English Monthly from Hyderabad, India

Aqua International

Estd. 1993

Health • Nutrition • Technology • Management

March 2025

Annual Subscription: ₹800 Foreign USD 100

Inside ...

Aqua International

English Monthly Magazine
(Established in May 1993)

Volume 32 Number 11 March 2025

Editor & Publisher
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Editorial & Business Office:
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Annual Subscription
India : Rs. 800
Foreign Countries : US $ 100
or its equivalent.

Aqua International will be sent to the subscribers in India by Book Post and to the foreign subscribers by AirMail.

Edited, printed, published and owned by M. A. Nazeer and published from BG-4, Venkataramana Apts., 11-4-634, A.C.Guards, Hyderabad - 500 004, India. Printed at Srinivasa Lithographics.
Registered with Registrar of Newspapers for India with Regn. No. 52899/93. Postal Regn. No. L II/ RNP/HD/1068/2021-2023.

NRS PUBLICATIONS
www.aquainternational.in

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Subscriptions for Aqua International, English monthly, should be sent to:
The Circulation Department, Aqua International, BG-4, Venkataramana Apartments, 11-4-634, A.C.Guards, Near Income Tax Towers, Hyderabad - 500 004, India. Email: info@aquainternational.in

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We need to have deliberations on certain aspects in addition to disease diagnosis and diagnosis of emerging pathogens in Indian shrimp aquaculture

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Turtle Excluder Devices are an essential conservation tool designed to reduce sea turtle by catch in trawl fisheries, particularly in shrimp trawling. By incorporating a grid mechanism within fishing nets, TEDs allow large marine organisms, such as sea turtles, to escape while retaining the target catch, ensuring minimal disruption to fisheries. Many countries, including the United States and Australia, have made TED usage mandatory to comply with marine conservation laws.

Dear Readers,

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

De-risking Shrimp Aquaculture Value Chain for Improved Global Competitiveness Dr Kuldeep K. Lal, Director, ICAR-Central Institute of Brackishwater Aquaculture, Chennai welcomed the learned participants, experts on the subject and scientists. Dr Lal mentioned that we need to have deliberations on certain other aspects in addition to disease diagnosis and diagnosis of emerging pathogens in Indian shrimp aquaculture. Correct diagnosis is important. Farm pond ecosystem should be kept healthy so that growing shrimps can cope up itself with the good environment and remain disease-free. Dr Lal emphasized on good environment management, good feed, prophylactic measures and SPF shrimp seeds, new precision techniques in shrimp farming, knowing new things. While speaking about de-risking aquaculture and critical inputs, he spoke about value chains like seed, feed and finance, traceability issues in feed chain, developing financial security for farmers. According to him, genetic fitness amongst shrimps should exist, National referral laboratory may be established for feed testing. We have to give improved quality of shrimps to the world (the importing countries), existing ground farms can be modified to new farms and we should keep all the three cultivable shrimp species Penaeus monodon, P. indicus and Litopenaeus vannamei.

Dr Jena further mentioned about proper disposal of used water in shrimp farms, in the context of increasing number of shrimp farms. Good water quality is essential for shrimp farming that should not lead to disease, and farms use brackishwater from canals. Collective wisdom (with that of farmers who do at practical level) and collective responsibility is needed. WSSV is a concern in P. monodon farms and farmers have to maintain good management practice (GMP) to check disease situations, need to have good management strategies, good surveillance. Farmers should join scientists in surveillance programmes, they can help researchers in better programmes. Developments can be taken to the benefit of industry. Quantum of production of shrimp feed is not important, but availability of the ingredients is important. About 30-40 million tonne of feed will be required for 40 million tonne fish and shrimp production in India by the year 2047. Quality of raw material (ingredient) and their quantity is important, also farming of Spirulina sp.

Novel fish health sampling technology lands funding undertaken by Esox Biologics – a biotech company which uses genomics to prevent the spread of infectious disease in aquatic livestock – the goal is to establish the UK aquaculture

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.

TALK TO US

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industry's first Regulatory Science and Innovation Network (RS&IN). The network will establish dialogue with Fish Health Inspectorate, Marine Directorate, CEFAS and DEFRA to assess the use of whole-genome metagenomics – an innovative technology that identifies every micro-organism in a sample by sequencing its unique genetic code, thereby enhancing health management in aquaculture and reducing analysis costs.

In the Articles section, article titled **Revolutionizing Shrimp Hatchery Nutrition: Elevia as a Single Dry Feed Solution**, authored by Skretting India, most shrimp hatcheries, particularly those cultivating Litopenaeus vannamei, have historically depended on mixed dry diets, or "cocktail feeding." This method, while aiming to provide comprehensive nutrition, introduces significant variability, labor costs and potential water quality issues. Hatchery managers must carefully balance multiple feed sources, leading to inconsistent nutritional delivery and increased risk of overfeeding or underfeeding. Furthermore, the sourcing and handling of multiple diet components add logistical complexity, increasing the likelihood of errors and inefficiencies. Another critical challenge with cocktail feeding is the potential for inconsistent feed quality. Depending on the ingredients used, some batches may be more nutritionally dense than others, resulting in fluctuations in shrimp growth performance. Physically, different diets often vary by upto 100% in the size distribution which impact both water quality and uniform growth. This inconsistency can create additional challenges for hatchery operators who rely on stable and predictable larval development.

Another article titled, **Turtle Excluder Devices (TEDs) in Fisheries: Balancing Marine Turtle Conservation and Fishers Livelihoods in India** authored by S.Felix, N.Karthik and M.S. Swathy, Devi College of Fisheries Science, St. Devasahayam Institute of Fisheries Science and Technology. Turtle Excluder Devices are an essential conservation tool designed to reduce sea turtle by catch in trawl fisheries, particularly in shrimp trawling. By incorporating a grid mechanism within fishing nets, TEDs allow large marine organisms, such as sea turtles, to escape while retaining the target catch, ensuring minimal disruption to fisheries. Many countries, including the United States and Australia, have made TED usage mandatory to comply with marine conservation laws. India introduced TEDs on a trial basis in the 1990s, particularly along the Odisha coast, home to significant Olive Ridley turtle nesting sites. The development of TEDs began in the 1970s in response to rising sea turtle mortality due to shrimp trawling. By the late 1980s and early 1990s, legislative measures, such as the U.S. Endangered Species Act, mandated TED use in commercial fisheries. Technological advancements in TED design improved their efficiency and International organizations like FAO promoted their adoption. India's TED implementation was driven by conservation concerns and trade regulations imposed by the U.S. TEDs have significantly reduced sea turtle mortality globally, though concerns about their economic impact on fisheries persist.

Another article titled, **Tilapia Parvovirus: A Growing Concern for Aquaculture in India**, authored by Vipul Singh Badguzar, Anjana A, Rajesh Kumar, Ayushi Bhardwaj said that in India, tilapia farming is carried out in several states, such as Andhra Pradesh, Maharashtra, Kerala, Karnataka, Tamil Nadu, Chhattisgarh and West Bengal. The top producers of tilapia are the southern states, especially Andhra Pradesh.

Unfortunately, tilapia farming faces a threat in the form of Tilapia Parvovirus (TiPV). The recent report of this virus in ponds in Walajah in Ranipet district of Tamil Nadu, India in the year 2023 has raised alarms in the aquaculture community across the country. The Aquatic Animal Health Laboratory of C. Abdul Hakeem College's research team reported this virus in February and March 2023, while regular screening work for viral pathogens was going on. This novel virus was first time reported in China in the year 2019 followed by Thailand in the year 2021 (Yamkasem et al., 2021). India is the third country to report the occurrence of TiPV. TiPV has resulted in mortality rates in fish farms ranging from 30% to 50%. Its devastating impact is demonstrated by the 100% mortality it has caused in experimental settings. TiPV virus has also been shown to cause co-infection with another virus like tilapia lake virus (TiLV) and secondary pathogenic bacteria like Streptococcus agalactiae and Aeromonas spp. Various mass mortality incidences due to this virus made it necessary for fish pathologists to conduct continuous screening of this virus and also to do research on disease characteristics, control, pathophysiological changes, early diagnosis, management and biosecurity strategies. The aim of this article is to aware the readers about TiPV infections and enable farmers to identify the infection based on the clinical signs. Understanding the virulence, host-specificity and epidemiological risk factors of this newly emerging virus requires a holistic strategy.

Another article titled, **Chromis viridis: The Shimmering Blue-Green Gem of Coral Reefs**, authored by Rekha M. U. and T. T. Ajith Kumar discussed that the aquaculture sector in Meghalaya faces a substantial production deficit with current output at 18,000 MT significantly below the regional requirement of 36,360 MT. This gap holds particular significance as over 22,000 individuals depend on fisheries for their livelihood. The state's distinctive matrilineal social structure presents a unique opportunity for sector development, as historical evidence suggests that women's participation in agricultural enterprises often correlates with higher success rates and improved productivity outcomes. The integration of traditional knowledge with modern aquaculture practices creates a foundation for sustainable development in the region.

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
Editor & Publisher
Aqua International

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* COMPOSITION:

Bacillus spp. > 1x 10^{11} cfu/kg	15%
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* STORAGE:

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* DIRECTION OF USE:

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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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De-risking Shrimp Aquaculture Value Chain for Improved Global Competitiveness

New Delhi: The 14th Asian Fisheries and Aquaculture Forum was held at ICAR Convention Centre, National Agriculture Science Complex, DPS Marg, Todapur, New Delhi during 12-15 February, 2025. It was organized by Asian Fisheries Society (AFS), Malaysia; AFS Indian Branch; Indian Council of Agricultural Research and Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India. As a part of this grand event and occasion, the Satellite Event 'Academia-Industry-Government Meet' was organized on 14 February, 2025 at Parijat Lecture Hall, Ground Floor, NAAS Block, National Agriculture Science Complex on the theme 'De-risking Shrimp Aquaculture Value Chain for Improved Global Competitiveness', with an aim towards sensitization and exchange of ideas on improving input usage efficiency and innovative practices in brackishwater aquaculture and discussion on emerging challenges and measures for sustainable shrimp culture in India.

In the inaugural session, Dr Kuldeep K. Lal, Director, ICAR-Central Institute of Brackishwater Aquaculture, Chennai welcomed the learned participants, experts on the subject and scientists. Dr Lal mentioned that we need to have deliberations on certain other aspects in addition to disease diagnosis and

Chief Guest Hon'ble B. Masthan Rao, Member of Parliament in Rajya Sabha addressing the audience

diagnosis of emerging pathogens in Indian shrimp aquaculture. Correct diagnosis is important. Farm pond ecosystem should be kept healthy so that growing shrimps can cope up itself with the good environment and remain disease-free. Dr Lal emphasized on good environment management, good feed, prophylactic measures and SPF shrimp seeds, new precision techniques in shrimp farming, knowing new things. While speaking about de-risking aquaculture and critical inputs, he spoke about value chains like seed, feed and finance, traceability issues in feed chain, developing financial security for farmers. According to him, genetic fitness amongst shrimps should exist, National referral laboratory may be established for feed testing. We have to give improved quality of shrimps to the world (the importing countries), existing ground farms can be modified to new farms and we should keep all the three cultivable shrimp species Penaeus monodon, P. indicus and Litopenaeus vannamei.

As Guest of Honour, Dr Bijay K. Behera, Chief Executive, National Fisheries Development Board, Hyderabad gave a comprehensive account of the major schemes of NFDB provided for fish farming community. He stated that in addition to research, NFDB aims at 'Farmers First', and to develop National Fisheries Development Platform; helping growth of small marginal farmers and to improve their livelihood; to adopt and apply entrepreneurial model of NFDB; awareness is being created about NFDB's support and help; Crop Insurance scheme, Fisheries Infrastructure Development Fund; strengthening of Fishermen Cooperative Societies and fish market information system; means of increasing domestic fish and shrimp consumption. Dr Behera informed that NFDB gives fund for organizing sensitization, outreach and training programmes, awareness creation, fund upto 5 crores provided for entrepreneurial project.

Dr J. K. Jena, Deputy Director General (Fisheries), ICAR, New Delhi and Guest of Honour in his address mentioned that we should give what we know, with so much transformation happened in technology in every area of fishery and aquaculture. Today Indian shrimp aquaculture industry is sufficient in pelleted feed; importance to be given on quality of shrimp seed, selective-bred seed, good brooders. There should be no risk from broodstock, we must be equipped with good broodstock facilities. Broodstock multiplication centre of P. monodon has been established. We must foresee and strategize the issues that shrimp industry will face in next 10 years. Market is major issue and has to be resolved, and also issue of domestic market. It will help to de-risk shrimp farming. Dr Jena made a brief comparison on availability of pelleted shrimp feed, cost of production of shrimp, farm gate price, FCR, shrimp hatcheries in year 2025 to that of year 1990. He emphasized on creation of new markets. There is not adequate amount of good shrimp available for home consumption. We should plan about ensuring and getting good quality shrimps and its

Dr K. K. Lal giving his Talk

more supply at doorsteps. Production can be met in higher amounts but 'what produced, that must be sold'. Good education is needed about shrimp quality.

Dr Jena further mentioned about proper disposal of used water in shrimp farms, in the context of increasing number of shrimp farms. Good water quality is essential for shrimp farming that should not lead to disease, and farms use brackishwater from canals. Collective wisdom (with that of farmers who do at practical level) and collective responsibility is needed. WSSV is a concern in P. monodon farms and farmers have to maintain good management practice (GMP) to check disease situations, need to have good management strategies, good surveillance. Farmers should join scientists in surveillance programmes, they can help researchers in better programmes. Developments can be taken to the benefit of industry. Quantum of production of shrimp feed is not important, but availability of the ingredients is important. About 30-40 million tonne of feed will be required for 40 million tonne fish and shrimp production in India by the year 2047. Quality of raw material (ingredient) and their quantity is important, also farming of Spirulina sp. Black soldier fly is a very good 'miraculous' animal protein for aquaculture but its production is not very high. We have to collaborate; knowledge for aquaculture production is not deficient now. We have to come out with better than the best, not only be dependent upon Andhra Pradesh and Gujarat for production. Mariculture finfish species have come, yellowfin tuna may be a candidate species for tomorrow (in near future). Marketable size of P. indicus could be increased from 20gm to 30gm after generations and generations of selective breeding programme. We have to strategize and think about 'De-risking' for next 15-20 years, short vision.

Dr Jena said that it is our moral responsibility to see that future generation get good quality shrimp, we have to ensure its quality and safety. Total system should be there in place for tracking traceability, also for domestic market. Quality feed determines the final product of shrimp – product must be made safe following all protocols of GMP. Pond sediment management must be done at farmer's level after 2-4 crops. Many farmers do not do tilling, ploughing and soil amendment. We should think about every small aspect in context of de-risking. In context of pond nutrient management, we should also discuss about micronutrients like zinc, cobalt, etc in addition to N, P, K. After application of recommended probiotics in pond water, the microbial load will not be the same in every pond. We have to think about how to manage it. 'Before de-risking, less should be the risk'. We have to go to villages, think and work on small things. After one crop of shrimp in brackishwater ponds, we can do a crop of finfish like Chanos chanos or Karimeen – reduction of disease by 50% is achievable. It is a small de-risking measure. It was entirely such an influential and informative talk of Dr J. K. Jena.

Chief Guest of this programme was Mr B. Masthan Rao, Hon'ble Member of Parliament in the Rajya Sabha; Founder Chairman and Managing Director, BMR Group of Industries, Andhra Pradesh; Member of Standing Committee in Fisheries and Aquaculture; eminent and progressive shrimp farmer and farmer representative to Rajya Sabha. Sri Rao comprehensively and thoughtfully discussed in detail about India's position in global seafood market; shrimp aquaculture as employment provider and foreign exchange earner; overview of BMR Group and sustainable shrimp farming; difficulties and challenges faced by Indian shrimp industry and possible means of overcoming it; trying to find out solutions for shrimp industry. He emphasized on promoting farmers' welfare, updating knowledge on the part of progressive shrimp farmers, implementing the practice and continuing improvement to ensure the effectiveness of quality marketable-sized farmed shrimp product. After Mr Rao's address, Dr Shubhadeep Ghosh, Asst. Director General (Marine Fisheries), ICAR gave the Vote of Thanks.

After the inaugural session of this Satellite Event, Technical Session-1 titled 'Critical inputs, efficiency, availability and innovations' was held. Invited experts who spoke in this Session were Dr Akshaya Panigrahi, Principal

Dignitaries in the inaugural session

Dr J. K. Jena giving his speech

Scientist, ICAR-CIBA; Dr Ravikumar Yellanki, President, All India Shrimp Hatchery Association; Dr K. Ambasankar, Principal Scientist, ICAR-CIBA; Dr K. P. Kumaraguru Vasagam, Principal Scientist, ICAR-CIBA and Mr U. Cherukuneedi, Managing Director, M/s Uday Aqua Connects Pvt. Ltd, Hyderabad. In addition to these persons, Panelists from reputed companies associated with shrimp farming industry presented their opinion.

In Technical Session-2 titled 'Shrimp farmer resilience and trade', invited experts and speakers included Dr Satyen K. Panda, Advisor (Quality Assurance), FSSAI, Govt of India and Principal Scientist, ICAR-CIFT, Kochi; Mr S. Santhana Krishnan, Chief Executive Officer, Maritech, Tamil Nadu; Dr P. Jayagopal, Deputy Director (Aquaculture), MPEDA; Dr Manoj M. Sharma, Director, Ms Mayank Aquaculture Pvt. Ltd, Surat; Mr P. Kosaraju, Aqua Exchange Agritech Pvt. Ltd and Dr T. Ravisankar, Principal Scientist, ICAR-CIBA. In addition to these persons, new team of Panelists from reputed companies presented their opinion in Technical Session-2. News communicator Subrato Ghosh was present as listener all throughout in this Satellite Event organized on the theme 'De-risking Shrimp Aquaculture Value Chain for Improved Global Competitiveness'. It was entirely a very good programme - enriching discussion and deliberations were made in the two Technical Sessions following the inaugural session.

Parijat Lecture Hall, venue of the Satellite Event

World Aquaculture Safari'25: Aquaculture Meet in Africa to Date

24 - 27 June 2025, Entebbe, Uganda
Speke Resort Munyonyo, Entebbe, Uganda

Africa: When thinking of Africa, especially East Africa, it is easy to conjure up scenes of wildlife and safaris. Less well-known is that this region boasts large and abundant inland water reserves, including Lake Victoria as the world's second largest freshwater lake and the world's largest tropical lake. Lake Victoria is roughly the size of Ireland and feeds the mighty Nile River (the world's longest river).

When one adds a warm tropical climate, an abundant marine environment on the East coast of Africa, and a well-developed society and growing population, then it does not take long to ponder the question: "… and aquaculture?"

Indeed, East Africa is the fastest growth node for aquaculture on the African continent. This is predominantly as a result of the farming of tilapia, but several other species contribute to the sector. East Africa is also a world leading region in the farming of seaweed, with exciting developments around several other marine species such as sea cucumber and more.

The EU-funded TRUEFISH Project, which seeks the advancement of aquaculture in the Lake Victoria Basin, showcased the region to the World Aquaculture Society (WAS) Board in 2022, which was

well accepted and led to the pinning down of June 2025 as a suitable date for an aquaculture conference in the region. This in turn led to the signing of an hosting agreement between WAS and Landell Mills as an implementing partner of TRUEFISH.

Selecting the shores of Lake Victoria for an aquaculture conference was easy. However, the only lake city that offers direct flights to major international air travel hubs, is Entebbe in Uganda. A mere 38 km from the airport (on good quality and uncongested roads) lies the Speke Resort Munyonyo - a world class conference and exhibition facility on the shoreline of Lake Victoria.

Through Egypt (2022), Zambia (2023) and Tunisia (2024), the African Regional Aquaculture (AFRAQ) Conferences have shown steady growth. It is however important to emphasize that Aquaculture Safari'25 is a World Aquaculture Conference, incorporation both the continental event and the showcase world event. Undoubtedly, it will address key African topics such as tilapia and catfish production, but the conference will cater for a

global audience covering a diverse range of papers, meetings, discussions, workshops and more. Already, commitments of participation have been received from the likes of the FAO, the World Bank, the African Development Bank, GIZ, the African Union and others. Moreover, the trade show and exhibition promises to assemble the largest selection of aquaculture goods and service providers under one roof, in Africa, to date.

Participants will range from academia to state officials, from technology providers to students, from farmers to fish buyers and exporters, and more. Apart from papers from across the world, plans are also afoot for an extensive farmer's day, several side events such as an aquaculture investment and a seaweed workshop, and a field day to some of the largest fish farms on Lake Victoria. African countries will also showcase their aquaculture sectors in the trade show, allowing for global networking.

Under the theme "***Aquaculture on the Rise***", the World Aquaculture Safari '25 aims to:

1. Showcase the aquaculture industry in Africa and globally.
2. Forge international collaborations and linkages, in areas such as research, development, species, feeds, investments, markets, trade and more.
3. Unify the global aquaculture sector.

For international visitors

the tourism opportunities before and after the conference are limitless. These include trekking for gorillas and chimpanzees (get your permits early!), visiting some of Africa's famous Big Five game reserves in Uganda, Kenya and Tanzania, visiting or rafting the Nile River, witnessing the majestic Murchison Falls, seeing Mount Kilimanjaro or the tropical seas of Zanzibar.

Africa awaits its international aquaculture guests with excitement. Registration is now open. The WAS welcomes interested Sponsors for World Aquaculture Safari '25.

ICAR-Central Institute of Fisheries Technology, Cochin Conducts Training Program on Sensory Analysis of Shrimp Decomposition

Cochin: The ICAR-Central Institute of Fisheries Technology (CIFT), Cochin, is organizing a two-day training program on Sensory Analysis of Shrimp Decomposition today. The program aims to equip seafood processing industry professionals with essential skills to assess shrimp decomposition as per FDA(Food and Drug Administration) protocol to maintain superior quality standards and enhance marketability. The training was inaugurated by Dr K.N. Raghavan, IRS, Secretary General of the Seafood Exporters Association of India. In his inaugural address, he emphasized the importance of maintaining high seafood quality standards in the face of global competition. He remarked, "We had a flourishing seafood industry growing exponentially, reaching $8 billion. To sustain and grow, we must improve our quality standards."

Dr K.N. Raghavan, IRS, Secretary General of the Seafood Exporters Association of India, inaugurates the training program and addresses the gathering.

Dr George Ninan, Director of ICAR-CIFT, delivered the Presidential address, highlighting the critical role of sensory analysis in ensuring seafood quality and preventing trade disruptions due to rejected consignments.

This specialized training program is designed for seafood technologists and quality assurance personnel to develop expertise in the sensory evaluation of shrimp. Participants will learn to conduct, interpret and report sensory analyses as a key regulatory tool for ensuring consumer safety and export compliance.

Dr Zynudheen A.A., Principal Scientist and Head of the Quality Assurance & Management Division, along with Dr Laly S.J. and Dr Priya E.R., Scientists from the Quality Assurance Division, ICAR-CIFT, also spoke at the inaugural session.

A total of 11 participants from various seafood export units across India are attending the training, benefiting from expert guidance and practical learning experiences.

Source: Central Institute of Fisheries Technology (CIFT)

Aditi Enterprise: Pioneering High-Quality Potassium Minerals for Aquaculture

Ankleshwar, Gujarat: Aditi Enterprise, led by Umesh Ramani, is a renowned manufacturer of *Potassium* and its derivative minerals for the aquaculture industry. The company is dedicated to strengthening the availability of high-quality raw minerals essential for shrimp and fish farming.

After completing his Bachelor of Engineering from Anna University, Chennai, he has begun his career in the food industry. Since 2012, he has been deeply involved in aquaculture, managing his own farming facilities in Gujarat. Facing challenges in sourcing high-quality minerals at sustainable rates, he embarked on a mission to find a viable solution.

Umesh Ramani, Head, Aditi Enterprise

Residing in India's largest chemical industrial hub, Ankleshwar, he recognized the potential to manufacture superior-quality minerals for the benefit of aquaculture and small-scale farmers who struggle to access premium-grade minerals at affordable prices. This vision led to the establishment of Aditi Enterprise's ultra-modern potash mineral manufacturing facility in Ankleshwar, Gujarat.

Through continuous research and testing, including trials on his own Vannamai, Tiger Shrimp, and fish cultures, company has meticulously developed the precise parameters for potassium that best suit aquaculture. The company's commitment to quality and consistency has driven its expansion, leading to the establishment of two additional manufacturing units in Bhavnagar and Saykha, Gujarat, with a total production capacity of 1,200 MT per month.

A view of the facilities in the factory

Today, Aditi Enterprise manufactures various grades of potassium used across multiple industries, including aquaculture, food, pharmaceuticals, and chemicals industries.

Addressing industry concerns, Umesh Ramani emphasizes that the production of aquaculture minerals should avoid harmful chemical substances, as long-term exposure to such materials can adversely affect farming yields. With extensive research and development, Aditi Enterprise has emerged as a market leader in aquaculture minerals, fulfilling the needs of various companies that incorporate these minerals into their products.

When *Aqua International* asked about the company's mission, Umesh Ramani stated, "Our primary focus is to reduce the cost of essential minerals, ensuring that farmers can use them whenever required without financial constraints. Successful aquaculture depends on various parameters such as climate conditions, seed quality, water conditions, timely monitoring, nutritious feed and high-quality minerals. At Aditi Enterprise, we not only deliver premium-grade potash on time but also continuously enhance its purity and quality to support hardworking farmers and the aquaculture industry."

With innovation, sustainability and farmer-centric solutions at its core, Aditi Enterprise continues to set new benchmarks in the field of aquaculture minerals.

Novel fish health sampling technology lands funding

A pioneering initiative that aims to improve the health of farmed fish by using cutting-edge technology to detect all pathogens in a given sample has been awarded £471,000 by Innovate UK.

Undertaken by a consortium led by Esox Biologics – a biotech company which uses genomics to prevent the spread of infectious disease in aquatic livestock – the goal is to establish the UK aquaculture industry's first Regulatory Science and Innovation Network (RS&IN).

The network will establish dialogue with Fish Health Inspectorate, Marine Directorate, CEFAS and DEFRA to assess the use of whole-genome metagenomics – an innovative technology that identifies every micro-organism in a sample by sequencing its unique genetic code, thereby enhancing health management in aquaculture and reducing analysis costs.

Existing methods for pathogen detection rely on PCR; a sensitive but limited approach as each test may detect only a single pathogen. Single-target methods mean the cost of pathogen detection scales linearly with each pathogen screened. Health managers and veterinarians frequently monitor a select-few pathogens when they suspect disease.

The project brings together key partners across multiple sectors:

Whole-genome metagenomics identifies every micro-organism in a sample, enhancing pathogen detection in aquaculture and reducing analysis costs

- Academia: University of Glasgow
- Fin-fish Production: Kames Fish Farming, Bakkafrost Scotland, Scottish Sea Farms.
- Aquatic Veterinary Medicine: Aquatic Vets Ltd
- Consultancy: Aquatic Consultancy Services and the British Trout Association.
- Biotechnology: Esox Biologics Ltd

Regulatory approval

Launching on 1 February, the project will establish an approved framework for utilising whole-genome metagenomics in aquaculture.

Currently, the absence of standardised regulatory guidance prevents reproducibility and consensus, limiting the technology's adoption. By working alongside regulators, the RS&IN will create a roadmap for regulatory approval, ensuring that pathogen detection in aquaculture meets robust scientific and policy standards.

Known as their 'Detect' platform, Esox Biologics launched whole-genome metagenomics for aquaculture in March 2024 and are servicing clients across the UK and Europe, analysing the microbiomes in water, swab and sediment samples. Due to its infancy, whole-genome metagenomics does not have a standardised method approved by regulators and guided by policy.

The new network will trial the use of whole-genome metagenomics on samples collected at key production sites along the west coast of Scotland.

They will then present these findings to the relevant regulators and together build a roadmap for the adoption of whole-genome metagenomics as an approved pathogen detection tool in aquaculture.

As Matthew Pope, managing director of Esox Biologics, explained to *The Fish Site*: "This funding from Innovate UK demonstrates the government's desire to support the development and implementation of innovative technologies. Whole-genome metagenomics will enhance health management and disease prevention in aquaculture, but many technical and regulatory hurdles must be addressed first. This funding will foster conversations between the regulators and industry and enable crucial datasets to be gathered which will inform new policy."

Source: The Fish Site

ICAR-CMFRI Celebrates 78th Foundation Day with 3-day Fish Fest and Open House Exhibition

Kerala: The ICAR-Central Marine Fisheries Research Institute (CMFRI), Kochi celebrated its 78th Foundation Day with a vibrant three-day Fish Festival and Open House exhibition held from 1 to 3 February 2025.

The Fish Fest featured seafood fest, technology exhibition, buyer-seller meet, workshops and training sessions. Latest advancements in the fisheries sector developed by various research institutes were showcased at the technology exhibition. An array of local delicacies of green mussel, oyster, octopus and various fish and shrimp dishes were the highlight of the seafood fest. A Buyer-Seller Meet of locally produced authentic farm fresh items was held with an aim of connecting farmers directly with consumers under the leadership of Ernakulam Krishi Vigyan Kendra of ICAR-CMFRI. The event witnessed a huge turnout of public helping them to familiarise authentic farm products of organic origin.This helped over 20 Farmer Producer Organisations (FPOs) secure business deals for their products. The Fest Festival also promoted women empowerment with the event offering a good opportunity for many women SHGs to showcase their products such as bamboo craft, home-made sweets and their seafood delicacies.

Farming inputs including nets were distributed to farmer SHGs belonging to the SC community under the Scheduled Caste Sub Plan (SCSP) scheme of ICAR-CMFRI.

Open House Exhibition

The Open House Exhibition held on 3 February offered a fascinating glimpse into the wonders of marine life, with conservation efforts of marine mammals and other endangered species getting particular attention. The exhibition turned out to be a powerful visual aid to create public awareness of conservation, marine pollution, climate change impact, ecosystem degradation etc. ICAR-CMFRI's National Marine Biodiversity Museum that housed 2856 specimens, laboratories, marine aquarium, library, hatcheries, BSF-based waste management unit, agricultural technology centre and various other facilities were open to the public at the open house exhibition. Large number of students flocked to the institute to watch a ringside view of diverse marine life, including fishes, molluscs, algae, sea snakes, crustaceans, precious pearls and shell jewellery. Display of massive whale skeleton became the centre of attraction at the event. An art installation depicting ocean strata highlighted the threat of plastic pollutions to the marine ecosystem.

A diverse array of captured fishes such as sharks, rays, swordfish, bat fish and tunas, along with shellfish varieties including prawns, lobsters, crabs and cuttle fishes showcased at various laboratories. Big eye binoculars used for off-shore marine mammal survey, oceanographic instruments for assessing physical ocean parameters, seaweed cultivation method and a range of marine technological advancements were exhibited. Models of cage fish farming, integrated multi-trophic aquaculture system (IMTA), recirculating aquaculture system (RAS) and biofloc farming were demonstrated.

A scientist-student interaction received special attention as it served as a platform for exchanging knowledge on ICAR-CMFRI's research works and technological innovations in the marine fisheries sector. Scientists from National Remote Sensing Centre also took part in this session. Laboratories related to molecular biology, bioprospecting, cell culture, fishery biology, environmental research, climate change, ocean acidification etc. also were opened to the public during the programme.

The Foundation Day was also celebrated at ICAR-CMFRI's various Regional Centres and Research Stations with innovative programmes.

Gassen Plus

Bon Ammonia and obnoxious Gasses

Shrimp / Fish performs all their body functions and growth in water. Good quality water and proper D.O. levels determines the success or failure. Good quality water, optimum D.O. level is of prime importance for health and growth of Shrimp / Fish.

Irregular water exchange, excess and leftout feed, dead algae, fecal matter, increases the organic load at the pond bottom. Accumulation of such waste absorbs available oxygen, creating anaerobic condition which leads to pollution of pond bottom. Polluted pond bottom and unhealthy environmental conditions triggers the release of toxic gasses like Ammonia, H_2S, Methane, etc, The toxicity of Ammonia, Hydrogen Sulphide, Methane attributed mainly due to unionized form. As the concentration in water increases, ammonia excretion by aquatic organism diminishes and the level of ammonia in blood and in other tissues increases. Ammonia increases oxygen consumption by tissues, damage gills and reduces the ability of blood to transport oxygen, and increases the disease susceptibility. To eliminate / overcome the above problems 'GASSEN PLUS' Yucca Schidigera, it contains Steroidal"Saponin" which help to reduce ammonia and other noxious gasses such as H_2S, Methane, etc., Microbial enzyme "Urease' Production inhibited by Saponin which leads to an increases D.O. and reduction of BODand COD levels.

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.

COMPOSITION:
YUCCA SCHIDIGERA
ALOEVERA
BACILLUS SUBTILIS
BACILLUS POLYMIXA
BACILLUS LICHENIFORMIS
NITRASOMONAS
NITROBACTOR
STABILIZERS

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Artemia:
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Zoea & Mysis:
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Stagewise control of *Vibrio sp.* results in remarkable reduction of *Vibrio sp.* load in post larval tanks. This results in high health seeds.

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PROBIOTIC	✓
SANITISER	✗
DISINFECTANT	✗✗
ANTIBIOTICS	✗✗✗

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ONE HEALTH APPROACH

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"V PHAGES" cocktail targets against most common pathog

• ***Vibrio parahaemolyticus*** • ***Vibrio alginolyticus*** • ***Vibrio h***

100 % Natural | Pathogen specific approach | V
Easy & Safe to use | Do

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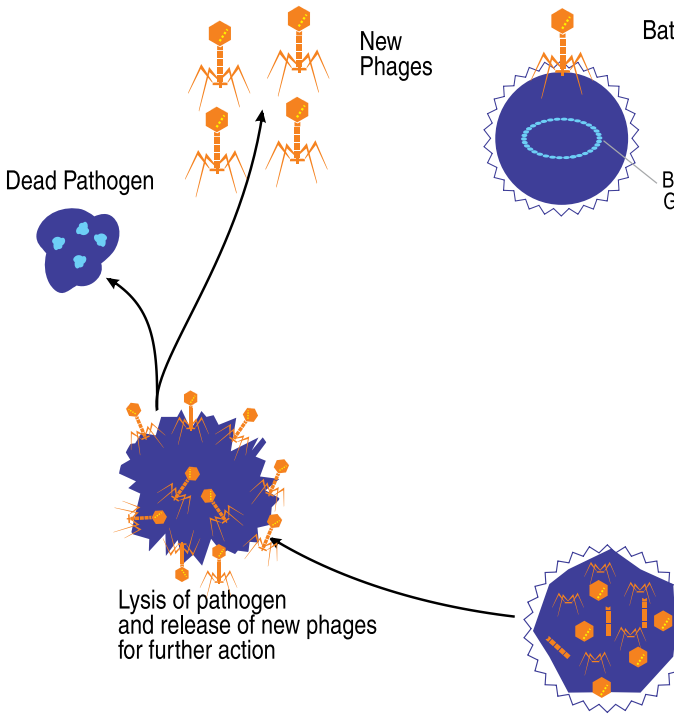

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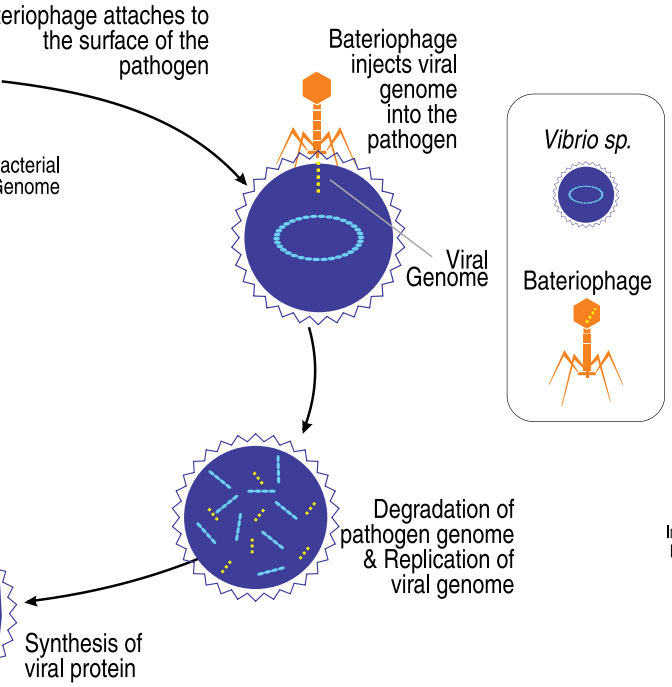

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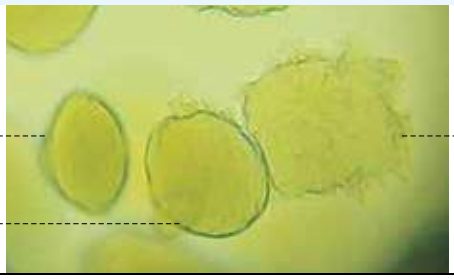
- Enhances Probiotic performance.

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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78 Foundation Day Celebrations at Mandapam

The 78 Foundation Day of ICAR – Central Marine Fisheries Research Institute (CMFRI) was celebrated at the Mandapam Regional Centre on 3 February, 2025 by organizing 'Open House' for the benefit of students and general public. The event was inaugurated by Mr R. John, Principal In-charge, PM Mr Kendriya Vidyalaya, Mandapam, Mr Ravichandran, Headmaster, Panchayat Union Primary School, Marakayarpattinam in the presence of Dr Vinod K., Principal Scientist & Head and staff of the Centre. More than 1950 students and 250 public representing three districts viz., Ramanathapuram, Sivagangai & Virudhunagar participated in the programme. They visited the Marine Aquarium, Marine Biodiversity Museum, Maine Fish Hatchery, Seaweed Plantlet Production Unit, National Marine Fish Broodbank and observed the display of research activities taken up at the centre. Scientists and staff of Mandapam Regional Centre of ICAR-CMFRI exhibited and explained the visitors about the on-going research activities and salient achievements. A student-scientists' interaction meeting was conducted to create awareness for 9 standard students on marine biodiversity conservation & motivation-career guidance was also given for 11 standard students. A total of 250 students were benefitted through the interaction programme.

78 Foundation Day Celebrations at Tuticorin

Tuticorin: ICAR-Central Marine Fisheries Research Institute is the premier nodal research organization conducting research on various aspects of Marine Fisheries in India. ICAR-CMFRI with its Head Quarters situated at Kochi, in Kerala has four Regional Centres and seven Regional Stations and two Krishi Vigyan Kendra situated all along the East and West coast of India catering to the needs of all the Maritime States of India in Marine Fisheries Sector.

ICAR-Tuticorin Regional Station of CMFRI situated in South Beach Road, Tuticorin (Near Roche Park) is one of its foremost and renowned regional station in Tamil Nadu founded in 1948 as a Survey Centre and grew to its current status of Regional Station is known Nationally and Internationally for its contribution to Marine Fisheries Research of India. ICAR-TRS of CMFRI conducts research in various aspects such as Fishery Resource Assessment, Environmental monitoring, Mariculture, Biodiversity and Socio Economics studies of fisher folks of this coast. The Station is known for developing hatchery technologies for seed production of bivalves; sea cucumber and marine ornamental gastropods. It also has developed farming technology, culture pearl production technology and tissue culture of marine pearls. The Station also has propagated the open sea cage culture of selected marine fin and shell fish species.

In the 78 Foundation day celebration on 03.02.2025, the Station has conducted "Open House 2025" and kept open its research laboratories and other facilities to the public. The function was inaugurated at 10.00 AM by Dr Loveson Edward L Senior Scientist & Scientist-in-Charge, of ICAR-TRS of CMFRI, Thoothukudi, in the presence of Scientists, staff of TRS of CMFRI, School teachers and students from various schools of Thoothukudi district.

The Researchers & Students from various schools and colleges and general public visited all the laboratories, museum, hatcheries, aquarium and video show arranged at the Conference Hall of the centre. The total number of visitors including the students and other public were more than 1500 numbers (includes school and college students from 15 institution and 100 number of public). All the Scientists explained various activities being carried out by them to the students and public. The programme was covered very well by the print and electronic media.

78 Foundation Day Celebration at Visakhapatnam

Visakhapatnam 3 February 2025: The ICAR-Central Marine Fisheries Research Institute (CMFRI), celebrated its 78th Foundation Day with great enthusiasm and participation from dignitaries, students, researchers and the general public. The event was inaugurated by the Chief Guest, Dr James S. K. Adams, M.D., Dr Agarwal's Health Care, Visakhapatnam, and attended by heads of various fisheries institutes, representatives from FSI, MPEDA, NIFPHATT, ICFRE, Andhra University, NIO, VPT, Department of Fisheries, CIFT etc.

The Foundation Day celebrations witnessed an overwhelming response, with around 1,000 students from 6 schools and research scholars from Andhra University visiting the center. The young minds were captivated by the institute's research activities and the Marine Museum, which houses over 250 specimens and live fish, including the Golden Trevally, Orange-spotted Grouper and Indian Pompano along with their babies. The exhibits on artificial reefs and marine biodiversity were major

crowd-pullers, drawing awe and curiosity from the visitors.

Located at the picturesque Ramkrishna Beach, the ICAR-CMFRI Regional Centre has been a cornerstone in supporting aqua farmers, fish culturists and marine fishers in the region for decades. The Foundation Day event highlighted the institute's commitment to marine fisheries research and conservation, while also engaging the community through interactive sessions and educational activities.

Students and visitors were particularly fascinated by the unseen world of marine fisheries, eagerly asking questions about various aspects of marine life. Dr Joe K. Kizhakudan, Head of the Regional Centre, along with a team of scientists, spearheaded the event, explaining the importance of marine life and inspiring young minds to explore the field of marine research.

The day-long program included:

- Display and Interpretation of marine biodiversity and research achievements.
- Scientist Interactions, where researchers answered queries from students and visitors.
- A Creative Marine Life Art Painting Contest, featuring 30 unique marine life art forms created by scientists.
- Distribution of educational handouts and mementos to participants.

The 78 Foundation Day of ICAR-CMFRI, Visakhapatnam, not only celebrated the institute's legacy but also ignited a passion for marine conservation among the younger generation, reinforcing the importance of preserving our marine ecosystems for the future.

78 Foundation Day Celebration at Karvar

The ICAR-Central Marine Fisheries Research Institute, Karwar Regional Station, proudly celebrated its 78 Foundation Day on 3 February 2025 with great enthusiasm. On this momentous occasion, Dr Shivakumar Haragi, Chairman of the Department of Studies in Marine Biology, Post Graduate Centre, Karnataka University, Karwar, Karnataka inaugurated the Open House and the accompanying exhibition.

In his address, Dr Haragi emphasized that unscientific fishing practices and climate change are increasingly impacting India's marine fisheries. He stressed the urgent need for the conservation of marine fish resources to ensure healthy stock levels and promote sustainable fisheries, aligning with the Sustainable Development Goal 14 (SDG-14). He also commended ICAR-CMFRI for its ground breaking research in isolating nutraceutical compounds from seaweed and green mussels, which have made remarkable contributions to the field of medicine at the national level.

The Guest of Honour, Dr Hanumanth, Assistant Professor in the Department of Commerce at Karnataka University's Post Graduate Centre in Karwar, highlighted the significant role of marine product exports in boosting India's blue economy.

The event featured an impressive display of commercially important marine finfish and shellfish species of Uttara Kannada & Goa coast, along with the centre's successful breeding and rearing achievements of selected marine food fishes. The larvae-to-sub-adult rearing of Rabbit fish, Goldsilk Seabream and Fanged Seabream was showcased. The marine fish & mariculture museums, the fish health and biotechnology and fish biology laboratories were opened to students & researchers.

Also, fish feed and various nutraceutical products developed by ICAR-CMFRI were prominently exhibited providing an enriching experience for Academicians, students, researchers and the general public. Additionally, the Station organized live fish sale of hatchery & farm produced high value marine food fishes including Asian Seabass, Rabbit fish, Silver Pompano and Goldsilk Seabream.

Dr Purushottama, G.B. Senior Scientist and Co-ordinator of the Foundation Day, successfully organized the exhibition, while Dr C. Kalidas, Principal Scientist and Scientist-in-Charge of the Karwar Regional Station, ICAR-CMFRI, presided over the event. The programme witnessed active participation from scientists, technical staff, multitasking personnel and administrative staff of ICAR-CMFRI, Karwar.

Source: Website (Central Marine Fisheries Research Institute (CMFRI), Kochi, Kerala).

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Insect-based barramundi feed launches in India

Insectika Biotech has introduced an insect protein-based feed for Asian seabass (barramundi) and aquarium fish, in collaboration with ICAR-CIBA.

Developed after two years of rigorous research and successful trials and including protein from black soldier fly larvae the formula was presented for the first time at the Shrimp Farmers Conclave 2025, in Odisha, in the presence of more than 500 aqua farmers, hatchery owners and delegates from the Government of India.

According to Insectika, the new feeds - YuM ToM for aquarium fish and Yum Pro for Asian seabass - which have been approved for use in India, bring numerous benefits including:

- Being rich in essential nutrients, insect protein supports optimal growth and health for Asian seabass and aquarium fish.

- Improved digestibility and palatability contribute to better overall fish welfare.
- By reducing dependency on traditional protein sources linked to deforestation, overfishing and food waste, insect protein helps promote an eco-friendly feed solution.
- Dr Kamlesh Mishra, Director of Sales and Marketing at Insectika, emphasised the importance of collaboration in achieving sustainability goals, stating: "We are proud to partner with ICAR-CIBA in advancing circularity and sustainability in feed production, especially for exportable fish varieties like Asian seabass. This collaboration aligns with ICAR-CIBA's mission to foster a responsible food chain for future generations. The future of food necessitates rethinking assumptions about production, origins and sustainability. A responsible food chain creates opportunities not only for environmental stewardship but also for economic growth."
- Dr JK Jena, deputy director general of ICAR, added: "To meet the growing demand for nutritious protein amid rising populations, humanity often resorts to practices such as deforestation and overfishing, exacerbating ecological degradation. Insectika's innovative approach to sustainable protein offers a natural, effective solution. ICAR CIBA is delighted to support Insectika in this transformative journey."

Dr Kuldeep Lal, Dr Panigrahi and Dr Ambashankar of ICAR-CIBA noted: "The launch of YuM ToM for aquarium fish and Yum Pro for Asian [sea bass] highlights the immense potential for scalable, nature friendly solutions in aquaculture. We are dedicated to supporting Insectika's efforts in India and beyond, as they aim to establish a global presence for their products. With a strong emphasis on low-carbon footprints and groundbreaking innovations, Insectika aligns perfectly with the vision of a sustainable and resilient food system."

ICAR-CIFT Conducts Awareness Workshop on Seafood Processing, Packaging and Waste Utilization

Kerala: The ICAR-Central Institute of Fisheries Technology (ICAR-CIFT), Kochi, hosted an awareness workshop on seafood processing, packaging, and waste utilization today. The workshop was organized for the coordinators of Kudumbashree, State Poverty Eradication Mission under the Government of Kerala.

Dr George Ninan, Director of ICAR-CIFT, inaugurated the workshop, highlighting the significance of sustainable seafood processing and packaging for the fisheries sector. The technical sessions covered topics such as seafood processing and packaging, fishery waste utilization, and machinery for fish processing. These sessions were led by scientists from ICAR-CIFT, including Dr U. Parvathy, Senior Scientist, Fish Processing Division, Dr Remya S, Senior Scientist, Fish Processing Division, Dr Binsi P.K., Senior Scientist, Fish Processing Division, Dr Murali S., Scientist, Engineering Section, Mr S. Sreejith, Scientist, Fish Processing Division. A total of 45 participants from the Kudumbashree Mission attended the workshop, including State Program

Managers, State Assistant Program Managers and District Program Managers.

Dr Bindu J., Head of the Fish Processing Division, ICAR-CIFT; and Dr. Rana Raj V.R., MVSc, Program Officer (Animal Husbandry), State Mission, Kudumbashree, spoke at the inaugural session. The event, led by the ZTM-ABI Centre of ICAR-CIFT, aimed to provide participants with comprehensive knowledge on advanced seafood processing techniques, value addition strategies, innovative packaging solutions and sustainable waste utilization practices. This workshop serves as part of a preliminary initiative for a proposed Memorandum of Understanding (MoU) focusing on technology transfer and training support, paving the way for future collaborations between ICAR-CIFT and Kudumbashree.

Source: Central Institute of Fisheries Technology (CIFT)

ICAR-CIFT and State Seed Farm Collaborate for Farmers' Meet at Okkal Farm Fest 2025

Cochin: The ICAR-CIFT, in collaboration with the State Seed Farm, Okkal, organized a Farmers' Meet & Field Demonstration on Converting Fish Market Waste to Aquafeed and Manure today at the Okkal Farm Fest 2025 under the Swachhta Action Plan (SAP). The event aimed to foster discussions on sustainable agricultural practices by bringing together farmers, scientists, and agricultural experts. Dr George Ninan, Director of CIFT, presided over the function, highlighting the institute's ongoing efforts to promote sustainability in the fisheries sector through various initiatives under the Swachhta Action Plan (SAP).

An MoU was formally handed over by Dr George Ninan, Director of CIFT, for joint collaboration in waste management to Mr Philip G., Senior Agriculture Officer, during the program. CIFT scientists Dr Binsi P.K. and Dr A. Jayakumari provided insights into the production process of converting fish market waste into aquafeed and manure, demonstrating its potential benefits for farmers. Following the session, Dr Zynudheen A.A., Principal Scientist at ICAR-CIFT, along with other CIFT scientists, engaged with farmers, answering their queries and providing expert guidance on the technologies developed by CIFT.

Dr Geethalakshmi V., Principal Scientist and Nodal Officer (SAP) at ICAR-CIFT, and Mr Philip G., Senior Agriculture Officer, Department of Agriculture, also spoke at the program. The event witnessed the participation of around 60 farmers and agricultural officers, reinforcing a shared commitment to sustainable waste management and resource optimization in the fisheries and agriculture sectors.

Source: Central Institute of Fisheries Technology (CIFT)

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Totally enclosed spraying space,
Precision & Efficient spraying proportion widely ranged from 2%-30%.

Revolutionizing Shrimp Hatchery Nutrition: Elevia as a Single Dry Feed Solution

Eamonn O'Brien, Global Product Manager LifeStart, Skretting

The traditional approach to shrimp hatchery nutrition has long relied on complex dry feed cocktails, blending multiple diets to support the development of shrimp larvae. However, new research and trials indicate that a simplified, single dry feed diet—such as Elevia from Skretting—can outperform traditional methods in key areas like growth, survival, and operational efficiency.

The Challenge of Cocktail Feeding

Most shrimp hatcheries, particularly those cultivating *Litopenaeus vannamei*, have historically depended on mixed dry diets, or "cocktail feeding." This method, while aiming to provide comprehensive nutrition, introduces significant variability, labor costs, and potential water quality issues. Hatchery managers must carefully balance multiple feed sources, leading to inconsistent nutritional delivery and increased risk of overfeeding or underfeeding. Furthermore, the sourcing and handling of multiple diet components add logistical complexity, increasing the likelihood of errors and inefficiencies.

Another critical challenge with cocktail feeding is the potential for inconsistent feed quality. Depending on the ingredients used, some batches may be more nutritionally dense than others, resulting in fluctuations in shrimp growth performance. Physically, different diets often vary by upto 100% in the size distribution which impact both water quality and uniform growth. This inconsistency can create additional challenges for hatchery operators who rely on stable and predictable larval development.

Elevia: A Game-Changer for Shrimp Hatcheries

Elevia, a carefully formulated larval diet developed by Skretting, offers a streamlined alternative to cocktail feeding. Designed to provide complete and balanced nutrition throughout the shrimp larval phase, Elevia enhances both biological and operational performance in hatcheries. With its advanced formulation and research-backed efficacy, Elevia delivers consistent results, eliminating the uncertainties associated with cocktail feeding.

1. Improved Growth and Survival Rates

Commercial-scale trials comparing Elevia to traditional cocktail feeds have demonstrated significant benefits. Shrimp larvae fed exclusively with Elevia exhibited:

- **Higher survival rates**—ensuring more robust post-larvae ready for grow-out.
- **Accelerated growth**—thanks to highly digestible, low molecular weight proteins and essential nutrients.
- **Better post-larval health**—as reflected in strong hepatopancreas development and vibrant coloration, indicating optimal food absorption.

These improved outcomes result in a stronger and more resilient shrimp population. By supporting early-stage development with a balanced and easily digestible diet, Elevia helps hatcheries achieve better productivity and profitability.

2. Enhanced Water Quality and Hatchery Efficiency

One of the key advantages of Elevia is its contribution to improved water quality. Unlike cocktail feeds, which often include inconsistent ingredients that degrade and pollute hatchery systems, Elevia maintains stability in water, reducing the risks of ammonia buildup and microbial contamination. This leads to:

- **Lower incidences of hatchery crashes** due to water degradation.
- **A more controlled feeding process**, with less waste and improved feed efficiency.
- **Reduced manual labor**—as a single diet, Elevia eliminates the need for complex feed mixing and preparation.

Water quality is a crucial factor in hatchery success, as poor water conditions can quickly lead to increased stress, disease outbreaks, and mortality. By using Elevia, hatcheries can maintain a cleaner environment, ensuring optimal conditions for shrimp larvae development.

3. Economic and Operational Advantages

Switching from cocktail feeding to a single diet such as Elevia presents clear operational benefits:

- **Simplified logistics**: Easier storage, handling, and application compared to multi-feed regimens.
- **Cost savings**: Less labor-intensive feeding processes and improved feed conversion ratios (FCRs).
- **Higher consistency**: Ensures uniform nutritional intake, leading to predictable larval performance and lower mortality.
- **Better inventory management**: With a single dry feed, hatcheries can reduce their reliance on multiple suppliers and lower the risk of supply chain disruptions.

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By eliminating the need for complex feed mixtures, hatcheries can streamline their feeding protocols, reducin g labor demands and minimizing potential errors. Additionally, the higher feed efficiency of Elevia means that hatcheries can optimize feed use, ultimately reducing waste and lowering costs.

The Science Behind Elevia's Success

The success of Elevia lies in its advanced nutritional composition and formulation. Unlike conventional diets that rely heavily on fishmeal, Elevia incorporates innovative ingredients
such as:

- **Highly digestible diverse proteins** to promote faster growth and efficient nutrient utilization.
- **Omega-3 fatty acids and DHA** sourced from high-quality algae to support immune function and stress resistance.
- **Natural bioactive compounds** that mimic live feed properties, enhancing digestibility and feed intake.

By leveraging these key ingredients, Elevia provides a nutritionally complete diet that aligns with the specific needs of shrimp larvae at different developmental stages. The formulation has been rigorously tested in commercial hatchery settings to ensure optimal performance across diverse production environments.

The Future of Shrimp Hatchery Nutrition

As the shrimp farming industry seeks more efficient and sustainable practices, single dry feed solutions like Elevia represent the future of hatchery nutrition. Its proven benefits in survival, growth, water stability, and ease of use make it a compelling choice for hatchery operators looking to optimize performance and profitability.

Furthermore, the use of Elevia aligns with broader industry trends focused on sustainability and responsible aquaculture. By reducing dependency on fishmeal-based diets, eliminating fish oil and improving feed efficiency, Elevia contributes to more environmentally friendly shrimp production.

By replacing complex cocktail feeding with a scientifically formulated single diet, Skretting's Elevia is setting a new standard in shrimp hatchery nutrition—paving the way for a more sustainable and successful aquaculture industry. As hatcheries continue to evolve, adopting innovative diets like Elevia will be critical to enhancing productivity while ensuring long-term sustainability and profitability in the global shrimp sector.

Tilapia Parvovirus: A Growing Concern for Aquaculture in India

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- Emergence in India: Tilapia Parvovirus (TiPV) was first reported in India in 2023, with high prevalence and mortality rates in tilapia farms
- High Mortality: Causes 30-50% mortality; 100% in experimental cases.
- Clinical Signs: Lethargy, appetite loss, eye lesions, and abnormal swimming in infected tilapia.
- Transmission: Spreads via water, fish, equipment, and co-infects with other pathogens like TiLV.
- Economic Threat: Significant losses for fish farmers and risks to aquaculture sustainability.
- Prevention: Biosecurity, regular screenings, and global research crucial for control.

Introduction:

In recent years, India has witnessed significant growth in its aquaculture industry, with tilapia emerging as a popular choice among fish farmers for its prolific breeding, adaptability to low oxygen levels in the water, fast growth rate, high range of salinity tolerance, high market price and good consumer preference.

In India, tilapia farming is carried out in several states, such as Andhra Pradesh, Maharashtra, Kerala, Karnataka, Tamil Nadu, Chhattisgarh, and West Bengal. The top producers of tilapia are the southern states, especially Andhra Pradesh.

Unfortunately, tilapia farming faces a threat in the form of Tilapia Parvovirus (TiPV). The recent report of this virus in ponds in Walajah in Ranipet district of Tamil Nadu, India in the year 2023 has raised alarms in the aquaculture community across the country. The Aquatic Animal Health Laboratory of C.Abdul Hakeem College's research team reported this virus in February and March 2023, while regular screening work for viral pathogens was going on. This novel virus was first time reported in China in the year 2019 followed by Thailand in the year 2021 (Yamkasem et al., 2021). India is the third country to report the occurrence of TiPV. TiPV has resulted in mortality rates in fish farms ranging from 30% to 50%. Its devastating impact is demonstrated by the 100% mortality it has caused in experimental settings. TiPV virus has also been shown to cause co-infection with another virus like tilapia lake virus (TiLV) and secondary pathogenic bacteria like Streptococcus agalactiae and Aeromonas spp. Various mass mortality incidences due to this virus made it necessary for fish pathologists to conduct continuous screening of this virus and also to do research on disease characteristics, control, pathophysiological changes, early diagnosis, management, and biosecurity strategies. The aim of this article is to aware the readers about TiPV infections, and enable farmers to identify the infection based on the clinical signs. Understanding the virulence, host-specificity, and epidemiological risk factors of this newly emerging virus requires a holistic strategy.

Understanding Tilapia Parvovirus:

This virus belongs to the family Parvoviridae, it is a spherical, non-enveloped, single-stranded DNA virus with a diameter of 30 nm. It is classified in the genus Chapparvovirus. With 208 bp in the 5' UTR, 396 bp in ORF1 and 1875 bp in non-structural protein 1 (NS1), 504 bp in NS2, 216 bp in ORF2, and 1665 bp

Fish having TiPV in fection
(Source: https://enaca.org/enclosure/?id=1304)

in capsid protein 1 (VP1), and 46 bp in 3' UTR9, TiPV's genome is 4269 bp in size.

Various disease incidence of TiPV
In the year 2023 Aeromonas spp. and TiLV were found together with TiPV in tilapia that were collected from Maharashtra, which also displayed typical clinical symptoms. On the other hand, fish from Uttar Pradesh seemed to be in good health, and these samples only contained TiPV. Maharashtra and Uttar Pradesh both had high rates of TiPV prevalence (59.6% and 95.0%, respectively) (Rajendran et al., 2023). Mass mortalities of tilapia from several tilapia farms were reported from different locations in Odisha in the summer of 2023.

In China, tilapia mortality from an outbreak of TiPV was 60–70% in natural environments. In Thailand, mortality rates were 50–75% across all age groups of tilapia.

Clinical Signs
TiPV is a highly contagious viral disease that affects tilapia fish, particularly young ones. Infected fish exhibit symptoms such as lethargy, loss of appetite, exophthalmia, severe ocular lesions, and abnormal swimming behavior.

Detection and diagnosis of TiPV
The spleen, liver, kidney, brain, and mucus are among the tissues where the virus has been detected. For identifying TiPV in tilapia that seemed to be in a healthy state, the spleen seemed to be the most useful tissue. Via PCR product sequencing, histopathological examination, virus isolation in a cell line, and electron microscopy, the existence of TiPV has been diagnosed earlier.

TiPV-related histological findings include an extensive infiltration of lymphocytes, increased melanomacrophage centers in the anterior kidney and spleen, and erythrocyte depletion in the hepatic syncytial cells and spleen. Dong et al. (2010) have shown that the pancreas is the primary target of TiPV infection in Nile tilapia histopathological diagnosis. Adult Nile tilapia that were naturally infected with TiPV were found to have Cowdry type A inclusion bodies in their pancreas as a histopathological diagnostic characteristic. TiPV-infested tilapia also tend to show multifocal granulomas in their tissues when get co-infected with Streptococcus agalactiae (a secondary pathogen).

Impact on Aquaculture:
The emergence of Tilapia Parvovirus in India has the potential to disrupt the country's growing aquaculture industry. Tilapia is known for its adaptability and high growth rate, making it a valuable commodity for fish farmers. However, the presence of this virus could lead to significant economic losses and impact the livelihoods of those dependent on tilapia farming.

Economic Consequences:
The outbreak of Tilapia Parvovirus could have far-reaching economic consequences for the aquaculture sector in India. Fish farmers may face losses due to increased mortality rates and reduced productivity. Moreover, the virus could spread to other fish species, further exacerbating the situation and impacting the overall fish farming industry in the country.

Transmission
Numerous factors, such as contaminated water, infected fish, and contaminated equipment, can cause the virus to spread throughout tilapia populations. The virus's potential to spread between other fish farms and even across international borders is a threat.

Prevention and Control Measures:
TiPV's main downside is that it is more dangerous due to its association with other deadly diseases. Furthermore, incorrect disposal techniques may allow the virus to infect wild fish populations, which could have an adverse effect on aquatic ecosystems. Hence, to prevent the spread of Tilapia Parvovirus, fish farmers and aquaculture authorities in India must implement strict biosecurity measures. This includes regular screening of fish stocks, disinfection of equipment and facilities, and control of the movement of fish and personnel. Educating fish farmers about the virus and its transmission pathways is also essential in preventing future outbreaks.

Global Context and Future Research:
India is now the third country to report TiPV after China and Thailand, highlighting the global distribution of this emerging virus. Further research is needed to understand the virulence, host specificity, and epidemiological risk factors of TiPV. This will aid in developing effective control measures and ensuring the sustainability of tilapia farming in India and beyond.

Conclusion:
In conclusion, the emergence of Tilapia Parvovirus (TiPV) in India poses a significant threat to the country's aquaculture industry, particularly the tilapia farming sector. TiPV has been associated with high mortality rates in tilapia, impacting the livelihoods of fish farmers and potentially leading to economic losses. Its ability to co-infect with other pathogens further complicates the situation and underscores the importance of strict biosecurity measures.

The detection of TiPV in India highlights the global distribution of this virus and the need for collaborative research efforts to understand its virulence, host specificity, and epidemiological risk factors. This will enable the development of effective control measures to prevent future outbreaks and ensure the sustainability of tilapia farming not only in India but also in other countries affected by this emerging virus.

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Chromis Viridis: The Shimmering Blue-Green Gem of Coral Reefs

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Introduction

The Blue-Green Damselfish (*Chromis viridis*, Cuvier, 1830), also known as the Green Reef Chromis, is a visually striking marine fish species belonging to the family, Pomacentridae. Native to the Indo-Pacific region, it thrives in coral reef ecosystems and shallow rocky habitats, often seen in association with *Acropora* corals (Fig. 1). It is renowned for its shimmering blue-green coloration, which provides excellent camouflage amidst corals. Its ease of care and peaceful nature in the aquarium, make it a favourite among enthusiasts.

This species' widespread appeal has contributed to its prominence in the marine ornamental fish trade, making it one of the most commercially significant species globally. The price of *C. viridis* ranges from $28 to $45, depending on size, in international markets, while domestic markets in India offer it for Rs. 100–250 per piece. The popularity of *C. viridis* has led to its dominance in the ornamental fish trade, accounting for over 10% of marine fish imports into the United States alone (Rhyne et al., 2012, 2017). However, increasing demand in the aquarium trade has raised several ecological concerns

Chromis viridis has flourished in captivity in marine aquaria and is sought after for its aesthetic appeal, it faces significant ecological challenges, due to unsustainable collection practices. High demand has led to the overexploitation of *C. viridis* and this unsustainable collection has severely impacted coral reef ecosystems, where the species plays an integral role in maintaining ecological balance as a planktivorous fish. The extraction of *C. viridis* in large numbers for the aquarium trade has contributed to significant habitat degradation and coral reef damage, disrupting the complex dynamics of the ecosystem.

Distribution

Chromis viridis is widely distributed across the Indo-Pacific region, thriving in tropical and subtropical waters. Its range spans the Red Sea and the Gulf of Aden in the Indian Ocean to eastern Africa, Madagascar, Seychelles, the Persian Gulf, the Arabian Sea, Maldives, Sri Lanka, and the Andaman Sea. It is commonly found in Australia and Indonesia, while in the Pacific Ocean, its distribution extends across the Gulf of Thailand, Indonesia, the Philippines, China, Taiwan, Japan, the Great Barrier Reef, New Zealand, New Caledonia, Polynesia, Melanesia, and Hawaii. This species is also reported in the eastern Pacific, from the Gulf of California to Peru and the Galapagos Islands. Occasionally, sightings occur in the Mediterranean Sea as well. *C. viridis* typically inhabits coral reefs and lagoons, living at depths of 1 to 12 meters, where it blends seamlessly into its vibrant, reef-rich environments. Its coloration, which varies from green to blue, is influenced by environmental lighting. Adults reach a size of 8–10 cm and display laterally compressed bodies.

Ecological significance

Chromis viridis plays a vital ecological role in maintaining the balance of coral reef ecosystems, particularly as a planktivorous species. It is typically associated with Acropora coral heads and feeds primarily on zooplankton, including copepods and diatoms, helping regulate plankton populations within the reef environment. Through its feeding activities, *C. viridis* contributes to the recycling of organic material, transferring energy from lower trophic levels to higher ones and supporting the reef's overall productivity. As a key member of the reef's food web, *C. viridis* serves as

- Chromis viridis plays a vital role in coral reef ecosystems and supports the reef's overall biodiversity and stability.
- It's a known live bait in Lakshadweep for tuna catch
- Its vibrant coloration, peaceful nature, and ease of care make it a popular species in the global aquarium trade, however, the overexploitation in wild habitats poses ecological threats.
- This species exhibits year-round spawning, distinct sexual dimorphism, and intricate courtship behaviours.
- The growing demand for C. viridis raises concerns about unsustainable collection practices, habitat degradation, and reef damage, highlighting the need for sustainable aquaculture methods.

an important prey species for larger predators, including carnivorous fish and seabirds. Its feeding behavior helps maintain the health of coral reefs by controlling plankton populations and preventing algal overgrowth, which could otherwise disrupt the balance of the reef ecosystem. In this context, *C. viridis* plays a significant role in sustaining both the biodiversity and stability of coral reefs. In its natural habitat, *C. viridis* has specialized feeding adaptations, such as a protrusible jaw, which allows it to capture small planktonic organisms from the water column. This evolutionary trait is particularly beneficial in coral reef environments, where the complex structures of coral colonies create nutrient-rich currents that bring abundant zooplankton.

Mastering Camouflage

Chromis viridis shines as a remarkable example of adaptation and survival among the vibrant tapestry of life on coral reefs. Studies by Marshall et al. (2019) reveal that *C. viridis* employs a remarkable thin-film interference mechanism to alter its coloration depending on the angle of observation. This structural adaptation relies on microscopic layers within the fish's scales that manipulate light wavelengths, producing different colors as the viewing angle shifts. This structural coloration enables *C. viridis* to appear blue against the surface waters, green against the water column, and yellow when seen from above against coral substrates. Such adaptive coloration is more than just beautiful, serves as a sophisticated camouflage system.

Role in marine aquarium trade

Chromis viridis is highly regarded in the aquarium trade, due to its relatively low maintenance requirements, making it a popular choice among both amateur and professional aquarium keepers. This species thrives with minimal care, which includes maintaining appropriate water conditions, ensuring proper filtration, and providing a balanced diet. It is resilient to slight fluctuations in water parameters, although regular monitoring is still essential to avoid extreme changes. One of the key factors contributing to its popularity is its peaceful nature, which allows it to coexist with a wide range of other fish species, further enhancing its appeal in community tanks. Its active schooling behavior makes it visually striking and engaging for aquarium enthusiasts. The species can tolerate moderate salinity and temperature variations, adding versatility. However, like all marine species, they do benefit from some care and attention, such as maintaining good water quality and monitoring for signs of stress or disease, ensuring they remain healthy and vibrant in-home aquaria. *C. viridis* in aquaria is also relatively easy to feed and thrives on various diets consisting of live, frozen, and dry foods. Live foods like brine shrimp (*Artemia*), copepods, and rotifers offer essential protein and encourage natural behaviours. High-quality dry foods, including marine pellets, flakes, and algae-based products, ensure balanced nutrition. Feeding small amounts 2-3 times daily with a variety of foods will support their health, vitality, and coloration.

Fig 1. Chromis viridis in its natural habitat at Kavaratti island, Lakshadweep

Chromis viridis thrives well in captive environments, that closely replicate its natural coral reef habitat. A suitable tank should be at least 200 liters in volume to accommodate groups of 5–10 individuals, with live rock, caves, and overhangs to provide essential shelter (Fig. 2). Social interaction is crucial for this fish, as maintaining groups reduces stress and enhances their overall well-being. In particular, *C. viridis* are peaceful fish and usually get along well with other reef fish. However, avoid keeping them with large, aggressive fish that might see them as prey.

Chromis viridis is susceptible to bacterial infections, including fish tuberculosis, fin rot, and pop-eye disease. These conditions can be treated with antibiotics; however, the appropriate dosage and method of administration should be determined by an authorized professional and used under careful supervision. Additionally, *C. viridis* may be affected by Scuticociliatosis, a disease caused by the protozoan *Uronema* sp. (Cardoso et al, 2020), characterized by hemorrhages and ulcerative lesions on the body. Preventive measures, such as maintaining optimal water quality, performing regular partial water changes, and monitoring the fish for abnormal behavior, are crucial to ensuring their health and well-being in aquarium settings.

Reproduction

Chromis viridis showcases captivating reproductive behaviors, including territoriality, elaborate courtship displays, and substrate cleaning. Captive breeding studies (Rekha et al., 2024) reveal that this species is a year-round spawner with a promiscuous mating system. Males and females can also be distinguished by the shape of their urinogenital papillae, blunt in females and pointed in males. During the breeding season, *C. viridis* exhibits striking sexual dichromatism. Male *C. viridis* display a vivid array of body color patterns, including a yellowish hue, a vibrant dark or deep green dorsal region, and orangish edges along their dorsal and anal fins. During spawning, their vents become distinctly orangish. In contrast, females are characterized by yellowish coloration, a prominently distended abdomen filled with ripe eggs, and a pronounced vent. A balanced sex ratio of 1:1 ensures a healthy breeding system and prefers at least 6-8 numbers of fish in a breeding tank. Males establish and defend territories around cleaning stations, performing intricate courtship displays to attract females. Females lay eggs within these territories, which are fertilized and vigilantly guarded by males until hatching. In tanks, they usually prefer tank walls and vertical substrates. In the wild, eggs are typically deposited on surfaces like *Acropora* corals and seagrasses, which males meticulously clean before spawning.

Chromis viridis reaches sexual maturity at a size of 7-9 cm. Captive breeding success depends on stable environmental conditions, including temperature of approximately 27°C, salinity of 35-36 ppt, and a consistent 12-hour light/dark photoperiod. These conditions promote spawning, with females laying small, transparent eggs that hatch within three days after being fertilized by males. Once hatched, the larvae of *C. viridis* are delicate and underdeveloped, requiring precise care and nourishment. Feeding regimen of green chromis larvae, which involves the use of specific copepod species for optimal larval development. Initially, the larvae were fed with two types of copepods: *Pseudodiaptomus serricaudatus*, a calanoid copepod, and *Euterpina acutifrons*, a harpacticoid copepod. These copepods provide suitable nutritional profile for the early developmental stages of the larvae. As the larvae progressed through their development, from day 32 of larval rearing, newly hatched *Artemia* nauplii were introduced as a supplementary food source, further supporting the growth and survival of the larvae.

Metamorphosis, a crucial transition in development, began on day 30 and was completed by day 49, marking the end of the larval phase and the beginning of juvenile development. However, the survival rate during this rearing process was relatively low, with approximately 5% of the larvae surviving to the metamorphosis stage. This survival rate reflects the challenges associated with larval rearing, including the complexities of feeding, environmental conditions, and the delicate nature of early-stage development in marine fish species. Despite these challenges, *C. viridis* holds great potential for sustainable aquaculture, provided further advancements in rearing techniques are achieved to improve larval survival and support broader cultivation efforts.

Conservation challenges

Chromis viridis is primarily found in the coral reefs of the Lakshadweep Islands (Jones, 1958), Gulf of Mannar (Joshi et al., 2016), and Andaman and Nicobar Islands (Rajan and Sreeraj, 2012). However, the population in Lakshadweep Islands

Fig. 2. C. viridis in community aquarium

is facing significant threats, due to overexploitation driven by high demand in the aquarium trade and its use as live bait. Overfishing, particularly during spawning periods, has led to a decline in population numbers (Koya et al., 2019), as it is being harvested beyond their maximum sustainable yield (Sivadas & Nasser, 2000) for the utilization as bait for tuna catch. This overexploitation is not only threatening the genetic diversity of *C. viridis,* but also jeopardizes the survival of its natural habitat, destabilizing the balance and health of coral reef ecosystems. As a key prey species for marine predators, its depletion disrupts the marine food web, potentially leading to cascading effects on regional biodiversity. These challenges highlight the urgent need for sustainable fishing practices and improved management of live bait fisheries to ensure the long-term viability of *C. viridis* and the broader marine ecosystem.

While captive breeding programs have shown promise, they face limitations, particularly with larval survival and the resource-intensive nature of the process. Overfishing also threatens food security for local communities and undermines the long-term sustainability of marine resources. Meanwhile, rapid tourism development, although economically beneficial, is causing environmental degradation through habitat destruction, pollution, and increased human activity. Improper waste disposal and unregulated coastal construction further exacerbate the impact on local ecosystems. Pollution, including plastics and chemical runoff, continues to harm aquatic life, disrupt ecosystems, and pose significant risks to food security and overall ecosystem health.

Effects of climate change

Coral bleaching, driven by rising sea temperatures, poses a significant threat to *C. viridis* and its reef habitats. Bleaching events in Lakshadweep Islands further underscore the vulnerability of these ecosystems to thermal stress, directly impacting *C. viridis* populations (Fig. 3). The loss of coral reefs, largely driven by climate change-induced stressors such as rising sea temperature, ocean acidification, and coral bleaching, has significant implications for marine species, including *C. viridis*. The degradation of coral reefs compromises these essential habitats, disrupting the reproductive success of *C. viridis* and other reef species, leading to a decline in their populations.

The loss of coral habitats further destabilizes the ecological balance, affecting both the predator-prey relationships and the overall biodiversity of the reef ecosystem. With coral reefs especially *Acropora* in decline, *C. viridis* faces increasing competition for food and shelter, which can reduce their survival rates, particularly for juveniles. The broader effects of climate change, including rising sea levels and intensified storms, are causing extensive damage to the island ecosystems. Coastal erosion and flooding exacerbate habitat loss, affecting both terrestrial and marine species.

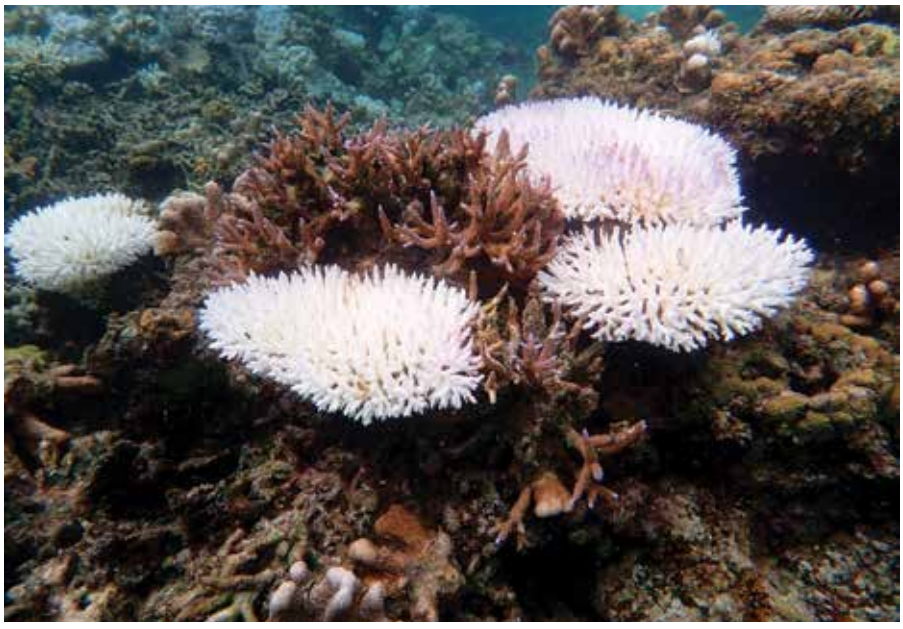

Fig. 3. Bleached Acropora coral in Agatti island, Lakshadweep

Conclusion

Chromis viridis is a striking and ecologically significant species found within coral reef ecosystems, prized for its vibrant coloration and peaceful nature, which have made it a popular species in the ornamental fish trade. However, the growing demand has led to overexploitation and coral reef habitat degradation, threatening both the reproductive success of the species and ecosystem health. Coral reefs provide vital spawning grounds, food, and shelter for *C. viridis*, and their loss exacerbates these challenges. In captive breeding experiments, survival rates during larval rearing are low, around 5%, impacting the effectiveness of ex-situ conservation efforts. This low survival rate highlights the challenges faced in replicating the conditions necessary for successful larval development and long-term conservation. To protect *C. viridis* and preserve coral ecosystems, it is essential to implement sustainable fishing practices, habitat restoration, climate change mitigation, establish marine protected areas, and make sustained efforts toward refining captive breeding protocols for enhanced fish seed production. These efforts are crucial not only for the species' survival but also for maintaining marine biodiversity and supporting the ecological and economic benefits of coral reefs for coastal communities.

Acknowledgments

The authors are thankful to the Director, ICAR-NBFGR for facilities and funding support.

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Turtle Excluder Devices (TEDs) in Fisheries: Balancing Marine Turtle Conservation and Fishers Livelihoods in India

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Summary

Turtle Excluder Devices (TEDs) are an essential conservation tool designed to reduce sea turtle bycatch in trawl fisheries, particularly in shrimp trawling. By incorporating a grid mechanism within fishing nets, TEDs allow large marine organisms, such as sea turtles, to escape while retaining the target catch, ensuring minimal disruption to fisheries. Many countries, including the United States and Australia, have made TED usage mandatory to comply with marine conservation laws. India introduced TEDs on a trial basis in the 1990s, particularly along the Odisha coast, home to significant Olive Ridley turtle nesting sites. The development of TEDs began in the 1970s in response to rising sea turtle mortality due to shrimp trawling. By the late 1980s and early 1990s, legislative measures, such as the U.S. Endangered Species Act, mandated TED use in commercial fisheries. Technological advancements in TED design improved their efficiency, and international organizations like FAO promoted their adoption. India's TED implementation was driven by conservation concerns and trade regulations imposed by the U.S. TEDs have significantly reduced sea turtle mortality globally, though concerns about their economic impact on fisheries persist. In India, conservation programs such as Operation Kachhapa have worked towards protecting sea turtles, though challenges like industrial pollution, beach tourism, and habitat destruction continue. Studies indicate that gillnets, trawls, and longlines contribute to high sea turtle bycatch, necessitating a broader approach to bycatch mitigation. While TEDs contribute to sustainable fishing, fishers often resist adoption due to perceived economic losses and operational difficulties. To balance conservation and livelihoods, India must focus on improving TED efficiency, incentivizing adoption, and integrating alternative conservation strategies, such as seasonal closures and marine protected areas. Continued research and policy interventions will be crucial in achieving a sustainable equilibrium between marine biodiversity conservation and the economic well-being of fishing communities.

1. The Role of TEDs – Their Function and Significance in Fisheries

Turtle Excluder Devices (TEDs) play a crucial role in mitigating the incidental capture of sea turtles in trawl fisheries, particularly in shrimp trawling operations. Their primary function is to allow sea turtles and other large marine organisms to escape from fishing nets while retaining the target catch, thereby reducing bycatch mortality. TEDs have been widely adopted as an effective conservation tool in various countries, including the United States, Latin American countries and Australia, to align fisheries with sustainable practices. India also has introduced TED's in a few states trial basis since 1990s.

TEDs operate based on a simple yet effective mechanism that incorporates an angled metal grid or a large mesh panel inside the trawl net. The grid or mesh acts as a physical barrier that prevents large organisms, such as sea turtles, from being dragged into the cod-end of the net. Once obstructed by the TED, turtles and other large marine life are directed towards a strategically placed escape opening, allowing them to exit the net safely. The design ensures that smaller target species, such as shrimp and fish, continue their passage through the TED into the cod-end, thus maintaining the efficiency of the catch. One of the most significant contributions of TEDs is the protection of endangered and vulnerable sea turtle populations. Trawling has been identified as a major cause of sea turtle mortality due to accidental entrapment, leading to drowning or severe physiological stress. TED implementation drastically reduces this threat by providing an escape route for turtles, thereby aiding in the conservation of species such as Olive Ridley, Loggerhead, and Leatherback turtles. Many nations have imposed stringent trade restrictions on fisheries that fail to implement TEDs.

The United States, for example, has enforced regulations requiring shrimp imports to originate from capture fisheries that utilize TEDs, ensuring compliance with marine conservation laws. Consequently, countries like India have developed and tested TEDs to align with these regulations

and maintain access to international seafood markets. TEDs promote responsible fishing by reducing bycatch, thereby minimizing the ecological footprint of trawl fisheries. By selectively allowing the escape of non-target species, TEDs contribute to the preservation of marine biodiversity and support the long-term sustainability of fisheries. While initial concerns about TEDs reducing shrimp catch were raised, research and field testing have demonstrated minimal impact on target species yield. Moreover, TEDs prevent entanglement of large debris and unwanted bycatch, reducing sorting time and improving operational efficiency for fishers.

Additionally, TEDs help fishers comply with legal requirements, preventing penalties and trade restrictions that could negatively impact their livelihood. Institutions such as the Central Institute of Fisheries Technology (CIFT), the Central Institute of Fisheries Navigation and Engineering Training (CIFNET), and the Fishery Survey of India (FSI) have played a pivotal role in testing, developing, and improving TED designs in India. Various TED models have been evaluated to ensure optimal functionality in different trawl fisheries, considering factors such as water depth, net type, and targeted species. The implementation of TEDs marks a significant advancement in balancing economic fishing activities with marine conservation. Their role in reducing bycatch mortality, ensuring regulatory compliance, and promoting sustainable fishing makes them an indispensable tool in modern fisheries management. With continuous research and adoption, TEDs can contribute to the long-term health of marine ecosystems while supporting the livelihoods of fishers worldwide.

2. History of TEDs – Development and Implementation Over Time – Global and India's States

Turtle Excluder Devices (TEDs) have played a crucial role in reducing sea turtle bycatch in commercial shrimp trawl fisheries. Over time, their development has evolved through scientific research, legal mandates, and technological advancements. The implementation of TEDs has significantly contributed to marine conservation while balancing the interests of the fishing industry.

i. Early Concerns and the Need for TEDs

During the mid-20th century, increased industrial fishing activities led to unintended capture, or bycatch, of non-target species, including sea turtles. Shrimp trawling was particularly responsible for high sea turtle mortality rates, as turtles would become trapped in nets and drown. By the 1970s, marine biologists and conservationists raised concerns over declining sea turtle populations, prompting efforts to mitigate this impact.

ii. Initial Development of TEDs (1970s - 1980s)

The early designs of TEDs originated in the late 1970s when fishermen and researchers sought practical solutions to reduce turtle bycatch. One of the pioneering models, the Georgia Jumper, was developed in collaboration with the National Marine Fisheries Service (NMFS). The device featured a grid-like structure installed in the trawl net, allowing small shrimp to pass through while directing larger turtles toward an escape opening.

iii. Legislative Actions and Mandatory Implementation (1980s - 1990s)

In response to growing environmental concerns, the U.S. government enacted significant legislative measures:

- **1987**: The NMFS issued regulations requiring TED use in certain shrimp trawl fisheries.
- **1989**: The U.S. Congress passed the **Endangered Species Act (ESA) amendments**, reinforcing TED requirements.
- **1991**: The United States fully mandated TED use in shrimp fisheries operating in waters where sea turtles were prevalent. Compliance was enforced through the **Turtle Conservation Agreement**, which restricted shrimp imports from countries that did not adopt similar measures.

iv. Global Adoption and Technological Advancements (2000s - Present)

TED technology continued to improve with refinements in design, efficiency, and enforcement. Key advancements include:

- **New Grid Designs**: Introduction of lightweight and more durable TED grids to enhance usability for fishermen.
- **Larger Escape Openings**: Increasing the escape opening size to accommodate larger sea turtle species such as loggerheads and leatherbacks.
- **International Regulations**: Organizations like the Food and Agriculture Organization (FAO) and the World Trade Organization (WTO) encouraged global TED adoption. Several countries in Latin America, Africa, and Asia integrated TEDs into their trawling practices.
- **Satellite Monitoring & Compliance Measures**: Authorities introduced vessel monitoring systems (VMS) and onboard inspections to ensure TED compliance.

v. TEDs in India

- TEDs were introduced in India during the 1990s, following international pressure, particularly from the United States, which imposed a ban on shrimp imports from countries that did not implement TEDs.
- The Orissa (Odisha) coast, home to one of the world's largest Olive Ridley sea turtle nesting sites (Gahirmatha, Devi River, and Rushikulya), became a key area for TED implementation.
- The Marine Products Export Development Authority (MPEDA) and Central Institute of Fisheries Technology (CIFT)

played a crucial role in designing and testing TEDs suitable for Indian fisheries.

3. Impact on Fisheries and Conservation – A Global Perspective and the Situation in India

i. **Impact of fishing on marine turtles**
Globally, the interaction between fisheries and marine conservation has been a complex issue, particularly concerning sea turtles. Various international organizations, including the Food and Agriculture Organization (FAO) and conservation groups, have emphasized the importance of mitigating bycatch in commercial fisheries. The implementation of Turtle Excluder Devices (TEDs) in trawl fisheries has been a significant step towards reducing sea turtle mortality. Countries such as the United States, Australia, and several in Latin America have successfully adopted TEDs, backed by stringent regulations and enforcement. Despite these efforts, the challenge remains in balancing conservation priorities with the livelihoods of fishing communities, who often face economic hardships due to restricted fishing activities.

ii. **Indian Scenario**
In India, the conservation of sea turtles has gained attention through initiatives led by both governmental and non-governmental organizations. Researchers and environmentalists have long highlighted the threats posed to sea turtles, particularly in the eastern coastal states, where mass nesting sites are located. Conservation programs such as Operation Kachhapa, collaboration between the Orissa Forest Department and NGOs, have played a vital role in protecting olive ridley turtles. However, threats such as industrial pollution, sand mining, beach tourism, and predation by stray animals have further impacted nesting populations along the Visakhapatnam coast. While forest officials emphasize fishing-related mortality, fisheries authorities argue that coastal afforestation with casuarina trees has reduced suitable nesting grounds, leading to additional conflicts in conservation efforts.

iii. **Impact of Fishing Gears on Sea Turtle Bycatch and Mortality**
Sea turtle bycatch in commercial fisheries remains a critical conservation challenge, with various fishing gears contributing to differing levels of incidental capture and mortality. Global estimates indicate that trawls have the highest impact, accounting for 40-50% of bycatch, followed by longlines (20-30%), gillnets (10-20%), purse seines (5-10%), and dredges (1-5%) (FAO, 2018). Mortality rates vary based on gear type, with trawls leading to 50-70% mortality, gillnets 30-60%, and longlines 20-50% (Lewison et al., 2004), primarily due to drowning, entanglement, or physical injuries. Studies by the Central Marine Fisheries Research Institute (CMFRI) in India further highlight gear-specific impacts, revealing that between 1985 and 1995, gillnets were responsible for 76.5% of incidental turtle catch, while trawls accounted for 17.8%. A 1997-98 survey found gillnets contributed to 60% of turtle mortality, followed by hooks and lines (22.6%), trawls (13.1%), and seines (4.2%). These findings underscore the need for comprehensive conservation strategies that go beyond focusing solely on trawl fisheries. Mitigation measures such as Turtle Excluder Devices (TEDs) in trawls, modified hooks and bait in longline fisheries, and alternative fishing techniques have been introduced to reduce bycatch. Additionally, seasonal closures, marine protected areas, and onboard observer programs play crucial roles in monitoring and enforcing conservation policies. However, balancing sea turtle conservation with the livelihood security of fishing communities remains a challenge, necessitating sustainable solutions that ensure both ecological protection and economic stability.

iv. **Economic impact an fishing due to TEDs.**
The enforcement of conservation measures, such as seasonal fishing bans and protected marine areas, has sparked significant debate. Since 2001, a closed season for fishing has been implemented along the east coast from April 15 to May 30. Orissa, in particular, has imposed strict restrictions on fishing near critical nesting habitats. Gahirmatha was declared a Marine Wildlife Sanctuary under the Wildlife Protection Act, 1972, and fishing within a 20 km radius of the sanctuary, as well as near the Devi and Rushikulya river mouths, has been prohibited. While these measures aim to protect sea turtles, they have also resulted in economic losses exceeding Rs. 1000 million for the fishing industry, severely affecting fisherfolk who rely on traditional and commercial fishing for their livelihoods. The additional requirement of TEDs has raised further concerns about fish catch reduction and economic sustainability.

v. **Impact on livilihoods of coastal community**
Social scientists and NGOs advocating for fisher folk rights have raised concerns over the impact of these stringent conservation policies. While conservation is crucial, ignoring the socio-economic consequences on fishing communities can lead to resistance and non-compliance. A balanced approach is necessary, involving sustainable fishing practices, the use of TEDs with economic incentives, community-based conservation programs, and better enforcement of existing regulations. Strengthening dialogue between conservationists, policymakers, and the fishing industry can help create an inclusive framework that safeguards both marine biodiversity and the livelihoods of

coastal communities.

4. Shrimp Export and TEDs – How TEDs Influence the Shrimp Export Industry

The implementation of Turtle Excluder Devices (TEDs) in India's shrimp fishing industry has become a critical issue for both conservation efforts and the seafood export sector. As per Mohapatra's statement, the resumption of wild-caught shrimp exports to the US hinges on India achieving certification through successful TED implementation. This is especially important given that Odisha's coastline, a key breeding ground for the Olive Ridley turtles, is heavily impacted by shrimp trawling activities. These turtles are a significant environmental concern, as they return to Odisha's beaches annually for nesting, particularly in the Gahirmatha Marine Sanctuary and Rushikulya Beach, which host 50% of the world's Olive Ridley population during their nesting season.

i. **Decline of shrimp export due to ban of marine shrimp**
The ban on wild-caught shrimp exports to the US has led to a steep decline in India's export figures, dropping from 153,286 metric tons (MT) in 2018-19 to 65,882 MT in 2023-24. This loss is compounded by the fact that the US market historically offered a premium price for Indian shrimp, with prices at $9.87 per kilogram, compared to $6.93 in other markets. The US market once accounted for 22% of India's wild-caught shrimp exports, making the ban a significant blow to the sector.

ii. **MPEDA'S initiatives in India**
In response, the Marine Products Export Development Authority (MPEDA) is actively training fishermen in the use of TEDs to ensure that shrimp trawling is less harmful to the turtle population. TEDs are designed to allow sea turtles to escape from trawl nets, ensuring their protection while maintaining the viability of the shrimp industry. This initiative aims to balance the need for both environmental conservation and the revival of the shrimp export sector, offering a way forward for India's seafood exports while safeguarding vulnerable marine species.

iii. **NGT initiatives in Turtle conservation**
As part of ongoing conservation efforts, the National Green Tribunal (NGT) has recently intervened in a case involving illegal mining in a turtle wildlife sanctuary in Uttar Pradesh, further underscoring the importance of protecting marine life and habitats in India. The training workshops by MPEDA and other initiatives reflect India's commitment to meeting international environmental standards while reviving its seafood export industry.

- The shift towards TED usage in shrimp trawling presents a complex challenge, but it holds the potential to reconcile the needs of the fishing industry with environmental conservation, especially concerning the Olive Ridley turtles that depend on Odisha's beaches for nesting.

5. Livelihood Concerns of Fishers – Socioeconomic Implications of TED Implementation

The economic impact on fishers is profound, as many argue that TEDs, though designed to exclude turtles, may also lead to the escape of commercially valuable species like shrimp and fish, thereby affecting their income. Additionally, modifying fishing gear and vessels to incorporate TEDs results in increased operational costs, which small-scale fishers struggle to bear. Unlike developed nations, India lacks a robust compensation mechanism for fishers affected by conservation policies, further straining their financial stability. Resistance from fishing communities is another significant challenge, primarily due to a lack of awareness and training. Many fishers are unfamiliar with the benefits of TEDs, leading to skepticism and reluctance in their adoption. Traditional fishing practices often conflict with conservation goals, and TEDs are perceived as an external imposition rather than a collaborative effort for sustainability. This has led to instances where fishers remove TEDs from their trawlers to maximize their catch, resulting in legal repercussions and conflicts with enforcement agencies. Employment and livelihood uncertainty also loom large. Since trawl fishing supports thousands of laborers, the decline in catch due to TEDs could result in job losses in the trawling sector. Consequently, fishers may be forced to seek alternative employment in sectors such as aquaculture or inland fisheries, which require skill adaptation and financial investment.

6. Collaborative & Balanced approach & stakeholders

To address these challenges, government support and policy reforms are necessary. Financial subsidies or incentives should be implemented to help fishers adopt TEDs without economic hardship. Additionally, alternative livelihood training programs in marine aquaculture and eco-tourism can help mitigate job losses. Stakeholder engagement and capacity building are equally important, requiring workshops and awareness programs to educate fishers about TEDs and their long-term benefits. Encouraging community-driven conservation initiatives can allow fishers to actively participate in marine resource management. Research and technological innovations also play a crucial role in minimizing the negative impact of TEDs. Developing TEDs specifically designed for Indian fisheries can help reduce the loss of commercial species while ensuring turtle conservation. Pilot studies and trials conducted in collaboration with fisher communities before making TEDs mandatory can provide valuable insights into their effectiveness. While TED implementation is crucial for marine conservation and sustainable fisheries, its socioeconomic implications for Indian fishers cannot be overlooked. A balanced approach involving government intervention, stakeholder participation, and

scientific advancements is essential to address the concerns of the fishing community while promoting environmental sustainability. Policy frameworks must prioritize fisher welfare to ensure conservation efforts do not compromise their livelihood security.

7. CIFT and Their Role in TEDs in India

i. TED's - Research

The Central Institute of Fisheries Technology (CIFT), Kochi has played a pivotal role in the research, development, and promotion of Turtle Excluder Devices (TEDs) in India. Designed by Dr. R. Raghu Prakash and a team of CIFT scientists, the CIFT-TED is an innovative solution aimed at reducing sea turtle bycatch in trawl fisheries while minimizing fish loss. The device consists of a circular stainless steel (316 marine grade) hoop with an accelerator funnel that directs the catch towards the cod end. A stainless steel ring with vertical deflector bars ensures that trapped turtles are guided toward the escape flap, allowing them to exit safely without significantly affecting the fish catch. Over 15 years of research, CIFT scientists analyzed approximately 500 trawl samples to optimize the TED's design, demonstrating a minimal loss of catch ranging from 0.52-0.97% for shrimp and 2.44-3.27% for non-shrimp resources making it more efficient than imported TED designs. The TED is also interchangeable within 20 minutes, making it adaptable for various net types used by local trawlers. These findings were validated through trials and demonstrations conducted by TREE Foundation in collaboration with the Fisheries and Forest Departments at Kasimedu Fishing Harbour, Chennai. CIFT has actively engaged with fishers, policymakers, and conservation groups, addressing concerns through scientific data and stakeholder consultations. Their efforts have significantly contributed to the adoption of TEDs in Tamil Nadu's trawl fisheries, ensuring sustainable fishing practices that protect olive ridley turtles while maintaining the economic viability of shrimp trawl operations.

ii. TEDs - Capacity Building Programs of CIFT

CIFT has initiated several capacity-building programs aimed at educating and training fishers on the benefits and proper use of TEDs. These programs include:

- **Workshops and Training Sessions:** Conducted in collaboration with state fisheries departments to demonstrate TED installation and operational efficiency.
- **Awareness Campaigns:** Targeting fishing communities to highlight the importance of TEDs in sustainable fisheries and marine biodiversity conservation.
- **Technical Assistance:** Providing fishers with guidance on TED modifications and implementation, ensuring minimal economic loss.
- **Pilot Projects:** Field testing TEDs in different maritime states to gather feedback and refine designs for better acceptance.
- Through these initiatives, CIFT is working towards the successful integration of TEDs into Indian fisheries while addressing economic and social concerns of the fishing community.

iii. Conclusion

Turtle Excluder Devices (TEDs) have emerged as a crucial innovation in modern fisheries, balancing marine conservation with the economic sustainability of fishing communities. Designed to reduce bycatch mortality, TEDs enable the escape of sea turtles and other large marine species from trawl nets while ensuring the retention of target species like shrimp and fish. Their implementation has been driven by global conservation efforts and international trade regulations, particularly in shrimp-exporting nations like India. While TEDs contribute significantly to protecting endangered turtle populations, their adoption has sparked debates over economic losses for fishers due to concerns about reduced catch and increased operational costs. However, studies indicate that well-designed TEDs have minimal impact on shrimp yield and can improve fishing efficiency by reducing debris and unwanted bycatch. In India, regulatory bodies like the Central Institute of Fisheries Technology (CIFT) and the Marine Products Export Development Authority (MPEDA) have played a pivotal role in designing TEDs suited to local fisheries. Despite initial resistance, integrating TEDs with community-based conservation initiatives and economic incentives can ensure sustainable fishing practices while preserving marine biodiversity.

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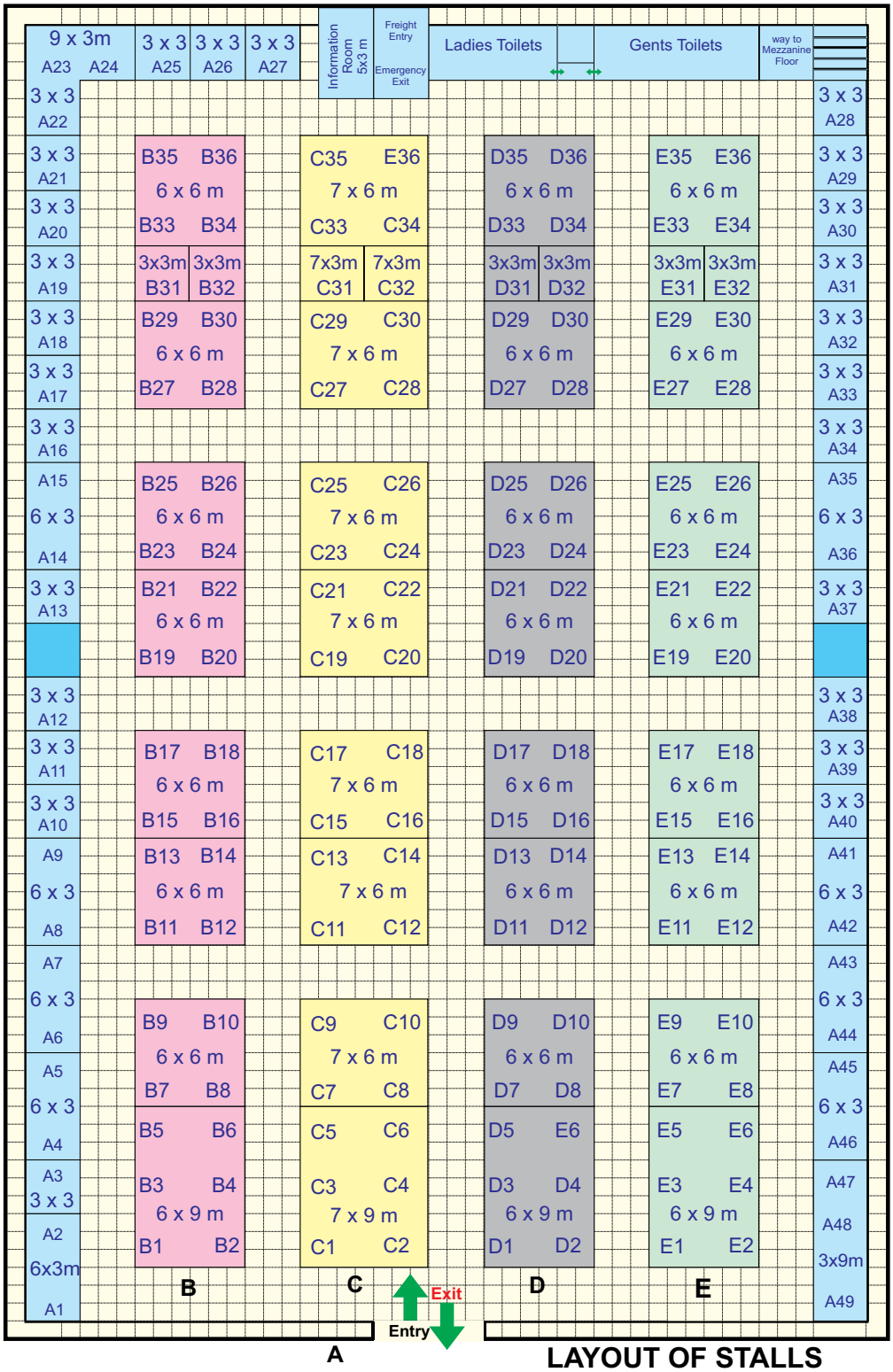

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