad	6-8th November 2024	ICAR-NAARM, Hyderabad
13	Dr. R. Ananda Raja, Principal Scientist	Advanced workshop on "Confocal microscopy techniques"	Chennai	11-13th November 2024	Satyabama University, Chennai
14	Dr. Vidya Rajendran, Senior Scientist	International Hands-On Training Course on Utilizing Microbiome and Genomic Resources for Understanding and Mitigating Antimicrobial Resistance in the One Health Context	Mangalore	18-22nd November 2024	FAO Centre, NITTE university
15	Dr. Aritra Bera, Senior Scientist	Genome editing using CRISPR technology in farmed fish and RAS rearing facilities	Norway	11th November -7th December 2024	Institute of Marine Research and Nofima
16	Dr. Sherly Tomy, Principal Scientist	Genome editing using CRISPR technology in farmed fish and RAS rearing facilities	Norway	11th November -7th December 2024	Institute of Marine Research and Nofima

Administrative Staff

S.No.	Name and designation of the Person	Programme Name	Venue	Duration	Organized by
1	Shri Aswin Haridas, A.O.	Foundational Training for Newly Recruited AOs and FAOs	Delhi	3- 28th June 2024	ISTM , OBC NAARM, Hyderabad
3	Shri. Anand S. T., Assistant	Orientation Training Programme for Newly recruited Assistants (Direct Recruitment)	Bengaluru	21- 25th October 2024.	IIHR, Bengaluru
4	Pradeep Biradar, Assistant	Orientation Training Programme for Newly recruited Assistnats (Direct Recruitment)	Bengaluru	21-25th October 2024	IIHR, Bengaluru
5	Vishal Dattatray Hinge Assistant	Orientation Training Programme for Newly recruited Assistnats (Direct Recruitment)	Bengaluru	21-25th October 2024	IIHR, Bengaluru
2	Smt. S. Nalini, Private Secretary	Administrative & Financial Management	Hyderabad	25-29th November 2024	ICAR-NAARM , Hyderabad
6	Shri. Anand S T Assistant	Training Programme on Administrative and Financial Management	Hyderabad	25-29th November 2024.	ICAR-NAARM, Hyderabad

Training Programmes Conducted

S.No.	Name of the Training	Duration	No. of Participants
1	Aquabiz	22-27 January, 2024	38
2	Certificate Course on Risk Management Survey and Loss Assessment in Shrimp Farming	19-23 February 2024	40
3	Workshop Smart Aquaculture- 2024	22-23 March 2024	25
4	Biofloc Based Smart Aquaculture	22-25 April 2024	13
5	Certificate course on Shrimp Crop Insurance	29 April-3rd May, 2024	22
6	National workshop on Climate Risks and Adaptations in Fisheries, at CIBA, Chennai	3-4 May, 2024	34
7	On-farm training cum interaction on improved nursery rearing and cage culture of seabass as an additional income generation activity under the SCSP programme	July 02, 2024	70
8	On-farm training cum farmers meeting on brackishwater aquaculture technology options for the SC/ST fishers of Shahada, Balasore, Odisha	7th August, 2024	130 farmers
9	Recycling of fish waste to value-added products among coastal communities	1-2 August, 2024	60
10	Certificate Course on Shrimp Crop Insurance and Loss Assessment at ICAR CIFE Kolkata	5-9th August 2024	36
11	Hands-on training programme on Bioinformatics Tools and Techniques	2-7, September 2024	22
12	Hands-on training programme on "Improved Technologies for Breeding, Seed Production and Farming of Candidate Brackishwater Finfishes"	9-13 September 2024	12

KRC

S.No.	Name of the Training	Duration	No. of Participants
1	Brackishwater aquaculture under the student ready programme for the 4th year B.F.sc students of college of fisheries, Gumla, Jharkhand	May 21st to June 3rd 2024	24
2	"Disease Management of Brackishwater Aquaculture"	December 9-14, 2024	6

NGRC

S.No.	Name of the Training	Duration	No. of Participants
1	Brackishwater finfish and shellfish farming practices for livelihood generation for scheduled Caste and Scheduled Tribal communities of Gujarat	4-7th March, 2024	60

Ph.D. Awarded

Ms C. Saranya

Ms C. Saranya was awarded PhD by University of Madras for her research on the topic "Microbial assemblage and their dynamics in biofloc based nursery rearing and grow-out system of *Penaeus (Litopenaeus) vannamei*". She did her research under the guidance of Dr A Panigrahi, Principal Scientist, Crustacean Culture Division of ICAR-CIBA

Mr. Muddukrishnaiah K

Mr. Muddukrishnaiah K, was awarded PhD by the Anna University, Chennai for his research on the subject, "Isolation and identification of antimicrobial agents from marine bacteria". He did his PhD under the guidance of Dr. M. Makesh, Principal Scientist, Fish Culture Division of ICAR-CIBA

Mr. Sabyasachi Kabiraj

Mr. Sabyasachi Kabiraj, was awarded PhD by the Anna University, Chennai for his research on the subject, "Change dynamics of salt affected lands using machine learning algorithms on remote sensing data for framing coastal management strategies". He did his PhD under the guidance of Dr. M. Jayanthi, Principal Scientist,Crustacean Culture Division of ICAR-CIBA

Workshops, Seminars & Meetings 2024 - (Jan-Dec)

Honourable Cabinet Minister of Forest, Cultural affairs and Fisheries, Government of Maharashtra Shri Sudhir SachchidanandMungantiwar, launched ICAR-CIBA project on Geospatial mapping funded by Govt. of Maharastra

Govt. of Maharashtra funded ICAR-CIBA project on "Geospatial mapping of potential zones for the expanding responsible aquaculture in Maharashtra". The project was inaugurated by the Honorable Cabinet Minister of Forest, Cultural affairs and Fisheries, Shri. Sudhir SachchidanandMungantiwar,on February 6, 2024 at Mumbai, Maharashtra. The Minister highlighted the importance of developing aquaculture in Maharashtra by utilizing the resources in an environmentally sustainable manner. The 95 lakhs project has been funded by Mangrove cell and Mangrove foundation through Department of fisheries, Government of Maharashtra, and it is aimed to expand sustainable coastal aquaculture. Dr Atul Patne, IAS, Commissioner of Fisheries, Government of Maharashtra narrated the need of the project. Dr Ramo Rao, IAS, Additional Principal conservator of Forest stated the initiative of mangrove cell and mangrove foundation in protecting the mangroves in Maharashtra. Dr Kuldeep K Lal, Director, ICAR-CIBA has detailed the importance of the project and CIBA technologies, and thanked the Department of Fisheries for supporting ecofriendly aquaculture development. Dr M. Jayanthi, Principal Scientist and Principal investigator of the project, ICAR-CIBA, presented the objectives and deliverables of the project and the work plan to promote responsible aquaculture.

ICAR-CIBA and its Regional Centres celebrated the 75th Republic Day of the Nation

ICAR-CIBA headquarters and its regional research centres at Kakdwip (West Bengal) and Navsari (Gujarat) celebrated the country's 75th republic day on 26th January, 2024 with fervor and patriotism. Dr Kuldeep K Lal, Director, ICAR-CIBA unfurled the National Flag and conveyed his greetings to all the colleagues. In his speech he highlighted the institute's significant Research and Development programmes during the last year like the progress made in Indian White Shrimp (*Penaeus indicus*) breeding and farming with cleaned broodstock, development of SOPs for screening of *P. indicus* broodstock, breeding and larval rearing. Development of shrimp larval feed and EHP-Cura-I are the CIBA's important contributions to the sector, he underlined. Shrimp Farmer Conclaves and initiatives for the popularization of shrimp crop insurance were the noteworthy activities in the development front he emphasized. As the shrimp farming sector is vibrant and progressive, the institute need to be vigilant and prepared to address the expectations of the sector in a time bound manner he added. The director handed over the appreciation certificates to all the scientists and technical officers who have participated in the Viksit Bharat Sankalp Yatra programme conducted by the Govt. of India during 15th November, 2023 to 25th January, 2024 during the occasion.

Dr S. Kannappan, Principal Scientist & Officer-in-Charge of Muttukadu Experimental Station, Dr Debasis De, Head of Research Centre, Kakdwip and Shri Pankaj A Patil, Nodal Officer, Navsari Gujarat Research Centre of CIBA, hoisted the National Flag at the centres and celebrated the Republic Day.

ICAR-CIBA Celebrated International Women's Day-2024

ICAR-CIBA, Chennai, celebrated International Women's Day on March 8, 2024, to commemorate the remarkable achievements of women and also to identify the challenges that women still face. Dr Jane Prasad, Registrar of IIT-Madras, was the chief guest and delivered a talk on "Invest in Women: Accelerate Progress," emphasizing the importance of women's empowerment and education and their relevance for the progress of India. In addition, her talk also highlighted different schemes introduced by the government, incorporating the changed focus from "women's development" to "women-led development." Dr Prasad shared her valuable experiences on balancing professional and personal life, urging women to pursue their dreams and actively participate in the progress of the nation. Information on the research opportunities and other academic courses available at IIT-Madras was also shared during the interaction session. Dr C. P. Balasubramanian, Director in-charge of ICAR-CIBA emphasized the dual roles women play encompassing traditional expectations and modern opportunities in his address. His speech highlighted the societal changes toward women's empowerment through education and economic participation providing new opportunities for women. Dr Sherly Tomy, Principal Scientist and Chairperson of Women Cell in her address gave on the importance of women's involvement and empowerment for the holistic development of the society.

ICAR-CIBA Celebrated World IP Day

World Intellectual Property Day, was celebrated at the Central Institute of Brackishwater Aquaculture (CIBA), Chennai on April 29, 2024. The main theme was to create awareness on IP rights and their role in encouraging innovation and creativity to young inventors, creators, entrepreneurs, researchers, and academicians to develop an interest in the Intellectual Property system. Even though young minds have entered science, technology, engineering, and allied fields in recent years, a wide gap exists in the IP system. To overcome the challenges facing the IP portfolio system and to motivate them through inspiring activities, World IP Day was organized.

Dr C. P. Balasubramanian, Director In-charge, CIBA welcomed the guest speaker and delivered the opening remarks. Dr Rajiv Kumar Singh, Controller of Patents, Patent Office, Chennai delivered the expert lecture on the topic. He elaborated on the World Intellectual Property Organization (WIPO), its significance, genesis, voyage so far on IPR, trademarks and copyrights in the developing world. He covered distinct aspects of amendments in IP legislations, subject matter of copyrights, Scientists, students and technical officers participated in the interactive session. The meeting ended with a vote of thanks by Dr P. K. Patil, OIC, ITMU-ABI Unit of ICAR-CIBA. The event was attended online by the staff and scholars of regional stations of ICAR-CIBA.

ICAR-CIBA Celebrated World Environment Day-2024

ICAR-Central Institute of Brackishwater Aquaculture (ICAR-CIBA) and its regional centres, Kakdwip Regional Centre (KRC) and Navsari Gujarat Research Centre (NGRC) observed the World Environment Day on June 5th, 2024 with the theme 'Land restoration, desertification and drought resilience'. On this occasion, Dr M. Kailasam, Head, Finfish Culture Division & Director (I/c) along with the staff participated in planting of fruit tree saplings at Government Higher Primary School, Kanathur, Reddikuppam, Chennai to create awareness among the younger generation. Dr Debasis De, Head, KRC of ICAR-CIBA organised the tree plantation programme in the presence of esteemed guests Mr. Triloki Nath, Chief Manager, SBI, Kakdwip Branch, and Mr. Wasim Raza, Teacher and Quiz Master from SonamukhiJanakalyan Vidyapith, Sarisha South 24 Parganas district, West Bengal. Dr Ritheshkumar, Tandel, Scientist (SS) and staff at NGRC, CIBA planted saplings of ornamental and fruit trees at Matwad farm of NGRC. All the speakers shared their insightful thoughts on the significance of World Environment Day, emphasising the crucial role of tree planting in combating climate change and fostering environmental sustainability. Dr M. Muralidhar and Dr R. Saraswathy, Principal Scientists, ICAR-CIBA, Chennai coordinated the overall tree plantation programme.

International Yoga Day Celebrations at ICAR-CIBA, Chennai on 21st June 2024

ICAR- Central Institute of Brackishwater Aquaculture, Chennai and its regional stations have celebrated the International Yoga Day on June 21, 2024. Dr Janani Subburaj, Yoga & Naturopathy Junior Doctor has conducted Yoga practice session at 7 am. The Director, Dr Kuldeep Kumar Lal, Scientists, Officers, Staff and Students have actively participated in the practical yoga session along with family members. Ms Alka Nangia Arora, Additional secretary (DARE) & Financial Advisor (ICAR) Krishi Bhavan, New Delhi 110 001 also has participated along with CIBA.

On-farm training cum interaction meet on improved nursery rearing and cage culture of seabass as an additional income generation activity under the SCSP programme

ICAR-Central Institute of Brackishwater Aquaculture (ICAR-CIBA) conducted an on-farm training and interaction meeting at Kottaikkadu coastal village in Chengalpattu district, Tamil Nadu on July 2nd, 2024, as part of the livelihood development initiatives under the Scheduled Caste Sub-plan. About 70 participants from the villages of Kottaikadu and Kolathur, participated in the training. Dr Kuldeep Kumar Lal, Director, CIBA handed over a cheque for Rs. 6.7 lakhs the income earned by the fisher Self-Help Groups through the sale of fish fingerlings and fishes reared in seabass nursery and cages with the technological support of ICAR-CIBA during 2023-2024. In his presidential remarks he stressed the importance of skill development, advanced grading techniques to improve survival rate, regular and continuous production supply of fingerlings for cage culture.An extension publication on Improved nursery rearing practice for fingerling production of Asian seabass (*Lates calcarifer*) was released. Additionally, participants were provided 6000 seabass fry for next cycle of nursery rearing along with safety kits. The participants gave their feedback and highlighted their livelihood enhancement through SCSP program of ICAR-CIBA. Dr R. Geetha, Senior Scientist & PI of the SCSP project at Kottaikkadu welcomed the gathering and apprised about the interventions undertaken and achievements of the project. Dr M. Kailasam, Principal Scientist & Head, FCD explained the details of technical aspects. Dr R. Jayakumar, Principal Scientist, Fish Culture Division conducted Hands on training on mechanical graders. Dr P. Mahalakshmi, Principal Scientist & Nodal Officer, SCSP underlined the main objective of the corpus fund. In the concluding session, Dr D. Deboral Vimala, Principal Scientist, SSD encouraged the fisher folk to utilize the advantage of improved technologies developed by the ICAR-CIBA and proposed vote of thanks.

ICAR CIBA and MSSRF jointly observed National Fish Farmers Day

ICAR CIBA and Fish for All Research and Training Centre of MSSRF Poompuhar jointly celebrated the Fish farmers' day onNovember10th, 2024 at Mathamppatinam village in Mayiladhuthurai district of Tamil Nadu. About 80 fishers including men and women participated in the event. Dr M. Kumaran Principal Scientist ICAR CIBA briefed about the significance of National Fish Farmers Day and the role of fish farmers in Indian economy. Dr R. Subburaj Chief Technical Officer ICAR CIBA highlighted on technical aspects of nursery rearing of Asian Seabass (Lates calcarifer). Dr VelVizhi Director Fish for All Research and Training Centre Poompuhar emphasized on importance of cohesiveness in group farming. ICAR CIBA and MSSRF are implementing Livelihood generation project for Scheduled Castes in this village

ICAR-CIBA participated in the Fisheries Summer Meet – 2024

ICAR-Central Institute of Brackishwater Aquaculture (ICAR-CIBA) participated in the Fisheries Summer Meet-2024 organised by the Department of Fisheries, Government of India on July 12, 2024 at Madurai, Tamil Nadu. The exhibition stall of ICAR -CIBA displayed the technologies developed by the institute. It consisted of candidate species of shellfish and finfishes suitable for brackishwater aquaculture, new age shrimp farming technology, nutritional solutions for fish, shrimp, larval and growth systems, genetic improvement program for Penaeus indicus, shrimp crop insurance, developing value added products from fish wastes, disease diagnostics, healthcare products to control *Enterocytozoon hepatopenaei* (EHP) and precision aquaculture technologies. In addition to that live specimen of fishes, shrimp, and crabs were also displayed for creating awareness to the farmers and other stakeholders, arrangements were also made for TV display of CIBA technologies and pamphlets in multilingual languages. Shri Rajiv Ranjan, the Honourable Union Minister of Fisheries Animal Husbandry and Dairying (MóFAH&D), Govt. of India, Prof. S. PSingh Baghel and Shri. George Kurian, Honourable Union Ministers of State Fisheries Animal Husbandry and Dairying visited the stall and Dr JK Jena, Deputy Director General (Fisheries), ICAR explained the activities taken up by ICAR-CIBA. Fish farmers, fisher folk, Officials from Development Departments including from other states visited the stall and interacted with the CIBA team. Dr T. Ravisankar, Dr D. Deboral Vimala, Dr R. Jayakumar, Dr PEzhil Praveena, Principal Scientists and Dr S. Sivagananam, Chief Technical Officer (CTO) and Shri C. Saravanan Technical Officer coordinated the event.

ICAR-Central Institute of Brackishwater Aquaculture (ICAR-CIBA), Chennai and ICAR-Central Institute of Fisheries Education (ICAR-CIFE) jointly organized a Certificate Course on Shrimp Crop Insurance and Loss Assessment at ICAR CIFE Kolkata during 5-9th August 2024

Shrimp Crop Insurance is gaining importance once again since 2020-21 thanks to the efforts of ICAR-CIBA duly supported by the National Fisheries Development Board (NFDB), Govt. of India. In order to train the personnel of insurance companies and other stakeholders', ICAR-CIBA jointly with ICAR-CIFE conducted a series of Certificate Courses on 'Shrimp Crop Insurance and Loss Assessment'. The third course was conducted at ICAR-CIFE Kolkata during August 5-9, 2024. A total of 45 participants including Officials from Insurance industry, State Departments, Startups, farmers and students attended this program.The core course content included overview on global and Indian shrimp industry, shrimp crop insurance Genesis and growth, crop cultural, management of nutrition, feed and disease aspects, socio economic analysis, shrimp insurance genesis and development, shrimp insurance policies details, role of surveyor and loss assessment etc. The course also included a field visit to Shrimp farm and to the Kakdwip Research Centre of CIBA, West Bengal. The course was inaugurated by Dr Kuldeep Kumar Lal, Director, ICAR-CIBA Chennai and in his inaugural address highlighted the International and Indian shrimp industry scenario and importance of shrimp crop insurance. Dr A. K. Jena Additional Director of Fisheries, Department of Fisheries Government of West Bengal stated that aquaculture is gaining importance in the State economy, and such courses would definitely provide technological skills to the shrimp farmers. Professor Abraham from University of Animal and Fisheries Sciences University, Kolkata stated that viral and bacterial pathogens cause major diseases to shrimp and this course will provide the knowledge to manage them thereby reducing the production and economic loss.Dr C. N. Ravishankar, Director and Vice Chancellor of ICAR-CIFE Mumbai chaired the valedictory session conducted on August 9, 2024.

ICAR-Central Institute of Brackishwater Aquaculture (ICAR-CIBA) and its Regional Centres organized interaction meet with brackishwater aquaculture farmers

ICAR-Central Institute of Brackishwater Aquaculture (CIBA), Chennai and its regional centres at Kakdwip, West Bengal and Navsari, Gujarat have organized an interaction meeting with brackishwater aquaculture farmers at its Muttukkadu Experimental Station (MES), Chennai on August 11, 2024 during the occasion of dedication of 109 bio-fortified and climate resilient crops varieties developed by the ICAR to the country by Shri. Narendra Modi, Hon'ble Prime Minister of India at the Research Farm of ICAR-IARI, Pusa, New Delhi. About 154 brackishwater aquaculture fish farmers from the adopted villages participated in the meeting. The brackishwater fish farmers interacted with the scientists and expressed their gratitude to CIBA in extending technical support to them to undertake brackishwater aquaculture to improve their livelihood. Subsequently, the fish farmers visited the ICAR- CIBA research facilities to understand the feed preparation techniques, mud crab hatchery, shrimp seed production, finfish hatcheries and nursery rearing units. Farmers interacted with the scientists and technical staff about various technologies of ICAR- CIBA to diversify the brackishwater aquaculture. The participants have shown keen interest to upscale their seabass nursery rearing and cage farming activities. Further, the farmers expressed their interest to take up mud crab culture in the backwaters adjacent to their villages and requested the help from ICAR- CIBA.Dr Deboral Vimala, Principal Scientist, Social Science Division delivered the welcome address and narrated the ICAR's initiatives in bringing climate resilient varieties for farming. Dr C. P. Balasubramanian, Head, Crustacean culture division presided over the function and explained the prospects of brackishwater aquaculture with special emphasis on mud crab farming. Dr K. Ambasanakar, Head, Nutrition, Genetics and Biotechnology division narrated about the importance of developing climate resilient varieties for sustainable food production and the role of balanced nutrients in brackishwater aquaculture. Dr M. Kailasam, Head, Fish Culture division highlighted the benefits of brackishwater finfish farming for improving the livelihood of rural fishers. Dr P. Mahalakshmi, Principal Scientist and Coordinator of SCSP and TSP programmes explained about the government initiatives to improve the income generating avenues of the rural communities.

ICAR-CIBA organised an Interaction meet for Development of Action Plan for Scheduled Caste sub plan programme

ICAR-CIBA has organized an interaction meeting at Kottaikadu village, Chengalpattu District of Tamil Nadu with the beneficiaries under the Schedule Caste Sub Plan (SCSP) programme involved in brackishwater nursery rearing and cage farming of Asian seabass Lates calcarifer, and Mud crab farming in monoculture and polyculture system on August 29, 2024. A total of 60 members from Dr APJ Abdul Kalam Magalir Meen VazharpuKuzhu, Kadal Raja Aangal Meen vazharpu kuzhu of Kottaikadu village and Dr B. R. Ambethkar Aangal Meen vazharpu kuzhu of Kolathur village and Pattipulam village, Chengalpattu District, Tamil Nadu, attended the meeting. Shri. Sethuraman representing M/s. Global Agri System Pvt. Ltd., New Delhi participated in the meeting to evaluate the progress and implementation of the SCSP programme. Dr P. Mahalakshmi, Principal Scientist and Nodal Officer of SCSP programmes of ICAR-CIBA delivered the welcome address, and narrated about the implementation of the SCSP programmes taken up in these villages. Dr T. Ravishankar, Scientist In charge, Social Science division explained about the need for inclusive growth, uplifting the livelihood of the rural Scheduled Caste communities through adoption of ICAR- CIBA technologies. Further he narrated the importance of unity among the group members, creating corpus fund and effective utilization of their spare time for additional income generating activities. Dr R. Jayakumar, Principal Scientist, Fish Culture division stated that after hands on training and continuous hand holding from the ICAR – CIBA these groups generated revenue of Rs. 17,01,800 during 2022-24 by adopting scientific farming methods. Mr R Aravind and Dr K. P. Sandeep explained about monoculture of mud crab farming, polyculture of mud crab with milkfish and mud crab with indigenous shrimp, integration of seaweed with mud crab and crab fattening with modified crab boxes adopted by the farmers.

ICAR-CIBA Celebrated the 78th Independence Day with zeal and commitment

ICAR-Central Institute of Brackishwater Aquaculture and its Regional Centres at Kakdwip, (West Bengal), Navsari (Gujarat), and Experimental Station at Muttukadu, Chennai celebrated 78th day of independence with a sense of pride and commitment for progressive growth in the focused areas of research and development. Dr Kuldeep K Lal, Director unfurled the National Flag and conveyed his Independence Day greetings to everyone. In his Independence Day speech to the scientists and staff he expressed his satisfaction about the achievements of the institute in the areas of precision shrimp farming, mudcrab larval rearing, finfish farming, seaweed farming, feed formulations, diagnostics, prophylactic protocols, carbon crediting and ecosystem management, genome editing, technology commercialization, decision support, domestic consumption of fish, crop insurance, capacity building and societal development. He emphasized the principles of 'need based and strategic focus', 'collective wisdom through team building', 'location/system specific farming models for different stratum of clients' and 'interdisciplinary, integration, uniqueness and novelty'

Navsari Gujarat Research Centre of ICAR-CIBA, jointly with Navsari Agricultural University, KVK, Navsari and Livestock Research Station, Kamdhenu University established an Integrated Aqua-Agri-Poultry-Goat Farming Unit at Sultanpur Village in Gujarat

Navsari Gujarat Research Centre of ICAR-CIBA, Navsari, Gujarat implemented an Integrated Aqua-Agri-Poultry-Goat Farming Unit at Sultanpur Village in Navsari District, on August 23, 2024 under the Scheduled Tribe Component (STC) for coastal tribal communities. The unit was formally inaugurated by Dr Z. P. Patel, Vice Chancellor, Navsari Agricultural University in the presence of Dr Kuldeep Kumar Lal, Director ICAR-CIBA, Chennai and Dr S. R. Chaudhary, Principal, College of Fisheries, Navsari. An interaction meet on livelihood opportunities for tribal communities was also conducted along with the event in the presence of scientists from ICAR-CIBA, subject matter specialists from KVK, Navsari and Livestock Research Station, Kamdhenu University. The inauguration cum interaction meet was attended by more than 150 tribal beneficiaries from Sultanpur, Eroo, Abrama and Singod villages of Navsari. The integrated unit is spread over a total area of 1.5 ha with a brackishwater pond of water spread area 1.0 ha and the dike area houses poultry and goat rearing sheds and horticulture activities. The unit encompasses nursery and grow out farming of high value brackishwater finfish and mud crab box culture along with animal husbandry and horticulture.

The tribal self-help group (SHG), Sultanpur Halpati Matsya Mandal, was trained during March, 2024 and activities were initiated during April, 2024. Inputs such as fish seed, feed, safety equipment, mango sapling and goats were distributed to the SHG. The group also received a cheque for Rs. 1.06 Lakhs against sale of milkfish fingerlings and poultry within a short period of three months of post intervention. The waste to wealth products developed by the institute such as CIBA-plankton plus, CIBA-Horti plus ICAR-CIBA were distributed to the beneficiaries for promotion of natural farming, and the products were also showcased to the staff of KVK, Navsari and Navsari Agricultural University for collaborative research on natural farming. Dr A. K. Shah, Head and Senior Scientist K. V. K. Navsari, Dr. Akshaya Panigrahi, OIC, NGRC of ICAR-CIBA and Dr P. Mahalakshmi, Nodal Officer, STC & SC SP, ICAR-CIBA addressed the gathering and detailed the activities taken up by the institute. Mr Pankaj Patil, PI, STC project Navsari, detailed the various components of the integrated model and livelihood opportunities of the technology. The integrated farming model was first successfully demonstrated in the tribal village of Singod during 2021-24 resulting in a total revenue of 29.30 lakhs and tribal SHG is currently self-reliant. A cheque for Rs. 3.95 lakhs was distributed to the tribal SHG SingodHalpati Samaj Yuva Matsya Udyog Juth against sale of table sized fish and poultry during the current financial year. The program was coordinated by Mr Pankaj A Patil, Dr Ritesh Tandel, Dr Pragyan Dash and Mr Jose Antony, Scientists, NGRC of ICAR-CIBA.

Kakdwip Research Centre of ICAR-CIBA organized Farmers' Interaction Meet on Sustainable Shrimp Farming on September 10, 2024

A Farmers Interaction Meet on Sustainable Shrimp Farming was organized at the Kakdwip Research Centre of ICAR-CIBA on September 10, 2024. A total of 32 farmers from the Namkhana block of South 24 Parganas was participated in the meet. The event was sponsored by the Ms Sundeep Packaging Industry, Kolkata, MoU partner for CHINGUDI PLUS feed technology of ICAR-CIBA. The program commenced with a lamp lighting ceremony and welcome address by the Head of KRC. Mr Biju I.F., Scientist delivered a lecture on Best Management Practices of Shrimp Farming, while Dr Sanjay Das, Principal Scientist at KRC, provided insights into disease management aspects. Dr Debasis De, Head of KRC, elaborated on "CHINGUDIPLUS" and ideal feed management practices for sustainable shrimp farming. The interactive session witnessed engaging discussions between farmers and scientists from KRC on various aspects of shrimp farming.

ICAR-CIBA achieved a milestone in Mud crab aquaculture – CIBA demonstrated the farming of hatchery produced seed crabs to the marketable size in earthen pond

Mud crabs (*Scylla serrata*) have been high valued delicacy in the seafood markets. Mud crab aquaculture program of ICAR-Central Institute of Brackishwater Aquaculture reached a milestone in crab farming in earthen ponds with a harvest from hatchery reared mud crab instars (~2 g) to marketable size crabs (above 500 g) within 165 days. A production of 70 kg with an average body weight of 720 g was achieved. The survival rate was 45% reasonably high for mud crabs, from a rearing density of 300 crabs per acre pond. The produce yielded ₹1, 10, 250 for the beneficiaries. The institute demonstrated Mud crab farming of under the Scheduled Caste Special Program (SCSP) with coastal communities of Pattipulam village, Chengalpattu district, Tamil Nadu.A harvest cum field day was organised on 5 October, 2024 at the demonstration site. Dr Kuldeep Kumar Lal, Director of ICAR-CIBA, witnessed the harvest and highlighted the growing importance of mud crab farming to meet the future demand and the role of mud crab farming in diversification of brackishwater aquaculture to ensure the sustainability of this sector in India. Dr C.P. Balasubramanian, Principal Scientist & Head of the Crustacean Culture Division (CCD), provided a detailed overview of the scientific aspects of mud crab farming in India. Dr P. Mahalakshmi, Principal Scientist & Nodal Officer of the SCSP program, pointed out the crucial role of this scheme in supporting the beneficiaries and reaching the benefits of brackishwater aquaculture to the coastal communities. This five-month demonstration program was carried out under the supervision of CIBA Scientists Mr R. Aravind, Dr J.A.J. Raymond, Dr K.P. Sandeep, and Mr K. Anantharaja.

ICAR-CIBA observed Vigilance Awareness Week 2024

ICAR-Central Institute of Brackishwater Aquaculture observed Vigilance Awareness Week (VAW) 2024 from October 28 to November 1, 2024. Dr Kuldeep Kumar Lal, Director, ICAR-CIBA administered the 'Integrity pledge' among the staff of the Institute including Regional Centres. All the family members of the employee, stakeholders and collaborators were sensitized to take 'Integrity pledge' for the citizen on the website of Central Vigilance Commission (CVC) for their commitment to the nation on corruption free India.

KRC of CIBA organized Farmers' Scientists Interaction Meet on Sustainable Shrimp Farming on November 5th, 2024

A farmers-scientists interaction meet on Sustainable Shrimp Farming was organized at the Kakdwip Research Centre of ICAR-CIBA on November 5, 2024, with active participation of 31 farmers from the Patharpratima block of South 24 Parganas. The event was sponsored by the M/s. Sundeep Packaging Industry, Kolkata, the MoU collaborator for CHINGUDI PLUS feed technology of the institute. The program commenced with a welcome address by Dr Debasis De, Head of KRC. Mr Biju I.F., Scientist at KRC, delivered a lecture on Better Management Practices of Shrimp Farming and Dr Sanjay Das, Principal Scientist at KRC, provided insights into disease management aspects. Dr Debasis De, Head of KRC, elaborated on "CHINGUDIPLUS " feed developed by ICAR-CIBA and discussed on ideal feed management practices for sustainable shrimp farming. The interactive session witnessed appealing discussions between farmers and scientists from KRC on various aspects of shrimp farming.

ICAR-CIBA organised the World Antimicrobial Awareness Week (WAAW) for the shrimp farmers

As a part of World Antimicrobial Awareness Week (WAAW) under All India Network Project on Antimicrobial Resistance (AINP-AMR), an awareness program was arranged for the shrimp farmers of Thiruvallur district, Tamil Nadu at Ponneri on November 19, 2024. About 68 shrimp farmers from different parts of district attended this program. The farmers were made aware of the consequences of AMR as a silent pandemic. The farmers were advised not to use antibiotics and adopt alternate strategies to combat shrimp diseases. They were also informed to fully utilize the facilities under the National Surveillance Programme for Aquatic Animal Diseases (NSPAAD) under PMMSY program of Govt of India regularly and know the extent of infection in their farm to minimize the use of antimicrobials in ponds. Current disease situation in shrimp farms of India, particularly the infection caused by *Enterocytozoon hepatopenaei*, was discussed with the farmers. Presentation was also made on good soil and water quality management to reduce stress and avoid disease. Dr D. Deboral Vimala, Dr S. K. Otta, Dr P. Ezhil Praveena, Principal Scientists, Dr T. Bhuvaneswari, Dr P. Kumararaja, Senior Scientists and Dr T. Sathish Kumar, Scientist of the institute made presentations on different aspects of shrimp farming and interacted with the farmers.

ICAR-CIBA Celebrated World Fisheries Day 2024

ICAR-CIBA celebrated the World Fisheries Day – 2024 (WFD) alongwith fishers and fish farmers at Pattipulam village, Chengalpattu district. Fish For All Centre of M. S. Swaminthan Research Foundation at Poombhuhar, Tamil Nadu, also joined with this world fisheries Day celebration. The event was held on November 21, 2024 in Pattipulam andPoombhuhar villages. Altogether 240 fishers, SCSP fish farmers, members of Fish Farmer Producer Organizations (FFPO) and community facilitators participated in the events. This year's WFD theme is "Investing in Social Protection to Secure Equitable Blue Transformation in the Fisheries Sector," highlighting the importance of sustainable fisheries and aquaculture management and well-being of fishing communities.At Pattipulam the scientists have explained about the role of brackishwater aquaculture in India's fisheries sector, fostering community-based conservation of water and fishery resources for livelihood development, sustainable fisheries practices to ensure healthy aquatic ecosystems and food security and ICAR-CIBA's aquaculture based livelihood development models focusing on innovations that empower small-scale fishers and farmers. During the event, fish net materials were distributed to the SC beneficiaries to support their aquaculture activities, reflecting ICAR-CIBA's commitment to empowering marginalized communities. Dr C. V. Sairam, Principal Scientist, Dr P. S. Shyne Anand, Senior Scientist, Dr Raymond Jani Angel, Senior Scientist, Dr K. Anantharaja, Shri C. Siva and Shri R. Aravind Scientists coordinated the event.InPoombhuhar the participants were sensitized about the importance of sustainable fisheries, habitat protection, responsible fishing methods and gears, climate change and its impacts on fisheries, the contributions of fishing communities towards fishery resource management and conservation of coastal ecosystems towards promoting equitable blue transformation in the fisheries sector. WFD awards were presented to various fisher groups for their outstanding contributions for sustainable management of fishery resources and environment conservation. Dr K. Ambasankar, Head, Nutrition, Genetics and Bio-technology Division and Dr M. Kumaran, Principal Scientist & Coordinator, along with Dr S. Velvizhi, Head, FFA centre of MSSRF coordinated the event.

Kakdwip Research Centre of ICAR-CIBA organized 3rd series of Farmers' Interaction Meet on Sustainable Shrimp Farming on November 28th, 2024

A successful Farmer-scientist-industry interaction meet on Sustainable Shrimp Farming was organized at the Kakdwip Research Centre of ICAR-CIBA on November 28, 2024. A total of 40 farmers from the Kakdwip block of south 24 Parganas participated in the program The event was sponsored by the Sundeep Packaging Industry, Kolkata, MoU partner for CHINGUDIPLUS The program commenced with a welcome address by Dr Debasis De, Head of KRC. Mr Biju I.F., Scientist and Dr Sanjay Das, Principal Scientist at KRC delivered a lecture on Better Management Practices of Shrimp Farming and disease management aspects. Dr Debasis De, Head of KRC, elaborated on "CHINGUDIPLUS" feed developed by ICAR-CIBA and discussed on ideal feed management practices for sustainable shrimp farming. Shrimp farmers expressed their concerns of new emerging diseases, raising cost of production which are hampering the profitability and sustainability of shrimp culture. The program concluded with a vote of thanks proposed by Dr Sanjay Das, Principal Scientist, KRC.

ICAR-CIBA signed Memorandum of Understanding (MoU) with Agrocel Industries Pvt. Ltd. For contract research on developing natural mineral mix product for shrimp farming

ICAR-CIBA signed Memorandum of Understanding (MoU) with Ms. Agrocel Industries Pvt. Ltd., Kachchh, Gujarat for undertaking contract research on evaluating the efficacy of a natural mineral mix product "AQUALAABH" and its variants in shrimp aquaculture at its Navsari Gujarat Research Centre (NGRC) at Navsari, Gujarat on December 4, 2024.Agrocel is a leading Indian mineral, specialty chemicals, plant and animal nutrition company and leader in India's bromine-based marine chemical industry. "AQUALAABH" is a seawater based natural mineral mix produced by the company in Kachchh for application in shrimp farming. Dr Kuldeep K Lal chaired the meeting and stressed on the importance of such collaborations between private companies and research institutes. Mr Ashish Sharma, General Manager, Agrocel Industries Pvt Ltd.,

signed the MoU on behalf of the company. Dr P. K. Patil, In-Charge ITMU, discussed the initiatives taken by the unit for public-private partnerships in the shrimp aquaculture sector. Mr. Jose Antony, Scientist, NGRC signed the MoU on behalf of ICAR-CIBA and the product evaluation will be completed within a period of one year. Dr A. Panigrahi, Scientist-In-Charge NGRC of CIBA detailed the research activities taken up by the centre on brackishwater aquaculture development in the western region.

ICAR-CIBA Celebrated World Soil Day on 5th December, 2024

On the occasion of World Soil Day, ICAR- Central Institute of Brackishwater Aquaculture, Chennai organised "Brackishwater Aquaculture Farmers Meet" at Kolathur, Chengalpattu District, Tamil Nadu on December 5, 2024. Around 120 fishers from the Kolathur and Kottaikkadu villages participated in the programme. The scientists explained about the impact of soil and water quality on disease occurrence and preventive measures by following the better management practices. Interactions on the aspects of ICAR-CIBA initiatives for the SC and ST farmers, fish farming practices, soil and water sampling protocol and their management for sustainable brackishwater aquaculture and demonstration of the use of Multiparameter water quality kit were held during the event. Dr M. Kailasam, Principal Scientist and HoD Finfish Culture Division & Director I/c,

emphasized the importance of soil management for sustainability and economic viability of aquaculturein his presidential address, and distributed farm inputs and water quality testing kits under the NICRA-SCSP to the beneficiaries during the programme. Shri Natesa Raja, Inspector of Fisheries, Kadappkkam, Chengalpattu District briefed about the Prime Minister Matsya Sampada Yojana (PMSSY) and other State Fisheries Department schemes meant for fishers were explained for the benefit of farmers. Dr M. Shashi Shekhar, Principal Scientist and HoD, Aquatic Animal Health and Environment Division, Dr Deboral Vimala, Dr R. Jeyakumar, Dr. R Saraswathy, Principal Scientists, Dr P. Kumararaja, Dr R. Geetha, Senior scientists and Dr A. Nagavel, Assistant Chief Technical Officer coordinated the event.

Kakdwip Research Centre of ICAR-CIBA organized 4th series of Farmers' Interaction Meet on Sustainable Shrimp Farming on December 06th, 2024

A Farmer-scientist-industry interaction meet on Sustainable Shrimp Farming was organized at the Kakdwip Research Centre of ICAR-CIBA on December 06th, 2024, with active participation from 30 farmers from the Sagar Islands, South 24 Parganas, West Bengal. This meeting was sponsored by the JMT group of M/s. Sundeep Packaging Industry, Kolkata which has signed an MoU with ICAR-CIBA for the commercial production of CHINGUDIPLUS shrimp feed developed by KRC of ICAR-CIBA. The program commenced with a welcome address by Dr Debasis De, Head of KRC, who elaborated on "CHINGUDIPLUS" feed developed by ICAR-CIBA and discussed on ideal feed management practices for sustainable shrimp farming. Mr Biju I.F., Scientist and Dr Sanjay Das, Principal Scientist at KRC delivered a lecture on Better Management Practices of Shrimp Farming and disease management aspects. Shrimp farmers interacted with scientists on BMP's, Feed management and expressed their concern of declining profitability over the years. The program concluded with a vote of thanks proposed by Ms. Babita Mandal, Scientist, KRC.

NABL Accreditation to ICAR-Central Institute of Brackishwater Aquaculture Feed laboratory

ICAR-CIBA established a new state of the art 'Aquafeed Analytical and Quality Assurance Laboratory' for testing and ensuring the quality of feed and feed ingredients and is accredited with National Accreditation Board for Testing and Calibration Laboratories (NABL), Quality Council of India, Government of India as per ISO/IEC 17025:2017. This strengthens ICAR-CIBA's position as a leader in the area of aquaculture feed development and quality assurance.ICAR-CIBA has experimental commercial scale feed mills and formulations are the basis for *Vanami*^{Plus}, *Larvi*^{Plus}, *Chengudi*^{Plus} series feeds for shrimp and seabassPlus for finfish like Seabass. The feeds are produced commercially by the partner industry. As the current scenario, there is emphasis on diversification and quality concerns for feed ingredients. This laboratory aims to serve as a National Referral Centre for feeds and feed ingredients testing for the aquaculture and this will ensure best practices and processes in the feed manufacturing.

National Accreditation Board for Testing and Calibration Laboratories

CERTIFICATE OF ACCREDITATION

AQUAFEED ANALYTICAL AND QUALITY ASSURANCE LABORATORY

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

ICAR - CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE, 75, SANTHOME HIGH ROAD, R A PURAM, CHENNAI, TAMIL NADU, INDIA

in the field of

TESTING

Certificate Number: TC-15103

Issue Date: 13/12/2024 Valid Until: 12/12/2028

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of thislaboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Entity: ICAR - CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

ICAR CIBA and its regional centres celebrates 'Kisan Diwas'

Kisan Diwas was celebrated by the ICAR-CIBA on December 12, 2024 to mark the birth anniversary of Shri. Choudhary Charan Singh, the fifth Prime Minister of India. This was commemorate his remarkable contribution for the development of agriculture in the country. On this occasion, 109 participants including fish farmers, fisherwomen and students attended the Farmer-Scientist interface session held at the Muttukkadu Experimental Station of ICAR – CIBA. Dr C.P Balasubramaniam, Director (I/c), briefed about ICAR-CIBA's achievements and various ongoing research activities of the institute to promote brackishwater aquaculture in the country. An awareness programme on seabass nursery rearing and crab farming was also conducted for the benefit of the participants. The participants interacted with the scientists and their queries and technical requirements were clarified by the scientists. Participants visited the facilities of ICAR – CIBA including shrimp, fish and crab hatcheries, feed mills and demonstration farms. Dr S. Kannappan, OIC, MES, and Shri Aswin Haridas, Administrative Officer delivered the felicitation address. The programme was coordinated by Dr D. Deboral Vimala, Dr R. Geetha, Dr. R Jayakumar and Dr T. Bhuvaneswari.

Kakdwip Research Centre (KRC) of ICAR-CIBA celebrated the Kisan Diwas on December 23, 2024 as a part of the SwachhtaPakhwada being observed during December 16-30, 2024 with the participation of around 200 farmers from Kakdwip area of West Bengal including members of women self-help group. Dr Sanjoy Das, Principal Scientist narrated the background of the day and sensitized the farmers to come together to achieve the increased national fish productivity. He also emphasized on the importance of cleanliness in their residents and farming premises. Additionally, he spoke about the various initiatives implemented by KRC to benefit farmers. The 'Learning while working' paradigm at KRC was the subject of positive past experiences expressed by members of the women's self-help group. Ornamental fish seeds of orange chromide were distributed among the selected farmers. The programme concluded with a formal vote of thanks proposed by Dr N.S. Sudheer, Scientist. All staffs of KRC of ICAR- CIBA participated in the programme.

NGRC OF ICAR-CIBA, Navasri organized "Kisan Diwas" at the tribal village of Sultanpur in Navsari on December 23, 2024 as part of the SwachhtaPakhwadaduring December 16-31, 2024. The integrated fish farming unit of ICAR-CIBA under STC in Sultanpur village was hosted the Kisan Diwas event. The event was inaugurated by Shri Sasikantbhai Patel, Sarpanch, Sultanpur village in the presence of Dr. Ritesh Shantilal Tandel, Nodal officer and Scientist NGRC. About 200 farmers attended the program. Mr Pankaj Patil, PI, STC Project, NGRC of CIBA addressed the gathering on the benefits of integrated fish farming models and their role in converting farm waste in to livelihood. Dr Ritesh Shantilal Tandel, scientist and nodal officer delivered a talk on classification of farm waste and their recycling within the farm to make necessary farm inputs. Shri RameshbhaiHalpati, President Sultanpur Halpati Samaj Matsya Udyog SHG spoke briefly during the event on the benefits of IFF technology and revenue generated by the group within a span of 1 year. Farm cleaning tools and waste management devices were distributed to the tribal farmers as part of the event.

ICAR- CIBA conducted Skill development programme for the coastal fishers under the SCSP

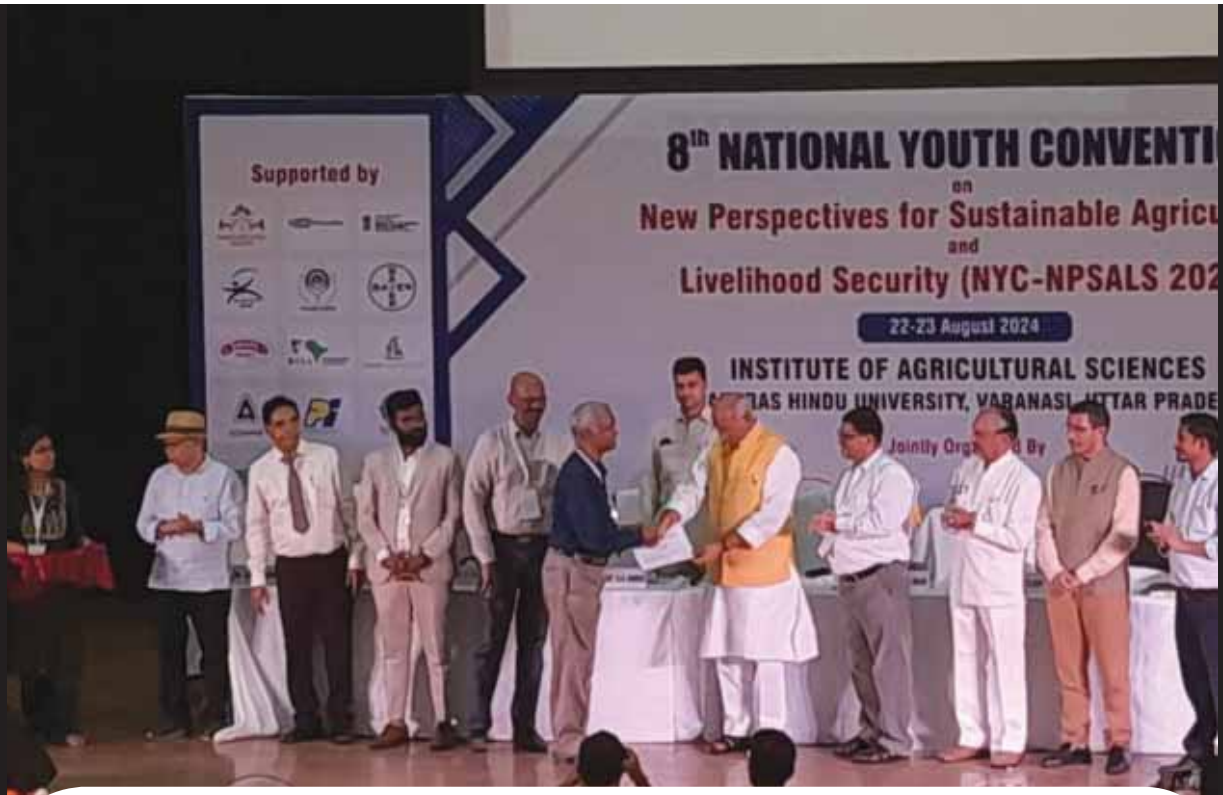
The ICAR-Central Institute of Brackishwater Aquaculture organized a training programme on "Brackishwater Aquaculture Technologies for Coastal Fishers under SCSP program during December 23-26, 2024 at Muttukadu Experimental Station (MES) of ICAR-CIBA. Twenty two fishers from the coastal villages attended the training. The objective of the training programme was to impart practical learning experience on brackishwater aquaculture technologies by providing them first-hand exposure on seeing is believing, learning by doing and interaction with the scientists. Dr C. P. Balasubramanian, Director-In-charge briefed the fishers about institute's activities, released training manual prepared in vernacular language and assured them that the required technical guidance and assistance would be provided by the institute for taking up brackishwater farming under SCSP. Dr S Kannappan, PS& SIC of MES explained the facilities available for field experimentation at MES of CIBA. DrR.Jayakumar, Principal Scientist, Mr .Thiayagarajan, Technical Officer, Fish Culture Division and Dr Shyne Anand, Senior Scientist, Mr R. Aravind, Scientist and Mr S. Rajamanickam, ACTO, Crustacean Culture Division gave lectures and practical sessions on Asian seabass nursery rearing, cage farming, mud crab seed production, mud crab nursery rearing and farming. Trainees visited the feed mill and Mr K. Ananthraja, Scientist, NGBD demonstrated fish and crab feed production techniques. Dr T. Bhuvaneswari, Senior Scientist, explained them the health management protocols to be adopted during nursery rearing and grow-out farming fishes and shellfishes. Dr D. Deboral Vimala, Principal Scientist briefed the trainees about the various technology delivery mechanisms. Dr K. Ambasankar, Head, NGBD delivered the valedictory address and distributed certificates to the participants. The training was co-ordinated by the scientific team comprised of Dr. D. Deboral Vimala, Dr R. Geetha, Dr R. Jayakumar and Dr T. Bhuvaneswari.

AWARDS & RECOGNITIONS

ICAR-CIBA obtained Swachhta Pakhwada Award 2023 (sharing) and Appreciation certificate for Swachhta Pakhwada Award 2022 (sharing) among all the ICAR Institutes. Award is based on the range and scale of organizing the innovative events besides documentation and dissemination of the activities undertaken during Swachhta Pakhwada. As a part of the Swachhta Pakhwada, CIBA scientists, staff and students has organized various activities at Institute campuses and adopted villages.

Dr. R. Ananda Raja

The best poster presentation award for a poster entitled "Incidence of *anisakiasis* in grey mullet, *Mugil cephalus* from Kovalam coast of Tamil Nadu" in the technical session of "Toxicopathology and aquatic animal pathology" at the IAVPCON 2024, National Symposium organized by Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Division of Veterinary Pathology, Jammu, 28-30th November 2024.



Dr M.S. Shekhar

Third Prize for poster presentation on "Flow cytometry based analysis of immune response in shrimp against WSSV infection" during National conference on challenges in animal health and production amidst climate change: Innovative, sustainable solutions and their translation- VIBCON 2024, 26-28th September, 2024, Madras Veterinary College, Chennai.

Springer Nature-IVS Award 2024 for the best paper of the year 2021 in the section of Aquatic Virology. A. Swati, M.S. Shekhar, V.K. Katneni, K.K. Vijayan (2021). "Flow cytometry analysis of apoptotic progression and expression analysis of four apoptosis-related genes in *Penaeus vannamei* in response to white spot syndrome virus infection".

Best Presentation Award. Genotyping of white spot syndrome virus: An overview. 8th National Youth Convention (Conference) on "New Perspectives for Sustainable Agriculture and Livelihood Security (NPSALS2023)" 22-23rd August 2024, Institute of Agricultural Sciences, BHU, Varanasi.

Best Presentation Award. "White spot syndrome virus: Molecular variability and genotyping". National Conference on Blue Revolution for Sustainable Fisheries Development from 25-27th September 2024 at Karnataka Science and Technology Academy, Bangalore.

Dr T. Sathish Kumar

Awarded with best oral presentation award with a cash prize of Rs 5000/- for the presentation 'CIBA EHP cura I in the National conference on 'Blue revolution for sustainable fisheries development' at Karnataka science and technology academy (KSTA), Bengaluru, 24-27th September 2024

Shri Dani Thomas

Best paper award for Captive maturation, spawning, and embryonic development of a potential brackish water ornamental goby, *Mangarinus waterrousi* (Herre , 1943) in National conference on, emerging opportunities and challenges in management of aquaculture and agriculture productivity and economic resilience (EOCMAA-2024) and marine bioresource conservation and sustainable utilisation of marine- based products (MBCSUM-2024). 15-16th March 2024

Dr A. Panigrahi

Best oral presentation award on the theme Frontiers in shellfish farming in in13th IFAF on 23-25th February 2024, held at Kolkata.

Dr R. Subburaj

Dr R. Subburaj got best presentation award in poster session at 13th Indian Fisheries and Aquaculture (IF&AF) for attaining sustainable development goals from 23-25th February 2024 organized by CIFRI held at Kolkata.

Dr. J. Syama Dayal

Dr J. Syama Dayal conferred with Dr Tilak Dhiman Best Researcher Award in the field of Animal Nutrition. The award was presented in 20th Biennial International Conference in the field of Animal Nutrition.

Linkage & Colloboration

THE INSTITUTE MAINTAINED LINKAGES WITH THE FOLLOWING NATIONAL AND INTERNATIONAL ORGANISATIONS

ICAR INSTITUTES

ICAR – Central Marine Fisheries Research Institute, Kochi, Kerala

ICAR – Central Inland Fisheries Research Institute, Barrackpore, West Bengal

ICAR – Central Institute of Fisheries Technology, Kochi, Kerala

ICAR – Central Institute of Fisheries Education, Mumbai, Maharashtra

ICAR – National Bureau of Fish Genetic Resources, Lucknow, Uttar Pradesh

ICAR – Central Institute of Freshwater Aquaculture, Bhubaneswar, Odisha

ICAR – Directorate of Coldwater Fisheries Research, Bhimtal, Uttarakhand

ICAR – Central Island Agricultural Research Institute, Port Blair

ICAR – Central Research Institute for Dryland Agriculture, Hyderabad

ICAR – National Academy of Agricultural Research Management, Hyderabad

OTHER CENTRAL / STATE GOVERNMENT DEPARTMENTS, SAUs / FOREIGN INSTITUTIONS

Agricultural and Processed Food Products Export Development Authority, New Delhi

Centre for Advanced studies in Marine Biology, Annamalai University, Parangipettai

Centre for Environment Fisheries and Aquaculture Science (CEFAS), Weymouth, Dorset, UK

Coastal Aquaculture Authority, Chennai

College of Fisheries, University of Agricultural Sciences, Mangalore

College of Fisheries, Sri Venkateswara Veterinary University, Muthukur

Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, New Delhi

Department of Biotechnology, New Delhi

Fisheries College and Research institute, Thoothukudi

ISRO Telemetry Tracking and command Network (ISTRAC), Peenya Industrial Area, Bangalore

Department of Fisheries Maharashtra, Mumbai

Agency for Development of Aquaculture Kerala (ADAK), Government of Kerala

Indian Institute of Technology, Chennai

Indian Institute of Technology, Kharagpur

Mangrove Cell, Government of Maharashtra, Mumbai

Ministry of Science and Technology, New Delhi

Ministry of Water Resources, New Delhi

Marine Product Development Authority, Kochi

MS Swaminathan Research Foundation, Chennai

National Fisheries Development Board, Hyderabad

National Institute of Ocean Technology, Chennai

Navsari Agricultural University, Navsari, Gujarat

Sundarban Development Board, Govt. of West Bengal

Department of Agriculture, Govt. of West Bengal

Ramakrishna Ashram KVK, Nimpith, South 24 Parganas, West Bengal

Nature Environment and Wildlife Society (NEWS), Kolkata

South Asian Forum for Environment (SAFE), Kolkata

Pinnacle Biosciences, Tamil Nadu

Tamil Nadu Agricultural University, Coimbatore

Tamil Nadu Veterinary and Animal Science University, Chennai

Tamil Nadu Dr. J. Jayalalithaa Fisheries University, Nagapattinam

The Pirbright Institute, UK

University of Madras, Chennai

University of Southampton, UK

Vellore Institute of Technology, Vellore

Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, Chennai

West Bengal University of Animal and Fisheries Science, Kolkata

Crescent Innovation Incubation Council (CIIC) BSAR Crescent Institution of Science & Technology, Chennai.

Sathyabama Institute of Science and Technology, Rajiv Gandhi Salai, Chennai

Shri A. M. M. Murugappa Chettiar Research Centre

SSN College of Engineering, Tamil Nadu

SRM Institute of Science and Technology, Kattankulathur, Tamil Nadu

The Neotia University, West Bengal

Guwahati University, Assam

NITTE University, Mangalore, Karnataka

Indian Immunologicals Limited, Hyderabad, Telangana

Guru Angad Dev Veterinary and Animal Sciences University (GADVASU) Ludhiana, Punjab

STATE FISHERIES DEPARTMENTS

The institute has well established linkage with state fisheries departments mainly for transfer of technologies

Consultancies, Technology Development & Transfer

ICAR-Central Institute of Brackishwater Aquaculture and M.S. Swaminathan Research Foundation, Chennai inked Memorandum of Understanding for collaborative technology validation and extension on 5th January, 2024

ICAR-Central Institute of Brackishwater Aquaculture (ICAR-CIBA), Chennai and M.S. Swaminathan Research Foundation, Tamil Nadu signed a Memorandum of Understanding for collaborative technology validation and extension on 5th January 2024. The aim of the MoU is to undertake collaborative research cum technology application programme for research uptake on brackishwater fish farming technology to enhance the livelihoods of resource-dependent communities including SC and ST of the coastal districts. Dr Kuldeep Kumar Lal, the Director, ICAR-CIBA said that the Institute and the Fish for all Research and Training Centre, (MSSRF, Poompuhar, Tamil Nadu) jointly validate location specific and clients need-based brackishwater aquaculture based livelihood development models in the coastal districts of Tamil Nadu. The MoU was exchanged in the presence of Dr Sowmiya Swaminathan, the Chairperson of MSSRF. She said that the project envisages the holistic development of coastal families particularly Scheduled Caste and Schedule Tribal families

ICAR-CIBA signed MoU with AUSSCO India Marine Products Pvt. Ltd, Surat for Collaborative Partnership For Demonstration, Supporting partner for Genetic Improvement Program (GIPPI) and Multi-Phased Nursery / Grow-Out Farming (Conventional and Biofloc) of Native Species of *Penaeus indicus*

ICAR-Central Institute of Brackishwater Aquaculture (ICAR-CIBA), Chennai and AUSSCO India Marine Products Pvt. Ltd, Surat signed a Memorandum of Understanding for Genetic Improvement Program (GIPPI) and Multi-Phased Nursery / Grow-Out Farming (Conventional and Biofloc) of Native Species of *Penaeus Indicus* on 12th January 2024. The highlight of this MoU is to provide technical guidance for development of Biofloc based nursery rearing and genetic improvement program of Indian white shrimp (*Penaeus indicus*) with Aussco at their farm facilities.

ICAR-CIBA inked MoU with 'Sri Krushna Feeds, Odisha ' under the Make in India programme for consultancy services on formulations, processing and production of indigenous shrimp and fish feeds

ICAR-CIBA formed a strategic alliance with M/s Sri Krushna Feeds, Odisha for production of indigenous fish and shrimp feeds. At present the fish feeds used in the state of Odisha are mostly coming from corporate feed mill with technology support from multinational firm/foreign consultants. Considering the demand for cost effective feeds for shrimp and finfishes, Sri Krushna Feeds approached ICAR- CIBA for the consultancy services on shrimp and fish feed formulations, processing and production and has entered into a MoU on 17th January 2024, at CIBA, HQ, Chennai and the MoU was signed in the presence of Dr Kuldeep Kumar Lal, Director ICAR-CIBA.

ICAR-CIBA inked MoU with 'QE Healthcare, Ahmedabad for consultancy services on Asian Seabass Cage farming as a sustainable livelihood activity in the coastal areas of Saurashtra region of Gujarat

ICAR-CIBA formed a strategic alliance with Ms QE Healthcare, Ahmedabad on 23rd January, 2024 for consultancy services on establishing Asian Seabass Cage farming in the coastal Saurashtra region of Gujarat. The MoU was signed at Navsari-Gujarat Research Centre (NGRC) of ICAR-CIBA in presence of Dr Kuldeep K. Lal Director, ICAR-CIBA, Chennai who attended on Virtual mode.

ICAR-Central Institute of Brackishwater Aquaculture, Chennai and Estuary Fisheries LLP, Mumbai, Maharashtra inked Memorandum of Understanding for Technical and Consultancy Service for "Development of Brackishwater Integrated Aquapark Model in Gujarat" on 6th February, 2024 at Mumbai

The institute formed a strategic alliance with Estuary Fishery LLP, Colaba, Mumbai, Maharashtra on 6th February, 2024 for technical and consultancy services on development of brackishwater integrated aqua park model in southern region of Gujarat. The MoU was signed at Sahyadri State Guest House, Malabar Hill, Mumbai in presence of Dr Kuldeep K. Lal Director, ICAR-CIBA, Chennai.

ICAR-CIBA signed MOU with M/s Manjha technologies Pvt. Ltd., Haryana for consultancy service for aquaculture feed processing and production

ICAR-CIBA formed a strategic alliance with M/s Manjha technologies Pvt. Ltd., Haryana for consultancy service for aquaculture feed processing and production. Considering the demand for cost effective feeds for shrimp and finfishes, M/s Manjha technologies Pvt. Ltd approached ICAR- CIBA for the consultancy services on shrimp and fish feed formulations, processing and production and has entered into a MoU on 8th February 2024, at CIBA, HQ, Chennai and the MoU was signed in the presence of Dr Kuldeep Kumar Lal, Director ICAR-CIBA.

ICAR -CIBA Signed MoU with Novozymes South Asia Pvt. Ltd. Karnataka for the evaluation of Novozymes product for its effect on growth and survival in Penaeid shrimps

The institute signed MoU with Ms.Novozymes South Asia Pvt. Ltd. Karnataka for the contract research for the evaluation of Novozymes BIORAS consortium product during nursery and grow-out farming technology in Penaeid shrimps in the presence of Dr Himanshu Pathak, Secretary (DARE) & Director General, Indian Council of Agricultural Research (ICAR) and Dr Joykrushna Jena, Deputy Director General (Fisheries),. During the occasion, Dr Kuldeep K Lal, Director, ICAR-CIBA outlined the genesis of this collaborative R&D programme. Shri B. Mallick who signed the MoU on behalf of the company narrated that they are specialized in finding enzymes and microbial solutions for aquaculture and has probiotic feed solutions, biodiesel, biogas, bio-augmentation, sludge treatment and advanced protein solutions, carbon capture with biological enzymes etc. Dr Himanshu Pathak, DG in his remarks appreciated the research activities of CIBA and insisted to aim towards enhancing the productivity of aquaculture and its inputs for sustainability in fisheries.

ICAR-CIBA signed MoU with M/s. Arthro Biotech Pvt. Ltd. for the consultancy services & collaborative research for the usage of insect based ingredients as a meal for aquaculture

ICAR-CIBA partnered with M/s. Arthro Biotech Pvt. Ltd, for the consultancy services and collaborative research for the usage of insect based ingredients as a meal for aquaculture. Through this memorandum of understanding (MoU) signed on 15th February 2024 to explore the possibilities of using insect based ingredients as a sustainable substitute for fish meal and soybean.

ICAR-CIBA signed MoU with M/s. Crisprbits Pvt. Ltd., Bengaluru for collaborative research for the development of diagnostics kits in brackishwater aquaculture

ICAR-CIBA, Chennai signed MoU with M/s. Crisprbits Pvt. Ltd., Bengaluru for collaborative research for the development of diagnostics kits in brackishwater aquaculture on 5th April 2024 at ICAR-CIBA, Chennai. M/s. CrisprBits Pvt. Ltd. is aimed to provide Diagnostic Test kits for brackishwater aquatic animal diseases, developing genome edited fishes, inducing pluripotency in cell lines using CRISPR and immortalization of fish cell line.

ICAR-CIBA signed MoU with M/s. Digisafe Insurance Broking Pvt. Ltd. and M/s. Swatantra Technologies pvt. Ltd. for the development of aquaculture insurance product

The institute signed a Memorandum of Understanding (MoU) with M/s. Digisafe Insurance Broking Pvt Ltd. and M/s. Swatantra Technologies Pvt Ltd. on April 22, 2024 for collaboratively developing an innovative and comprehensive aquaculture insurance product. The collaboration between ICAR-CIBA, M/s. Digisafe Insurance Broking Pvt Ltd, and M/s. Swatantra Technologies Pvt Ltd, aims to address the gap in aquaculture crop insurance coverage in India through research and development, leveraging expertise in aquaculture science, insurance distribution, and risk modelling to create a comprehensive aquaculture insurance product.

ICAR-CIBA signed MoU for the technology transfer of '*Kalor*^{Plus}', indigenous formulated feed for ornamental fishes, with Agro Wiz, Haryana

The novel "*Kalor*^{Plus}", an import substitute feed for aquarium fish rearing, is the outcome from focused research program on feed development by ICAR-CIBA. This feed is scientifically formulated to maintain good health and colour of the ornamental fishes. Agro Wiz, Gurugram, Haryana signed a MoU with ICAR-CIBA on 27th April 2024. Through this MoU, the company envisaged to produce "*Kalor*^{Plus}" technology based ornamental feed with CIBA's technical cooperation.

ICAR-CIBA inked MoU with The Neotia University, West Bengal for collaborative research

A Memorandum of Understanding (MoU) was signed between The Neotia University and ICAR-Central Institute of Brackishwater Aquaculture on 13th May 2024 for a collaboration of research and development in brackishwater aquaculture sector. Dr Manish, Registrar – The Neotia University, and Shri Navin Kumar Jha, Chief Administrative Officer, ICAR-CIBA, signed the MoU on behalf of their respective institutes.

ICAR-CIBA inked MoU with Guwahati University, Assam for collaborative research

A memorandum of understanding (MoU) was signed between ICAR-Central Institute of Brackishwater Aquaculture, Chennai and Aquaculture & Biodiversity centre, Guwahati University, Assam for collaborative research, on 15th May 2024. Both the organizations entered into the present agreement for the purpose of pursuing collaborative research on aquaculture and for implementing the Development of Livelihood Business Incubators (LBI) for the youth and farmers of North East region of India under ASPIRE scheme of MSME, GoI.

ICAR-CIBA signed MoU with NITTE University, Mangalore, Karnataka for collaborative research

ICAR-CIBA signed a MoU with NITTE (Deemed to be University), Mangalore, on 21st May , 2024, to promote collaborative research, student exchanges and faculty interactions between these two institutions and to explore new avenues to improve the fisheries education and farming sector. The MoU was signed at the NITTE Mangalore campus by Dr Kuldeep K. Lal, Director, ICAR-CIBA, and Prof. Dr Harsha Halahalli, Registrar, NITTE University

ICAR-CIBA inked MoU with M/s GSR Hatcheries, Andhra Pradesh technical and consultancy service on hatchery technology of Mudcrab production

The ICAR-Central Institute of Brackishwater Aquaculture, Chennai signed the Memorandum of Understanding (MoU) with the M/s. GSR Hatcheries, Andhra Pradesh for technical and consultancy service on hatchery technology of Mudcrab production on 31st May 2024. Dr Kuldeep K. Lal, Director, ICAR-CIBA highlighted that, it is a potential species for diversification and an economically viable production system in aquaculture. He also added that there is a need for the transfer of the Mudcrab nursery seed production technology to the farmers by upscaling its seed production.

ICAR-CIBA signed Memorandum of Understanding (MoU) with M/s Neomeds Hyderabad, Telangana, for the technology transfer of 'CIBA EHP Cura I'

ICAR-CIBA signed a Memorandum of Understanding (MoU) with M/s Neomeds, Hyderabad, Telangana on 3rd June 2024 for the technology transfer of 'CIBA EHP Cura I'- technology. This innovative technology addresses the *Enterocytozoon hepatopenaei* (EHP) a microsporidian pathogen that poses a severe threat to the global shrimp industry. 'CIBA EHP cura I' is a natural product which significantly controls the proliferation of EHP, reduces bacterial load and significantly improves the immunity, health, survival and growth of shrimp.

ICAR-CIBA inked MoU with Indian Immunological Limited, Hyderabad for collaborative research for production and commercialization of Nodavac-R (Fish Vaccine)

A Memorandum of Understanding (MoU) was signed between ICAR-Central Institute of Brackishwater Aquaculture and Indian Immunological Limited, Hyderabad on 5th June 2024 for a collaborative research for Testing, collaboration, production and Commercialization of Nodavac-R (Fish Vaccine).

ICAR-CIBA and Indian Immunologicals Limited enter into an agreement for commercial development of fish vaccine

The institute signed a partnership agreement with Indian Immunologicals Limited, Hyderabad for the commercial development of CIBA vaccine "Nodavac-R" against viral nervous necrosis in finfishes at Chennai, on 29th August 2024. Viral nervous necrosis (VNN) or Viral Encephalopathy and Retinopathy (VER) is an acute viral disease affecting several species of marine, brackishwater and freshwater fishes. The disease causes up to 100% mortality in larval and early juvenile stages. ICAR-CIBA has developed a recombinant monovalent viral nervous necrosis vaccine for finfish, Asian Seabass which will be commercially produced in partnership with Indian Immunologicals Limited (IIL), a leading vaccine manufacturer in India.

ICAR-CIBA and Avanti Foundation, Andhra Pradesh signed MoU for jointly conducting skill development training programs

ICAR-Central Institute of Brackishwater Aquaculture (ICAR-CIBA) is to collaborate with Avanti Foundation, Andhra Pradesh for organizing skill development training programs in the area of brackishwater shrimp and fish farming. A Memorandum of Understanding (MoU) was signed between the organizations on 19th June 2024 at AU-Avanti Skill Development Centre, Vishakapattinam, Andhra Pradesh.

ICAR-CIBA signed MoU with M/s. Uday aqua connects pvt. Ltd., Hyderabad, Telangana for consultancy service to establish hatchery, farming and feed production unit for Asian seabass and Mudcrab

A Memorandum of understanding (MoU) was signed between the organizations on 21st June 2024 for consultancy service to establish hatchery, farming and feed production unit for Asian seabass and mud crab. Mr Udaykishan Cherukuneedi, Managing Director briefed that M/s. Uday Aqua Connects Pvt. Ltd. was established as a startup company operating in the field of aquaculture and seafood business.

ICAR-CIBA joined hands with M/s Loopworm startup for evaluating the utility of insect based protein and oil in aqua feeds

The institute signed a MoU with the team of M/s. Loopworm, an insect biosciences and bio manufacturing startup firm based in Bangalore on 26th June 2024 for evaluating the utility of insect based protein and oil in aqua feeds. Loopworm is the India's largest insect based protein and fat producer with a processing capability of 6,000 MT insects annually. The present MoU is for evaluating the utility of Loopworm's products in shrimp and Asian seabass.

ICAR-CIBA New Startup initiative with M/s. Nutrigene Biosciences Pvt.Ltd., for evaluating the effectiveness of plant based vitamin D3 in shrimp feeds

ICAR-CIBA joined hands with the team of Nutrigene Biosciences Pvt.Ltd, Telangana, a technology driven company working on high value botanical molecules startup firm based in Hyderabad on 25th July 2024. Nutrigene Biosciences primary focus is on providing high value botanicals and other novel standardized plant extracts to the nutraceuticals, food, feed and cosmetic industry. The present MoU is for evaluating the utility of plant based vitamin D3 for the improved growth.

ICAR-CIBA signed MoU with M/s Sundeep packaging industries, Kolkata, West Bengal for new series shrimp feed, *Chingudi* ^{Plus} , developed by ICAR-CIBA

ICAR-CIBA inked two MoUs with M/s Sundeep packaging industries, for upscaling and mass production of *Chingudi*^{Plus} feed and with West Bengal Accelerated Development of Minor Irrigation Project (WBADMIP), Water Resource Investigation & Development Department, Government of West Bengal for providing project based consultancy for brackishwater aquaculture development in the state of West Bengal.

ICAR-CIBA signed a Memorandum of Understanding (MoU) with Rameswaram sigaram fish farmer producer organisation, Rameswaram, Ramanathapuram District, Tamil Nadu, for marketing of CIBA-*Plankton*^{plus} and CIBA-*Horti*^{plus}

The institute signed a Memorandum of Understanding (MoU) with Rameswaram Sigaram Fish Farmer Producer Organisation (RSFFPO), Rameswaram, Ramanathapuram, one of the aspirational district of Tamil Nadu, on 10th September 2024 for marketing of CIBA-*Plankton*^{Plus} and CIBA-*Horti*^{plus}. Both are the value added products developed from fish waste using a unique technology. CIBA-*Plankton*^{Plus} is a micro and macro nutrient rich hydrolysate which enhances the natural productivity in the aquaculture systems. ICAR-CIBA has successfully tested and demonstrated the product in farmers ponds in many costal states of India including Tamil Nadu, Andhra Pradesh, Kerala, Odisha, Gujarat and West Bengal. CIBA-*Plankton*^{Plus} also has immense potential in enhancing agriculture production, especially paddy. ICAR-CIBA through joint research collaboration with Shri A.M.M. Murugappa Chettiar Research Centre (MCRC), Chennai standardized the application of *Plankton*^{Plus} in paddy cultivation by multi location trials in Tiruvallur and Chengalpattu districts, Tamil Nadu. CIBA-*Horti*^{plus} is used to enhance the production of agriculture and horticulture crops.

Shri George Kurian, Honourable Union Minister of State for Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying and Minority Affairs, Government of India launched Shrimp Crop Insurance product at ICAR-CIBA on 8th October, 2024

Shri. George Kurian, Honourable Union Minister of State for Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying and Minority Affairs, Government of India has witnessed the 8th consecutive harvest of this new age shrimp production system as Chief Guest.

Three MoUs were singed with CIBA in the presence of the Hon'ble Minister for transfer of this Super-Intensive Precision Shrimp Farming Technology for further validation was singed during the occasion with M/s.Waterbase Pvt Ltd., Chennai and M/s. Prasidhi Exports Pvt Ltd, Nellore, Andhra Pradesh. The other MoU was signed for the sustainable integration of seaweeds in shrimp aquaculture for enhancing growth, environmental health and seed bank development with Ms. TSC Purple Pvt. Ltd., Gujarat. In addition to this new shrimp production model, the Honourable Minister has also launched a parametric shrimp crop insurance product developed by the Ms. Digisafe Insurance Ltd., with the technical support of ICAR-CIBA.

ICAR-CIBA signed MoU with M/s. TATA AIG Insurance Pvt. Ltd. and M/s. Aon Insurance Brokers Pvt. Ltd. for the development of aquaculture insurance product

ICAR-CIBA signed a Memorandum of Understanding (MoU) with M/s. TATA AIG Insurance Pvt. Ltd. and M/s. Aon Insurance Brokers Pvt. Ltd on 2nd December 2024 for developing an innovative and comprehensive aquaculture insurance product. The collaboration between ICAR-CIBA, M/s. TATA AIG Insurance Pvt. Ltd. and M/s. Aon Insurance Brokers Pvt. Ltd, aims to address the gap in aquaculture crop insurance coverage in India through research and development, leveraging expertise in aquaculture science, insurance distribution, and risk modelling to create a comprehensive aquaculture insurance product.

ICAR-CIBA signed MoU with SV Bio Marine Hatcheries for technical and consultancy services on mud crabs and blue swimmer crab hatchery construction and technology 2nd Dec 2024

The institute signed Memorandum of Understanding (MoU) with M/s. SV Bio Marine Hatcheries for technical and consultancy services on mud crabs and blue swimmer crab hatchery construction and technology on 2nd December 2024. Dr. Kuldeep K. Lal, Director, ICAR-CIBA highlighted that there is a need for the transfer of the Mudcrab nursery seed production technology to the farmers by upscaling its seed production

ICAR-CIBA signed MoU with Mansi patel for consultancy services on mudcrabs and blue swimmer crab hatchery technology 10th Dec 2024

The ICAR-Central Institute of Brackishwater Aquaculture, Chennai signed the Memorandum of Understanding (MoU) with the M/s. Mansi Patel, Gujarat for consultancy services on mudcrabs and blue swimmer crab hatchery technology on 10th December 2024. Mudcrab nursery seed production technology is an emerging as one of the most valuable and viable production in aquaculture.

ICAR-CIBA signed MoU with Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana 23rd December 2024

To promote sustainable development of aquaculture in the inland saline areas of Punjab, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, has signed a Memorandum of Understanding (MoU) with ICAR-Central Institute of Brackishwater Aquaculture (CIBA), Chennai on 23rd December 2024.

Dr. Meera D. Ansal, Dean, College of Fisheries (COF), shared that the MoU will primarily focus on diversification and include provisions for the mutual exchange of scientific information, capacity building for stakeholders (faculty, students, and farmers) and collaborative research to develop sustainable aquaculture models for inland saline areas.

ICAR-CIBA new Start-up initiative with M/s. BRC Marine Products, Odisha, for evaluating the effect of rice distillers dried grains with solubles (DDGS) in the diet of pacific white shrimp, *P. vannamei* 27th December 2024

ICAR-CIBA joined hands with the team of BRC Marine Products, Dhamana, Bhadrak district, Odisha, a seafood processing and exports firm specializing in marine products on 27th December 2024. The present MoU is for evaluating the utility of rice distillers dried grains with solubles (DDGS) in the diet of pacific white shrimp, *P. vannamei* for this This MoU was signed in the presence of Dr Kuldeep Kumar Lal, Director ICAR-CIBA.

राजभाषा

आईसीएआर-सीबा में 14-20 सितंबर, 2024 के दौरान हिंदी सप्ताह का आयोजन

राजभाषा के रूप में हिंदी के उपयोग को बढ़ावा देने के लिए आईसीएआर-सीबा ने 14-20 सितंबर 2024 के दौरान हिंदी सप्ताह का आयोजन किया। राजभाषा सप्ताह के दौरान, हिंदी टिप्पण- प्रारूप लेखन, कविता और गीत गायन, आशु भाषण, शब्दावली, प्रश्नोत्तरी (क्विज) जैसी विभिन्न प्रतियोगिताओं का आयोजन किया गया, जिसमें सीबा के वैज्ञानिकों, कर्मचारियों और अनुसंधान विद्वानों ने उत्साहपूर्वक भाग लिया।

उपरोक्त के अलावा, आधिकारिक कामकाज में हिंदी के उपयोग को बढ़ावा देने के लिए "हिंदी प्रोत्साहन योजना" के तहत एक और प्रतियोगिता भी आयोजित की गई थी। इन प्रतियोगिताओं में कुल 143 प्रतिभागियों ने भाग लिया। समापन समारोह के दौरान श्रीमती कोमल श्योकंद, वरिष्ठ वित्त एवं लेखा अधिकारी एवम श्री अश्विन हरिदार, प्रशासनिक अधिकारी ने क्विज प्रतियोगिता का संचालन किया जिसमें लगभग 115 प्रतिभागी ने बढ़-चढ़ कर भाग लिया।

समापन समारोह 20 सितंबर, 2024 को संस्थान के सभागार में आयोजित किया गया था जिसमें डॉ. डी. नागेश्वर राव, वरिष्ठ सहायक प्राध्यापक, हिंदी विभाग, श्री चन्द्रशेखरेन्द्र सरस्वती विश्व महाविद्यालय, एनाथुर , कांचीपुरम मुख्य अतिथि थे। श्री नवीन कुमार झा, प्रभारी अधिकारी, हिंदी सेल ने वर्ष 2023-24 के दौरान हिंदी सेल की उपलब्धियां प्रस्तुत कीं। श्री झा ने प्रतिभागियो को सूचित किया कि हिंदी सप्ताह के दौरान कार्यालय के फाईल संबंधी कार्य में लगभग 17% पत्राचार एवम टिप्पण में राजभाषा के प्रयोग में वृद्धि देखा गया। राजभाषा विभाग द्वारा

जारी वार्षिक कार्यक्रम के अनुसार 2025 तक सभी का प्रशिक्षण पूरा हो जाना चाहिए। श्री झा ने हिंदी के प्रवीण एवं कार्यसाधक ज्ञान जिन्हे नहीं प्राप्त है उन्हे इंटरनेट के माध्यम से प्रशिक्षण प्राप्त करने को कहा है। इस अवसर पर संस्थान के निदेशक डॉ. कुलदीप के. लाल ने वर्तमान गतिशील विश्व में हिंदी एवम क्षेत्रीय भाषा के महत्व पर बल दिया। अध्यक्षीय भाषण में, निदेशक ने भारत की भाषाई विविधता और पूरे देश के संचार में हिंदी के महत्व को सम्पर्क भाषा के रूप में महत्व पर प्रकाश डाला।

अपने भाषण में मुख्य अतिथि ने कर्मचारियों को दैनिक कार्यालय कार्यों में हिंदी का यथासम्भव प्रयोग करने के लिए प्रेरित किया। निदेशक महोदय एवम मुख्य अतिथि ने सीबा वार्षिक रिपोर्ट-2023 (हिंदी संस्करण) का विमोचन भी किया। समापन समारोह के दौरान खारा जलीय कृषि में प्रगति: जल कृषको हेतु एक पुस्तिका का भी विमोचन किया गया।

सप्ताह के दौरान आयोजित विभिन्न प्रतियोगिताओं के विजेताओं को पुरस्कार एवम प्रमाणपत्र भी वितरित किए। हिंदी सेल के सदस्य डॉ. एम. शशि शेखर, डॉ. सुजीत कुमार, डॉ. जे. रेमंड जानी एंजेल, कोमल श्योकंद एवम अश्विन हरिदास आदि ने कार्यक्रमों के संचालन में सक्रिय सहयोग किये। कार्यक्रम का समापन डॉ. सुजीत कुमार एवं सदस्य, हिन्दी कक्ष के धन्यवाद ज्ञापन के साथ हुआ। हिंदी दिवस 2024 एवम चतुर्थ अखिल भारतीय राजभाषा सम्मेलन में संस्थान की तरफ से श्री नवीन कुमार झा, मुख्य प्रशासनिक अधिकारी सह प्रभारी हिंदी कक्ष ने भाग लिया जिसका आयोजन भारत मंडपम, नई दिल्ली में किया गया था।

सीबा के काकद्वीप शोध केंद्र में हिंदी सप्ताह समारोह

सीबा के काकद्वीप शोध केंद्र में 20 से 26 सितंबर 2024 तक हिंदी सप्ताह समारोह का आयोजन किया गया, जिसमें हिंदी क्विज़, पैराग्राफ लेखन, आशु भाषण और हिंदी सांस्कृतिक प्रदर्शनी सहित विभिन्न प्रकार की प्रतियोगिताएं शामिल थीं। कार्यक्रम की शुरुआत केआरसी के प्रमुख डॉ. देबाशीश डे के गर्मजोशी भरे स्वागत भाषण से हुई और सकारात्मक माहौल तैयार किया।

प्रतियोगिताओ में सभी कर्मचारियों ने अपनी भाषा कौशल और रचनात्मकता का प्रदर्शन करते हुए उत्साहपूर्वक भाग लिया। इस कार्यक्रम की शोभा श्री प्रकाश चंद्र ठाकुर, पूर्व सहायक निदेशक (राजभाषा), सूचना एवं प्रसारण मंत्रालय ने बढ़ाई, जिन्होंने आधिकारिक संचार में हिंदी के महत्व पर व्यावहारिक टिप्पणियाँ साझा कीं। समारोह का समापन एक भव्य पुरस्कार वितरण समारोह के साथ हुआ, जहां विजेताओं को सम्मानित किया गया। कार्यक्रम का समापन श्रीमती बबीता मंडल, वैज्ञानिक, आईसीएआर- सीबा द्वारा धन्यवाद ज्ञापन से हुआ। इस उत्सव ने जीवंत और संवादात्मक वातावरण में हिंदी के उपयोग को प्रोत्साहित करते हुए एकता और उत्साह की भावना को बढ़ावा दिया। सप्ताह के दौरान हिन्दी के पत्राचार एवम सम्वाद में वृद्धि दर्ज किया गया।

Revenue generated

During 2024, ICAR-CIBA generated a total of ₹ 91.25 lakhs from the consultancy services, contract research and transfer of research. Apart from this, experimental and demonstration research activities as well as diagnostic services carried out in head quarters, KRC and NGRC were able to generate ₹ 205.23 lakhs.

S. No	Services offered & Name of the firm	Amount (₹)
1.	Consultancy services for shrimp and fish feed processing and production for Sri Krushna Feeds Bideipur, Naikanidhi, Basudevpur, Bhadra, Odisha	5,00,000
2.	Consultancy services for Asian Seabass Cage Farming for M/s. QE healthcare products, Shivalik Yash, Opp. Shastri Nagar, BRTS, Bus stop, Naranpura, Ahmedabad, Gujarat	50,000
3.	Consultancy service for feed processing and production M/s. Manjha Technologies Pvt Ltd., 6A, Near Bharat Mandir, MC Colony, Hisar, Haryana.	4,32,000
4.	Contract research for the evaluation f Novozymes product for its effect on water quality, growth, survival and immunity in penaeid shrimp for M/s. Novozymes South Asia Pvt. Ltd. Plot No. 32, 47-50, EPIP Area, Whitefield, Bangalore, Karnataka	5,40,000
5.	Consultancy services and Collaborative research for the usage of insect based ingredients as a meal for aquaculture, M/s. Arthro Biotech Pvt. Ltd., Aspire Bionest - 21C, School of life Sciences, University of Hyderabad, Gachibowli, Hyderabad, Telangana	59,000
6.	Transfer of technology of '*Kalor*^{Plus}', Indigenous formulated feed for ornamental fishes, with M/s. Agro Wiz, NM 16, Old DLF, Sector 14, Gurgaon, Haryana	4,72,000
7.	Technical and consultancy service on hatchery technology of Mudcrab production for M/s. GSR Hatcheries, Sy No. 192/1 & 5, 199/1,2, Kanuru Post, Machilipatnam, Krishna District, Andhra Pradesh.	1,18,000
8.	Transfer of technology of CIBA EHP Cura I for M/s. Neomeds, 64/B, 1st Floor, Vengal Rao Nagar, S.R. Nagar. Hyderabad, Telangana.	5,90,000
9.	Contract research safety and potency testing of VNN Vaccine for Indian Immunologicals Limited, No.44 Jubilee Hills Hyderabad, Telangana	2,33,640
10.	Consultancy service for evaluating the utility of insect based protein and oil in aqua feeds for M/s. Loopworm Private Ltd. 677, 1st Floor, 27th Main 13th Cross, HSR Layout, 1st Sector, Bangalore, Karnataka	17,70,000
11.	Consultancy service for evaluating the effectiveness of plant based vitamin D3 in shrimp feeds for M/s. Nutrigene Biosciences Pvt. Ltd. #201, Teja Block, Hitech City, Hyderabad, Telangana.	9,44,000
12.	Technology transfer of Chingudi Plus shrimp feed for M/s. Sundeep Packaging Industries, Sunildeep, CB 12, Sector I, Salt Lake City, Kolkata, West Bengal	4,72,000
13.	Consultancy service for eco-smart high-density precision shrimp farming system under public private partnership mode M/s. The Waterbase Limited, Egmore, Chennai, Tamil Nadu.	2,50,000

S. No	Services offered & Name of the firm	Amount (₹)
14.	Consultancy service for validation of eco-smart high-density precision shrimp farming system under public private partnership mode Ms/. Prasidhi Exports Private Limited, Survey No.157/A, A-7, PotupalemPanchayathi, ThurpuGudur Village, Chillakur Mandal, SPSR Nellore Dist, Andhra Pradesh	2,00,000
15.	Technology transfer of VNN Vaccine for M/s. Indian Immunologicals Limited, No.44 Jubilee Hills Hyderabad, Telangana	7,90,600
16.	Consultancy service for developing and supporting implementation of an innovative, self-sustaining and comprehensive shrimp crop insurance for Tata AIG General Insurance Company Ltd and AON Insurance Brokers Private Limited, Mumbai	4,36,000
17.	Contract research for the evaluation of natural mineral mix product on growth and survival of *Penaeus vannamei* reared in low saline water for M/s.Agrocel Industries Private Limited, Agrocel House, Revenue Survey No. 135/P1/P1 and 135/P2/P1, Village-Bhujodi, Taluka-Bhuj, District-Kutch, Gujarat	5,11,920
18.	Consultancy service for evaluating the effect of distillers dried grains with solubles (DDGS) in the diet of pacific white shrimp, *P. vannamei* for M/s. BRC Marine Products, Plot No. 288/1123 and 1124, Narasinghprasad, P.O. Dosinga, Via. DhamaraBhadrak, Odisha.	7,56,000
	TOTAL	**91,25,160**

Particulars	₹ (lakhs)
Fertilized eggs/fry/fingerlings of finfish	8.12
Shrimp post larvae/mud crab instar/juveniles	6.68
Water analysis kit sale	1.68
Animal heath diagnosis services	49.25
Formulated feed sale	51.6
Revenue generated at KRC CIBA	74.85
Revenue generated at NGRC CIBA	13.05
Total	**205.23**

Research & Administrative Meetings

Research Advisory Committee (RAC)

The Research Advisory Committee of CIBA was constituted by ICAR (council's order F. No. 18-3/2016-ASR-1 dated February 10th, 2023) for a period of three with effect from January 1st, 2023 to December 31st, 2025

Chairman	**Dr Iddya Karunasagar**
Members	Dr A. Laxminarayana Prof. T. J. Abraham Dr A. K. Pal Dr M. Sudhakar Dr Shubhadeep Ghosh, ADG (M. Fy) Dr Kuldeep K. Lal, Director, ICAR-CIBA
Member Secretary	**Dr K. P. Kumaraguruvasagam**

The 29th meeting of the Research Advisory Committee (RAC) of CIBA was held on February 3rd, 2024 at CIBA headquarters, Chennai

Institute Research Council (IRC)

Chairman	**Dr Kuldeep K. Lal, Director**
Members	Dr C. P. Balasubramanian, Principal Scientist & HoD, CCD Dr M. Kailasam, Principal Scientist & HoD, FCD Dr M. S. Shekhar, Principal Scientist & HoD, AAHED Dr K. Ambasankar, Principal Scientist & HoD, NGBD Dr T. Ravisankar, Principal Scientist & SIC-SSD Dr Debasis De, Principal Scientist & Head, KRC, Regional Centre Dr Akshaya Panigrahi, Principal Scientist & SIC-NGRC Principal Investigators of all the projects
Member Secretary	**Dr Ashok Kumar**

The 41st IRC meeting was held March 19th to 21st, 2024 at CIBA headquarters, Chennai and the progress of the work was reviewed.

Institute Management Committee (IMC)

The Institute Management Committee has been constituted as follows

Chairman	**Dr Kuldeep K. Lal, Director**
Members	The Commissioner of Fisheries and Fishermen Welfare Department
	The Commissioner of Fisheries State Fisheries Department
	The Vice Chancellor Tamil Nadu Dr J. Jayalalitha Fisheries University
	Dr Pravata K. Pradhan, Principal Scientist & HOD, ICAR-National Bureau of Fish Genetics Resources, Luknow
	Dr G.S. Saha, Principal Scientist, Social Science Division, ICAR-Central Institute of Freshwater Aquaculture (CIFA)
	Dr Divya, P.R, Principal Scientist The Peninsular Aquatic Genetic Resources, ICAR - NBFGR,Kochi
	Dr T.K. Ghoshal Principal Scientist ICAR – Central Institute of Fisheries Education , Kolkata.
	Dr Shubhadeep Ghosh Assistant Director General (Marine Fisheries) Indian Council of Agricultural Research
	Shri Kunal Kalia Deputy Director (Finance), ICAR, New Delhi
	Shri Aswin Haridas Administrative Officer, ICAR- CIBA
Co-opted Members	Sh Navin Kumar Jha, Chief Administrative Officer & HOO, ICAR-CIBA Dr Prasanna Kumar Patil, PS & OIC, PME Cell, ICAR-CIBA, Dr P. Mahalakshmi, PS & OIC, Engg. Cell, ICAR-CIBA, Smt Komal Sheokand, Chief Finance & Accounts Officer, ICAR-CIBA Sh A. Sekar, Asst Administrative Officer (Estt.), Sh P. Srikanth, Finance & Accounts Officer, ICAR-CIBA Smt E.Mary Desouza, Asst Administrative Officer (Stores), ICAR-CIBA
Non-official Members	Shri Senthil Nathan, P., Farmers' Representative Shri S. Elangovan, Farmers' Representative

Institute Joint Staff Council (IJSC)

The composition of the institute joint staff council was reconstituted by CIBA for a period of three years with effect from September 13th, 2022 to September 12th, 2025 (office order F No. 13-1/2012-Admn. Vol-V111 of September 14th, 2022

Official Side	
Chairman	**Dr Kuldeep K. Lal, Director**
Member Secretary	Dr T. Ravisankar, Principal Scientist
Members	Dr M. Jayanthi, Principal Scientist Dr S. Kannappan, Principal Scientist Shri Navin Kumar Jha, CAO & Head of the office Smt Komal Sheokand, Chief Finance and Account officer Administrative officer
Member Secretary	**Dr Ashok Kumar**
Staff Side	
Secretary and CJSC member representative	**Shri N Jagan Mohan Raj, Technical officer**
Members	Shri Solin Igneshus, LDC Shri Kishorkumar, V. LDC Shri S. Prabhu, Technical Assistant Shri R. Mathivanan, Skilled Support Staff Shri Indra Kumar, Skilled support staff

Grievance Committee

Chairman	**Dr Kuldeep K. Lal, Director**
Elected members	
Scientific members	Dr K. Ambasankar, Principal Scientist and HoD, NGBD Dr Nila Rekha, Principal Scientist
Technical member	Dr Joseph Sahaya Rajan, ACTO
Administrative Members	Administrative officer Shri P. Srikanth, FAO
Staff member	Shri R. Mathivanan, Skilled Support Staff

Woman Complaint Committee

Chairperson	**Dr R. Saraswathy, Principal Scientist**
Members	Dr Prasanna Kumar Patil, Principal Scientist Dr P. Nila Rekha, Principal Scientist Shri N. Jagan Mohan Raj, Technical Officer Smt E. Mary Desouza, AAO
External Member	Dr A. Sumathi, Asst. Prof & Head-in-charge, Department of Biomedical Sciences, Shri Ramachandra Medical College, Porur, Chennai

Women Cell

Chairperson	**Dr Sherly Tomy, Principal Scientist**
Members	Dr P. Mahalakshmi, Principal Scientist Smt K. Jacquline, ACTO Smt E. Mary Desouza, AAO Smt S. Nailini, Private Secretary Smt K. Subhashini, Personnel Assistant
Member Secretary	Smt V. Usharani, AO (until 31st March 2024)

The meeting of the Women Cell of CIBA was held at CIBA Headquarters, Chennai on 20th November, 2023 and 15th February, 2024.

Services & Assignments

Dr Kuldeep K. Lal, Director

- Meeting of Fisheries SMD & Directors of Institutes, convened by DDG (Fy.), ICAR, virutual mode on 3rd January 2024

- 14th Anniversary of Fish for All Centre of MSSRF and Exchange of MoU between ICAR-CIBA and MSSRF for research and development. Fish for All Centre of MSSRF, Poompuhar on 4th January 2024

- Meeting with the representatives of Fish and Shrimp Farmers Associations and Shrimp Hatchery Assocaition of A.P. to discuss on current issues in aquaculture, convened by the Co-Vice Chairman, Andhra Pradesh State Aquaculture Development Authority Department of Fisheries, A.P. Vijayawada on 8th January 2024

- Technical Seminar on Biosecurity management of shrimp farming – Black tiger and vannamei shrimp, for the shrimp farmers at Surat, organized by Grasim Industries Limited, Aditya Birla Group, Mumbai Royal Dine Restaurant & Banquet, Surat on 11th January 2024

- Workshop/Seminar on PMMSY organized by CIFNET, in connection with Matsya SampadaJagrukta Abhiyan CIFNET, Chennai 23rd January 2024.

- Meeting of the Directors of ICAR Fisheries Research Institutes with RAC Chairs, on Research Programmes, Mutual Learnings and Collaborations, convened by Deputy Director General (Fy.), ICAR at Central Institute of Fisheries Education, Mumbai. CIFE, Mumbai on1st February 2024

- Meeting with ICAR-Central Institute of Fisheries Education (CIFE) to discuss on 'Modalities of supplying feed for their experiments and Training Programme on Insurance" CIFE, Mumbai on12th February 2024

Participated in the Inaugural function of the 33rd Governing Council Meeting of NACA, held at ICAR Convention Centre, New Delhi during 5-8th March 2024

- Monthly Meeting of Fisheries SMD & Directors of Institutes, convened by DDG (Fy.), ICAR, on virtual mode SMD (Fisheries) ICAR, New Delhi 1st April 2024

- Genome Editing Plan Meeting - Fisheries Division, with DDG (Fy.), ICAR and Director, CIFA and Scientists of ICAR-CIBA. ICAR-CIBA Chennai 3rd April 2024

- Meeting on Viksit Bharat, convened by Secretary, DARE & Director General, ICAR, on virtual mode ICAR, NASC, New Delhi 16th April 2024

- Meeting for discussion on Mariculture and allied activities, chaired by Joint Secretary (M.Fy.), DoF, MFAHD, New Delhi, Department of Fisheries, MFAHD, New Delhi on19th April 2024

- Meeting with Delegation of researchers from University of Tromso - The Arctic University of Norway (UiT), organized by the Office of Ambassador, Embassy of India, Norway, to discuss on academic and research collaboration, on 24.4.2024 at Royal Norwegian Embassy, New Delhi. Royal Norwegian Embassay, New Delhi 24th April 2024

- Launch of CIBA-CIFE Program on Shrimp Insurance. Central Institute of Fisheries Education, Mumbai 29th April 2024

- 77th Meeting of Coastal Aquaculture Authority, on virtual mode, Coastal Aquaculture Authority, Chennai 30th April 2024

- Meeting for conducting the personal hearing of the Petitioner, Shri John Joseph D'Souza – W.P.No.1111 of 2019, held at CAA, Chennai (Virtual mode) Coastal Aquaculture Authority, Chennai on 6th May 2024

- Meeting to discuss on Standard Operation Procedures for import of SPF broodstocks of crustaceans with special reference to AHPND, under the Chairmanship of Joint Secretary (Marine Fisheries), DoF, Govt. of India, on Virtual mode. Department of Fisheries, MFAHD, New Delhi 7th May 2024

- Meeting to discuss on drafting of new guidelines under CAA Act, convened by Joint Secretary (Marine Fisheries), DoF and Secretary CAA, through video conference Department of Fisheries, MFAHD, New Delhi on 7th May 2024

- Meeting on new Sub Scheme, PM-MKSSY under the Chairmanship of Secretary, Department of Fisheries, GoI. Department of Fisheries, MFAHD,New Delhi 9th May 2024

- Meeting with all ICAR institutes on Five Action Points under Pradhan Mantri Matsya Sampada Yojana (PMMSY), organized by Department of Fisheries, MFAHD, GOI. Department of Fisheries, MFAHD, New Delhi on 14th May 2024

- Launch workshop of Indian Network for Fishery and Animals Antimicrobial Resistance (INFAAR), on 22nd May 2024 at NASC Complex, New Delhi. NASC Complex, ICAR, New Delhi on 22nd May 2024

- Presentation meeting on commodities of Fisheries Science Division of ICAR, in respect of Viksit Bharat Meeting (Fisheries Science), convened by Secretary, DARE and Director General, ICAR on 30th May 2024

- Meeting of the Directors of Fisheries Research Institutes and the Officers of SMD (Fisheries) convened by DDG (Fy.), ICAR, to discuss various technical and administrative matters. SMD (Fisheries), ICAR, New Delhi on 6th June 2024

- Meeting to discuss the issues related to Fisheries & Aquaculture Infrastructure Development Fund (IDF) and Broodstock management, held under the Charipersonship of Hon'ble Finance MinisterFMO, North Block, New Delhi on 15th July 2024 (11.00 hrs.)

- 96th ICAR Foundation and Technology Day-2024 to be held at NASC Complex, New Delhi, during 15-16 July 2024 at NASC Complex, New Delhi

- Seventy Eighth meeting of Coastal Aquaculture Authority, on Virtual mode. CAA, Chennai on 18th July 2024

- Inauguration Function of the Training Programme on "Entrepreneurial Opportunities in fisheries sectors", to SC, ST and General Category of Fishermen, Farmers, Youth and Women, organized by Guru Nanak College, Chennai. Guru Nanak College, Velacherry, Chennai on 22nd July 2024

- Meeting to discuss Innovative Projects / Technology Demonstrations, Chaired by Deputy Director General (Fy.), ICAR and Co-chaired by Chief Executive, National Fisheries Development Board (NFDB). NFDB, Hyderabad on 13th August 2024

- 29th Meeting of Scientific Panel on Fish and Fisheries Products, as a Member in the Scientific Panel.FSSAI, New Delhi on 21st August 2024

- 244th Meeting of the Board of Directors of Tamil Nadu Fisheries Development Corporation Limited Secretariat, Chennai – 9, 30th August 2024

- Stakeholders Consultation on Transforming Agriculture Research-Enhancing Role of Private Sector, organized by Ministry of Agriculture and Farmers' Welfare, Govt. of India, on virtual mode. Krishi Bhavan, New Delhi on3rd September 2024

- Stakeholders Consultation on "Fisheries Export Promotion with focus on Shrimp Farming and Export Value Chain", organized by Department of Fisheries, Govt. of India Visakhapatnam on 6th September 2024

- 4th Anniversary of Pradhan Mantri Matsya Sampada Yojana, organized by Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Govt. of India. Sushma Swaraj Bhawan, Chankyapuri, New Delhi on 11th September 2024

- Progamme Chaired by Shri. George Kurian, Hon'ble Union Minister of State, Ministry of Fisheries, Animal Husbandry & Dairying and Minority Affairs, GoI, on the occasion of the Inauguration of Black Soldier Fly based bio-waste conversion unit at CMFRI. Kochi on 26th September 2024

Meeting to discuss on the forthcoming 14 AFAF, organized by SMD (Fisheries), ICAR SMD (Fisheries), ICAR, New Delhi on 30th September 2025

- Seventy Ninth Meeting of Coastal Aquaculture Authority, on virtual mode Coastal Aquaculture Authority, Chennai on 21st October 2024

- 3rd edition of the Shrimp Retail 2024 Conference, organized by P2C Communications, New Delhi. Crowne Plaza Hotel, Mayur Vihar, New Delhi on 5-6 December 2024

- Meeting of the Committee Members of 14th AFAF, on virtual mode ICAR-CMFRI, Kochi 24th December 2024

Services in Committees/ Societies/Board:

Executive Committee and Governing Body, Rajiv Gandhi Centre for Aquaculture (MPEDA), Mayiladuthurai.

ICAR Regional Committee No. VIII

Executive Committee Member - National Centre for Sustainable Aquaculture (NaCSA)

Coastal Aquaculture Authority

Director – Board of Tamil Nadu Fisheries Development Corporation Limited, Chennai.

Extension Council of ICAR-Central Institute of Fisheries Education, Mumbai

Board of Management of ICAR - Central Institute of Fisheries Education, Mumbai

Academic Council of ICAR-Central Institute of Fisheries Education, Mumbai

Scientific Advisory Committee, Krishi Vigyan Kendra, Tiruvallur

Scientific Advisory Committee, Dr Perumal Krishi Vigyan Kendra

Scientific Advisory Committee, ICAR- Krishi Vigyan Kendra, Tiruvannamalai

National Committee on Introduction of Exotic Aquatic Organisms into Indian waters, constituted by the Ministry of Agriculture & Farmers Welfare, DAHDF, Govt. of India, New Delhi.

Advisory Committee on Hilsa Conservation and Research.

Central Standing Committee (CSC) on Pradhan Mantri Matsya Sampada Yojana (PMMSY) for formulation of unit cost norms, unit costs and guidelines in respect of all the components and sub-components of the PMMSY.

Technical Advisory Committee for the GNF-BMZ Project "Building a transnational, civil society partnership to increase the resilience of coastal population in South Asia", constituted by the Governing Board of Centre for Research on New International Economic Order (CReNIEO), Chennai.

Scientific Panel on Fish and Fisheries Research Products, constituted by the Food Safety and Standards Authority of India, New Delhi.

Expert Committee to draft Rules/Regulations and Guidelines for 'The Coastal Aquaculture Authority (Amendment) Act, 2023, constituted by the Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, Govt. of India.

Sub-Committee on "SPS & Quality Assurance for Marine Products Export Promotion" constituted by MPEDA, Kochi

Sub-Committee on Species Diversification & New Technology Adoption for Marine Products Export Promotion, constituted by MPEDA, Kochi.

Sub-Committee on Aquaculture Regulation & Traceability for Marine Products Export Promotion, constituted by MPEDA, Kochi.

Society of Coastal Aquaculture and Fisheries (SCAFi)

Member - Asian Fisheries Society Indian Branch & Councilor, Asian Fisheries Society, Kuala Lumpur

Member – National Advisory Committee constituted for organizing 13th Indian Fisheries and Aquaculture Forum : Fostering Indina Fisheries and Aquaculture for attaining Sustainable Development Goals, during 23-25th Febraury 2024 at Kolkata.

Member – National Organizing Committee constituted by NIOT for organizing World Ocean Science Congress (WOSC – 2024) during 27th February – 1st March 2024 at Chennai.

Member – National Advisory Committee constituted for organizing the 2nd International Conference on the theme "Sustainable Fisheries and Aquaculture Resource Management: Life Below Water" during 12-14 September 2024, organized by Central Calcutta Science & Culture Organisation for Youth, Kolkata.

Dr J. Ashok Kumar

NICRA Technical review workshop of fisheries domain held on 21st October 2024 at MES of ICAR-CIBA

Integrated modelling technical meeting on 18 December 2024 held at IIHR, Bangalore.

Dr M. Muralidhar

Member, ITMC of ICAR-IIOPR, and attended the Technology Management Committee meeting held on July 12th, 2024 at ICAR-IIOPR, Pedavegi

Dr S. K. Otta

Invited speaker - International Fisheries Congress & Expo 2024, 12-14 January, 2024, Kochi, Kerala

Lead speaker - 13th Indian Fisheries & Aquaculture Forum (13 ifaf), 23rd -25th February 2024, Kolkata

Member of the International Scientific Committee for the organization of the DAA 12, Chennai, September 2025, under Fish Health Section-Asian Fisheries Society (FHS-AFS)

Key note speaker, FIFCA 2050, Dr MGR Fisheries College and Research Institute, Thalainayeru, 19th June 2024

Member for developing draft on National Aquaculture Biosecurity Guidelines for Govt of India under the chairmanship of DDG (Fy), ICAR

Associate editor – Frontiers in Aquaculture – August 2024 onwards

Editorial committee member – Scientific Reports – September 2024 onwards

Lead speaker – VIROCON 2024, Gwalior

Co-chair of Aquatic virology section – VIROCON 2024, Gwalior

Academic Council Member, KUFOS, Kochi

IMC member, ICAR-CIFRI, Barrackpore

2nd meeting of the Expert Committee to draft the Guidelines related to the Coastal Aquaculture Authority (Amendment) Act, 2023 – 8 February 2024.

Virtual meeting under the chairperson of JS (Mf) to discuss on SOP for import of SPF broodstocks of crustaceans with special reference to AHPND-7 May 2024

41st Meeting of the National Committee on Introduction of Exotic Aquatic Species into Indian Waters 18th June, 2024 under the Co-Chairmanship of Joint Secretary (IF) and Joint Secretary (MF)

Review meeting to discuss on the drafting of guidelines in accordance with CAA rules 2024 (Rule 3), DoF, Govt of India – 3 June 2024

Meeting to discuss the status of drafting of guidelines under

the CAA rules 2024 (Rule 3) – 28 June 2024 under the chairmanship of JS, DoF, Govt of India.

Meeting to discuss the status of remaining draft guidelines and draft SOPs under the CAA rules 2024 (Rule 3) – 25 July 2024 under the chairmanship of JS, DoF, Govt of India.

NSPAAD meeting discussion with state govt directors, NFDB, Hyderabad, 3 August 24

IMC meeting, ICAR-CIFRI, 21 August 2024

Thirty-eighth Academic Council Meeting, KUFOS, 30th August 2024

Stakeholders interactive meeting on aquaculture insurance and national fisheries digital platform (NFDP), ICAR, CIBA – 24th October 2024

Meeting with FAO personnel, Ms TipparatPongthanapanich and Mr Michael Phillips on CIBA activities – 25 October 2024

Twenty forth Meeting of the Technical Committee to oversee and monitor the functioning of Aquatic Quarantine Facility (AQF) – on 29.11.2024

Webinar conducted by Genics, Australia in coordination with Department of Fisheries, Govt of India on 28th November 2024

Thirty ninth Academic council meeting of KUFOS on 13th December 2024

Dr Sujeet Kumar

CRPVD annual review meeting in Bengaluru held on 04.03.2024 to 05.03.2024.

Served as examiner for CIFE, Mumbai for Fish and shellfish immunology, August 2024

Dr R. Ananda Raja

Technical and Inspection Committee member for registration and renewal of 47 *P. vannamei*, three *P. monodon*, one polychaete, one artemia and one *M. rosenbergii* hatcheries located in Tamil Nadu and Andhra Pradesh during 2024.

National Accreditation Board for Testing and Calibration Laboratories (NABL) Assessor as per ISO/IEC 17025:2017 to Central Aquaculture Pathology Laboratory, Rajiv Gandhi Centre for Aquaculture (RGCA), Avian Disease Diagnostic Laboratory (ADDL), Thiruvalla, State Institute For Animal Diseases (SIAD), Thiruvananthapuram, Jain Research & Development, Jain Irrigation System Limited, Jalgaon, Southern Regional Disease Diagnostic Laboratory (SRDDL), Hebbal during 2024

Committee for Control and Supervision of Experiments on Animals (CCSEA) nominee to the Institutional Animal Ethics Committee (IAEC) of BCG Vaccine Laboratory (BCGVL), Government Kilpauk Medical College (GKMC), Christian Medical College, and Ramachandra Medical College and Research Institute, Tamil Nadu during 2024

Selection committee member for the selection of project associate II under the DBT scheme on "Molecular biological studies on New castle disease virus (NDV) for differentiation of diagnostic assay using gene editing technology for rapid differentiation of field and vaccine strains of NDV from field outbreaks" in the Department of Veterinary Pathology, Madras Veterinary College, Chennai-600007, 9th January 2024.

Organized and attended the "Interface meeting with farmers on shrimp crop insurance" in Veeravasaram, Bhimavaram, West Godavari district, Andhra Pradesh, 27th January 2024

Expert Committee member to draft Guidelines related to the Coastal Aquaculture Authority (Amendment) Act, 2023 and attended the Expert Committee meeting with the Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Govt. of India, 8. February 2024

Organized and attended the Regional Committee Meeting (RCM) - VIII at National Institute of Ocean Technology (NIOT), Chennai, 16th February 2024.

Attended the Institutional Animal Ethics Committee (IAEC) of Ramachandra Medical College and Research Institute, Tamil Nadu as CCSEA nominee, 29 February 2024.

Attended the U.S. Food and Drug Administration (USFDA) and the U.S. Department of Agriculture, Animal and Plant Inspections Services (APHIS) joint thematic workshop on One Health related to aquatic lifecycle and trade at Coastal Aquaculture Authority (CAA), Chennai, 6th March 2024.

Examiner to set a question paper and evaluate answer scripts for examination of the M.F.Sc. programme at ICAR-CIFE, 19th March 2024

Served as a technical expert for the tender evaluation committee for PCR kits for aquatic animal disease diagnosis in Rajiv Gandhi Centre for Aquaculture (RGCA) at Sirkali, 4 & 12 April 2024

Served as an ISO 9001:2008 and ISO 9001:2015 internal auditor since 26 August 2013 and audited this financial year on 4 April and 3rd October 2024

Acting as an honorary advisor to develop an IoT& computer vision based product for identifying the diseases based on the fish behavioural changes, visual indicators, symptoms, lesions and clinical signs in aquarium

species by Ms. Shraddha ParshuramBashetti, FisHealth14 AI Ventures Pvt. Ltd., A start-up venture for funding under BIRAC's BIG scheme, 5th April 2024

Attended the IAEC of BCG Vaccine Laboratory (BCGVL), Chennai under the Directorate General of Health Services (DGHS), Ministry of Health and Family Welfare, Government of India as CCSEA nominee, 27th April 2024

Conducted a systematic scientific scrutiny, identified the probable causes based on available scientific evidences and advised the farmers and insurance company about shrimp crop insurance atAquaExchangeAgritechPvt. Ltd, Veeravalli, Vijayawada, 3rd May 2024

Organised and demonstrated the "ReportFishDisease app" in the Shrimp Farmers' Conclave, Edition 3.0 - 2024 in association with the National Fisheries Development Board, Hyderabad at Kakdwip Research Centre of ICAR-CIBA, West Bengal, 9-10 August 2024

Examiner to set a question paper and evaluate answer scripts for examination of the M.F.Sc. programme at ICAR-CIFE, 14th August 2024

Visited and inspected for executing the TAHDCO brackishwater farming project at Poraiyar, Nagapattinam district, Tamil Nadu, 20th August 2024

Attended the meeting with Indian Immunological Limited, Hyderabad for Developing the Regulatory Guidance Document for Fish Vaccines in India, 3rd September 2024

Technical inspection committee member for inspection of the shrimp evaluation study unit (SESU) at Rajiv Gandhi Centre for Aquaculture (RGCA), Rajakkamangalam, Tamil Nadu, 24-25 September 2024

External Examiner for evaluating the two Dissertations and for conducting online/virtual mode viva voce of M.F.Sc. students in the discipline of Aquatic Animal Health Management, ICAR-CIFE, Mumbai,7th October 2024

Attended the Stakeholder Meeting-Fisheries Segment organized by the Agriculture Skill Council of India (ASCI) and given inputs for revision of various Qualification Packs in Marine Fisheries and Fishery Assistance related segments, 20th December 2024

Annual animal house inspection of Government Kilpauk Medical College (GKMC), 30th December 2024 – Dr R. Ananda Raja

Delivered a live interview on "Health management in brackishwater aquaculture" in VelaanKalam, Doordarshan programme on 13th September 2024– Dr R. Ananda Raja

Dr M. Poornima

Served as ICAR-CIBA nominee for linkage with KVK's in zone-X. Visited KVK, RASS, Tirupathi, assessed their performance as per guidelines of DDG(Extension) and submitted the report to nodal officer

Served as CIBA Nominee for CAA inspection of hatcheries located in Bapatla, Nellore and Prakasam districts in Andhra Pradesh.

Participated in pledge and Swachhata Hi Seva (SHS) 2024 campaign along with CAA, State fisheries department officials and other team member's .Took part in a cleanliness drive on 18 September 2025 organized at Srinivasasathram and Koduru II on 18th September, 2024 to ensure cleanliness at rural villages.

Attended online Ecoregional Working Group Programme on 10th May 2024 organized by ICAR, New Delhi

Attended Programme on commodities of the Fisheries Science Division of ICAR, held on 30th May, 2024 by ICAR, New Delhi through Online Mode.

Participated in meeting and discussion with Dr Priyabrata Pattnaik, Deputy Managing Director, Indian Immunologicals Limited on 3-9-2024. Provided technical inputs in preparation of draft Regulatory Guidance Document for Fish Vaccines in India

Dr M. S. Shekhar

8th Annual review workshop ICAR-CRP on Genomics, 18.9.24, NASC, New Delhi

39th Meeting of the National Committee on Introduction of Exotic Aquatic Species into Indian Waters 10th April, 2024

lecture series "Matsya Manthan" on the latest technology applications to the Fisheries and Aquaculture 25th April 2024.

National Webinar on Aquaculture Insurance Product Development, organized by Department of Fisheries, MFAHD, GoI & ICAR-CIBA, on 19th July 2024

Learning programme: Role of AI in spoken Hindi and Official Language, AVNL, Chennai, 29.4.2024

Meeting of Town Official Language Implementation Committee (TOLIC), Chennai, 07-08-2024

Executive Committee and 31st Annual General Body meetings of RGCA, 24.10.2024

Shri Dani Thomas

Participated in National Stakeholder Consultation on Sustainable Development of ornamental fisheries in India" organized by ICAR-CIFA during August 1st - 2nd 2024.

Dr R. Jayakumar

Served as an External Expert in the technology screening, approval and documentation committee meeting held at Dr J. Jayalalitha Fisheries University, Nagapattinam on 21st December 2024

Served as panellist in the "3rd International Conference on Higher Education Institute Challenges and Solutions for Sustainable Development Goals (ICSDG 2024)", organized by the SRM Institute of Science and Technology (SRMIST) on 4th December 2024.

Attended the Project Appraisal and Monitoring Committee (PAMC) on Ocean Science and Resources meeting held at INCOIS, Hyderabad on 03rd & 4th July 2024 for the project proposal on "Developing viable methods for propagation of seed material and cultivation of edible brackish water seaweeds" for funding from Ministry of Earth Sciences (MoES).

Participated in the "Chintan Shivir" workshop on "Strategies to promote Marine Exports from India" jointly organized by MPEDA & Department of Commerce held during 10-11th May 2024 at Bangaram Island, Lakshadweep.

Dr Riteshkumar Shantilal Tandel

Member of Coastal Aquaculture Authority Committee for inspection of farms and hatcheries in Gujarat

Dr Pragyan Dash

Acting as an Academic Editor of the Journal of Applied Ichthyology journal of Hindawi/ Wiley publisher.

Shri Jose Antony

Acting as Principal member of BIS Sectional Committee, TXD 18, Textile Materials for Marine/ Fishing Purposes.

Member of SHAPHARI Certification committee of MPEDA for Gap audit and Certification audit of shrimp farms and hatcheries in Gujarat

Shri Pankaj Amrut Patil

External subject expert for M.F.Sc. and Ph.D. thesis evaluation, College of Fisheries, Ratnagiri, Maharashtra

Dr C. V. Sairam

Participated in the 15th Scientific Advisory Committee meeting of KVK Villupuram on 26th February 2024

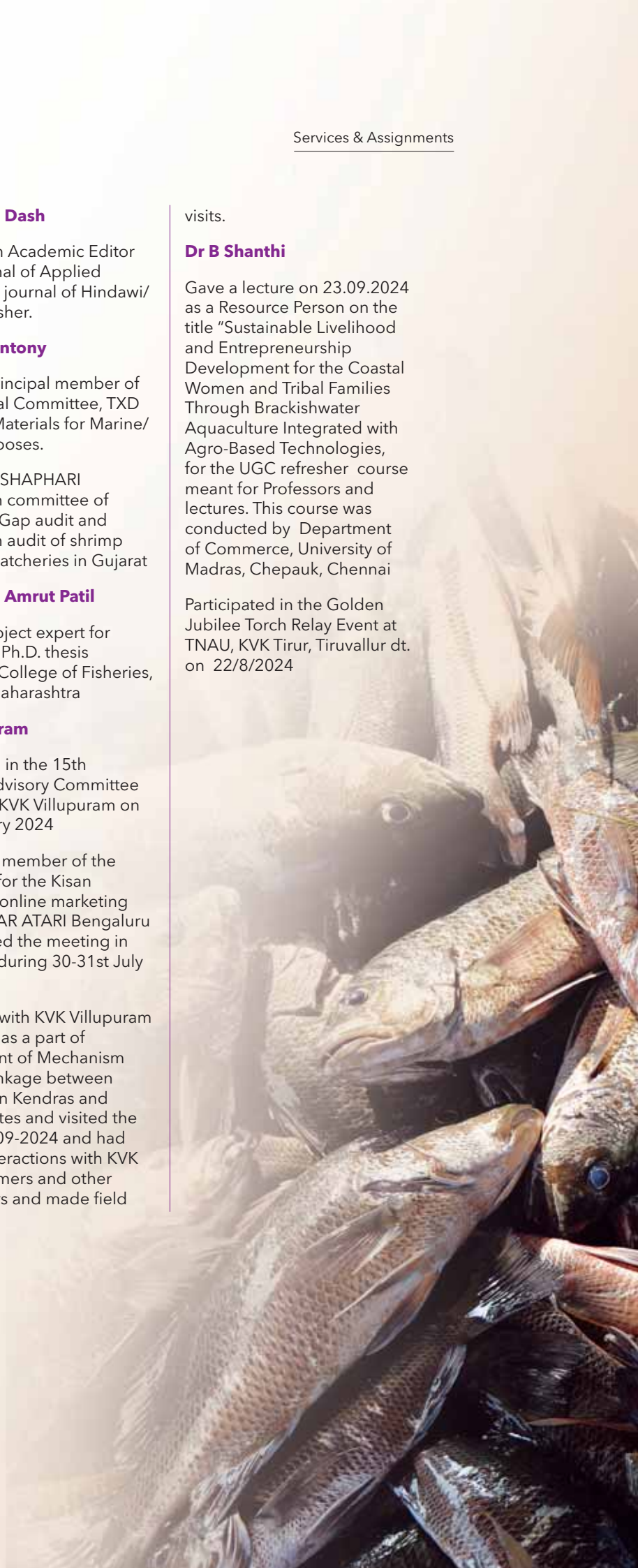
Served as a member of the committee for the Kisan Samruddhi online marketing portal of ICAR ATARI Bengaluru and attended the meeting in this regard during 30-31st July 2024

Associated with KVK Villupuram Tamil Nadu as a part of development of Mechanism for better linkage between Krishi Vigyan Kendras and ICAR Institutes and visited the KVK on 13-09-2024 and had detailed interactions with KVK officials, farmers and other stakeholders and made field visits.

Dr B Shanthi

Gave a lecture on 23.09.2024 as a Resource Person on the title "Sustainable Livelihood and Entrepreneurship Development for the Coastal Women and Tribal Families Through Brackishwater Aquaculture Integrated with Agro-Based Technologies, for the UGC refresher course meant for Professors and lectures. This course was conducted by Department of Commerce, University of Madras, Chepauk, Chennai

Participated in the Golden Jubilee Torch Relay Event at TNAU, KVK Tirur, Tiruvallur dt. on 22/8/2024



Swachh Hi Sewa & Swachhta Pakhwada Activities

Honourable Prime Minister of India, on Aug 15, 2014, gave a call for Swachhata to become a national priority, and subsequently the Swachh Bharat Mission was launched on 2nd October 2014 under a 'Whole of Government' approach, making sanitation 'everyone's business'. To offer tribute to the Mahatma on his Jayanti, 2nd October is observed as Swachh Bharat Diwas.

As a prelude to that, to strengthen voluntarism and collective action for Swachh Bharat, a fortnight of 'Swachhata Hi Seva' (SHS) has been observed since 2017. Over the past decade, Central Institute of Brackishwater Research with its headquarters at Chennai and two Research Centres and two field stations has chalked out elaborate plans to carry out the National Sanitation Campaign

During the current year, ICAR-CIBA organised "Swachhata Hi Sewa" from September 15, to October 2, and observed "Swachhta Pakhwada" from 16th to 31st December, 2024 at Headquarters, Chennai,

Muttukadu Experimental Station (MES) of CIBA, Muttukadu, Kovalam Experimental Station (KES) of CIBA, Kovalam, Kakdwip Research Centre (KRC) of CIBA, Kakdwip, West Bengal, and Navsari-Gujarat Research Centre (NGRC) of CIBA, Navsari, Gujarat.

The "**Swachhta Pledge**" was taken by the Scientists, Officers, Staff and Students administered by Dr. Kuldeep Kumar Lal, Director, ICAR-CIBA. The regional centres MES, KRC and NGRC of ICAR- CIBA joined online for the pledge.

Swachhata Hi Seva reinforced the importance of cleanliness and efficient waste management. The initiative not only enhanced workplace hygiene but also contributed to environmental conservation through proper scrap disposal and recycling. As part of this campaign, various activities were conducted, including the cleaning of ponds, removal of tree waste, and systematic waste disposal. Cleaning materials were distributed to local villagers and farm field workers to encourage continued cleanliness efforts. Additionally, a medical camp was arranged, and health kits were distributed to both locals and office staff, promoting community well-being alongside hygiene.

Also a village cleaning activity was conducted in **Thiruvidanthai Village**, focusing on improving sanitation and public hygiene. The cleaning drive involved sweeping public pathways and removing accumulated animal waste enhancing the cleanliness of the area. This effort not only facilitated smoother and safer movement for pedestrians but also contributed to the creation of a more hygienic environment for the local community.

Banners and Name boards were created and displayed at strategic locations both inside and outside the office premises to create awareness among staffs and public. Activities such as Swachhta Seminar, Swachhta Cleanliness and Sanitation Drive, setting up a selfie booth and tree plantation drive were organised to promote cleanliness and to foster sense of environmental stewardship among participants.

Kisan Diwas was celebrated on December 23, recognizing farmers' contributions and promoting sustainable farming practices. Events at CIBA's Head Quarters, MES, NGRC and KRC brought together more than 200 farmers, including women from self-help groups, to discuss modern fish farming techniques and sustainable agriculture.


KISAN DIWAS


FOSTERING HEALTHY COMPETITIO

Farmers were provided with tools for waste management and awareness about biodegradable and non-biodegradable waste segregation, along with ornamental fish seeds for livelihood enhancement.

Engagement with schoolchildren was another highlight of the Pakhwada. A drawing competition held at Matwad Primary School in Gujarat encouraged young students to express their ideas on cleanliness through art. The event fostered awareness about the importance of hygiene among the next generation, with the best entries awarded prizes.

These initiatives not only enhanced workplace and community hygiene but also contributed to environmental conservation through tree plantations, recycling efforts, and responsible waste disposal. The active participation and enthusiasm displayed throughout the campaign reflect a growing commitment to making cleanliness a way of life.

Mera Gaon Mera Gaurav

ICAR-CIBA implemented the MGMG programme in 12 villages adopted in the three districts of Chengelpattu, Chennai and Thiruvallur. A total of 48 scientists in12 teams were in regular touch with the shrimp/fish farmers of these villages through visits, mobile advisories, WhatsApp messages, interface meetings, training, literature distribution and awareness programme on aquaculture insurance, soil heath card, Swachhta Abhiyan, climate change and waste from wealth. programmes etc., Training was also given to the two groups of scheduled caste fishers to impart practical learning experience on brackishwater aquaculture technologies by providing them first-hand exposure on seeing is believing, learning by doing. Training manuals were prepared in vernacular language and assured them that the required technical guidance and assistance would be provided by the institute. The fish/shrimp farmers were also given information on better management practices in shrimp culture and issued soil health cards. Around 2,00,000 fish fry was also distributed to the adopted village fish farmers

benefitting two scheduled caste groups. On Kisan Diwas, about 70 participants including fish farmers, fisherwomen from MGMG villages attended the Farmer-Scientist interface session held at the Muttukkadu Experimental Station of ICAR – CIBA. An awareness programme on seabass nursery rearing and crab farming was also conducted for the benefit of the participants. Cutting across all disciplines, farm problems were diagnosed and effective solutions were delivered to the fish farmers.

Regular activities undertaken in MGMG adopted villages

- Established linkages with Panchayat, Anganvadi, veterinary doctor, Department of Fisheries, village leaders and farmers
- Farmers scientist interaction meet
- Created awareness on brackishwater aquaculture technologies.
- Distribution of farmers friendly literature on brackishwater aquaculture technologies
- Mobile advisory services was provided on , hapa based nursery rearing of seabass, cage culture and mudcrab farming
- Provided information to farmers about, seed, fingerlings& market linkages.
- Created awareness among fish farmers about the programmes being implemented by various organizations and institutions working at local level e.g. voluntary organizations, farmers' organisation, other Govt. departments.

Distinguished visitors

S.no	Details of Visitors	Date of Visit
1.	Dr Sowmiya Swaminathan, the Chairperson of MSSRF	5th January 2024
2.	Hon'ble Shri Sudhir Sachchidanand Mungantiwar, Cabinet Minister of Forest, Cultural affairs and Fisheries, Government of Maharashtra at Mumbai	8th February 2024
3.	Dr Himanshu Pathak, Director General, ICAR and Secretary, DARE	15-16th February 2024
4.	Dr Joykrushna Jena, Deputy Director General (Fisheries), ICAR, New Delhi	20th February 2024
5.	Dr R. Shankar Narayanan, CGM, NABARD Regional Office	29th February 2024
6.	Dr Santhana Krishnan, CEO, Marine Technologies Pvt Ltd., Chennai	28th March 2024
7.	Shri V. Srinivasa Rao, Director, Department of Fisheries, Government of India	15th April 2024
8.	Dr L N Murthy, Chief Executive of the NFDB	15th April 2024
9.	Dr Rajiv Kumar Singh, Controller of Patents, Patent Office, Chennai	30th April 2024
10.	Dr S. Bandyopadhyay, climate adaptation expert, BISA	7th May 2024
11.	Dr C.A. Rama Rao, Principal Scientist, CRIDA and National Principal Investigator of ACASA project	7th May 2024
12.	Dr Hemanth Kumar Nath, Registrar, Guwahati University	17th May 2024
13.	Shri Shivaraj Singh Chouhan, Hon'ble Union Minister for Agriculture and Farmers Welfare & Rural Development, Govt. of India and the President of Indian Council of Agricultural	6th July 2024
14.	Dr K Anand Kumar, Managing Director, Indian Immunologicals Limited	29th August 2024
15.	Dr Priyabrata Pattnaik, Deputy Managing Director, Indian Immunologicals Limited	29th August 2024
16.	Mr Tamil Selavaraja, CEO, RSFFPO, Ramanathapuram district, Tamil Nadu,	11th September 2024
17.	Shri George Kurian, Honourable Union Minister of State for Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying and Minority Affairs, Government of India	9th October 2024
1.	Shri Venkata Swami, IAS, Chairman, the Marine Products Export Development Authority (MPEDA)	9th October 2024
2.	Dr B.K. Behra The Chief Executive, NFDB, Coastal Aquaculture Authority (CAA), DoF	9th October 2024
3.	Dr S.K. Chaudhari, Deputy Director General (NRM)	24th October 2024
4.	Dr V.K. Singh, Director, ICAR-CRIDA	24th October 2024
5.	Mr S.N. Yadav, BRC Marine Products, Odisha	27th December 2024
Kakdwip Research Centre		
1.	Hon'ble Union Minister of Fisheries, Animal Husbandry and Dairying, Govt. of India, Shri Parshottam Rupala	11th January 2024
2.	Ms Neetu Kumari Prasad, Joint secretary (Marine fisheries)	11th January 2024
3.	Dr L. Narasimha Murthy, Chief Executive I/c & Senior Executive Director.	11th January 2024
26	Shri Santosh Das, Directorate of Fisheries, Govt. of Tripura, Agartala, West Tripura	5th April 2024
Navsari Gujarat Research Centre		
27	Dr Z. P. Patel, Vice Chancellor, Navsari Agricultiural University	23rd August 2024
28	Dr S. R. Chaudhary, Principal, College of Fisheries, Navsari	23rd August 2024

Hon'ble Union Minister of Fisheries, Animal Husbandry and Dairying, Govt. of India, Shri ParshottamRupala visited Kakdwip Research Center of ICAR-CIBA, Kakdwip, West Bengal.

Shri, Parshottam Rupala, Hon'ble Union minister of Fisheries, Animal Husbandry and Dairying visited the Kakdwip research centre of ICAR-CIBA on January 11th, 2024, and witnessed the ongoing research activities of the centre. The minister was accompanied by Ms. Neetu Kumari Prasad, Joint secretary (Marine fisheries) and Dr L. Narasimha Murthy, Chief Executive I/c & Senior Executive Director. Dr Debasis De, Head of the research centre welcome the honourable Minister and delegates. In his remarks, hon'ble minister emphasized the importance of scaling up of the technologies developed by the centre and also recommended the need for popularization of the technological advancements made in the sector among the farming community. He assured that DoF will provide all support for the farmer centric activities of the Centre.

Dr. Himanshu Pathak, Director General, ICAR and Secretary, DARE Visited ICAR-CIBA, Chennai during 15-16th February, 2024

Dr Himanshu Pathak, Director General, ICAR and Secretary, DARE visited ICAR-CIBA during February 15-16, 2024. He visited the research facilities at the Muttukadu Experimental Station of CIBA as well as its head quarters at Chennai. He was impressed with the facilities particularly at MES and the research achievements of the institute. He released shrimp seeds in the nursery tank of the newly developed New Age Shrimp Farming Facility. The DG suggested that scientists should emphasize on application-oriented programs, aligning with the developmental needs of the brackishwater sector. Dr Kuldeep K Lal, the Director of CIBA, highlighted the institute's notable achievements, emphasizing CIBA's pivotal role in providing technological support

for advancing brackishwater aquaculture. The DG extended his congratulations to the Director and scientists of CIBA for their outstanding work and achievements. He appreciated CIBA's successful track record in commercializing viable technologies, contributing significantly to the development of brackishwater aquaculture in the country.

Shri Shivaraj Singh Chouhan, Hon'ble Union Minister of Agriculture and Farmers Welfare & Rural Development, Govt. of India visited ICAR-CIBA, Chennai and reviewed the Research and Development programmes during July 5- 6, 2024

Shri Shivaraj Singh Chouhan, Hon'ble Union Minister for Agriculture and Farmers Welfare & Rural Development, Govt. of India and the President of Indian Council of Agricultural Research visited ICAR-CIBA, Chennai and its Experimental Station at Muttukadu, Chennai and reviewed the Research and Development programmes during July 5- 6, 2024. The minister visited the institute's research labs and experimental facilities at the field station: Feed mill, Shrimp, Mud crab and Finfish hatcheries, New Gen shrimp production facility, farming facilities and acquainted himself with the ongoing research programmes at CIBA. He emphasized that all our research outputs should focus towards improving the production and income of small and marginal farmers and poor families through societal development initiatives. Dr Kuldeep K Lal, Director, ICAR-CIBA, in his welcome speech, expressed his gratitude to the Minister for visiting the institute and guidance to scientists in fulfilling the expectations of the nation. He briefed the minister about the importance of brackishwater aquaculture, the high value shrimps and recent R & D achievements such as launch of shrimp crop insurance scheme with CIBA's technical support, development and popularization of PlanktonPlus and HortiPlus the 'fish waste to wealth' products and their promising applications in both aquaculture and agriculture.

Shri George Kurian, Honourable Union Minister of State for Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying and Minority Affairs, Government of India witnessed the harvest of ICAR-CIBA's Super-Intensive Precision Shrimp Farming Technology and launched Shrimp Crop Insurance product at CIBA on October 8th, 2024

The Honourable Minister invited the shrimp farming industry to adopt and scale up this new shrimp production system which has the potential to put the Indian shrimp farming in right trajectory. Dr J.K. Jena, DDG (Fy), ICAR underlined that customization of this technology for different locations is the key for its up-scaling.

Personnel

Sl. No.	Name Designation
1.	**Dr Kuldeep Kumar Lal** Director
2.	**Dr C. P. Balasubramanian** Head, CCD
3.	**Dr M. Kailasam** Head, FCD
4.	**Dr K. Ambasankar** Head, NGBD
5.	**Dr M. Shashi Shekhar** Head, AAHED
6.	**Dr K. P. Jithendran** Principal Scientist, Superannuation on 31.7.2024
7.	**Dr C. V. Sairam** Principal Scientist
8.	**Dr T. Ravisankar** SIC, SSD
9.	**Dr M. Muralidhar** Principal Scientist
10.	**Dr (Smt) M. Jayanthi** Principal Scientist
11.	**Dr (Smt) B. Shanthi** Principal Scientist
12.	**Dr (Smt) D. Deboral Vimala** Principal Scientist
13.	**Dr (Smt) P. Nila Rekha** Principal Scientist
14.	**Dr J. Syama Dayal** Principal Scientist
15.	**Dr Akshya Panigrahi** Principal Scientist
16.	**Dr M. Kumaran** Principal Scientist
17.	**Dr S. Kannappan** Principal Scientist
18.	**Dr (Smt) M. Poornima** Principal Scientist
19.	**Dr (Smt) R. Saraswathy** Principal Scientist
20.	**Dr M. Makesh** Principal Scientist
21.	**Dr (Smt) Sherly Tomy** Principal Scientist
22.	**Dr Prasanna Kumar Patil** Principal Scientist
23.	**Dr Subhendu Kumar Otta** Principal Scientist
24.	**Dr (Smt) P. Mahalakshmi** Principal Scientist
25.	**Dr K. P. Kumaraguruvasagam** Principal Scientist
26.	**Dr R. Jayakumar** Principal Scientist
27.	**Dr T. Senthil Murugan** Principal Scientist
28	**Dr Vinaya Kumar Katneni** Principal Scientist
29	**Dr B. Sivamani** Principal Scientist
30	**Dr (Smt) P. Ezhil Praveena** Principal Scientist
31	**Dr R. Ananda Raja** Principal Scientist
32	**Dr (Smt) N. Lalitha** Senior Scientist
33	**Dr Ashok Kumar Jangam** Senior Scientist
34	**Dr (Smt) Shyne Anand** Senior Scientist
35	**Dr Sujeet Kumar** Senior Scientist
36	**Dr (Smt) R. Geetha** Senior Scientist
37	**Dr P. Kumararaja** Senior Scientist
38	**Dr (Smt) T. Bhuvaneswari** Senior Scientist
39	**Dr (Smt) Vidya Rajendran** Senior Scientist
40	**Dr J. Raymond Jani Angel** Senior Scientist
41	**Dr Aritra Bera** Senior Scientist
42	**Dr T. Sathish Kumar** Scientist
43	**Dr K. P. Sandeep** Scientist
44	**Smt Mary Lini** Scientist
45	**Shri C. Siva** Scientist
46	**Dr T. Sivaramakrishnan** Scientist
47	**Shri Dani Thomas** Scientist
48	**Shri R. Aravind** Scientist
49	**Dr K. Anantharaja** Scientist
Navsari-Gujarat Research Centre Of CIBA, Gujarat	
50.	**Shri Ritesh Kumar Shantilal Tandel** Scientist & Nodal officer, NGRC
51.	**Dr (Smt) Pragyan Dash** Scientist
52.	**Shri Pankaj Amrut Patil** Scientist
53.	**Shri Jose Antony** Scientist
Kakdwip Research Centre Of CIBA Scientists	
54.	**Dr. Debasis De** Principal Scientist & Head, KRC
55.	**Dr. Sanjoy Das** Principal Scientist
56.	**Ms. Babita Mandal** Scientist
57.	**Dr. N.S. Sudheer** Scientist
58.	**Shri. I.F. Biju** Scientist
59.	**Mrs. Misha Soman** Scientist
60.	**Mrs. Moumita Ash** Scientist


Sl. No.	Name Designation
Technical	
61.	**Dr S. Sivagnanam** Chief Tech. Officer
62.	**Shri D. Raja Babu** Chief Tech. Officer
63.	**Shri R. Puthiavan** Chief Tech. Officer, Superannuation on 31.5.2024
64.	**Shri S. Rajamanickam** Chief Tech. Officer
65.	**Shri Joseph Sahayarajan** Chief Tech. Officer
66.	**Smt K. Jacquline** Chief Tech. Officer Superannuation on 31.5.2024
67.	**Shri S. Nagarajan** Assistant Chief Tech. Officer
68.	**Dr A. Nagavel** Assistant Chief Tech. Officer
69.	**Shri R. Subburaj** Assistant Chief Tech. Officer
70.	**Shri N. Jagan Mohan Raj** Tech. Officer
71.	**Shri D. M. Ramesh Babu** Tech. Officer
72.	**Shri G. Thiagarajan** Tech. Officer
73.	**Shri K. Karaiyan** Senior Tech. Asst.
74.	**Shri S. Prabhu** Technical Asst.
75.	**Shri K. V. Delli Rao** Technical Asst.
76.	**Shri C. Saravanan** Technician
77.	**Shri C. Ragu** Technician
78.	**Shri R. Indrakumar** Technician
Technical-NGRC	
79.	**Shri M. D. Reyajuddin** Technician T-1

Sl. No.	Name Designation
Technical-KRC	
80.	**Smt Chhanda Mazumder** Technical Officer
Administration	
81.	**Shri Navin Kumar Jha** Chief Administrative Officer
82.	**Smt Komal Sheokand** Chief Finance & Account Officer
83.	**Smt V. Usharani** Senior Administrative Officer VRS on 31.3.2024
84.	**Mr Aswin Haridas** Administrative Officer
85.	**Shri P. Srikanth** Assistant Finance Accounts Officer
86.	**Smt E. Amudhavalli** Asst. Admn. Officer Superannuation on 31.7.2024
87.	**Shri A. Sekar** Asst. Admn. Officer
88.	**Smt E. Mary Desouza** Asst. Admn. Officer
89.	**Smt S. Nalini** Private Secretary
90.	**Smt K. Hemalatha** Personal Assistant
91.	**Smt K. Subhashini** Personal Assistant
92.	**Smt R. Vetrichelvi** Assistant
93.	**Smt M. Mathuramuthu Bala** Assistant
94.	**Shri Pradeep Biradar** Assistant
95.	**Shri S. T. Anand** Assistant
96.	**Miss J. Sambhavi** Assistant
97.	**Shri S. Karthick** Assistant

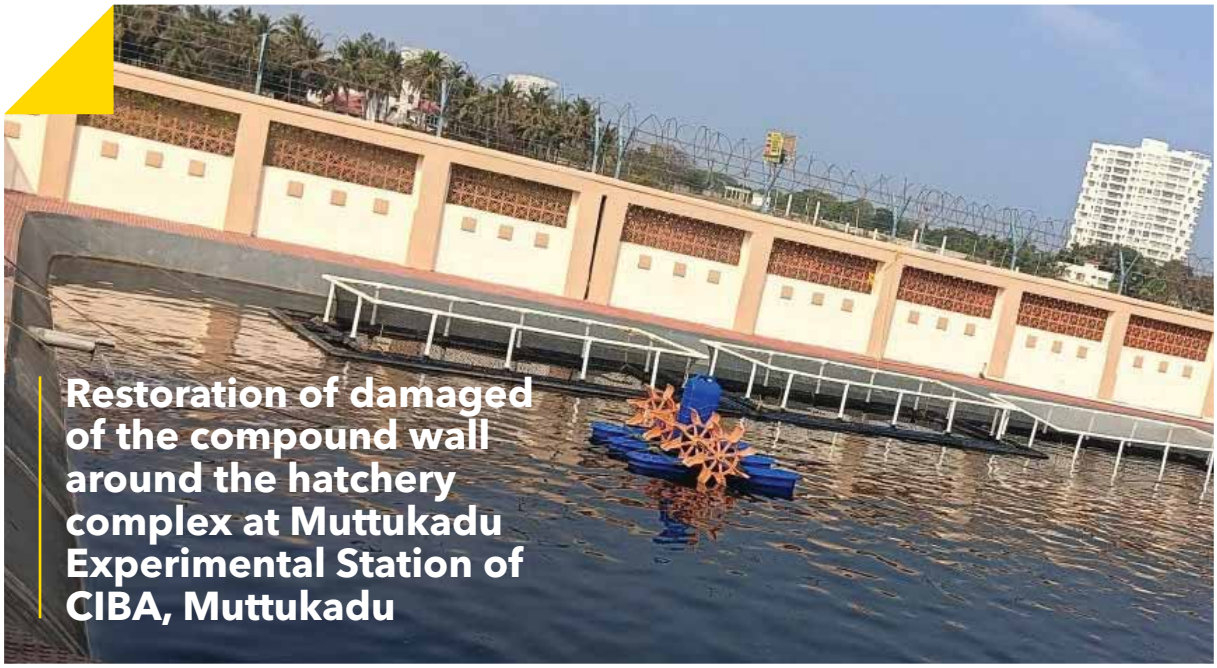
Sl. No.	Name Designation
98.	**Shri Hinge Vishal Dattatray** Assistant
99.	**Miss R. Jayasri** Assistant
100.	**Shri Kushal Mukherjee** Assistant
101.	**Smt B. Prasanna Devi** Assistant
102.	**Shri R. Kumerasen** Upper Division Clerk
103.	**Shri A. Paul Peter** Upper Division Clerk
104.	**Shri V. Kishor Kumar** Lower Division Clerk
105.	**Shri S. Solin Igneshus** Lower Division Clerk
Administration-KRC	
106.	**Shri Sanjoy Some** Lower Division Clerk
Skilled Support Staff	
107.	**Shri S. Selvababu** Skilled Support Staff
108.	**Shri P. G. Samuvel** Skilled Support Staff
109.	**Shri M. Sakthivel** Skilled Support Staff
110.	**Shri R. Mathivanan** Skilled Support Staff
111.	**Shri G. Dayalan** Skilled Support Staff
112.	**Shri Kanaka Prasad** Skilled Support Staff
113.	**Shri J. Murugan** Skilled Support Staff
Skilled Support Staff-KRC	
114.	**Shri P. C. Das** Skilled Support Staff

Infrastructure Development

1	State-of-the-art 'Environment controlled water recirculatory facility for fish broodstock maturation' established under the NICRA programme was inaugurated at ICAR-CIBA
2	Supply and installation of Generator including panel board and cabling etc., for CIBA Hqrs, Chennai
3	Restoration of damaged of the compound wall around the hatchery complex at Muttukadu Experimental Station of CIBA, Muttukadu
4	Restoration of damaged of the shed in the western side (Live feed culture - algae and Rotifers) of sea bass hatchery at Muttukadu Experimental Station of CIBA, Muttukadu
5	Restoration of damaged of the Fish culture Nursery pond– 6 Nos and earth filling around the RAS system in the FCD hatchery at Muttukadu Experimental Station of CIBA, Muttukadu
6	Restoration of damaged of the hatchery entrance gate, repair the pump room, security room, shrimp hatchery portico room, seaweed experimental shed roof sheet replacement work including truss and Fish Hatchery Gen Set Wall Repair work at Muttukadu Experimental Station of CIBA, Muttukadu
7	Restoration of damaged of the snapper & mullet ponds in Fish Hatchery at Muttukadu Experimental Station of CIBA, Muttukadu
8	Renovation of sides of the farm house by retaining wall, damaged due to soil erosion at KES of ICAR- CIBA,Kelambakkam.
9	Restoration of damaged of the earthen grow-out pond used for Artemia culture at Kovalam Experimental Station of CIBA, Kelambakkam
10	Restoration of damaged of the Pheriperial bund and earth filling breached by the heavy water flow caused by the Michaung cyclone at Kovalam Experimental Station of CIBA, Kelambakkam

State-of-the-art 'Environment controlled water recirculatory facility for fish broodstock maturation' established under the NICRA programme was inaugurated at ICAR-CIBA

Installation of Generator



Restoration of damaged of the compound wall around the hatchery complex at Muttukadu Experimental Station of CIBA, Muttukadu

Restoration of damaged of the shed of seabass hatchery at Muttukadu Experimental Station of CIBA, Muttukadu

Restoration of damaged of the Fish culture Nursery pond at Muttukadu Experimental Station of CIBA, Muttukadu

Seaweed experimental shed roof sheet replacement work at Muttukadu Experimental Station of CIBA

Restoration of damaged of the snapper & mullet ponds at Muttukadu Experimental Station of CIBA, Muttukadu

Renovation of sides of the farm house by retaining wall, at Kovalam Experimental Station of CIBA, Kelambakkam.

Restoration of damaged of the Peripherical bund at Kovalam Experimental Station of CIBA, Kelambakkam

Name board at Kovalam Experimental Station of CIBA, Kelambakkam

Library & Documentation

ICAR-CIBA possesses a full-fledged library and e-resource centre hosting valuable referral books and journals in aquaculture, physiology, nutrition, aquatic health, environment, biotechnology, genetics, bioinformatics, socio-economics and extension catering to the needs of scientists, research scholars, scientific personnel of other research organisations, academicians, university students and other stakeholders.

Library and e-Resource Centre

CIBA library has been upgraded as Library and e-Resource Centre to access e-books, online journals, Institute publications and scientists' publications for easy retrieval and use by scientists and scholars.

Automation

CIBA library is fully automated on the KOHA library management system platform with various features, including holdings and circulation facilities. Online Public Access Catalogue (OPAC) module has been activated, which provides a simple and clear interface for searching books, journals and other documents in the library.

Exchange Services

CIBA library maintains regular exchange services with national and international organisations of mutual interest in the sector. Institute's annual reports, newsletters and other research publications are being sent to various research organizations, universities and other stakeholders to familiarise the Institute's research and development programmes. The library also receives similar services from other organizations. The library sent the research papers requested by scientists of various ICAR institutes under CeRA document delivery request (DDR).

Library Resources

ICAR-CIBA library has arich collection of around 3,133 referral books, 1,631 journal back volumes, 6,998 journal issues, 4,870 abstracts, newsletters and reports, 145 Ph.D. thesis and 2,680 other publications are available in the CIBA library. The library is expanding every year with the purchase of new books and subscriptions to national and international journals. The library has established online connectivity for the Consortium for Electronic Resources in Agriculture (CeRA), consisting of more than 200 international and national journals related to fisheries and aquaculture. It can be accessed online by scientists at headquarters and research centres at Kakdwip and Navasari. CIBA has subscribed to the antiplagiarism software iThenticate to assist in the publishing of high-quality research papers in reputed journals.

Data Repository

The CIBA digital library system has been established to manage library holdings and maintain records. The system provides inventory of books available in the library, journals under CeRA, scientists and Institute publications. It is programmed to monitor the lending of books and scientists can indent the books required for purchase within the same portal. Under the digitization initiative, all Institute and scientists publications have been digitized and uploaded in the ICAR-KRISHI portal.

Library


Refferral Books
3,133
Ph.D. Thesis
145
Journals
6,998
Newsletter & Reports
4,870
Journal Back Volumes
1,631
Other Publications
2,680

Publications, Oral Presentations

Peer Reviewed Articles

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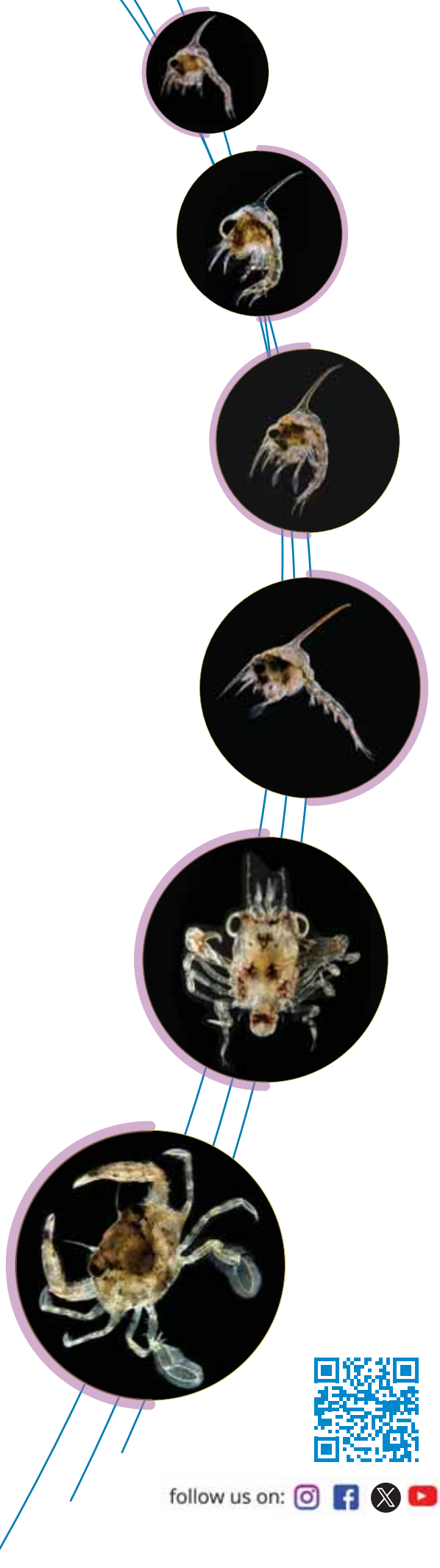

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