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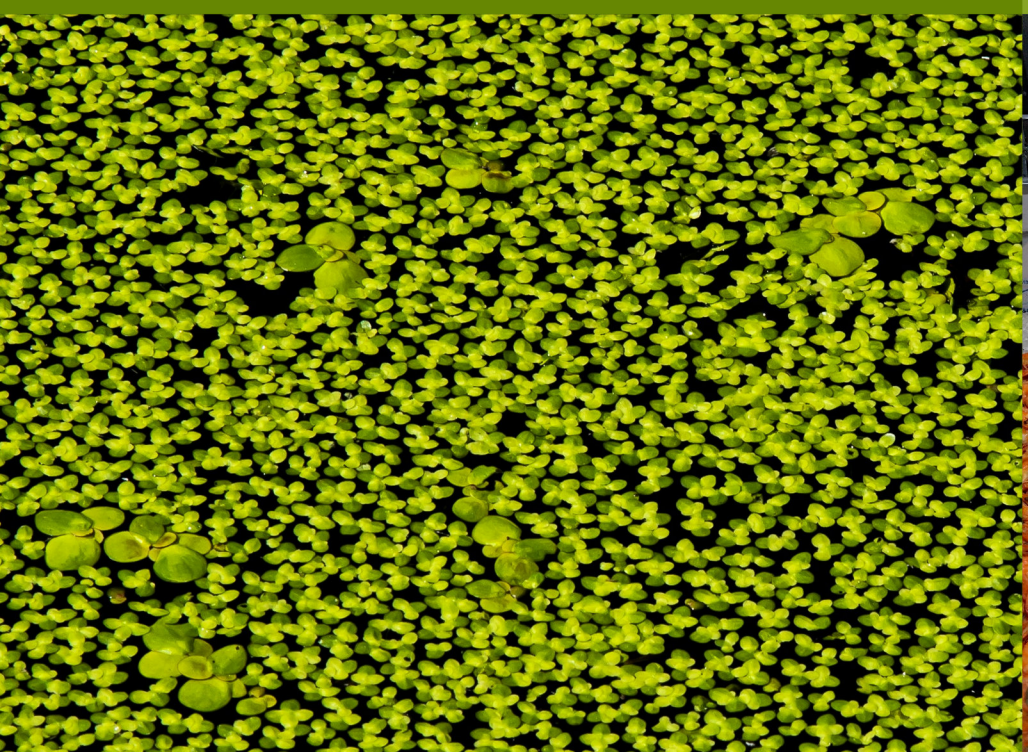
AQUACULTURE ASIA

Innovative insurance for shrimp crops

Rejuvenating fisher cooperative societies

Duckweed in feeds

Gangetic mystus production



Aquaculture Asia

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NACA

An intergovernmental organisation that promotes rural development through sustainable aquaculture. NACA seeks to improve rural income, increase food production and foreign exchange earnings and to diversify farm production. The ultimate beneficiaries of NACA activities are farmers and rural communities.

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AQUACULTURE ASIA

Aquaculture transformation: The digital divide grows larger?

Digital innovation is rapidly reshaping global aquaculture, from real-time water quality monitoring and power (read 'aerator') management to automated feeders to blockchain-based traceability. But as enthusiasm grows for "tech-driven transformation," we must ask a hard question: are these tools genuinely helping small-scale farmers—or leaving them further behind?

Across Asia, new platforms and mobile apps now promise everything from disease diagnostics to pond management support. Governments and donors alike are investing in digital aquaculture as a pathway to efficiency, transparency, and environmental control (and if we are honest, to reduced staff costs). In theory, this holds great promise for smallholder producers who often face chronic knowledge gaps, market fluctuations, and biosecurity risks.

Yet the reality on the ground is uneven. Many small-scale farmers lack the digital literacy to use complex applications or to interpret technical charts and graphs. Others provide overly generic advice, divorced from local ecological and socio-economic contexts. Even when technologies are accessible, they may offer limited value if broader services—such as responsive extension support, credit, or cold chains—are missing.

There are positive stories. Online services providing extension and animal health advice have shown impact when embedded in strong institutional networks. But success requires more than innovation—it demands participatory design, local testing, realistic expectations and an economic model that can support innovators or service providers while remaining affordable by farmers. Digital tools are, by their nature, developed by the Technorati, and are frequently designed from the top down, with little input from the farmers they aim to serve.

There is no doubt that digital tools offer tremendous opportunities, for example real-time optimisation of aeration and feeding to lower costs—and greenhouse emissions— while also protecting the stock, providing timely and actional warnings, while improving profit.

There is a growing risk, or perhaps it is a certainty, that digital aquaculture will widen existing inequalities—benefiting better-resourced producers and those with formal training while excluding those with lower income, education, or infrastructure. A more inclusive approach would treat small-scale farmers not as passive recipients of technology, but as co-developers, testers, and evaluators.

Context matters, and the needs, capabilities and experiences of the end user are a critical part of the context within which an application or technology will operate. The issue is particularly pronounced at the small-scale producer level, where capacity to pay for commercial services is limited.

AQUACULTURE ASIA

From risk to resilience: Innovative crop insurance solutions for securing shrimp aquaculture in India

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Brackishwater aquaculture has emerged as a highly promising sector within the aquaculture industry due to its considerable development potential. India's extensive coastline offers substantial scope for brackishwater aquaculture, which remains underutilised despite its promise. The country has an estimated potential of 1.2 million hectares for brackishwater farming, of which only 155,598 hectares have been developed—representing just 12.96% of the total potential area (DoF, GoI, 2017).

Shrimp farming, in particular, is attractive due to its high market value and steady global demand. India ranks second in global shrimp production, with an output of 1.184 million tonnes, and exported approximately 711,000 tonnes of frozen shrimp in 2023, earning around USD 5.83 billion (MPEDA, 2023). More than 90% of shrimp production in India comes from small-scale farmers operating on holdings of less than two hectares (CAA, 2021), underscoring their key role in the sector.

Small-scale shrimp farmers in India face numerous challenges, including poor farm management, crop losses, low yields, limited resources, and a lack of access to credit or insurance. In addition, many continue to rely on unscientific practices and have limited exposure to innovative solutions that could support their resilience and growth (Ravisankar et al., 2020). The development of shrimp aquaculture in India has seen both significant achievements and major setbacks. In this context, the introduction of shrimp crop insurance is vital for mitigating risks, protecting livelihoods, and promoting stability and growth within the industry.

This article highlights the importance of crop insurance as a risk management tool against losses caused by disease outbreaks and extreme weather events in shrimp farming.

Risks associated with shrimp farming

Climate and Weather Risks: Shrimp farming is vulnerable to a range of climatic and weather-related risks, including floods, droughts, storm surges, heavy rainfall, extreme temperatures, and prolonged cloud cover. These

Training program on "Risk Management Survey and Loss Assessment in Shrimp Farming" held at ICAR-CIBA, Chennai

factors can severely disrupt farming operations. Over the past two decades, the frequency of extreme weather events has nearly doubled compared to the period from 1980 to 1999. Events such as cyclones and floods—including Nisha, Aila, Thane, and Phailin—have caused significant damage to shrimp farms along India's coastal regions (UNDRR, 2021).

Disease Risks: Disease outbreaks are a major threat to shrimp farming, with significant production losses and economic impacts. Key viral pathogens include white spot syndrome virus (WSSV), *Macrobrachium rosenbergii* nodavirus (MrNV), which causes white tail disease (WTD), infectious hypodermal and haematopoietic necrosis virus (IHHNV), and infectious myonecrosis virus (IMNV). In addition, microsporidian parasites such as *Enterocytozoon hepatopenaei* (EHP), bacterial pathogens like *Vibrio* spp., and disease syndromes such as white faecal syndrome (WFS) and running mortality syndrome (RMS) contribute to substantial losses. Annual production losses due to shrimp diseases are estimated at 34.4% (Patil et al., 2021).

Market volatility: Shrimp farming is highly sensitive to fluctuations in market prices, which can affect both profitability and long-term sustainability.

Financial challenges: Rising input costs, limited access to affordable credit, high interest rates, and increasing labour expenses present significant financial barriers for shrimp farmers.

Regulatory and policy changes: Changes in environmental regulations, international trade restrictions, import/export policies, and evolving standards for aquaculture practices can disrupt farming operations and increase the complexity of regulatory compliance.

Risk management strategies in shrimp aquaculture

Risk management in shrimp aquaculture involves a multifaceted set of strategies aimed at early detection and mitigation of threats to crop survival and market value. The risk assessment and management process comprises four key components: Risk perception, risk prioritisation, risk management, and risk communication.

The process typically starts with farm-level surveys and group discussions to identify potential risks. These are then analysed and categorised based on their likelihood and potential impact. Expert input is used to develop risk prevention and mitigation strategies at both individual and institutional levels.

Capacity building through training programmes, practical handbooks, and mobile applications supports effective communication and the adoption of best practices. These efforts collectively help to reduce risks and enhance the sustainability of shrimp farming (Anand et al., 2021).

Above, below: Training program on "Shrimp Crop Insurance and Loss Assessment" held at ICAR-CIFE, Mumbai.

Adaptation of better management practices and biosecurity measures

Implementing better management practices (BMPs) and biosecurity measures in shrimp farming (Fig. 1) is crucial for ensuring sustainability. BMPs should be adapted to suit different farming systems and local conditions, focusing on practical actions that are cost-effective and simple for small-scale farmers to adopt. These practices should address all stages, from pond preparation to shrimp health management. Farmer associations and cooperative groups can help improve compliance, enabling shared resources and better water management.

Educating farmers about BMPs and developing certification frameworks can promote widespread adoption, thereby sustaining economically viable shrimp production. Effective extension services and support systems, including national health programmes and diagnostic laboratories, are essential to improve awareness and biosecurity measures. These efforts help to prevent disease outbreaks and maintain long-term farm productivity and health (Poornima et al., 2022).

Contingency plans for risk management

Contingency planning in shrimp aquaculture involves comprehensive strategies covering disease management, environmental resilience, financial safeguards, emergency responses, and risk mitigation. Regular farm audits and bioeconomic scenario modelling strengthen these plans by forecasting potential challenges and enabling proactive adjustments. The use of advanced technologies and collaborative efforts further supports effective risk management. Together, these measures ensure the sustainability and resilience of shrimp farming operations in rapidly changing environments.

Insurance and risk management

Insurance plays a pivotal role in shrimp aquaculture by protecting farmers from a range of uncertainties, including disease outbreaks, extreme weather events, market price fluctuations, and operational disruptions.

- It provides a financial safety net by compensating farmers for losses, stabilising income, and supporting business continuity.
- It improves access to credit and strengthens the supply chain, thereby enhancing the overall resilience and sustainability of the shrimp farming sector.
- The initiative to reintroduce shrimp crop insurance was led by the Indian Council of Agricultural Research–Central Institute of Brackishwater Aquaculture (ICAR-CIBA), with support from the National Fisheries Development Board (NFDB), which offered a 20% premium subsidy.
- Under the Pradhan Mantri Matsya Sampada Yojana (PMMSY), ICAR-CIBA and NFDB have developed two shrimp crop insurance products in partnership with Oriental Insurance Company Ltd. (OICL) through Alliance Insurance Brokers Private Ltd., and with the Agriculture Insurance Company of India Ltd. (AICL).

Training program on "Shrimp Crop Insurance and Loss Assessment" held at ICAR-CIFE, Kolkata.

Significance of shrimp crop insurance

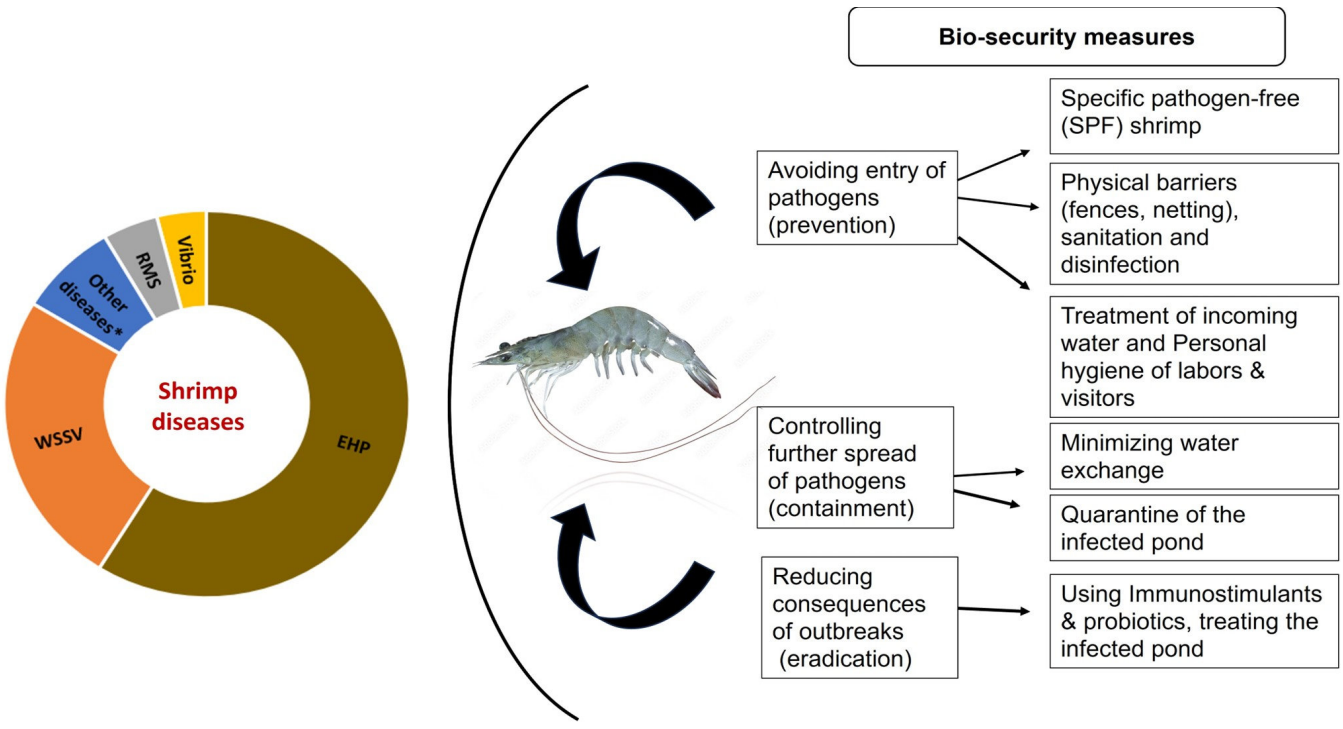
Risk management against extreme climatic events

Shrimp aquaculture is vulnerable to multiple risks, including disease outbreaks, adverse weather, poor water quality, and natural disasters. These can lead to substantial financial losses for farmers. Insurance serves as a risk mitigation tool by providing financial compensation when such events occur.

Investment protection

Insurance safeguards the considerable investments made in aquaculture infrastructure, helping to protect financial resources from unexpected losses.

Fig 1: Biosecurity in shrimp farming.



Market confidence

The availability of shrimp crop insurance boosts confidence among farmers and investors, encouraging further investment and expansion within the sector. This confidence also supports growth in related industries such as hatcheries, feed mills, and input supply chains.

Promoting sustainability

Insurance contributes to the long-term sustainability of aquaculture operations by enabling recovery from unforeseen setbacks. It also encourages the adoption of responsible and sustainable farming practices, which can help reduce both risk exposure and insurance costs.

SWOT analysis

A SWOT analysis was carried out to assess shrimp crop insurance, identifying key factors influencing its effectiveness and future potential. Strengths include strong government support and the provision of financial relief to farmers. However, weaknesses remain, such as relatively high insurance premiums and limited coverage scope. Opportunities lie in the use of advanced technologies and expanded farmer training initiatives. On the other hand, threats include the impact of natural disasters and changes in regulatory or policy frameworks. This analysis provides valuable insight into both the current status and the future development of shrimp crop insurance.

The details of the SWOT analysis are presented below.

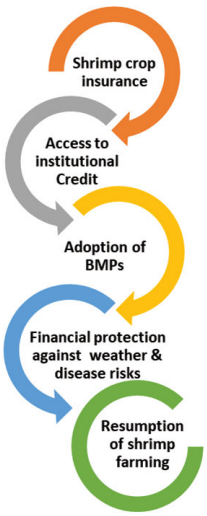
Strengths

- Financial support helps reduce economic losses caused by extreme climatic events and disease outbreaks.
- Sustainability is promoted through the adoption of better management practices.
- Farmers gain improved access to institutional credit.
- Strong government support through schemes such as PMMSY and PM-MKSSY.
- Technical guidance is available from ICAR-CIBA experts.

Weaknesses

- Shrimp farming is inherently risk-prone, making it vulnerable to falsified claims and moral hazards by unscrupulous individuals.
- Premium rates are relatively high.
- Insurance coverage is limited to specific periods.
- Disparities exist between farmers' expectations and the offerings of insurance providers.
- Lengthy and bureaucratic claims processes often lead to delays in payouts.

Fig 2. Significance of shrimp crop insurance.



- Shortage of fisheries professionals within insurance companies and limited understanding of the practical challenges faced by shrimp farmers.

Opportunities

- Use of technological advancements—such as remote sensing, artificial intelligence, and the Internet of Things—to improve risk assessment and streamline claims processes.
- Awareness and training programmes for farmers to increase understanding and uptake of insurance schemes.
- Public–private partnerships to design more comprehensive and affordable insurance products.

Threats

- Natural disasters and disease outbreaks can result in increased claims, driving up insurance costs.
- Changes in international and national regulations or policy frameworks may affect the stability and viability of the insurance market.

Challenges in implementing the shrimp crop insurance schemes

Key concerns faced by aquafarmers as insured policy holders

- **Record-keeping challenges:** Many farmers struggle to maintain detailed records of farming practices, often due to time constraints or a lack of awareness about the importance of documentation.
- **Low insurance literacy:** A significant number of shrimp farmers lack a clear understanding of insurance schemes, which limits their participation.

The Hon. Shri George Kurian, Minister of State, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India, releasing new insurance product.

- **Need for comprehensive coverage:** Farmers seek broader and longer-term coverage, including protection for input costs and full compensation for losses. However, insurers generally cover only around 70% of the losses.
- **High premium rates:** Premiums for shrimp crop insurance typically range between 4% and 8.5%, which farmers consider too expensive.
- **Salvage value deductions:** Policies often deduct the estimated value of remaining stock from the final claim amount, placing an added financial burden on farmers.
- **Unilateral termination:** Insurance coverage is frequently terminated by insurers after a crop failure, raising concerns about continuity and trust.
- **Cumbersome procedures:** Farmers face difficulties navigating complex documentation, exclusions for named perils, and the requirement to notify insurers during emergency harvests.
- **Advocacy for subsidised coverage:** Given their significant contribution to national income, farmers are calling for more affordable, subsidised insurance options.

Strategies recommended for shrimp crop insurance schemes

Developing innovative insurance solutions for shrimp farmers requires a thorough understanding of the complexities of aquaculture operations across different regions. This includes recognising the diverse risks and challenges farmers face, as well as the technologies available to address them. Insurers must carefully assess factors such as site-specific characteristics, infrastructure, farm management practices, environmental conditions, disease prevalence, and surveillance systems.

Presenting this information in a structured, data-driven format allows producers to clearly convey their risk profile to insurers. This, in turn, supports the development of customised insurance products that reflect the specific needs of shrimp farming operations. By offering targeted coverage, insurers can help farmers manage risks more effectively, strengthening the resilience of the aquaculture sector and supporting its sustainable growth.

Major concerns faced by insurers

- **Shortage of technical expertise:** Many insurance companies lack fisheries specialists and have limited knowledge of modern aquaculture systems, making accurate claim assessment challenging.
- **Moral hazards and claim authenticity:** Insurers are concerned about the authenticity of claims and the risk of moral hazard, which could result in significant financial losses.
- **Quantifying climate and disease risks:** Accurately assessing the impact of extreme weather events, epidemics, and emerging diseases is difficult. This complicates risk modelling and the development of standardised premium rates.
- **Operational challenges:** High demand for skilled personnel, elevated operational costs, and the difficulty of collecting premiums from a large number of farmers create logistical and financial burdens.
- **Lack of trained assessors:** The shortage of qualified assessors hinders effective risk evaluation and the proper implementation of BMPs, increasing farms' vulnerability.
- **Diverse risk profiles:** The wide variation in risk profiles among farms makes it difficult to design standardised insurance products that meet the needs of all stakeholders.

- **Complex scheme management:** Administering the scheme—including premium collection and timely claims processing—adds significant complexity to insurance operations.

Strategies for safeguarding insurers' interests

Bankers and insurance officials should routinely review water quality reports submitted by farmers throughout the culture cycle. Particular attention must be paid to significant fluctuations in parameters such as dissolved oxygen, pH, and salinity. Determining whether these changes result from farm management practices or abrupt climatic variations is essential, as such shifts act as stressors and potential triggers for disease outbreaks.

These observations are vital for the effective implementation of shrimp crop insurance. To mitigate disease-related risks, insurance providers should require all insured farmers to adopt BMPs and follow established biosecurity measures.

Implementation of shrimp crop insurance in India

During its initial phase (1991–1995), shrimp aquaculture insurance in India encountered major setbacks due to outbreaks of WSSV. These outbreaks led to unsustainable compensation payouts and moral hazard issues globally. The programme failed largely due to inadequate risk assessment and poor classification of farmers, which discouraged insurers from further participation.

The situation changed in 2009 with the introduction of Specific Pathogen Free (SPF) *Penaeus vannamei* shrimp. This development renewed optimism and led countries such as India, Vietnam, and Bangladesh to revisit shrimp insurance, with products better tailored to support farmers under evolving industry conditions.

In India, ICAR-CIBA, in collaboration with the NFDB, led efforts to reintroduce shrimp crop insurance under the PMMSY. This initiative involved partnerships with both national and international insurance brokers, as well as public and private insurers, to re-establish crop insurance in the shrimp sector.

ICAR-CIBA provided technical support for the development of a new shrimp crop insurance product with OICL, through Alliance Insurance Brokers Private Limited, in 2020. Based on scientific input, the product was formally registered by OICL with the Insurance Regulatory and Development Authority of India (IRDAI) in 2022. It was launched nationally at ICAR-CIBA, Chennai, in February 2022.

Additionally, in 2023, ICAR-CIBA supported the AICL in developing a second shrimp insurance product, following the signing of a Memorandum of Understanding with NFDB in February 2023. ICAR-CIBA also undertook implementation of the PMMSY pilot project on crop insurance in Tamil Nadu, Andhra Pradesh, and Gujarat.

During 2023–24, OICL and AICL jointly insured a total of 588 hectares of shrimp farms in Andhra Pradesh and Tamil Nadu. The total insured input cost amounted to ₹147.7 million. Farm sizes ranged from 1 to 9 hectares, covering both small- and large-scale shrimp farming operations.

ICAR-CIBA Initiatives in Risk Management and Capacity Building

ICAR-CIBA has played a key role in strengthening risk management and loss assessment capabilities in shrimp farming through a range of targeted training programmes. Notable initiatives include:

- **Training Workshop on Risk Management**:
  Held from 1st–3rd March 2023, this workshop on "Risk Management in Shrimp Farming" was attended by 26 participants, primarily from the Agricultural Insurance Company, representing the insurance sector.

- **National Consultative Workshop on Aquaculture Insurance Product Development:**
  Organised on 13th April 2024, this workshop brought together around 50 delegates, including officials from the Ministry of Fisheries (Government of India), World Bank representatives, NFDB officials, major insurance companies, progressive farmers, and leading scientists.

- **Certificate Course on Risk Management, Survey, and Loss Assessment in Shrimp Farming:**
  Conducted in collaboration with ICAR-Central Institute of Fisheries Education (ICAR-CIFE), this five-day course was held at three locations:

  - ICAR-CIBA, Chennai (19–23 February 2024) with 40 participants
  - ICAR-CIFE, Mumbai (29 April–3 May 2024) with 22 participants
  - ICAR-CIFE, Kolkata (5–9 August 2024) with 45 participants

In total, 183 participants—including insurance professionals, industry experts, state fisheries officials, aquaculture consultants, farmers, and students—attended these programmes. These initiatives have been highly effective in raising awareness of risk management, shrimp crop insurance, and loss assessment. They have equipped participants with the necessary skills to serve as competent loss assessors and have contributed to strengthening the resilience of the shrimp farming sector.

Trail to progress – the pathway

Managing the complex risks inherent in aquaculture requires advanced underwriting expertise that combines in-depth knowledge of business operations with technical proficiency in shrimp and fish farming. The active involvement of key stakeholders and the establishment of a strong governance framework are essential for the long-term success and efficient implementation of aquaculture crop insurance schemes for both shrimp and fish farmers.

The aquaculture crop insurance initiative under the PMMSY seeks to mitigate risks for fishers and farmers, encourage investment, and enhance national food security. However, challenges such as limited data availability, low awareness, adverse selection, and administrative barriers continue to constrain its effectiveness.

In response, the Union Cabinet has approved the Pradhan Mantri Matsya Kisan Samridhi Sah-Yojana, a Central Sector Sub-scheme under PMMSY. This initiative aims to formalise the fisheries sector and support micro and small enterprises, with a total investment of over ₹60 billion for the period from FY 2023–24 to FY 2026–27, covering all States and Union Territories. A key focus of this scheme is the development of aquaculture crop insurance, for which standard operating procedures are currently being prepared.

Reinsurance—essentially insurance for insurers—plays a critical role by enabling insurers to transfer a portion of their risk and premiums to other entities. This approach helps to diversify risk exposure and provides an alternative to equity or debt financing, with reinsurers assuming responsibility for all covered losses.

In shrimp aquaculture, crop insurance typically covers only the shrimp stock, excluding farm infrastructure and related assets. Extending insurance coverage to include infrastructure and assets is essential for comprehensive risk management, helping to strengthen the resilience and long-term sustainability of shrimp farmers.

Creating a centralised database is crucial for the development of tailored insurance products. This database should include detailed information on aquaculture production systems, farm financial records, disease occurrences and treatments, as well as weather-related data. Agricultural insurance professionals and farmers should have access to this resource to facilitate informed decision-making.

The Ministry of Fisheries, Animal Husbandry and Dairying, Government of India, should establish a specialised team of aquaculture insurance experts. This team would provide technical support and training to agricultural insurers, covering critical areas essential to effective aquaculture risk management.

Acknowledgement

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Efforts to rejuvenate primary fisher cooperative societies in South 24 Parganas District, West Bengal

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Importance of fisher cooperative societies

In 1988, the Secretary of the West Bengal Fisheries Department stated that the development of fisheries and the welfare of fishing communities must go hand in hand. One cannot succeed without the other. Cooperatives were seen as essential to this joint development process[1 8].

An article in this magazine (July–September 2024) argued that fishermen and women should be organised at the community level. This would help solve problems like weak management of local fisheries and lack of institutional support. Many people working in fisheries and aquaculture come from disadvantaged backgrounds. They need better systems for livelihood support.

Fisheries Cooperative Societies were created in India to meet these needs. They play a key role in improving the economy and sustainability of the fisheries sector. These cooperatives encourage teamwork and help members share benefits. They also provide jobs, food security, and social protection to poor and rural communities. By working together, members can get better access to nutritious foodfish[2].

At the Sixth Indian Fisheries Forum in 2002, a speaker explained how cooperatives can help farmers use both open water and confined water more efficiently. Scientific methods and teamwork can improve fish production and meet market demands—both domestic and international. In India, strong farmer cooperatives can boost fish production and help the country become more self-reliant[1].

According to a former Managing Director of the West Bengal State Fishermen Cooperative Society, a Fishery Cooperative Society (FCS) is a group where professional fishers voluntarily join together. They work as equals to improve their own economic conditions through honest and fair means. Developing fishery cooperatives is an important way to raise the income of fishermen. In West Bengal, support from government departments has made it easier to grow these cooperatives[3].

Many Fisher Cooperative Societies (FCSs) have been established near medium and large freshwater bodies across West Bengal. These include beels, which are large, closed freshwater wetlands. Most members of these societies are villagers with low incomes and limited education. The aim is to improve their socio-economic conditions.

It would be beneficial to fix the term of any Board of Directors or newly formed Committee in a Primary Fisher Cooperative Society (PFCS) to either three or five years[4].

Author conducting Election process at Nalban 2-1 FCS.

In rural West Bengal, cooperative-based fish production is vital. This approach should be expanded widely, as it can help increase the income of fishing and fish-farming families[5].

According to Prof. V. Sapovadia of the National Institute of Cooperative Management in Gujarat, the fisheries and aquaculture sector becomes stronger through mutual cooperation among individual fishermen and fish farmers.

Currently, there are 906 registered PFCSs in all 23 districts of West Bengal (Source: Handbook of Fisheries Statistics, Department of Fisheries, Government of West Bengal).

Fisheries and aquaculture in South 24 Parganas, West Bengal

South 24 Parganas has strong potential for producing valuable finfish and shellfish. The district is suited for both freshwater and brackish water aquaculture, as well as marine fisheries.

It is the largest district in West Bengal by area. It includes 7 municipalities, 29 community development (CD) blocks, and 312 gram panchayats.

The district is close to Kolkata, a major city. This helps fish farmers easily transport their products—such as ornamental fish, shrimp, prawns, and inland finfish—to large wholesale markets within and outside the state.

West Bengal is the second-highest fish-producing state in India, after Andhra Pradesh. Among West Bengal's 23 districts, South 24 Parganas ranks second in annual production of table fish.

In 2021–2022, the district produced 262,000 tonnes of table fish. This rose to 288,000 tonnes in 2022–2023. The supply now exceeds the district's annual demand for fish.

Vested water bodies handed over to PFCSs

Most large water bodies in West Bengal are vested, meaning they are owned by the government. The state government has leased many of these to Fisher Cooperative Societies as a matter of policy.

Two major reforms in West Bengal have helped this process[8,11]:

- Management and administration of FCSs were transferred to the Fisheries Department.
- Government-owned fishery waters were allocated to fishermen's cooperatives.

The government leases inland water bodies larger than 5 acres (about 2 hectares) to PFCSs. These leases usually last 3 to 7 years, with an option to renew for another 3 to 5 years. The leases are given through a bidding process to encourage sustainable fish farming and improve the livelihoods of fish farmers.

The leasing process is managed by the office of the Additional District Magistrate (Land and Land Reforms) or the Sub-Divisional Officer, depending on where the water body is located. South 24 Parganas has five such subdivisions.

According to the West Bengal Inland Fisheries Policy, 2023 (published in the Kolkata Gazette on 27 July 2023), the state will amend rules to allow private groups and community-based organisations to take part in the first round of the bidding process. PFCSs and Fish Production Groups (FPGs) will get a 5% price preference over the highest bidder.

Auction notices for leasing ponds and larger water bodies are published by the Zilla Parishad of each district or the office of the ADM (Land Reforms).

Members of all PFCSs are responsible for using their leased water bodies properly. They must follow correct fish farming methods and avoid destructive or banned fishing gear.

Author as ARO giving winning certificate to a candidate at Nalban 2-1 FCS.

Author with members of Nalban 2-1 FCS.

Fish fingerlings released into water body of Nalban 2-1 FCS.

They should not harvest Indian major carps (IMCs) from culture ponds if the fish weigh less than 500 grams. Instead, they should focus on producing stunted fingerlings or yearlings of IMCs for stocking.

Members are also encouraged to plant trees, flowers, or vegetables on the embankments around the water bodies.

Only those who earn their livelihood from fish catching, fish farming, or related activities are eligible to become members of a PFCS.

Election of active fisher cooperative societies

There are 158 FCSs in South 24 Parganas District. These are located in areas under the Kolkata Municipal Corporation, municipalities, and community development blocks. All are registered with the Assistant Director of Fisheries (ADF), under the Directorate of Fisheries, Government of West Bengal.

Currently, 43 of these societies are actively functioning. This includes 2 Central Fishermen Cooperative Societies (CFCSs) and 41 PFCSs. Among the PFCSs:

- 26 are involved in freshwater carp farming, mostly in government-owned water bodies leased to them.
- 3 focus on ornamental (aquarium) fish rearing.
- 12 are engaged in marine and estuarine capture fisheries and fish drying.
- Nine PFCSs use domestic wastewater (sewage-fed water) for carp culture. Six PFCSs are located within the Kolkata Municipal Area.

At the village level, PFCSs are responsible for fish production. CFCSs, which operate mainly at the district level, handle the supply of inputs for fisheries and aquaculture.

According to regulations, each PFCS involved in freshwater fish culture must have at least 10 active members. Each member must own a fish pond (of any size). The combined water area managed by the PFCS must be at least 10 acres (about 4 hectares).

In recent years, some PFCSs at the block level have continued operations without a CEO or Board of Directors. These societies are not eligible for government support. As a result, it became urgent to start the election process.

During September and October 2024, secretaries or acting secretaries of several PFCSs sent formal requests to the Cooperative Election Commission (CEC) of West Bengal and the ADF of South 24 Parganas. They asked for permission to hold elections for their Board of Directors, since the terms of their elected committees had expired in 2022 or earlier. In the meantime, nominated boards had been managing these societies with ADF approval.

Winning certificate presented by ARO at Chachcharia FCS (Courtesy CEO of the Society).

Supply of pelleted fish feed to Chachcharia FCS (Courtesy CEO of the Society).

CEO and members of Chachcharia FCS.

These letters were supported by the respective CEOs of the FCSs. Following a directive from the Secretary of the CEC dated 11 September 2024, it was decided that elections must be held for all CFCSs and PFCSs in the district. After completing their audits and annual general meetings, several PFCSs requested the ADF to take steps and approve elections for their Boards of Directors.

Election Procedure

The Cooperative Election Commission in West Bengal was set up under Section 96 of the West Bengal Cooperative Societies Act, 2006. This was done through a government notification dated 15 March 2012. As per a later notification dated 10 April 2012, the CEC is responsible for conducting elections for all cooperative societies, including Fishermen Cooperative Societies.

According to the West Bengal Cooperative Society Rules, 2011, the CEC appointed the Assistant Director of Fisheries, South 24 Parganas, as the Returning Officer (RO) for elections in all FCSs in the district. The RO assigns duties to Assistant Returning Officers (AROs), following the CEC's notification dated 16 May 2012.

The ADF/RO also serves as the Ex-Officio Assistant Registrar of Cooperative Societies in the district. The RO appoints departmental officers (such as Fishery Extension Officers or Assistant Fishery Officers) as AROs to manage the elections of Delegates and Boards of Directors for each FCS.

The ARO asks the PFCS CEO to submit the following documents:

- Certified copy of the Member Register.
- Bye-law (Upo-bidhi, in Bengali).
- Draft Electoral Roll.

These are used to prepare and publish the electoral roll and set the election schedule. All PFCS members are then informed about the upcoming election.

Each PFCS has 6 to 9 seats for election, as per its bye-law. These include reserved seats (for women or Scheduled Caste/Scheduled Tribe members) and unreserved seats (General category).

The steps of the election process, carried out on specific dates, include:

- Publication of Draft Voter List.
- Period for claims and objections.

Author conducting election process at Naraharipur Agradut Khunti FCS.

- Hearing and resolution of claims and objections.
- Publication of final voter list.
- Distribution and submission of nomination papers.
- Scrutiny of nomination papers.
- Declaration of valid nominations.
- Withdrawal of nominations (if any).
- Announcement of final candidates.
- Allotment of election symbols.
- Notification of polling date, time, and location.
- Vote counting and result announcement on the same day.

The draft voter list is displayed at the PFCS office notice board. A responsible person (usually the manager, past secretary, or acting president) is assigned to manage communication under ARO guidance. The CEO of the PFCS also plays a key role.

Author (left) with new elected Board of Directors of Naraharipur Agradut FCS Ltd.

The final voter list includes each member's name, membership number, registration date, age, gender, address, and membership date. The ARO also checks the meeting resolution register, latest audit date, previous Board of Directors list, and financial records.

On election day, results are declared, and the ARO gives certificates to the winners. These elected members then form the new Board of Directors.

One week after the election, a formal meeting is held in the presence of the ARO and PFCS CEO to appoint office bearers. These include the Chairman (or President), Vice-Chairman (or Vice-President), Secretary, and Treasurer. The remaining members are designated as Board Members.

The ARO then issues an official notification listing the names and roles of the newly elected BoD.

Between December 2024 and April 2025, with the help of AROs, elections were successfully held for most of the 41 PFCSs and 2 CFCSs in South 24 Parganas. New Boards of Directors have now been formed. The ADF of South 24 Parganas, as the district's fisheries head, is also the registering authority for all PFCSs.

Declaration of Election When a Seat Is Uncontested

During the PFCS election process, if the number of valid candidates is equal to or fewer than the number of available Board of Director (BoD) seats, the election is not held for those seats.

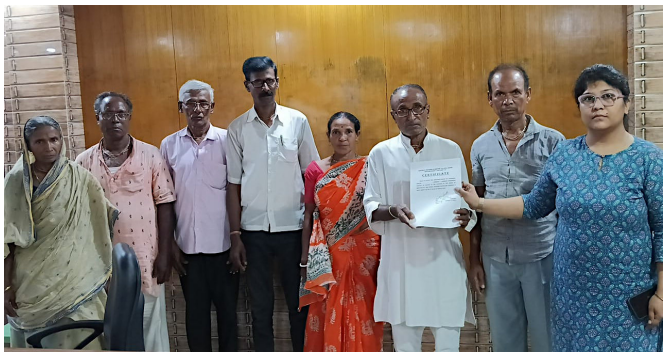
In such cases, the Assistant Returning Officer (ARO) officially declares, as per the rules in the CEC notification, that the nominated individuals are elected unopposed to the BoD of the PFCS.

Benefits provided to PFCSs in South 24 Parganas in recent times

Between January and mid-February 2025, seven selected Primary Fishermen Cooperative Societies (PFCSs) received inputs under the "Development of Sewage-Fed Fisheries" scheme (2024–2025). The Department of Fisheries, Government of West Bengal, provided Indian major carp fingerlings weighing 50–75 grams and calcium oxide (lime). This scheme supports PFCSs that use treated domestic wastewater from Kolkata for carp culture in grow-out ponds.

In 2024–2025, another group of PFCSs received inputs under the "Big Fish Production in Big Water Bodies" scheme. These included Indian major carp yearlings (100–150 grams), floating pellet fish feed, and quicklime. This scheme aims to promote large-scale production of major carps in big freshwater ponds managed by PFCSs.

During 2023–2024, under the scheme "Distribution of Fishing Nets and Fishery Requisites in Inland and Marine Sectors", eligible PFCSs received fishing equipment. These included drag nets (66 metres long) and aluminium hundis (50 cm diameter), with more than one unit provided to each PFCS.



Newly-elected BoD of a FCS with ARO Madam (Courtesy FEO, Canning-I CD Block).

New Board of Directors of Madhabnagar Young FCS (Courtesy FEO, Patharpratima Block).

Under the Fishermen Old Age Pension scheme, elderly and infirm fishermen who are members of CFCSs and PFCSs in South 24 Parganas receive a monthly pension of ₹1,000. This provides financial security to poor fishermen in their old age.

One PFCS was selected to receive a subsidy under the "Medium-Scale Ornamental Fish Rearing Unit" scheme in 2022–2023. This falls under the Pradhan Mantri Matsya Sampada Yojana / Banga Matsya Yojana and is jointly funded by the Central and State Governments.

In February and March 2023, members of all active PFCSs in South 24 Parganas participated in need-based training sessions organised by the Department. These were held over three days in batches at conference halls in CD Block offices.

The training covered a wide range of topics, including:

- Fishing ban periods and marine fishery regulations.
- Government relief schemes for marine fishermen.
- Conservation of important species like *Tenualosa ilisha* (hilsa).
- Hygienic fish drying and improved methods.
- Safety at sea and post-harvest loss reduction.
- Fish preservation, processing, and handling.

- Prohibition of harmful chemicals.
- Management of beels and promotion of pen culture.
- Inland Fisheries Act and wetland conservation.
- Scientific farming of new freshwater and brackish water species.
- Monitoring water and soil quality in ponds.
- Cooperative registration, by-laws, audits, and inspections.
- Management of PFCSs, including AGMs, accounts, and records.
- Appointment of CEOs and special officers.
- Internal functioning of PFCSs and fair benefit sharing among members.

These training programmes were designed to strengthen PFCS operations and improve fisheries management.

End note

My first abstract paper was published in the Abstract Book of the National Seminar on Human Resource Development in Fisheries and Aquaculture for Eastern and North-Eastern India, organised by ICAR-CIFE Kolkata Centre, held on 14–15 March 2002. I was a second author while studying MSc (Previous Year) at Barkatullah University, Bhopal. The study examined the success of a Fisheries Federation managing the Tawa Reservoir in Hoshangabad District, Madhya Pradesh. The federation included 33 FCSs and over 1,000 fish farmer members, and significantly improved fish production.

Since India's independence, fishermen in West Bengal have formed Fisher Cooperative Societies (FCSs) wherever water bodies were available, driven by the need to earn a livelihood. The state government's policy of leasing vested freshwater bodies to fisher cooperatives helped strengthen the cooperative movement in the region. Over time, substantial support—both financial and managerial—has been provided to these societies[6].

There is great potential for improving fish productivity and income generation in local communities through cooperative formation[7]. According to a former Joint Director of Fisheries (Technical), Government of West Bengal, village fishermen—by caste and profession—have organised into FCSs to manage fishing in rivers, beels, and reservoirs in a planned and sustainable way. This contributes not only to fish production but also to livelihood security and wise use of freshwater resources[9].

Such cooperatives can support sustainable social development in rural and semi-urban areas, improving the welfare of their members.

Since the Cooperative Societies Act of 1904, efforts have focused on supporting collective rights through cooperatives. West Bengal was the second state in India to form FCSs, beginning in 1918[10]. One of the oldest is the Captain Bhery

Stocking of Indian major carp fingerlings by members of PFCS in a beel.

Government scheme on pisciculture in big water bodies at Mudialy FCS.

Fishermen Cooperative Society, founded in 1927. Several such societies remain active, successful, and self-supporting. Their contributions to fisheries development and community welfare have been recognised at both the state and national levels through Fish Productivity Awards.

Fishing cooperatives are inherently focused on maximising resource use, improving livelihoods, and supporting the economic well-being of their members. Importantly, these cooperatives must grow out of the needs and aspirations of fishermen themselves[12].

In December 2025, I completed a five-day 'Training of Trainers' program on Cooperative Management and relevant Acts and Rules, organised by the West Bengal State Cooperative Union. It was aimed at building the capacity of Fisheries Department officers.

In South 24 Parganas, I served as Assistant Returning Officer for elections in the Nalban 2/1 Fishermen Cooperative Society (Bhangore-I CD Block) and Naraharipur Agradut Samudrik Matsyajibi Khuti Samabay Samity (Sagar CD Block). These elections were held on 20 January 2025 and 11 April 2025, respectively. I also served as Presiding Officer for the Board of Directors election of the Mudialy Nature Park Fishermen Cooperative Society, KMC area, on 18 November 2024.

Most PFCS members are elderly and have low to moderate literacy levels. However, they are respectful, courteous, and carry valuable indigenous technological knowledge, grounded in experience and practicality.

Acknowledgement

This article was prepared in early 2025, designated as the United Nations International Year of Cooperatives. I sincerely thank the Assistant Director of Fisheries, South 24 Parganas District, Directorate of Fisheries, Government of West Bengal, who is also my departmental head. I also express my gratitude to all Fishery Extension Officers, Assistant Fishery Officers, and the District Fishery Officer of South 24 Parganas for their support and cooperation.

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Captive production of Gangetic mystus (*Mystus cavasius*): A guide for farmers

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Gravid females ready for breeding operation.

Aquaculture in Asia began long ago as a small part of farming. Over time, it grew into a commercial industry, thanks to research on many types of fish. Today, Asian aquaculture contributes significantly to global fish production—both in quantity and value. It supports food security, helps rural communities earn a living, and boosts the economy. Governments in many countries are now encouraging more fish farming. With new technology and more fish species being added, the industry is likely to keep growing.

One focus area is farming small indigenous species (SIS) in South Asia. Researchers are working to promote these species and show farmers how to raise them. One such fish is *Mystus cavasius*, a freshwater catfish. It is popular in South Asia because of its taste and nutritional value. This species has strong market demand and is a good choice for freshwater aquaculture. Captive breeding and seed production techniques can help farmers raise it commercially. This article provides guidance to overcome the challenges of seed production.

Brief biology

M. cavasius is found in many parts of Southeast Asia. It is a common food fish in the Indian subcontinent. It lives in freshwater and can also be found in tidal rivers and lakes. Other habitats include ponds, tanks, ditches, flooded areas, and paddy fields.

The fish is silver-white or grey-white. It has a long, flat body and a cone-shaped head. It has four pairs of barbels (whisker-like organs). In adults, the maxillary barbels stretch past the base of the tail fin. The mouth has small teeth in a crescent-shaped band. The tail fin is deeply forked, and the dorsal spine is weak. There is a large section of adipose tissue (a soft fleshy area) after the dorsal fin, ending before the tail fin.

This catfish is omnivorous. It eats many types of food, such as phytoplankton, zooplankton, roundworms, insects and their larvae, and plant materials. Its diet is mainly plant-based.

The fish grows evenly in size. In its first year, it usually reaches 8–10 cm. In the wild, it can grow up to 20–25 cm. Female fish are more common than males. It breeds during the monsoon season, usually after the first rains in July or August. It matures at around one year of age, when it is over 10 cm long. This fish lays many eggs—a 50-gram fish can produce 13,000 to 15,000 eggs.

Broodstock management

M. cavasius brood fish (brooders) are raised in small ponds or cement tanks. The ideal stocking density is 3 to 4 fish per square metre. Earthen ponds are better because they provide natural food along with artificial feed. If using cement tanks, add a 2–3 cm layer of soil at the bottom. This prevents injury to the underside of the fish when they rub against the tank floor.

Brooders are fed twice a day with a fish meal-based diet that contains 30–35% protein. The amount of feed should be 2–3% of the fish's body weight.

Good water quality is important. Maintain the following levels:

- pH: 7.8–8.5
- Dissolved oxygen (DO): 5–6 mg/L
- Total hardness: 80–180 mg/L
- Total alkalinity: 80–180 mg/L

If rearing in tanks, change the water regularly. Also, apply manure to ponds or tanks as needed to encourage natural food production and maintain water quality.

Brooder selection

M. cavasius reaches sexual maturity in its first year and breeds during the monsoon season, from June to August. Females weighing 50–80 grams are ideal for captive breeding. Smaller females can also carry eggs during the monsoon.

Mature males and females can be identified by their secondary sexual features. During the breeding season, males have a long genital papilla, while females have a swollen belly.

Induced breeding

Synthetic hormones like Ovatide, WOVA-FH, Gonopro, or Spawnpro are commonly used to breed *M. cavasius* in captivity. Female brooders are injected with 1.0–1.5 ml of hormone per kilogram of body weight. After the injection, the females are usually ready for egg collection (stripping) in 10–12 hours. The timing may vary depending on the condition of the fish and its response to the hormone.

The stripped eggs are collected in a tray for fertilisation. These eggs are small (0.4–0.6 mm), round, and pale yellow or white in colour. A female weighing 40–80 grams can produce 10,000–22,000 eggs.

Identification of male and female broodstock.

Testes location and morphology.

Sperm must be prepared before stripping the female. Male brooders are dissected to remove the testes, which appear like a lump of muscle with thread-like structures. The testes are located just before the anal opening and below the digestive tract. Once removed, the testes are crushed and mixed with normal saline to create a sperm solution. This is gently mixed with the eggs in the tray for a few seconds to allow fertilisation. One male provides enough sperm to fertilise eggs from two females of the same weight.

The fertilised eggs are sticky when in contact with water. They should be incubated immediately to prevent clumping, which reduces hatching success. A glass jar or flow-through hatchery system is used for incubation. In jar hatcheries,

ropes are hung inside to let eggs stick to them. Alternatively, eggs can be spread in shallow tubs or tanks with a flow-through water system.

Natural spawning method

M. cavasius can also spawn naturally after hormone injection. In this method, the male is not sacrificed, and there is no need to wait 10–12 hours for stripping.

Use a round or rectangular tank of at least 1 square metre. The tank should have a wall outlet and hold water at a height of about 30 cm or slightly less. Injected male and female brooders are released into the tank in a 1:1 ratio (same weight). Keep a continuous water shower running in the tank.

Fertilisation of stripped eggs with sperm suspension.

Fertilised egg incubation for hatching.

Feeding the larvae with compound feed.

Within 12 hours, the female releases eggs, which stick to the tank bottom. After spawning, collect and return the spent brooders to the brood tank. Replace the water in the spawning tank and continue showering. By the next morning, hatchlings can be seen on the tank walls. These are collected using a siphon and transferred for larval rearing.

Primary rearing (larvae to fry)

The newly hatched larvae of *M. cavasius* are very small and transparent. They measure about 3 mm in length. The yolk sac, which provides early nutrition, is oval-shaped and about 0.7–0.9 mm in size. The yolk sac is fully absorbed within 60 hours after hatching. After this, the larvae need external feeding and further care.

Some farmers release yolk-free larvae directly into nursery ponds, often along with carp larvae, due to limited space. However, this leads to high mortality and low survival rates.

To improve survival, it is important to rear the larvae indoors for a few days before transferring them to fingerling tanks or ponds. This early indoor care helps reduce mortality during their most vulnerable stage.

There are three key areas to focus on during larval rearing:

- Good husbandry practices
- Proper water management
- Appropriate food and feeding methods

These factors must be managed carefully to increase the survival rate of the larvae.

Husbandry practice

To ensure survival, tiny *M. cavasius* larvae should be raised in tanks. Once the yolk sac is absorbed, the larvae begin swimming short distances and tend to stay near the bottom and walls of the tank.

It is best to keep the rearing density low—about 5 larvae per litre of water. At this density, the larvae grow well, reaching 22–25 mg in three weeks, with a survival rate of 75–80%.

If too many larvae are kept together, growth and survival rates drop sharply. Some farmers believe high-density rearing will give them more fry, but this often causes crowding stress and poor water conditions, leading to high mortality. For the best results, larvae should be raised in stress-free conditions with proper care.

Water quality management

Because *M. cavasius* larvae are small and fragile, they need clean and stable water to survive. The water in their rearing tanks should be renewed twice a day, with 50–60% of the water replaced each time. Use aerators to maintain good oxygen levels. Gentle water flow or mild recirculation systems can also help, but strong currents should be avoided as they can stress the larvae.

Keep the water depth at around 15–20 cm. In high-density tanks, waste and uneaten food can quickly degrade water quality. These wastes release harmful substances like:

- Free ammonia (NH_3) – toxic even at low levels, damaging the gills
- Ionised ammonia (NH^{4+})
- Hydrogen sulphide (H_2S)
- Carbon dioxide (CO_2)

Levels that may not affect larvae are:

- CO_2: up to 15 ppm
- NH_3: up to 0.05 ppm
- NH^{4+}: up to 0.25 ppm

Even at these levels, long exposure can reduce survival and growth. Regular cleaning and careful water management are essential to keep the larvae healthy.

A haul of fingerlings.

Fish infected by red patch disease.

Dropsy in M. cavasius.

Larval feed management

The yolk sac of *M. cavasius* larvae is absorbed within 72 hours after hatching. After that, the larvae need external feeding. Live feed is the best option during this early stage.

Common live feeds include:

- Mixed zooplankton (like copepods, *Daphnia*, *Moina*)
- *Artemia* nauplii
- Chopped *Tubifex* worms

Before feeding mixed zooplankton, sieve it once or twice to remove larger plankton. Large copepods or *Daphnia* can injure the delicate larvae, reducing survival rates.

Artemia nauplii are rich in protein and support better growth than plankton. *Tubifex* worms can be chopped for easier consumption until the larvae are 7–8 days old. After 8–10 days, chopping is no longer needed.

From the 15th day, gradually replace live feed with a formulated feed containing:

- 35% crude protein
- 8% crude fat

Feed the larvae two or three times a day. Feed as much as they can eat (ad libitum), adjusting based on how much they consume. Remove uneaten feed and faeces daily, and refresh the water to maintain good quality and prevent disease.

Harvest of marketable fish.

After three weeks of indoor rearing, the fry can be moved to nursery ponds or cement tanks for further growth. At this stage, larvae usually reach 30 mg in weight, with a survival rate of 60–70%.

Fingerling production

Fry that are 2–3 weeks old are usually moved to cement tanks or nursery ponds for fingerling production. Farmers often use small, plankton-rich ponds of 50–100 square metres. These ponds provide both natural food and additional compound feed, helping to grow a good number of fingerlings.

However, natural ponds can have problems with predators like birds or aquatic animals. To improve survival, cement tanks can be used as a controlled alternative.

In soil-based tanks, it's helpful to create shelters before stocking the fry. Maintain a water depth of 30–50 cm. These shelters give the fish a place to hide and make them feel safe. They also make feeding easier, as the fish tend to stay near the shelter. This setup can improve survival rates.

Feed the fingerlings with a formulated diet that has:

- 30% crude protein
- 6% crude fat

Feed them 5–6% of their body weight daily. Adjust the feed amount based on how much the fish are eating and seasonal changes in appetite.

If you notice fish coming to the surface early in the morning, this could mean low oxygen levels. This is often caused by filamentous algae or waste buildup at the tank bottom. In such cases, remove the algae with a net and clean the tank bottom. Also, replace some of the water to improve quality.

In 2–3 months, the fingerlings usually grow to 3–4 grams, making them ready for stocking into grow-out ponds.

Grow-out culture

For grow-out farming of *M. cavasius*, small perennial earthen ponds are recommended. These ponds can be easily drained, which is helpful because fully harvesting this catfish with nets is difficult. Cement tanks can also be used, but growth rates are lower compared to earthen ponds.

Although this species is mainly fed with compound feed, the pond should be manured (like in carp culture) to promote natural food. Because *M. cavasius* grows slowly, it is best to stock fingerlings of at least 4–5 grams at a low density—only 2–3 fish per square metre. The fish use natural food well, which supports their growth and survival.

Ideal water quality for grow-out ponds includes:

- pH: 6–8
- Alkalinity: less than 140 ppm
- Dissolved oxygen: above 5 ppm

- Ammonia: less than 0.05 ppm

Feed should contain 30–32% protein to support good body growth. This catfish accepts both floating and sinking feeds. Because of its slow growth, expected production is below 1 tonne per hectare per year. In that time, fish typically reach 30–40 grams. This size has high market demand in the Indian subcontinent.

Health management

Disease is rarely seen in the larval or fry stage. However, illness can appear during the winter or when the season shifts from winter to summer, especially in fingerling tanks and grow-out ponds.

Common issues include:

- Fin rot.
- Skin ulcers.
- Red patches near the tail or body.

Affected fish swim slowly and eat less. To manage outbreaks:

- Replace the water frequently at the first sign of disease.
- Use CIFAX (developed by ICAR-CIFA) to treat tanks or ponds.
- Remove and isolate sick fish to prevent the spread.

Another occasional issue is dropsy, seen in tanks with high organic waste or debris. Affected fish develop swollen bellies, stop swimming normally, and usually die within a few days. These fish should be removed from the tank immediately.

Overall, good environmental management is essential to prevent disease and ensure healthy fish throughout the culture period, and will increase the probability of successful culture.

Shrimp farm biosecurity in Saudi Arabia: A journey from past practices to future vision

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Shrimp Aquaculture in Saudi Arabia

Saudi Arabia has a coastline of 7,572 km, with the Red Sea to the west and the Arabian Gulf to the east. Approximately 2,400 km of undeveloped coastline can be used for aquacultural development in the pollution-free coastal environment. Due to limited freshwater resources and regulatory restrictions, the conditions for mariculture development are more favourable than those for freshwater aquaculture.

Saudi Arabia started the development of its aquaculture industry in the 1970s, with a first emphasis on freshwater fish species, like many other developing countries. During the 1970s and 1980s, the primary focus was farming tilapia (Oreochromis niloticus). However, in the mid-1990s, driven by policy planning, market demand, and favourable environmental conditions, the shrimp farming industry began to develop and eventually surpassed freshwater aquaculture production.

Since the 1990s, shrimp farming has become increasingly prosperous in Saudi Arabia due to economic development, market demand, and environmental factors. Initially, the primary species cultured was the Indian prawn (Fenneropenaeus indicus). However, the white spot syndrome virus, which emerged in the early 2000s, decimated this species. Since then, aquaculture industries in Saudi Arabia have started farming Pacific white shrimp (Penaeus vannamei) to cover the shortage of Indian prawns.

In 2023, Saudi Arabian aquaculture production reached approximately 139,949 tonnes, while mariculture production (including marine shrimp and finfish) was recorded at 92,491 tonnes. Pacific white shrimp farming has accounted for more than 70% of the total mariculture production since 2010. Shrimp farming is widespread in Saudi Arabia to meet local and global demand.

Notably, while a few mega-companies dominate the shrimp farming industry, most freshwater fish farms are operated by small-scale farmers and scattered across the country. Nine licensed mariculture companies exist, while around 350 freshwater fish farms exist.

Issues of shrimp farm biosecurity in Saudi Arabia

Disease prevention has been a significant issue in Saudi shrimp aquaculture. It has even changed the direction of the country's shrimp farming industry development and primary cultured species.

However, in the early stages, the Ministry of Environment, Water & Agriculture (MEWA) struggled to understand the operations and needs of most aquaculture farms due to a lack of guidance policies and measures. Ineffective farm management resulted in inconsistent product quality, difficulties estimating production, and difficulties preventing disease.

First, as most shrimp broodstock and larvae were imported from abroad and few local hatcheries existed, the risk of introducing pathogens was high. Furthermore, traceability issues arose as certain companies did not document the origins of broodstock and larvae.

Additionally, MEWA had difficulty monitoring farm operations because of the enormous differences in farm operating models and facilities and their scattered distribution before the 2000s. This also hindered the implementation of effective measures during disease outbreaks.

Environmental constraints and higher-cost production facilities were common in Saudi Arabia. Additionally, on the coastline of the Red Sea, the seawater salinity is approximately 42‰–45‰ during the producing period. The high cost of freshwater is also an essential factor that influences aquaculture production costs in Saudi Arabia.

Due to the short development history of the aquaculture industry, Saudi Arabia also lacked experienced shrimp farm management personnel in the 1990s and 2000s, making recruitment and training of local personnel a significant challenge. The absence of vocational training organisations was also one of the key issues.

Solution and improvement of shrimp farm biosecurity

Since 2018, MEWA has promoted aquaculture development under Vision 2030, the new national development program in Saudi Arabia, which aims to set up sustainability strategies for the country's environment and agriculture sectors.

The new national development program has integrated government, private, and academic resources into the shrimp farming industry. It aims to improve and strengthen technology transfer, farm management and operations, workforce training, and disease prevention.

On disease prevention and biosecurity, MEWA regularly meets leading aquaculture companies to hold biosecurity workshops to understand the current operating status of the industry. They also compile annual statistics on aquatic animal disease types and accumulated cases for year-to-year tracking. The import of live shrimp is strictly regulated to prevent disease outbreaks. Only licensed operators can import live shrimp; a list of approved companies is maintained for import and biosecurity purposes. MEWA also provided shrimp farmers with free disease prevention and biosecurity manuals and regularly monitored farm operations to prevent disease outbreaks.

Moreover, MEWA has collaborated with local universities, international organisations, and national research centres to improve technology transfer and farm management. National research centres and multiple semi-official organisations offer assistance and consultation. Additionally, MEWA has actively joined international animal health organizations to enhance its disease prevention capabilities and knowledge. They also encourage its personnel to attend training programs to expand their ability further.

MEWA requires biosecurity personnel to have on-site practical experience for biosecurity operations. They must also regularly inspect shrimp farms, compile monthly reports, and send them to the office. MEWA has established aquatic disease centres in major aquaculture-producing regions to help prompt diagnosis and monitoring. Mmost leading Saudi aquaculture companies have set up biosecurity departments and relevant measures, such as the National Aquaculture Group (NAQUA). MEWA has been training national-related biosecurity staff members whose responsibilities cover the entire country.

Future development of shrimp farm biosecurity in Saudi Arabia

MEWA actively supports the growth and development of the shrimp industry. It helps in the search for suitable farming locations, provides technical consultations, and offers vocational training. Moreover, it continues to cooperate internationally to import high-quality shrimp broodstock and larvae, assisting industry operators in producing quality products.

There is still a need to recruit more experienced biosecurity personnel. Currently, internships and on-the-job training programs are being utilised to enhance the quantity and competency of relevant personnel. Moreover, MEWA currently monitors shrimp diseases using PCR technology. In the future, real-time monitoring equipment could be considered to improve detection efficiency.

Overall, stability is crucial for shrimp aquaculture's sustainable development. Hence, it is imperative to prioritize broodstock. Given the limited availability of local hatcheries supplying broodstock and larvae, expanding larvae production and establishing more hatcheries is necessary.

Current policies aim to prevent disease and ensure biosecurity. MEWA has been developing sustainability strategies for the aquaculture sector, including a national aquaculture centre for private enterprises, enhancing production from hatcheries and farms, and commercializing native shrimp species.

Acknowledgments

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Wolffia globosa (duckweed) in aquafeeds for profitability and eco-friendly sustainable aquaculture

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Aquaculture is growing fast and produces high-quality animal protein. But to stay profitable and sustainable, farmers need affordable fish feed. Fish in tanks grow better and stay healthier when fed nutritious aquafeeds.

Good fish feed needs to have several key qualities. It should have all essential amino acids, be easy to digest, taste acceptable to fish, and be free from harmful substances. Fishmeal has been the main protein source in aquafeeds. It is rich in essential amino acids, minerals, omega-3 fatty acids, and vitamins like B12, A, D, E, biotin, and choline.

However, using only fishmeal harms wild fish populations. Fishmeal is also becoming more expensive, which limits the growth of aquaculture. Feed makes up about 50% of total aquaculture costs, with protein being the biggest part of that cost.

Duckweed (*Wolffia*) is a plant that grows well in controlled environments. *Wolffia*, the smallest type of duckweed, has a simple structure and unique biology. It is useful for genetic research and synthetic plant biology. Its small genome and flexible biological clock make it easy to modify. Since *Wolffia* grows in water, it allows fast and precise experiments to study plant functions and design synthetic plants.

There is growing interest in using plant-based proteins instead of animal proteins. Plant proteins are more eco-friendly and cheaper to produce. They can help solve future food shortages and improve protein intake.

In aquaculture, feed makers are replacing costly and non-renewable fishmeal with plant proteins like soybean meal, wheat gluten meal, and cottonseed meal. Some aquatic plants, such as *Wolffia*, are also suitable for fish feed. But they are often seen as waste.

Wolffia can be farmed quickly and cheaply in a controlled environment. Through photosynthesis, it absorbs nitrogen from the air and carbon dioxide to produce ammonia and carbohydrates. This can reduce the need for chemical nitrogen fertilisers and help improve crop quality and yield.

Wolffia also lowers water evaporation in irrigated rice fields. It can be fed to many animals, including ducks, chickens, pigs, cattle, buffalo, fish, prawns, snails, and crabs.

Morphology

Wolffia globosa, also known as “water lentils,” belongs to the Wolffioideae subfamily of the Lemnaceae plant family. It shares many traits with other members of this group.

It is the smallest flowering plant in the world and grows faster than any other plant. Unlike most plants, it does not have roots. Because of its fast growth, high protein content, and good nutrition, it is useful for food production—especially in areas where farming is difficult.

Wolffia globosa is very different from other plants. It does not have roots, stems, or leaves. Instead, it has only a small, flat structure called a frond.

With enough carbon dioxide and nutrients, one plant can produce over 1,000 new plants in just four months.

Wolffia can be grown in different ways:

- Pits.
- Containers.
- Ponds.
- Cement tanks.

The size of the setup depends on how much *Wolffia* is needed and how much space is available. The method is low-cost, so small-scale and low-income farmers can use it easily.

At the College of Fisheries, Central Agricultural University (Imphal), Lembucherra, Tripura, India, a study was done using six outdoor cement tanks. Each tank was 20 cubic metres (4 m × 5 m × 1 m). They kept Labeo rohita fry that were 20 days old, with a stocking density of 30 fry per square metre.

Three tanks were fed with prepared feed. The other three received live *Wolffia*. Before adding the fish, each tank was prepared with a 6–8 cm layer of soil, cleaned, dried, and treated with 500 grams of calcium hydroxide $Ca(OH)_2$. This is equivalent to a rate of 250 kilograms per hectare. The tanks were filled with groundwater and left under sunlight.

Fertiliser was added using a mix of cow dung and mustard oil cake soaked in water for 24 hours. This was done a week after filling the tanks with water. Healthy plankton developed before the fish were added.

Fish were fed twice daily—at 9:00 and 16:00. They received either formulated feed or fresh *Wolffia*, at 8%–10% of their body weight (dry matter basis). Both feeds were adjusted to provide the same amount of nitrogen.

Fresh *Wolffia* was harvested daily before feeding. Since it contains about 95% moisture, the amount given was calculated to match the protein in dry feed.

Fish were sampled every two weeks to check growth and adjust the feed amounts.

Conditions for *Wolffia* culture

Wolffia grows best in shallow water—at least 13 centimetres deep. It needs sunlight but does well in partial shade.

The ideal temperature for growth is between 25°C and 35°C. The water should have a pH between 5.0 and 7.3. Humidity should be high, between 80% and 90%.

It is best to grow *Wolffia* in places with enough sunlight but not strong, direct exposure. Nutrient supplements are important, especially micronutrients, to support healthy growth.

Nutrient profiling

Wolffia species are traditionally eaten in some Asian countries. They are now being studied as possible food sources for people. The nutrient content depends on the plant's genetics and how it is grown.

Protein content ranges from 20% to 30% (dry weight). Starch and fat range from 10% to 15%, and fibre is about 25%. *Wolffia* is rich in essential amino acids and polyunsaturated fatty acids, which make up over 60% of its total fat.

Wolffia microscopica grows quickly and produces a large amount of biomass, making it suitable for human nutrition.

For *Wolffia globosa*, the dry weight composition is:

- Protein: 45.54%
- Fat: 5.33%
- Crude fibre: 9.98%
- Ash: 20.43%
- Nitrogen-free extract: 19.21%
- It also contains 15.1% (w/w) of 15 different amino acids.
- Other components per gram of dry weight include:
- Total phenolics: 55.28 ± 1.35 µg GAE
- Flavonoids: 159.84 ± 6.65 µg catechin equivalent (QE)
- Chlorophyll: 22.91 ± 0.15 mg
- Triacylglycerides: 0.02% to 0.15%

Application of *Wolffia* in aquaculture

Wolffia and *Lemna* are aquatic plants (macrophytes) that can improve water quality in recirculating aquaculture systems (RAS). They help increase dissolved oxygen and reduce harmful substances like ammonia, nitrite, orthophosphate, total phosphorus, and total dissolved solids. These improvements also support better growth in carp fingerlings.

Wolffia is also useful in managing wastewater from climbing perch (*Anabas testudineus)* cultures. It helps control pH and oxygen levels in water and reduces ammonia, total suspended solids, total nitrogen, and phosphorus.

Duckweeds, including *Wolffia*, are effective at removing dissolved inorganic nitrogen from wastewater. They can extract:

- 49–95% from municipal wastewater
- 43–55% from swine wastewater
- 46–62% from anaerobic digestion effluent

This makes *Wolffia* a valuable tool for wastewater treatment. At the same time, it produces nutrients that can be used in other sectors.

Wolffia globosa can remove nitrogen (NH_4^+, NO_3^-) and phosphorus from aquaculture wastewater. It also provides useful substances like starch, antioxidants, phenols, flavonoids, and carotenoids.

Because of this, *Wolffia* is used as a protein and carotenoid source for ornamental fish and as live feed for rohu. Duckweeds are also useful in making animal feed, biofuels, bioethanol, bioplastics, medicines, and cosmetic products.

Steps for Wolffia culture in cemented tank.

Effects of *Wolffia* in the diet of fish and livestock

In India, aquaculture mainly focuses on three carp species: Rohu (*Labeo rohita)*, catla (*Catla catla*), and mrigal (*Cirrhinus mrigala*). These species make up 87% of freshwater fish production.

Fish raised in clay ponds are usually fed low-nutrient food. For seed rearing, *Wolffia globosa* can be used as a complete replacement for extra feed. It has been successfully used to replace

feed for fish like silver barb (*Barbonymus gonionotus*), rohu, pengba (*Osteobrama belangeri*), and amur common carp (*Cyprinus carpio*).

Duckweeds like *Wolffia* grow quickly, are rich in protein, low in fibre, and contain useful bioactive compounds. As the smallest flowering plant, *Wolffia* thrives in polyculture systems and can be eaten raw.

In goldfish (*Carassius auratus*), simulated diets with *Wolffia* improved both colour and nutrition. In recirculating systems, *Lemna* and *Wolffia* increased the growth of common carp while reducing ammonia, nitrite, total dissolved solids, and orthophosphate.

Studies show *Wolffia arrhiza* is a good alternative feed for various fish, including tilapia fry. It also improves the taste and quality of fish meat in intensive polyculture systems.

Wolffia globosa has been tested as a substitute for soybean flour in broiler chicken diets. It shows strong potential as a clean food source for both humans and as feed for fish and livestock.

Wolffia as human food

Duckweed is eaten by people in several countries. *Wolffia globosa*, a rootless duckweed, is sold in traditional markets in Thailand. It is known as khai nam, kai-pum, or kai nhae, which all mean “water eggs.”

Because of its high protein content, *Wolffia globosa* is a good plant-based protein. It can be used as a nutritious food and as an ingredient for making functional food products.

Wolffia as a source of bioactive compounds

The nutritional value and bioactive content of duckweed can change depending on how it is grown—such as the type of container or light intensity used. These factors have not been fully compared to commercial standards.

Understanding the best growing and drying conditions can help increase the amount of useful bioactive compounds in duckweed, such as flavonoids, chlorophyll, and total phenolics. This information is useful for scientists and food technologists.

Duckweed is also used in making biofuel, bioethanol, and animal feed. In addition, it is a resource for producing bioplastics, medicines, and cosmetics.

Challenges for *Wolffia* use in aquafeed

Plant cells have high amounts of carbohydrates and fibre. Carnivorous fish cannot digest high-fibre diets well because they lack the enzymes needed to break down plant cell walls.

Plant-based protein sources, including *Wolffia*, often contain anti-nutritional factors (ANFs). These include phenolic compounds, protease inhibitors, phytates, lectins, and oligosaccharides. ANFs must be removed or reduced before using these plants in aquafeeds.

For example, soybeans contain ANFs that can reduce fish disease resistance by triggering enzyme activity and inflammation in the body.

Even though ANFs can harm fish health and nutrition, many plant ingredients—including Wolffia—can still be used in feed if their ANFs are properly treated and reduced.

ANF reduction techniques for *Wolffia*

There are two main ways to reduce anti-nutritional factors (ANFs) in plant-based feeds: thermal processing and chemical processing.

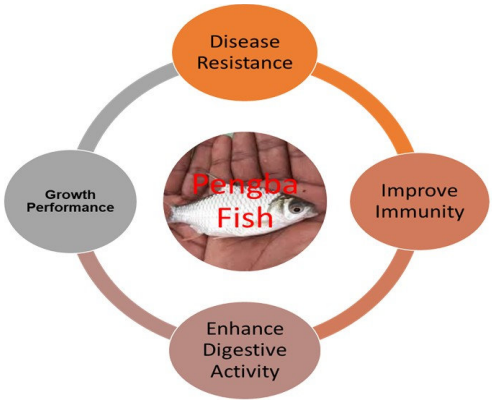
Thermal methods, such as baking, toasting, steaming, and extrusion, change the structure of the feed. This makes nutrients easier to digest and reduces harmful compounds. For example:

- Boiling reduces trypsin inhibitors, which block protein digestion.
- Extrusion destroys lectins, which interfere with carbohydrate absorption.
- Chemical treatments can also remove ANFs. For instance, the enzyme phytase breaks down phytates, which are otherwise indigestible.

Feeds with *Wolffia* can lower harmful ANF levels in the body, making it safer and more effective for aquaculture use.

Environmental benefit of *Wolffia* in aquafeed

Wolffia can naturally absorb carbon dioxide and nitrogen from the air, making aquaculture more sustainable. It is rich in essential amino acids, vitamins, minerals, and crude protein, supporting fish growth and health.



Effects of Wolffia feed on cultured fish.

Wolffia globosa also acts as a phytoremediator—it can remove heavy metals like cadmium from water. This helps clean the environment and reduces the need for chemical treatments.

Using *Wolffia* in fish feed can cut feed costs and reduce the environmental impact of fishmeal production. When it breaks down, *Wolffia* adds organic carbon and nitrogen to soil, improving soil quality.

It also has potential uses in biofertiliser, livestock feed, medicine, water purification, biogas, and even mosquito control. These applications help lower ammonia emissions and carbon footprint, contributing to efforts against global warming.

Conclusion

Wolffia globosa, or duckweed, is a rich natural source of protein. It can be used as feed for fish, livestock, and even humans.

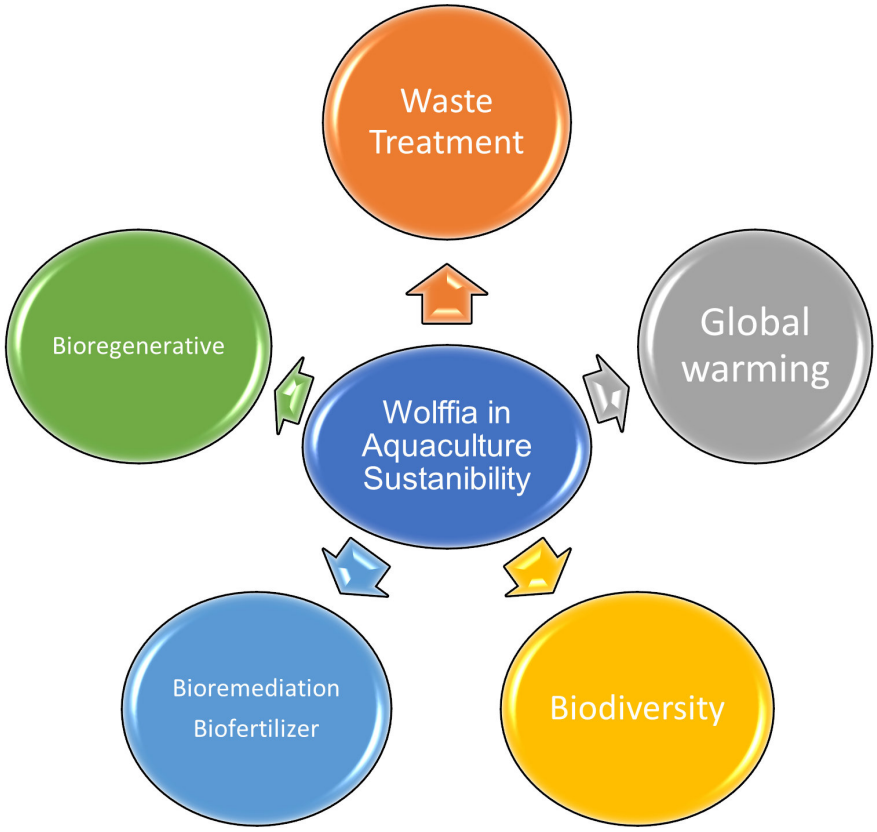
This plant grows well in both indoor and outdoor environments, but outdoor conditions support faster and more productive growth.

Wolffia meal contains high levels of crude protein, essential amino acids, vitamins, and minerals. These support the growth and health of farmed fish, while helping to reduce feed costs and the environmental impact of traditional fishmeal production.

To use *Wolffia* effectively in aquafeed, anti-nutritional factors (ANFs) must first be reduced. Once treated, the meal is easily digested.

Wolffia also has a high level of healthy unsaturated fatty acids, as well as strong antioxidant compounds like phenolics and flavonoids—more than many common crops.

Its low ANF content and good digestibility suggest that *Wolffia* globosa could be a valuable and sustainable food and feed source.



Performance of Wolffia towards aquaculture sustainability.

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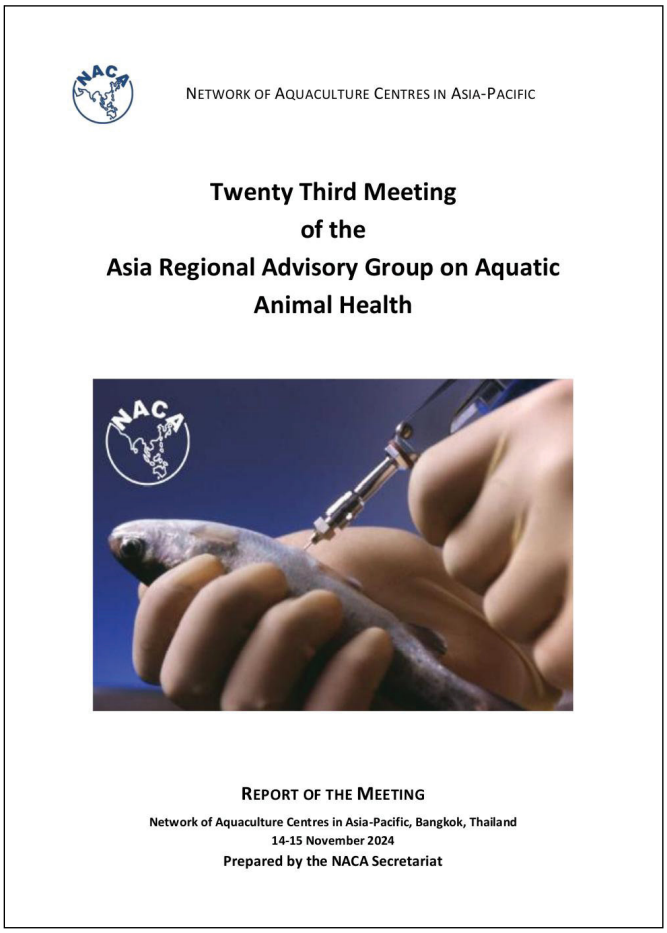
Report of the 23rd Asia Regional Advisory Group on Aquatic Animal Health

This report summarises the proceedings of the 23rd meeting of the Regional Advisory Group on Aquatic Animal Health, held 14-15 November 2024 by video conference. The role of the group is to review trends in disease and emerging threats in the region, identify developments in global disease issues and standards, to evaluate the Quarterly Aquatic Animal Disease Reporting Program and to provide guidance on regional strategies to improve aquatic animal health management. The meeting discussed:

- Progress on NACA's Asia Regional Aquatic Animal Health Programme.
- Updates from the WOAH Aquatic Animal Health Standards Commission.
- Aquaculture Biosecurity:
- Progressive Management Pathway for Improving Aquaculture Biosecurity and FAO's Aquatic Animal Health Initiatives in the Asia-Pacific Region.
- FAO/ASEAN Training on Risk Assessment for Developing an On-Farm Biosecurity Plan in the Aquaculture Value Chain.
- Methodology for Assessing Biosecurity Risk in Small-scale Farms: Experience from Colombia.
- Farming Without Fear: The Power of Proactive Biosecurity.
- AMR in Aquaculture: Importance of Epidemiological Cutoff Values for Aquatic Animal Health Antimicrobial Sensitivity Testing.
- Updates on WOAH Asia-Pacific Network on Aquatic Animal Health (AP-AquaNet).
- Updates on Regional Disease Reporting and Disease List.
- Other matters.

Members of the Advisory Group include invited aquatic animal disease experts in the region, representatives of the World Animal Health Organisation and the Food and Agricultural Organization of the United Nations, collaborating regional organisations such as SEAFDEC Aquaculture Department and WOAH-Regional Representation in Asia and the Pacific, Thailand Department of Fisheries Aquatic Animal Health Research and Development Division, and the private sector.


NETWORK OF AQUACULTURE CENTRES IN ASIA-PACIFIC

Twenty Third Meeting of the Asia Regional Advisory Group on Aquatic Animal Health

REPORT OF THE MEETING

Network of Aquaculture Centres in Asia-Pacific, Bangkok, Thailand
14-15 November 2024
Prepared by the NACA Secretariat

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https://enaca.org

AQUAINNOVATE: An AquaHub Event

12-19 May, Bangkok

A networking and coaching event for aquaculture entrepreneurs and startups will be held in Bangkok from 12-19 May. AQUAINNOVATE will bring together promising startups to pitch their ideas, network, and participate in expert coaching circles.

Convened by NACA and FutureFish with funding support from Canada's International Development Research Centre, the programme will include sessions on business fundamentals, investing for impact, nature and community based business innovations, and interactions with experts from the National Innovation Agency, Center of Excellence for Shrimp Molecular Biology and Biotechnology, the National Center for Genetic Engineering and Biotechnology, and Mahidol University.

The packed programme includes visits to local farms that are driving innovation and leading the industry, panel discussions on the aquaculture startup ecosystem and nature-based seafood markets and creative partnerships.

The indicative programme and participant profiles are available from: https://enaca.org/aquainnovate/

Workshop on sustainable brine shrimp *Artemia* cultivation

17 February, Tashkent

Although the drying up of the Aral Sea and the salinization of a lot of agricultural lands in different regions in Uzbekistan and Kazakhstan have major negative consequences, there is a high potential to develop a new profitable industry and create new job opportunities in this region: the environmental-friendly and sustainable pond farming of brine shrimp *Artemia*, a wellknown source of food in the farming of fish and crustacean species around the world.

The regional project ECO ARAL (Ecologically oriented development of the Aral Sea Region) financed by the German Federal Ministry for Economic Cooperation and Development (BMZ) and implemented by GIZ has initiated a pilot project in Karakalpakstan to showcase the feasibility of a sustainable *Artemia* cultivation in environmentally friendly earth ponds. The Artemia Project is implemented in cooperation with the International Innovation Center for the Aral Sea Region in Nukus under the Ministry of the Ecology, Environmental Protection and Climate Change of the Republic of Uzbekistan, the Academy of Science in Nukus, Ghent University (Belgium) and Can Tho University (Vietnam).

A workshop was held in Tashkent on 17 February to showcase the outcomes of the implemented *Artemia* pilot project, present guidelines and recommendations important for such a new business sector, lessons learned and discuss prospects of *Artemia* production to further develop aquaculture sector in Uzbekistan and Kazakhstan.The presentations included experiences from other countries including Bangladesh, Thailand, and Vietnam.

Tuskfish CMS V2.1 released

Tuskfish CMS is a free, fast and lightweight open source software project used to build the NACA website Version 2.1 is a feature release that adds support for blocks (the equivalent of 'widgets' in Wordpress or 'modules' in Joomla). The minimum PHP version has been raised to 8.3.

New feature: Blocks

- Extensible block system added with separate block administration page.
- Spotlight, recent content and custom HTML block types available by default.
- Block display is regulated by route (URL path), customisable block positions and various configuration options.
- Block templates can be readily customised to develop alternative variations.

Updates

- Typed properties for entities, system traits and core Tfish classes.
- Converted switch statments to match for simple cases.
- Implement union types.
- Implement nullable union types on parameters.
- Core interfaces have been moved into a dedicated directory.

Deprecations

- Blocks have been removed as a content type. Blocks are now independent layout components.

Get it from: https://github.com/crushdepth/tuskfish2/releases

TCRS Shrimp Summit To Spotlight Issues

Driving Industry Changes

Shrimp Welfare among trending new topics

PORTSMOUTH, NH: Shrimp experts from around the world will gather in Bali this June for the third annual TCRS Shrimp Summit—a one-of-a-kind event that explores the issues impacting the industry's health and future, from the pond to the market. The summit is unique not just because it represents the full value chain, including major buyers, but because it spotlights the topics, both technical and tactical, that are driving change.

This year's Summit, which takes place 22-25 June, 2025, introduces several new sessions that demonstrate the event's role as a singular forum for investigating the issues that matter.

One such issue is Shrimp Welfare, particularly the use of eyestalk ablation for rapid egg production. Dr. Simão Zacarias, one of the session speakers and a recipient of the 2020 Global Aquaculture Innovation Award, says that, "although eyestalk ablation can boost egg production, it is also associated with significant levels of female broodstock stress, physiological imbalance and mortality, and compromised resistance to disease in offspring." Addressing this issue is important not just for social licensing, he says, but for commercial success: "A growing number of international buyers/retailers are beginning to source only shrimp produced from eyestalk ablation-free systems," Zacarias notes, "so it is critical that hatcheries and farmers understand how to move to non-ablation."

Similarly, Zacarias' colleague at the University of Stirling, Amaya Albalat, will speak at the session on current practices for the harvesting, stunning, and slaughter of shrimp. These practices are varied and unregulated, which her research has shown impacts the physiology of decapod species and may impact product quality. Legislative bodies and markets are increasingly demanding more rigorous development and application of best practices in these aspects of shrimp production.

About the 2025 TCRS Shrimp Summit

The Shrimp Summit is co-hosted by the Global Seafood Alliance, the Shrimp Club of Indonesia, and the Indonesian Fisheries Producers Processing and Marketing Association. Early sponsors include USSEC, The Nature Conservancy, Devi Seafoods, Monterey Bay Aquarium, and the North American Renderers Association (NARA).

Areas of special focus at this year's event include Improver Programs; Digital Technology; and Sustainable Feeds and Feeding. Other sessions include Shrimp Welfare; Antibiotic Residues and Management; Regenerative Production; Global Production and Markets; Breeding and Disease Management; Growout Intensification; and Innovation.

A trade show showcasing innovative, leading-edge solutions focused on sustainability has also been added to this year's program.

To make the Shrimp Summit accessible to as many people as possible, registration is offered for both in-person and virtual attendance. AI-powered language-translation services (audio and text) will be available for over 30 languages.

A post-conference tour, available for an additional fee, will provide a firsthand look at local shrimp production. More details about the tour will be announced soon.

Learn more about the 2025 TCRS Shrimp Summit at:

https://responsibleseafood.org/shrimpsummit

About The Center for Responsible Seafood

The Center for Responsible Seafood is focused on finding impactful solutions to large issues where the stakes are high for environmental, economic, and social well-being. TCRS strives to continually transform aquaculture through knowledge sharing, applied research, and collaboration. Its track record includes effective programs in areas such as disease management, animal welfare, food safety, and the development of an online educational platform. The nonprofit organization's ongoing work includes global surveys of practices, the identification of solutions, the development of collaborative strategies, and improver programs leading to third party certification.

Global Artemia Summit: 27 June, Entebbe, Uganda

Artemia (brine shrimp) plays a pivotal role in aquaculture, especially as a live food for larval stages of high-value fish, shrimp, prawn and crab. However, despite growing global demand, Artemia availability is increasingly constrained due to overexploitation, habitat degradation, and climate-related changes in hypersaline ecosystems. Untapped potential for Artemia aquaculture exists in many parts of the world, with the opportunity to improve hatchery performance, reduce feed imports, generate livelihoods, and contribute to broader blue economy goals.

To raise awareness, share the knowledge and services generated by the World Bank Global Advisory Services and Analytics on Artemia production and conservation, and foster partnerships, the World Bank and FutureFish will host a Global Artemia Summit, focused on Artemia production, conservation, and innovation, as part of the WAS 2025. The objectives of the summit are to:

- Showcase global and regional advancements in Artemia aquaculture production and resource management, development and conservation.
- Share country experiences, innovative production models, integrated production
- Strategies for Artemia as a feed and as human food, and scalable investment opportunities.
- Raise awareness of Artemia's role in sustainable aquaculture development and biodiversity conservation.
- Facilitate networking and technical exchange between researchers, governments, investors, producers, and other stakeholders.

The summit is expected to provide participants with:

- An understanding of the global and regional trends in Artemia production and use.
- Insights into cost-effective Artemia farming practices, including integration with salt production and other aquaculture practices.
- Awareness of environmental pressures on wild Artemia resources and strategies for conservation.
- Tools and approaches for scaling Artemia value chains in Africa and globally.
- Knowledge of key areas for research, investment, and policy engagement.

Scope and themes

- Artemia Biology and Ecology: Fundamentals of Artemia species, production and conservation requirements, and ecological roles.
- Production Systems: Integrated Artemia-salt farming, pond-based and tank culture, hatchery applications.
- Genetic Resources and Conservation: Wild stock pressures, species and strains biodiversity, biosecurity, and habitat preservation.
- Market Trends and Trade: Global demand, supply bottlenecks, and Africa's potential.
- Novel Artemia Products: Artemia applications in animal and aquaculture feeds and human foods
- Regulatory Frameworks: including laws and policy.
- Investment: Public-private models, enabling policies, and donor-led initiatives.
- South-South Knowledge Sharing: Lessons from Asia, Africa and Latin America on Artemia development.

Target audience

- National aquaculture authorities and ministries.
- Selected Africa country participants.
- Aquaculture private sector, hatchery operators and other supporting activities.
- Investors and agribusiness stakeholders.
- Researchers and academics.
- Development partners.
- NGOs.
- Donor institutions and investor financing platforms.

The programme will provide a global overview and business case for Artemia, new applications and opportunities for investment, new prontiers and will include an open discussion on catalysing innovation and investment.

For more information, please download the prospectus from:

https://www.was.org/Meeting/pdf/AFRAQ25_GlobalArtemiaSummit.pdf

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NACA is a network composed of 20 member governments in the Asia-Pacific Region.