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Inside ...

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Budget 2025-26: Govt boosts fisheries sector with focus on Islands

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Freshwater fisheries are highly dependent on controlled environments like ponds, reservoirs and tanks. Although, fisheries are a major contributor to employment generation, changing climate patterns are disrupting breeding cycles and increasing disease outbreaks in farmed fish, putting the livelihoods of people associated with fisheries at risk.

Dear Readers,

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

Budget 2025-26: Govt boosts fisheries sector with focus on Islands – Experts believe the development of deep-sea fisheries, particularly mesopelagic resources, could transform the seafood industry and benefit coastal communities. Aimed at strengthening the fisheries sector and unlocking its untapped potential, the Union Finance Minister, Nirmala Sitaraman, has announced plans to strengthen the sector with a special focus on the Andaman & Nicobar and Lakshadweep Islands. Grinson George, Director of the Central Marine Fisheries Research Institute (CMFRI) said, efforts to create an enabling framework for harvesting marine resources in the EEZ and high seas are expected to boost India's blue economy, giving a fillip to sustainable utilisation of off-shore fisheries potential. India's EEZ offers a significant opportunity for increased sustainable fishing. While current fishing activity primarily concentrates within the 12-nautical-mile territorial waters, vast underutilised resources exist beyond this limit. "Our fishing is small-scale or subsistent based. The estimated harvestable potential in the EEZ is 7.1 million tonnes. But, we are presently harvesting close to 4 million tonnes, which indicates substantial scope for expansion into deep sea. There is a possibility of utilising another 2 million tonnes of resources from the deep sea," he said.

Scientists of Rajiv Gandhi Centre for Aquaculture (RGCA), a research wing of Marine Products Export Development Authority (MPEDA), have arranged a mobile laboratory that visits aquaculture ponds to detect diseases and help farmers by suggesting remedial measures. According to MPEDA officials, the laboratory would conduct various tests like water quality analysis, PCR analysis and for detection of viruses and bacteria at the ponds. RGCA Director S. Kandan stated that the aim of arranging '**lab at pond**' is to reach aqua farmers at ponds, diagnose diseases and give them advice on the spot.

Centre issues guidelines on solid waste management in aquaculture units. The regulations impose a ban on burning of plastic. The Centre has introduced new guidelines for solid waste management in coastal aquaculture units to promote sustainable practices in aquaculture sector. These instructions delineate protocols spanning from waste handling to prohibiting its burning. The Ministry of Fisheries, Animal Husbandry and Dairying published the regulations on March 16, which advocate reducing and managing waste across all stages of production, including hatcheries, farms and breeding centres. The guidelines aim to minimise waste generation and ensure its responsible disposal. This comes amid growing concerns over the environmental impact of coastal aquaculture, which can contribute to rising levels of pollution if not managed effectively. According to a report by The Energy and Resources Institute (TERI), India produces over 62 million tonnes of waste in a year. Only 43 million tonnes of the total generated waste gets collected, with 12

Contd on next page

NRS GROUP
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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million tonnes being treated before disposal, and the remaining 31 million tonnes discarded in waste yards.

Tamil Fishermen who helped the National Bureau of Fish Genetic Resources in identifying the species wanted it named after Tamil Nadu. Researchers at the National Bureau of Fish Genetic Resources functioning under the Indian Council of Agricultural Research, have discovered a new species of Congrid eel and named it after Tamil. The species, belonging to the genus Ariosoma, was found off the Thoothukudi coast and was named tamilicum, "with reference to the world's oldest language, Tamil", said T.T. Ajith Kumar, Director (acting) of ICAR-NBFGR. "The fishermen who helped us in finding the eel requested that it be named after the State. It was then decided to name it after Tamil, the oldest language in the world. The name was also approved by international reviewers," he said. Scientists from NBFGR are working in waterbodies off northeast Lakshadweep to explore the poorly studied fish group called Anguilligormes.

Mass Fish deaths in historic Mansar Lake spark concerns over ecological imbalance. A recent mass fish die-off in the historic Mansar Lake has drawn attention to the fragile interplay between human activities and natural ecosystems. This recurring tra gedy, now exacerbated, underscores the urgent need for collective and sustained action by authorities, environmental experts, and the local community. Mansar Lake, renowned for its religious and cultural significance, is a vital resource supporting diverse aquatic life and providing drinking water to nearby communities. However, the mass deaths of fish have sparked alarm over potential water contamination and the spread of waterborne diseases, posing threats to public health and ecological stability. Investigations Highlight Causes A study by the Fisheries Department of Sher-e-Kashmir Agricultural Science University last year identified oxygen depletion as the primary cause of fish mortality.

Minister for MSMES, Rural Poverty Alleviation and NRI Empowerment Kondapalli Srinivas has emphasised the need for enhancing the earnings of Self-Help Group members and Farmer Producer Organisations by adding value to their products. He received proposals from various organisations on value additions and income enhancement for farmers' produce. During a review meeting held at his office in the Secretariat's Block-5 recently, the Minister discussed potential strategies with officials from the Society for Elimination of Rural Poverty and representatives from Farmveda, Millet Bank, Capital Management Services and Flipkart.

In the Articles section, article titled **"Spotted Scat Fish (Scatophagus Argus): A Potential Species for Brackishwater Aquaculture and Aquarium Trade"**, authored by E. Suresh, N. Kalaiselv and N. Hemamalini, Scatophagusargus, known as "spotted scat," is prized in both aquarium trade and culinary spheres across South and Southeast Asia. Inhabiting a diverse range of waters, from freshwater to estuarine environments, S. argus demonstrates adaptability and resilience. Challenges to its aquaculture include a slow growth rate, prompting research into growth enhancement methods and polyculture strategies. Despite ongoing efforts, commercial cultivation of S. argus remains limited, signalling the need for further advancements in the field.

Another article titled, **"The superfood of the Century: Fish for Health, Hunger & Sustainability"** authored by Bonika Pant, Neeraj Pathak and Sunil Prajapati, Fish is regarded as the superfood of the 21st century as it is rich in essential nutrients such as omega-3 fatty acids, high-quality proteins and various vitamins that are vital in combating hunger. Economical aquatic foods, such as small pelagic fish, are low-cost yet essential sources of protein and micronutrients for underserved populations. Sustainable fisheries are consistent with SDG 2 (Zero Hunger) and SDG 14 (Life Below Water), while contributing to the enhancement of the ecosystem's health. The fisheries sector strengthens rural economies and employment through production, export and processed products. PMMSY has set a vision to double fish production by 2024-25 through progressive research, innovation and sustainable practices in fisheries.

Another article titled, **"Genetic Improvement of Fishes: A Comprehensive Overview"**, authored by Dr Aman Divakar said that in India, Genetic en hancement or improvement became a keystone for increasing production, sustainability and disease resistance in growing fish populations in modern aquaculture. The infusion of selective breeding and modern biotechnological techniques gave fish production desirable characteristics like higher growth rate, enhanced feed efficiency and advanced disease resistance. In the current scenario, Seafood demand grows worldwide and genetic improvement plays an important role in ensuring food security and sustainable aquaculture methods. This article evaluates the methodology, advantages, issues and various possibilities for the genetic improvement of fishes. Key Traits Targeted in Genetic Improvement Advanced Genetic Techniques, Benefits of Genetic Improvement, Ethical and Ecological Challenges, Future Directions in Fish Genetics.

Another article titled, **"Climate Change & Fisheries: The Silent Crisis Threatening India's Blue Economy"**, authored by Mr Amit Saraogi, Managing Director, Anmol Feeds & Founder – PrraniGanga discussed that India is the world's second-largest producer of fish with an annual production of more than 17 million tonnes. With Andhra Pradesh at the forefront, a large percentage of this production comes from freshwater aquaculture. In 2022-23, Andhra Pradesh contributed to almost 40.9% of the total fish production in the country with 4.5 million metric tonnes of fish. West Bengal ranked second with roughly 12.58%, amounting to 2 million metric tonnes. Other significant contributors are Odisha and Bihar, each playing critical roles in strengthening India's inland fish production. While marine fishery is an important part of this, freshwater fishery is the backbone of India's fisheries industry.

Another article titled, **"Carambola And Turmeric extracts as Growth and Immunity Enhancers for Hill Aquaculture in Northeast India"**, authored by Mr Chandan Debnath, Research in Northeast India reveals significant aquaculture improvements using indigenous plant extracts. Carambola (4%) and turmeric (2%) supplementation in fish feed enhanced growth rates by nearly 49% and increased survival rates from 78.4% to 86-90% in cold-water conditions. Both extracts improved blood parameters indicating enhanced immunity and stress resistance. These natural additives, prepared through simple extraction methods accessible to remote communities, address the physiological challenges of hill aquaculture while potentially increasing farmer income by 30-40% per production cycle through improved productivity and reduced dependence on expensive commercial additives. This study explores the innovative integration of indigenous horticultural resources - carambola (star fruit) and turmeric as natural feed additives in Northeast India's hill aquaculture systems.

M.A.Nazeer
Editor & Publisher
Aqua International

Uni-President

AQUACULTURE PROBIOTICS EXPERT

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Probiotics for water treatment

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* STORAGE:

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/10,000 m² Quantity	10 - 30 pl/m² tiger prawn or < 80 pl/m² Vannamei	For >30 pl/m² tiger prawn or > 80 pl/m² Vannamei	For > 150 pl/m² Vannamei
7 days before stocking	800 g - 1,000 g	1,200 - 1,500 g	1,200 - 1,500 g
Day of stocking	300 g - 500 g	800 g - 1,000 g	800 g - 1,000 g
Every 7 - 10 days after stocking	300 g - 500 g	800 g - 1,000 g	3 - 5 days / use 1,000g - 2,000g

****Dosages can be adjusted according to the water conditions and practices.*

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Budget 2025-26: Govt boosts fisheries sector with focus on Islands

February 01, 2025: Experts believe the development of deep-sea fisheries, particularly mesopelagic resources, could transform the seafood industry and benefit coastal communities

Aimed at strengthening the fisheries sector and unlocking its untapped potential, the Finance Minister, Nirmala Sitaraman, has announced plans to strengthen the sector with a special focus on the Andaman & Nicobar and Lakshadweep Islands.

Grinson George, Director of the Central Marine Fisheries Research Institute (CMFRI), said efforts to create an enabling framework for harvesting marine resources in the EEZ and high seas are expected to boost India's blue economy, giving a fillip to sustainable utilisation of off-shore fisheries potential. India's EEZ offers a significant opportunity for increased sustainable fishing. While current fishing activity primarily concentrates within the 12-nautical-mile territorial waters, vast underutilised resources exist beyond this limit.

"Our fishing is small-scale or subsistent based. The estimated harvestable potential in the EEZ is 7.1 million tonnes. But, we are presently harvesting close to 4 million tonnes, which indicates substantial scope for expansion into deep sea. There is a possibility of utilising another 2 million tonnes of resources from the deep sea," he said

Deep-sea fisheries, spanning depths of 200-2000 meters, have significant potential for commercial exploitation. Mesopelagic resources (200-1000 meters), including myctophids, are among the world's most abundant yet largely unexploited fish resources. These mesopelagic fishes, rich in fatty acids and lipids, present significant potential for industrial, pharmaceutical, and nutraceutical applications.

While some deep sea mesopelagic species contain high levels of wax esters, rendering them unsuitable for direct human consumption, their protein content can be effectively utilised for fish meal production.

T Pradeep Kumar, Vice Chancellor of Kerala University of Fisheries and Ocean Studies, said the budgetary announcement will catalyse the fisheries development, especially when the Government intends to increase the export revenue to Rs One lakh crore. Although highly resourceful, the Andaman and Lakshadweep islands remained underutilised for a long time. The scientific steps to encourage fisheries' resource utilisation can change the economic and social scenario of the sea-going communities of India.

Depleting ocean catch has been a source of worry for fishermen and seafood exporters. Measures to enhance ocean catch and sustain marine flora and fauna are the need of the hour, says K.N. Raghavan, secretary general of the Seafood Exporters Association of India.

Nithin Awasthi of InCred Equities said the efforts to streamline shrimp exports and reduce customs duties on essential inputs (hatchery products, feed, and export materials) would significantly lower production costs and improve industry profitability. Financial support through NABARD and the Fisheries and Aquaculture Infrastructure Development Fund (FIDF) will accelerate shrimp farming and export infrastructure, including Nucleus Breeding Centres for brood-stock development.

Policy initiatives, including duty cuts on key inputs (fish hydrolysate, frozen fish paste), and targeted financing (Rs1,528 crore interest subvention by FY26) aim to strengthen India's position as a leading seafood exporter, he added.

Analysts at Samco Securities said the Government reaffirmed the continuation of Kisan Credit Cards, which provides short-term loans to 7.7 crore farmers, fishermen, and dairy farmers. Key beneficiaries of these initiatives include Godrej Agrovet, Apex Frozen Foods, and Avanti Feeds.

Source: Business Line

Mobile Lab arranged to detect diseases in Aquaculture Ponds

Vijayawada: Scientists of Rajiv Gandhi Centre for Aquaculture (RGCA), a research wing of Marine Products Export Development Authority (MPEDA), have arranged a mobile laboratory that visits aquaculture ponds to detect diseases and help farmers by suggesting re-medial measures.

The laboratory would conduct various tests like water quality analysis, PCR analysis, and for detection of viruses and bacteria at the ponds, the MPEDA officials said. "The aim of arranging 'lab at pond' is to reach aqua farmers at ponds, diagnose diseases and give them advice on the spot," said RGCA Director S. Kandan.

In Andhra Pradesh, the mobile lab visited the coastal villages in West Godavari, Nellore, Krishna and other districts, said senior field officer P. Krishnakanth Varadaraju.

Centre issues guidelines on solid waste management in aquaculture units

The regulations impose a ban on burning of plastic

The Centre has introduced new guidelines for solid waste management in coastal aquaculture units to promote sustainable practices in the aquaculture sector. These instructions delineate protocols spanning from waste handling to prohibiting its burning.

The Ministry of Fisheries, Animal Husbandry and Dairying (MoFADH) published the regulations on March 16, which advocate reducing and managing waste across all stages of production, including hatcheries, farms, and breeding centres. The guidelines aim to minimise waste generation and ensure its responsible disposal.

This comes amid growing concerns over the environmental impact of coastal aquaculture, which can contribute to rising levels of pollution if not managed effectively.

According to a report by The Energy and Resources Institute (TERI), India produces over 62 million tonnes (MT) of waste in a year. Only 43 MT of the total generated waste gets collected, with 12 MT being treated before disposal, and the remaining 31 MT discarded in waste yards.

Most of the waste generated remains untreated and even unaccounted for. Inadequate waste collection, transport, treatment, and disposal have become major causes of environmental and public health concerns in the country.

An expert, speaking on condition of anonymity, expressed cautious optimism regarding the new guidelines, acknowledging their positive intent. However, the expert emphasised that the real challenge lies in their effective implementation. "Despite existing principles, pollution persists, indicating gaps in enforcement. The government should impose stringent penalties and robust enforcement measures to ensure the guidelines are adhered to effectively," the expert said.

The new guidelines mandate a systematic approach to identify, categorise, and manage waste streams effectively. Each unit will have to assess waste generation, segregate solid waste into biodegradable, non-biodegradable, and hazardous categories, and provide adequate bins for segregation. The facility managers will have to plan waste transportation and implement reuse or recycling measures to minimise environmental impact.

The guidelines also impose a ban on the burning of plastic. "Plastics of any grade shall not be burnt at any time by the units, and shall be handed over to the local body or the appointed agency," it said.

Emphasis is also put on the importance of temporary storage and proper disposal. Each unit is required to maintain adequate temporary storage capacity to handle different categories of waste effectively. Recyclable non-degradable waste can be stored and periodically sold or handed over to recyclers based on storage facility capacity and disposal schedules.

Larger units generating significant sewage are also required to operate in-house sewage treatment plants meeting Pollution Control Board standards. Various methods such as fermentation and composting are recommended for biological waste management. Incineration of old or dead animals is advised in certain facilities.

Units will also have to create designated spaces for landfill disposal. Storing of fuel, oil, and lubricants must adhere to legal requirements, with regular maintenance and staff training to prevent spills and ensure safety compliance.

Courtesy: Business Standard

New eel species discovered off Thoothukudi coast named after Tamil

Fishermen who helped the National Bureau of Fish Genetic Resources in identifying the species wanted it named after Tamil Nadu

Chennai, March 13, 2025
Researchers at the National Bureau of Fish Genetic Resources (NBFGR), functioning under the Indian Council of Agricultural Research (ICAR), have discovered a new species of Congrid eel and named it after Tamil.

The species, belonging to the genus Ariosoma, was found off the Thoothukudi coast and was named tamilicum, "with reference to the world's oldest language, Tamil", said T.T. Ajith Kumar, director (acting) of ICAR-NBFGR.

"The fishermen who helped us in finding the eel requested that it be named after the State. It was then decided to name it after Tamil, the oldest language in the world. The name was also approved by international reviewers," he said.

Scientists from NBFGR are working in waterbodies off northeast Lakshadweep to explore the poorly studied fish group called Anguilligormes. The identity of the species was validated by international experts in the field of

eel taxonomy, and the finding was published in the international peer-reviewed journal, Zootaxa.

Researchers from the Bureau and scientists from the Zoological Survey of India conducted morphological analysis, skeleton radiography and advanced molecular studies to ascertain the uniqueness of the species among the genus Ariosoma.

They found several differences: the new species presented with dorsal surface of head with single whitish band across anterior eye margin; the ventral portion of lower jaw had tiny dark pigmentation patches, forming a dark line along the isthmus. It had long, vomerine teeth patch, reaching half the length of maxillary, and possessed 120-129 total vertebrae.

Mr Kumar said only a handful of research institutes were dedicated to studying the biodiversity of the less-explored, little known eel group in Indian waters.

"The NBFGR is giving more focus to this group, and this is the 14th eel species discovered from the Indian coast by the NBFGR team. We are conducting nutritional profiling of the species. If the protein level is comparable to other edible fish, we could even suggest that it be commercialised for consumption," he said

Source: The Hindu

India's Olive Ridley turtle numbers improve, but climate skews sex ratio

New Delhi: A 16-year-long assessment of trends in turtle populations in India says the numbers of the Olive Ridley species suggest a "steady or growing" population. However, rising sand temperatures due to climate change are causing a large proportion of these turtles to be females, "raising questions" on the long-term viability of the population.

The report, spanning studies from 2008 to 2024, has been prepared by the Dakshin Foundation and is a long-term monitoring project carried out in partnership with the Indian Institute of Science (IISc), Bengaluru, and several State Forest departments. It provides important information about population trends, threats and conservation along India's mainland and island coasts. Along with the Olive Ridley, the most populous of marine turtles, the study encompasses other species of sea turtles found in the Indian territory such as the leatherback turtles of the Andaman and Nicobar islands and the Green Turtles of the Lakshadweep islands.

Sea turtles are long-lived, late-maturing and highly migratory species. Any changes in their populations occur over years or decades, making long-term monitoring essential for understanding population trends and environmental impacts.

Striking phenomenon

A striking natural phenomenon that evokes considerable public interest is the arribada or mass nesting of the Olive Ridley turtle, when tens or hundreds of thousands of female turtles come ashore to nest simultaneously. Gahirmatha and Rushikulya in Odisha are two of the largest "rookeries" or nesting grounds worldwide, with other similar sized ones found only in Mexico and Costa Rica.

This month, Rushikulya witnessed one of the largest arribadas in recent years, with 400,000 to 500,000 turtles nesting in a span of just a few days.

"The overall trend from nearly two decades of monitoring is that the Ridley population is stable or increasing. The fact that arribadas don't occur in some years is puzzling as our offshore monitoring indicates that there are large numbers of turtles in the water. However, it may not be a cause for immediate alarm. Nevertheless, we must remain wary of threats to both coastal and oceanic habitats," Professor Karthik Shankar, who led the study, said in a statement.

This month, Rushikulya witnessed one of the largest mass nesting of Olive Ridley turtles in recent years.
BISWARANJAN ROUT

Minister calls for strategies to raise income of SHGS, FPOS

Kondapalli Srinivas receives proposals from various organisations on value additions and income enhancement for farmers' produce

AMARAVATI: Andhra Pradesh Minister for MSMES, Rural Poverty Alleviation, and NRI Empowerment Kondapalli Srinivas has emphasised the need for enhancing the earnings of Self-Help Group (SHG) members and Farmer Producer Organisations (FPOs) by adding value to their products.

Kondapalli Srinivas

During a review meeting held at his office in the Secretariat's Block-5 recently, the Minister discussed potential strategies with officials from the Society for Elimination of Rural Poverty (SERP) and representatives from Farmveda, Millet Bank, Capital Management Services and Flipkart.

He said women from SHGs were actively involved in producing various goods and sought systematic measures to increase their market value and maximise their income.

He directed officials to devise effective action plans to ensure that SHG and FPO products fetched higher prices in the market.

Representatives from Farmveda, Millet Bank, Capital Management Services and Flipkart presented proposals on value addition and income enhancement for farmers' produce.

The Minister stressed the importance of aligning these initiatives with the aspirations of SHG and FPO members, ensuring that all necessary steps were taken to boost their earnings.

One of the key outcomes of the meeting was the decision to sign Memorandums of Understanding (MoUs) between SERP and these companies in the near future. The agreements aim to facilitate better market access and financial benefits for SHG and FPO members.

Source: The Hindu Bureau

India International Aquaculture Expo 2025 Postponed

See page 20 for details

Mass Fish deaths in historic Mansar Lake spark concerns over ecological imbalance

A recent mass fish die-off in the historic Mansar Lake has drawn attention to the fragile interplay between human activities and natural ecosystems. This recurring tragedy, now exacerbated, underscores the urgent need for collective and sustained action by authorities, environmental experts, and the local community.

Mansar Lake, renowned for its religious and cultural significance, is a vital resource supporting diverse aquatic life and providing drinking water to nearby communities. However, the mass deaths of fish have sparked alarm over potential water contamination and the spread of waterborne diseases, posing threats to public health and ecological stability.

Investigations Highlight Causes

A study by the Fisheries Department of Sher-e-Kashmir Agricultural Science University last year identified oxygen depletion as the primary cause of fish mortality. Factors such as overpopulation of fish, excessive feeding with flour by visitors, and organic waste accumulation were cited as key contributors. Decomposing waste produces ammonia, which depletes oxygen levels, rendering the lake uninhabitable for aquatic species.

Despite efforts by the Wildlife Conservation Department to curtail household wastewater discharge into the lake, some residents continue to violate these guidelines, exacerbating water pollution and hampering conservation efforts.

Cultural Reverence and Ecological Challenges

The lake holds immense religious significance, with beliefs discouraging the removal of aquatic life. While this cultural practice has historically protected the lake's biodiversity, it now poses challenges. Overpopulation of fish, coupled with a reluctance to intervene, has led to severe ecological imbalances. Balancing cultural beliefs with ecological preservation is both delicate and essential.

Experts and authorities stress the importance of immediate and long-term measures, including:

Removal of Dead Fish: Clearing the lake of deceased fish to prevent further water contamination.

Aeration Systems: Installing fountains or aerators to enhance oxygen levels, particularly during winter months when oxygen depletion is most severe.

Fish Relocation: Controlled relocation to reduce overcrowding while respecting cultural beliefs.

Wastewater Management: Strict enforcement of regulations against household wastewater discharge and alternative waste disposal solutions for residents.

Awareness Campaigns: Educating locals and tourists on the harmful effects of overfeeding fish and polluting the lake, with religious leaders playing a pivotal role.

Regular Monitoring: Conducting scientific studies and predictive modelling to anticipate and mitigate future incidents.

Preserving Mansar Lake's Heritage

Saving Mansar Lake requires a balanced approach integrating science, tradition, and community participation. The government must allocate resources for conservation, including research funding and sustainable management practices. Partnerships with NGOs, academic institutions, and religious organisations can amplify efforts.

This environmental crisis is a stark reminder of the consequences of inaction. Mansar Lake is not merely a water body; it is a living testament to the region's heritage and biodiversity. Swift and decisive actions are essential to preserve it for future generations, ensuring it remains a vibrant and life-sustaining ecosystem.

Call to Action

Authorities, experts, and citizens must act collectively to save Mansar Lake from further degradation. The time to act is now—before the lake's ecological and cultural legacy is lost forever.

Courtesy: Fishery News

Prawn farmers seek relief from additional charges

Prakasam district Prawn Farmers Association members submitting a representation to Minister DSBV Swamy in Turpu Nayudupalem on Sunday

Naresh Nandam Ongole

MEMBERS of the Prakasam district Prawn Farmers As-sociation have sub-mitted a petition to the Minister for Social Wel-fare Dr Dola Sree Bala Veeranjaneya Swamy at his camp office in Turpu Nayudupalem on Sunday. seeking intervention on electricity charges and the installation of digital smart meters.

The members highlighted several concerns affecting approximately six coastal ar eas in the Prakasam district where farmers are engaged in prawn cultivation.

According to the farmers, they have been suffering losses for the past few years due to low-quality seed and unfavourable market prices. The situa-tion has become so dire that many feed suppliers are refusing to provide prawn feed on credit. They informed that the state government provides sub-sidised electricity at Rs 1.50 per unit to farmers with less than 10 acres in designated Aqua Zones. This subsidy has been crucial for keeping small-scale prawn farming operations viable. However, farmers in Non-Aqua Zone and those with more than 10 acres do not receive this benefit, forcing many to abandon their ponds due to unsustainable costs, they explained.

In the petition, the farm-ers urged the minister to convince the government to extend subsidised elec-tricity to all prawn farmers regard-less of their location in Aqua or Non-Aqua Zones, halt the additional true-up charges and electricity ad-justment fees, suspend the installation of digital smart meters that was initiated without proper communica-tion to farmers.

The Prakasam district Prawn Farmers Associa-tion president Duggineni Gopinath, secretary Kunturi Subbareddy, honorary pres-ident Pamidi Subbanayudu, and other members met the minister.

India International Aquaculture Expo 2025 Postponed

Dear Exhibitors & Stakeholders,

We would like to inform you that India International Aquaculture Expo 2025 (IIAE 2025 & IIPE 2025) scheduled to be held on 17-18-19 April 2025 at HITEX Exhibition Centre, Madhapur, Hyderabad, India, has been postponed due to unavoidable circumstances. We sincerely regret for the inconvenience caused to you with the postponement.

We want to cancel the above mentioned dates for the Expo as things and situation in poultry sector are bad to conduct the event at this juncture. Since third week of February 2025 the pandemic of Bird Flu is spreading in poultry birds causing huge mortality and losses to poultry farmers and others. This pandemic disease is presently prevailing in Telangana, Andhra Pradesh and Karnataka States and is further spreading to other areas.

A kind of panicky situation is prevailing among poultry farmers and the entrepreneurs (Exhibitor companies) and they are not in a position to participate under current situation in the above mentioned Expo on 17 to 19 April 2025.

Many of the companies and stakeholders in aquaculture sector are preferring the expo to be organised exclusively on aquaculture sector. Considering the views and suggestions the new dates for the expo will be announced in due course.

We request you to kindly understand the circumstances and cooperate.

Best Regards,

M. A. Nazeer
Chief Executive – IIAE 2025
Editor & Publisher – Aqua International
Hyderabad, India

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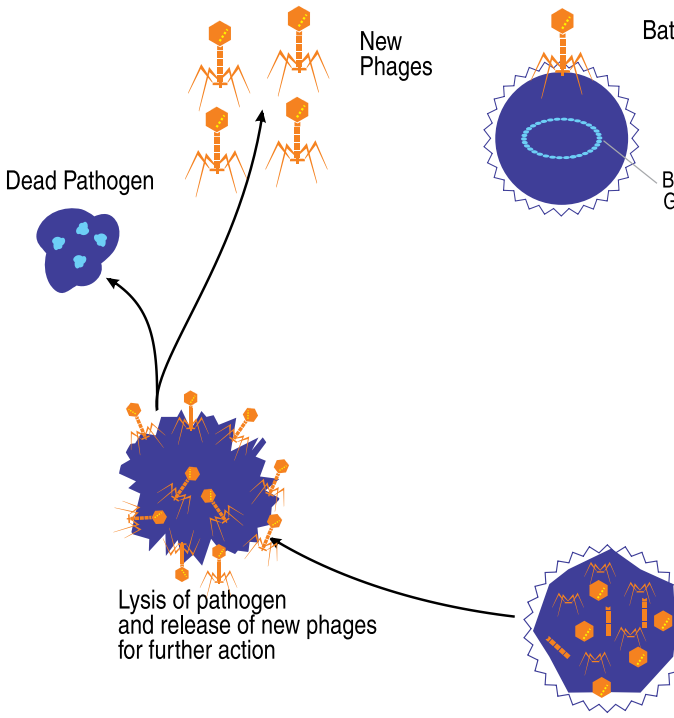

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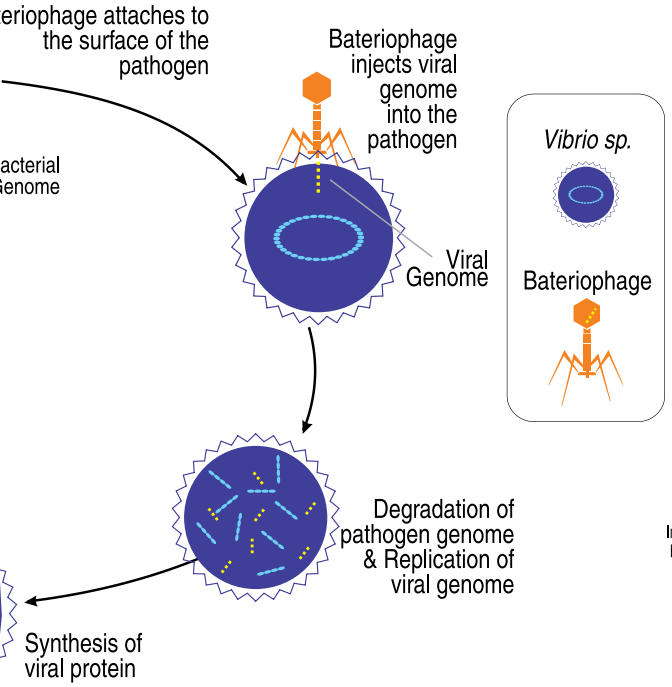

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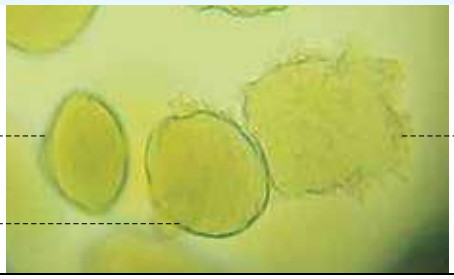
Colony 1 in Stage 1: Intact Colony may be infected or yet to get infected.

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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Spotted Scat Fish (Scatophagus Argus):

A Potential Species for Brackishwater Aquaculture and Aquarium Trade

E. Suresh, N. Kalaiselv and N. Hemamalini

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Scatophagus argus is a brackishwater fish, that belongs to the family Scatophagidae under the order Perciformes. It is commonly known as "spotted scat" due to the presence of numerous black spots on its body. It is also known as leopard pomfret, butterfish, argus fish, spade fish, and spotted spade fish. In the ornamental fish markets of India, it is popularly known as "Indian discus." It is a popular aquarium fish species around the world due to its colourful appearance, hardiness, slow growth, and calm behaviour. It is a euryhaline teleost fish, widely distributed in fresh, brackish, and marine waters of the Indo-Pacific. S. argus is an economically important aquaculture species in East and Southeast Asia due to its easy cultivation, low feeding cost, and high market price. It is also popular as a food fish with a low fat and high-protein content and is a popular aquarium species due to its colourful appearance and calm behaviour. It has a native range in the Indo-Pacific, the Malay Archipelago, Philippines, China, Australia, South and South East Asia especially in India and Sri Lanka.

Scatophagus argus

- Scatophagus argus, known as "spotted scat," is prized in both aquarium trade and culinary spheres across South and Southeast Asia.
- Inhabiting a diverse range of waters, from freshwater to estuarine environments, S. argus demonstrates adaptability and resilience.
- Challenges to its aquaculture include a slow growth rate, prompting research into growth enhancement methods and polyculture strategies.
- Despite ongoing efforts, commercial cultivation of S. argus remains limited, signalling the need for further advancements in the field.

Physical Description

S. argus has a body which is quadrangular and strongly compressed with the head having a steep dorsal profile. It has a moderately large eye which has a diameter noticeably smaller than the length of the rounded, snout. They have a small, horizontal mouth which is not protractile. There are a number of rows of small bristle-like teeth in the jaws. The dorsal fin has 10-11 spines and 16-18 soft rays, while the anal fin has 4 spines and 13-15 soft rays. The spines and rays of the dorsal fin are separated by a deep notch and the first spine in the dorsal fin lies flat. The rear margins of the soft parts of the dorsal and anal fins are roughly vertical. The caudal fin is rounded in juveniles and truncate to weakly emarginate adults. Small ctenoid scales cover the body. Spotted Scat fish are easily recognizable by their distinctive coloration and markings. The body is greenish-brown to silvery with many browns to red-brown spots. Juveniles are a greenish-brown with either a few large, dark, rounded blotches, or five or six dark, vertical bars. This species attains a maximum total length of 38 cm (15 in). In large adults, spots may be faint and restricted to the dorsal part of the flanks.

Natural Habitat and Diet

S. argus lives in freshwater, natural embayment's, brackish estuaries and the lower reaches of freshwater streams, often in mangrove areas.

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Bacterial strains such as Bacillus Subtilis, Nitrobactor, Nitrasomonas, rapidly converts ammonia into Nitrates, Nitrites and finally non-toxic Nitrogen. Hydrogen Sulphide converts into Sulphates, Sulphites and finally non-toxic Sulphur, Methane into Non-toxic carbon. This conversion reduces the obnoxious gasses in the pond bottom. Reduction of this gasses improve the D.O. level in the water and bottom.

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They are found in marine waters or estuaries of the Indo-Pacific region from the western coast of India to New Guinea and northern Australia and also along the coast of Africa. Occasionally they enter various freshwater habitats. Juveniles generally live in muddy coastal areas, including estuaries, mangroves, harbors and the lower courses of rivers, whereas adults migrate to marine environments. S. argus can stand with various water bodies due to its strong ability of osmoregulation. S. argus is native to the following countries: Andaman Islands, Bahrain, Bangladesh, Cambodia, China and Taiwan, India, Indonesia, Iran, Iraq, Japan (including Ryukyu Islands), Kuwait, Malaysia, Myanmar, Oman, Pakistan, Philippines, Qatar, Saudi Arabia, Singapore, South Korea, Sri Lanka, Thailand, Timor-Leste, United Arab Emirates, Vietnam, Australia, Fiji, French Polynesia, Micronesia, New Caledonia, Palau, Papua New Guinea, Samoa, Tahiti, Tonga, and Vanuatu. Scat has a broad diet and eats detritus, filamentous algae, phytoplankton, aquatic macrophytes, zooplankton, benthic invertebrates and other macrozoobenthos. Adult scats are primarily herbivorous while the juveniles prefer zooplankton.

Reproduction

Sexes of S. argus can be distinguished by observing the head shape. In the females, the head profile ascends at a constant slope, but the males have a concave curvature in the head above the eyes. This difference is more prominent in the larger fish, but noticeable also in the fish as small as 100 gm. In addition, the females are often lighter, olive-green in colour compared to the darker males. Multiple spawning nature of S. argus have been reported. Spotted scat is used to spawn twice in a season; once during the southwest monsoon season (June to August) and the other during the northeast monsoon season (October to December) in the Mandapam coastal region, Southeast coast of India. It has been reported that a total length of 12–12.9 cm and 14–14.9 cm as length at first maturity for male and female, respectively.

Importance in aquaculture and aquarium trade

In aquaculture, the Spotted Scat fish has shown great potential for commercial production. Its ability to thrive in brackishwater conditions make it an economically viable option for aquaculture operations. Usually, the natural habitat of S. argus is characterized by fluctuations in salinity, temperature, dissolved oxygen, tidal movements, river runoff, turbidity, and turbulence. It can also tolerate other conditions like high/low temperature, tidal motion and opacity. These characteristics make S. argus, a desirable native fish for aquariums. Adaptations to live in such ever changing environments endow scats with many biological attributes that are highly desired in cultured finfish. It has been reported that high temperature tolerance limits for S. argus adults. It has the ability to tolerate low dissolved oxygen concentrations even less than 2 mg/L and has a large pH tolerance range. Further, it has several excellent characteristics for culture such as a calm nature, favourable taste and appearance, and good market price. It also has the ability to take advantage of the most profitable food source available in the habitat at a particular time and to select necessary food items that maximize fitness and energy gain. It has been reported that scat is one of the few teleost species of economic importance that could potentially thrive in tropical brackish water fish ponds. S. argus is one of the potential candidate species for brackish water aquaculture and ornamental fish trade. With its unique appearance and adaptability to various environments, the Spotted Scat fish has garnered attention from aquaculturists and aquarium enthusiasts alike. It has characteristics such as colourful appearance, hardiness, calm behaviour, high protein content and good taste. This species has been reported to fetch good market price in inland markets and are in demand for ornamental fish trade in India. So far, the culture of this species has not been taken up in India except for one experimental rearing of S. argus with Etroplus suratensis in West Bengal.

Challenges and Considerations

Despite recognizing the potential of cultivating scats in captivity, significant progress has yet to be made. The primary challenge in scat culture is their inherently slow growth rate. To address this, several studies have been conducted to enhance and standardize their growth in captivity. These studies have explored the use of growth-promoting substances and examined the effects of salinity and stocking density on scat growth. Additionally, researchers have investigated induced breeding using specific agents, as well as the potential for polyculture with tiger prawns (Penaeus monodon) and milkfish (Chanos chanos).

Summary

S. argus, also known as "spotted scat," is a brackish water fish belonging to the Scatophagidae family, widely recognized for its popularity in both aquarium trade and culinary use, particularly in South and Southeast Asian countries. With its native habitat spanning the Indo-Pacific region, including areas like India and Sri Lanka, this species boasts a striking appearance characterized by its rectangular, compressed body adorned with brown spots. Inhabiting freshwater, inshore, and estuarine waters, often amidst mangroves, S. argus exhibits a diverse diet, ranging from detritus and algae to benthic invertebrates, with a preference for herbivory among adults. Its reproductive behaviour is marked by sexual dimorphism and multiple spawning seasons, typically occurring during the southwest and northeast monsoon periods in India. Despite its potential for aquaculture, the species faces challenges, notably its slow growth rate. Efforts were made to address this hurdle including research into growth-promoting substances, breeding techniques, and potential polyculture with other species like tiger prawns and milkfish. However, commercial cultivation of S. argus remains limited, with further progress needed to harness its full potential in the aquaculture industry.

The Superfood of the Century:
Fish for health, hunger & sustainability

Bonika Pant, Neeraj Pathak and Sunil Prajapati
Krishi Vigyan Kendra, Gautam Buddha Nagar, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh. Division of Fisheries Science, The Neotia University, West Bengal, E: neeraj.pathak@tnu.in

- Fish is regarded as the superfood of the 21st century, as it is rich in essential nutrients such as omega-3 fatty acids, high-quality proteins, and various vitamins that are vital in combating hunger.
- Economical aquatic foods, such as small pelagic fish, are low-cost yet essential sources of protein and micronutrients for underserved populations.
- Sustainable fisheries are consistent with SDG 2 (Zero Hunger) and SDG 14 (Life Below Water) while contributing to the enhancement of the ecosystem's health.
- The fisheries sector strengthens rural economies and employment through production, export and processed products.
- PMMSY has set a vision to double fish production by 2024-25 through progressive research, innovation and sustainable practices in fisheries.

Aquatic food systems can provide six times more food, deliver diverse and comprehensive nutritional benefits and nourish healthy and fulfilling lives, livelihoods, equality and environments

Ms Shakuntala Thilsted, 2021 World Food Prize Laureate

Water, the most precious resource of the world has the potential to mitigate both hunger and thirst in numerous developing countries across the world. The vast coastline and pristine quality waters of the Indian sub-continent are abundantly blessed with a rich biodiversity of aquatic flora and fauna. In the vibrant tapestry of Indian cuisine- fish stands out for its nutritional richness and culinary versatility. Also referred as poor man's protein, fish are overlooked as a source of food and nutritional security due to its affordability, not only in India but across the globe. The intricate relationship between the fish and Indian culture goes beyond the plate, influencing traditions, health practices and economic prosperity. The unique combination of vital nutrients and high-quality protein makes fish invaluable.

Today, Indian fisheries production is at all time high of more than 174 lakh tonnes in the year 2022-23. According to FAO, the average annual growth rate of fish consumption has increased at 3.1 % outpacing the annual population growth rate of 1.6%. There are more than 34,000 varieties of fish found in the world and it is a great alternative to eating red meat, with a variety of flavours and cooking styles to suit any taste. In many coastal regions of India and the world, food fish which is a term given to fish destined for human consumption play the role of both staple food and income generator. Owing to its nutritional superiority and potential to mitigate hunger and malnutrition, fish is termed as "Super Food of the 21st Century" and WHO recommends regular fish consumption of at least 1 -2 servings per week.

Mitigating hunger & malnutrition

According to the State of Fisheries and Aquaculture, 2022 (SOFIA) published by Food and Agriculture Organization (FAO) the total aquaculture and fisheries production has reached a record 214 million tonnes in 2020. Largely due to the growth of aquaculture, this comprises of 178.0 million tonnes of aquatic animals and 36.0 million tonnes of aquatic algae. Human consumption (excluding algae) has also increased upto 20.2 kg per capita, which is more than double the average of 9.9 kg per capita in the 1960s. The consumption of aquatic products is seeing a growth across the planet and is also expected to rise and feed the ever-increasing population along with the much-needed nourishment. For around 3.3 billion people in the world, aquatic foods are providing at least 20 % of the average per capita intake of animal protein.

In a country like India, there are a few common aquatic high-value food species like, Tuna, crab, shrimp etc and along with these there is a wide variety of low trophic level based aquatic animals and plants that can be incorporated in the plates

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of men due to their potential to deliver micronutrients, omega-3 fatty acids and protein and which offer alternatives to the large fish species and terrestrial animal-source foods common in today's diets. The fishes and shellfish lying in low trophic like small pelagic fish fill the nutritional gap sustainably and are affordable to poorer populations covering their nutritional needs, meanwhile, other practices like seaweed cultivation may provide income-generating opportunities for coastal communities. Encouraging people to eat low-trophic aquatic foods is undoubtedly the prime strategy for using the aquatic nutrient resources of our country in more efficiently, as they are more affordable for common man and also, they mitigate the environmental impacts of food production. India can take an example from Kiribati, which relies on subsistence fishing and has one of the highest consumptions of aquatic foods in the world.

According to FAO, fish is now providing more than 100 calories per capita per day in many countries where the preference of fish has been developed and has accounted for 17 percent of the global population's intake of animal proteins and 7 percent of all proteins consumed in 2017. Globally, fish provided more than 3.3 billion people with 20 percent of their average per capita intake of animal proteins, reaching 50 percent or more in countries such as Bangladesh, Cambodia, Gambia, Ghana, Indonesia, Sierra Leone, Sri Lanka and several small island developing states. Dried fish-based products which are easily prepared like fish powder and fish chutneys offer multiple employment opportunities and an accessible, affordable and culturally appropriate way to include more micronutrients in the daily meals of children and women.

In low-income food-deficit countries (LIFDCs), the poor and rural populations find small fish as the most accessible as well as affordable animal-source food which also leads to contribution in the diversification

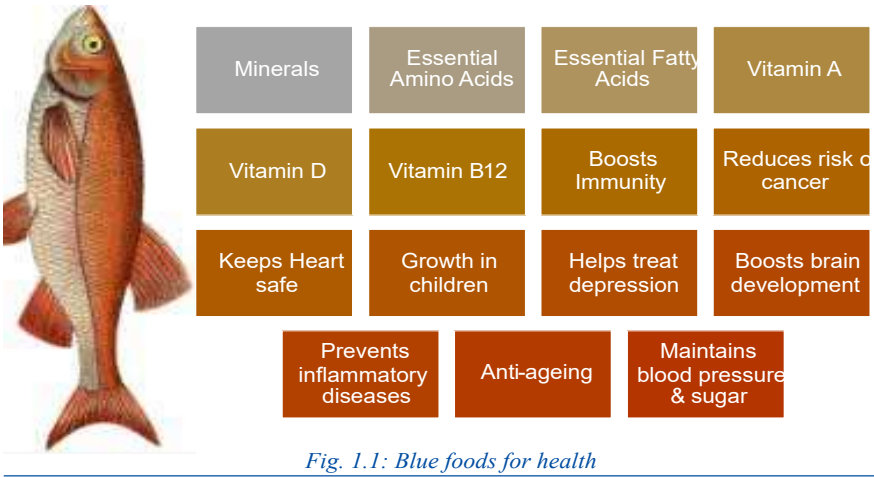

Fig. 1.1: Blue foods for health

of diets currently dominated by staple land crops. These Small fish are being harvested, sold and consumed in small quantities and combined with other foods, making them more frequently available and inexpensive to poor and vulnerable populations than other animal-source foods, such as livestock. Hence, aquatic foods can be a major part of the solution to building food systems which are resilient, available and accessible.

Nutritive Value: A menu of solutions

The world is now consuming more than six times of the blue foods compared to sixty years ago as fish provides an extensive range of health benefits from head to toe and also helps significantly in the growth and development of the body. Proper knowledge of these benefits is very imperative in these challenging times of the post-pandemic era, where being health conscious and changing unhealthy lifestyles is one of the top priorities of the majority of people. WHO recommends having 1–2100 g servings of fish/week, while the European Food Safety Authority (EFSA) recommends adults to consume 300 g of fish/week. Indian fisheries and aquaculture are playing a pivotal role in sustainably feeding the growing population and one of the major objectives of the Government is to augment domestic consumption of fish from 5 kg to 12 kg per capita and double the fish export earnings to 1,00,000 crores by 2024-25. The present rate of consumption of the country is considerably low when compared to global consumption of per capita and hence, fulfilling the gap is only achievable when the people of India realize the benefits of these superfoods in terms of health, nourishment and nutrition along with wealth and employment.

Fish has many nutrients that do not occur in such quantity and diversity either in cereals or other crops or in meat and are critical in maintaining healthy muscles, organs, and blood vessels. Fish is a great source of protein which supports cell division, hair growth and hormone signaling. Fish is also filled with essential nutrients, like omega-3 and omega -6 fatty acids, taurine and selenium which positively impact the functions of human body by lowering heart risks, improved liver and brain health, helping in sound sleeping, working as anti-depressant and last but not the least, aiding weight loss. The nutrient content of fish can vary depending on the species and the method of consumption i.e. fresh, frozen, smoked, chilled, marinated, battered or dried.

Although, the most significant difference is the fat content: species like salmon and tuna are considered fatty, while cod and catfish are lean. Fish is also considered rich in vitamins and minerals which are vital and a few of them are which the body can't produce on its own. Iodine is one such example, as it is important for the functioning of thyroid gland. Other crucial minerals like phosphorus, iron, zinc, magnesium, potassium are also constituents of fish muscles. Fish is also enriched with vitamin A, D, E, Niacin (B3), B6 and

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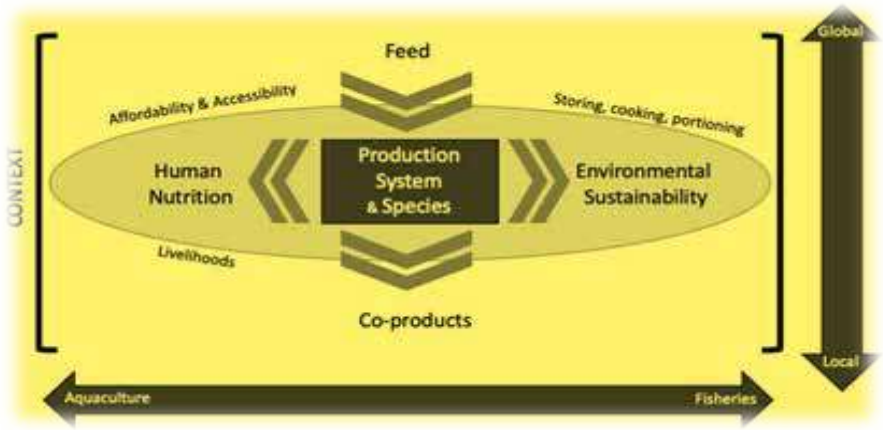

Fig. 1.2.: Framing of the role of aquatic animals in food systems by Pounds et al (2022)

B12, which are being used by every system of the body in one way or another and is highly recommended for pregnant ladies as well. Although the fish has various health charms, yet just like any animal product cooking fish appropriately before eating is very important since the catching, handling, storing conditions and transportation can harbor microbes under the wrong conditions. Therefore, eating fresh fish or thoroughly frozen fish is the best way to ensure safety of the food.

The question of sustainability

With the forecast that the aquatic production can grow to another 14 percent by 2030, it is crucial that this growth goes hand in hand with protecting biodiversity, preserving ecosystems, plummeting pollution, and guaranteeing social equity. FAO has suggested a Blue Transformation, that proposes a series of actions designed to back resilience in aquatic ecosystems and ensuring that fisheries and aquaculture grow sustainably so that no one stays behind. Climate-and environment-friendly policies and practices, as well as technological innovations, are critical building blocks for Blue Transformation. Fish is the world's single most traded food commodity when compared to all other foods and fish is highest exchange earner for India when compared to all other foods with USA, China and the European Union (EU) being the leading importers. Frozen shrimp is the major export item followed by frozen fish. Aquatic animals can supply an array of commonly deficient, bioavailable micronutrients for humans and along with this, aquatic animal value chain systems are critical as food to attain the Sustainable Development Goals (SDGs) and fall directly under two main SDGs: SDG 14 (Life Below Water) stresses the need to reduce environmental impacts on marine environments, whereas nutritional outcomes are encompassed by SDG 2 (Zero Hunger).

Sustainable food systems in terrestrial as well as water systems rely on well-managed natural ecosystem services for now and in the future. Aligning with the principle of 'planetary boundaries', the habits of consumption which are culturally acceptable, protective and respectful of biodiversity and ecosystems, accessible, economically fair and affordable, safe and healthy are defined as sustainable diets. Aquatic animals are crucial for achieving both food security as well as more sustainable food systems. Studies have suggested that consuming aquatic foods, both wild-caught and farmed presents opportunities for greater sustainability, as the production of aquatic animal-source foods tend to have lower environmental impacts than than the production of most terrestrial animal-source foods.

The key to a prosperous future lies in the diversification of aquatic products being eaten as it plays a pivotal role in managing the sustainability and it has become extremely important to include different amounts of multiple fish species or catch of the day in our plate. National Health Service of the United Kingdom advises that "to ensure there are enough fish and shellfish to eat, choose from as wide a range of these foods as possible. If we eat only a few kinds of fish, then numbers of these fish can fall very low due to overfishing of these stocks. Present day requires an explicit consideration of the stressors in fisheries and aquaculture management by connecting transformative management plans and adaptation actions at local, state and national levels with particular attention to the most vulnerable i.e. small-scale fisheries and aquaculture.

Roadmap to the future

The 26th session of the Conference of the Parties to the UN Framework Convention on Climate Change (COP26) held in Glasgow, opened opportunities for fisheries and aquaculture to expand its contribution to global efforts, sharing adaptation and mitigation solutions, and international climate discussions in a global stage.

To feed the most populated country in the world, the time has come when we need to shift our focus from the land-based production of rice and wheat. The Governments and authorities can support the inclusive and sustainable growth of aquatic food systems by devoting more resources and investment towards research and studies, prioritising investments as well as policies to sustainably develop the aquatic foods sector and support small-scale fisheries and aquaculture.

Although FAO has projected that by the year 2029, 90% of the fish production will be consumed as food, since time unknown, the vital nutrients are being slipped through the hands of the malnourished and the nation is missing a golden opportunity to transform food systems for the poorest. Developing fish products of consumer preference, increasing consumption points of fish, spreading awareness through various means like fish fair and exhibitions, value addition, training, capacity building and providing ample opportunities to the youth of the

nation to work in the field of fisheries can pave the way for a healthy future of the country. Apart from this, various initiatives like awareness on digital platforms and social media can bring massive outreach of the fish benefits where consumer-specific marketing and strategic initiatives in the daily plate of a common man to the fancy plates of Ho-re-Ca (Hotal-Restaurants-Café) need to be planned.

The Government's focus on fisheries like the availability of Kisan Credit Card (KCC) to cater the needs of fish producers or farmers and implementing flagship schemes like Pradhan Mantri Matsya Sampada Yojana (PMMSY) in June 2020 to take the fish production to 22 million tonnes by 2024-25 with an estimated investment of Rs. 20,050 crores under the Aatmanirbhar Bharat Package in all the inland and marine states and UTs of the country is a big step in the road of fisheries development. In February 2024, the cabinet also approved Pradhan Mantri Matsya Kisan Samridhi Sah Yojana (PM-MKSSY) which is focusing to address challenges like formalization of fisheries sector and supporting small and micro fisheries enterprises.

The development of new industries and additional facilities for fish by-products development in the existing industries will also be helpful in boosting the economic returns from the sector manifolds as well as generate enormous employment opportunities especially in the rural areas. To conclude. fisheries sector has the potential to establish as major health food to mitigate hunger and malnutrition as envisaged in the Sustainable Development Goals while generating opportunities for employment generation and livelihood leading to creation of wealth. The Indian fisheries sector, also called as sunrise sector, is on its way to play its part in the holistic development of the country and the world by harnessing the potential of the sector in a sustainable, responsible, inclusive and equitable manner.

References will be provided on request by the readers.

Genetic Improvement of Fishes: A Comprehensive Overview

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Genetic enhancement or improvement became a keystone for increasing production, sustainability, and disease resistance in growing fish populations in modern aquaculture. The infusion of selective breeding and modern biotechnological techniques gave fish production desirable characteristics like higher growth rate, enhanced feed efficiency, and advanced disease resistance. In the current scenario, Seafood demand grows worldwide, and genetic improvement plays an important role in ensuring food security and sustainable aquaculture methods. This article evaluates the methodology, advantages, issues, and various possibilities for the genetic improvement of fishes.

1. Principles of Genetic Improvement in Fishes

Fundamentally, the primary goal of genetic improvement of fish is to improve traits with economic and environmental value. Selective breeding is the main strategy, which includes selecting parents with superior features to inherit desired genetic traits. These traits accumulate in the population over many generations leading to improved performance.

Selective breeding involves the following key steps:

Trait Selection: Determining the traits that are advantageous to aquaculture such as disease resistance, growth rate, and feed efficiency.

Genetic Evaluation: Using genetic markers to predict the likelihood of desirable traits in offspring.

Crossbreeding and Hybridization: Crossing genetically distinct populations to introduce hybrid vigour, improving the overall performance of farmed fish.

2. Key Traits Targeted in Genetic Improvement

Several traits are critical for the success of aquaculture, and genetic improvement programs primarily aim to enhance these characteristics:

Growth Rate: Faster-growing fish use less time and feed to reach market size. Selective breeding for growth is a popular and financially important goal in aquaculture breeding projects.

Disease Resistance: Fish are susceptible to a variety of diseases, including viral infections (e.g., VHS, IPN) and bacterial diseases (e.g., streptococcus). Breeding fish with better immune systems minimizes the need for antibiotics, which is critical for economic and environmental sustainability.

Feed Conversion Efficiency (FCR): Fish with a greater FCR convert feed into body mass more efficiently, minimizing the costs and environmental impact of feed production.

Environmental Tolerance: Climate change has made it more vital to breed fish that can withstand fluctuating environmental

circumstances such as temperature swings, salinity shifts, and oxygen deprivation.

Reproductive Traits: Increasing fish reproductive efficiency, such as fecundity or breeding efficiency, ensures consistent and high-quality brood stock for aquaculture.

3. Advanced Methods in Genetic Improvement

While traditional selective breeding methods remain dominant, advancements in molecular genetics and biotechnology have introduced more precise tools for genetic improvement:

Marker-Assisted Selection (MAS): This strategy selects breeding stock by using molecular markers linked to desired traits. It speeds up the breeding process by recognizing fish with high genetic potential at an early stage.

Genomic Selection: This involves conducting whole-genome research to find genetic variants related to essential traits. Genomic selection enables breeders to select individuals with desired qualities based on their genetic makeup before they reach maturity.

Gene Editing (CRISPR/Cas9): One of the most promising new approaches, CRISPR/Cas9, enables direct editing of fish genomes to create particular, beneficial genetic modifications. For example, gene editing could improve disease resistance or growth rates, creating new opportunities for precision genetic alteration in aquaculture.

Hybridization: Crossbreeding different species or strains of fish to combine desirable characteristics is a well-known procedure. When complementary genetic backgrounds are combined, hybrids often exhibit greater growth or disease resistance.

4. Benefits of Genetic Improvement in Aquaculture

The genetic improvement of fish offers several advantages that contribute to the sustainability and efficiency of aquaculture:

Increased Productivity: Genetic enhancement produces fish that develop quicker and use fewer resources, such as feed and water, resulting in higher production rates and profitability.

Disease Resistance: Breeding fish with innate disease resistance reduces the need for chemical treatments, antibiotics, and vaccinations, lowering aquaculture's environmental impact and encouraging healthier fish populations.

Improved Feed Efficiency: Selecting fish that convert feed into biomass more efficiently minimizes aquaculture's environmental impact, especially in terms of fish feed production, which is frequently generated from wild-caught fish.

Sustainability: Breeding fish that are better acclimated to diverse environmental pressures, such as temperature and oxygen changes, helps aquaculture systems remain resistant in the face of changing climate conditions.

5. Challenges and Ethical Considerations

Despite the significant benefits, there are challenges and ethical considerations associated with genetic improvement in fish:

Loss of Genetic Diversity: Selective breeding over several generations may limit genetic diversity, making fish populations more susceptible to diseases and environmental changes. Maintaining a balance between selective breeding and genetic diversity is critical to long-term viability.

Ecological Risks: The release of genetically modified fish into the wild can result in ecological hazards, such as the possibility that these modified fish will compete with wild populations or disrupt local ecosystems.

Consumer Acceptance: Genetically modified organisms (GMOs) are under public scrutiny, and consumer worries about food safety and ethical issues could hinder the acceptance of genetically enhanced fish. Labelling transparency and comprehensive safety assessments are critical for addressing these concerns.

Regulatory Hurdles: Different countries have different rules on genetic alteration and selective breeding of fish. There is a need for internationally recognized standards that ensure acceptable and ethical activities in fish genetic improvement.

6. Future Directions in Genetic Improvement of Fish

The future of genetic improvement in fish holds promising possibilities, driven by advances in genomics and biotechnology:

Precision Breeding: Advances in genomic techniques will enable the exact identification and enhancement of specific traits, resulting in more customized breeding programs that can address specific production needs.

Sustainable Aquaculture: The emphasis will progressively turn to developing fish that can flourish with minimal environmental impact, requiring fewer resources and lowering the ecological impact of aquaculture systems.

Gene Editing: As gene editing technologies such as CRISPR/Cas9 advance, more precise genetic modifications to fish populations are expected, improving productivity, disease resistance, and overall health.

Conclusion

Genetic improvement of fish is critical to the future of sustainable aquaculture, allowing farmers to produce more fish with fewer resources and a smaller impact on the environment. While selective breeding has been used for decades, modern genetic technologies including marker-assisted selection, genomic selection, and gene editing provide unprecedented prospects to improve the efficiency and sustainability of fish farming. However, resolving the difficulties of genetic variety, ecological hazards, and ethical considerations will be critical for the long-term viability and public acceptance of genetically altered fish in the market.

References will be provided on request by the readers.

Climate change & fisheries:
The silent crisis threatening India's blue economy

Mr Amit Saraogi, *Managing Director, Anmol Feeds & Founder – PrraniGanga*

India is the world's second-largest producer of fish with an annual production of more than 17 million tonnes. With Andhra Pradesh at the forefront, a large percentage of this production comes from freshwater aquaculture. In 2022-23, Andhra Pradesh contributed to almost 40.9% of the total fish production in the country with 4.5 million metric tonnes of fish. West Bengal ranked second with roughly 12.58%, amounting to 2 million metric tonnes. Other significant contributors are Odisha and Bihar, each playing critical roles in strengthening India's inland fish production. While marine fishery is an important part of this, freshwater fishery is the backbone of India's fisheries industry.

Freshwater fisheries are highly dependent on controlled environments like ponds, reservoirs, and tanks. Although, fisheries are a major contributor to employment generation, changing climate patterns are disrupting breeding cycles, and increasing disease outbreaks in farmed fish, putting the livelihoods of people associated with fisheries at risk.

Rising temperature and its effect

The rise in temperature caused by climate change has resulted in thermal stress in freshwater ecosystems. Most freshwater fish species like carp and katla thrive only within a certain temperature range. Higher water temperatures can decrease oxygen levels, decrease fish growth, and increase mortality. Research indicates an increase in temperature is affecting the growth of Rohu and Katla in Andhra Pradesh. The production has gone down almost 10% in some districts.

Erratic monsoons and extended dry spells are also affecting water availability. Bihar, for instance, has witnessed a 15% reduction in fish production in drought-prone areas due to falling water levels in key aquaculture zones. The Sundarbans mangrove forest, stretching across West Bengal and Bangladesh, has been seriously threatened by climate change. The sea levels are rising, cyclones are often causing havoc in these areas. These changes pose a great threat to the region's biodiversity and the livelihoods of almost 600,000 fishers and aquaculture communities.

Disease outbreaks and biodiversity loss

Increased water temperature equates to greater risk of disease outbreaks in fishes. While bacterial infections and parasitic infestations have always been a concern for freshwater fish farmers, these infections are now becoming more frequent due to fluctuating environmental conditions. A 2023 in Odisha showcased that disease-related mortality in farmed fish has increased by nearly 20% over the last decade.

Moreover, pollution and runoff caused by extreme weather are degrading the water quality, compromising fish health. Species diversity maintains the balance of the ecosystem, yet pollution, habitat destruction, and climatic changes are reducing the availability of indigenous fish species.

How good quality fish feed can help

In the 2023-24 financial year, Karnataka's Dakshina Kannada district experienced a dramatic 43% decline in fish production. Climate resilience in aquaculture is not only about environmental factors but also about ensuring optimal fish nutrition and farming practices. High-quality fish feed can play a critical role in alleviating the impact of climate change on fisheries by:

- Well-balanced feed helps fish develop stronger immunity, making them more resistant to diseases
- Efficient feed utilization minimizes waste and water pollution, resulting in healthier aquatic habitats
- Effective feed management reduces wastage of resources, ensuring sustainability and profitability for fish farmers

Government initiatives: A step in the right direction

The Pradhan Mantri Matsya Sampada Yojana (PMMSY), which was introduced with a fund of ₹20,050 crore in 2020-21, has played a crucial role in shaping India's fisheries sector. By improving production, upgrading infrastructure, and encouraging sustainable fishing, PMMSY has raised fish production to 22 million tonnes by 2024-25. As of August 2024, ₹1,148.88 crore have been spent on the scheme to help set up fish hatcheries, and processing units. Some key initiatives under this scheme include encouraging climate-resilient alternatives, creating 100 climate-smart coastal villages for the safety of fishing communities, and equipping one lakh fishing boats with transponders to enhance navigation and security. While these efforts are commendable, their success largely depends on continued implementation, community engagement, and modern strategies that go beyond the provision of short-term relief. Through a focus on sustainability, enabling fishing communities, and innovation, India can safeguard its marine assets and ensure the long-term sustainability of its fisheries industry. The hour is now—before the silent crisis turns permanent.

Carambola and turmeric extracts as growth and immunity enhancers for hill aquaculture in Northeast India

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Research in Northeast India reveals significant aquaculture improvements using indigenous plant extracts. Carambola (4%) and turmeric (2%) supplementation in fish feed enhanced growth rates by nearly 49% and increased survival rates from 78.4% to 86-90% in cold-water conditions. Both extracts improved blood parameters indicating enhanced immunity and stress resistance. These natural additives, prepared through simple extraction methods accessible to remote communities, address the physiological challenges of hill aquaculture while potentially increasing farmer income by 30-40% per production cycle through improved productivity and reduced dependence on expensive commercial additives.

Abstract
This study explores the innovative integration of indigenous horticultural resources—carambola (star fruit) and turmeric—as natural feed additives in Northeast India's hill aquaculture systems. Research conducted in Meghalaya demonstrated significant improvements in fish health and productivity when these extracts were incorporated into feed formulations. Carambola extract at 4% inclusion and turmeric extract at 2% inclusion showed remarkable enhancement in growth parameters (approximately 49% increase), survival rates (improved to 86-90%), and physiological indicators in Labeo species. These findings present a sustainable, locally-sourced solution for cold-water aquaculture challenges while optimizing resource utilization and supporting economic development in hill regions.

Keywords: Hill aquaculture, Indigenous horticulture, Natural feed additives, Sustainable aquaculture

Introduction

Aquaculture in Northeast India's hill regions presents distinct operational challenges that require innovative solutions. The cold water conditions and complex topography of Meghalaya's elevated landscapes significantly impede fish metabolism and growth compared to conventional lowland aquaculture systems. Recent research, however, has identified a promising solution within the region's indigenous plant resources.

Investigation into locally abundant horticultural species—specifically carambola (star fruit) and turmeric—reveals their significant potential as natural feed additives for cold-water fish farming. This research demonstrates a transformative approach for hill aquaculture, where local botanical resources effectively address the physiological challenges faced by fish in highland environments. The integration of these indigenous plant extracts into aquaculture feed formulations represents a sustainable development pathway that not only resolves specific cold-water cultivation obstacles but also enhances the utilization of native plant resources while strengthening regional agricultural systems.

Challenges of hill aquaculture and nature's solutions

Meghalaya's aquaculture operations at 950 meters elevation face significant environmental limitations. Water temperatures rarely exceed 20°C and can drop to 6°C during winter months (November-February), creating substantial physiological stress for fish as poikilothermic organisms. These conditions suppress metabolic activity, reduce feed intake, and compromise immune function, resulting in extended growth periods, increased disease susceptibility, and lower production yields compared to lowland systems.

The region's topographical complexity further constrains aquaculture development through limited suitable areas for pond construction and reduced accessibility. Conventional aquaculture methods and commercial additives developed for lowland conditions prove either inadequate or economically unfeasible in these remote highland communities, contributing to reduced profitability and inability to meet growing market demand.

The geographical complexity of hill regions further complicates aquaculture operations. The terrain often limits pond size and accessibility, while natural water sources may be seasonal or limited. Traditional fish farming practices developed for lowland areas often prove inadequate in these highland conditions. Additionally, commercial feed additives designed to enhance fish growth and health are frequently expensive, difficult to obtain in remote areas, and sometimes poorly adapted to the specific challenges of cold-water aquaculture.

The ICAR research team investigated indigenous plants as potential solutions for cold-water aquaculture

challenges, focusing on regionally abundant carambola and turmeric. Phytochemical analysis of carambola revealed significant concentrations of vitamin C (34.4 mg/100g), proanthocyanidins (0.9-1.3 mg/g), flavonoids (104-235 mg/100g), and essential minerals. The fruit's complex bioactive profile—including saponins, alkaloids, tannins, and phenolic compounds—offers documented benefits for immune function, stress mitigation, and metabolic regulation, addressing key physiological requirements for fish in challenging highland environments.

The second local ingredient we tested was "Megha Turmeric-1," a superior variety developed through selection from the renowned *Lakadong* turmeric of Meghalaya. This specific variety isn't just any turmeric – it contains an exceptional 6.4% curcumin content, significantly higher than most commercial varieties. Turmeric has been valued in traditional medicine systems for centuries for its anti-inflammatory, antioxidant, and immune-enhancing properties. These properties are particularly relevant for fish facing the physiological stresses of cold water environments. The rich golden rhizomes of Megha Turmeric-1 represent not just a cultural heritage but a biological treasure trove of compounds that could potentially address the specific challenges of hill aquaculture.

Remarkable results from simple techniques

When we added star fruit extract to fish feed at a 4% concentration, the results were striking. Rohu fish (*Labeo rohita*), one of India's most commercially important freshwater fish species, fed with this enhanced diet showed nearly 50% faster growth rates, with specific growth rate increasing from 1.03% per day in the control group to an impressive 1.5-1.53% per day in the treatment group. This translated to a 36.4% higher final weight compared to fish receiving standard feed. Perhaps equally important for farmers, survival rates improved significantly from 78.4% in the control group to between 86.7% and 88.4% in fish receiving the star fruit-supplemented diet. We also observed significantly better blood parameters indicating improved health, including increased red blood cell counts, higher white blood cell counts, and improved hemoglobin levels.

Similarly impressive results came from turmeric. When incorporated at just 2% in the diet of Kurio Labeo (*Labeo gonius*), an indigenous medium carp valued in local markets, turmeric extract delivered remarkable benefits. Fish showed 34.2% to 36% higher weight gain compared to the control group, while the specific growth rate improved by an impressive 47.5% to 48.5% (increasing from 1.03% per day to 1.52-1.53% per day). Survival rates increased substantially to between 88.4% and 90% compared to 78.4% in fish receiving standard feed. Blood parameter analysis revealed enhanced immune function and stress resistance, with notable improvements in both cellular and humoral immune responses.

Both supplements were prepared using straightforward, farmer-friendly methods that require minimal technology and investment. For star fruit, the process involves harvesting ripe, sweet carambola fruits from local trees, washing and slicing the fruits, crushing them to extract the juice, straining to remove solids, and mixing the resulting extract with standard fish feed ingredients before pelletizing. The simplicity of this process means it can be implemented even in remote areas with limited infrastructure. The entire extraction can be completed using basic kitchen equipment available in most rural households.

For turmeric, the preparation process remains straight forward and accessible. It involves harvesting mature Megha Turmeric-1 rhizomes after 8-9 months of cultivation, thoroughly cleaning them, grinding the fresh rhizomes, and extracting the juice through squeezing. This fresh juice is then incorporated at a precise 2% concentration with standard fish feed ingredients during pellet formulation. This methodology integrates seamlessly with existing turmeric production practices, creating additional value streams for a crop already widely cultivated throughout the region.

The beauty of these approaches lies in their simplicity, sustainability, and cultural relevance. Farmers can produce these feed supplements using locally available materials, reducing dependency on expensive commercial additives while improving fish production. Both star fruit and turmeric are already integrated into the agricultural landscape and cultural practices of Northeast India, making adoption of these techniques more likely to succeed compared to entirely novel approaches.

Comparing benefits and practical applications

Our research with Indian major carp (*Labeo rohita*) and indigenous medium carp (*L. gonius*) revealed distinct efficacy patterns between the two extracts. Star fruit extract (4%) demonstrated superior performance in growth enhancement, cholesterol regulation (25% greater reduction than control), and hepatic enzyme normalization. These differential profiles suggest targeted implementation strategies depending on specific production objectives, with both extracts functioning through comprehensive physiological mechanisms rather than isolated pathways.

Our research revealed distinct efficacy patterns between the two extracts. Star fruit extract (4%) excelled in growth enhancement and cholesterol regulation, while turmeric extract (2%) delivered better survival rates more economically. Turmeric particularly enhanced immune parameters and improved length-weight relationships in fish, with 'b' values showing significant improvements over control groups.

Both supplements elevated blood protein levels and reduced glucose levels, indicating better nutritional status and stress management. These natural additives comprehensively impact fish health by improving oxygen-carrying capacity, liver

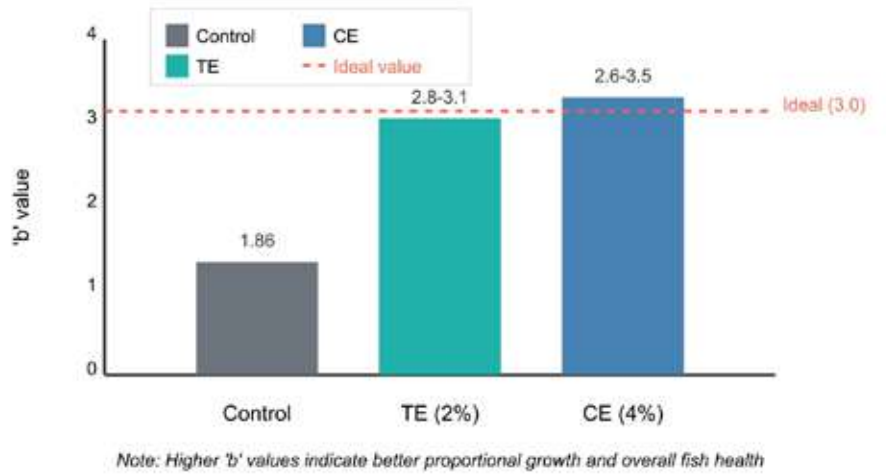

Figure 1. Comparison of fish condition ('b' value) across different feed additive treatments in hill aquaculture of Meghalaya; TE: Turmeric extract, CE: Carambola extract

function, and muscle development—creating more resilient fish better equipped to withstand the challenges of hill aquaculture environments.

What makes these natural additives particularly valuable is their comprehensive impact on fish health. They don't just target a single parameter but improve multiple aspects of fish physiology simultaneously. The improvements in hematological parameters indicate enhanced oxygen-carrying capacity, which is crucial for fish in cold water where dissolved oxygen levels can fluctuate. The normalized enzyme activities suggest better liver function and overall metabolic health. The improved protein levels indicate better nutritional status and muscle development. Collectively, these changes create more resilient fish that can better withstand the challenges of hill aquaculture environments.

The economic implications for farmers are significant. Even factoring in the cost of preparing the extracts, the improvements in growth and survival rates translate to substantial increases in productivity and profitability. For a typical small-scale fish farm in Meghalaya with a pond size of 100 square meters and stocking density of 2 fish per square meter, the improved survival alone could mean 20-24 additional marketable fish per harvest. When combined with the faster growth rates, farmers could potentially increase their income by 30-40% per production cycle.

Table 1. Comparative effects of carambola and turmeric extracts on fish growth and health parameters in hill aquaculture of Meghalaya

Feature	Carambola Extract (4%)	Turmeric Extract (2%)	Control
Fish species	*Labeo rohita* (Rohu)	*L. gonius* (Kurio Labeo)	-
Initial weight	6.41 ± 0.34 g	6.38 ± 0.35 g	Similar baseline
Final weight increase	36.4% higher than control	34.2-36% higher than control	Baseline
Growth rate	1.5-1.53%/day (49.5% increase)	1.52-1.53%/day (48.1% increase)	1.03%/day
Survival rate	86.7-88.4%	88.4-90%	78.4%
Blood values			
- Red blood cells	1.1-1.2 × 10^6/mm³	1.16-1.23 × 10^6/mm³	0.82 × 10^6/mm³
- White blood cells	27.2-32.0 × 10^3/mm³	27.6-31.6 × 10^3/mm³	25.4 × 10^3/mm³
- Hemoglobin	8.1-9.3 g/dl	8.6-9.3 g/dl	7.8 g/dl
Biochemical markers			
- Total protein	8.4-8.9 g/dl	8.5 g/dl	7.4 g/dl
- Blood glucose	73.7-78.8 mg/dl	77.5-80.3 mg/dl	91.2 mg/dl
- Cholesterol	131.4-132.4 mg/dl	152.1-160.7 mg/dl	174.9 mg/dl
Liver enzymes			
- GOT	48.4-54.3 IU/L	46.2-51.1 IU/L	61 IU/L
- GPT	13.7-14.8 IU/L	14.1-14.7 IU/L	16.3 IU/L

Note: All studies were conducted under similar environmental conditions in Meghalaya, with water temperature ranging from 21.15-22.05°C during the experimental period.

Implementation and future prospects

For fish farmers in Meghalaya and similar hill regions, these findings offer practical solutions to longstanding challenges. Implementation requires careful consideration of several factors to maximize benefits. Farmers should choose the right extract based on their specific goals and resources. For maximum growth acceleration, star fruit extract at 4% is ideal, particularly for operations focusing on rapid production cycles. For better survival with more economical input, turmeric extract at 2% is preferred, especially for farmers working with limited resources or in areas where turmeric is more readily available than star fruit.

An innovative integrated approach involves cultivating these beneficial plants on pond dikes or embankments. This strategic placement allows natural exudates from roots and fallen plant materials to leach directly into pond water, creating a continuous, low-dose supplementation that can improve overall pond ecology and water quality while reducing the need for manual extract preparation.

The potential competition between human consumption and aquaculture use of these valuable resources requires thoughtful management. This concern can be addressed through dedicated cultivation zones, where a portion of the harvest is specifically allocated for aquaculture applications. Additionally, processing by-products and lower-grade produce unsuitable for premium markets can be redirected to fish feed preparation, ensuring optimal resource utilization while minimizing competition with human food systems.

Seasonal adaptation is another important consideration. These supplements are particularly valuable during colder months (November to February) when fish face maximum stress from low temperatures. During these periods, the immune-enhancing and metabolism-boosting effects of the extracts can help prevent the growth slowdown and increased mortality typically observed in hill aquaculture systems. During warmer seasons, farmers might reduce the inclusion rates slightly to optimize cost-effectiveness while maintaining benefits.

Quality considerations are essential for maximizing benefits. For star fruit, using sweet varieties rather than sour ones ensures higher levels of beneficial compounds. Similarly, high-curcumin turmeric varieties like Megha Turmeric-1 provide much greater benefits than common commercial varieties with lower curcumin content. Farmers should also ensure proper storage of the extracts to maintain their potency, ideally preparing fresh batches regularly rather than storing for extended periods.

Integration with existing practices is key to successful adoption. These natural supplements can complement rather than replace existing feeding regimens, potentially reducing the need for expensive protein sources in fish diets. They can also be combined with other local management practices such as pond water quality management using lime or integration with poultry or livestock farming.

Image A shows a Carambola fruit (Averrhoa carambola, sweet large variety), while Image B displays Turmeric (var. Megha Turmeric 1, 6.4% curcumin), a premium variety from North East India. Images C and D document the solvent-free extraction processes of Carambola and Turmeric, respectively. Image E demonstrates fish feed preparation using a hand pelletizer, and Image F shows the experimental feeds incorporating both Carambola and Turmeric extracts. The final two images feature the test fish species used in the study: Image G shows Labeo rohita (an Indian major carp, commonly known as rohu), and Image H presents Labeo gonius (an indigenous medium carp).

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