English Monthly from Hyderabad, India
RNI Regn. No. 52899/93
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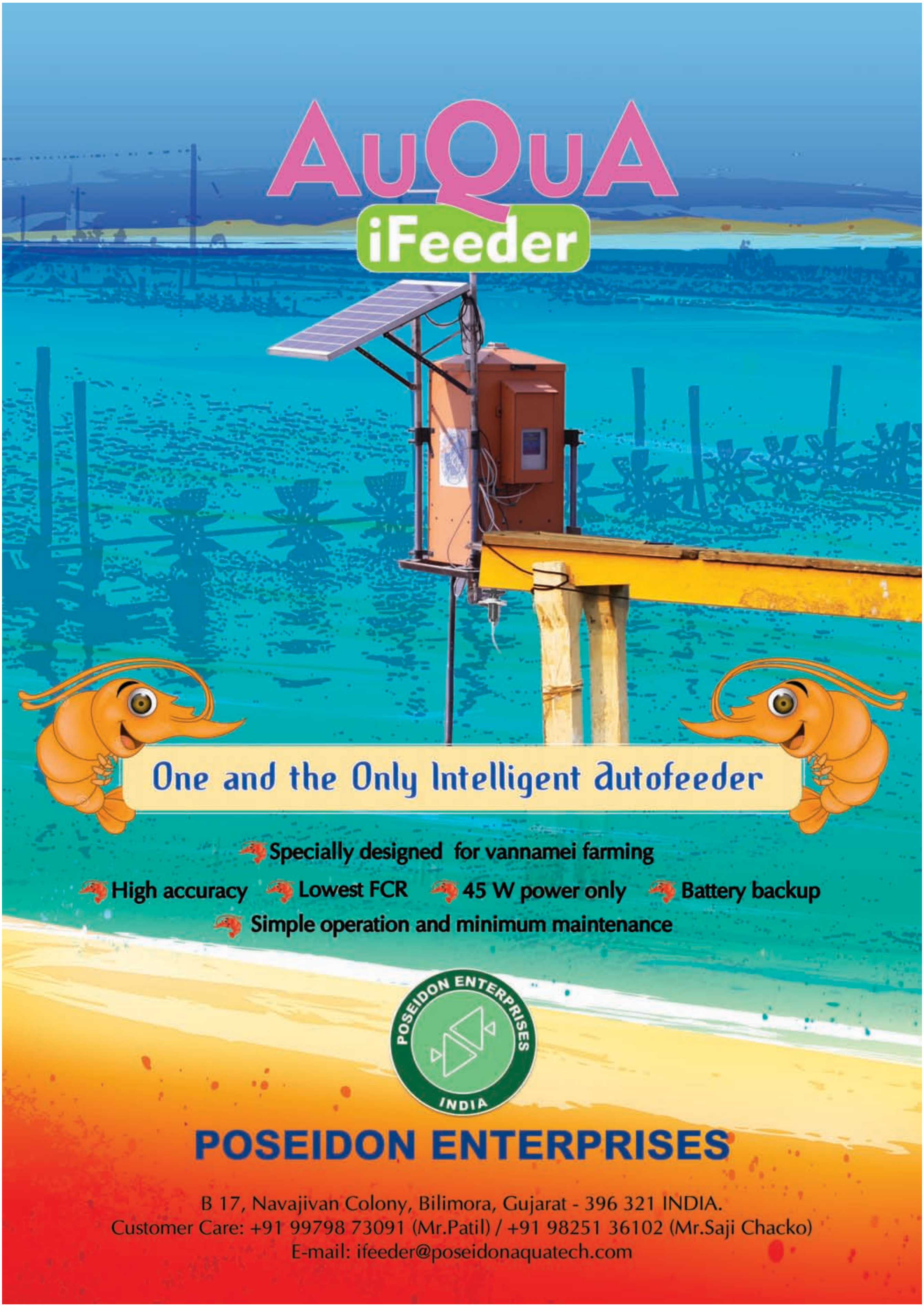
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Aqua International

English Monthly Magazine
(Established in May 1993)

Volume 29 Number 09 January 2022

Editor & Publisher
M. A. Nazeer

Editorial & Business Office:
AQUA INTERNATIONAL
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E-mail: info@aquainternational.in
Website: www.aquainternational.com

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.

Views and opinions expressed in the technical and non-technical articles/ news are of the authors and not of Aqua International. Hence, we cannot accept any liability for any loss or damage arising from the use of the information / matter contained in this magazine.

- Editor

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

SFMA team asks Union Commerce Minister for import of balance Soya DOC and to control unnatural hike in Soya seed prices

CIBA decodes Indian White Shrimp's Genome and it will help to cut the dependence on Pacific white shrimp

Dear Readers,

The January 2022 issue of ***Aqua International*** is in your hands.

Shrimp Feed Manufacturers Association headed by its President Mr B. Masthan Rao and his team of office bearers met Union Minister for Commerce & Industry Mr Piyush Goyal in Parliament Bhavan in New Delhi and the team discussed with the Union Minister for importing the balance Soya DOC out of the quantity of 12 lakh MT already permitted till March 2022 and to control unnatural hike in Soyabean seed prices due to speculation business and hoarding.

Scientists of the Chennai based Central Institute of Brackishwater Aquaculture (ICAR-CIBA) have sequenced and assembled the whole genome of Indian white shrimp Penaeus indicus. It is considered a milestone in the country because Penaeus Indicus is a native species and one of the world's most important seafood commodities. Prof M.S. Shekhar, Principal Scientist, Genetics and Bio-technology Division, and the leader of the team said they achieved the breakthrough and that the whole genome decoding would shift the focus to the native Indian white shrimp (Penaeus indicus) and reduce the dependence on Pacific white shrimp, Penaeus vennamei, from the U.S., which has been the major species farmed in India. The other members of the team are Vinaya Kumar Katneni, Ashok Kumar Jangam and K.K. Vijayan. The project was financially supported by ICAR-Consortium Research Platform on Genomics and coordinated by J.K. Jena, Deputy Director-General (Fisheries Science), ICAR. Dr Shekhar said that the breakthrough would help to evolve strategies for control and prevention of the white spot syndrome virus disease, a major problem faced by shrimp farmers as CIBA had already decoded the genome of the virus.

The I C T Cell of Faculty of Fisheries, Sher-e-Kashmir University of Agricultural Sciences and Technology, Kashmir organized the NAHEP sponsored National Webinar entitled 'Trends, Prospects and Problems in Inland Fisheries in India' on 18 December 2021 in Google Meet platform. Dr Dilip Kumar, Former Director-cum-Vice Chancellor, ICAR-Central Institute of Fisheries Education, Mumbai spoke on the afore-mentioned subject topic. He discussed about World fisheries and aquaculture production, utilization and trade; World's capture fisheries and aquaculture production and that Asia's inland waters contribute 66% of global capture fish production.

Matrix Research Foundation celebrated the first anniversary of their ***Royye Raju*** digital services. Commemorating their journey of establishing 40,000-farmer network across Andhra Pradesh, Matrix launched Royye Raju mobile app for Android and iOS. This app has recorded 6,000 downloads during the pre-launch period alone. Matrix is also making 'Manabadi' edtech in Aquaculture available on the app in the Aqua School feature. Mr Siva Prasad Vempuluru, Chief Executive Officer, Matrix Research Foundation. Matrix launched Mana Feed for Vannamei.

In the Articles section, Article titled **Impact of Corona virus in Fisheries Sector** authored by Abhay Kumar and S.M. Shaik, Mumbai Research Centre of CIFT, Vashi, Navi Mumbai and College of Fisheries, Shirgaon (Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli).

The COVID-19 pandemic has rapidly spread around the world with extensive social and economic affects. The pandemic affected small-scale ishers, marketing, processing industry and coastal fishing communities. Its disruption of demand and supply chain of agricultural commodity like fish and fishery products for the prolonged nation-wide lockdown directly affected 14.5 million people associated with the sector.

Thus, we urge governments, development organizations, NGOs, donors, the private sector and researchers to rapidly mobilize in support of small-scale fishers, coastal fishing communities and associated civil society organizations to help and respond to the COVID-19 pandemic.

Contd on next page

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Aqua International

Our Mission

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

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

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

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

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

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Another Article titled **"Biofloc Technology for Shrimp Culture – A small outline"** authored by Monica K.S, Department of Aquaculture, College of Fisheries, Mangaluru stated that Biofloc technology is a method of aquaculture that is considered ecologically benign. The effective use of water and nutrients, as well as the low discharge of effluent into the environment are typically associated with the sustainability of biofloc-based cultivation. Furthermore, BFT allows for the establishment of integrated multi-trophic aquaculture systems, in which one organism's waste is used as feed by another without causing harm to co-cultured species.

Another article titled **Feed Binders and its Application in Aquafeed** authored by Abhishek Sreechandan, Dr Amit Ranjan and Dr S. A. Shanmugam highlighted that feed binders are principally used in aquafeeds to improve the efficiency of the feed manufacturing process, to reduce feed wastage, and / or to produce a water-stable pellet, improve pelletability and enhance durability of aquafeed and hence reduce the total operating cost. Feed binders serve as an additive that can reduce the dusty and powdery nature of fine ground feed materials. In order to reduce the total operating cost from manufacturing to its consumption stage, feed binders are observed to increase the health benefits of feed materials, and thus, are widely being opted by feed manufacturers.

Asia-Pacific dominates the aquafeed binders market due to the consumption of the seafood along with rising production of aquaculture in the region while Europe region is the second largest region in the market growth due to the prevalence of various producers along with rising demand of salmon in the region. The major players who are involved in aquafeed binders business are Cargill, Nutreco, Alltech, ERBER Group, BioMar Group, Kevin, Avanti Feeds Ltd., Charoen Pokphand Foods, Growel Feeds, DSM, Evonik Industries, De Heus Animal Nutrition, INVE Aquaculture etc.

Article titled **Effluent Composition, Guidelines for Effluent Treatment and Water Quality Standards in Shrimp Pond** - authored by S. Subhashree Devasena, a Ph.D. Scholar. The article is mainly focused on the impacts of shrimp farm effluent in environment. The higher concentrations of various physico-chemical parameters in effluent affects the water quality of draining area. It affects the metabolic rate and survival of aquatic organisms. Stringent regulations need to be maintained to control the release of untreated effluent into then environment. This article gives a wide outline about the effluent water quality parameters, target standards to be maintained and management measures.

Fertilizers and feeds are applied to ponds to promote shrimp and fish production, and normally no more than 25 to 30% of the nitrogen and phosphorus applied to ponds in fertilizers and feeds is recovered in fish or shrimp at harvest. Ponds have a remarkable ability to assimilate nitrogen and phosphorus through physical, chemical, and biological processes. Ponds often have higher concentrations of nutrients, plankton, suspended solids and oxygen demand than the water bodies into which they discharge. Thus pond effluents are potential sources of pollution in receiving waters.

Due to the efforts of environmental protection groups, many nations are beginning to make regulations for aquacultural effluents. Some European nations have made relatively strict regulations for cage and net pen fish culture. Australia has developed regulations for pond culture of fish and shrimp. The National Pollution Discharge Elimination System (NPDES) of the United States Clean Water Act has allowed individual states to apply NPDES permits to aquaculture effluents for many years. Most states with significant aquacultural production, however have not required NPDES permits for aquaculture because the United States Environmental Protection Agency (USEPA) has made no federal rule for aquaculture effluents. The USEPA has initiated a rule-making procedure for aquaculture, and the final rule will be available on 30 June 2004. After this, aquaculture projects in all states will be subject to regulation by the federal rule. Many tropical nations also have made aquaculture effluent regulations. Some examples are Belize, Brazil, Ecuador, India, Mexico, Oman, Thailand and Venezuela.

Other Article titled **Sustainable Shrimp Farming Through Aquamimcry Technique** authored by K.S.Vijay Amirtharaj, A.R.Anumol and G.Arul Oli. Aquamimicry is a concept to stimulate the natural estuarine conditions by enhancing the growth of copepods along with the development of beneficial bacteria (Copefloc) in the system which is used as supplemental feed to the cultured shrimp and maintains the water quality. Copepods are tiny crustacean arthropods found in fresh brackish and seawater all around the world. These creatures have a promising nutritional profile. Such an eco-friendly, greener alternative and sustainable concept for shrimp production is the new age aquamimicry technology. This is done by fermenting a carbon source such as rice or wheat bran along with probiotics like Bacillus sp. to function in the release of their nutrients. Though this method is similar to biofloc technology, there are certain differences such as the amount of carbon added and the sediments reduced to be used by otheranimals.Thus, the water mimics the appearance and composition of natural estuarine water that includes microalgae and zooplankton. The presence of bacteria provides nutrition and serves as probiotics. This system mimics the natural estuarine system with a balanced composition of microalgae and zooplankton. Under this condition, the pH and dissolved oxygen fluctuation are minimized thus providing a conducive culture condition with minimum stress to the shrimps.

Article titled **Potential of Integrated Multi-Trophic Aquaculture System** authored by Mahesh Chand Sonwal, Jyoti Saroj, Rameshwar Venkatrao Bhosle and R. Tamil Selvan discussed that IMTA is the practice that combines the cultivated of fed aquaculture species (e.g., finfish / shrimp) with organic extractive aquaculture species (e.g., shellfish / herbivorous fish) and inorganic extractive aquaculture species (e.g., seaweed) to create balanced ecological systems for conservational sustainability and economic stability. This system is different from the Polyculture based system.

"Integrated" refers to intensive and synergistic cultivation, using waterborne nutrient and energy transfer."Multitrophic" means that the various species occupy different trophic levels, i.e., different (but adjacent) links in the food chain. IMTA is a specialized form of the age-old practice of aquatic polyculture, which was the co-culture of various species, often without regard to trophic level. In this broader case, the organisms may share biological and chemical processes that are minimally complementary, potentially leading to significant ecosystemshifts / damage. Some traditional systems did culture species that occupied multiple niches within the samepond but limited intensity and management.

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

SFMA team meets the Union Minister Piyush Goyal in Parliament

Delhi: On December 7, 2021 Mr Shri Bida Mastan Rao, President, Shrimp Feed Manufacturers Association (SFMA) and his team met Union Minister for Commerce & Industry, Consumer Affairs, Food & Public Distribution, and Textiles Mr Piyush Goyal at Parliament Bhavan in New Delhi. He discussed with the Union Minister for importing the balance soya DOC out of the quantity of 12 lakh MT already permitted till March 2022 and controlling unnatural growth in soya bean seed prices due to speculation business and hoarding.

Mastan Rao said, the Shrimp Feed Manufacturers Association appealed that the Government of India had approved the import of 12 lakh MT soya DOC to protect the shrimp industry from last year's

B. Mastan Rao, President, CFMA

crisis, but only 6.5 lakh MT was imported and it was not possible to import the remaining 5.5 lakh MTs within the permitted period.

Due to soya imports, soybean prices have come down from Rs 104 to Rs 65 per kg.

Mr A Indra Kumar said the aquaculture sector expected soya seed prices to be in range of Rs 50 to Rs 57 per kg this year, but now soya seed prices are Rs. 67 to Rs.72 per kg.

Bida Mastan Rao said, we fear that this trend will lead to the crisis faced by the entire aquaculture industry last year due to severe shortage of soya DOC and prices of soya DOC extreme irregularities, so the Government of India has been asked to intervene immediately in the following matters.

1. Instructing the DGFT to allow the import of nearly 5.5 lakh metric tons immediately in the out of the total 12 lakh metric tons allowed earlier till 31 March 2022.
2. Control local soya prices by permanently opening import of GM soyameal and keeping dynamic import duty structure done for edible oil imports. This is how to protect the interests of soya farmers and aqua farmers.
3. Removal of soyabean and soyabean complex from NCDEX.
4. Set stock limits for all warehouses and stockist positions in Maharashtra, Madhya Pradesh, Rajasthan and Andhra Pradesh.
5. Strengthen monitoring mechanism on stocks on daily and weekly basis by the concerned authorities as prescribed by the Ministry of Food and Public Distribution.
6. Bida Mastan Rao thanked the Union Minister asking to give immediate directions to the concerned persons to take immediate action on the above submitted matters to protect India's shrimp and aquaculture industry. Representatives of IB Group Director Gulrej Alam and Fedora Chief Narahari Reddy participated in the meeting.

Every 100gm fish contains 80 microplastic plastics

After Study, Mumbai University to Push Beach for Clean-up

Mumbai: People consume as many as 80 particles of microplastic – widely suspected to be cancer-causing – when they eat 100g of fish caught off the coast of Mumbai, found a study by the Central Institute of Fisheries Education (CIFE) in 2018 – 19.

Dr Martin Xavier of the institute said samples of croaker (Dhoma) fish, a sweet flavoured saltwater fish, caught 10Km off Mumbai showed they had microbeads when tested for biochemicals. Microbeads are very small (less than 5mm), solid,

FISH – EATING MUMBAI

2 lack metric tonnes of fish eaten every year in Mumbai Region.

- Biggest catch come at Ferry Wharf and Sasoon Docks in the island city, with smaller pockets at Worli, Mahim and Cuffe Paade.
- Madh Island follows at third place, followed by Versova, Yerangal and Manori.
- Island city fish stock is increasing, also because mechanized boats that can go deeper into the sea are deployed.

PLASTIC IN FISH

- 80 particles of microplastic or microbeads found in 100g of fish fcaught 10 – 15 Km off Mumbai.
- Studies are still on, but microbeads are widely considered to be cancer-causing.

MUMBAI'S PLASTIC TRASH BURDEN

- 408 tonnes of mixed plastic waste every day, including plastic washed up by the sea on beaches.
- It is enough to fill 500 shipping containers.
- This is after a 30% fall in waste after the plastic ban.

plastic particles used in a range of products, including rinse-off cosmetics, personal care and cleaning products, and don't degrade or dissolve in water.

On one hand, residents of Mumbai region consume over 2 lakh metric tonnes of fish every year. On the other, Mumbai generates 408 tonnes of plastic trash every day, enough to fill 500 shipping containers. And much of this and untreated seawage enters the sea from the city. The amount of plastic waste generated is despite a 30% fall after a broad-based single use plastic and in the state, said Rutuja Bhalerao, sub-regional officer of the state pollution watchdog.

These worrying facts were presented on Monday at a roundtable conference on marine plastic pollution organised by Teri (The Energy and Resource Institute) and UN Environment Programme at Mumbai University's Fort campus to launch their 'Rethink Plastic' campaign. Vice Chancellor Suhas Pednekar, who chaired the meet, said colleges, especially those closer to beaches will be directed to take up regular clean-up drives.

Rishi Agarwal of Safai Bank, an initiative to collect multi-layered food packs, said its workers collected 20 lakh wrappers every day, prompting Teri adviser MS Gill (a retired IAS officer) to call for massively incentivising plastic recycling through attractive buyback pricing at a faster pace to tackle the growing menace of litter in the seas. Around 25% of Mumbai's domestic waste, mostly from slums, flows straight into nullahs and creeks polluting the marine eco-system, said Jaysh Rambhia of the All India Plastic Manufacturers' Association. The remaining 75%, which enters the city's 1,915km sewer network, is also not properly treated before being released into sea.

CIBA decodes Indian White Shrimp's Genome

It will help to cut the dependence on Pacific white shrimp

A cure: The breakthrough will help to evolve strategies for prevention of the white spot syndrome.

Scientists of the Chennai based Central Institute of Brackishwater Aquaculture (ICAR-CIBA) have sequenced and assembled the whole genome of Indian white shrimp penaeus indicus.

It is considered a milestone in the country because Penaeus indicus is a native species and one of the world's most important seafood commodities.

"The whole genome decoding would shift the focus to the native Indian white shrimp (Penaeus indicus) and reduce the dependence on Pacific white shrimp, Penaeus vennamei, from the U.S., which has been the major species farmed in India," said M.S. Shekhar, principal scientist, Genetics and Bio-technology Division, and the leader of the team that achieved the breakthrough.

The other members of the team are Vinaya Kumar Katneni, Ashok Kumar Jangam and K.K. Vijayan.

The project was financially supported by ICAR-Consortium Research Platform on Genomics and coordinated by J.K. Jena, Deputy Director-General (Fisheries Science), ICAR.

Mr. Shekhar said the breakthrough would help to evolve strategies for control and prevention of the white spot syndrome virus disease, a major problem faced by shrimp farmers, as ICAR-CIBA had already decoded the genome of the virus.

Economic Engine

The scientists said shrimp was the economic engine of the seafood exports in India and it accounted for Rs 40,000 crore in national income, about 75% of the value of the seafood exports.

The Indian shrimp industry accounts for about 11% of the global production (7,59,906 tonnes valued at $ 4 billion in 2019)

"This important genomic resource will help in enhancing the growth potential, reproduction and maturation in captivity. Further, it will pave the way for producing more shrimp at low cost by intervening in the nutritional requirement of the shrimp," said K.P. Jithendran, Acting Director, CIBA.

He said the whole genome sequence of shrimp would be an invaluable genomic resource for researchers and shrimp-breeders.

"It would serve as a reference genome for future genetic improvement programmes for developing shrimp with desired economically important traits," he added.


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Before
After
Improve water color
Before
After
* COMPOSITION:
Bacillus spp. > 1x 10¹¹ cfu/kg 15%
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Keep at dry, well-ventilated condition. Avoid direct sunlight exposure and use as soon as possible once opened for best quality.
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No cultivation is needed. Apply Nuri BSL with water-soluble bag near to the working water wheel or pour into the pond evenly. Recommend apply Uni-Light PSB together with Nuri-BSL on sunny day to achieve a clear pond more efficiently.
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/10,000 m² Quantity | 10 - 30 pl/m² tiger prawn or < 80 pl/m² Vannamei | For >30 pl/m² tiger prawn or > 80 pl/m² Vannamei | For > 150 pl/m² Vannamei
7 days before stocking | 800 g - 1,000 g | 1,200 - 1,500 g | 1,200 - 1,500 g
Day of stocking | 300 g - 500 g | 800 g - 1,000 g | 800 g - 1,000 g
Every 7 - 10 days after stocking | 300 g - 500 g | 800 g - 1,000 g | 3 - 5 days / use 1,000g - 2,000g
***Dosages can be adjusted according to the water conditions and practices.
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Fishery scientist Dr Dilip Kumar speaks on Inland Fisheries in India

The ICT Cell of Faculty of Fisheries, Sher-e-Kashmir University of Agricultural Sciences and Technology, Kashmir organized the NAHEP sponsored National Webinar entitled 'Trends, Prospects and Problems in Inland Fisheries in India' on 18th December, 2021 in Google Meet platform. As the 1st speaker in this Webinar, Dr Dilip Kumar, Former Director-cum-Vice Chancellor, ICAR-Central Institute of Fisheries Education, Mumbai spoke on the afore-mentioned subject topic.

Dr Kumar began his audio-visual presentation with Uniqueness of inland fisheries where participation is high, a diverse and dynamic sector with small-scale household-based activities and insignificant byecatch. It comprises a range of ecosystems whose fish communities respond differently to internal and external drivers. All of the catch from inland fisheries must be recorded, Dr Kumar mentioned. He discussed about World fisheries and aquaculture production, utilization and trade; World's capture fisheries and aquaculture production and that Asia's inland waters contribute 66% of global capture fish production; Inland water capture fish production and major producing countries being China, India, Bangladesh; World employment for fishers and fish farmers, by region; Relative contribution of aquaculture and capture fisheries to fish available for human consumption; World capture fisheries and aquaculture production during 1980-2030 (projected); Performance and growth in Indian fisheries sector as 16 million fishers and fish farmers are involved; Performance indicators as India's fish production rose to 14.72 million tonnes in 2021 (total inland fish 11.248 million tonnes and marine fish 3.479 million tonnes) from 0.75 million tonnes in 1952 and that from 2.3kg fish availability/capita/year to presently 10kg/capita/year.

Major contributors in Indian fisheries sector are primarily the fish farmers and fishers and all subsectors of fisheries (private sectors, research institutes, Fishery Departments, etc) should complement each other, Dr Kumar opined. Proper coordination and trained human resources should be there; also guidance and governance are very much needed. Priorities of the sector and core concerns should be identified and perceived. India's inland fishery resources provide a wide range of social benefits, many of which contribute to household livelihoods, food and nutrition, national economies and sustaining our environment where we live. Dr Kumar spoke about objectives and voluntary guidelines for securing sustainable small-scale (SS) fisheries in the context of food security and poverty eradication and promoting SS fisheries to a sustainable future. Dr Kumar informed participants about Global Zero Hunger challenge programme implemented in many countries.

He spoke about water stress and trend in per capita water availability in India and also per capita water storage capacity. While speaking about floodplain wetlands as biologically-rich and sensitive ecosystems, Dr Kumar emphasized on its carbon sequestration potential, unique aquatic biodiversity, which stores floodwater and rainwater. After planning, we can draw participation of stakeholders and this resource can be used effectively. Wetlands come under area of focus in UN Decade of Ecosystem Restoration (2021 - 2030) where coordinated and pro-active actions are required. Core message is people must realize and participate in these movements. Physical interventions include human-led awareness, participation, action, restoration, rehabilitation and development; also there are institutional and technical interventions. We need to ensure all players in fisheries sector work in harmony, institutions are strengthened of its capacity of organization and personal built-up.

While highlighting about knowledge and skill and his works on Pond Aquaculture Extension Services in Bangladesh, Dr Kumar mentioned that Bangladesh is 1.5 times or little more in area than Assam but population density is ten times more than that of Assam, with similar agro-climatic conditions. Bangladesh produces about 4.4 million tonnes of fish per year and Assam produces 4.4 lakh tonnes of fish per year. Beel fisheries production is 2000kg/ha and 860kg/ha in Bangladesh and Assam respectively.

Each household in Bangladesh has small ditch or pond 0.1ha in area, and the fish production level is 4.1 tonnes / ha from each pond. Towards end of presentation, Dr Kumar emphasized on continuing working with same zeal and interest; we have to debate, discuss and decide; precise solution should come out and actions should be taken for development of India's inland fishery sector. Inland fishery are common property resources, should be managed collectively; local people should be awared and social mobilization and motivation required. Fishery officers should be well-versed in social mobilization, should help people in getting organized.

It was an excellent and extensive eye-opening and thought-provoking talk of Dr Dilip Kumar; News communicator Subrato Ghosh could learn a lot. As the 2nd speaker in this Webinar, Dr Sajina A. M., Senior Scientist, ICAR-Central Inland Fisheries Research Institute, Barrackpore spoke in detail on newer research on the fisheries of *Hilsa ilisha* in river Ganga and advancement and status of our knowledge on it.

World's First Biodegradable, Patent Pending, EcoWrap Stretch Film, Received TUV Austria's OK Compost Certificate

Cortec Corporation is veryexcitedto receive industrial compostability certification of it'sEco Wrap stretch film! Cortec received the 'OK compost IN¬DUSTRIAL' certificate from TÜV Austria on November 24th. This certifies that Eco Wrap conforms to the criteria for industrial compostability under EN 13432 (European equivalent of ASTM D6400). EcoWrap is world's first compostable industrial strength machine grade stretch film launched by the company earlier this year. Considering Cortec's longtime focus on compostable films and green packaging materials, this is a huge step forward. Eco Wrap users can benefit from material/ waste reduction in many ways. Most applications requiring three wraps of standard film can use two wraps of Eco Wrap without sacrificing strength or protection. Eco Wrap is certified industrially compostable by TÜV Austria (#TA8012106218) and meets EN 13432/ ASTM D6400 standard for commercial composting.

This green packaging solution may allow its users to avoid tariffs, fines, and tip fees in areas where polyethylene is prohibited or restricted. Eco Wrap is shelf and curb stable and will retain its integrity until disposed of properly. The latest formula of Eco-Wrap uses a certified compostable resin plus a tackifier additive to make an industrial strength compostable stretch wrap that can be used on most standard automated stretch wrap equipment. This is a breakthrough for the industrial packaging and warehousing industries which rely heavily on automated stretch wrapping to prepare pallets of goods for storage, inventory, or shipment.

Eco Wrap can be used in numerous applications where conventional stretch film is needed, such as:

- Agriculture bundling (e.g., hay bales and lumber)
- Corralling of goods for storage and shipment
- Pallet wrapping
- Luggage wrapping at airports
- Packaging construction materials
- Transporting furniture

Eco Wrapis extremely elastic and works on most existing automated machines. The filmis easily applied by adjusting the tension. By opting for Eco Wrap, users can improve their environmental image while getting the necessary packaging job done.

Development of Eco Wrap is huge step toward making commercially compostable packaging more versatile and widely available around the world. This compost certification

of Eco Wrapand is a breakthrough after many years in development, making this compostable machine grade stretch wrap a viable option for use in countless industrial applications.Eco Wrapis available from Cortec's European plant, EcoCortec located in Croatia and North American film production base, Cortec Advanced Films.

Biodegradation process of EcoWrap lasts up to 10 weeks.

Matrix Research Foundation celebrates its first anniversary of ***Royye Raju*** digital services

Matrix launches *Mana Feed* for Vannamei

Hyderabad: Matrix Research Foundation on 26th December 2021 hosted an event at Bhimavaram on the first anniversary of their ***Royye Raju*** digital services. Commemorating their journey of establishing the 40,000-farmer network across Andhra Pradesh, Matrix launched the most awaited Royye Raju mobile app for Android and iOS. This app has recorded 6,000 downloads during the pre-launch period alone. We are also making our 'Manabadi' edtech in Aquaculture available on our app in the Aqua School feature, informed Mr Siva Prasad Vempuluru, Chief Executive Officer, Matrix Research Foundation.

Further, twenty new "aquapreneurs" (Entrepreneurs in Aquaculture) have joined us during this event, agreeing to establish Matrix Aqua VignanaKendrams in their locality. The concept of Matrix Aqua VignanaKendram started in February 2020 involving

V. Siva Prasad
CEO, Matrix Research Foundation

aquafarmer culture literacy improvement within an area of 500 acres of culture. This idea allowed us to forge entrepreneurs from within the farmers, educating them and spreading knowledge across the entire village, he stated in a note to *Aqua International*.

Furthermore, keeping the farmer's need of the hour in mind, we developed '*Mana Feed*' and launched the revolutionary, cost-effective product during the event. Mana Feed is a highly effective functional feed for Vannamei, the formulations of which were developed in collaboration with Ohio Soy Bean Council and Batelle research, said the CEO.

The event was attended by over 500 farmers and 80 aquapreneuers, who took a vow to make aquaculture more sustainable in their locality. Ten display stalls were set up in the venue, showcasing various techniques and know-hows of aquaculture including seed selection to disease management. There were also stalls of MAAARC, Matrix VignanaKendrams, Royye Raju Digital services and Raithu Services.

Our way forward

Matrix Research Foundation is aiming to spread its network pan-India and reach 100,000 farmers through our Royye Raju digital services in 2022. We are also aiming to establish Matrix Aqua VignanaKendrams across the country with one centre for every 500 acres of culture. Here, we are not only improving aquaculture literacy across aquaculture localities but also build new aquapreneurs through our entrepreneur development program. We are aiming to improve culture practices and overall net yield per acre of aqua farmers through our experiments at Guntur Matrix Acharya Nagarjuna University Advanced Aquaculture Research Centre (MAAARC), Siva Prasad informed.

In 2022, Matrix' areas of focus include:
developing the best feed formulations, providing best seed,
innovating robust antibiotic-free chemicals and improving crop management.

Key People of Matrix

Mr Siva Prasad Vempuluru, Chief Executive Officer.

Mr Rohith Sampathi, Chief Strategic Officer.

Ms Mrudula Vempuluru, Marketing Director.

Dr Yokesh Mohanarangan, Research Scientist.

A view of celebration of Royye Raju digital services and the launch of Mana Feed for vannamei by Matrix Research Foundation


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Impact of Corona virus in Fisheries Sector

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Highlight Points

- The COVID-19 pandemic has rapidly spread around the world with extensive social and economic effects.
- The pandemic affect small-scale fishers, marketing, processing industry and coastal fishing communities.
- Its disruption of demand and supply chain of agricultural commodity like fish and fishery products for the prolonged nation-wide lockdown will directly affect 14.5 million people associated with the sector.
- Thus, we urge governments, development organizations, NGOs, donors, the private sector, and researchers to rapidly mobilize in support of small-scale fishers, coastal fishing communities, and associated civil society organizations to help and respond to the COVID-19 pandemic.

Introduction

Starting from Wuhan City, China, on December 31 2019, COVID-19 pandemic has immobilized the world by its health and economic shock (Hongzhou et al., 2020). By observing the terrible extent of the outbreak, World Health Organization (WHO) declared COVID-19 as a global emergency on January 30 2020 (Sohrabi et al., 2020). As the disease is highly transmissible and vaccine has not been developed, so the ways to "flatten the curve" (Nicola et al., 2020) include the imposition of self- quarantine, social distancing, travel restrictions, close down of different public facilities, transportation, even lockdown of the entire country (Dev &Sengupta, 2020). The mortality rate is 3.5percent globally (WHO, 2020a), but its psychological and economic strike is pernicious (Chohan, 2020).

The COVID-19 pandemic has rapidly spread around the world with extensive social and economic effects. This pandemic affect small-scale fish farmer, fish market, fish processing industry and coastal fishing communities. The consequences of covid 19 included complete shut-downs of some fisheries, knock-on economic effects from market disruptions, increased health risks for fishers. Some positive outcomes during covid 19 such as food sharing, the revival of local food networks, increases in local sales through direct marketing and deliveries, collective actions to safeguard rights, collaborations between communities and governments, and reduced fishing pressure in some places. While the crisis is still unfolding, there is an urgent need to coordinate, plan and implement effective short- and long-term responses. Thus, we urge governments, development organizations, NGOs, donors, the private sector, and researchers to rapidly mobilize in support of small-scale fishers, coastal fishing communities, and associated civil society organizations, and suggest actions that can be taken by each to help these groups respond to the COVID-19 pandemic.

Indian Fisheries in the pre-COVID-19 period

The COVID-19 shock is playing out in almost a similar manner in all around the world by squeezing out demand and supply and the consequent economic slowdown. In India, the problem might be long-lasting because before the pre-COVID-19 period Indian economy had deteriorated significantly after years of infirm performance (Dev & Sengupta, 2020). In 2018-19 India's fish production was 13.34 million metric tonnes which was about 6 percent greater than the previous year (Seafood Source, 2020). As per seafood export is concern, it is the fourth biggest exporter in the world (Seafood Source).

COVID-19 pandemic affect local / global fish food chains?

Fish and fisheries products are among the most traded food products in the world, with 38 percent of fish/seafood entering international trade. At the same time, fishing and fish farming are important at local level for the livelihoods of many fish-dependent communities, as well as for low-income countries and small island developing states.

Measures to contain the spread of COVID-19 (e.g. closure of food services, cessation of tourism, reduction of transport services, trade restrictions, etc.) have caused disruption in both domestic and international supply chains.

What are the implementations for most vulnerable

The pandemic has created in an unprecedented economic, social and health crisis with impacts on the most vulnerable groups including women (harvesters, processors and vendors), migrant fishers, fish workers, ethnic minorities and crew members. Many individuals are not registered, operate in the informal labour market with no labour market policies, including no social protection and no access to relief package/aid. These conditions might exacerbate the secondary effects of COVID-19, including poverty and hunger.

Working conditions and the safety of fishers at sea will be negatively affected should the number of fishers available to crew vessels be reduced. The availability of crew may be reduced for various reasons including inter alia contracting COVID-19, restrictions on movements or wider lockdowns. In addition, it is difficult for fishermen to maintain physical distancing measures of a metre apart on board fishing vessels. Should fishing vessels be forced to operate with fewer crew members, this may result in working longer hours, which will compromise safety measures and thereby put the well-being and health of fishers at risk.

Impact of pandemic in the Aquaculture sector

The aquaculture sector and its practices are recognized for the importance in providing food (high quality proteins) and employment for hundreds of millions of people worldwide. The rapid, global spread of SARS-CoV-2 pandemic (COVID-19) and the effects of control measures may have threatened jobs and incomes, generating food-insecurity and threatening the social capital. The pandemic will exert a detrimental effect on the global population both exacerbating and creating new sources of inequality and poverty.

Impact of pandemic

- Lockdown
- Restaurants limited working time
- Ban of celebrations
- Consequences in Aquaculture production:
- Low demand, decreased sales (40-50%)
- Uncertainty of production/market for next period

Support for aquaculture industry to reduce the impact of pandemic

- No specific measures/interventions in aquaculture sector
- Economic measures
- Support of payment of minimal salary amount for employees
- Subsidized contributions for the employees
- Delayed and reprogrammed repayment of loans to the Bank
- Non-interest credits for small and medium enterprises

The economic impact of COVID-19 on national fisheries

- The COVID-19 impact on both coasts east and west and economic impact has been swift and severe.
- As restaurants closed, a primary distribution channel for seafood closed with them.
- Another significant percentage of seafood sales has traditionally involved shipping product to overseas markets.

- However, with the grounding of international flights, getting produce to markets created additional hardships.
- National Fishermen, the nation's fisheries reported a sales decline as high as 95%. Unlike other agricultural sectors that have seen a significant increase in grocery store sales as a result of restaurant closures, stores have cut back on seafood purchases

How Pandemic Is Affecting Fisheries and Aquaculture Food Systems

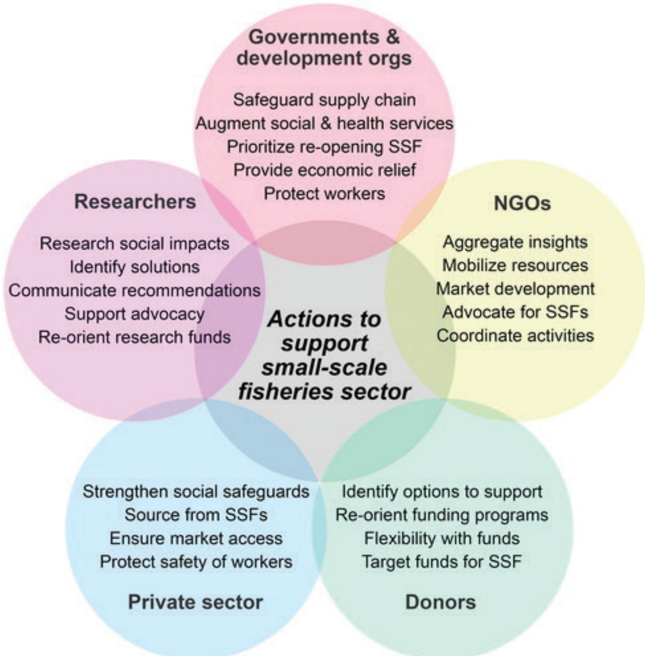
The Corona Virus Disease 2019 (COVID-19) started as a locally circulating infection. On 11 March 2020, WHO characterized the COVID-19 outbreak as a pandemic with a growing number of cases reported outside of China, from Eastern Asia to Europe and North America (WHO, 2020a). In the first half of 2020, the pandemic entered all regions of the world, some worse than others, including many major fish-producing and/or fish-consuming countries and global suppliers of fish feed. While fishing and aquaculture and the distribution of their products are considered an essential activity in most countries, the measures adopted to contain the spread of infection caused significant direct and indirect challenges to the sector, as explained below

The direct impact of COVID-19 on commercial fishermen's safety and health

- In addition to economic challenges, reducing the spread of COVID-19 on commercial fishing vessels presents its own unique challenges.
- Work environments, even onboard larger commercial fishing vessels, provide little space for workers, with sleeping bunks and communal eating areas.
- Typically laid out in close quarters.
- Fishermen are also often required to accommodate fisheries observers (scientists who gather data for monitoring fisheries).
- These workers live in close quarters with fishermen and travel from vessel to vessel, which can further elevate potential COVID-19 exposures.

Conclusion

COVID-19 outbreak has been deemed a global health emergency, and its impact on developing countries like India is one of heightening concern. With 1.3 billion populations and the precarious situation of the economy in the pre-COVID period, prolonged lockdown would be ruinous for the economy. While there are some positive initiatives and outcomes, these are likely far outweighed by the negative consequences, especially for groups that



are most vulnerable to these changes. Furthermore, the crisis is far from over. The short-term impacts that we have highlighted here are likely to be followed by long-term crises related to economic hardships and global food crises. Globally, the SSF sector plays a vital role in food and livelihood security. Thus, we emphasize the need for rapid mobilization by all parties in support of the SSF sector. Short-term responses must be swift and targeted to the most vulnerable. Especially agriculture and the allied sector will be in a most vulnerable condition. India, with its apt governance, took the situation as a challenge and doing in all way of possibilities to combat with the pandemic. At the same time, the government and policymakers need to be prepared to minimise the impact of the shock and V-shaped recovery of the economy in the post COVID period.

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More references can be provided on request.


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Biofloc Technology for Shrimp Culture – A Small Outline

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Highlight Points

Biofloc Technology (BFT) is a method of aquaculture that is considered ecologically benign. The effective use of water and nutrients, as well as the low discharge of effluent into the environment, are typically associated with the sustainability of biofloc-based cultivation. Furthermore, BFT allows for the establishment of integrated multi-trophic aquaculture (IMTA) systems, in which one organism's waste is used as feed by another without causing harm to co-cultured species.

Introduction

"Biofloc" is a general term that describes aconglomeration of living (bacteria, cyanobacteria, algae, fungi, protozoans) and non-living (detritus, uneaten feed, waste products) components that form suspended aggregates in aquaculture systems. Biofloc farming is a technique of enhancing water quality in aquaculture through balancing carbon and nitrogen in the system. The basic principle of the biofloc technique is generating the nitrogen cycle by maintaining a higher C:N ratio by stimulating the heterotrophic microbial growth. These microbes assimilate the nitrogenous waste which is further fed upon by the cultured species. The biofloc system is not only effective in treating the waste but also provides nutrition to the culture species.

The biofloc technology can be easily implemented in shrimp farming because of its bottom - dwelling habitat. This biofloc technology can be used as an alternative solution for wastewater treatment and feed re- utilization. This technology can minimize the water exchange and water usage in aquaculture system by maintaining adequate water quality within the culture unit.

In a typical shrimp farm, only 20 – 25% of the feed protein is utilized by the shrimp. The remaining is wasted in the form of nitrogenous metabolites. This inorganic nitrogen is converted into microbial protein known as biofloc by the manipulation of carbon: nitrogen ratio in the shrimp ponds. Thus, the biofloc technology combines the removal of nutrients from the aquaculture system by the production of microbial biomass, which in turn can be utilized by the cultured species in situ as an additional food source.

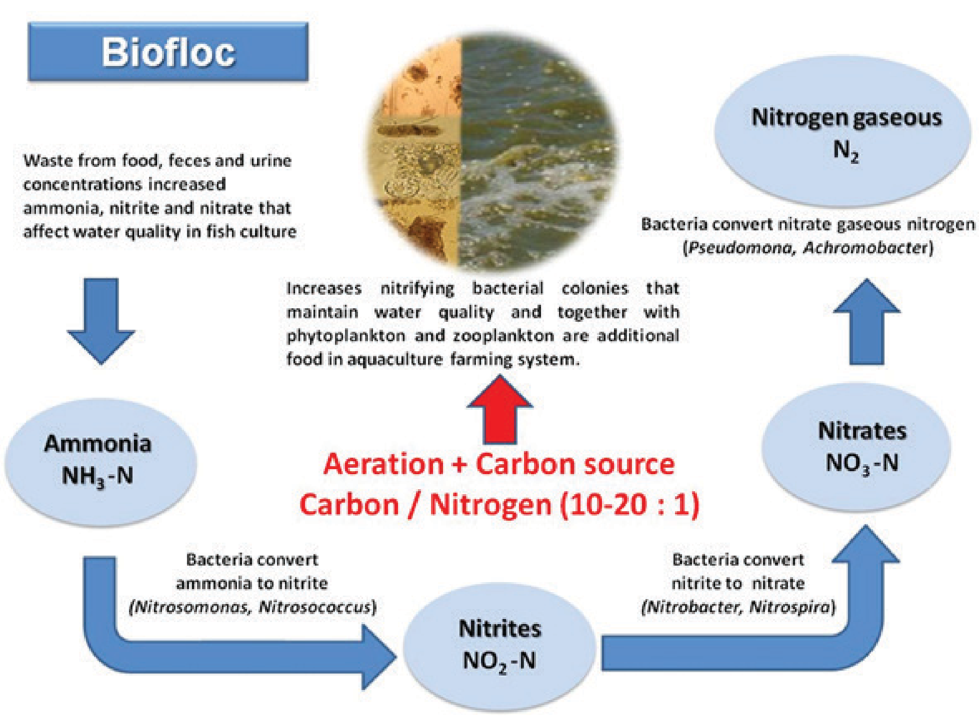

Figure 1: Biological processes in biofloc cultivation

Advantages of biofloc technology

1. It is an eco- friendly culture system.
2. It improves the utilization of land and water efficiency.
3. It encourages limited or zero water exchange.
4. It gives higher productivity.
5. It facilitates high stocking density.
6. It reduces the cost of feed production.
7. It reduces the utilization of protein rich feed.
8. It reduces the feed conversion ratio of the cultured organism.
9. It reduces water pollution.
10. It provides higher biosecurity and reduces the environmental impact.
11. It reduces the risk of introduction and spread of pathogens.
12. Biofloc reduces the pressure on capture fisheries. It reduces the dependence on cheap food fish and trash fish for feed formulation.

Disadvantages of biofloc technology

The only disadvantage of biofloc technology is that it requires high energy inputs for aerators. Power failures for long durations can be critical. This drawback can be resolved by utilizing solar powered aerators.

Shrimp feed has a carbon to nitrogen ratio of about 7-10: 1. The heterotrophic bacteria require a ratio of 12-15: 1. Hence simple sugars or starch is added to increase the C: N ratio and promote the bacterial growth. Additives such as molasses, sugar, sucrose, dextrose etc. are provided as carbon source. High protein feed requires higher carbon supplementation.

Factors affecting the biofloc technology

1. Temperature

The optimum temperature of water for shrimp culture in the biofloc system is found to be between 25- 310C. The water temperature affects the metabolism, oxygen consumption and feeding rate of the shrimp. It also influences the survival and tolerance of the cultured species towards the toxic metabolites.

2. Salinity

The optimum salinity to be maintained for shrimp culture in the biofloc technology is around 15- 25ppt. Salinity mainly depends on the amount of precipitation and rate of evaporation.

3. pH

The ideal pH level to be maintained for shrimp culture in biofloc technology is 6.8- 8.7. pH plays an important role in the growth and survival of the culturespecies as it affects the metabolism and other physiological processes in the animal.

4. Aeration

All biofloc systems require constant motion to maintain both high oxygen levels and to prevent solids from settling. Areas without movement will rapidly lose oxygen and turn into anaerobic zones which release large amounts of ammonia and methane.

To prevent this, every pond, tank or raceway system needs a well-planned layout of aerators. Ponds typically use paddlewheel aerators. Paddlewheel aerators should be strategically installed to create current in the pond. Biofloc systems require up to 6mg of oxygen per litre per hour. Hence, it is recommended to start with at least 30 horsepower of aerators per hectare.

Stocking density of shrimp in biofloc farming

Post larvae of the shrimps are stocked in the biofloc farming systems at the rate of 250- 500 numbers per meter square. The feeding of the stocked post larvae is done based on the calculation of biomass, feed conversion, mortality and weight gain percentage. A production of around 3- 7 kgs/ m3 of shrimp can be expected from the biofloc technology.

Biofloc farming in India

Various research institutes of India have initiated efforts to develop a biofloc model suitable for Indian brackishwaterfarming systems.A series of experiments in pilot scaleconducted at CIBA, showed measurablegain in the production as well as FCR in tiger shrimp (*Penaeusmonodon*) farming by following these biofloc techniques. Various training programmes have be undertaken by CIBA – Central Institute of Brackishwater Aquaculture, CIFA – Central Institute of Freshwater Aquaculture to educate the farmers regarding the biofloc farming.

In conclusion, this biofloc technology helps aquaculture growing towards an environment friendly approach. It reduces the spread of the pathogen and simultaneously improves the health of the shrimp by maintaining a better water quality. Biofloc technology helps in seafood production in a sustainable manner.

Biofloc of bacteria | Biofloc of algae | Biofloc of bacteria-algae

Figure 2: Types of biofloc

FEED BINDERS AND ITS APPLICATION IN AQUAFEED

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Highlight Points

Feed binders are principally used in aquafeeds to improve the efficiency of the feed manufacturing process, to reduce feed wastage, and/or to produce a water-stable pellet, improve pelletability and enhance durability of aquafeed and hence reduce the total operating cost.

Introduction:

Feed binders serve as an additive that can reduce the dusty and powdery nature of fine ground feed materials. In order to reduce the total operating cost, from manufacturing to its consumption stage, feed binders are observed to increase the health benefits of feed materials, and thus, are widely being opted by feed manufacturers. Asia-Pacific dominates the aquafeed binders market due to the consumption of the seafood along with rising production of aquaculture in the region while Europe region is the second largest region in the market growth due to the prevalence of various producers along with rising demand of salmon in the region.The major players who are involved in aquafeed binders business are Cargill, Nutreco, Alltech, ERBER Group, BioMar Group, Kevin, Avanti Feeds Ltd., Charoen Pokphand Foods, Growel Feeds,DSM, Evonik Industries, De Heus Animal Nutrition and INVE Aquaculture etc.

A binder or binding agent is any material or substance that holds or draws other materials together by cohesion or adhesion. These substances provides a cost efficient solution to binding requirements, which improves the water resistance of shrimp feed and finally improves return on investment, and minimize pollution problems related with feed residue.Binding agents, such as guar gum, corn starch, agar, carrageenan, and gelatin, are highly effective binders but are very expensive to include in the feed. To optimize the cost of feed ingredients, compound feed mixers, or livestock, farmers opt for binders with high-cohesive properties to reduce the amount of inclusion as well as to limit the cost. Cost-effective binders, such as lignosulphonates and clay, are moderately expensive, with very low inclusion levels from 0.2% to 0.8%.

Binders are principally used in aquafeeds to improve the efficiency of the feed manufacturing process, to reduce feed wastage, and/or to produce a water-stable diet, improve pelletability, enhance durability.Fish feeds must be formed in to particles or pellets that are strong enough to withstand normal handling and shipping without disintegrating. Binders can either be liquid eg.molases or solid that forms bridges to make strong interparticle bonding. Solid bridges are formed by high pressure through diffusion,chemical reaction, crystallization, hardening of binders after cooling and solidification of melted particle after cooling or drying. Many substances are known to increase the water stability. Some of these are specialist chemicals and others are natural products, raw or refined. Some of the specialist chemicals are guar gum, carrageenin, agar, various forms of starches, carboxymethylcellulose,alginates,bentonites and hemicelluloses etc.

Classification of Feed Binders

It is broadly divided into two types:1) Natural Substances 2) Synthetic Substances

Natural substances: It is also known as natural binders or nutritive binders as it contains certain amount of nutrients. It includes:Marine (Agar, Alginates, Carrageenan) and terrestrial vegetable extracts (Pectin, Starch,Guar gum) animal extracts (Chitosan,Gelatin), Wheat gluten, Rice flour, Finely milled wheat bran, Gelatin , Fish hydrolysates and Pre-gelatinized starches etc.

Synthetic substances: It is also known as synthetic or artificial binders. It includes Bentonite, Lignin-sulfonate,Hemi-cellulose extract, Carboxy methyl cellulose (CMC), Alginate, Gumacacia and Zein etc.

Classification of Binders on the basis of durability

It is divided into two types: 1) Short term water stability binders, 2) Long term water stability binders

Short term water stability binders includes, Lignosulphonates, Hemicelluloses and Carboxymethycellulose (CMC) etc.

Long term water stability binders includes, Starch, Alginate, Starch, seaweed extract, plant gum, chitosan and gelatine etc.

Specialized binders: Polymethylcarbamide is an important specialized binder that binds proteins and carbohydrates. Such binders are not approved by the USFDA (United States


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Food and Drug Administration) because they are tasteless. Urea formaldehyde/calcium sulphate mixtureis a USFDA approved binder and has no harmful role. The allowable level of both the binders are 0.5%.

Inclusion level of different binders used in aquafeed:

The most common synthetic binders used in fish and shrimp feed and their inclusion level are reported in parenthesis: Bentonites (1-2%), Lignosulphonates (1-4%), Hemicelluloses - 1-2%, Carboxymethycellulose: 0.5-2.0% and Starches (<3%). Alginates are a type of binder used in moist / semi-moist foods.It usually attaches to food by producing gels. Occasionally calcium ions, vitamins calcium sulphate, etc. are used to make food by producing gels.The dietary level of alginates used in feed rations generally varies between 0.5 and 5%.For those diets which have a low soluble calcium content for adequate gel formation by alginates, the addition of soluble calcium salt such as calcium sulphate, calcium carbonate or calcium phosphate will be required.

Binders such as bentonites, lignosulphonates, hemicellulose and carboxymethylcellulose are used primarily within feed rations to improve the efficiency of the feed manufacturing process (ie. during pelleting by reducing the frictional forces of the feed mixture through the pellet dies and thereby increasing the output and horse power efficiency of the feed mill) and for the production of a durable pellet (ie. by increasing pellet hardness and reducing wastage in the form of 'fines' during the pelleting process and during handling/transportation). The dietary inclusion level of these binding agents generally varies between 1 and 2% of the dry diet.By contrast, for those aquaculture species which have a slow feeding habit and require to masticate their food externally prior to ingestion (ie. marine shrimp and freshwater prawns), it is essential that specific binders be used to delay the physicaldisintegration of the pellet or feed mash within the water until ingestion is complete. Under these circumstances additional dietary binding agents will be required such as starchy plant products (ie. sago palm starch, cassava starch, potato starch, bread or wheat flour, rice and maize. binding being achieved through heat treatment and consequent starch gelatinization), alginates (ie. salts of alginic acid extracted from seaweeds), carrageenin, plant gums (ie. guar gum, locust bean gum, gum arabic), agar, high-gluten wheat flour, chitosan, propylene glycol alginate and gelatin.

What feature does Feed Binder should have?

These are the following features a feed pellet binder should have:

- Perfect adhesiveness
- Easy to produce, have the feasibility of industrial production.
- High chemical stability and heat stability.
- Should not generate chemical reaction with other feed component.
- It should be non-toxic.
- Should not have harmful effect to digestion process of cultured finfish and shellfish.

How to choose Feed Binder?

While choosing a feed pellet binder one should keep in mind these following points:

- The nutritive value of binder. Most of binder are protein and sugar which can provide a certain amount of nutritive value.
- Consider the impacts of binder on aquatic animals' growth and survival, if there are too much starch that will effect the growth of fish.
- The interaction between binder and feed component.
- Raw material conditions.
- Binder should be dry and shall be kept in damp proof shade place.
- Binder should be chosen based on the food and feeding habit of cultured fish or shrimp.

Effectiveness of Binding Agents:

The effectiveness of individual binding agents will depend upon a variety of factors including:

- Feed particle size - binding efficiency and pellet durability decreases with increasing feed particle size.
- Manufacturing process - the binding capacity of starch based feed ingredients increases with heat treatment and starch gelatinization.
- Pellet diameter and die thickness - binding efficiency increases with decreasing pellet diameter and increasing die thickness.
- Diet composition: Low-fibre foods present little yield to extrusion in a pellet die. High fat ingredients and added fat lubricate the food during extrusion limiting the work of compression in the die to form a solid pellet. Pellets which are formed with little compression are easily broken on handling and when wetted by water.
- Added fat also covers the surface of carbohydrate particles in a food, preventing proper starch gelatinization during the steam conditioning and extrusion process.

Advantages of Feed Binders:

- It improves the traction of flour and increases significantly the output of the pellet press and improve feed integrity of finished feed whilst reducing power consumption and risks of blockage.
- It avoids waste in rearing costs by increasing the durability and water stability of fish feed pellets.
- Binders protects the fish feed pellets from many adverse conditions endured during handling, transportation and storage and reduces trucking and storage loss.
- Pellet binder absorbs the moisture, the pellets keep their original physical form and freely flows from the silos.
- By minimizing the percentage of fines, fish feed pellet binder reduces the loss and waste of feed during feeding and therefore significantly improves animal performance.

Application of Feed Binder:

The feed binder is used to bind every nutrient in an ingredient together. Feed Binder is very suitable for pelletizing due to high strength capacity. It helps to keep the feed stable in water and reduce breakage and fines in prepared feeds.

Conclusion:

Feed binders plays an important role in minimizing the percentage of fines and reduces the loss and waste of feed during feeding, improves the water stability of prepared feed and therefore significantly improves animal performance.

Effluent Composition, Guidelines for Effluent Treatment and Water Quality Standards in Shrimp Pond

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ABSTRACT

The article is mainly focused on the impacts of shrimp farm effluent in environment. The higher concentrations of various physico-chemical parameters in effluent affects the water quality of draining area. It affects the metabolic rate and survival of aquatic organisms. Stringent regulations need to be maintained to control the release of untreated effluent into then environment. This article gives a wide outline about the effluent water quality parameters, target standards to be maintained and management measures.

1. INTRODUCTION:

Aquaculture contributes significantly to the world food supply, providing around 30% of fisheries production. Because capture fisheries are being exploited to their sustainable limit and beyond, aquaculture is expected to continue to have an important role. Apart from finfish farming, shrimp culture attracts farmers due to its high revenue. The export value of cultured shrimps has increasing contribution to country's income.Cultured shrimps, primarily the Vannamei variety, accounted for nearly 70% of the India's seafood exports worth Rs. 37,871 crore in 2016-17. Most of the output increase has come from Andhra Pradesh, Odisha, West Bengal and Gujarat. However, construction of several shrimp farms has a significant impact on the environment and a number of concerns have been expressed by both environmental activists and scientists.

2. IMPACTS OF SHRIMP FARM EFFLUENT:

The most serious concerns are the following:

(a) Destruction of mangrove, wetlands, and other sensitive aquatic habitat by aquaculture projects.

(b) Conversion of agricultural land to ponds.

(c) Water pollution resulting from pond effluents.

(d) Excessive use of drugs, antibiotics, and other chemicals for aquatic animal disease control.

(e) Inefficient utilization of fish meal and other natural resources for fish and shrimp production.

(f) Salinization of land and water by effluents, seepage, and sediment from brackishwater ponds.

(g) Excessive use of ground water and other freshwater supplies for filling ponds.

(h) Spread of aquatic animal diseases from culture of organisms to native populations.

(i) Negative effects on biodiversity caused by escape of non-native species introduced for aquaculture, destruction of birds and other predators, and entrainment of aquatic organisms in pumps.

(j) Conflicts with other resource users and disruption of nearby communities.

Of these and other possible negative impacts, water pollution by pond effluents is probably the most common complaint and this concern has attracted the greatest official attention in most nations. Most shrimp and fish production is conducted in ponds, and ponds have effluents after heavy rains and when they are drained. Water also is discharged from some ponds in response to water exchange. Although there is considerable interest in water reuse, or closed-cycle production systems, it currently is not technically or economically feasible to conduct most types of aquaculture without discharge.

3. ENVIRONMENTAL REGULATIONS:

Fertilizers and feeds are applied to ponds to promote shrimp and fish production, and normally, no more than 25% to 30% of the nitrogen and phosphorus applied to ponds in fertilizers and feeds is recovered in fish or shrimp at harvest. Ponds have a remarkable ability to assimilate nitrogen and phosphorus through physical, chemical, and biological processes. Ponds often have higher concentrations of nutrients, plankton, suspended solids, and oxygen demand than the water bodies into which they discharge.Thus pond effluents are potential sources of pollution in receiving waters.

Due to the efforts of environmental protection groups, many nations are beginning tomake regulations for aquacultural effluents. Some European nations have made relativelystrict regulations for cage and net pen fish culture. Australia has developed regulations forpond culture of fish and shrimp. The National Pollution Discharge Elimination System(NPDES) of the United States Clean Water Act has allowed individual states to applyNPDES permits to aquaculture effluents for many years. Most states with significantaquacultural production, however, have not required NPDES permits for aquaculturebecause the United States Environmental Protection Agency (USEPA) has made no federalrule for aquaculture effluents. The USEPA has initiated a rule-making procedure foraquaculture, and the final rule will be available on 30 June 2004.After this, aquaculture projects in all states will be subject to regulation by the federal rule.Many tropical nations also have made aquaculture effluent regulations. Some examples areBelize, Brazil, Ecuador, India, Mexico, Oman, Thailand, and Venezuela.

4. EFFLUENT COMPOSITION AND WATER QUALITY STANDARDS:

One of the major environmentalconcerns about shrimp farmingis the possibility that shrimp farmeffluents could cause eutrophicationand sedimentation in coastal waters. Thus, water quality standards for shrimpfarm are an extremely importantfeature.It is not easy to formulate water quality standards for effluents from a previously unregulated activity such as shrimp farming. Standards must be strict enough to provide environmental protection, or those representing environmental interests will object. On the other hand, standards must not be too strict, or shrimp farmers will notbe able to comply with them.

A reasonable approach to this problem is to compare water quality concentrations in shrimp farm effluents with water quality limits applied to activities that are currently regulated. This comparison should reveal ifsome variables in shrimp pond effluents are likely to be outside normally accepted ranges, and suggest the measures necessary to provide a satisfactory effluent. Standards could then be established based on the effluent concentrations that can be expected if shrimp farmers apply the best management practices and treatment methodology economically feasible within the industry.

To develop effluent standards for application on large shrimp farms, a literature review was conducted to obtain as much information as possible on concentrations of water quality variables in shrimp farm effluents. The results of the literature review helped establish suggested water quality limits for GAA effluent standards.

Many scientists conducted several project works to find out the desirable water quality standards for important variables. Effluent data(water quality variables) were collected from semi intensive and intensive shrimp farms. Generally , intensive shrimp ponds have more concentrated effluent than semi intensive farms. For example, total suspended solids (TSS) concentrations averaged 91 mg/l in semi-intensive shrimp farm effluentsand 214 mg/l in effluents from intensive farms. The biochemical oxygen demand was about twice as large in intensive shrimp farm effluents as in those from semi-intensive farms. The greater concentrations of suspended solids in intensive shrimp farm effluents result mainly from sediment resuspension by mechanical aeration, but greater phytoplankton abundance from larger

nutrient inputs also contributes to suspended solids.

5. GUIDELINES FOR EFFLUENT MANAGEMENT AT FARM LEVEL:

Adoption of Best Management Practices:

Shrimp farms have limited options for effluent treatment. The only economically feasible ways of improving effluent quality appear to be adoption of best management practices (BMPs) and installation of sedimentation basins. Application of BMPs can lower nutrient inputs, reduce sediment resuspension and erosion, and improve dissolved oxygen concentrations. It can also moderate pH and total ammonia nitrogen concentrations in pond waters, with resulting effluents of higher quality.

On many shrimpfarms, application of BMPs alone will not be sufficient to lower total suspendedsolids and total phosphorusconcentrations below limits in typical effluent standards. Total phosphorus is associated mainly with suspended particles, and sedimentation lowers both total phosphorus and total suspended solids concentration. Application of BMP's help to improve farms economic performance. For example, suppose that theBMPs are to lower stocking rates and use better feed management. The lower stocking rates and smaller feed inputs will result in better water quality, less stress, faster growth, better feed conversion ratios, and less waste produced. However, this scenario also will increase efficiency and profits.

Reference Practices in GAA Codes:

References to many better management practices can be found in "Codes of Practice for Responsible Shrimp Farming," and shrimp farmers can readily adopt these practices. Sedimentation basins are already in use on some shrimp farms, but most farms would have to design and construct them.Sedimentation basins should have hydraulic retention times of six to eight hours to allow settling of coarse and medium-sized particles, and cause a decrease in total suspended solids and total phosphorus concentrations. Water with a low dissolved oxygen concentration will become re-aerated while standing in the sediment basin. There also should be a moderate reduction in biochemical oxygen demand, and possibly a moderation of pH and some decrease in total ammonianitrogen concentration through nitrification during retention.

Target Standards :

Table 3. Suggested initial and target water quality standardsfor shrimp farm effluents.

VARIABLE (units)	INITIAL STANDARD	FINAL STANDARD
pH	6.0-9.5	6.0-9.0
Total suspended solids (mg/l)	100 or less	50 or less
Total phosphorus (mg/l)	0.5 or less	0.3 or less
Total ammonia nitrogen (mg/l)	5 or less	3 or less
5-d biochemical oxygen demand (mg/l)	50 or less	30 or less
Dissolved oxygen (mg/l)	4 or more	5 or more

6. ADDITIONAL EFFLUENT CONSIDERATIONS :

1. Discharge from settling basins can cause erosion within final discharge canals or at outfall points if water velocity is too great. Final discharge should not suspend soil material, and thereby increase the concentration of total suspended solids or create a turbidity plume.

2. Shrimp farm effluent is brackish water or seawater, and to prevent salinization, it should not be discharged into freshwater or onto agricultural land. As a general rule, the effluent probably should not cause a salinity increase or decrease in the receiving waters of over 10% of the seasonal average. It would be difficult to establish salinity limits except on a site-bysite basis.

3. Shrimp farmers sometimes apply substances to pond water during preparation for the new crop in order to destroy disease organisms and their hosts. Drugs and antibiotics may be applied during crops in response to diseases. When mass mortality of shrimp occurs in ponds, substances may be applied to disinfect pond water as a disease prevention measure before the water is discharged into natural water bodies. Some of these substances can be harmful to native aquatic organisms. After pond treatments, water should be held in ponds with no discharge until the potentially harmful substances have degraded.

4. Water quality permits may specifically state that foam, scums, or turbidity plumes should not be visible at the discharge point. Shrimp farm effluent sometimes has foam on its surface. This foam probably can be contained in settling basins if a floating skimmer is mounted across the discharged end of the basin. Sedimentation should prevent turbidity plumes resulting from suspended soil particles, but discoloration of effluent by plankton can also result in a turbidity plume. The only method for preventing this plume would be subsurface discharge.

FIGURE NO: 1 - Foam is often associated with aerated shrimp ponds.

7. CONCLUSION :

Discharge of untreated shrimp farm effluent into the surrounding environment will adversely affect the biodiversity. Intensive shrimp farms have more concentrated effluent than semi intensive farms .So the shrimp farmers should comply with the standards of important variables present in effluents. In small scale shrimp farms, proper application of BMP's are enough to meet with the targeted effluent quality standards. These practices will result in good yield and helps to sustain a safe environment.

References can be provided on request.

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Sustainable Shrimp Farming through Aquamimcry Technique

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Aquamimicry is a concept to stimulate the natural estuarine conditions by enhancing the growth of copepods along with the development of beneficial bacteria (Copefloc) in the system which is used as supplemental feed to the cultured shrimp and maintains the water quality. Copepods are tiny crustacean arthropods found in fresh, brackish and seawater all around the world. These creatures have a promising nutritional profile. Such an eco-friendly, greener alternative & sustainable concept for shrimp production is the new age aquamimicry technology. This is done by fermenting a carbon source such as rice or wheat bran along with probiotics like *Bacillus sp.* to function in the release of their nutrients. Though this method is similar to biofloc technology, there are certain differences such as the amount of carbon added and the sediments reduced to be used by other animals. Thus, the water mimics the appearance and composition of natural estuarine water that includes microalgae and zooplankton. The presence of bacteria provides nutrition and serves as probiotics. This system mimics the natural estuarine system with a balanced composition of microalgae and zooplankton. Under this condition, the pH and dissolved oxygen fluctuation are minimized thus providing a conducive culture condition with minimum stress to the shrimps.

Aquamimicry – Sustainable approaches in shrimp farming.

Aquamimicry's development can be traced back to the 1990s in Thailand. At the time, it was realized that shrimp raised on a rice bran diet avoided disease despite being close to infected ponds. Aquamimicry is highly economical compared to a biofloc system as it provides a better production rate due to natural food production at less power consumption compared to a biofloc system and the FCR is better and the nutritional requirements of the shrimp are satisfied.

Pond Preparation

Probiotics are applied to the pond filled with filtered seawater to a depth of 80-100 cm and chain is dragged for a week. If HDPE lined ponds are used, probiotics are applied to the pond bottom and instead of chain heavy ropes should be used to prevent tearing of HDPE lined sheet. Dragging is done gently for proper mixing of probiotics in soil and to prevent the development of biofilms which is toxic to the shrimp.

Highlight Points

- Natural estuarine condition is simulated for healthy shrimp culture
- Natural food (Copepods) provides better health condition in shrimp with better disease resistance
- Supplementary feed utilization is reduced in this aquamimicry based culture system with a better Food Conversion Ratio
- Water quality parameters like pH and Dissolved Oxygen are maintained with minimum fluctuation due to the appropriate composition of microalgae and zooplankton
- The culture pond bottom is maintained in good quality due to the growth of beneficial bacteria

Pre stocking management of Liquid Fermented Rice Bran (LFRB)

Carbon sources like rice or wheat bran (without husk), water (1.5-10 ratio) and probiotics are mixed under aeration for 24 hours. The finely powdered bran along with entire mixture can be added to the pond, if it is crumbled, the "milk " or "juice" can be added to the pond and bran solids are fed to the fish on the bio-filter pond. Shrimps are stocked at a density of 30-100 animals /square meters. The amount of fermented carbon source that can be added depends on the system and turbidity level. Generally, the recommended dose of fermented carbon source is 1 ppm and 2-4ppm for extensive and intensive systems respectively. The ideal turbidity should be around 30-40cm. Rice bran should be adjusted based on the turbidity.

Post stocking management of Liquid Fermented Rice Bran (LFRB)

Maintains Liquid Fermented Rice Bran (LFRB) daily between 1-5 ppm (10-50 kg per hectare) depends on the pond turbidity preferably at 30 cm. If the turbidity is higher than 20-30 cm, reduce the amount of LFRB. If the turbidity is lower than 30-40 cm, increase the amount of LFRB. Turbidity (Biocolloids) should not be less than 30 cm


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throughout the cycle. Daily check for the early morning and late noon turbidity and LRFB application is done accordingly. Make sure the pH is not fluctuated more than 0.2 log with max of 0.3 log throughout day and night. Most preferably at 0.0-0.1 log. Dissolve oxygen (D.O) should be maintained at least 5 ppm during late night and should not exceed 10 ppm during the daytime between 5 – 8 ppm is most preferably. Divides the LFRB solution for 1-2 times per day (early morning and afternoon), dilute with pond water and slowly widespread the LFRB throughout the pond if possible. If observed any depletion in dissolved oxygen, immediately stop adding LFRB. Fully aerate the system and chain dragging around the feeding zone for the first 15 days after stocking is still preferably (20% of total area/ day). Avoid chain dragging around the center of the pond. Additional probiotics are added to the grow-out pond, to maintain water quality and increase the formation of bio-colloids (flocs consisting of detritus, zooplankton, bacteria etc). After 15 days of stocking, slowly dragging chains or ropes on the pond bottom is encouraged to decrease the formation of bio-films. Generally, an extensive system does not require further water quality management but there is a need to remove sediments two hours after feeding for an intensive system.

Sedimentation Pond

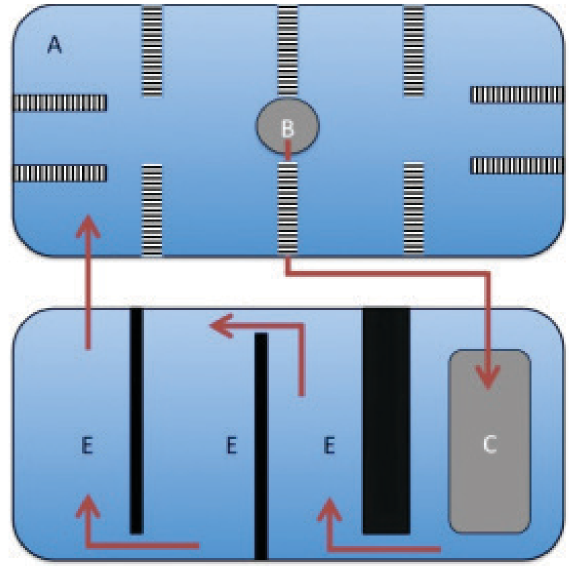
In aquamimcry system, the sediment from the culture pond is pumped to the sedimentation pond and this pond should be deeper than the grow-out pond. For bio-mitigation of the sediment, detritus and algae feeding fishes like catfish or milkfish are stocked to clean the pond sediment. The sediment contains fish food such as worms and benthic invertebrates, which is used as feed for stocked fishes. After the sedimentation, water is directed to another pond and increases the retention time and acts as bio-filter and tilapia can be added at low densities. From here,

Liquid Fermented Rice Bran

water is directed back to the grow-out pond but with little nitrogenous waste. The sedimentation pond is cleaned at an interval of every three years. After the harvest, the pond does not have a smell, black soil, or accumulated sediments and it is even ready for the next production cycle. It has been reported that the shrimp, which is cultured under Aquamimicry system have deeper red color when cooked, resulting from the additional pigments released from the natural food in the pond. The omega 3 fatty acid content of the shrimp is increased by this technique and provides additional health benefits.

Issues in Aquamimicry

Aquamimicry includes the difficulty in applying this concept to indoor conditions and in large treatment ponds. An indoor system in Korea with this concept gave better results but it produced excessive sediments which cannot be used again. In the case of large treatment ponds, recent efforts are being made to reduce the 1:1 ratio but on more extensive system no treatment ponds are needed. First of all, farmers should make a trial and confirm whether the concept is suitable for their present environmental conditions.



A.Culture Pond, B.Central Drainage, C. In Pond sedimentation tank, D. Retention System, E. Fish Culture System

Advantages of Aquamimicry Farming

- Maintained water quality at optimum level and reduced fluctuations. Stress-free environment is created as there is no fluctuation in the water medium as result in minimized water exchange.
- Increased nutritional composition of cultured shrimp, as it uses the live microbial compound as feed and improved FCR.
- Automatically bottom soil problem is rectified by beneficial microbes.
- It decreased production cost, as supplementary feed usage is reduced.
- Pond conditions should mimic the natural estuarine conditions resulting in good growth of shrimp.

Future Prospects

As there is no use of chemicals or antibiotics shrimp grown will be rich in nutritious content and fetch a higher price in the market. Aquamimicry offers more sustainability than conventional farming. It gives better results than bio-floc technology. Good quality shrimp can be produced at a low production cost with health benefits. Aquamimicry will benefit future generations and can be a source of employment in coastal regions.

Conclusion

Aquamimicry is one of the eco-friendly shrimp farming techniques but still, it is not commercialized due to a lack of awareness of scientific approaches in farming and farm-level adoption of this technique. Therefore, awareness of aquamimicry has to be created among the farming community and farm-level studies have to be done for further validation of this technology for adoption by farmers.

References can be provided on request.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Our Other Activities :
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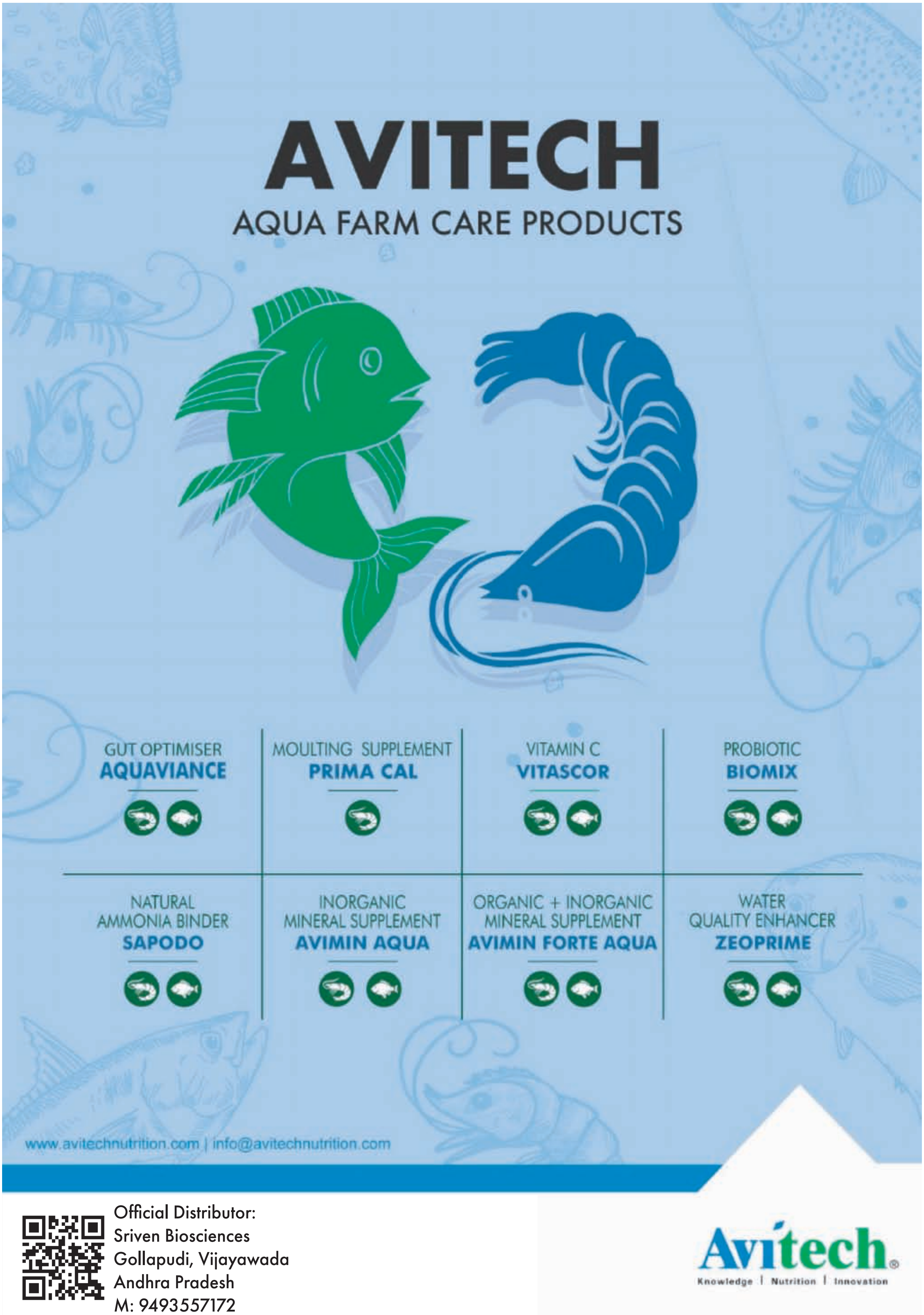
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Potential of Integrated Multi-trophic Aquaculture System

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Introduction

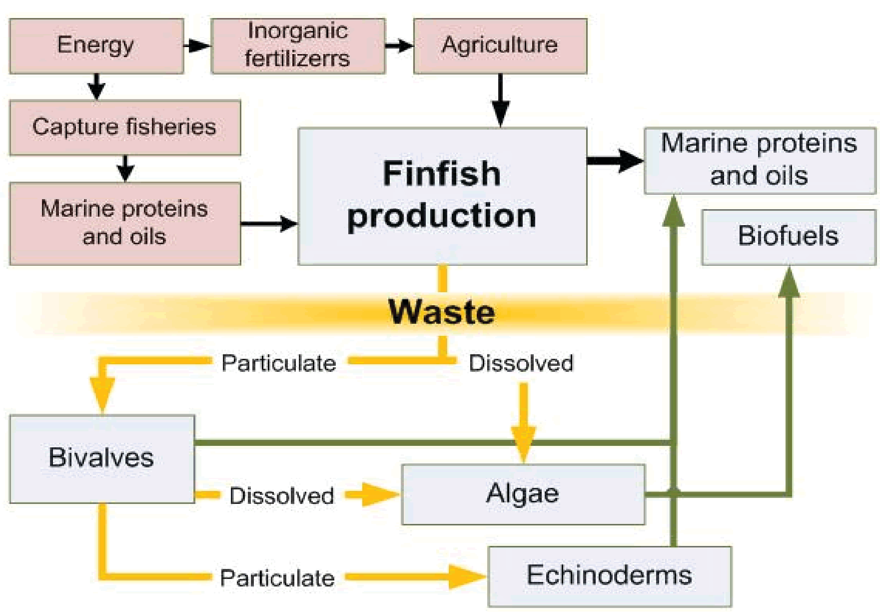
IMTA is the practice that combines the cultivated of fed aquaculture species (e.g., finfish/shrimp) with organic extractive aquaculture species (e.g., shellfish/herbivorous fish) and inorganic extractive aquaculture species (e.g., seaweed) to create balanced ecological systems for conservational sustainability and economic stability (product diversification and risk reduction. This system is different from the 'Polyculture'based system (Shah *et al.* 2017).

Worldwide mostly practiced the polyculture-based culture system in different coastal areas but lacked a problem they face, like properly balanced feed. IMTA is the most beneficial and sustainable system is developed globally. It is an IMTA. IMTA simple way to diffed as the farming of aquaculture species from different trophic levels and with complementary ecosystem functions, in a way that allows one species' uneaten feed and wastes, nutrients, and by-products to be recaptured and converted into fertilizer, feed, and energy for the other crops, and to take advantage of synergistic interactions between species. IMTA is based on principle nitrification and conversion through diversification (Barrington et al. 2009)

In this system, selecting appropriate species and sizing the various populations to provide essential ecosystem functions allows the biological and chemical processes involved to achieve a stable balance, mutually benefiting the organisms and improving ecosystem health. Ideally, the co-cultured species each yield valuable commercial "crops." IMTA can synergistically increase total output, even if some of the crops yield less than they would, short-term, in a monoculture. The primary function of IMTA

"Integrated" refers to intensive and synergistic cultivation, using waterborne nutrient and energy transfer. "Multitrophic" means that the various species occupy different trophic levels, i.e., different (but adjacent) links in the food chain. IMTA is a specialized form of the age-old practice of aquatic polyculture, which was the co-culture of various species, often without regard to trophic level. In this broader case, the organisms may share biological and chemical processes that are minimally complementary, potentially leading to significant ecosystem shifts/damage. Some traditional systems did culture species that occupied multiple niches within the same pond but limited intensity and management.

The more general term "Integrated Aquaculture" is used to describe monocultures' integration through water transfer. The terms "IMTA" and "integrated aquaculture" differ primarily in their precision and are sometimes interchanged. Aquaponics, fractionated aquaculture,



Layout of Integrated multi-trophic aquaculture System (IMTA)

integrated agriculture-aquaculture-systems, integrated peri-urban-aquaculture-systems, and integrated fisheries-aquaculture-systems are variations in the IMTA concept.

The different step should be need development of IMTA

1. To develop the economic and environmental value of IMTA systems and their co-products.
2. Species should be selecting the right, appropriate to the habitat, available technologies, and oceanographic conditions
3. The government should be support and promoting to the farmers and commercialization of IMTA technology.
4. Recognizing the benefits of IMTA and educating stakeholders about this practice.
5. Establishing the R&D&C continuum for IMTA.

Selection of species

Species selection is the most important and useful factor in IMTA aquaculture because it is a growing semi-naturally handling system. Suitable for ecological balance and sustainability is the primary consideration in IMTA. Fed organisms, such as predatory fish and shrimp, are nourished by feed, comprising pellets or trash fish. Extractive organisms extract their nourishment from the environment. The two economically significant cultured groups that fall into this category are bivalves and seaweed. Combinations of co-cultured species will have to be carefully selected according to several conditions and criteria:

- **Complementary roles with other species in the system:** Use species that will complement each other on different trophic levels.
- **Adaptability concerning the habitat**: Native species that are well within their normal geographic range and available technology can be used. This will help prevent the risk of invasive species causing harm to the local environment and potentially harm other economic activities.
- **Culture technologies and site selection**: Particulate organic matter and dissolved inorganic nutrients should be both considered, as well as the size range of particles when selecting a farm site.
- **Ability to provide both efficient and continuous bio-mitigation**: Use species capable of growing to significant biomass. This feature is vital if the organisms act as a bio-filter that captures many of the excess nutrients and can be harvested from the water.
- **Market demand for species**: Use species that have a growing market value. Farmers must be able to sell alternative species to increase their economic input.
- **Commercialization potential**: Use species, for which regulators and policymakers will facilitate the exploration of new markets, not impose new regulatory impediments to commercialization.

IMTA system designs:

An effective IMTA operation requires the selection, arrangement, and placement of various components or species to capture both particulate and dissolved waste materials generated by fish farms. The selected species and system design should be engineered to optimize the recapture of waste products. As larger organic particles, such as uneaten feed and feces, settle below the cage system, they are eaten by deposit feeders, like sea cucumbers and sea urchins. Simultaneously, the fine suspended particles are filtered out of the water column by filter-feeding animals like mussels, oysters, and scallops. The seaweeds are placed a little farther away from the site in the direction of water flow so they can remove some of the inorganic dissolved nutrients from the water, like nitrogen and phosphorus. IMTA species should be economically viable as aquaculture products and cultured at densities that optimize the uptake and use of waste material throughout the production cycle.

Present studies of IMTA worldwide:

In this culture, technology beneficial to ecological and sustainability globally. Nowadays, IMTA commonly culture practices worldwide. In temperate waters, Canada, Chile, China, Ireland, South Africa, the United Kingdom of Great Britain and Northern Ireland (mostly Scotland), and the United States of America are the only countries to have IMTA systems near the commercial scale. France, Portugal, and Spain have ongoing research projects related to the development of IMTA. The countries of Scandinavia, especially Norway, have done some individual groundwork towards the development of IMTA, despite possessing an extensive finfish aquaculture network (Barrington *et al.* 2009).

Studies have focused on integrating seaweeds with marine fish culture for the past fifteen years in Canada, Japan, Chile, New Zealand, Scotland, and the USA. The integration of mussels and oysters as bio-filters in fish farming has also been studied in several countries, including Australia, the USA, Canada, France, Chile, and Spain. Recent IMTA research includes a focus on seaweeds, bivalves, and crustaceans. Studies conducted in an IMTA system incorporating *Gracilaria lemaneiformis* and *Chlamys farreri* in North China have shown a bivalve/seaweed biomass ratio from 1:0.33 to 1:0.80 was preferable for efficient nutrient uptake and for maintaining lower nutrient levels. Results indicate that *G. lemaneiformis* can efficiently absorb ammonium and phosphorus from scallop excretion.

In China reported the Seaweeds, *Gracilaria lemaneiformis*, grown over 5 km of culture ropes near fish net pens on rafts increased the density from 11.16 to 2025 g/m 3-month growing period. During the following 4 months to 80 km of rope, the scaling up of culture area reported an increase in culture density on ropes to 4250 g/m. An increase in the biomass of *Gracilaria* (in the culture area) to 340 tonnes wet weight was estimated due to its culture close to fishnet pens. Different work along similar principles has taken place elsewhere.

Studies on IMTA have been carried on the East coast of Canada, where Atlantic salmon (*Salmo salar*), kelp (*Saccharina latissima* and *Alaria esculenta*), and blue mussel (*Mytilus edulis*) were reared together at several IMTA sites in the Bay of Fundy. The study has shown that the growth rates of kelp and mussels cultured in proximity to fish farms have been 46 and 50% higher, respectively, than at control sites. Several other studies have also reflected on the faster growth of mussels and oysters grown adjacent to fish cages. This reflects an increase in nutrients and food available from the finfish cages. Taste tests of mussels grown in conventional aquaculture and mussels grown at these IMTA sites showed no discernible difference; meat yield in the IMTA mussels was, however, higher. Findings of the economic models have also shown that increased overall net productivity of a given IMTA site can increase the farm's profitability compared with monoculture.

Studies from land-based systems indicated that seaweeds could remove between 35% and 100% of the fed species' dissolved nitrogen. The capacity of seaweeds in open-water cultures to remove nutrients from the water column can be estimated based upon the fraction of available nutrients bound by the seaweeds at any given point in time. Experimental data and mass balance calculations indicated that a large area of seaweed cultivation, up to one ha for each ton of fish standing stock, would be required for the full removal of the excess nitrogen associated with a commercial fish farm.

The open-sea IMTA in India is very recent; however, various investigations have been carried out on the various mariculture species' beneficial polyculture. The collaborative culture of compatible species of prawns and fishes is of considerable importance in augmenting yield from the field and effective utilization of the pond system's available ecological niches. Finfish culture, *Etroplus suratensis*, in cages erected within the bivalve farms (racks) resulted in high survival rates and the finfish's growth in the cages. Co-cultivation of *Gracilaria* sp. at different stocking densities with *Feneropenaeus indices* showed nutrient removal from shrimp culture waste by the seaweed. The ratio of 3:1 was found suitable for the co-cultivation. The seaweed (600 g) reduced 25% of ammonia, 22% nitrate, and 14% phosphate from the shrimp (200 g) waste. Polyculture of shrimp with mollusks helps break down organic matter efficiently. It serves as an important food source for a range of organisms and either directly or indirectly provides shelter or creates space for the associated organism, thus increasing the ecosystem's species diversity. Studies have shown that an individual mussel can filter between 2-5 l/h and a mussel rope more than 90000 l/day. The culture of mussels could thus be used in the effective removal of phytoplankton and residues and reduce the eutrophication caused by aquaculture.

Along the east coast of India, the introduction of IMTA in open sea cage farming yielded 50% higher production of seaweed, *Kappaphycus alvarezii*, when integrated with finfish farming of *Rachycentron canadum*. Open-sea mariculture of finfishes, when integrated with raft culture of green mussels, *P. Viridis* resulted in a slight but not significant reduction in nutrients along with Karnataka. The beneficial effect of combining bivalves such as mussels, oysters, and clams as bio-filters in utilizing such nutrient-rich aquaculture effluents has been documented in estuaries. In a tropical integrated aquaculture system, the farming of bivalves (*Crassostrea madrasensis*) along with finfish (*Etroplus suratensis*) resulted in controlling eutrophication effectively (Viji *et al.*, 2013, 2015). The filter-feeding oysters improved the clarity of the water in the farming area, thereby reducing eutrophication. The optimal co-cultivation proportion of fish to oysters reported was 1:0.5 in this farming system.

Benefits:

- Mitigation of effluents through bio-filters is suited to the ecological niche of the aquaculture site. This can solve a number of the environmental challenges posed by monoculture aquaculture.
- The increased overall economic value of an operation from the commercial by-products that are cultivated and sold. The complexity of any bio-filtration comes at a high financial cost. To make environmentally friendly aquaculture competitive, it is necessary to raise its revenues.
- Improving economic growth through employment (both direct and indirect) and product processing and distribution.
- Certain seaweeds can prevent disease prevention or reduce disease among farmed fish due to their antibacterial activity against pathogenic fish bacteria.
- Potential for differentiation of the IMTA products through eco-labeling or organic certification programs.

Challenges in IMTA

- **Higher investment**: Integrated farming in the open sea requires a higher level of technological and engineering sophistication and up-front investment.
- **Difficulty in coordination**: If practiced utilizing different operators (e.g., independent fish farmers and mussel farmers) working in concert, it would require close collaboration and coordination of management and production activities.
- **Increase the farming area requirement**: While aquaculture can release pressure on fish resources and IMTA has specific potential benefits for the enterprises and the environment, and fish farming competes with other users for the scarce coastal and marine habitats. Stakeholder conflicts are common and range from concerns about pollution and impacts on wild fish populations to site allocation and local priorities. The challenges for expanding IMTA practice are therefore significant. However, it can offer a mitigation opportunity to those areas where mariculture has a low public image and competes for space with other activities.
- **Difficulty in implementation without open water leasing policies**: Few countries have national aquaculture plans or well-developed integrated management of coastal zones. This means that decisions on site selection, licensing, and regulation are often ad hoc and highly subject to political pressures and local priorities. Moreover, as congestion in the coastal zone increases, many mariculture sites are threatened by urban and industrial pollution and accidental damage.

References:

Shah, T. K., Nazir, I., Arya, P., & Pandey, T. (2017). Integrated multi-trophic aquaculture (IMTA): An innovation technology for fish farming in India. *International Journal of Fauna and Biological Studies*, 4(1), 12-14.

***More refrence can be proded on request.**

Highlights 2021 – *Aqua International*

JANUARY

- MPEDA launched India's first Aquaculture farmers Call Centre in Vijayawada.

- India produces 63 billion shrimp seed with 550 hatcheries.

FEBRUARY

- Skretting and Proteon Pharmaceuticals introduced novel phage technology for aquaculture.

- Garware Technical Fibres leads mechanized fishing market in India

MARCH

- Five major fishing harbours will get substantial investments for modernisation and development in India.

- Eminent marine biologist Prof. Amalesh Choudhury passes away

APRIL

- CAA Facilitation Centre opened at Vijayawada

- Aquaculture is the Great Industry; Let us Protect it Aqua International organises its 35th Expo at Nellore

MAY

- Blue Aqua International launches Doctor Shrimp to support Global Shrimp Farming industry with Skills Training and Shrimp Diagnostic Services.

- Mobile Feed Mill, an innovative approach for transforming farm-made feed to quality feed

JUNE

- India exports 11,49,341 MT of marine products worth Rs 43,717 crore during FY 2020 – 21
- AP supplying power to aqua farmers at Rs 1.50 per unit, costing Rs 1500 crore annually
- Yaas-hit aquaculture biz to lose Rs 1k cr

JULY

- CLFMA & NCDEX organise webinar on Hedging Price Volatility of Feed Ingredients using Commodity Derivatives.
- Skretting India Introduces AquaCare: to safeguard water quality for aquaculture productivity.

Awareness Programme on Balanced Use of Fertilizers in Freshwater Aquaculture

AUGUST

- Shrimp Feed Manufacturers Association team meets Union Ministers and officials at Delhi
- Grobest Feeds announces its commitment to feeding the world through Development of innovative products to support safe and sustainable Aquaculture

SEPTEMBER

- MPEDA enters 50 years of its existence; launches year-long Golden Jubilee celebrations.
- Short term strategies to maintain 'Business As Usual' status in Aquaculture amidst COVID-19

OCTOBER

- CLFMA holds its 54th AGM and 62nd National Symposium
- First Ornamental Aquaculture Field School of Odisha Inaugurated at Kochila Nuagaon, Cuttack

NOVEMBER

- CAFÉ, Kolkata Centre organizes online meet on Brackish Water Polyculture as a Sustainable Livelihood Option for Small and Marginal Farmers.
- Farmers Advisory Meet held on Brackish Water Polyculture of Finfish and Shellfish.

DECEMBER

- CAA Advisory to Coastal Aqua Farmers, Dealers ...

- Matrix Research Foundation launches 'Mana Feed' for Vannamei.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Published on 7 January 2022