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42nd Edition



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Website : www.goldenmarine.in

Contact : +91 99944 35858
 Golden Marine-Harvest GMH



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Hyderabad - 500 004, India.
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- Editor



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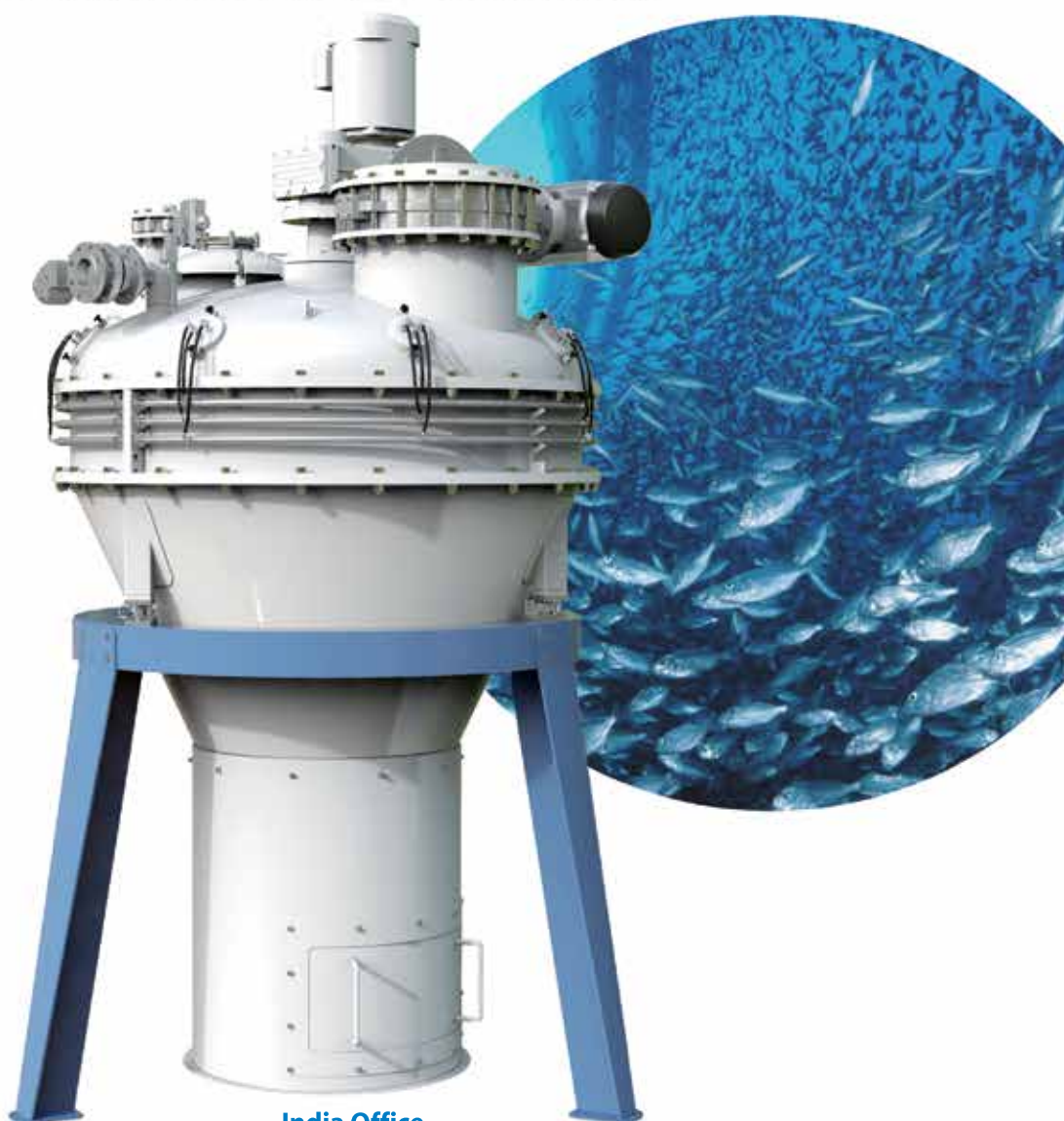
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Shrimp Farmers Seek Govt Help for Shrimp Exports, Electricity Tariff and reduce Soy Feed prices

Often questions are raised against increasing trend of illegal & unregulated shrimp cultivation and conversion of mangrove areas to commercial shrimp farms in coastal regions of West Bengal, Odisha and Andhra Pradesh. Recently emphasis is given on preserving and restoring mangrove habitat and its protection. Integrated Mangrove Aquaculture with shrimp and mangrove trees existing and growing in the same time and place, is an environment friendly idea put into reality having beneficial impact.



Dear Readers,

The September 2025 issue of Aqua International is in your hands. In the news section, you may find news about....

Prawn Farmers in India are requesting Govt's

help to rescue them from the tariffs imposed by the US President Donald Trump which has come into effect. The leaders of prawn farmers' associations from the south coastal districts of Andhra Pradesh have demanded that the A.P. State Government supply electricity at Rs 1.50 per unit, reduce the price of soy feed by Rs 15 per kg. Exporters are also seeking help to diversify markets and also open more warehouses in new markets and immediately take measures. The district leaders of the prawn farmers from Tirupati, Nellore, Prakasam, Bapatla, Guntur and Krishna districts met in Ongole on 12 August 2025 which was presided over by Prakasam District Prawn Farmers Association President Mr Duggineni Gopinath.

They discussed the plight of prawn farmers and the effect of tariffs imposed by the Trump administration on India and passed resolutions. Observing the reduction in price of soy and other raw materials used to manufacture feed for the prawns, the farmers demanded that the government see the companies reduce at least Rs 15 per kg in the price of the feed and supply electricity to all prawn ponds at Rs 1.50 per unit. They demanded an MSP of Rs 250 per 100 count Vanamai prawns, Rs 400 per 30 count Vanamai, Rs 470 per 30 count of Tiger prawns, and provide a bonus if the exporters didn't pay the price.

Frozen shrimp major item of exports; USA and China are top importers. India shipped 16,98,170 metric tonnes of seafood worth Rs 62,408.45 crore (US\$ 7.45 billion) during 2024-25, with frozen shrimp sustaining its prominence as the top exported item in terms of quantity and value amid the USA and China turning out to be the major importers of the country's seafood. Frozen shrimp earned India Rs 43,334.25 crore (US\$ 5,177.01 million), enabling this variety retain its position as the most significant item in the basket of seafood exports, Marine Products Export Development Authority revealed. As for its quantity, frozen shrimp accounted for a 43.67 percent share, thus mustering 69.46 of the total dollar earnings. Shrimp exports during the period increased by 8.30 % in ₹ value and 6.06% in value US\$, MPEDA Chairman, Mr D.V. Swamy, told a media conference.

National Fish Farmers Day 2025 was celebrated at ICAR-CIFA, Bhubaneswar. The Ministry of Fisheries, Animal Husbandry and Dairying, Government of India, in collaboration with Department of Fisheries, Government of Odisha and National Fisheries Development Board organized the National Fish Farmers Day 2025 at ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar. Celebrated every year on July 10, the day marked the pioneering achievement of Dr K.H. Alikunhi and Dr H.L. Chaudhari, who carried out the first successful induced breeding of carp fish in 1957, which transformed the landscape of Indian aquaculture. Addressing the gathering, Rajiv Ranjan Singh, Union Minister reaffirmed the Government's commitment to transform fisheries sector through innovation, capacity building and continued support under the Pradhan Mantri Matsya Sampada Yojana.

Contd on next page



Aqua International

Our Mission

Aqua International will strive to be the reliable source of information to aquaculture industry in India.

AI will give its opinion and suggest the industry what is needed in the interest of the stakeholders of the industry.

AI will strive to be The Forum to the Stakeholders of the industry for development and self-regulation.

AI will recognize the efforts and contribution of individuals, institutions and organizations for the development of aquaculture industry in the country through annual Awards presentation.

AI will strive to maintain quality and standards at all times.

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Input for advancements to the Indian Fisheries Sector, the Global Fisheries Conference 2023 held in Ahmedabad brought stakeholders from across the fisheries ecosystem onto a single platform. With nearly 200 exhibitors, including companies, institutions and start-ups from across the country, the event provided a vibrant space for meaningful dialogue and collaboration.

Awareness Programme on Aquaculture Insurance for Fish Farmers. The Department of Aquaculture, Dr M.G.R. Fisheries College and Research Institute, Ponneri, organized an awareness programme on “Aquaculture Insurance for Fish Farmers” on 10 July 2025. This programme was designed to address one of the most pressing needs in modern aquaculture -risk management through insurance coverage. The session commenced with an inspiring inaugural address by Dr S. Balasundari, Dean, who emphasized the growing vulnerability of aquaculture operations to unpredictable challenges such as climate variations, disease outbreaks and economic instabilities. She highlighted the pivotal role of insurance as a safeguard to protect the livelihood of fish farmers from unexpected losses. She remarked: “Aquaculture insurance is not just a financial tool; it is a lifeline that empowers fish farmers to recover from unforeseen setbacks and continue their contributions to food security and economic growth”.

On the occasion of National Fish Farmers Day 2025, the Department of Aquaculture, Dr M.G.R. Fisheries College and Research Institute, Ponneri, organized a webinar titled “Breeding Breakthroughs: Recent Advances in Induced Finfish and Shellfish Breeding”. The event was held in hybrid mode, facilitating participation from both on-campus attendees and virtual participants across various regions. The programme commenced with an inaugural address by Dr S. Balasundari, Dean of the Institute, who emphasized the vital importance of continual innovation in aquaculture seed production. She highlighted how advancements in breeding technologies directly contribute to the welfare of fish farmers and the sustainability of aquaculture sector.

Dr Naga Murali Chalamalasetti wrote his experience and views that Sustainable Harnessing of Fisheries Balancing Conservation and Industry Growth. Impact on Environment is a broad term and we will simplify that into Key elements which will be impacted by Aquaculture. Land – Ponds based Aquaculture need lot of land which will be dug to make embankments and then filled with water. By doing so, the land adjacent to these ponds will be not suitable for agriculture further due to various reasons like seepage or due to salinisation of soil when the ponds are pumped with salt water. Water – Almost all the water bodies adjacent to fish / shrimp ponds or water bodies harbouring fish cages have been polluted or getting polluted and ending up eutrophication.

In the Articles section, article titled “**Aquatic Jewel of Amboli: Schistura Hiranyakeshi and India's First Fish - Dedicated Biodiversity Heritage Site**”, authored by Krishna Patil, Omkar Patil, Swapnil Ghatge says that India is abode to rich biodiverse flora and fauna spanning through the landmass from the towering Himalayas to Kanyakumari, with over 7% of the world's recorded species and varieties of endemic plants and animals. Protection of these invaluable rich treasures is need of the hour. Indian Government have enacted the Biological Diversity Act, 2002, which

empowers states to declare areas of significant ecological value as Biodiversity Heritage Sites and are legally recognised under Section 37(1). These BHS sites are not just reservoirs of flora and fauna, but also carry deep cultural, historical and ecological significance often shaped by centuries of human nature interaction. These NHS sites are well-defined areas that are ecologically fragile, rich in wild and domesticated species.

Another article titled, “**Establishing a National Fisheries Council in Bangladesh: A Strategic Imperative for Sustainable Aquaculture**”, authored by Md Abu Kawsar proposes, the formation of a National Fisheries Council in Bangladesh to regulate and professionalize the aquaculture sector. Highlights critical issues such as antibiotic misuse, weak governance and lack of coordinated oversight. Outlines the Council's key roles including professional certification, policy implementation, ethical regulation and disease management. Presents a stepwise roadmap for establishing the Council, drawing lessons from international models.

Another article titled, “**Ecological Role of Virophages**”, authored by Mohit, Avneesh Singh, Lavish Saran, Litha Ceral, Shiwam Dubey, says Virophages are a unique class of viruses that parasitize other viruses, specifically giant viruses such as mimi viruses and phycodna viruses. These viruses, which are typically circular double-stranded DNA entities, rely on the replication machinery of their host viruses to propagate. Virophages infect host cells that are already infected by a giant virus, using the viral factory of the giant virus for their own replication. First, discovered in 2008 with the Sputnik virophage, this remarkable discovery has opened new avenues of research into virus interactions and viral ecology.

Another article titled, “**Tiger Shrimp-Brackishwater Finfish Mangrove Polyculture in Mitigation of Climate Change-induced Coastal Flooding**”, authored by Subrato Ghosh says Since 2001, often questions are raised against increasing trend of illegal & unregulated shrimp cultivation and conversion of mangrove areas to commercial shrimp farms in coastal regions (Blocks) of West Bengal, Odisha and Andhra Pradesh. Recently emphasis is given on preserving and restoring mangrove habitat and its protection. Integrated Mangrove Aquaculture with shrimp and mangrove trees existing and growing in the same time and place, is an environment friendly idea put into reality having beneficial impact. It is a novel initiative taken by Kolkata based NGOs in North 24 Parganas district near to Sundarbans region since 2019. Observations on management practices followed at chemical free IMA sites of progressive brackishwater aquaculturists by profession, Mr Pintu Kumar Das and Mr Saheb Ali Mondal are presented in this write up, compiled on World Mangrove Day on 26 July 2025, emphasizing on commendable work done by Mr Mondal on promoting organic shrimp production.

Readers are invited to send their views and comments on the news, special feature and articles published in the magazine which would be published under “Readers Column”. Time to time, we shall try to update you on various aspects of Aquaculture sector. Keep reading the magazine Aqua International regularly and update yourself. Wish you all fruitful results in your efforts.

M.A.Nazeer
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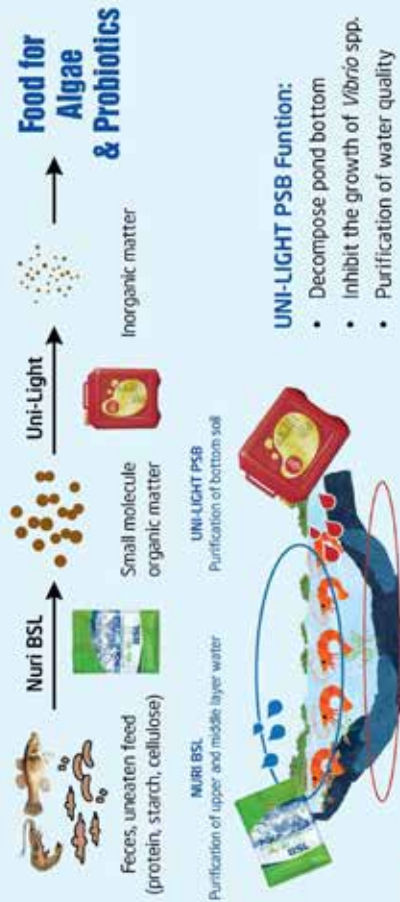
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Prawn Farmers Seek Govt Help

Demand the government to supply electricity at Rs 1.50 per unit, reduce price of Soy feed by Rs 15 per kg



Duggineni Gopinath speaking at the meeting with south coastal prawn farmers leaders on 12 August 2025 in Ongole, Andhra Pradesh.

Ongole, Andhra Pradesh: The leaders of prawn farmers' associations from the south coastal districts of Andhra Pradesh have demanded that the government supply electricity at Rs 1.50 per unit, reduce the price of soy feed by Rs 15 per kg and immediately take measures to rescue them from the tariffs imposed by the US President Donald Trump.

The district leaders of the prawn farmers from Tirupati, Nellore, Prakasam, Bapatla, Guntur, and Krishna districts met in Ongole on 12 August 2025, as Prakasam district Prawn Farmers Association president Duggineni Gopinath presided over the meeting. They discussed the plight of prawn farmers and the effect of tariffs imposed by the Trump administration on India, and passed resolutions.

Observing the reduction in price of soy and other raw materials used to manufacture feed for the prawns, the farmers demanded that the government see the feed companies reduce at least Rs 15 per kg in the price

of the feed, and supply electricity to all prawn ponds at Rs 1.50 per unit.

They demanded an MSP of Rs 250 per 100 count Vanamai prawns, Rs 400 per 30 count Vanamai, Rs 470 per 30 count of Tiger prawns, and provide a bonus if the exporters didn't pay the price.

They also asked the government to introduce prawns in the menu of meals at government schools, hostels, and Anganwadi centres. The farmers also demanded that the government ensure that about 30 percent of the prawns procured by exporters are sold in local markets, provide loans at a 50 percent subsidy to establish processing units, and encourage exports to Australia, South Korea, and European countries to reduce dependency on the US and China.

The Prawn Farmers Association state vice-president, K Srinath Reddy, assistant secretary, M Venkateswara Rao, presidents, secretaries, and leaders from the district associations also participated in the meeting.

Technological advancements, industry growth, and policy updates

Land-based salmon farming is seeing record production, while new aquaculture tech groups are expanding. Global aquaculture production surpassed capture fisheries in 2022, and the seafood market is expected to reach \$650 billion in 10 years. Policy changes, like the EU's deforestation rules, are also impacting the seafood industry.

Technological Advancements & Industry Growth:

- **Land-based salmon farming:** Land-based salmon farms are achieving production records, highlighting the potential of this technology.
- **Aquaculture tech groups:** New land-based aquaculture tech groups are hiring new leadership and expanding into new markets.
- **Global production:** Aquaculture production has surpassed capture fisheries, with global aquaculture reaching 130.9 million tonnes in 2022, including 94.4 million tonnes of aquatic animals.
- **World seafood market:** The world seafood market is projected to reach \$650 billion in the next decade.
- **India's aquaculture:** India's aquaculture sector is seeing government support and investment, with a focus on boosting seafood exports.

Policy and Trade Impacts:

- **EU Deforestation Rules:**

The EU's deforestation rules are impacting the seafood industry, requiring companies to demonstrate sustainable sourcing practices.

- **India's Fisheries Sector:** The Indian government is focusing on boosting the fisheries sector, including deep-sea fishing and seafood exports.
- **US Tariffs:** The US and China's trade war is impacting the seafood market, with tariffs affecting certain companies and products.
- **UK-EU Trade Deal:** A UK-EU trade deal is affecting the salmon industry, with Salmon Scotland welcoming the deal.

Other Notable News: New Eel Species Discovered:

- A new eel species has been discovered off the coast of Thoothukudi, India, and named after Tamil.
- **Red Snapper Seed Production:** The ICAR-CIBA has developed a seed production technology for red snapper, a high-value fish, which could boost brackishwater aquaculture in India.
- **Aquaconnect R&D:** Aqua connect, a Chennai-based aquaculture company, is investing \$4.5 million in biologicals R&D.
- **eFishery Funding:** An Indonesian aquaculture startup, eFishery, raised a record \$90 million in a Series C funding round.



Aquaculture: Opportunities, Options, and Optimism

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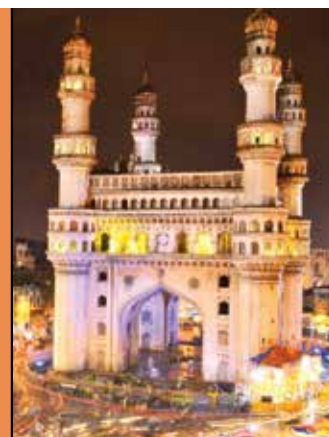


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India's seafood exports US\$ 7.45 billion in FY 2024-25: MPEDA

Frozen shrimp major item of exports; USA and China are top importers



Kochi, Aug 23: India shipped 16,98,170 metric tonnes of seafood worth Rs 62,408.45 crore (US\$ 7.45 billion) during 2024-25, with frozen shrimp sustaining its prominence as the top exported item in terms of quantity and value amid the USA and China turning out to be the major importers of the country's seafood.

Frozen shrimp earned India Rs 43,334.25 crore (US\$ 5,177.01 million), enabling this variety retain its position as the most significant item in the basket of seafood exports, Marine Products Export Development Authority (MPEDA) revealed today.

As for its quantity, frozen shrimp accounted for a 43.67 per cent share, thus mustering 69.46 of the total dollar earnings. Shrimp exports during the period increased by 8.30 % in ₹ value and 6.06% in value US\$, MPEDA Chairman Shri D.V. Swamy, IAS, told a media conference here.

The overall export of frozen shrimps during 2024-25 was pegged at

7,41,529 MT. USA, which is the largest market, imported (3,11,948 MT) of frozen shrimp, followed by China (1,36,164 MT). The other top importers in the order are European Union (99,310 MT), South-East Asia (58,003 MT), Japan (38,917 MT) and the Middle East (32,784 MT). Other countries all together totalled 64,403 MT. The export of Vannamei, Black Tiger and Scampi showed an increase in both the volume and value.

Frozen Fish, the second largest exported item, fetched Rs 5,212.12 crore (\$ 622.60 million).

Frozen squid, which is the third largest exported item, earned Rs 3078.01 crore (US\$ 367.68 million), showing a positive export trend of 0.54 per cent in terms of rupee value.

The export of dried Items pegged at 2,52,948 MT, earning Rs 2852.60 crore (\$ 340.75 millions), Shri Swamy pointed out at the press meet, where MPEDA Director Dr Ram Mohan M.K. gave a power-point presentation on the milestones of MPEDA in its

services to the sector.

Frozen cuttlefish showed a growth in terms of volume and value in US dollars by 9.11 per cent and 3.99 per cent respectively. The exports were 59,264 MT worth US\$ 285.57 million.

The export of chilled items fetched ₹659.41 crore (US\$ 78.79 million), while that of live Items gained a growth of 15.21 per cent in value (US\$ 56.01 million).

As for overseas markets, USA continued to be the major importer of Indian seafood in value terms with an import worth US\$ 2,714.94 million, with volume handled 3,46,868 MT. Exports to the US increased by 6.50 per cent in US dollars, 8.76 per cent in rupee value and 5.37 per cent in volume. Within USA's seafood import basket by India, frozen shrimp continued to be the principal item with share of 92.55 per cent in terms of US dollar.

China emerged as the

largest seafood export destination from India in terms of quantity: 3,96,424 MT worth US\$ 1,276.58 million. European Union continued to be the third largest destination by terms of dollars, with an import of 2,15,080 MT (\$ 1,125.60 million).

South East Asia is the fourth largest market by with an import of 3,47,541 MT worth 974.99 million dollars. Japan continued to be the fifth largest importer by terms of dollar with an import of 1,02,933 MT worth US\$ 411.55 million. The Middle East is the sixth largest destination by dollar terms with an import of 65,956 MT worth US\$ 278.31 million.

The top two ports handled seafood cargo were Vizag (Andhra Pradesh) and Jawaharlal Nehru Port Authority (Navi Mumbai).

Also present at the conference was MPEDA Joint Director (Training) Dr S. Kandan.

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Awareness Programme on “Aquaculture Insurance for Fish Farmers”



The **Department of Aquaculture**, Dr M.G.R. Fisheries College and Research Institute, Ponneri, organized an **Awareness Programme on “Aquaculture Insurance for Fish Farmers”** on 10th July 2025. This programme was designed to address one of the most pressing needs in modern aquaculture—**risk management through insurance coverage**.

Inaugural Address

The session commenced with an inspiring inaugural address by **Dr S. Balasundari, Dean**, who emphasized the **growing vulnerability of aquaculture operations** to unpredictable challenges such as **climate variations, disease outbreaks, and economic instabilities**. She highlighted the **pivotal role of insurance as a safeguard** to protect the livelihoods of fish farmers from unexpected losses.

“Aquaculture insurance is not just a financial tool; it is a lifeline that empowers fish farmers to recover from unforeseen setbacks and continue their contributions to food security and economic growth,” she remarked.

Technical Session

The technical session was led by **Mr Th. Srinivasan**, representing **Alliance Insurance Brokers, Chennai**. His session was **informative, interactive, and solution-oriented**, focusing on the real-world applications of insurance for aquaculture. Key topics covered included:

Types of Coverage:

Detailed explanation of available aquaculture insurance schemes designed for different farming systems and production scales.

Eligibility and Premium Structures:

Clear insights into eligibility criteria and premium calculations tailored to farmers' specific needs.

Claim Processes & Documentation:

A simplified guide to claim

settlements and necessary documentation to ensure timely financial support.

Importance of Financial Protection:

How insurance helps mitigate losses due to disease outbreaks, natural calamities, operational failures, and other production risks.

The presentation successfully addressed farmers' doubts and clarified misconceptions regarding insurance procedures and benefits, making it a highly **engaging knowledge-sharing session**.

Interactive Participation

The programme witnessed **active participation** from **20 aqua farmers and 55 students**, who engaged in meaningful discussions and asked practical questions concerning their farming experiences. This exchange of perspectives enriched the session and created a platform for building awareness about **financial risk management** in aquaculture.

Vote of Thanks

The session concluded with a vote of thanks by

Mr R. Dinesh, Assistant Professor, Department of Aquaculture, who acknowledged:

The Dean for her unwavering support and leadership

The resource person for his expert guidance and comprehensive presentation

The participants for their enthusiastic involvement

The organizing team for their efforts in successfully conducting the event

Impact and Outcome

This awareness programme marked a significant step towards fostering financial literacy and security among aquaculture farmers. By introducing participants to various insurance schemes and their benefits, the session empowered farmers to adopt risk mitigation strategies, ensuring both economic stability and sustainable growth in the aquaculture sector.

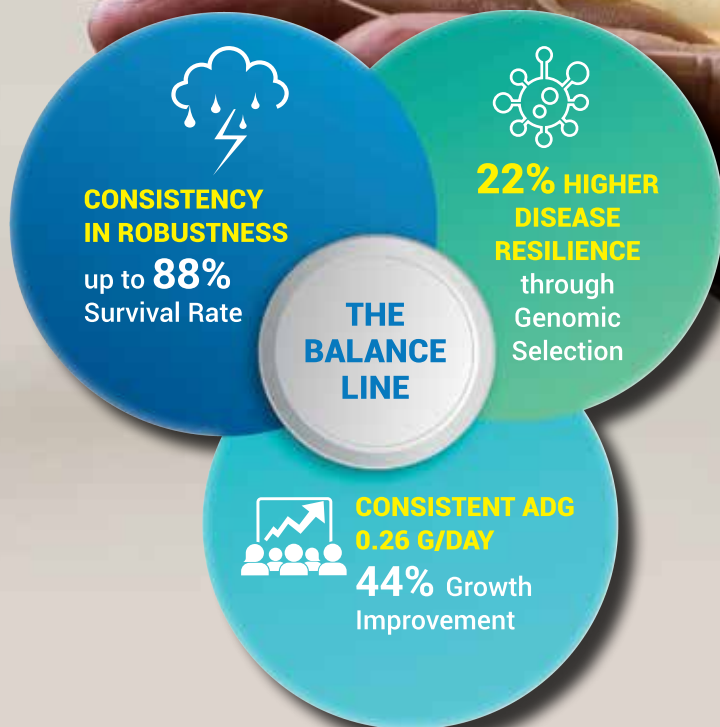
The event served as a timely and impactful initiative, aligning with the broader goals of promoting resilient and secure aquaculture practices, ultimately benefiting both farmers and the aquaculture industry at large.



A View of participants

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Breeding Breakthroughs: Recent Advances in Induced Finfish and Shellfish Breeding



On the occasion of National Fish Farmers Day 2025, the Department of Aquaculture, Dr M.G.R. Fisheries College and Research Institute, Ponneri, organized a webinar titled “Breeding Breakthroughs: Recent Advances in Induced Finfish and Shellfish Breeding”. The event was held in hybrid mode, facilitating participation from both on-campus attendees and virtual participants across various regions.

The programme commenced with an **inaugural address by Dr S. Balasundari**, Dean of the Institute, who emphasized the vital importance of continual innovation in aquaculture seed production. She highlighted how advancements in breeding technologies directly contribute to the welfare of fish farmers and the sustainability of the aquaculture sector.

The technical session comprised three distinguished expert talks, each providing valuable insights into the latest developments in the field



of induced breeding in finfish and shellfish species.

- **Dr Aritra Bera**, Senior Scientist, ICAR-CIBA, Chennai, delivered a comprehensive lecture on recent advancements in the hatchery seed production of brackishwater fishes. His presentation covered key topics such as broodstock management, larval rearing techniques, and innovative breeding technologies successfully developed by ICAR-CIBA.
- **Smt. M. Kavitha**, Scientist, ICAR-CMFRI, Tuticorin Regional Station, spoke on the progress made in hatchery seed production of molluscan shellfishes. She focused particularly on enhanced breeding practices for oysters and cephalopods, outlining practical methodologies and improvements in hatchery protocols.
- **Dr S. Selvaraj**, Assistant Professor and Head in-charge of the Department of Aquaculture, Dr M.G.R. FCRI, discussed the latest advancements in hypophysation techniques used in induced breeding of freshwater finfishes. His talk shed light on improved hormonal induction protocols, leading to better spawning success rates and seed quality.

The event concluded

with a vote of thanks by Dr S. Selvaraj, who acknowledged the invaluable contributions of the guest speakers, the support of the organizing committee, and the enthusiastic participation of attendees.



The webinar was attended by **over 100 students in person** and **42 participants online**, marking the event as a successful and impactful initiative. It served as a significant platform for **knowledge dissemination, academic collaboration, and promotion of innovative practices** in the field of aquaculture breeding.

Invitation **42nd Edition**

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Venue: Hotel Mirasol Resort,
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Programme: Exhibition: 10 am to 6 pm
Experts - Farmers Interaction Meet
from 3 pm to 5 pm on 19th November 2025

Aquaculture Experts and Consultants are invited to take part in Interaction Meet and answer to the queries and issues of the farmers during the meet from 3 pm to 5 pm on 19 November 2025

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Sustainable Harnessing of Fisheries Balancing Conservation and Industry Growth

By Dr Naga Murali Chalamalasetti



About Me & What I Do

I am a qualified fish farmer who completed B.F.Sc from College of Fishery Science, Muthukur, Andhra Pradesh, completed MFSc from College of Fishery Science, Ratnagiri, Maharashtra and Ph.D from MSU, Tirunelveli, Tamilnadu.

I am a shrimp farmer since 1991 when my father started shrimp farming and I was taking care of PI sourcing and nursery management.

I am a entrepreneur from 2013 where I started my own company in Ghana

I am an researcher since 2021 when I started researching into food safety & security post COVID

Finally emerged as a Biofloc Technologist producing Fish & Shrimp which is social friendly, environmental friendly

and safe to eat.

Aquaculture and Its impact on Environment

Environment is a broad term and we will simplify that into Key elements which will be impacted by Aquaculture

- Land – Ponds based Aquaculture need lot of land which will be dug to make embacments and then filled with water. By doing so, the land adjacent to these ponds will be not suitable for agriculture further due to various reason like seepage or due to salinisation of soil when the ponds are pumped with salt water.
- Water – Almost all the water bodies adjacent to fish/shrimp ponds or water bodies harboring fish cages have been polluted or getting polluted and ending up eutrophication. Finally most of the water

bodies become unfit to use the water for drinking purpose due to high usage of chemicals, pesticides, drugs in Aquaculture and also the effluent water contains high nitrite, nitrate, phosphate etc.

Air

- Ammonia (NH_3) Emissions, Ammonia is released from fish waste and uneaten feed., High in intensive or poorly managed systems, especially recirculating aquaculture systems (RAS) and ponds with high stocking densities., NH_3 is a harmful air pollutant, causing respiratory issues in humans and contributing to eutrophication and acid rain when deposited on land.
- Methane (CH_4) Emissions, Anaerobic decomposition of organic matter in sediments or sludge (bottom of ponds), Especially significant in poorly aerated ponds, where sludge accumulates and breaks down without oxygen, Methane is a potent greenhouse gas (GHG).
- Hydrogen Sulphide (H_2S) Release, Produced under anaerobic conditions in sediment, Has a rotten egg smell

and is toxic to fish and humans in high concentrations, Common in poorly maintained pond bottoms or sludge-heavy systems.

- Nitrous Oxide (N_2O) Emissions, Formed during nitrification and denitrification in water and biofilters, N_2O is a powerful greenhouse gas, with 300x the warming potential of CO_2 .
- Particulate Matter (PM), In land-based operations, activities like feed handling, fish processing, or construction can release dust and fine particles, Can affect local air quality, especially near large aquaculture farms.

Key Pollutants and Indicators of Pollution

- Ammonia Content in Air & Water
- Nitrite and Nitrate contents in water bodies adjacent to Aquaculture ponds/ Cages
- Phosphates in water
- Blue green algae
- Hydrogen sulphide
- Sludge and sedimentation in water bodies
- Mineral profile
- Pesticides and Organophosphates
- Species diversification

Most affected regions in India where aquaculture pollution has significantly degraded water and surrounding ecosystems:

1. Kolleru Lake, Andhra Pradesh, Once a vast

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Diocetyl Dimethyl Ammonium Chloride 80% (DDAC)



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Algaecides	Potassium Permanganate, Sodium Percarbonate
Oxidizing Agents	Triple Salt (Potassium Monopersulfate, KMPS), Potassium Permanganate
Water Conditioners	Zeolite, Tea Seed Powder, Yucca Liquid
Biocides	Diocetyl Dimethyl Ammonium Chloride 80%, Octyl Decyl Dimethyl Ammonium Chloride 80%



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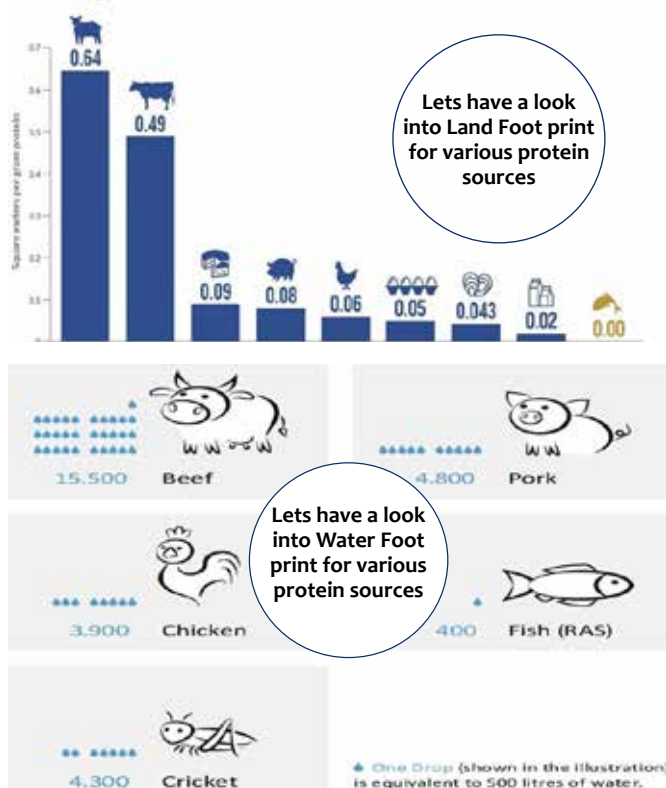
- freshwater lake, now ~42% converted into fish/shrimp ponds by 2001, Effluent from extensive aquaculture has; Blocked natural water flow, causing flooding and reducing drinking water quality. Introduced high levels of nutrients, chemicals, heavy metals, antibiotics, and pesticides .
2. Pulicat Lake, Andhra Pradesh/Tamil Nadu, Estuarine lagoon facing pollution from sewage, agricultural runoff, and industrial/seafood processing waste. Shrimp farms and salt works on 1,000 acres emitting heavy nutrients and chemicals. Consequences include loss of biodiversity, turbidity, drying up of 40% of the lake, and livelihood threats for 50,000 locals .
 3. Chilka Lake, Odisha, Brackish-water lagoon where commercial prawn farming expanded heavily Resulted in freshwater weed proliferation, loss of biodiversity, and reduced productivity. Declared on the Ramsar Montreux Record due to ecological degradation from aquaculture .
 4. Andhra Pradesh Delta Region, Intensive pond aquaculture (e.g., shrimp) in Godavari/ Krishna deltas is leaching ammonia, nitrates, and chemicals into soils and groundwater .Organic-rich effluents pollute nearby canals, adversely affecting adjacent agriculture .
 5. Radhanallur (Tamil Nadu) & Mangalore Coast, Shrimp farms experience salinity fluctuations, soil acidification, plus eutrophication and harmful red tides .Clam poisoning incidents due to paralytic toxins in coastal areas near Chennai and Mangalore .
 6. Karnataka – Netravati River (Cage Aquaculture), Pollution suspected from upstream sources killed pompano and mussels in cages near Ullal Hoige (Mangalore) in 2023 .Official probes are ongoing to identify responsible contaminants .
 7. Kerala – Ashtamudi Lake, Intensely polluted by sewage, industrial discharge, boat oil spills, and microplastics in fish/shellfish .Aquaculture adds to the pollution stress along with habitat destruction and heavy metals .
- Common Impacts Across Regions**
- Water contamination: Elevated nutrients (N, P), heavy metals (lead, cadmium), antibiotics, organic sludge.
 - Ecological harm: Algal blooms, oxygen depletion, fish kills, harmful red tides, biodiversity loss.
 - Human health & livelihoods: Polluted drinking water, contaminated seafood, loss of fisheries/ agriculture.
- Dr Naga Murali Chalamalasetti



Cage Culture in Nile River before Govt banned them



Kolleru Lake: A once-thriving ecosystem drowned by Aquaculture's Growth



Water Foodprint (litres of water per 1 kg)

National Fish Farmers Day 2025 celebrated at ICAR-CIFA, Bhubaneswar



The Ministry of Fisheries, Animal Husbandry and Dairying, Government of India in collaboration with Department of Fisheries, Government of Odisha and National Fisheries Development Board organized the National Fish Farmers Day 2025 at ICAR-Central Institute of Freshwater Aquaculture, Kaushlyaganga, Bhubaneswar.

Celebrated every year on July 10, the day marks the pioneering achievement of Dr K.H. Alikunhi and Dr H.L. Chaudhari, who carried out the first successful induced breeding of carp fish in 1957, which transformed the landscape of Indian aquaculture.

Addressing the gathering, Shri Rajiv Ranjan Singh, Union Minister reaffirmed the Government's commitment to transform fisheries sector through innovation, capacity building and continued support under the Pradhan Mantri Matsya Sampada Yojana (PMMSY). On the occasion, he launched 17 fisheries clusters, ICAR-NFDB training calendar, seed certification and hatchery guidelines, and ICAR-CIFA publication

“Freshwater Aquaculture Technologies: Innovations for Diversification and Sustainability”. The Minister also felicitated traditional fishermen, FFPOs, start-ups and beneficiaries of Government schemes like Kisan Credit Card and Aquatic Crop Insurance.

He virtually inaugurated and laid the foundation stone of several PMMSY projects, with an emphasis on improving infrastructure and holistic support for fish farmers. Pointing out that fish production has grown by 103% in the last decade (2014-2024), he emphasised the importance of skill development in emerging sectors like pearl farming, organic aquaculture, pabda and murrel farming.

Senior Government officials

including Prof. S.P. Singh Baghel, and Shri George Kurien, Union Ministers of State; Shri Gokulananda Mallick, Minister of Fisheries, Odisha; Shri Sukanta Kumar Panigrahi, MP; Shri Ashrit Patnaik, MLA; Dr Abhilakshya Likhi, Secretary, Department of Fisheries; Dr J.K. Jena, Deputy Director General (Fisheries), ICAR; Dr B.K. Behera, Chief Executive Officer, NFDB; and Dr P.K. Sahu, Director, ICAR-CIFA; were present at the event among other prominent dignitaries.

The main attraction was an exhibition showcasing value-added products, innovations and grassroots aquaculture initiatives by FFPOs, start-ups and women-led fishermen groups.

With over 1,500 participants including farmers, entrepreneurs, scientists, and stakeholders, the event showcased strong grassroots engagement and served as a platform to strengthen synergies between science, policy, and community-led aquaculture in advancing India's Blue Revolution.



Input for advancements to the Indian Fisheries Sector

The Global Fisheries Conference 2023 held in Ahmedabad successfully brought stakeholders from across the fisheries ecosystem onto a single platform. With nearly 200 exhibitors, including companies, institutions, and start-ups from across the country, the event provided a vibrant space for meaningful dialogue and collaboration.

As we now look beyond the Pradhan Mantri Matsya Sampada Yojana (PMMSY), the Department of Fisheries is committed to exploring new avenues to further empower and elevate the Indian fisheries industry.

In this regard, we genuinely want to hear your suggestions and innovative ideas. We are particularly keen and serious about **understanding what support, interventions, addition of line items under PMMSY or facilitation mechanisms you believe could significantly drive innovation, sustainable growth, and advancement for the fisheries sector, specifically for your businesses and institutions.**

Whether your ideas are related to *technological advancements, infrastructure development, market access improvements, skill-building initiatives*, or any other area, your input is highly valued and will directly influence our approach and planning for the future.

We would greatly appreciate it if you could share your thoughts and ideas directly by replying to this email and will eagerly await your valuable suggestions and will thoroughly review each response received.

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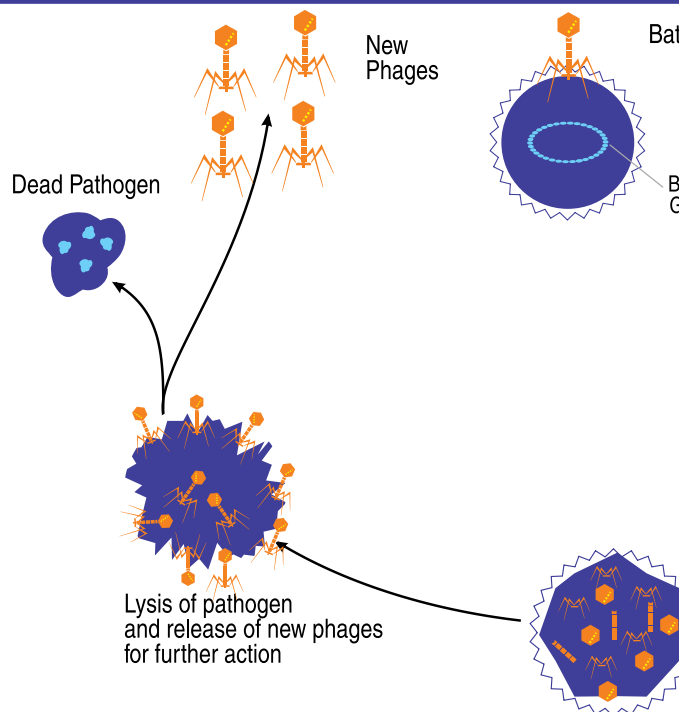
V PHAGES HATCHERY & V PHAGES GROWOUT are a cocktail of bacteriophages that target *Vibrio* spp. they are safe on aquatic animals, people and ecosystems. They are resistant to antibiotics and increase the health of the shrimp.

"V PHAGES" cocktail targets against most common pathogens

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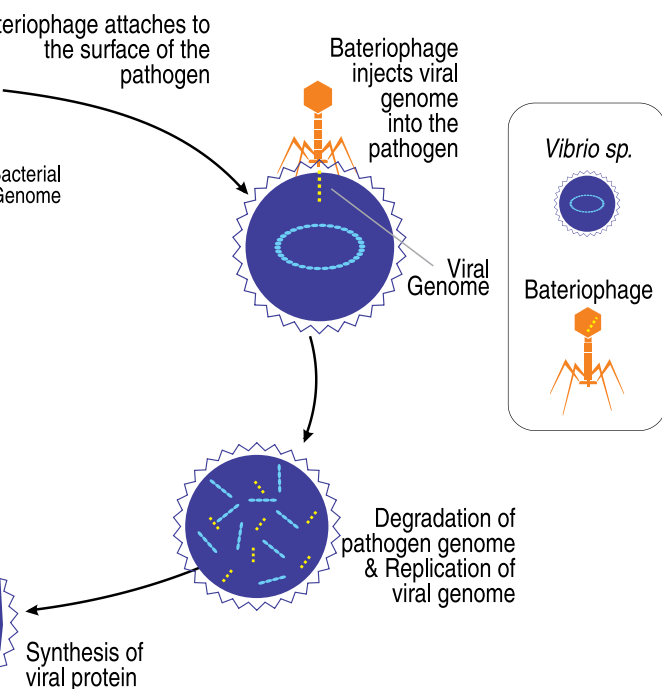
cocktail of Phages isolated from Natural environment. Hence
s. This destroys the pathogenic bacteria which are even
eases the efficacy of probiotics.

enic *Vibrio* species in Shrimp Hatchery & Farming

arveyi • *Vibrio campbellii* and other pathogenic *Vibrio* sp.

Very Fast action | Enhances Probiotic performance
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ON A TARGET VIBRIO BACTERIA



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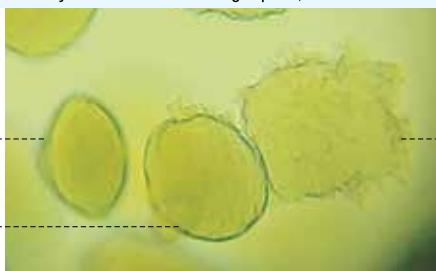
- Effective against Vibriosis, other Bacterial Infections and Running Mortality Syndrome (RMS).
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- Prevents sudden crop loss and extends Life of Pond during critical profit-making period.
- Enhances Probiotic performance.

Works as an Alternative to Antibiotics and complies with International Seafood export regulations.

Stages of *Vibrio* sp. colonies infected with Bacteriophages & Progressive Lysis observed on an Agar plate, under Stereo Microscope

Colony 1 in Stage 1:
Intact Colony may be infected or yet to get infected.

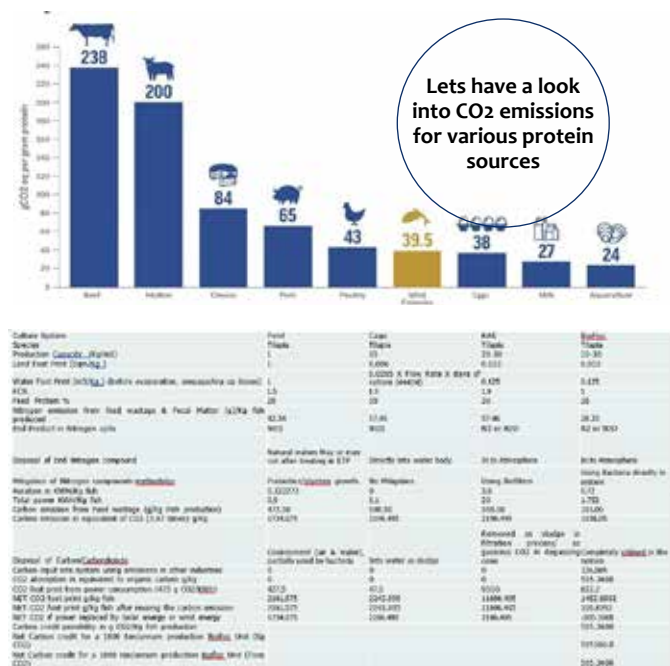
Colony 2 in Stage 2:
Phage infected Colony showing Partial lysis.



Colony 3 in Stage 3:
Phage infected Colony Completely lysed, cell contents with multiplied phages spreads out in search of their host.

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A Brief comparison of Production systems



Biofloc Tilapia Farm with complete Solar energy

Major advantages of Biofloc



Lowest FC



Lowest water usage /foot print – there will be zero water exchange in this system, only evaporation losses (2 lit/sqm/day) will be topped up, water will be either recirculated or used for plants or for hydroponics



Negative carbon foot print – we will be using the carbon produced in other food industry as waste as raw material here which gives a negative carbon foot print. But yes since we depend more upon the aeration in this system, there will be carbon foot print coming from electricity, generator fuel etc. which we are trying to avoid by using solar and wind energy.



Zero/least Nitrogen emissions, since carbon is neutralising it and converting into floc which is consumed by fish again.



By growing fish in this culture I can decalre the lowest land/water usage and least nitrogen and phosphorus emissions and lowest carbon foot print which makes my product environment friendly and sustainable.

What is Biofloc Technology

Biofloc technology (BT) is defined as the use of aggregates of bacteria, algae, or protozoa, held together in a matrix along with particulate organic matter for the purpose of improving water quality, waste treatment and disease prevention in intensive aquaculture systems.

In other words, Biofloc is a symbiotic process that includes confined aquatic animals, heterotrophic bacteria and other microbial species in the water. Consumption of bio flocs also provides nutritional value to cultured aquatic species.

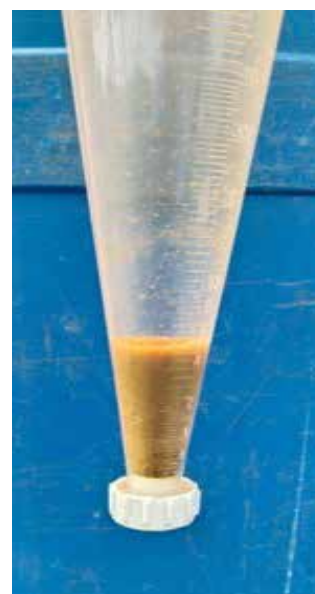
This simply means that BT can be an ideal option for sustainable and environmentally friendly aquaculture (Crab et al., 2009, 2012).

I will also add what I understood about BT, “conversion of waste generated in aquaculture systems using the

biological relation between Carbon and Nitrogen (C:N = 12:1)”

What is the solution to keep growing in Aquaculture but not polluting environment and create a circular economy

One and Only solution for the situation what we face now where we can still have Sustainable Harnessing of Fisheries Balancing Conservation and Industry Growth is Biofloc Technology.



My Message

Eat whatever you want BUT eat responsibly

Demand whatever you want to eat BUT compromise on environmental safety

Do Aquaculture BUT do it responsibly

Intensify your production system BUT do it responsibly.

We have to protect the right of future generations also to live, we cannot ruin their future by damaging the environment today.





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Aquatic Jewel of Amboli: Schistura hiranyakeshi and India's First Fish-Dedicated Biodiversity Heritage Site

Krishna Patil^{1*}, Omkar Patil², Swapnil Ghatge³

¹ Ph D Scholar, College of Fisheries, Ratnagiri, Maharashtra

² UG Scholar, College of Fishery Science, Udgir, Maharashtra

³ Associate Professor, College of Fishery Science, Udgir, Maharashtra

India is abode to rich bio diverse flora and fauna spanning through the landmass from the towering Himalayas to Kanyakumari, with over 7% of the world's recorded species and varieties of endemic plants and animals. Protection of these invaluable rich treasures is need of the hour (Goyal & Arora, 2009). Indian Government have enacted the Biological Diversity Act, 2002, which empowers states to declare areas of significant ecological value as Biodiversity Heritage Sites (BHS) and are legally recognised under Section 37(1). These BHS sites are not just reservoirs of flora and fauna, but also carry deep cultural, historical, and ecological significance often shaped by centuries of human-nature interaction.

These NHS sites are well-defined areas that are ecologically fragile, rich in wild and domesticated species, and often include rare, endemic, threatened, or keystone species. They may also feature ecosystems of evolutionary significance, fossil records, or hold aesthetic, cultural, or ethical value. Unlike national

This article highlights the ecological and cultural significance of the Amboli region in Maharashtra, focusing on the recent discovery of *Schistura hiranyakeshi* and its unique recognition under India's Biodiversity Heritage Site framework. It also emphasizes the role of sacred ponds and community-driven conservation efforts in the Western Ghats.

parks or wildlife sanctuaries, BHSs are managed decentralised, in consultation with local communities and stakeholders, allowing sustainable use and the continuation of traditional practices, with voluntary restrictions if agreed upon by local bodies (<http://nbaindia.org/>).

The first BHS was the Nallur Tamarind Grove in Bengaluru, Karnataka, which was declared in 2007 and is known for its ancient tamarind trees and cultural heritage (<http://nbaindia.org/>). Over time, the list

has grown to include sacred groves, wetlands, hill ecosystems, lateritic plateaus, and rare forest patches. As of May 2025, India has notified 47 Biodiversity Heritage Sites across 16 states (Table 1), each with its unique ecological narrative. But among all these, Amboli in Maharashtra holds a special place, as the first BHS in India dedicated to a fish species (Government of Maharashtra, 2021).

Amboli lies in the Northern Western Ghats Biodiversity Hotspots in the Sawantwadi Tehsil of Sindhudurg district. In 2021, a small yet ecologically significant area of 2.11 hectares near the origin waters of the Hiranyakeshi River — including a sacred pond adjacent to the Mahadeo (Lord Shiva) temple — was notified as a Biodiversity Heritage Site (Government of Maharashtra, 2021). This move recognised the discovery of a new freshwater fish species, *Schistura hiranyakeshi*, which was found exclusively in this microhabitat. The discovery contributed significantly to documenting new species in the Western Ghats. Named after its genus, Schistura, and the



Fig. 1 The pond of the Sri Hiranyakeshi temple, the only known locality & *Schistura hiranyakeshi*

Hiranyakeshi River, this freshwater loach is a small, oxygen-loving fish found in clear, fast-flowing spring waters. The naming also pays homage to the local deity and temple, underscoring this region's close ties between biodiversity and cultural tradition.

The species limited distribution and habitat sensitivity highlight the urgency of its conservation, especially as freshwater ecosystems are among the most endangered in the world. The Amboli BHS is not just about a single fish species; it reflects the broader ecological richness of the region. The area is surrounded by cloud forests, lateritic plateaus, and the rare *Myristica* swamp ecosystem, one of the last remnants of a prehistoric wetland forest, now found only in three known locations across India. These swamps support a unique biodiversity assemblage and act as vital water regulators in the monsoon-drenched Western Ghats. The designation of Amboli as a Biodiversity Heritage Site serves multiple purposes. It protects an ecologically fragile ecosystem and recognises the value of local conservation traditions, particularly those linked to temple ponds and sacred springs. The advantage of BHS status is that it does not impose stringent restrictions but works in harmony with local communities to promote sustainable development, eco-tourism, and awareness-building. Amboli has become a model for community-led conservation, where spiritual reverence and scientific discovery converge.

The BHS framework promotes a bottom-up approach to conservation. Rather than top-down enforcement, it encourages voluntary protection measures, local livelihood enhancement, and education initiatives to build a sense of stewardship. It is a reminder that biodiversity conservation concerns large charismatic megafauna like tigers and elephants, and small, lesser-known species equally vital to ecological balance and cultural identity.

Amboli is now the fifth Biodiversity

Table 1. Biodiversity heritage sites of India

Sr. No.	Biodiversity Heritage Site	Area (ha)	District & State
1.	Majuli River Island	87500	Majuli, Assam
2.	Borjuli Wild Rice Site	0.41	Sonitpur, Assam
3.	Hajong Tortoise Lake	526.78	Dima Hasao, Assam
4.	Purvatali Rai	0.73	North Goa, Goa
5.	Sacred Grove at Sural Bhatori Monastery	0.6	Chamba, Himachal Pradesh
6.	High Altitude Meadow, HudanBhatori	8.74	Chamba, Himachal Pradesh
7.	Birch-pine Forest Patch, Nain Gahar	12.22	Lahaul&Spiti, Himachal Pradesh
8.	Nallur tamarind groves	21.85	Bengaluru, Karnataka
9.	Hogrekan	1015	Chikmagalur, Karnataka
10.	University of Agricultural Sciences, GKVK Campus	167	Bengaluru, Karnataka
11.	Ambaragudda	3857.17	Shimoga, Karnataka
12.	Asramam	57.33	Kollam, Kerala
13.	Naro Hills	200	Satna, Madhya Pradesh
14.	Patalkot	8367.49	Chhindwara, Madhya Pradesh
15.	Amarkantak	7681.5	Anuppur, Madhya Pradesh
16.	Glory of Allapallii	6	Gadchiroli, Maharashtra
17.	Bambarde Myristica Swamps	2.59	Sindhudurg, Maharashtra
18.	Ganeshkhind Garden	33.01	Pune, Maharashtra
19.	Landorkhori	8.08	Jalgaon, Maharashtra
20.	Schistura hiranyakeshi	2.11	Sindhudurg, Maharashtra
21.	Dialong Village	1135	Tamenglong, Manipur
22.	Khlaw Kur SyiemKmielng	16.05	Ri-Bhoi, Meghalaya
23.	Mandasaru	528	Kandhamal, Odisha
24.	Mahendragiri	4250	Gajapati, Odisha
25.	Gandhamardan Hill	18964	Bolangir and Bargarh, Odisha
26.	TungkyongDho	0.065	North Sikkim, Sikkim
27.	Arittapatti	193.215	Madurai, Tamil Nadu
28.	Ameenpur Lake	229.05	Sangareddy, Telangana
29.	Gharial Rehabilitation Centre	10	Lucknow, Uttar Pradesh

Sr. No.	Biodiversity Heritage Site	Area (ha)	District & State
30.	Baramura waterfall	150	Khowai, Tripura
31.	Unakoti	40	Unakoti, Tripura
32.	Silachari Caves	100	Gomati, Tripura
33.	Debbari or Chabimura	215	Gomati, Tripura
34.	Betlingshib and its surroundings Tonglu	350	North district, Tripura
35.	Tonglu	230	Darjeeling, West Bengal
36.	Dhotrey	180	Darjeeling, West Bengal
37.	Chilkigarh Kanak Durga	22.62	Jhargram, West Bengal
38.	State Horticulture Research and Development Station	39.61	Nadia, West Bengal
39.	Char Balidanga	46.862	Nadia, West Bengal
40.	Amkhoi Wood Fossil Park	10 0.667	Birbhum, West Bengal
41.	Baneswar Shiva Dighi	0.667	Coochbehar, West Bengal
42.	NamthingPokhari	4.819	Darjeeling, West Bengal
43.	Birampur-BaguranJalpai	95.91	Purba Medinipur, West Bengal
44.	Haldir Char Island	4.73	Purba Medinipur, West Bengal
45.	Gupteswar Forest	350	Koraput, Odisha
46.	Lyago	1.24	Lower Subansiri, Arunachal Pradesh
47.	Thungeey Gonpu	6.27	West Kameng, Arunachal Pradesh

Heritage Site in Maharashtra, joining the ranks of Glory of Allapalli (Gadchiroli), Landor Khori Park (Jalgaon), Ganeshkhind (Pune), and the Myristica Swamps (Sindhudurg). Each site showcases Maharashtra's rich and diverse natural heritage, from dry deciduous forests to sacred groves and swamp forests. However, Amboli stands apart as a symbol of freshwater biodiversity conservation, an area often underrepresented in India's conservation priorities.

In conclusion, the Amboli Biodiversity Heritage Site represents a powerful example of inclusive conservation, where scientific research, community

engagement, and traditional beliefs come together to protect a unique ecosystem. Such models offer hope and direction in an era marked by rapid ecological degradation and climate change. Protecting *Schistura hiranyakeshi* is not just about saving a fish it's about preserving a living heritage, ensuring that our rivers, springs, and forests continue to support life in all its vibrant forms.

More such species specific freshwater BHS sites shall be identified in the vast forest areas of Maharashtra state in order to conserve the valuable fish resources along with the ecosystem for the future generations to come.

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Establishing a National Fisheries Council in Bangladesh:

A Strategic Imperative for Sustainable Aquaculture

Md Abu Kawsar, Doctoral Researcher, Chinese Academy of Science & Assistant Professor, Department of Aquaculture, Sylhet Agricultural University, Bangladesh

Bangladesh ranks as the world's fifth-largest aquaculture-producing country, playing a vital role in national food security, rural livelihoods, and economic growth. However, the sector suffers from weak regulation, fragmented oversight, antibiotic misuse, and poor farm-level practices. This article highlights the urgent need for establishing a National Fisheries Council- a professional, multi-stakeholder body that can guide sustainable aquaculture development through better regulation, professional certification, disease control, ethical standards, and coordinated policy implementation. Drawing on international models and the growing demands of the fisheries sector, the article proposes a roadmap for building the council and outlines the key benefits it would bring to ensure a safer, more accountable, and globally competitive aquaculture industry in Bangladesh.

HIGHLIGHTS:

- ▶ Proposes the formation of a National Fisheries Council in Bangladesh to regulate and professionalize the aquaculture sector.
- ▶ Highlights critical issues such as antibiotic misuse, weak governance, and lack of coordinated oversight.
- ▶ Outlines the Council's key roles including professional certification, policy implementation, ethical regulation, and disease management.
- ▶ Presents a stepwise roadmap for establishing the Council, drawing lessons from international models.
- ▶ Emphasizes the Council's potential to ensure safer aquaculture products, protect public health, and support sustainable sectoral growth.

Keywords: Bangladesh Fisheries Council; Aquaculture Governance; Bangladesh Fisheries Sector; AMR; Sustainable Fish Farming.

Introduction:

Bangladesh stands proudly among the world's top fish-producing nations, ranking as the 5th largest

aquaculture-producing country, and has emerged as a cornerstone of food security, rural livelihoods, and export earnings (FAO, 2022). However, despite this impressive growth, aquaculture in Bangladesh remains poorly organized and weakly regulated, facing major problems

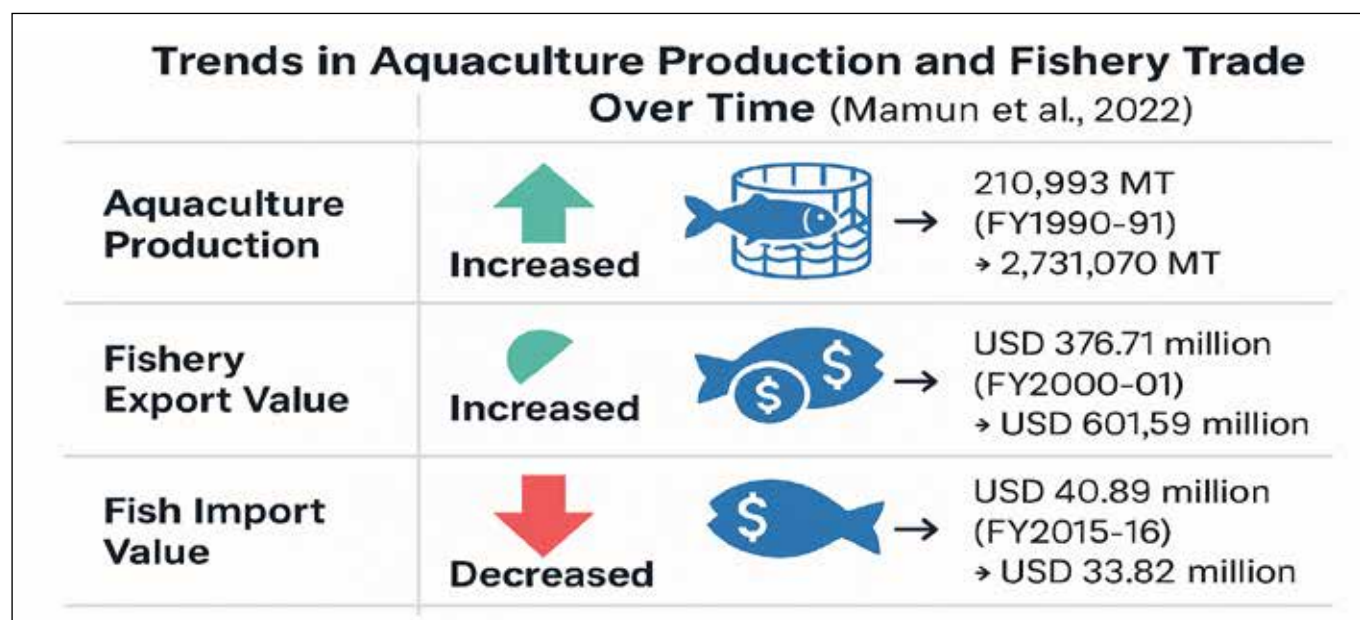


Figure 1: Trends in Aquaculture Production and Fishery Trade in Bangladesh

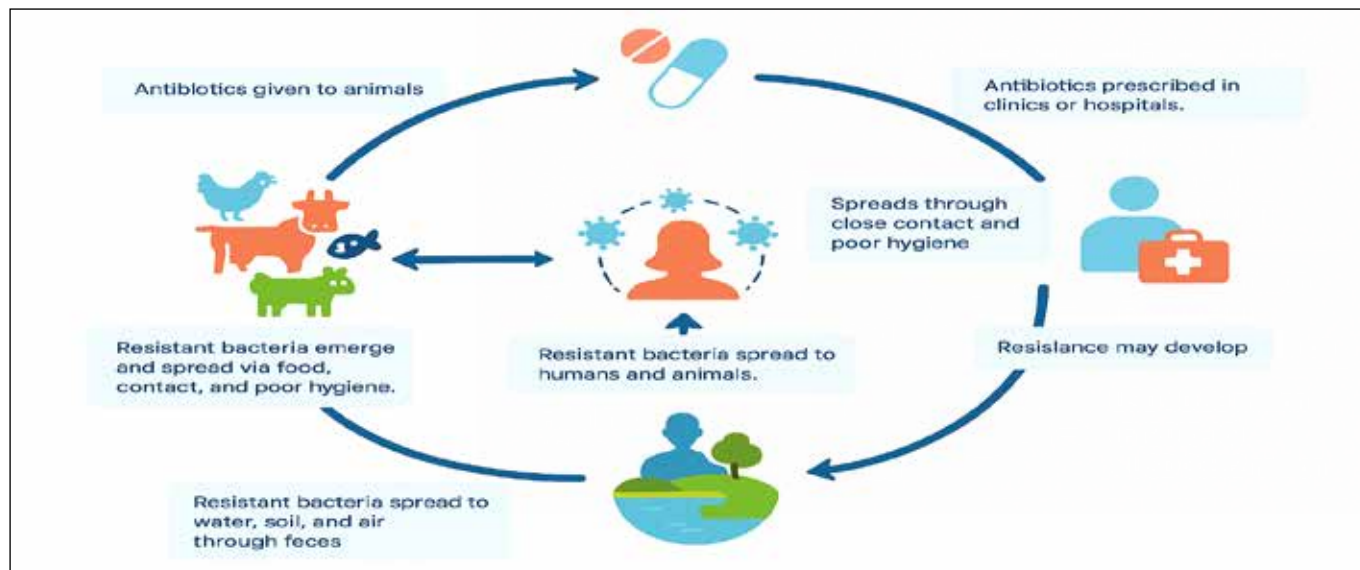


Figure 2: Pathways of antibiotic resistance transmission

such as frequent disease outbreaks, poor farm hygiene, overuse of antibiotics and weak enforcement of rules and regulations (Kawsar et al., 2022). Although aquaculture plays a vital role in the national economy, there is still no dedicated central authority to oversee, coordinate, and regulate its practices nationwide unlike the well-structured system in the veterinary sector. This absence has led to inconsistencies in farming standards, a lack of accountability, and growing threats to public health and the environment. In response, the formation of a Bangladesh Fisheries Council is no longer just an idea it is an urgent necessity. Such a body could unify the sector under a shared vision, enforce good aquaculture practices, and guide Bangladesh toward a safer, more sustainable, and globally competitive aquaculture future.

The Growing Importance of Aquaculture in Bangladesh

Aquaculture has become one of the fastest-growing industries in Bangladesh. The country produces 2.73 million metric tons of fish annually, with over half of this coming from aquaculture (Figure 1) (Mamun et al., 2024). Fish contributes to over 60% animal protein in the diet and supports millions of people through direct and indirect employment (Hossain, 2014). However, this rapid growth highlights the need for improved planning and regulatory

oversight. Intensive fish and shrimp farming has increased the demand for inputs like antibiotics and chemicals many of which are used without proper knowledge or supervision (Kawsar et al., 2022).

The Problem: A Sector Without a Central Guiding Body

Currently, aquaculture in Bangladesh is managed by a combination of institutions, including the Department of Fisheries (DoF), fisheries research organizations, local government bodies, and various non-governmental organizations (NGOs). However, the absence of a dedicated unified authority has resulted in a fragmented system marked by overlapping responsibilities, inconsistent policies, and weak enforcement. Several critical issues have been identified under this uncoordinated structure:

1. Excessive input use such as feed, fertilizer, and chemicals has led to frequent disease outbreaks and mass mortalities in farmed fish.
2. Farmers commonly use antibiotics without proper guidance, contributing to the development of antimicrobial resistance (AMR) in both aquatic animals and the surrounding environment.
3. There are no clearly defined national guidelines or legal frameworks governing the responsible use of antibiotics in

aquaculture.

4. Unauthorized individuals, lacking scientific knowledge, frequently advise farmers on antibiotic and drug use, leading to misuse.
5. Good Aquaculture Practices (GAP) are not widely understood or followed by many farmers, increasing disease risks and reducing product quality.
6. Biosecurity measures are poorly implemented and rarely monitored, making farms highly vulnerable to infectious disease outbreaks.

Public Health and Environmental Risks

The misuse of antibiotics in fish farming doesn't just affect aquatic animals, it also threatens human health (Figure 2). Residues in fish products can contribute to antimicrobial resistance (AMR), while untreated waste pollutes water bodies, harming ecosystems. In Bangladesh, bacteria from farmed fish and shrimp are becoming increasingly resistant to antibiotics such as tetracycline, ciprofloxacin, and amoxicillin, making future infections harder to treat (Hossain et al., 2018).

What is a Fisheries Council?

A National Fisheries Council would be an independent, multi-stakeholder body responsible for overseeing and guiding the sustainable development

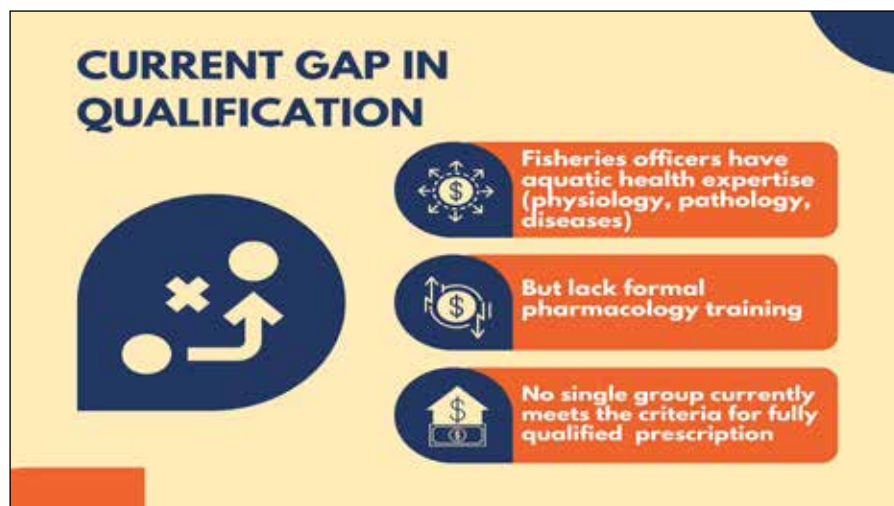


Figure 3: Current expertise and gaps in qualification of the graduates

of aquaculture and fisheries in Bangladesh. Considering the growing complexity, increasing professional demands, and evolving regulatory needs of the aquaculture sector, the establishment of a Fisheries Council is both timely and essential. This council would serve as the central professional authority for the registration, regulation, and capacity development of fisheries graduates, extension officers, and aquaculture professionals across the country. Its establishment would bring much-needed coordination and structure to the sector. The core powers and functions of the proposed Bangladesh Fisheries Council would include:

1. Registration, certification, and professional regulation of fisheries

graduates, extension officers and aquaculture professionals ensuring legal recognition of their qualifications and safeguarding their professional rights and benefits.

2. Monitoring and upgrading the quality of fisheries education, research, and services.
3. Formulating, supervising, and implementing codes of professional conduct and ethical standards for aquaculture practitioners.
4. Help to designing and reviewing the fisheries curriculum, upgrading degree standards, and developing internship and hands-on training frameworks.

5. Accrediting educational institutions offering fisheries programs based on predefined quality standards.
6. Evaluating and recognizing foreign degrees or diplomas in fisheries science for equivalence and professional acceptance in Bangladesh.
7. Organizing capacity-building programs and specialized training to improve professional skills.
8. Developing work plans for continuous professional development (CPD) of fisheries graduates.
9. Fixing registration, renewal, and service fees as required, and executing administrative functions under the framework of the law
10. Taking legal and disciplinary actions against unprofessional conduct or unethical practices in the fisheries sector.
11. Executing any other responsibilities and auxiliary functions necessary to achieve the council's objectives, as defined by applicable rules and regulations.

By institutionalizing such a council, Bangladesh can build a more professional, ethical, and accountable aquaculture and fisheries workforce. Countries such as the Philippines (PCAF),

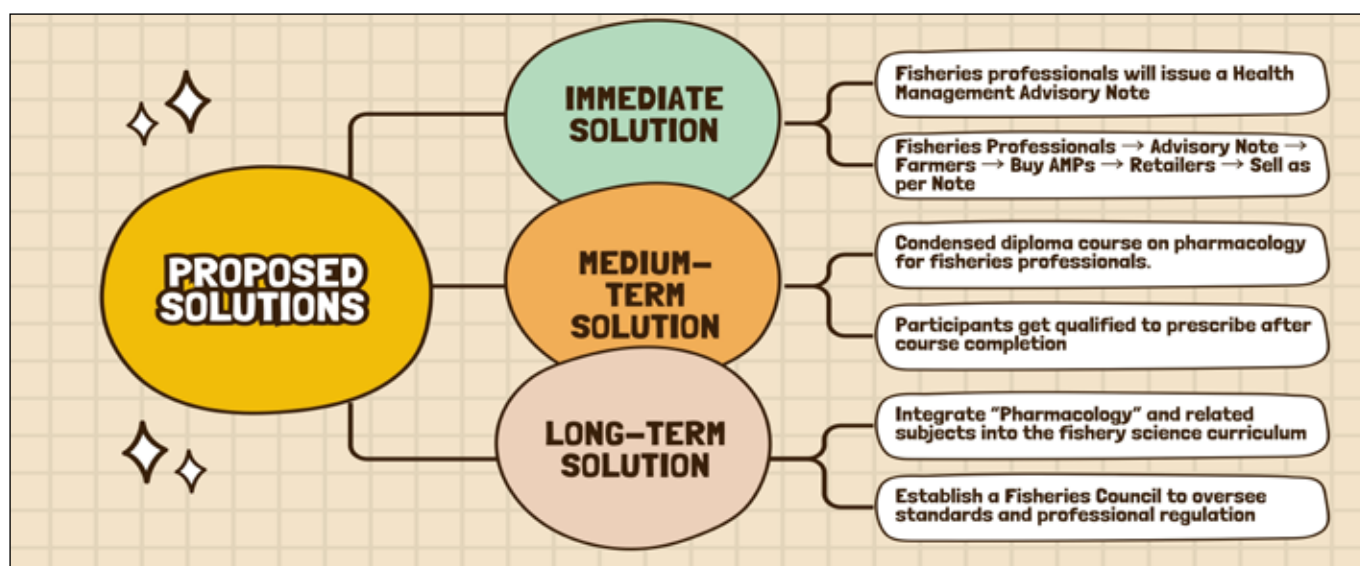


Figure 4: Proposed solution inspired by DGHS

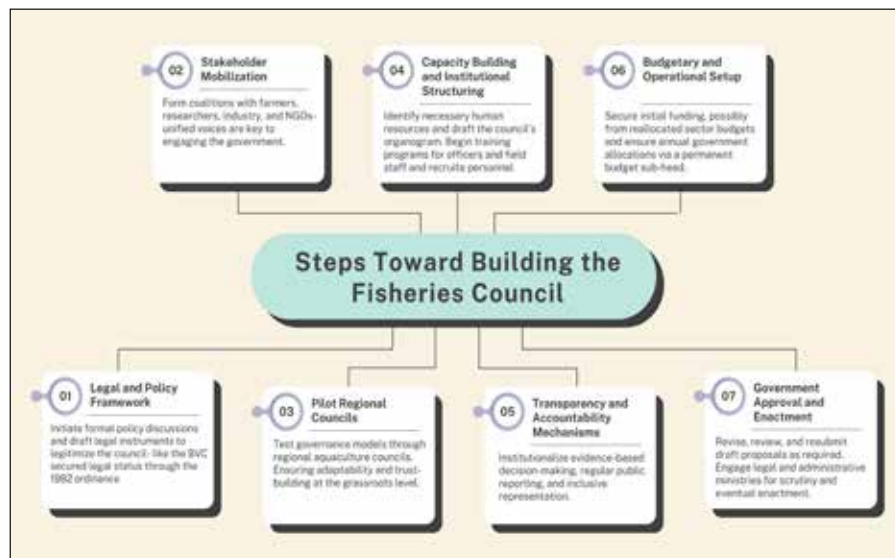


Figure 5: Stepwise roadmap for establishing Bangladesh Fisheries Council

Canada (FCC), Kenya (KeFAC), Scotland (SCF), and Norway (NSC) already operate national fisheries or aquaculture councils/boards that provide regulatory oversight and promote responsible practices. To safeguard the future of the sector, Bangladesh must now take a similar step.

Benefits of a National Fisheries Council

Establishing a National Fisheries Council in Bangladesh would bring a wide range of benefits both for the aquaculture sector and for national development. Key benefits include:

- Stronger Regulation and Professional Oversight**

The Council would standardize the registration and certification of fisheries professionals, including graduates, and extension officers. This legal recognition would ensure accountability, reduce malpractice, and protect the rights and responsibilities of practitioners nationwide.

- Effective Disease and Antibiotic Management**

Through structured training and policy oversight, the Council could reduce antibiotic misuse and promote responsible practices like probiotics and biosecurity. It would also support the establishment of diagnostic labs and monitoring systems to prevent disease

outbreaks.

- Safer Aquaculture Products**

By enforcing ethical guidelines and proper withdrawal periods, and encouraging the use of certified professionals, the Council would contribute to safer fish products free from harmful residues ensuring public health and consumer trust.

- Stronger Institutional Coordination**

Acting as a centralized body, the Council would reduce fragmentation among stakeholders. It would serve as a bridge between academia, farmers, the private sector, and government—ensuring better policy implementation, research integration, and knowledge transfer.

- Legal and Ethical Accountability**

With clear authority to monitor conduct and enforce disciplinary actions, the Council would help uphold professional ethics and reduce misinformation or exploitation by unauthorized advisors in the sector.

Core Guideline:

Aqua drugs should only be recommended by fisheries professionals or qualified personnel who are educated and experienced in aquatic animal health and disease management. While these professionals are responsible for

prescribing treatment regimens—including dosage, intervals, duration, and withdrawal periods—they often lack formal training in pharmacology (Figure 3). Currently, 17 universities in Bangladesh offer graduate degrees in fisheries science, and some have already incorporated fish pharmacology into their academic curricula. To address this gap, a phased approach is proposed, consisting of immediate, medium-term, and long-term solutions (Figure 4).

Steps Toward Building the Council

To establish a Fisheries Council, a stepwise approach is proposed (Figure 5). It includes developing a legal framework, mobilizing stakeholders, piloting regional councils, and building institutional capacity. Transparent governance, budgetary planning, and iterative government engagement are essential for formal approval and sustainable operation.

Concluding Remarks

The growth of aquaculture in Bangladesh is a national success story but its long-term sustainability depends on how well it is governed. Without coordinated oversight, the industry risks becoming a source of environmental damage, health hazards, and lost economic opportunity. The time to act is now. A National Fisheries Council can provide the leadership, structure, and strategy needed to turn Bangladesh's aquaculture sector into a global model of sustainable development.

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Ecological Role of Virophages

Mohit¹, Avneesh Singh¹, Lavish Saran¹, Litha Cerbal V², Shiwam Dubey²

¹College of Fisheries Science, Hisar, Haryana

²College of Fisheries, Mangaluru Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, Karnataka

Abstract

Virophages are a unique class of viruses that parasitize other viruses, specifically giant viruses such as mimiviruses and phycodnaviruses. These viruses, which are typically circular double-stranded DNA (dsDNA) entities, rely on the replication machinery of their host viruses to propagate. Virophages infect host cells that are already infected by a giant virus, using the viral factory of the giant virus for their own replication. First discovered in 2008 with the Sputnik virophage, this remarkable discovery has opened new avenues of research into virus-virus interactions and viral ecology. This article explores the biology, life cycle, ecological significance, and potential applications of virophages, highlighting their role in viral ecosystems and suggesting future directions for research in virology and medicine.

Keywords: Virophages, giant viruses, mimivirus, parasitism, Zoonosis and microbial ecosystems

Protect microbial hosts (e.g., algae, amoebae) from lytic viral infections.

Help maintain balance in microbial

ecosystems.

Influence nutrient cycling, especially carbon and nitrogen turnover in aquatic systems.

Contribute to the stability and productivity of marine and freshwater ecosystems.

Drive evolutionary interactions among viruses, hosts, and virophages.

Introduction of Virophage:

A virophage is a type of small virus that infects and parasitizes larger viruses, specifically giant viruses that themselves infect host cells (like amoebae). In simple terms, a virophage uses the replication machinery of a giant virus and the host cell it infects to make copies of itself, often interfering with or harming the giant virus in the process. In contrast to ordinary viruses that infiltrate host cells on their own, virophages reproduce by using the machinery of "giant viruses" such as the mimivirus (La Scola et al., 2008). The 2008 discovery of the Sputnik virophage marked the introduction of the idea of virophages into the scientific literature. An amoeba infected with the

mimivirus, one of the biggest viruses ever discovered, contained Sputnik (Desnues et al., 2008). In contrast to ordinary viruses that infiltrate host cells on their own, virophages reproduce by using the machinery of "giant viruses" such as the mimivirus. (La Scola et al., 2008).

Classification of virophage:

In terms of genome and particle size, virophages are at least as complex as members of several families of bona fide viruses with isometric capsids and dsDNA genomes, including Polyoma-, Papilloma-, Cortico-, and Tectiviridae, or podoviruses such as Bacillus virus phi29. The largest virophage genomes assembled from metagenomic datasets are comparable in size to adenoviral genomes.

Life Cycle of Virophage:

1. Entry into the Amoeba:

Sputnik virophage enters the amoeba *Acanthamoeba castellanii* in association with its predominant host, Mamavirus or Mimivirus. These large DNA viruses act as "helper viruses," facilitating the internalization of Sputnik. Upon entry, the amoeba

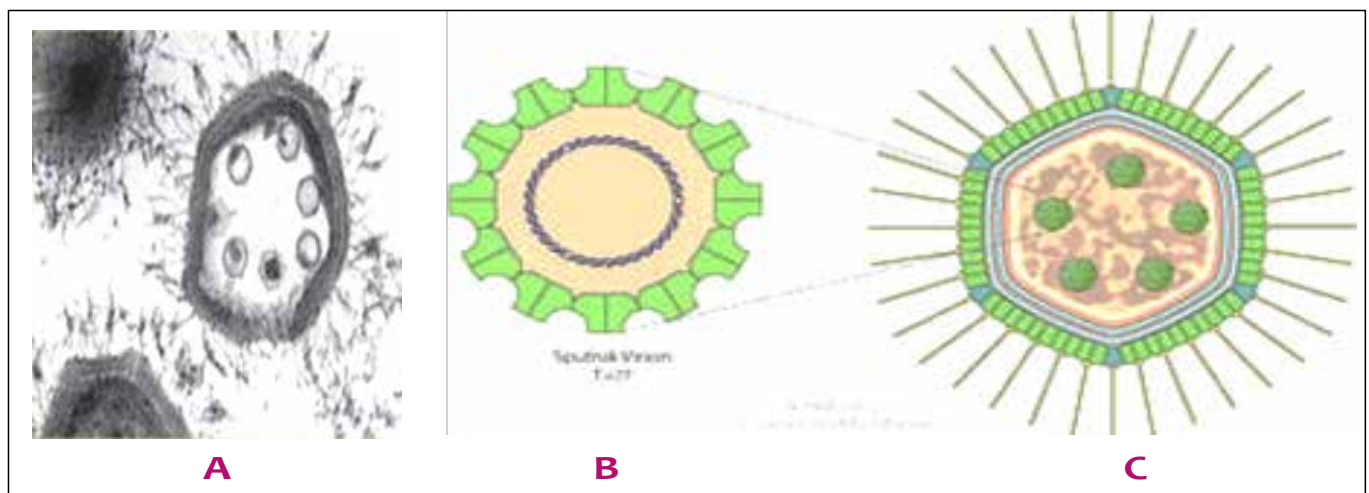


Fig. Virophage: (A) Sputnik inside the Mamavirus capsid (B) Schematic image of the virophage Sputnik and (C) its location in the Mimivirus
Source: (https://microbewiki.kenyon.edu/index.php/Sputnik_virophage).

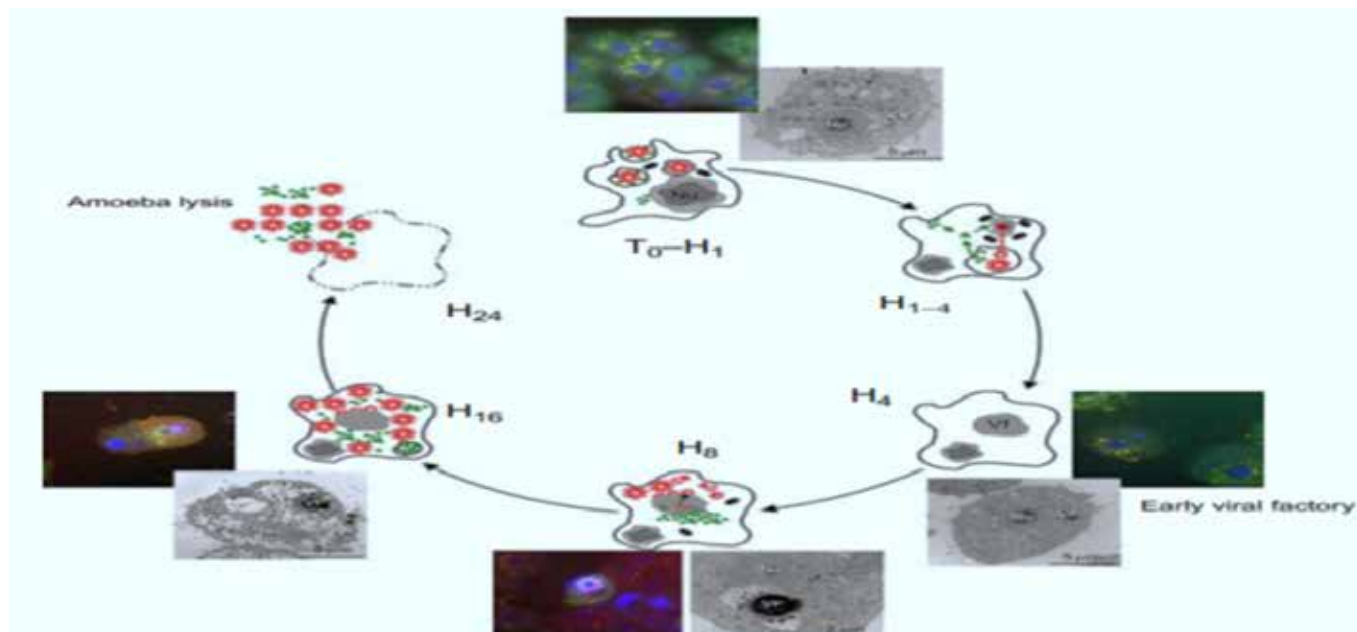


Fig: Life cycle of Mamavirus and Sputnik at T₀-H₁, H₄, H₈, H₁₆, and H₂₄. Immunofluorescence (IFF), and transmission electron microscopy (TEM) images are shown. Viral factory (Vf) and nucleus (Nu) are indicated. **Source:** (Desnues and Raoult, 2010).

phagocytoses the viral particles into vacuoles, where the Mimivirus or Mamavirus establishes its viral factory (La Scola et al., 2008).

2. Virophage Hijacking of the Viral Factory:

After entry, the host Mimivirus or Mamavirus begins constructing its viral factory, a specialized cytoplasmic site for replication and assembly of its progeny. Sputnik hijacks this machinery, using it for its own replication. This process interferes with the helper virus's replication and assembly, reducing its progeny yield and virulence (Fischer et al., 2010).

3. DNA Replication, Transcription, and Translation:

Sputnik virophage relies on the enzymes and resources provided by the viral factory to replicate its circular double-stranded DNA genome. Transcription and translation are carried out using the machinery and substrates hijacked from the Mimivirus or Mamavirus factory (Raoult et al., 2008). Sputnik genes encode proteins essential for its replication and assembly, bypassing the amoeba's own cellular machinery.

4. Assembly and Maturation:

Progeny Sputnik virions are assembled

within the viral factory of the helper virus. The capsid proteins self-assemble around the replicated Sputnik DNA, forming mature virions. This stage involves structural proteins encoded by Sputnik's genome (Yutin et al., 2013).

5. Production and Release of Progeny Virions:

Once mature, the progeny Sputnik virions are released as the amoeba lyses, coinciding with the release of Mimivirus or Mamavirus particles. This lysis results from the exhaustion of cellular resources due to viral hijacking. Notably, the presence of Sputnik reduces the fitness of the helper virus, highlighting its parasitic nature (Desnues et al., 2012).

6. Coinfection with Other Viruses:

Sputnik can coinfect *A. castellanii* along with multiple Mimivirus-like viruses, including Mamavirus. However, its efficiency and affinity vary depending on the host virus. While Sputnik's replication kinetics are similar within Mamavirus and Mimivirus, it shows a preference for Mamavirus due to higher affinity (La Scola et al., 2008).

Biological and Ecological Significance of Virophages

Virophages are small viruses that infect and impair the replication of **giant viruses** (like Mimiviruses) inside host

cells, usually amoebae. When both a virophage and a giant virus co-infect a host cell, the virophage hijacks the replication machinery provided by the giant virus to replicate itself often **reducing** the reproduction rate of the giant virus. They can protect host populations from the destructive effects of giant virus infections by **attenuating host cell lysis**. In aquatic ecosystems (oceans, lakes), virophages help regulate the **population dynamics** of giant viruses. This balance affects microbial mortality rates, nutrient cycling, and organic matter release influencing **global biogeochemical cycles** (e.g., carbon cycling).

Conclusion

Our knowledge of microbial ecosystems and viral interactions has changed dramatically since the discovery of virophages. As "viruses of viruses," virophages offer an intriguing illustration of parasitism in the viral realm. In addition to upending established virus-host dynamics, their reliance on big viruses for reproduction adds significant complexity to viral ecology and evolution. Future studies must concentrate on comprehending the complex relationships that exist between large viruses, virophages, and their eukaryotic hosts.

Tiger Shrimp-Brackishwater Finfish-Mangrove Polyculture in Mitigation of Climate Change-induced Coastal Flooding

Subrato Ghosh; Kolkata, West Bengal; Email: subratoffa@gmail.com

HIGHLIGHTS:

Since 2001, often questions are raised against increasing trend of illegal & unregulated shrimp cultivation and conversion of mangrove areas to commercial shrimp farms in coastal regions (Blocks) of West Bengal, Odisha and Andhra Pradesh. Recently emphasis is given on preserving and restoring mangrove habitat and its protection. Integrated Mangrove Aquaculture (IMA), with shrimp and mangrove trees existing and growing in the same time and place, is an environment-friendly idea put into reality having beneficial impact. It is a novel initiative taken

by Kolkata-based NGOs in North 24 Parganas district near to Sundarbans region since 2019. Observations on management practices followed at chemical-free IMA sites of progressive brackishwater aquaculturists by profession Sri Pintu Kumar Das and Sri Saheb Ali Mondal are presented in this write-up, compiled on World Mangrove Day 26/07/2025, emphasizing on commendable work done by Sri Mondal on promoting organic shrimp production. Conversation was made in great detail with both persons at their farm site on 24/05/2025.



Author with Sri Pintu Kr. Das

Integrated Mangrove Aquaculture – a novel approach

Integrated Mangrove Aquaculture (IMA) is the practice of farming of *P. monodon* and brackishwater finfishes in integrated way (i.e., in polyculture system) in the presence of mangrove trees sown on inner side of pond embankments around same IMA farm and periphery of aquaculture water bodies. When leaves (thicker than normal terrestrial plants) shed from grown-up mangrove trees, it falls over water body, decompose and form detritus ('leaf litter'; organic matter produced by decomposition of leaves) – thereby increase fertility of water by providing more nutrients. In this practice, water in IMA plots remain in good and purified condition, leaves of the plants are thick and don't pollute the water. Mangrove trees play an important role in capturing and storing carbon dioxide from atmosphere, which helps in reducing greenhouse gas concentration - thereby mitigate the effects of global warming.

Since year 2019, IMA technology has been started in brackishwater aquaculture areas at Minakhan, Joygram and Chaitalhat villages in Minakhan Block, and Andulpota and Sadiknagar villages in Basirhat-2 Block in North 24 Parganas. In the context of cyclonic storms 'Aila' (May 25, 2009), 'Amphan' (May 19-20, 2020), 'Bulbul' (November 9-10, 2019), 'Yash' (May 25-26, 2021) and spring tides affecting the areas located in close vicinity of Indian Sundarbans, mangrove trees play a significant

role. Intensity of such storms in North and South 24 Parganas districts is expected to increase in days to come. Root system of mangrove trees help to stabilize the embankment soil of brackishwater aquaculture plots and serves as natural barrier against severe storm, thereby preventing significant loss of brackishwater aquaculture crops during adverse climatic conditions. As embankment on four sides is strengthened, its erosion is prevented during incidences of supercyclone,



Part of IMA plot of Sri Mondal

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Sri Mondal in a Seminar at Hyderabad



A foreign expert at Sri Mondal's farm



Author with Sri Saheb Ali Mondal

flood and climate change-induced (environmental) disasters.

As climate-adaptive modified-extensive brackishwater aquaculture technology, IMA Project is implemented at farm sites of some progressive brackishwater fish farmers (as beneficiaries) in North 24 Parganas, West Bengal by reputed non-Government scientific organizations namely Nature Environment and Wildlife Society (NEWS), Kolkata; Sustainable Aquaculture in Mangrove Ecosystem (SAIME), an initiative of NEWS; Global Nature Fund (GNF); Blue Sea Aquaculture Private Limited; Naturland; Bangladesh Environment and Development Society (BEDS). Sri Sourabh Kumar Dubey and three co-authors have described the strategy and concept of IMA in their article 'A pilot of integrated mangrove

aquaculture as a nature-based solution to mitigate climate change in West Bengal', published in Vol. 26 No. 4 (Year 2022) of Aquaculture Asia magazine.

My field observations on IMA

During June and July 2022 and May 2023, I had visited farm sites of four beneficiaries under IMA Project; they are: 1) Sri Achintya Mondal, Vill. Minakhan, Minakhan Gram Panchayat (GP), Minakhan Block (Area: 1.04 hectare, water depth 0.9m); 2) Sri Sankar Baj, Vill. Joygram, Minakhan GP, Minakhan Block (Area: 1.15 hectare, water depth 0.9-1.4m; both doing IMA since June 2022); 3) Sri Pintu Kr. Das, Vill. Chaitalhat, Chaital GP, Minakhan Block; 4) Sri Saheb Ali Mondal, Vill. Andulpota, Rajendrapur GP, Basirhat-2 Block (near to Basirhat town). My aim was to know the present state-of-art

and steps of management of IMA from progressive and experienced brackishwater fish farmers who are practicing IMA with financial and technical support of NEWS and other organizations, and know the benefits of IMA strategy for mitigating the impact of climate change-induced disaster (in the form breaching of embankments and saline water intrusion in brackishwater aquaculture plots during incidences of intense storm & supercyclone, accompanied by spring tide and flooding).

I presented my observations concerning the management practices followed at IMA sites of Sri Achintya Mondal and Sri Sankar Baj in my article 'Present status of medium-saline bheri fishery and integrated mangrove aquaculture in West Bengal: a short study Part-2', published in Vol. 27 No. 2 (Year 2023) of Aquaculture Asia magazine.

Commercially-important finfish, shellfish and mangrove species cultured and produced in well-maintained IMA plots

The finfish and shellfish species include *Liza parsia*, *Liza macrolepis*, *Liza tade*, *Macrobrachium rosenbergii*, *P. monodon*, sex-reversed all-male *Tilapia nilotica*, *Lates calcarifer* (seldom used), *Metapenaeus monoceros*, *Metapenaeus brevicornis*, *Mystus gulio*. For the first seven species, riverine and hatchery-produced seeds are procured and stocked in IMA plots. For the last three species, auto-stocking occurs, along with tidal river water of Bidyadhari and Ichhamoti. The mangrove plants planted and grown



Another species of mangrove tree



Sri Mondal with scientists from MPEDA

in IMA plots include *Rhizophora apiculata* ('gorjon'), *Heritiera fomes* ('sundori'), *Sonneratia apetala* ('keora'), *Nypa fruticans* ('golpata'), *Avicennia* sp ('Baeen'; three species), *Xylocarpus granatum* ('dhudhul'), *Bruguiera gymnorhiza* ('kankra').

IMA farmer Sri Pintu Kumar Das

Sri Das's IMA plot is 1.60 hectare in effective water area, water depth 0.9-1.2m; he is doing IMA since June 2022. He does *P. monodon* stocking from December-January every year, 20mm size seeds that costs Rs 3000-4000 / 10000nos, stocking density 1000nos / 0.13ha. These are first stocked in small earthen chambers inside plot, size gained 5-6cm in 20-25 days, thereafter it enters into main plot. Newly-bought seeds stocked again after 21 days, done 3-4 times every year. Size becomes 25-35g in 90-110 days, harvesting begins from 90th day during full moon and new moon period.

L. parsia seed stocking is done by him during January to April, 10000-12000nos in 1 kg, costing Rs 3000-4000 / kg, total 3kg stocked in plot.



Mangrove tree at Sri Das's IMA farm



Sri Mondal and an aquaculture expert from Romania

Harvesting done during October to December, 40-50g in size (20-25 nos / kg). *L. tade* seeds 72-84mm at stocking, total 1000nos, Rs 8 / piece. Marketable-sized ones harvested in December at 500-700g body weight. Milkfish *Chanos chanos* seed size 1-2cm, brought from Chennai and stocked. Harvesting done at advanced fry stage, 60-90mm, supplied to interested grow-out fish farmers in nearby region. *M. rosenbergii* PL stocking done in May-June, 24-36mm size, total 2000nos stocked, that costs Rs 500-600 / 1000nos. Harvesting done in December after dewatering the plot when it is allowed to dry, at 50-60g size. Indian major carp fingerlings 100-200g size, stocked only in small numbers in June-July with onset of rainfall - harvested in next 3-4 months at 600-700g weight. Sri Das's mangrove plants are in good condition, have attained good height, and will grow further.

IMA farmer Sri Saheb Ali Mondal

Sri Mondal's IMA plot at Andulpota is 27 hectare in area, water depth 0.9-1.2m, involved in brackishwater aquaculture since 2010. He is doing IMA since June 2019 in two large brackishwater plots each at Basirhat-2 Block and Haroa Block, total 40 hectare. He is Leader of both Andulpota Brackishwater Fish Production Group and Andulpota Aqua-Farmers Welfare Society. In July 2021, food and relief materials were provided by him to villagers who were badly affected due to Yash supercyclone that hit the region. He is doing farming of *L. parsia*, *L. tade*, *L. macrolepis*, *M. gulio*, *L. calcarifer*, *M. gulio*, *M. monoceros*, *M. brevicornis* and



Sri Pintu Kumar Das at his IMA Plot

M. rosenbergii. Sri Saheb Ali Mondal is the first person in West Bengal to initiate brackishwater aquaculture in association with mangrove trees with NGO support; slowly and steadily encouraging and guiding many other farmers to do the same. He is the first person in India to get license from MPEDA, Govt of India on production and export of organic *P. monodon*.

Aquaculture experts and representatives from Government of West Bengal, Government of India and eight countries of the world have visited his farm site. He has taken initiative in spreading (among villagers in general) the importance of mangrove trees to human health and welfare, have acquainted common people with the grown-up trees, their identification and important features. Mangrove saplings, planted on embankments of his fish farm in 2018-2019, have now become fully grown trees.

Important features of IMA practiced in North 24 Parganas district



Mangrove tree on embankment



Another species of mangrove sapling

1. Mangrove leaf litter, benthic algae, periphyton growth over submerged aquatic weeds and over portion of pneumatophores below water level serve as natural food matter (basic food) for growing shrimp and finfishes.
2. Low density stocking of *P. monodon* and finfishes is maintained - no incidences of viral diseases observed.
3. It is an 'Organic' approach of aquafarming - use of commercial fertilizers, antibiotics, chemical compounds and commercially-available formulated feed is completely avoided.
4. Farmers believe that if unfortunately production of *P. monodon* goes down unexpectedly due to diseases, production and sale of marketable-sized healthy finfishes and *M. rosenbergii* produced will compensate for the loss.
5. IMA practices aim to support the restoration of mangrove ecosystems.
6. Total 37 farmers in Minakhan Block (35 in Chaitalhat, 1 each at Joygram and Minakhan villages) and 2 farmers in Basirhat-2 Block are doing IMA with technical and financial (partly) support of NGOs.
7. NGO representatives analyze and monitor essential water quality parameters in IMA water bodies of beneficiaries like Sri Das, Sri Mondal and others; growth of mangrove trees and carbon sequestration measure are also estimated.
8. Blue nylon net and split bamboo fencing set up around every IMA plot all along upto 1mt height to prevent entry of cattle and goats.
9. In the years 2019 and 2022, mangrove saplings 30-60cm in height (4-10 months old) have been planted on inner sides of embankments of IMA water bodies.
10. Farm-made feed prepared for growing finfishes and shrimps using locally-available plant- and animal-based ingredients.
11. On-site meetings are organized every month between IMA farmers and Project personnel.
12. Coastal flooding near to Sundarbans region that cause breaching of pond embankments, introduction of unwanted fish species, worsening of water quality – all are checked and do not take place in IMA plots of Sri Das and Sri Mondal.
13. For the IMA farmers, embankment repairment cost is saved at the beginning of every year due to plantation of mangrove saplings done 3-5 years back.

These have now grown up (also with strong root system deep into embankment soil) with advancement of time.

14. Leaves of palm and date palm trees are placed over bottom soil, upon which periphyton is produced and also benthic algae – it is used by growing shrimps as natural food source. These grow depending only on natural food produced by and over submerged aquatic weeds ('jhanjhee' in local dialect).

Other aspects of management practices

There is a growing interest on 'chemical free' fish and shrimp farming practice among farmers, who keep faith on organic-based fish farming - a new version of fish farming initiated at Basirhat Sub Division of North 24 Parganas district. There is no use of commercially-available pelleted finfish or *P. monodon* feed. Fish farmers in this region are determined to continue organic fish farming to save next generation and secure healthy fish for them. The main organic produce is *P. monodon*. Brackishwater polyculture is practiced comprising mullets, *M. gulo*, *L. calcarifer* and giant freshwater prawn. Importance given on natural fish food production in water body in organic method to enhance plankton production, pre-stocking water body management.

Organic shrimps produced by Sri Mondal got a good standard and value in importing countries. Presently its selling price is Rs 600-800 / kg in local markets, but it is almost double (Rs 1500 / kg) in European Union and USA markets. It is beneficial and caused improvement in lives and livelihood of both brackishwater finfish and shrimp farmers as well as land owners (from whom Sri Das, Sri Mondal and others have taken the plot on lease for IMA). Application of fermented mohua oil cake *Basia latifolia* (for 16-18 days) and/or mustard oil cake before seed stocking helps in enriching planktonic population in water body. Lime is applied to build up Calcium in bottom

soil. Taste of such marketable-sized finfishes and *P. monodon* is excellent, also investment cost/cost of production is reduced on the part of farmers. IMA is an environment-friendly approach and sustainable means of brackishwater finfish and shrimp farming. Dense periphyton growth occurs over submerged-type soft aquatic weeds, fed by growing fishes.

Sri Mondal's vast IMA plots in close vicinity of Sundarbans region is popular as 'mini-Sundarbans' to many people in Basirhat Sub-division including Andulpota village. It is a scenic beauty for nature lovers; a pollution-free, clean and quiet environment that exhibits Sri Mondal's love and care for nature. His initiative is unique that provokes curiosity to visitors - embankments of *P. monodon*-cum-brackishwater finfish farming water bodies beautified with fifteen species of big mangrove trees. Mustard oil cake is applied in IMA water bodies after 4 days of application of lime, before seed stocking. Thus, macro-algae like food matter is produced on the 15th day. Good quality of bottom soil maintained, environmental balance is secured.

In June 2024, team of experts from Romania and representatives of companies (related to shrimp industry) from farmed *P. monodon* importing countries have visited Sri Mondal's IMA plots at Basirhat-2 and Haroa Blocks to have a review of the farmers' practice of chemical-free brackishwater aquafarming. They have examined the quality of *P. monodon* harvested from Sri Mondal's IMA plots, plankton density, important water and soil quality parameters, finfish and *P. monodon* harvesting methods. It will encourage Sri Mondal and associated brackishwater farmers to produce more for export.

Here, a mangrove-based environment created for sustainable *P. monodon* farming. At low stocking density, *L. parsia* is harvested by Sri Mondal at 40-80g size (riverine seeds, 5000-5500nos / kg at stocking), *L. tade* 350-800g (2.0-2.5 inch at stocking),

giant freshwater prawn 60-150g with pond-bred seeds brought from Purba Medinipur, harvest begins from August-September. *P. monodon* seed stocking done by him first in November-December, continues at 15-18 days interval; first harvest done in early-March. *P. monodon* 13-15 PL stocked first in nurseries, then reared in grow-out water bodies. Seeds brought from hatcheries in Chennai, Vizag, Odisha. The mullets and *M. gulio* exhibit slow growth, requires long culture duration and longer time for harvest.

End note

Presence of macroalgae and scattered thick masses of submerged green aquatic weeds with soft stems and small leaves, *Najas graminea* and *Ceratophyllum demersum* are important in such extended brackishwater polyculture plots near the periphery and in the shallow regions, Sri Mondal stated. These prevent dissolved oxygen scarcity in water, absorb dirt and pollutants from water body through their roots and stems, and provide food and shelter for growing finfishes and shrimp. These are allowed to grow in low water column before stocking seeds. Mulletts are herbivorous in their food and feeding habit. At the end of one year, dewatering is done in IMA plots and black topsoil is scrapped off at the areas of water body where shedding of mangrove leaves has occurred excessively. Mangrove trees give 100% pure oxygen. Good quality jaggery may be produced from *Nypa fruticans*; pickle good in taste and concentrated liquid (edible juice) from *Sonneratia apetala* or 'Guti keora' tree.

The most important mangrove species *Heritiera fomes* grows upto 10-12 feet height in normal high saline conditions of Indian Sundarbans region, but found to grow to 22-23 feet tall at IMA plot of Sri Mondal, which is a semi-saline region. The other commercially-important brackishwater shrimp *Litopenaeus vannamei* cannot be produced organically because it depends only on commercially available pelleted feed. It is not stocked in IMA

plots. Sri Mondal aims to provoke consciousness among villagers about mangrove trees, create 'plastic-free' village, has sown mangrove saplings on his own in addition to that provided to him from the Project. He has visited many parts of India, in Bangladesh and Vietnam (twice each) and once to USA. Natural breeding of the brackishwater catfish *M. gulio* had occurred in favourable conditions in his IMA plots. He participated in National-level conferences organized by MPEDA, NFDB. In November 2022, MPEDA conducted its demonstration on giant prawn culture at Sri Mondal's farm.

Previously there occurred transformation and conversion of some mangrove forest areas to shrimp aquaculture areas (ponds constructed) in or near to Indian Sundarbans region, which gave rise to certain unpleasing issues, environmental concern, socio-economic conflicts. The mangrove trees at Basirhat-2 and Haroa Blocks in North 24 Parganas are nurtured and used to cultivate organic shrimp in the IMA farms. Mangrove trees are not cleared for shrimp farming; instead it is done in association with it. The mangrove ecosystem of Sundarbans is restored in this process, and 'brackishwater polyculture of shrimp combined with finfishes' is continued. On 01/11/2018, a team from USA along with senior officers from MPEDA visited Sri Mondal's IMA sites to see the management system, water bodies and the traps for harvest of *P. monodon*. Seeds are stocked 7-8 times in a year, harvested when high tide sets in; marketable-sized ones moves in opposite direction and caught in split bamboo traps placed underneath water surface and over bottom soil. IMA practice corroborates with a recommendation of 13th Indian Fisheries & Aquaculture Forum held in February 2024 that environmental degradation in fish/shrimp production systems needs to be critically addressed through modifications in culture practices. Author gratefully acknowledges the help received from Sri Milan Sinha, Fishery & Aquaculture Expert, NEWS, Kolkata.

Monsoon Management in Shrimp Farming:

A Comprehensive Guide for Indian Farmers

Ramachandran Elamparathy, Technical Head (Aqua), Skretting India

Monsoons challenge shrimp farmers with unpredictable conditions that demand timely and proactive farm management. From strengthening pond bunds and improving drainage systems to optimizing water parameters and adjusting feeding strategies, each step plays a crucial role in building a resilient and effective monsoon management plan.

Understanding India's Monsoon Patterns:

In India there are two different monsoon seasons affecting various part of the country.

- **Southwest monsoon** (June-September) begins over the Arabian sea near Lakshadweep and moves towards Kerala and other northern states of India. It brings rainfall to most parts of India except in some parts of Tamil Nadu and southern Andhra Pradesh.
- **Northeast monsoon** (October-December) brings most of the rainfall to Tamil Nadu and southern Andhra Pradesh, mainly due to cold northeastern winds and cyclones in the Bay of Bengal.

Timely tracking of monsoon forecasts through news channels or other media is essential for shrimp farmers to take necessary precautionary measures. Based on the seasonal

patterns, farmers should plan and prepare their shrimp crops carefully to minimize the risk of contamination and disease. The monsoon impacts the pond environment physically, chemically, and biologically affecting the soil, water quality, and the health of shrimp and fish.

Precautionary Measures for Shrimp Farming During Monsoon:

1. Strengthening of pond bunds/ Dykes:

Before the onset of monsoon, the pond bunds should be strengthened, especially in loose soil and low-lying areas. Addition of sandbags in the weaker portion of the dykes and the peripheral bunds bordering canals, river systems or sea areas should be done to strengthen the bunds so that the bunds are not washed away in rain or overflowing water or floods.

2. Pond preparation:

If stocking is planned during the monsoon, wet pond preparation method is recommended.

Flushing the pond bottom with water through powerful hoses and dragging the pond bottom manually with wooden planks to remove bottom sediments.

- Apply agriculture lime (calcium carbonate) at 2000 kg/ha to pond bottom before pond filling.
- In case the pond was in earlier crop affected with EHP then application of calcium oxide at 4000-6000 kg/ha to increase pH of soil and kill the EHP carriers is essential.

3. Reservoir and water treatment:

The pond shall be filled with water after completion of drying, manuring, liming of pond bottom.

- If using creek or seawater, then it shall be treated with 60% active chlorine (bleaching powder) at 300 kg/ha or if 30% active chlorine at 600 kg/ha.
- In case of bore water apply 10 ppm chlorine.

The chlorine in any form shall be applied after 72 hours of water filling to allow any spores to germinate and



larvae shall be killed in the water after treatment. After chlorination, water should be left for dichlorination for 72 hours. In shrimp farming 20 to 30% of the area or ponds shall be allocated as reservoir to maintain good supply of treated water.

4. Strengthen biosecurity:

The biosecurity of the farm mainly crab fencing, bird fencing and killing of any crabs inside the pond dikes or bottom are necessary to prevent horizontal transmission of diseases.

5. Water quality maintenance:

- The rainwater is acidic and less dense in nature, which makes it float in the top layers of water column of pond water which is normally saline and dense. Hence top water draining, continuous running of aerators to mix the water along with oxygen and application of lime 40-60 kg/ha helps to maintain temperature, salinity, oxygen and pH of the pond water during raining periods.
 - Application of **AquaCare Mineral Balance** which provides complete mineral solution to shrimp, after soaking at 10 to 15 kg/acre during the rainy period. It provides good osmoregulation to shrimp in these fluctuating periods of salinity.
 - Temperature tends to become low on continuous cloudy, rainy days, hence operate aerators to manage temperature.
 - Increase in suspended solids due to erosion of soil particles along with aeration will cause plankton crashes and water becomes turbid in rainy situations. Hence the application of lime, magnesium, and potassium are essential for pond water.
- #### 6. Regulation of water depth:
- The water level may increase during incessant rains and there is always a chance of an overflow of pond water in some low-lying areas. If such potential danger is there then the surface water shall be periodically removed through drainpipes on the top portion of

the bund but many shrimp ponds do not have a bottom and top outlet nowadays, putting their culture at risk.

7. Feed Management:

Low temperature situation results in low metabolic rate in shrimps causing low digestion rate taking more time for digestion. Hence reduce feeding during rainy days. Mixing probiotics like **Santron** in feed helps to improve feeding.

8. Improving shrimp immunity:

- Providing **Relaxx** at 4 g/kg feed to improve immunity should be done to prevent outbreak of diseases.
- Probiotic applications in water can be made on sunny days only as it will demand more oxygen for bacteria, ultimately decreasing DO levels in ponds.
- Daily observation of shrimp for health conditions via check tray observation is essential.
- Prevent usage of chemicals in pond

water during rainy and cloudy days as it would cause further crash of plankton and DO problems.

9. Disease outbreak situation:

If there are any severe outbreaks of diseases like white spot virus then it's always better to harvest the shrimp otherwise mass mortality may occur during rainy season. In the case of Monodon farms during rainy season black or brown gill problems of choked gills will occur due to fungus and hence proper maintenance of pond bottom is essential.

Summary:

While monsoons are unavoidable, their effect on shrimp farming can be greatly lessened with proper planning and timely actions. By strengthening infrastructure, maintaining water quality, adjusting management practices, and focusing on animal health, Indian shrimp farmers can successfully handle the challenges of the monsoon and achieve stable, productive farming results.

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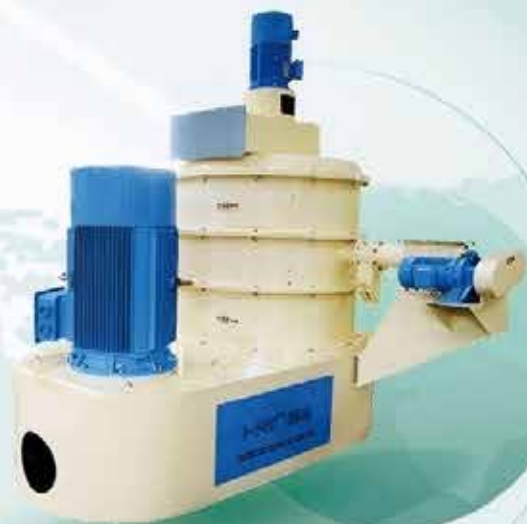
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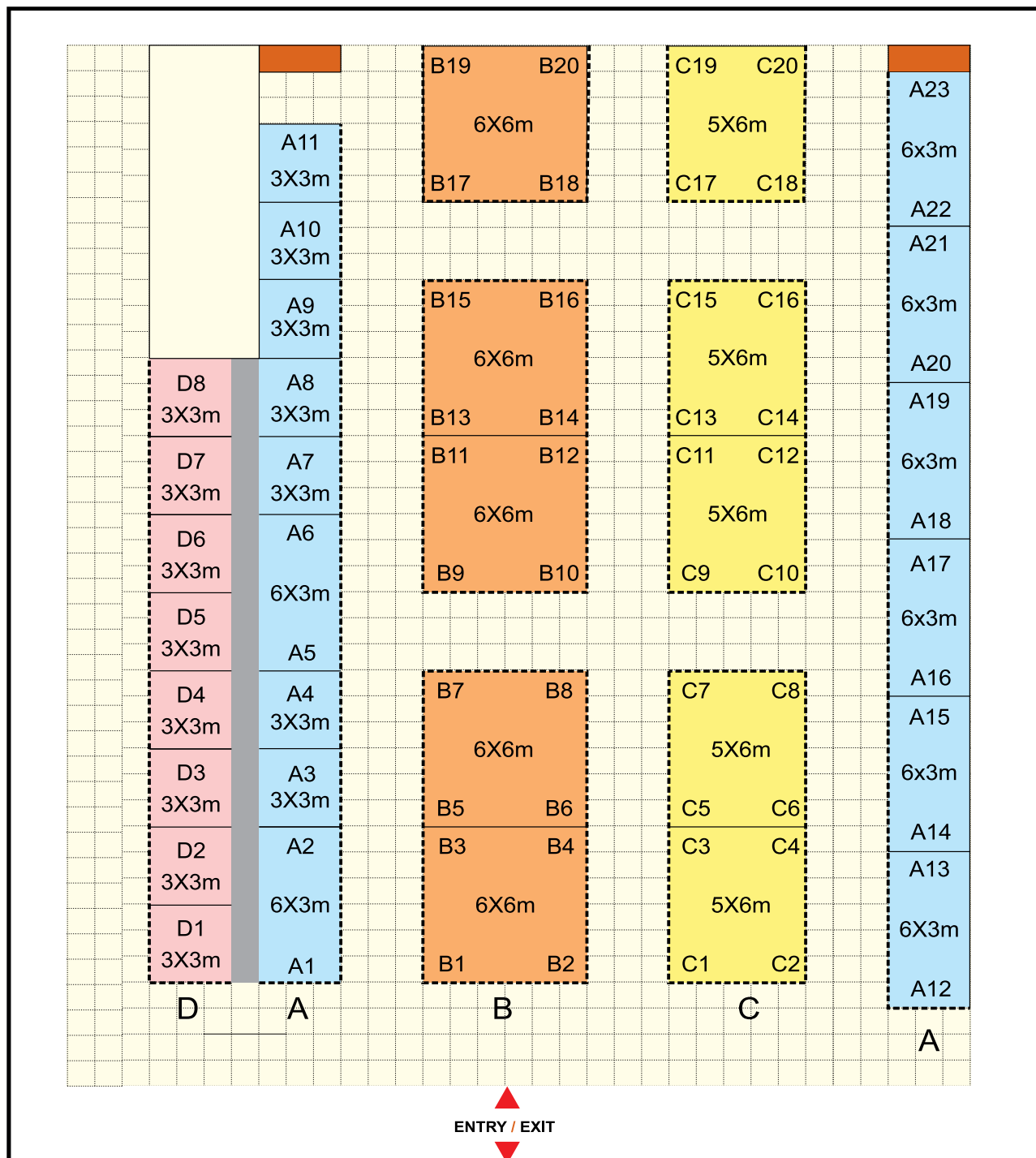
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