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CONTENTS

ADVERTISERS' INDEX

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MPEDA targets Rs 1 lakh crore seafood exports by 2025

Chairman K.N. Raghavan congratulating the MPEDA officials for celebrating the 50 years of service of the organisation thanked the Andhra Pradesh aquaculture farmers for their contribution to the nation. MPEDA will be in the forefront to help aqua farmers in the State, and encourage more cultivators to come into the field, which has a good potential in A.P.

To overcome the problems, application of an environmental friendly culture system known as "Bio-floc Technology" is more advantageous, because it is a green culture system in which nutrients are reused and recycled continuously with minimum or zero water exchange. It is mainly based on the growth of microorganisms (bio-floc), which helps to improve the water quality by the uptake of nitrogen and to produce a microbial protein; in addition, FCR can be reduced, which ultimately reduces the feed cost.

Dear Readers,

The August 2022 issue of *Aqua International* is in your hands. In the news section you may find news about ...

The National Fish Farmers Day (NFFD) 2022 - cum - National Campaign on 'Emerging Aquaculture Systems and Practices' was organized by ICAR-Central Inland Fisheries Research Institute, Barrackpore at Moyna Ramkrishnayan Association, West Bengal on July 10. Too much use of nutrients in the form of fertilizers and more accumulation of organic matter facilitate growth of pathogenic micro-organisms in greater density, which attacks growing finfish and shrimp under culture. Fertilizers should be applied in proper dosage. Use of pesticides (if any) in ponds will lead to problems and human health hazards *via* consumption of unsafe fishes. Pisciculturists should not aim at high income and profit, but at sustainable income. According to Dr Samanta, only natural pesticides should be used; pond environment, farmed fishes, shrimps and consumers should remain safe.

Congratulating the MPEDA officials for celebrating the 50 years of service of the organisation, the Chairman thanked the Andhra Pradesh aquaculture farmers for their contribution to the nation. MPEDA will be in the forefront to help aqua farmers in the State, and encourage more cultivators to come into the field, which has a good potential in A.P. He said that MPEDA is planning to export marine products worth about Rs.1 lakh crore and double the production and the exports from Andhra Pradesh. The Chairman sought the cooperation of the farmers in this regard. "Andhra Pradesh stood top in aquaculture production in the country followed by Gujarat, West Bengal and Tamil Nadu.

Ranendra Pratap Swain, Minister for Agriculture & Farmers Empowerment, Fisheries & ARD inaugurated the Seminar as Chief Guest and congratulated MPEDA for rendering essential service to the aquaculture farmers and exporters of India which have made records all-time high exports figures i.e. 7.7 billion US $ during 2021-22 in spite of COVID-19 Pandemic. The Minister expressed his pleasure in the overall Fisheries development of Odisha, which is 4th in terms of Aquaculture production in the country and the total production was 9.91 lakh Metric tons during the last financial year. Seafood exports from Odisha touched a record Rs 4560 Crores last year and all credits go to the farmers, hatchery operators, feed manufacturers, exporters, researchers and workers who contributed to fish production and exports. Diversification of species and Best Management Practices must be adopted in an intensive manner so as to ensure eco-friendly and sustainable aquaculture for better production. Some sort of rectification in policy and more funding for R & D is required to scale up the socio-economical development of the farmers through aquaculture activities.

Contd on next page

NRS GROUP
Aqua International

Our Mission

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

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

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

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

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

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In the Articles section – *Bio-Floc Technology* *authored by* Gora Shiva Prasad, Faculty of Fishery Science, WBUAFS, Kolkata, discussed that Bioflocs are the heterogeneous macro aggregations of algae, diatoms, protozoa, microbial grazers, filamentous and floc forming bacteria with uneaten feed, faeces, and sludge, which were grouped into floc biomass by a biological adhesive such as poly-hydroxy alkanoates (PHA) released by the microorganisms within the water column. Bio-flocs are very light, highly porous, delicate and irregular in shape and vary from 50 - 200 microns (reach up to 1000 microns) in size (Chu and Lee2004, Avnimelech 2009), Contains rich nutrients such as proteins, lipids, carbohydrates and ash (Crab et al., 2010a) and directly forms as feed to culture species in the Pond. Moreover, aquaculture also has some limitations like less availability of land, water, feed ingredients and bio security measures. To overcome these above problems application of an environmental friendly culture system known as "Bio-floc Technology" is more advantageous, because it is a green culture system in which nutrients are reused and recycled continuously with minimum or zero water exchange. It is mainly based on the growth of microorganisms (bio-floc), which helps to improve the water quality by the uptake of nitrogen and to produce a microbial protein; in addition, FCR can be reduced, which ultimately reduces the feed cost.

Another article titled ***Impact of Coral Bleaching on Marine Life,*** *authored by* Satyaveer, College of Fisheries, N. K. Suyani, Karnataka Veterinary, Manjunath N, Animal and Fisheries Sciences University, Mangaluru, Karnataka, said that coral reefs are marine ecosystems that are colonies of living animals. These colonies are groups of individual animals called polyps. The polyps actually secrete a substance that is called calcium carbonate that forms the reef structure upon which they live. Within each coral polyp are single celled algae called zooxanthellae. Zooxanthellae, utilize sunlight for photosynthesis, a process by which the algae is using the sunlight to produce food and oxygen for the polyp. In return, the zooxanthellae receive compounds needed for sustenance and photosynthesis. Thus, the polyp and zooxanthellae live in a relationship that is mutually beneficial for both.

Article titled ***Management of Aquaculture Sludge Using Biocatalytic Enzymes: A Novel Approach,*** *authored by* Saurav Kumar, Scientist, Aquatic Environment & Health Management, ICAR-Central Institute of Fisheries Education, Shilpa Pradeep, Aquatic Environment & Health Management, ICAR-Central Institute of Fisheries Education, Tapas Paul, College of Fisheries, Bihar Animal Sciences University, Mumbai, informed that the growing human population has greatly influenced the aquaculture industry, which led to the release of large amounts of effluents which are becoming one of the main reasons for water and ground pollution. Thus, before releasing the aquaculture sludge to the receiving water, it needs to be treated efficiently to reduce its pollutant concentration. Various methods, including physical and chemical, are there for the treatment, but they possess their limitations. So, enzymatic pretreatment is becoming preferable due to its eco-friendliness and low cost of operation. But, a commercial enzyme application on pretreatment of sludge requires high costs, and it will be less economical for large scale industries. Thus, it is required to produce a low-cost enzyme production that can be produced from readily available raw materials. Garbage enzymes or eco enzymes produced from organic wastes through fermentation are increasingly used for the pre-treatment, which were proved to have the potential to remove the substances presented in the sludge. Further studies are still required in this area to find out the variety of other organic wastes which can be utilised for preparing eco enzymes. This approach will efficiently treat the sludge from aquaculture activities before release into the aquatic system to protect the aquatic ecosystem and biodiversity.

Another article titled ***Toward a Blue Economy: The Power of the Ocean and its Sustainable Development,*** *authored by* Ashish Sahu, Department of Fisheries Resource Management, PhD scholar, Faculty of fisheries, Sagar Satkar, Kerala University of Fisheries and Ocean Studies, Panangad,

Cochin, Kerala, said that Blue economy is an economic term linked to exploitation and conservation of the maritime environment, sometimes referred to as a "sustainable ocean-based economy". The UN specifies Blue Economy as a range of economic activities related to oceans, seas and coastal areas, and whether these activities are sustainable and socially equitable. An important key point of the Blue Economy is sustainable fishing, ocean health, wildlife, and stopping pollution. A blue economy is low-carbon, efficient, and clean. It is also an economy that is based on sharing, circularity, collaboration, solidarity, resilience, opportunity, and interdependence (UNEP, 2015). Its growth is driven by investments that reduce carbon emissions and pollution, enhance the energy efficiency, harness the power of natural capital - such as the oceans - and halt the loss of biodiversity and the benefits that ecosystems provide (UNEP, 2013).

Article titled ***Role of Bacillus based probiotics in Aquaculture,*** *authored by* Dr. G. Raghavendrudu, Product Manager-Feeds, Skretting India, discussed that Probiotics shows a new dimension in disease resistance and improving water quality in aquaculture industry. The Greek word probiotic means "for life", was introduced by Parker et al. According to him, probiotics are "Organisms and substance, which contribute to intestinal and microbial balance". Fuller, et al defined probiotics as "live microbial feed supplement which beneficially affect the host animal by improving its intestinal microbial balance". Probiotics are used in aquaculture to improve growth performance nutrition decrease diseases and develop immune system. Water probiotics are applied to reduce organic pollutants and various contaminants in water by directly applying to rearing medium. These improve water quality by converting organic matter to smaller units. Breakdown of organic matters evolve simpler substances like glucose and amino acids that are used as food for beneficial bacteria which reduce the accumulation of organic pressure and provide congenial environment to farmed stock. Probiotic bacteria such as Bacillus sp.

Results in Shrimp, Fish and Crab farming can be achieved as per specifications when the pond management guidelines are followed. Farmers and Integrators have to give sufficient time and attention to farm management and check the developments there to ensure results. When you invest your hard earned money into it, a little more care and attention can prevent losses and help in profitable farming all the time.

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.

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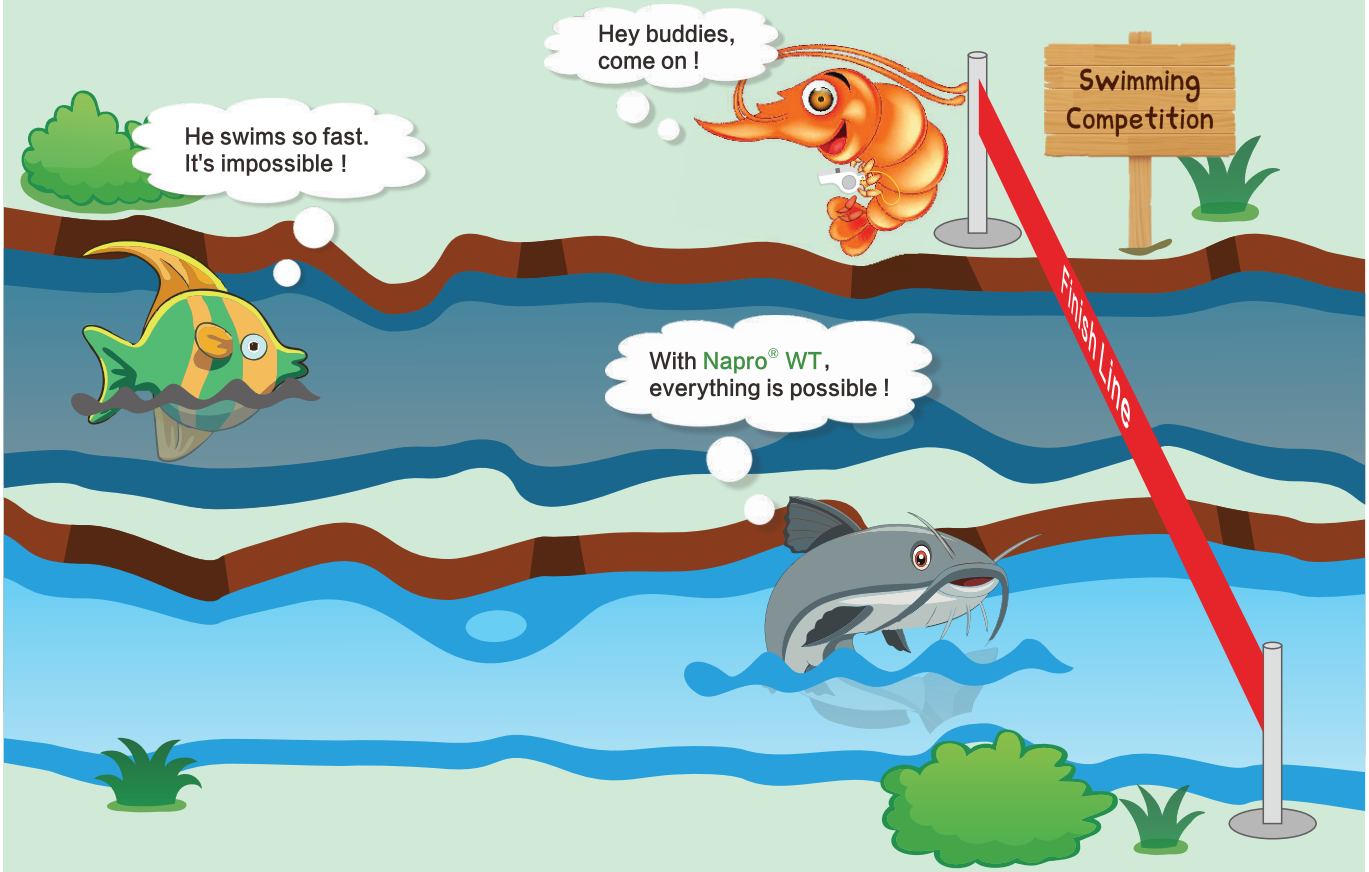

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National Fish Farmers Day 2022 observed by ICAR-CIFRI, Barrackpore

The National Fish Farmers Day (NFFD) 2022 - cum - National Campaign on 'Emerging Aquaculture Systems and Practices' was organized by ICAR-Central Inland Fisheries Research Institute (CIFRI), Barrackpore at Moyna Ramkrishnayan Association, Village. Harkulibhanderchak, P.O. and PS Moyna, District Purba Medinipur(a place 118 km on road from Barrackpore), West Bengalon 10th July 2022. It was the 22nd NFFD. Purba Medinipur is the leading district in WB in production of adult and table-sized Indian major carps every year and Moyna Block, along with progressive fish farmers here, are well-known throughout WB for production of such fishes.

To begin with, at 11.30am, Dr B. K. Das, Director, CIFRI and President, NFFD programme 2022 and other dignitaries paid respect and tribute to Late Prof. Hiralal Chaudhuri, Father of induced fish breeding in India by placing garland over his hard-bound photo. Dr (Mrs) A. Roy, Senior Scientist, CIFRI in her welcome address explained why the day 10th July is celebrated and given importance and that Late Prof. Chaudhuri, world-renowned fishery scientist, started his professional career from CIFRI in 1948. She translated the topic of National Campaign as '*Udiomaan Jolojoprani-protipalonpontha o onusilon*'. Dr S. Samanta,

Learned dignitaries in the programme at Moyna

Principal Scientist, CIFRI spoke lucidly on water and soil quality management for long term and sustainable pisciculture. He highlighted on the path shown by Late Prof. Chaudhuri, success in pisciculturein ponds and seed production in hatchery comes along with beginning of rainfall every year. Addressing the participants, Dr Samanta said that pisciculturists must be aware about the important features of pond water and soil required for successful fish, prawn and shrimp farming. Dissolved oxygen (DO) present in fish culture ponds (6-10ppm) is 10,000 times less than that present in air, where oxygen consumption occurs during night by fishes, invertebrates, plankton and microbes. Peak hours of DO deficiency in summer reach in dawn time; aerators operated in shrimp farms in early morning.

Different kinds of reactions in culture ponds depend upon its pH value. Pisciculture water bodies at Moyna are naturally productive and have proper pH. Presence of different ions and nutrient elements are needed for plankton growth. Pond bottom soil has more important role to play than water in successful fish and shrimp culture in confined system (ponds); fertile and good productive nature of ponds depends on characteristics of bottom

Late Prof. Hiralal Chaudhuri

soil. Fine clay particles in soil helps to preserve N, P and K. Pond water and soil must be conserved for obtaining good production. Application of urea, SSP helps in plankton production, fish waste accumulates at pond bottom. Too much use of nutrients in the form of fertilizers and more accumulation of organic matter facilitate growth of pathogenic micro-organisms in greater density, which attacks growing finfish and shrimp under culture. Fertilizers should be applied in proper dosage. Use of pesticides (if any) in ponds will lead to problems and human health hazards *via* consumption of unsafe fishes. Pisciculturists should not aim at high income and profit, but at sustainable income. According to Dr Samanta, only natural pesticides should be used; pond environment, farmed fishes, shrimps and consumers should remain safe.

Dr B. K. Mahapatra, Retd. Principal Scientist, ICAR-CIFE Kolkata Centre informed that Late Prof. Chaudhuri was given the epithet 'Father of induced breeding in India' by Japanese ichthyologist Dr Kuronuma in 1975. Quite a few less-regarded finfishes exist in eastern and north-eastern India which are threatened, but are valuable indigenous ornamental fishes, *viz.* the *Colisalalia*, Indian glassfish *Chanda*sp (less-important in India but is made increasingly colourful by biotechnological interventions in Singapore and now highly-priced), the 'Bhutobele' *Eleotrisfusca*, *Channabarca* (that costs more than a lakh in international market), *Nandusnandus*; naturally-occurring in water hyacinth-infested ponds but have captured domestic and export market. *Mastacembelus*sp costs Rs 10-25/- / piece as edible fish but Rs 200/- as ornamental fish.These can be induced-bred, cultured in nylon net hapas fitted in major carp culture ponds and in rectangular cages.

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Best choice of *Bacillus* spp. that rapidly decompose uneaten feed, feces and other organic substances in pond water, keeps water quality optimal

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No cultivation is needed. Easily adapt to the changes of surroundings and grow fast in freshwater or seawater culture farming, even under low oxygen environment

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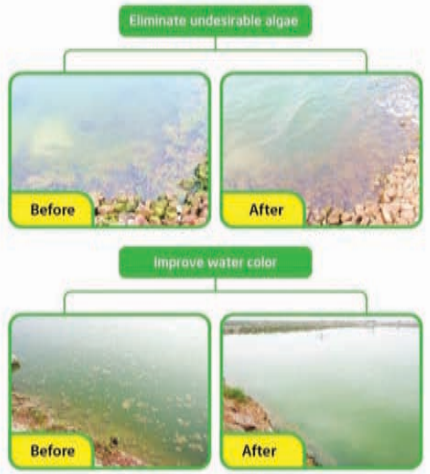
Prevent the accumulation of toxic substances such as NH_3, NO_2, etc.

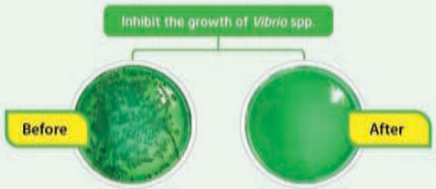
4. IMPROVE WATER COLOR

Improve water color regulate the algae and bacteria balance in water, turning your pond from green to clear



5. ESTABLISH BALANCED POND BACTERIA SYSTEM

Compete nutrition with vibrio and inhibit them to grow. Provide nutrition for probiotics in the pond, to establish a well-balanced farming system.



6. INCREASE AQUACULTURE PRODUCTION

Good quality of water prevents fish/prawn infections, making high profit of production

* COMPOSITION:

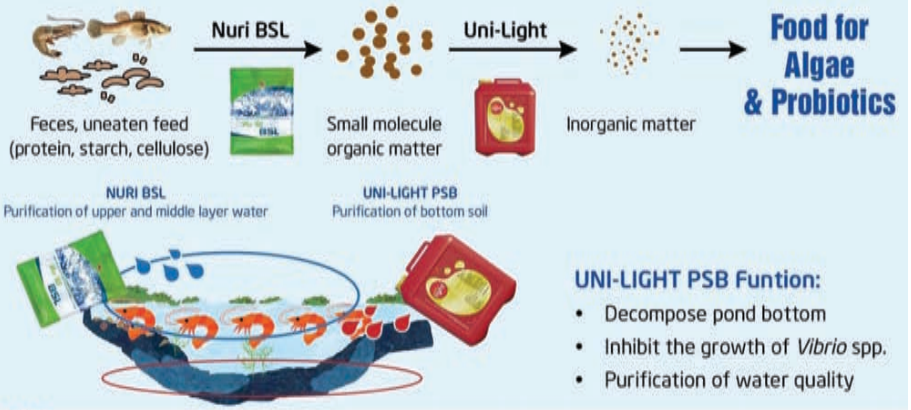
Bacillus spp. > 1x 10^{11} cfu/kg	15%
(Bacillus subtilis, Bacillus amyloliquefaciens, Bacillus licheniformis)	
Carrier (rice bran, corn gluten)	75%
Moisture	10%

* STORAGE:

Keep at dry, well-ventilated condition. Avoid direct sunlight exposure and use as soon as possible once opened for best quality.

* DIRECTION OF USE:

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.



UNI-LIGHT PSB Funtion:

- Decompose pond bottom
- Inhibit the growth of *Vibrio* spp.
- Purification of water quality

BSL Dosage:

/10,000 m³ 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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Entry of the venue at Moyna

Their integrated marketing channels will open up new vistas in pisciculture.

Total 261 and 27 species of exotic ornamental fishes (egg layerers and live bearers respectively) are found in India, can be cultivated in large earthen vessels ('maateermejla'), rectangular FRP cisterns, durable black geomembrane encompassed areas and good market exists. These are valuable bio-resource, feed upon mosquito larvae, can be cultivated for controlling mosquito-borne diseases. Indigenous technologies like infusoria culture in small earthen containers using banana peel-offs and drops of milk (infusorians serve as best starter food for some ornamental fishes), zooplankton culture using poultry excreta, fish food preparation using kitchen waste and non-edible parts of vegetables are valuable. Village women can adopt ornamental fish farming, subsidy-based schemes of Govt of India exists. While emphasizing on these facts, Dr Mahapatra said that Late Prof. Chaudhuri's epoch-making discovery has provided source of food and income to many fish breeders, fish workers, technical officers and scientists; brought prosperity in entire India.

Dr S. K. Das, Professor at Department of Aquaculture, WBUAFS, Chakgaria stated that Late Prof. Chaudhuri was both scientist and University teacher till the end. Standard practices followed nowadays in inland pisciculture are his contributions only, who, in 1948 and little later, worked painstakingly in observing the developing Gobiid fish and carp embryoinside fertilized eggs and just hatched-out larvae under microscope and drawing their sketches in 'no electricity' condition. Invention of Late Prof. Chaudhuri has given us food, clothes, livelihood, identity; India's productive water and soil resource makes us proud. He was invited at Israel, Africa, Russia and other countries to demonstrate the marvellous technology of induced fish breeding, which was his craftsmanship. He will remain revered for long. With more and more knowledge input and motivation, fish farmers have now become well-educated but will not be successful if they try to learn from videos available in social media. A newer fish farming technology is suitable for which particular fish species and geographic & environmental conditions must be known first. Biofloc technology is suitable for only those fishes which will be able to utilize the floc produced, those can be stocked. Cage culture in inland open lentic water bodies has now become a model and commercial technology, adopted by farmers and is expanding. But aquaponics (hydroponics) technology hasn't yet become farmer-friendly in India, more demonstration needed to convince fish farmers about its economic viability. More and more earthen freshwater bodies must be brought under commercial pisciculture. Marginal fish farmers in distant villages will not be able to adopt and afford the complex high-tech RAS model, it cannot be propagated to them but big farmers can do it. Fish farmers should be selective in adopting new technology.

While explaining these ideas, Dr Das also spoke about use and misuse of aquaculture inputs and emphasized on responsible and sustainable fishing and aquaculture. In the one-health approach (system), we should not aim at increasing food fish production only, must look into health consciousness. Farm-produced finfishes and shrimps must be 100% safe (for us, our next generation) and is our responsibility, with no use of pesticides and banned medicines. Agriculturists and pisciculturists have to be careful and cautious before application of raw materials and inputs, approach should be changed. Dr Das spoke about perceptions of fish farmers and the changes (modifications / improvements) they have brought in six-species composite fish culture system since 1971. Indian fish farmers are smart, have scientific aptitude who do field-based experiments. Few inputs are applied in 'more than required' amounts in some fish culture water bodies at Moyna, it can lead to deterioration of bottom soil and water quality in years to come. Once aquatic environment gets degraded, it cannot be reclaimed, Dr Das said.

Sri S. Maity, Founder Secretary, Moyna Ramkrishnayan Association and Moyna Vivekananda Mission said that Bengalee scientist Late Prof. Chaudhuri was a pride of entire India. Farmed fish production and large confined freshwater resource of Moyna Block has brought considerable upliftment in economic conditions of people in different Gram Panchayats of this Block. He informed that Moyna was declared as fishery hub in WB by Hon'ble Chief Minister in 2017 and the 'Moyna Model' of pisciculture practice is accepted as an instance of large-scale production of big-sized major carps in confined freshwater bodies throughout WB. Recorded Bengalee song on 'Moyna fish farming' composed by Sri Maity was played in the programme. In the form of hard copy newsletter, radio talk, talk show and discussion with invited scientists, improved technology and organic

mode of fish farming have been disseminated to fish farmers here from this institute since 2016. FPOs, fish farmers cluster and Moyna Fishermen Cooperative have been developed. Some farmers are doing water and soil testing of fish farming areas, Sri Maity spoke about its importance in saving farmed major carps of Moyna from important diseases. Fresh, safe and hygienic big-sized major carps in live condition will be sent to different districts of WB and extent of import of ice-preserved Rohu and Catlafrom Andhra Pradesh and Bilaspur will diminish greatly. Moyna fish farmers will take its responsibility. Sri Maity urged the Director, CIFRI to arrange for on-site water and soil quality analysis of pisciculture water bodies at Moyna every month, for the benefit of farmers.

While connoting Moyna as the aquaculture capital of WB, Dr B. K. Behera, Principal Scientist, CIFRI mentioned that we have to know the basis of functioning of RAS and Biofloc technologies before making into use. Farmers should be provided information on fish disease diagnosis, fish feed technology, soil and water testing for upgrading their knowledge and skill. Research is a continuous process, fish farmers know many things but still some important things not yet known. In RAS, the metabolites are removed *via* bio filter, rapid sand filter, UV, ozonizer – water is recirculated and no water loss occurs. Biofloc is 'zero water exchange' technology, fish farmers should have an idea about beneficial and harmful micro-organisms. Metabolites are eliminated by bacterial population, C:N ratio is fixed and it is a gradually developing technology. Dr Behera also stated that RAS is functioning in industrial scale and factories of RAS developed in Haryana, with use of small land and water. The CIFRI-ARGCURE DANAV product developed and commercialized by CIFRI can kill *Argulus*sp and other crustacean ectoparasites without killing plankton in fish ponds.

Dr B. K. Das, Director, CIFRI in his address mentioned that Moyna fish farmers are the front-runners and leaders ('*Agroni*') in successfully implementing the practice of big-sized carp production. Recommended chemicals must be judiciously used in aquaculture ponds. Medicines should be applied after proper identification of the disease and its causative agent. Research organization like CIFRI can help in developing Moyna fish farming, organic carp farming should be made a reality here. Team of technical officers will sometimes come at Moyna and estimate basic water parameters like pH, alkalinity, DO, hardness. After induced fish breeding and composite fish culture, campaigning is being made on newer technologies like cage and pen culture, RAS, roof-top aquaculture, Integrated multi-trophic aquaculture, fish seed raising in cluster, multiple stocking-multiple harvesting. Pisciculturists using commercially-available fish feed should calculate its FCR and must not neglect importance of >> natural planktonic food in fish ponds, its production method. Dr Das explained all the concepts clearly. At one side of the programme arena, CIFRI stall was set up where officers were present for instant testing of water and soil samples of Moyna ponds and larger fish farming water bodies. Photocopies of newer technologies developed by CIFRI scientists and their usefulness and disease-causing bacteria in fishes in the form of grown colonies in large petri-plates were exhibited in the stall.

At the end of the programme, Dr A. K. Das, Senior Scientist, CIFRI gave the vote of thanks. He informed that CIFRI has entered into the 76th year of existence and functioning on 17th March 2022 and India is now the leading country in the world in terms of annual inland fish production. CIFRI has stood and will remain beside Moyna Ramkrishnayan Association and Moyna fish farmers in days to come. About 350 enthusiastic fish farmers from different villages of Moyna, including 40% women, participated in this programme till the end. News communicator Subrato Ghosh also participated in it attentively and learnt from the intellectual and thought-provoking speech of dignitaries.

Aqua International editor M.A. Nazeer's elder brother M.A.K. Jilani passes away

Mr M.A.K. Jilani, elder brother of M.A. Nazeer, Editor, Aqua International, passed away due to cardiac arrest on 26 July 2022 at Rajahmundry. He was 69. Mr Jilani helped in developing Aqua International from its inception in 1993. Jilani, a businessman was like the father figure in the family after the demise of their parents.

M.A.K. Jilani

From left : M.A. Nazeer, Editor, Aqua International, M.A.K. Jilani (elder brother), mother Saberunnisa, M.A. Waheed, brother, B.V. Rao, Chairman, VHPL and father Meer Talib Ali during an occasion of the publications in 1990s in Hyderabad.

MPEDA targets Rs 1 lakh crore seafood exports by 2025

Efforts are on to double production in A.P., says its Chairman, K.N. Raghavan

Vijayawada: The Marine Products Export Development Authority (MPEDA) has set a target to export seafood products worth about Rs.1 lakh crore from the country by 2025, said its Chairman K.N. Raghavan.

The Chairman, along with the National Fisheries Development Board (NFDB) Chief Executive C. Suvarna, Commissioner (Fisheries) K. Kanna Babu, MPEDA Director M. Karthikeyan, Secretary K. S. Pradeep and RGCA Director S. Kandan, launched the golden jubilee celebrations of MPEDA here on July 26.

Addressing the farmers, Mr Raghavan said during 2021-22, MPEDA had shipped marine products worth about Rs 57,586 crore ($7.76 Billion) from India, and the share of Andhra Pradesh in the overall exports was about 23.66% in quantity and 34.76% in terms of the total export value.

While congratulating the MPEDA officials for celebrating the 50 years of service of the organisation, the Chairman thanked the A.P. aquaculture farmers for their contribution to the nation.

"MPEDA will be in the forefront to help aqua farmers in the State, and encourage more cultivators to come into the field, which has a good potential in A.P.," he said.

"We are planning to export marine products worth about Rs 1 lakh crore, and double the production and the exports from A.P.," the Chairman said and sought the cooperation of the farmers in this regard.

"Andhra Pradesh stood top in aquaculture production in the country followed by Gujarat, West Bengal and Tamil Nadu. There is a lot of scope to enhance the production as there are abundant natural resources in the State," he said.

He said the Rajiv Gandhi Centre for Aquaculture (RGCA), a research unit of MPEDA, would set up Broodstock Multiplication Centre (BMC) of Tiger variety shrimp, developed from Andaman and Nicobar Islands, in Visakhapatnam soon. The pilot project was being established with the aid of Department of Fisheries, he said.

He appealed to the farmers to produce disease-free shrimp as the consumers in the international market were preferring quality stocks without antibiotics.

"We are exporting marine products to many countries, including the U.S., European Union, South East Asia and Japan. More avenues are being explored," he said.

Later, Mr Raghavan interacted with farmers, hatchery owners, processing unit heads, exporters, feed and seed developers and other stakeholders. Along with Mr Kandan, he visited the GIFT Tilapia fish project and research unit, being raised by the RGCA at Manikonda village in Krishna district.

Diversification

The NFDB Chief Executive said that A.P. farmers were the leaders in the country, and advised them to take up diversified aquaculture and raise seabass, mud crab and other varieties.

"NFDB is extending loans to aqua farmers through Pradhan Manthri Matsya Sampada Yojana (PMMSY) and the Fisheries Institute Development Fund (FIDF)," Dr. Suvarna said.

The Fisheries Commissioner stressed the need for increasing cage culture in sea, as the demand for shrimp and fish was growing fast.

"Aquaculture ponds along the coast can be diversified for growing mud crab, seabass, tilapia, cobia, pompano and other varieties," Mr Kanna Babu said.

Kerala Fisheries department to promote inland aquaculture

30 marketing outlets to come up in five districts

As part of its efforts to expand inland aquaculture and ensure marketability, the Fisheries department will open state-of-the-art outlets in Ernakulam, Thrissur, Malappuram, Wayanad and Kozhikode districts. A total of 30 marketing outlets will be set up with an investment of ₹10 lakh per unit.

Inland fish collected directly from farmers through the Agency for Development of Aquaculture Kerala (ADAK) will be made available at the outlets. The department, in collaboration with the ADAK, aims at creating a centralised marketing system to solve the problems in inland aquaculture. Fish from agency's farms will be sold at the marketing outlets along with those purchased from farmers for a fixed rate. The ADAK will identify farmers after collecting district-level data. Live fish marketing unit and fresh fish sales will also be part of the outlets.

The outlets are being set up as part of a project to increase the fish resources of the State and prevent

the entry of stale fish from other States. Apart from the marketing outlets, the department has implemented a recirculatory aquaculture system, biofloc fish farming and cage culture in reservoirs.

Under the Pradhan Mantri Matsya Sampada Yojana (PMMSY), ₹16 crore has been spent for fish farming in the Banasura Sagar, Karapuzha, Peruvannamoozhi and Kakki reservoirs. Moreover, ₹66.62 crore has been earmarked for aquaculture development activities along with ₹5 crore for seed production units in the financial year 2022-23.

The department is implementing a range of projects, including freshwater aquaculture, carp culture in private and public ponds, integrated paddy-fish culture, brackish water culture, scientific shrimp farming, crab culture, oyster farming and backyard seed production.

The department will provide assistance for private enterprises and individuals to start fish farming. Depending of the farming method, 40% of the unit cost will be offered as financial assistance.

Units set up in the previous years will receive 20% of the operating cost as assistance. To promote fish farming, fish seeds are being produced and distributed in farms and hatcheries under the Department of Fisheries. Farmers will also get fish feed at affordable rates through the ADAK.

Awareness programme on jellyfish sting management for seaweed cultivators at Sambai, Rameswaram under Azadi ka Amrit Mahotsav Initiative

On July 14, 2022, an awareness programme on jellyfish sting management at Sambai fishing village, Rameswaram, was organised for seaweed farmers as a part of Azadi ka Amrit Mahotsav initiative of the Government of India. The programme was presided over by Dr. G. Tamilmani, Head in Charge of Mandapam Regional Centre of ICAR-CMFRI, and he distributed the "Jellysafe" first aid kit to fisherwomen. Dr. R. Saravanan, Senior Scientist, explained about the different jellyfish found in Palk Bay and the jellyfish sting management using the first aid kit "JellySafe." Nearly 46 fisherwomen who are involved in seaweed cultivation attended the programme. The ward councillor, Ms. Thillai Pushpam, and village seaweed cultivator group leaders, Mr M. Murugesan and Ms. Murugeswari facilitated the event. This awareness programme was organised under the ongoing in-house project on jellyfish bloom dynamics in India's coastal and marine ecosystems (MB/JBD/32).

Complete technical guidance and support was provided by the Mandapam Regional Centre of ICAR-CMFRI for successful operation and seed production. The hatchery can produce a maximum of 10 million seeds in a cycle. This hatchery recently received the Best Hatchery Award on 21 st November 2021 on World Fisheries Day. The hatchery currently has stock of seeds of Seabass, silver pompano and Indian pompano. Dr.A.K. Abdul Nazar, Principal Scientist, CMFRI and Principal Investigator of the project, apprised the Hon'ble Minister and the other dignitaries, of all the activities of the hatchery in detail. The dignitaries appreciated the functioning of the hatchery and congratulated the owners of hatchery, Mr M Venkata Ramana and brothers.Following the visit of the hatchery, a farmers' meet was conducted and seeds of seabass and silver pompano were distributed to the selected farmers.

Gassen Plus

Bon Ammonia and obnoxious Gasses

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

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

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

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

DOSAGE : 1 Kg per Acre or consult your Aqua Technician For Specific Usage & Dosage

PRESENTATION: 500 gms &1 kg

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ANTIBIOTIC FREE,
STEROIDAL FREE.

Why rainbow trout could benefit from a herbal approach

25 July 2022: A new research project has found that eucalyptus and basil oils are effective and economical way to anaesthetise rainbow trout during handling and transport.

Rainbow trout

The aquaculture industry could turn to essential oils as a safe, sustainable and low-cost fish anaesthetic.

Anaesthetics are used in aquaculture to reduce stress and prevent injury during handling and transport procedures. The most common anaesthetics used by fish farmers are benzocaine, quinaldine, tricaine methanesulfonate (MS-222), and 2-phenoxyethanol.

However, these compounds can cause unwanted side effects including stress, gill irritation, hyperactivity and excessive mucus secretion. These chemicals are also expensive.

Laboratory Research

Researchers found that essential oils from vegetable sources are an excellent alternative to synthetic products. There is growing interest in using herbs to anaesthetise fish due to their wide range of beneficial health effects – namely their antioxidant and antimicrobial abilities, as well as their immune enhancement effects.

Existing chemical anaesthetics in aquaculture can cause unwanted side effects including stress, gill irritation, hyperactivity and excessive mucus secretion.

Researchers from Isparta University of Applied Sciences (Turkey) and Burdur Mehmet Akif Ersoy University wanted to determine the anaesthetic and histopathological effect of basil (*Ocimum basilicum*) and eucalyptus (*Eucalyptus globulus*) essential oils on rainbow trout (*Oncorhynchus mykiss*).

Finding the ideal concentrations of essential oils

The rainbow trout juveniles were exposed to 20, 50, 70, 100, 150, 200, 300, 400, 500, and 600 mg L–1 of essential oils, and the researchers recorded the induction of anaesthesia, and the recovery times for each fish.

Acute toxicities of essential oils (10 min LC50 concentration) in rainbow trout were determined at 70-400 mg L-1.

Researchers were trying to determine the ideal dose of essential oil that would achieve anaesthesia and avoid adverse health effects.

The researchers also studied the histopathological effects of essential oils on fish tissues after deep anaesthesia.

The ideal dose: "As a result of this study, the essential oil of O. basilicum at a dose of 300 mg L-1 and the essential oil of E. globulus at a dose of 400 mg L-1 showed the ideal anaesthetic effects in rainbow trout," the researchers report.

According to various reports and investigations, deep anaesthesia in fish should occur in a period of less than 5 minutes, and the recovery time of the fish should not exceed 10 minutes.

After learning the ideal dose of anaesthetic, the researchers wanted to identify the ideal timings for anaesthesia introduction (stage 4) and recovery time.

- Eucalyptus: 186 and 117.5 seconds, respectively
- Basil: 220.5 and 61 seconds, respectively

The researchers found no toxic effects of essential oils on rainbow trout. In addition, they point out that essential oils do not cause pathological effects on the gills, liver and kidneys of trout.

"This study demonstrates that the essential oils of O. basilicum and E. globulus can be used as an effective and safe anaesthetic in juvenile rainbow trout," they conclude.

According to the researchers, 400 mgL-1 for eucalyptus essential oil and 300 mgL-1 for basil essential oil should be used to anaesthetise juvenile rainbow trout.

Fisheries & ARD Dept, Odisha holds Seminar on Diversified Aquaculture with Special focus to GIFT

Bhubaneswar: Marine Product Export Development Authority (MPEDA) and Rajiv Gandhi Centre for Aquaculture (RGCA) in association with Fisheries & Animal Resources Development Department, Government of Odisha organised a seminar on "Diversified Aquaculture with Special Focus to GIFT" on 11th July 2022 at Krushi Bhawan, Bhubaneswar on the occasion of the celebration of Golden Jubilee of MPEDA and Silver Jubilee of RGCA.

Ranendra Pratap Swain, Minister for Agriculture & Farmers Empowerment, Fisheries & ARD inaugurated the seminar as Chief Guest and congratulated MPEDA for rendering essential service to the aquaculture farmers and exporters of India which have made records all-time high exports figures i.e. 7.7 billion US $ during 2021-22 in spite of COVID-19 Pandemic.

The Minister expressed his pleasure in the overall Fisheries development of Odisha, which is 4th in terms of Aquaculture production in the country and the total production was 9.91 lakh Metric tons during the last financial year. Seafood exports from Odisha touched a record Rs. 4560 Crores last year and all credits go to the farmers, hatchery operators, feed manufacturers, exporters, researchers and workers who contributed to the fish production and exports. Diversification of species and Best Management Practices (BMP) must be adopted in an intensive manner so as to ensure eco-friendly and sustainable aquaculture for better production. Some sort of rectification in policy and more funding for R & D is required to scale up the socio-economical development of the farmers through aquaculture activities.

Odisha deserved to be the No.1 State in India in aquaculture to which the present Govt. is highly committed and he assured that all the help required for the sector will be extended. He said the Hon'ble Chief Minister of Odisha has introduced a 5T system in Odisha for good governance which is unique in our country. It is time to learn from diversified aquaculture from other countries such as Japan, Indonesia, Thailand, Vietnam, China and even our neighbour Bangladesh where they grow more than 50 varieties of fish. This has made those countries grow speedily in aquaculture and make their farmers very prosperous. In any business, product diversification is key for growth and enduring success. Diversification gives vast options to farmers and the entire sector and makes them very resilient to various shocks including disease epidemics, climate changes and market fluctuations. Similarly, diversification gives consumers a wide range of seafood options, said the minister. In spite of a marathon achievement in vannamei production in the last one and half decades, still introducing more and more viable species must be included in the brackish water culture system to enhance productivity and accelerate foreign export. The use of unused water bodies and sustainable exploitation of aquaculture resources must be emphasized by the department. Like trending now, aquaculture infrastructure development must be at the peak in the priority list.

Odisha government has signed a Memorandum of Understanding with MPEDA-RGCA for developing and renewing OSSPARC in Gopalpur for Seabass and P. monodon seed production centre which is a dream project of the Chief Minister of Odisha. With the joint effort of MPEDA, the Dept. of Fisheries can do more projects in Odisha State, which is well known for mineral deposits always and it will be well known for "Odisha Machha" hereafter, added the Minister.

Addressing the keynotes, Mr R Raghu Prasad, Principal Secretary, Fisheries and ARD thanked MPEDA, RGCA, NETFISH, NaCSA for rendering untired support to the farming community of Odisha and for conducting a useful seminar on diversified aquaculture with special focus to GIFT, which is an exotic species but yet very nutrients fortified fish with affordable cost for an ordinary man.

Empowering the farmers, the department of fisheries is ensuring subsidies in all components under all schemes. To make ease of "application process" for the beneficiaries under different schemes/ components the Department of Fisheries has introduced the Go-SUGAM portal.

Odisha really required an alternative species for freshwater aquaculture and thus GIFTTilapia can fulfil the requirements. Odisha has 4.18 lakh ha of Brackish water resources and 480 Kms. of coastline for fisheries development of the state. These brackish water and coastal lines are very important for Odisha for augmenting fish production by introducing diversified species. Fisheries Dept of Odisha is very keen on introducing diversified species to the farming community for their livelihood, increasing the exports by the exporters and also supporting the domestic market. Steps have been taken to set up hatcheries for seabass, P. monodon and GIFT Tilapia very soon in our State in association with MPEDA. An agreement has been signed with the R&D Arm of MPEDA, RGCA the activities will begin very shortly. The old shrimp hatchery OSSPARC which was the landmark for Odisha for shrimp aquaculture has been reinvented for setting up of seabass and P. monodon hatchery, he added.

Dr K. N. Raghavan, Chairman, MPEDA and President, RGCA presided over the function and elaborated on the Role of MPEDA and RGCA in the field of Aquaculture with reference to the Species diversification of aquatic species.

Mr Smruti Ranjan Pradhan, Director of Fisheries expressed his view on the importance of species diversification in aquaculture. He told that, with a massive initiative, GIFT hatchery has been established at Kausalyaganga, which is the first of its kind in Odisha to provide quality GIFT seeds at the doorstep of Fish farmers of Odisha and neighbouring states. With diverse aquatic resources at its disposal, the State could benefit greatly from the development of the fisheries sector with the diversification of species thereby generating employment, promoting trade, securing nutrition and empowering the local community. A diverse range of aquaculture practices can promote synergies among farmed species, enhance system resilience, enable conservation, decrease ecological footprints, and provide social benefits such as additional income and nutritional security, he added. Through the introduction of circular cage culture in Hirakud Reservoir, Odisha has immense potential to produce an additional 1.25 lakh MT of fish from major reservoirs in collaboration with the PFCS members and private entrepreneurs. He expressed that the MoU with RGCA for the establishment of a new GIFT Tipalia hatchery at Bomlai fish farm in Sambalpur and the development of facilities for P.monodon and Sea bass seed production will go a long way for Odisha farmers in species diversification and foreign exchange earning. He also emphasized the exploitation of aquatic resources in a sustainable manner for better earning livelihoods for the fishermen and fish farmers of Odisha.

Dr M. Karthikeyan, Director, MPEDA delivered a welcome address. Dr T.G Manoj Kumar, Project Director(Diversified Aquaculture), RGCA highlighted the initiatives taken by MPEDA for diversified aquaculture in India and Dr Anup Mandal, Project Director (selective Breeding & Aquaculture) elaborated on the MPEDA initiatives for GIFT aquaculture in India. Mr Sibasish Mohanty, Assistant Director, MPEDA, Bhubaneswar briefed the GIFT aquaculture in Odisha.

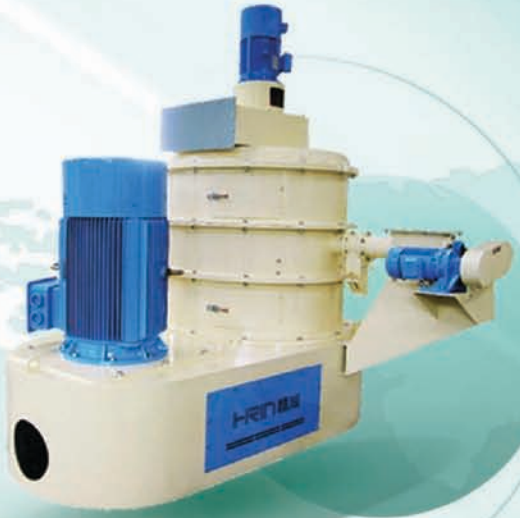
During the occasion, Fisheries Experts and Progressive Fish Farmers were felicitated. Vote of thanks rendered by Mr Rajakumar S. Naik, Deputy Director, MPEDA, Bhubaneswar.

India competes China as second largest exporter of marine products

Vijayawada, July 27: India is now the second largest marine products exporting country after China, said Dr K.N. Raghavan, Chairman of Marine Products Export Development Authority (MPEDA).
In the last 70 years India has achieved a growth 18 times to secure the second place, said Raghavan on Tuesday inaugurating a seminar.
As a part of the golden jubilee celebrations of MPEDA the event was on 'Initiatives of MPEDA for Promotion of Diversified Aquaculture in India with special focus on Andhra Pradesh'.
Andhra Pradesh exports 35% of aquaculture products in the country with its 974-km coastal line and producing aquaculture products in 1.2 lakh hectares.

In addition, various aqua products are being produced in 1.74 lakh hectares of saltwater areas, 2.34 lakh hectares of reservoirs and lakes, 28,200 hectares of mangrove and swamp lands.

Professional Feed Machinery Manufacturer



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Vertical shaft with no-screen grinding, Bearing no maintenance. The production is uniform and the fineness is adjustable (Range from 40~200 mesh.)

Hengrun HRYTZ Series Vacuum Sprayer

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

Kemin Industries South Asia Celebrates "61 Since '61– A Celebration of Partnership"

Opening remarks - Chris Nelson, President & CEO, Kemin Industries Inc., USA

Chennai, Tamil Nadu, India (9th July 2022): Kemin Industries, a global ingredient manufacturer that strives to sustainably transform the quality of life every day for 80 percent of the world with its products and services, celebrated the **"61 Since '61 –Celebrating Partnership"** - themed anniversary, to acknowledge the essence of partnerships along with its key stakeholders in South Asia. The event took place on 9 July 2022 in The Leela Palace, Chennai, Tamil Nadu.

Kemin crafted the theme 'Celebrating Partnership' to acknowledge the essence ofpartnerships, innovations, and care for communities, which they have been practicing in association with their partners across the globe, for the past 61 years.

The invitees of the event included key customers, distributors, and media representatives from across the business units of Kemin. As keynote speakers, quite unconventionally, Kemin invited the top two business professionals, ***R Gopalakrishnan and Suresh Mahalingam*** who had served in leading capacities in the TATA group, which is the most respected organization in the Indian subcontinent for upkeeping the business values and business partnership. In addition, Kemin partnered with a group of design thinking enthusiastswho conducted a workshop in which the participants along with the Kemin team engaged in building up the ***Partnership Wall*** in a unique storytelling pattern. The participants were divided into teams and were given separate pieces of puzzle boards to color with their own creativity. At the end of the session, those pieces were assembled to build the **Wall of Partnership**. Thus, the workshop gave the opportunities for the attendees to create a cohesive experience, reinforce the importance of partnership, and connect the participants of the event.

The celebration evening kick-started with a Kemin 'formulated' special mocktail, named **Shirly'61** which was tossed with all the participants in the event.The evening was also graced by well-themed performing artists and musicians. They epitomized Kemin's innovation, multinational footprints, and partnership with the confluence of hip hop, flamenco, Chinese lion, Irish Folk, Bharatnatyam fusion, and Brazilian carnival styles. The audience was enthralled by the performances and the celebration.

To acknowledge the role of media in the industry, Kemin invited top media representatives from the livestock and food industries, and a press conference was organized with the panel comprising Chris Nelson, President & CEO, Kemin Industries Inc., USA, Ramesh GS, Group President Animal Nutrition & Health, R Sureshkumar, President, Kemin Industries - South Asia, C Sugumar, Commercial Director – Aquasciences, Michelle Lim, President, Kemin Food Technologies. Around 20 questions were deliberated in this session which was moderated by Tanweer Alam, Director, Marketing.

From left - R Gopalakrishnan, Chris Nelson and Suresh Mahalingam

The Wall of Partnership

Partnership Workshop

Fusion dance Cultural Program

The celebration

Bharatnatyam Fusion

Tossing Shirly '61

Press Meet session

Kemin took this opportunity to convey gratitude to all its customers and business partners for the mutual trust and confidence bestowed upon the organization for the past 61 years and is confident that this will further strengthen a strong foundation of trust with the partners in the coming decades as well.

About Kemin Industries

Kemin Industries (www.kemin.com) is a global ingredient manufacturer that strives to sustainably transform the quality of life every day for 80 percent of the world with its products and services. The company supplies over 500 specialty ingredients for human and animal health and nutrition, pet food, aquaculture, nutraceutical, food technologies, crop technologies, textile, biofuel, and animal vaccine industries.

For over half a century, Kemin has been dedicated to using applied science to address industry challenges and offer product solutions to customers in more than 120 countries. Kemin provides ingredients to feed a growing population with its commitment to the quality, safety, and efficacy of food, feed, and health-related products.

Established in 1961, Kemin is a privately held, family-owned-and-operated company with more than 3,000 global employees and operations in 90 countries, including manufacturing facilities in Belgium, Brazil, China, Egypt, India, Italy, San Marino, Singapore, South Africa, and the United States.

Kemin's growth from 1961

Advancing science, expanding to six continents, creating community around the globe — Kemin has done a lot in just over six decades. Follow the timeline to see just how far we've come since 1961.

- **1961** – *R.W. and Mary Nelson founded Kemin Industries—then known as Chemical Industries—to provide feed additives to the Midwest agriculture and animal production markets, later expanding to provide animal nutrition and health products on six continents.*
- **1965** – *Launched two of the U.S. agriculture industry's first feed antioxidants.*
- **1967** – *Established worldwide headquarters in Des Moines, Iowa, U.S.*
- **1970** – *Established regional headquarters for Europe, Middle East and North Africa in Belgium.*
- **1983** – *Developed natural pigmenter extracted from marigolds to replace artificial yellow coloring in egg yolks.*
- **1983** – *Developed world's most widely sold mold inhibitor for animal feed.*
- **1988** – *Established regional headquarters for Asia-Pacific region in Singapore.*
- **1992** – *Developed a liquid antimicrobial that transformed how bakery and tortilla products are kept fresh.*
- **1995** – *Discovered the benefits of lutein, found in marigolds, for human eye health and began producing the first-of-its-kind natural ingredient for vision supplements in the global market.*
- **1995** – *Formed Kemin Human Nutrition and Health business unit to provide ingredients for dietary and nutritional supplements.*
- **1996** – *Established regional headquarters for South Asia in India.*
- **1997** – *Began growing proprietary rosemary with high level of carnosic acid, extracted to use in pet food products to protect against flavor and color loss.*
- **2000** – *Formed Kemin Nutrisurance, the pet food and rendering technologies business unit, to serve the fast-growing pet food industry.*
- **2000** – *Established regional headquarters in China.*
- **2004** – *Formed Kemin Food Ingredients, which became three regional Kemin Food Technologies business units, to serve the food and beverage markets.*
- **2004** – *Established regional headquarters for South America in Brazil.*
- **2014** – *Established regional headquarters for Sub-Saharan Africa in South Africa.*
- **2014** – *Became first company and largest producer in the world to have its proprietary rosemary Certified Sustainably Grown by SCS Global Services.*
- **2015** – *Formed the Kemin Crop Technologies initiative, which grew into a business unit serving commercial specialty crop growers in the U.S.*
- **2017** – *Achieved global vision to touch half the world's population (3.8 billion people) every day with Kemin products and services by 2019—two years earlier than planned.*
- **2018** – *Acquired Garmon Chemicals, a chemical solutions company for the denim and apparel industry, and formed Kemin Textile Auxiliaries business unit, based in San Marino.*
- **2018** – *Formed Kemin AquaScience™ business unit to serve the aquaculture industry.*
- **2019** – *Launched new company logo and vision to sustainably transform the quality of life every day for 80% of the world with our products and services by 2042.*
- **2020** – *Continued partnership with the United Nations' World Food Programme, Nobel Peace Prize recipient and the world's largest humanitarian organization, which impacted more than 115 million lives in 84 countries in 2020.*
- **2021** – *Announced global sustainability vision to achieve net zero greenhouse gas emissions by 2050.*
- **2021** – *Became majority shareholder in Egypt-based animal vaccine manufacturer MEVAC to expand its global reach and form the Kemin Biologics business unit.*
- **2021** – *Acquired antimicrobial technology company Bio-Cide International to form the Kemin Bio Solutions business unit, which encompasses Kemin's key enzymes and antioxidants for biofuels and Bio-Cide's solutions to disinfect and sanitize equipment for food processing and water treatment applications.*

BIO-FLOC TECHNOLOGY

Kolupula Akhil Kumar[1], Dudaboina Shivani[1], Gora Shiva Prasad*[1], Sangram Keshari Rout
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Introduction:
Globally, the aquaculture sector is the fastest-growing food-producing sector, as the demand for low-cost animal protein is increasing due to the shortage of protein food supply in many countries to feed the ever-growing population, besides its eliminates hunger and malnutrition.

Presently, the total world fishery production is about 178.5MT, of which aquaculture production is 82.1MT, which contributes about 50% of the total Production (Sofia 2020). This enormous increase in aquaculture production is due to the introduction of high-density intensive culture practices in fish/shrimp farming in the limited culture area. Apart from these benefits, intensive culture systems are also associated with some environmental and economic problems because, it requires more than 50% of the total production cost is driven to feed only. However, only 20-30% of feed is utilised by the culture species; the remaining 70-80% will be accumulated as organic waste (uneaten feed and excretory products) in pond water, leading to water quality deterioration (Avnimelech 1999), affect culture species in terms of growth, survival and ultimately causes disease outbreaks.

Moreover, aquaculture also has some limitations like less availability of land, water, feed ingredients and bio security measures. To overcome these above problems application of an environmental friendly culture system known as "Bio-floc Technology" is more advantageous, because it is a green culture system in which nutrients are reused and recycled continuously with minimum or zero water exchange. It is mainly based on the growth of microorganisms (bio-floc), which helps to improve the water quality by the uptake of nitrogen and to produce a microbial protein; in addition, FCR can be reduced, which ultimately reduces the feed cost.

Bioflocs are the heterogeneous macro aggregations of algae, diatoms, protozoa, microbial grazers, filamentous and floc forming bacteria with uneaten feed, faeces, and sludge, which were grouped into floc biomass by a biological adhesive such as poly-hydroxy alkanoates (PHA) released by the microorganisms within the water column. Bio-flocs are very light, highly porous, delicate and irregular in shape and vary from 50-200 microns (reach up to 1000microns) in size (Chu and Lee2004, Avnimelech 2009), Contains rich nutrients such as proteins, lipids, carbohydrates and ash (Crab et al., 2010a) and directly forms as feed to culture species in the Pond. By this process, 7-13% of nitrogen retention can be increased (Hari B et al. & Schneider O et al.). Protein utilisation is significantly higher in the bio-floc system (Protein conversion ratio-2), when compare to conventional farming (PCR-4), and it shows more than 46% of PCR in the bio floc system (Chamberlain et al., 2001a)

Highlight Points

- In Biofloc technology about 7 to 13% of nitrogen retention can be enhanced compared to conventional farming. In this article, we have updated the importance of Importance of C/N ratio in BFT (Bio-Floc Technology), Reutilization of excreated ammonia as a food source for culture species, which enhances species immunity and growth performance as well as disease resistance.
- Most Preferable species in BFT are *L.vennamei* and Tilapia, as they can withstand poor water quality, filter feeding habit makes them to culture in biofloc, which can utilize the nitrogen resources efficiently.
- Continuous oxygen supply should be maintained in BFT, as it is essential for floc formation with addition to that it helps in respiration for both cultural organisms and microbial species.
- Use of IOT(Internet of things)- based smart water quality management system in which sensors are used to analysis the water quality fluctuation in BFT tank.

Proximate composition of biofloc:
The nutritional values in the bio-floc mainly depend on what type of carbon source is used.

Table:1, Proximate composition of Biofloc

Component	Percentage
Protein	24.3 - 53.85%
Lipid	0.5–5.4%
Fibre	0.7–16.65%
Carbohydrate	21.1 – 81.1%

Ash	6.3- 31.9%
Nitrogen free extract	18 - 29.24%
Energy	12 - 19KJ/g

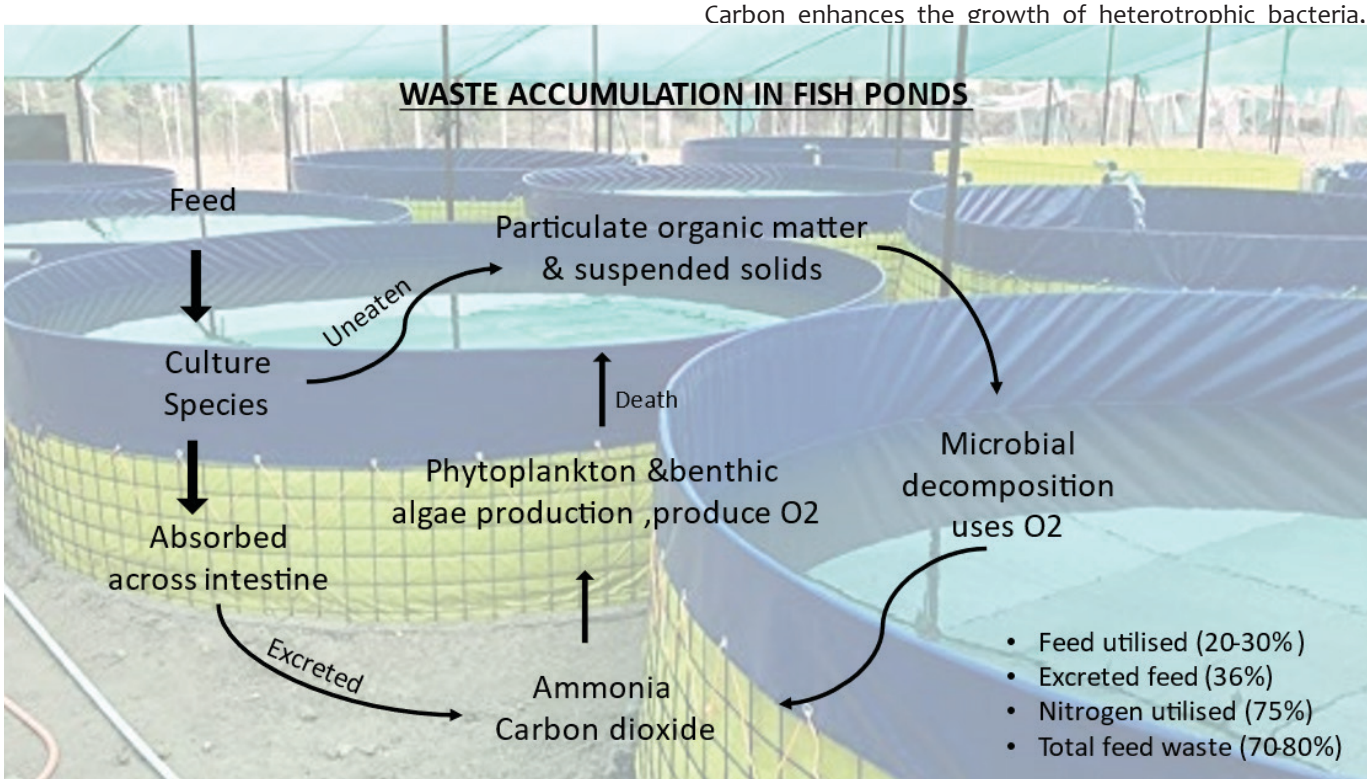
Principle of bio-floc Technology:

"Nitrogenous wastes present in the uneaten feed and animal excreta are converted into a consumable 'bacterial floc', with the addition of carbon sources at high oxygen levels with limited (less than 10%) or zero exchange of water "(Schneider et al. 2005, Avnimelech 1999; Crab et al. 2009)

due to continuous aeration, and carbon supply,usually highest densities of biofloc are observed in this system only. In this system, algae won't grow sufficiently or not at all grow and this biofloc system is solely based on bacteria, hence it is called as "True/brown biofloc system". This system is alone recommended for shrimp/ fish culture.

Carbon - Nitrogen Ratio:

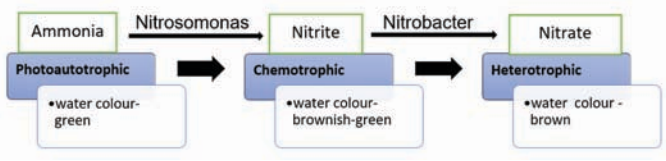
C/N ratio plays a vital role in the formation of bacterial biomass from the organic waste accumulated in the water. Carbon enhances the growth of heterotrophic bacteria.



Formation of biofloc:

Continuous aeration in the pond water promotes the bio-floc development by oxidising the ammonia in three stages that can be identified based on water colour as following

1. **Photo-autotrophic stage:** This is the very initial stage of the biofloc system, the water appears in green colour due to the growth of filamentous microalgae such as chlorella, spirogyra, algae, anabaena and Oscillatoria are mostly dominated.
2. **Chemotrophic stage:** It is the later nitrifying stage, in this system nitrifying bacteria such as Nitrosomonas, Nitrobacter and pseudomonas are mostly dominated as they convert the toxic ammonia to less toxic nitrate and water appears in the form of greenish brown in colour.
3. **Heterotrophic stage:** Water appears in brown this indicates the domination of Heterotrophic Bacteria



and these bacteria take the nitrogen and produce a single-celled microbial protein (Avnimelech, 1999). Therefore, the optimal C/N ratio required by the heterotrophic bacteria is 12-15g:1g (Lechevallier et al., 1991; Henze et al., 1996; Avnimelech, 1999), but only 10g:1g is present in the fish feed, but the heterotrophic bacteria require C/N ratio higher than 10(Lancelot & Billen, 1985). Therefore, a well-balanced C/N ratio should be maintained by adding external carbon sources such as rice bran, jaggery, glycerol, molasses etc. However, the choice of using a carbon source depends on its price, availability, ease of application, and efficacy of the source.

Table:-2 Carbon percentage in different Carbon Sources

Carbon source	Percentage of carbon
Molasses	28%
Rice bran	46.52%
Sugar	42.11%

Jaggery	28.8%
Rice flour	40%
Glycerol	39.19%
Maize flour	46%
Acetate	40%
Wheat flour	40%
Dextrose	40.89%

Amount of carbon to be added :

By calculating the total fish / shrimp biomass and the total ammonia nitrogen produced in the pond / tank in a day the amount of carbon to be added can be calculated.

Fish biomass = Total number of fish X average body weight (ABW)

1kg of Fish, upon feeding with 25% protein @ 2-3% body weight

Feed to be added is 20g -30g and contains 5g - 6g of protein

(1kg feed protein contains 160g of nitrogen)

Nitrogen in the added feed is about 0.8g - 0.96g

75% of feed-N remains unutilized (uneaten+ excreted

About 0.6 – 0.72g of Nitrogen is produced per day

(Heterotrophic bacteria require a C/N ratio of more than 10)

More than 6g -7.2g of carbon to be added per 1kg fish per day

Bio-floc tank setup:

If the tank diameter is 16m, the area of tank is calculated by $A = \pi X r^2$(where,π= 3.14)

Radius = diameter/2 i.e 16/2=8m

Then, area = 3.14 X $(8)^2$= 3.14 X 64 = 200.96m2 (Ideal depth of the tank should be 1.5m)

Then the volume of the tank will be 200.96 X1.5m= 301.44m^3(1m^3can hold 1000litres of water)

Then the tank water holding capacity is 301.44m^3 X 1000L = **3,01,440 litres**

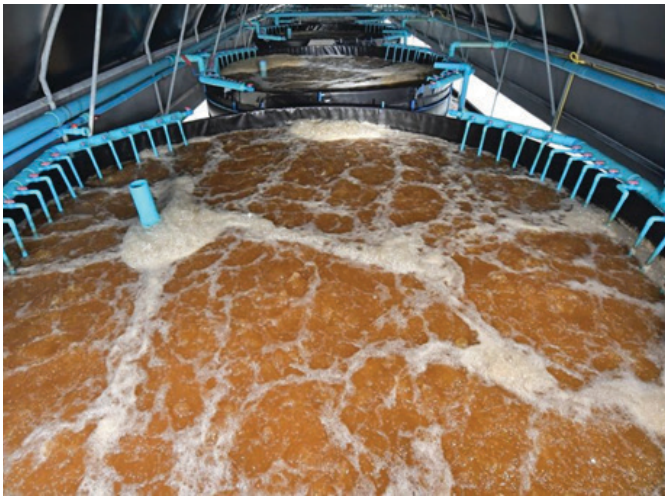


Table-3- Required equipment for bio-floc tank setup:

Equipment	Purpose
Iron frame /fish pond	holds the tarpaulin tank
Tarpaulin tank	used for water storage to culture
Aeration pump	used for aeration; to maintain DO
Air tube Air tube connectors Air stones	distributes the air and helps in lifting water near the substrate to the top of the tank
Test kits	to monitor the various parameters of water like NH_3, pH, TDS, NO_2, NO_3, temperature etc,
Imhoff cones	The volume of Bio floc mass is measured
PVC pipes and fittings	For inlet and outlet; to maintain the structure of the tank

Preparation of bio-floc inoculum:

Wash the tank/pond cleanly and dry it properly.

↓

Now fill the water up to 35-50% of the tank capacity and start aeration

↓

Start aeration and keep for 24hrs; (Total dissolved solids (TDS) initially 800 – 1000)

↓

Add 1kg of salt/10,000lit. of water to maintain the total dissolved solids (TDS) range between 1400 to 1600. (Do not use iodised salt, use only raw salt).

↓

Check pH should be between 7.5 to 8.5 (add $CaCO_3$ to maintain)

↓

Now add urea @1g/1000litres or Triple Super Phosphate @ 0.14gms/1000litres of water.

↓

Then add carbon source 7gms/1000litres, if using jaggery add 2gms/10litres

↓

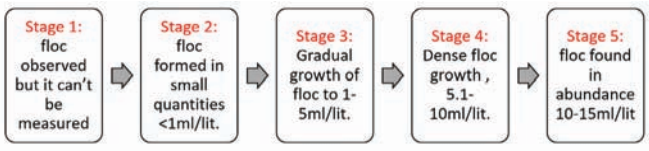
After one day add probiotic powder @ 20g/1000lit. of water

↓

Continuous aeration is required

↓

Within 7 to 10days, the floc will be formed



*From 1gm of ammonia, about 15.85gm of algae biomass; 0.2gm of nitrifying bacteria; 0.87gm of heterotrophic bacteriacan be produced

*Daily add 600gm of carbon for every 1kg of feed (maintenance phase@ 0.6:1) added until the floc reaches10-15ml/Lto maintain a C/N ratio of 10:1

*Ideal density of floc is 10-15ml/L for shrimp and 25 - 35ml/L for fish

Preferable species for culture in Bio-floc Technology:

Fish / shrimp species that can tolerate high stocking density, high total suspended solids concentrations, intermediate levels of DO, TAN and filter-feeding / omnivorous habit (Taw N,2010) are best suitable

1. **Non-air-breathing fishes** such as *Labeo rohita*, Common Carp, Grass Carp, Silver carps, Tilapia (*Oreochromis aureus, O. niloticus, O. mossambicus*)
2. **Air-breathing fishes** include Magur (*Claries batrachus*), Murrels, Anabas, Channel catfish, and *Clarias gariepinus*.
3. **Shell fishes** such as *Litopenaeus vennamei* (Indian white leg shrimp) and *Penaeus monodon*(Tiger shrimp)

- *Among all the culturable species *Litopenaeus vennamei* and Tilapia are highly recommended to culture in bio-floc technology as they are filter feeders with omnivorous/ detritivorous habit and can also withstand poor water quality conditions

Shrimp (vennamei) culture with bio-floc technology:

Litopenaeus vennamei is a most successful cultured shrimp species using bio-floc technology. In bio floc technology, vennamei are stocked at very high densities of about 200-500 PL/$m^2$and the post-larvae of 10 to 11 days size are used. Very high aeration is required to meet the oxygen demand of the shrimps and bacterial biomass. Feeding rate is about 3-6% of the body weight the average growth is about 1.3 – 2g/week. They reach the final body weight up to 22g within the 3month period of culture. Survival of shrimp obtained in this system is about 85%to 90%.Production upto 5-9kg/m^3 can be obtained in bio-floc system.

Tilapia culture with bio-floc technology:

Tilapia is an omnivorous fish and can be capable to feed upon suspended bio-floc mass detritus and commercial feed. It is the second important commercial fish after the carps. In BFT the stocked density of tilapia is about 150-200 fingerlings/$m^2$and the survival rate is about 80%. Floating type of pelleted feed is used and fed at 2 – 3% of body weight. Tilapia utilises the 51% of the incorporated nitrogen and the FCR is reduced to 1.3.The average growth rate is about 6-12gm/week with a protein efficiency ratio (PER) of 2.62gm weight gain per 1gm protein consumed. Tilapia will reach up to 600 – 800g within 6months of culture period and the production obtained is about 20 – 30 kg/m^3.

Table - 4, Management practises in BFT of shrimp and tilapia culture

Requisite	Shrimp	Tilapia
Stocking density	250 - 500 PL/m^2	150-200 fingerlings/m^2
Feeding rate	3-6% body weight	2-3%
Survival	85-90%	80%
Growth rate	1.3 – 2g/week	6-12g/week
Culture period	80days	6months
Final weight	22g	600-800g
Production	5-9kg/m^3	20-30kg/m^3

Table-5, Water quality parameters in Bio-floc technology

Parameter	Ideal range (shrimp)	Ideal range (Tilapia)	Recommendations
Temperature	28-30°C	26-34°C	High temperatures cause stress; low temperatures slower the growth
pH	7.8-8.0	7.5 -8.0	Fluctuations in pH effect the nitrification process
Dissolved oxygen (DO)	> 5mg/L (60%saturation)	>5mg/L	Essential for culture species and microbiota respiration
Salinity	4-35ppt	<5ppt	ranges between 0-50ppt depending on culture species
Alkalinity	>160mg/L	120 - 280mg/L	Helps in moderating pH fluctuations; helps in nitrogen assimilation and nitrification process

TAN	0.03mg/L	< 1mg/L	Toxicity depends on pH
Nitrite	0.3mg/L	0.3mg/L	Rises with increasing salinity
Nitrate	18-23mg/L	0.5-20mg/L	High levels increase stress
Settling solids	10-15ml/L	20-50ml/L	High amounts lead to anaerobic conditions; gill occlusions
Orthophosphate	0.5-10mg/L	0.5-20mg/L	Safe levels for culture species
Total suspended solids	400-500mg/L	<600mg/L	Excess amounts cause gill irritation; less amounts leads to poor production

Advancements in bio-floc Technology:

1. In bio-floc technology, an IoT(internet of things)-based smart water quality management system is developed in which sensors are used to analyse the water parameters such as pH, temperature, DO, TAN, suspended solids, salinity etc. They transmit the interpreted data to mobile phones, which helps farmers easily control water quality problems and reduces the labour cost for maintaining these parameters in water.
2. In Bio-floc technology, about 2000 different kinds of bacteria will be developed, of which few bacteria show mRNA expressions of the genes related to disease resistance that helps to enhance the immunity of the shrimp and helps in controlling WSSP and infectious myonecrosis virus disease in shrimp (Nyan Tawet *al* 2015) and in *Labeo rohita* on consuming the bio-floc improved the resistance towards *Edwardsiella tarda.*
3. Biofloc helps reduce the typical off flavours in the channel catfish (*Ictalurus punctatus*). Geosmin and 2-methylisoborneol (MIB) produced by cyanobacteria give earthy or muddy flavours to the fish cultured in earthen ponds; these off flavours reduce the palatability of fish; this can be controlled inBio floc technology because continuous aeration and no earthen bottom minimises the growth of off-flavour producing cyanobacteria(Kevin K. Schrader *et al.* 2013)
4. Bio-floc technology helps in controlling various diseases in shrimps, such as the pathogenic effect of *Vibrio harveyi* and *V. parahaemolyticus* in *Litopenaeus vannamei*, *Penaeus monodon* and in gnotobiotic brine shrimp, *Artemia franciscana*(Crab et al., 2010) controlled by disrupting the pathogen's quorum sensing mechanism through which the pathogen communicates cell-to-cell, using signalling molecules (Spoering and Gilmore, 2006, Defoirdt et al., 2008)

Merits:

1. It is a green approach to reducing the environmental impact
2. High productivity compared to conventional fish farming
3. Increased growth and survival rate of cultured species
4. Lower the feed conversion ratio (FCR) and reduce the feeding cost
5. High stocking density in less space
6. Consuming the floc biomass enhances the immune system of culture species
7. Control the pathogenic effects of microbes by quorum sensing
8. Bio-floc forms as an alternative feed source and reduce the feeding cost
9. Efficient use of land and water resources
10. Low risk of pathogen entry into the culture
11. Improves the water quality by recycling the nutrients
12. Reduction of sensitivity to light fluctuations of water parameters
13. Minimum (<10%) or zero exchange of water
14. Minimize effluent discharge in the surrounding water bodies
15. Improves farm biosecurity

Demerits:

1. Cost-effectiveness
2. Maintaining a constant C/N ratio is problematic during culture
3. Monitoring floc volume, oxygen saturation, and ammonia levels requires highly skilled persons and a fully equipped laboratory at the farm only
4. Constant supply of electricity is needed because continuous aeration is necessary to maintain the bio-floc imposing higher energy costs.
5. High turbulence may also lead to floc breakage as they held together by a loose matrix

Conclusion:

Bio-floc technology doubles the farmer's income with efficient use of available resources. Unless the initial cost bio-floc system is more economical in production, in regular pond-based farming, 2000kg /6months is produced in a 1acre area, but the same crop yieldcan be obtained in 4small tanks of each 4m dia. and 1.2m depth in a floor area of 100-150m^2. Fast growth and improved disease resistance help the farmer overcome the financial loss due to disease outbreaks. In this system, adding supplementary

feed is reduced to half as the culture species mainly feed upon the floc biomass in water; thus, the input feed cost is minimized. Unlike the conventional fish farming, frequent exchange of water is minimum or zero in this system; this reduces the labour cost, saves time, and prevents the entry of pathogens and also environmental degradation caused due to aquaculture effluents can be controlled by using the bio-floc culture system

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More References can be provided on request.

Impact of Coral Bleaching on Marine Life

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Abstract

Coral reefs are the most diverse ecosystems present around the world supporting rich biodiversity and livelihood of millions of people. But currently they are threatened by rising CO_2 levels through increase in sea surface temperature and ocean acidification. Changes in environmental conditions, such as water temperatures, pH values, and turbidity will directly affect the symbiotic relationship between corals and zooxanthellae and thus coral bleaching occurs. Bleached corals are expected to have reduced growth rates and decreased reproductive capacity which increases the susceptibility to diseases and higher mortality rates. Awareness programme and collaborations with national and international institutes is required for the reduction in the climate change phenomenon and for the successful management and conservation of the coral reef ecosystem.

Introduction

Coral reefs are the most diverse marine ecosystems. They are living, colorful, multi-faceted underwater ecosystems, hosting a variety of organisms such as fish, invertebrates, (crabs, shrimp, sea stars), algae, benthos, and many more. They teem with life, with perhaps one-quarter of all ocean species depending on reefs for food and shelter. This is a remarkable statistic when you consider that reefs cover just a tiny fraction (less than one percent) of the earth's surface and less than two percent of the ocean bottom. Because they are so diverse, coral reefs are often called as rainforests of the sea. The value of coral reefs has been estimated at 30 billion U.S. dollars and perhaps as much as 172 billion U.S. dollars each year, providing food, protection of shorelines, jobs based on tourism, and even medicines.

Coral reefs are marine ecosystems that are colonies of living animals. These colonies are groups of individual animals called polyps. The polyps actually secrete a substance that is called calcium carbonate that forms the reef structure upon which they live.Within each coral polyp are single celled algae called zooxanthellae. Zooxanthellae, utilize sunlight for photosynthesis, a process by which the algae

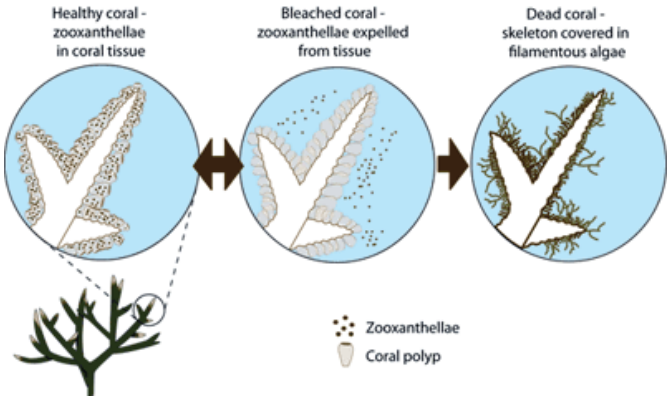

Fig. 1. Coral bleaching phenomena (Source: Great Barrier Reef Marine Park Authority)

is using the sunlight to produce food and oxygen for the polyp. In return, the zooxanthellae receive compounds needed for sustenance and photosynthesis. Thus, the polyp and zooxanthellae live in a relationship that is mutually beneficial for both. There are different types of coral reefs based on type of formation and skeletal structures such as fringing reef, barrier reef, atoll, bank or platform reef and patch reef and hard and soft coral respectively.

Importance

Coral reefs are an indispensable part of the entire marine ecosystem. They harbor many marine creatures. All manners of creatures inhabit, breed, feed, and avoid predators in coral reefs, which naturally forms a rich ecosystem. They provide shelter for fish and provide local communities with fishing grounds. There can be as many as 1,500 types of fish species within coral ecosystem. One square kilometre of healthy, well-managed coral reef can yield over 15 tons of seafood every year. By acting as a barrier and breaking strong waves, corals provide protection from storms. They serve as indicators of the health of our planet. They represent how effectively we are caring for our earth. Importantly, they serve as protection for coastlines. In addition, they are an essential source of food and protein for millions of people throughout the world. No wonder 500 million people live within 60 miles of coral reefs. They also supplement us with medical benefits. A chemotherapy drug used to treat leukemia is derived from sponges that live on the reefs. Antiviral drugs are also derived from sponges.

Coral Bleaching

Coral bleaching phenomena occurs when coral polyps expel algae that thrive inside their tissues. Due to changes in the surrounding water conditions such as temperature, light and nutrients, coral expel the symbiotic algae (zooxanthellae) living in their tissues causing them to turn completely white. Corals can survive a bleaching event, but they are under more stress and are potential to mortality. Coral bleaching occurs due to various factors. They are extremely sensitive to the surrounding environment. Changes in environmental conditions, such as water temperatures, pH values, and turbidity will directly affect the symbiotic relationship between corals and zooxanthellae. It may also result from increases in seawater temperature, particularly when associated with elevated levels of solar irradiance (ultraviolet radiation), or it may be caused by changes in seawater chemistry (ocean acidification or pollution), increased levels of sediment in seawater or exposure to sodium cyanide (a chemical used in the capture of coral reef fish). Under such conditions the zooxanthellae may lose substantial amounts of their photosynthetic pigmentation, which decreases rates of photosynthesis and produces bleaching.

Yonge and Nicholls (1931) in 1930s reported the first coral bleaching episode in the Great Barrier Reef, when surface water temperature was 35 °C. Since the 1980s, scientists have observed an increase in the frequency, intensity and extent of bleaching episodes worldwide. This is caused by a "record" increase in ocean surface temperature due to global warming, combined with the reinforcement of the El Niño phenomenon. Significant ocean surface temperature anomalies caused a loss of more than 16% of coral reefs around the world (Hoegh-Guldberg *et al.,* 2017). In fact, 1998 was the first "global bleaching episode" declared by National Oceanic and Atmospheric Administration (NOAA)

Climate Change

Globally coral reefs harbour the highest biodiversity of any ecosystem and directly support over 500 million people worldwide, mostly in poor countries. They are among the most threatened ecosystems on earth, mainly due to unusual global warming and climate change phenomenon, combined with growing local pressures. Over the last three years, reefs around the world have suffered from mass coral bleaching events as a result of the increase in global surface temperature caused by emission of anthropogenic greenhouse gas from various industries and automobiles.

Anthropogenic greenhouse gas emissions have caused an increase in global surface temperature of approximately 1°C since pre-industrial times. A spike of 1-2 °C in ocean temperatures sustained over several weeks can lead to bleaching, turning corals white. If corals are bleached for prolonged periods, they eventually die. Coral bleaching events often lead to the death of large amounts of corals. Reefs around the world have suffered from mass bleaching events for three consecutive years. Iconic reefs such as the Great Barrier Reef in Australia and the Northwestern Hawaiian Islands in the United States have all experienced their worst bleaching on record with devastating effects. Corals cannot survive the frequency of current bleaching events from global temperature rise. If temperatures continue to rise, bleaching events will increase in intensity and frequency. Scientists estimate that even those events that occur twice per decade can threaten corals' survival. The first global scientific assessment of climate change

impacts on World Heritage coral reefs, published in 2017 by UNESCO, predicts that the coral reefs in all 29 reef-containing World Heritage sites would cease to exist as functioning coral reef ecosystems by the end of this century if humans continue to emit greenhouse gases under a business-as-usual scenario (Heron *et al.,* 2017). In recent years, due to sudden changes of climatic events, global warming has caused seawater temperatures to rise, and the greenhouse effect has also caused ocean acidification that weakened coral's absorption of calcium carbonate. When coral reefs are not strong enough to resist natural erosion it will take longer for them to recover from bleaching. NOAA's coral reef observing system uses satellites to monitor the sea surface temperature and marks areas with high water temperatures to alert the risk of coral bleaching.

Impacts

Coral reefs support some of the most biodiverse ecosystems on the planet. Thousands of marine animals depend on coral reefs for survival, including some species of sea turtles, fish, crabs, shrimp, jellyfish, sea birds, starfish, and more. Coral reefs provide shelter, spawning grounds, and protection from predators. They also support organisms at the base of ocean food chains. As reef ecosystems collapse, already at-risk species may face extinction. Additionally, reefs provide a wide variety of ecosystem services such as subsistence food, protection from flooding and sustaining the fishing and tourism industries. Their disappearance will therefore have economic, social and health consequences.

Coral bleaching impacts peoples livelihoods, food security and safety. Coral reefs are natural barriers that absorb the force of waves and storm surges, keeping coastal communities safe. Without them, we must rely on manmade seawalls that are expensive, less effective, and environmentally damaging to construct. Also, many island and coastal populations depend on coral reefs for nutrition, fisheries and income from tourism, as well as coastal protection, coral bleaching may result in significant social and economic impacts, as well as potential loss of marine biodiversity Bleached coral also affects the feeding and spawning grounds of many commercially important marine organisms. Reef tourism provides billions of dollars to the Indian economy each year and provides jobs to thousands of peoples. Bleached coral reefs, devoid of magnificent marine species, threatens it all Coral bleaching and associated mortality not only have negative impacts on coral communities, but they also impact fish communities and the human communities that depend on coral reefs and associated fisheries for livelihoods and wellbeing.

Bleached corals are likely to have reduced growth rates, decreased reproductive capacity, increased susceptibility to diseases and elevated mortality rates. It also declines the genetic and species diversity due to death of coral reefs as a result of bleaching.

Measures to reduce the coral bleaching

In the face of the unusual increase in seawater temperature caused by climate change, more ambitious carbon reduction targets should be set to replace fossil fuels with sustainable energy. As human beings get to know the importance of coral reefs, the related restoration work can be started on the grass root (individual) level.

There are different ways to prevent coral bleaching phenomenon. They are:

- Create awareness among the local peoples, stakeholders, fisher folks and associated peoples regarding the importance of coral reefs.
- Support reef amiable businesses
- Support different conservation organisation such as WWF (World Wide Fund for Nature), UNEP (United Nations Environment Programme), etc.
- Reduce the pollution by organizing a beach clean-up programme, recycling the harmful plastic wastes, etc.
- Don't waste the water: The less water you use, the less runoff and waste water that eventually finds its way back into our oceans.
- Report illegal dumping of wastes and pollutants and harvesting of live corals for aesthetic purpose.
- Don't disturb the coral reef environments by anchoring the boats on the coral ground.
- Don't touch the corals while diving in the oceanic environments or along the coastal belt.
- Volunteer a reef clean-up programme.
- Support the creation and maintenance of marine national parks, reserves and sanctuaries.

Conclusion

Coral reefs form the world's most productive ecosystems, supplementing complex and varied marine habitats that support wide range of marine life. They deliver ecosystem services to tourism, fisheries and coastline protection. They protect shorelines by absorbing wave energy and various small islands would not exist without their reefs to protect them. But currently due to various anthropogenic and climatic impacts, coral reefs are the most threaten ecosystem. Due to rise in temperature and ocean acidification phenomena, coral reefs are at the highest risk of bleaching and mortality. So during this period the protection of coral reefs is highly importance. Acting now to manage the existing threats and allow for future adaptation is vital for the coral reef ecosystem.

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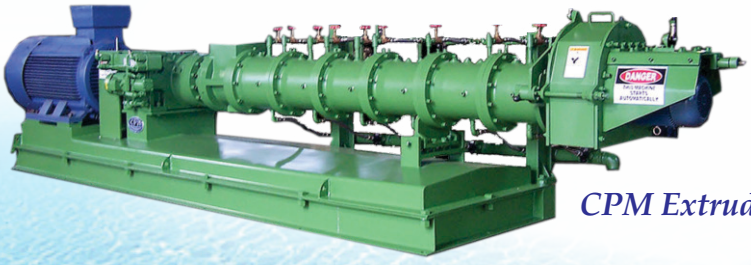

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Management of Aquaculture Sludge Using Biocatalytic Enzymes: A Novel Approach

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Highlight Points

- Aquaculture sludge is one of the major concern to adjacent surface and groundwater.
- Physical and chemical method of treatments are costly and require chemical addition.
- Enzyme technology is an eco-friendly and cost-effective treatment strategy.
- Use of eco-enzymes produced from organic wastes is a novel approach.

Introduction

Aquaculture is one of the fast-growing industries among all the food-producing sectors globally, and it has been growing tremendously during the last 50 years. The current production from the aquaculture sector is more than 50 million compared to the early 1950s (Mikawlrawng, 2016; Gómez *et al.,* 2019). Multiple factors boost aquaculture production, including technological advancement, species diversification, government schemes and blue economy earned by farmers. Further, the major source can be attributed to the paradigm shift of consumer's preference towards a quality protein-rich diet and increasing population, which offerings a growing demand for fish consumption. In line with maintaining growth, the aquaculture industry has been exploited and expanded for fish seed production, feed mills, fish, inputs for health management of stocked animals, processing plants, and other relevant sectors. Large amounts of effluents and sludge were produced from aquaculture activities in the industry which contains high organic content and nutrient load, resulting in surface and groundwater pollution. Drinking contaminated groundwater can cause serious health effects, and it can also harm wildlife. Exposure to polluted water may result in other long-term effects, such as certain types of cancer. So, the sludge should be efficiently treated before releasing into the watercourses. Several methods, including physical and chemical, have been employed for its treatment, but as they require chemical addition, higher energy, and high costs to operate and handle, enzyme treatment is becoming a preferred method due to its eco-friendly and low operating cost features. The present article focuses on providing an overview of the usage of biocatalytic enzymes for the management of aquaculture sludge.

Aquaculture sludge

Aquaculture sludge can be defined as the waste resulting from fish farming activities that caused deposits at the bottom of the water bodies. The primary cause of sludge formation is from fish feeding (Turcios and Papenbrock, 2014; Axler*et al.,* 1997). The sludge includes animals' excrement and the decaying materials, which causes the sludge to have total suspended solids (TSS), total dissolved solids (TDS), chemical oxygen demand (COD) and biological oxygen demand (BOD) (Summerfelt*et al.,* 1999; Rafiee and Saad, 2005). Besides, the sludge (in slurry form) from aquaculture also contains high nitrogenous compounds like ammonia, nitrite and nitrate, phosphorus, and dissolved organic carbon caused by the unconsumed foods, which leads to severe environmental degradation (Manios*et al.,* 2002). This will increase aerobic bacterial activity, which ultimately will reduce the oxygen amount in the culture water (Akinwole*et al.,* 2016). Sludge will affect the habitat availability of cultured animals, produce toxic matters that can threaten the lives of aquatic animals. Ammonia overload results in a decreased rate of excretion of aquatic animals, leading to an increase in ammonia levels in their blood and tissues, decreasing oxygen consumption by tissue, and affecting metabolic enzyme activity. All these changes will cause stress to the animals making them more susceptible to disease infections (Yusoff*et al.,* 2011). Excess amounts

of nitrogenous compounds and phosphorus can affect the aquatic systems and cause eutrophication, leading to mortality of aquatic flora and fauna (Lananan*et al.*, 2014). Therefore, these contents will cause environmental problems such as water pollution even though it is characterized as a non-toxic waste. Thus, before disposing of the sludge, it should be treated efficiently to reduce its pollutant concentration.

Table 1. Waste production characteristics of aquaculture sludge (Chen *et al.*, 1993)

Parameter	Range
Total solids (%)	1.4-2.6
TVS (% of TS)	74.6-86.6
BOD5(mg/L)	1590-3870
TAM (mg/L)	6.8-25.6
TP (% of TS)	0.6-2.6
Alkalinity	284-415

Methods for treatment of aquaculture sludge

Various methods have been employed for the treatment of sludge, as shown in Table 1, which includes land application of sludge as fertilizers to improve the soil condition and crop quality and the incineration method (Jang *et al.*, 2014). But they possess several limitations because although the sludge is applied directly on the land or after some treatments, it will cause the odour problem, increase the costs of sludge management and finally cause severe groundwater contamination since it still contains those organic matters (Chen *et al.*, 1997; Timmons and Ebeling, 2007; Mirzoyan*et al.*, 2012). Thus, treatment of aquaculture sludge by biological processes has been widely encouraged since it requires low costs and fewer environmental issues (Zhang *et al.*, 2013). Nevertheless, biological processes such as aerobic and anaerobic digestion possess their limitations. They will be inhibited by the high concentration of solids and nutrients present in the sludge (Zhang *et al.*, 2013; Chen *et al.*, 2008). To overcome this, various pre-treatment technologies and methods have been invented in recent years. As physical (mechanical, thermal, ultrasonic, microwave) and chemical methods (alkaline, ozone oxidation) of pre-treatment possess limitations like they require higher energy, chemical addition and high costs to operate and handle, enzyme pre-treatment is becoming a more preferred method due to its eco-friendliness and low operating cost features (Yi *et al.*, 2013).

Table 2. Methods for Aquaculture Sludge Treatment and Disposal from Previous Studies

Methods	Advantages	Disadvantages	Reference
Land spreading	High nutrient contents have beneficial impacts on the physical condition of land and productivity of the crop.	Odour problem and increased risk of groundwater contamination.	Teuber*et al.*, 2007; Teuber*et al.*, 2005
Incineration	Dispose of a large amount of sludge at one time.	Smoke and ash produced will cause pollution, and it is expensive to operate and maintain.	Celis*et al.*, 2008; Arun and Sivashanmugam, 2015
Sedimentation ponds	Economical	Less effective in reducing the nutrient concentrations	Kawasaki *et al.*, 2016
Treatment (Stabilization)	Carried out through thermal, chemical or biological processes. The biological process is highly preferred as it requires low costs and creates fewer issues on environment and operation.		Arun and Sivashanmugam, 2015; Im*et al.*, 2001

Biocatalytic Enzymes and their application in sludge treatment

Enzymes are defined as substances that act as a catalyst in living organisms, controlling the rate at which chemical reactions progress without themselves being altered in the process. Enzymatic pre-treatment was demonstrated to be an effective treatment to increase the solubility of the selected inhibitor in several types of wastewaters. Hydrolytic enzymes like amylase, lipase and protease are amongst many commercial enzymes used in improving sludge solubility. In a study conducted to find out the influence of biocatalytic enzymes produced from the fermentation of vegetable and fruit wastes, it was found that the lipase activity was comparable and higher in all garbage enzymes compared to protease and amylase (Rasit and Mohammad, 2018). The optimum pH for each enzyme activity is different. Selvakumar and Sivashanmugam (2017) claimed that the maximum lipase activity normally occurs at pH 8 and will keep increasing until pH 9. Smitha (2010) mentioned that the higher catalytic property of amylase would be happened by maintaining the pH values ranging from 6 to 7. Generally, the pH value required to maximize the protease activity must be within the range of pH 6 up to pH 7 (Gómez *et al.*, 2019). A commercial enzyme application on pre-treatment of sludge requires high costs, and it will be less economical for large-scale industries. Thus, there is a

requirement to produce a low-cost enzyme system that can be produced from fruit and vegetable wastes. Eco enzymes are enzymes produced in that manner which seem to be the best alternative to induce the pre-treatment process of sludge. It is because it exhibits better performance and is less expensive than other chemical additive products containing chemical compounds and hazardous to human health or the environment that demand high energy and cost during the manufacturing process. (Verma*et al.,* 2019; Ng *et al.,* 2020; Sharma *et al.,* 2020). Novozymes is a biotechnology company producing biocatalytic enzymes as solutions for several problems, including sludge management.

Garbage enzyme or eco enzyme

Garbage enzyme or eco enzyme is produced through fermentation of organic waste into useful enzymes. It is known to have cleansing characteristics and has multi-functional applications as a multipurpose cleaner (Ho*et al.,* 2014; Verma*et al.,* 2019). Thus, it can be used as a low-cost alternative to increase sludge quality by removing the impurities and bacteria, thus catalyse the process of waste back into the soil (Gómez *et al.,* 2019; Ng *et al.,* 2020). Tang and Tong (2011) reported the influence of garbage enzymes on domestic wastewater and observed that total dissolved solids (TDS) and Chemical Oxygen Demand (COD) were removed within the range of 20 to 60 per cent when pre-treated with 9 per cent of garbage enzyme. Nazim and Meera (2013) had produced garbage enzyme and used it to treat synthetic greywater with 5 per cent and 10 per cent dilution to wastewater. The treatment successfully removed phosphorus and nitrogen. Arun and Sivashmugam (2015) studied the solubility of waste-activated sludge using garbage enzyme and observed that the pre-treatment had shown a reduction of Chemical Oxygen Demand (COD), total nitrogen (TN) and total phosphorus (TP). In a batch test carried out for ten days to find out the effect of 5 %, 10 % and 15 % dosage of the eco enzyme in treating aquaculture sludge, it was observed that the eco enzyme solution is very efficient in the removal of Total Suspended Solids (TSS), Volatile Suspended Solids (VSS), Total Ammonia Nitrogen (TAN), Total Phosphorus (TP), and stabilization of the COD. The results significantly showed that the most efficient and economic concentration of the eco enzyme is 10% dilution times and reported with 89% removal percentage of TSS, 78 % removal percentage of VSS, 88% reduction percentage of COD, 94 % removal percentage of TAN and 97 % removal percentage of TP (Galintin*et al.,* 2021).

In a study where the eco enzyme was prepared from fruit and vegetable waste from pineapple, orange, tomato, and mango dregs, it was observed that the optimum pH for amylase activity in the mixed eco enzyme is at pH 6.5, and the lower amylase activity is at pH 3.07. It states that amylase activity is very low in acidic conditions and increases in the basic pH. Thus, higher amylase activity of the mixed eco enzyme solution could be accomplished by sustaining the pH between 6.5 and 8. Regarding the protease activity, the highest activity was achieved at pH 6, and the lowest protease activity was at pH 3.07, suggesting that the pH of the eco enzyme should be maintained in the range of pH 6 - pH 7 to achieve the highest protease activity. Lipase activity in the enzyme solution increased dramatically when the pH reached pH 7, pH 7.5, and pH 8. It was also observed that the maximum lipase activity was at pH 8, and the lowest lipase activity was at pH 3.07. It states that the optimum lipase activity is falling at pH 7 – 10 and will slowly drop if the pH increases until it reaches pH 12. Therefore, to achieve the optimum lipase activity for the mixed eco enzyme, pH has to be maintained in the range from pH 7 to pH 8 (Galintin*et al.,* 2021).

Conclusion

The growing human population has greatly influenced the aquaculture industry, which led to the release of large amounts of effluents which are becoming one of the main reasons for water and ground pollution. Thus, before releasing the aquaculture sludge to the receiving water, it needs to be treated efficiently to reduce its pollutant concentration. Various methods, including physical and chemical, are there for the treatment, but they possess their limitations. So, enzymatic pretreatment is becoming preferable due to its eco-friendliness and low cost of operation. But, a commercial enzyme application on pretreatment of sludge requires high costs, and it will be less economical for large scale industries. Thus, it is required to produce a low-cost enzyme production that can be produced from readily available raw materials. Garbage enzymes or eco enzymes produced from organic wastes through fermentation are increasingly used for the pre-treatment, which were proved to have the potential to remove the substances presented in the sludge. Further studies are still required in this area to find out the variety of other organic wastes which can be utilised for preparing eco enzymes. This approach will efficiently treat the sludge from aquaculture activities before release into the aquatic system to protect the aquatic ecosystem and biodiversity.

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More References can be provided on request.

Role of Bacillus based Probiotics in Aquaculture

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Highlight Points

- Probiotics use in aquaculture show great impact on aquatic organisms. Probiotics decrease accumulation of organic load and maintain water quality in an efficient way.
- Probiotics help in:
  - Improving water quality by reducing nitrogenous compounds such asammonia, nitrite and nitrate
  - Control diseases and vibrio
  - Improving immunity
- Probiotics work on the concept of competitive exclusion
- Skretting's AquaCare Control helps in improving water quality, support fish andshrimp health and improve farmers profitability

Introduction

Aquaculture is one of the fastest emerging food producing sectors of the world. World aquaculture has immensely grown during the last few years as well as becoming an economically significant zone.

Probiotics

Probiotics shows a new dimension in disease resistance and improving water quality in aquaculture industry. The Greek word probiotic means "for life", was introduced by Parker et al. According to him, probiotics are "Organisms and substance, which contribute to intestinal and microbial balance". Fuller, et al defined probiotics as "live microbial feed supplement which beneficially affect the host animal by improving its intestinal microbial balance". Probiotics are used in aquaculture to improve growth performance nutrition decrease diseases and develop immune system.

Micro Organisms of Probiotics

Research shows that Lactic Acid Bacteria have been broadly used as probiotic strains which are usually present in the intestine of healthy fishes such as the Lactobacilli and Bifidobacterium. Some gram-positive bacteria like *Bacillus, Enterococcus, Streptococcus* act as common probiotic strains which are the main gastrointestinal microbiota.

Types of Probiotics

Probiotics are two types namely feed probiotics and water probiotics.

Feed Probiotics

Some bacterial, fungal strains can be blended with feeding pellets or by encapsulating into live feed stock or administered orally to feed rearing animals to prevent disease and enhance essential microbial flora of the gut.

Water Probiotics

Water probiotics are applied to reduce organic pollutants and various contaminants in water by directly applying to rearing medium. These improve water quality by converting organic matter to smaller units. Breakdown of organic matters evolve simpler substances like glucose and amino acids that are used as food for beneficial bacteria which reduce the accumulation of organic pressure and provide congenial environment to farmed stock. Probiotic bacteria such as Bacillus sp.

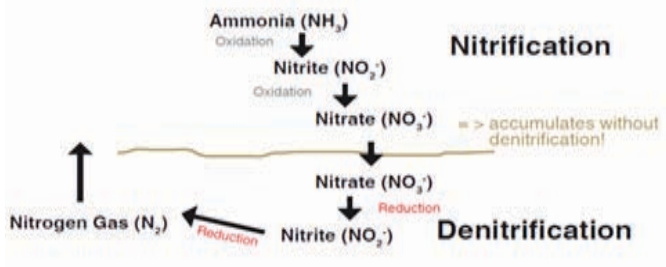
Significance of Probiotics in Aquaculture

Probiotics use in aquaculture show great impact on aquatic organisms. Probiotics decrease accumulation of organic load and maintain water quality in an efficient way.

Improvement of water quality

According to Michael et al, the contamination of various nitrogenous compounds such as ammonia, nitrite and nitrate has been a serious problem in aquaculture system. Ma et al, described that Lactobacillus sp. simultaneously eliminates nitrogen and pathogens from polluted shrimp farms. The aerobic gram-positive bacteria, such as Bacillussps. Aquatic pathogens are able to grow and proliferate in the environment, as they benefit from high organic matter loading, which is primarily derived from feed, feces and phytoplankton.

Fig1: Nitrogen cycle

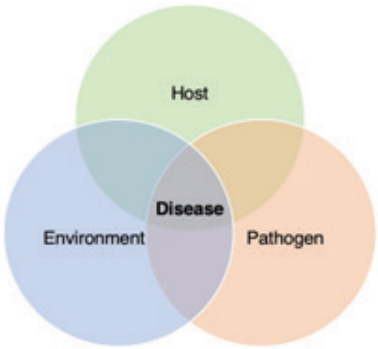


Control of Diseases

The important role of probiotics in aquaculture is increasing. This is primarily due to disease, which represents the biggest constraint in aquaculture, and is a huge challenge for future growth and expansion.

In order to effectively manage disease, three factors must be considered:

1. Host
2. Pathogen



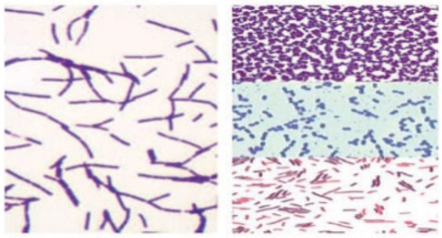
3. Environment

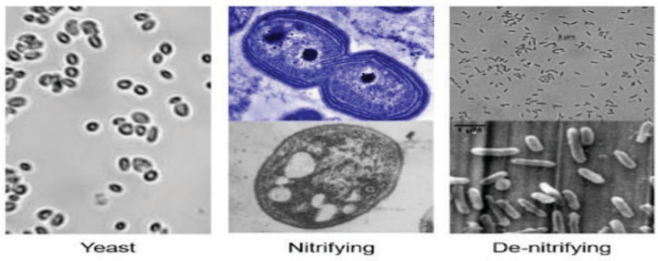
Environment

Competitive exclusion

If a probiotic bacteriumis able to colonize the intestine, at least temporarily, by adhering and growing within the intestinal mucus and mucosa, it can reduce the available receptor sites for pathogens and stimulate their removal from infected regions. This mechanism is called competitive exclusion.

Fig: 3 Microscopic pictures of bacterial strains





Vibrio control in Aquaculture

The use of probiotics in aquaculture to improve pond environment and control Vibrio populations has been one of the most common strategies used by farmers to fight EMS outbreaks.

An effective aquaculture probiotic which can colonize the gut has two benefits:

- Competitive exclusion of pathogens
- Immune support

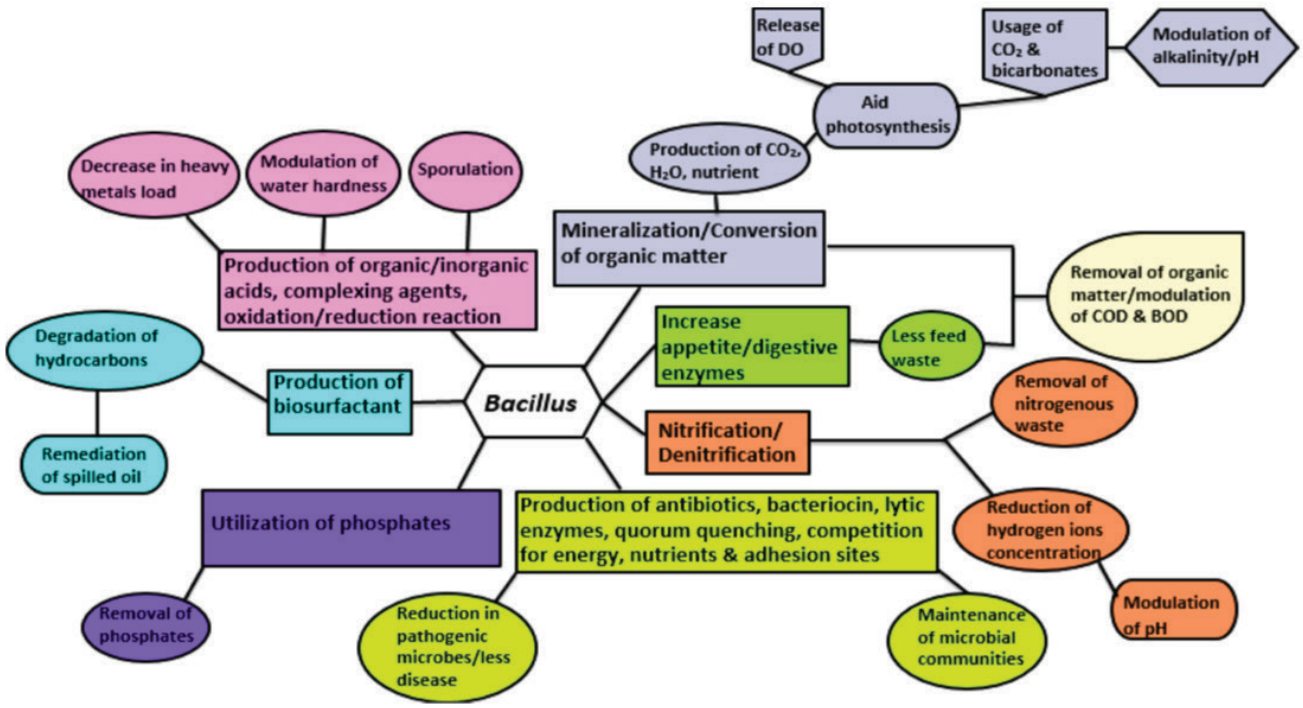
Competitive exclusion

If a probiotic bacteriumis able to colonize the intestine, at least temporarily, by adhering and growing within the intestinal mucus and mucosa, it can reduce the available receptor sites for pathogens and stimulate their removal from infected regions. This mechanism is called competitive exclusion.

Immune support

By attaching to different receptors, probiotics are able to interact with the host immune system. Many studies have investigated the effect of probiotics on the immune system in fish and shrimp, focusing on both the innate and adaptive immune response as well as the localized (i.e., intestine) and systemic (whole organism) response.

Fig :4 Bacillus role in aquaculture



Healthy shrimps from AquaCare Control Ponds

Skretting's AquaCare Control Probiotic

Bacillus as probiotics for finfish and shellfish

Use of *Bacillus* as probiotics species like *B. subtilis,B. velezensis,Bacillusamyloliquefaciens, Bacillus circulans, Bacillus thuringiensis,Bacillus aerius* increased resistance of finfish and shrimp to pathogenic bacteria including *Streptococcus, Aeromonas Vibrio, Enterococcus* and *Lactococcus, Bacillus species* are also a natural resource for screening new quorum quenching bacteria and are commonly regarded as safe bacteria for the use in aquaculture (e.g.Aquacare control, Skretting) as agents for improving water quality and disease control. It has been demonstrated that use of *Bacillus* probiotics as the bioremediatory tools in the rearing water of aquaculture species and soil of aquaculture ponds have been exhibited as a feasible way of improving water quality in *Bacillus subtilis, B. licheniformis, B. cereus and B. coagulans* are suggested as suitable bioremediatory tools for removing of organic waste and *Bacillus subtilis* and *B. licheniformis* are suggested as more suitable candidates for bioremediation of aquaculture.

About AquaCare Control

AquaCare control harbours bacterial strains of live *Bacillus* Sps in lyophilized form and does not need fermentation. It degrades the organic material such as Faecal matter, unusedfeed, and sludge as well as it also controls ammonia by bacterial de-nitrification process. Moreover, Aqua care *Bacillus* strains also reduces the *vibrio*Sps by bacterial synergism so aqua care control regarded as a highly efficient probiotic in Aqua culture.

Conclusion

In recent years, probiotics, prebiotics have become an essential part of the aquaculture practices for improving the growth performance and disease resistance. Probiotics play an important role in feed conversion, growth rates, weight gain, immune response and disease resistance of shrimp and fish. On the other hand, prebiotics also have various beneficial effects mainly in disease resistance and nutrient availability of aquatic species. The combined application of probiotics and prebiotics, which improve the survival and establishment of the live microbial dietary supplement in the gastrointestinal tract of the host.

Healthy pond environment

Toward a Blue Economy: The Power of the Ocean and its Sustainable Development

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Introduction:

Oceans are the world's largest ecosystem, cover three-quarters (71%) of the Earth's surface, contain 97% of the Earth's water and billions of people depend on for their livelihoods. Oceans protect biodiversity, keep the planet cool, and absorb about 30% of global CO_2 emissions. According to the United Nations (UN), Maritime transport remains an essential part of international trade as 80% is carried by the seas. At least 3-5% of global GDP is derived from oceans. The oceans are increasingly viewed as a lucrative new frontier for economic development.

Figure 1: Ocean and its services (Source: KPMG, 2021)

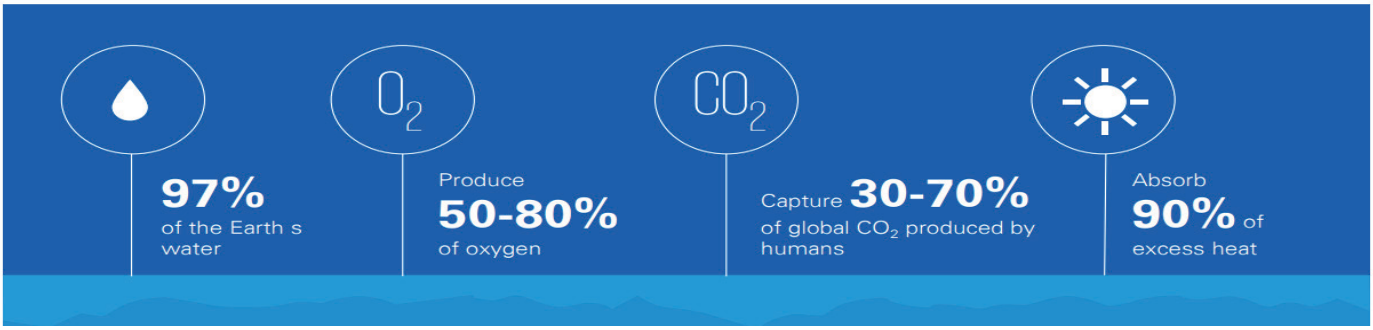
The genesis of the blue economy: The Ocean-based Blue Economy is the next sunrise issue for development experts. Father of Blue Economy-Dr Gunter Pauli introduced this concept in 1994 in his book – "The Blue Economy: 10 years, 100 innovations, 100 million jobs". The term "Blue Economy" became significant after the United Nations Conference on Sustainable Development, 2012 (UNCSD), also known as Rio +20 or the Earth Summit.

Highlight Points

- Since the 21st century, The Blue Economy is a sunrise sector and its concept has become increasingly popular because of its sustainable use of the ocean.
- "Blue Economy" has emerged as a term referring to a healthy ocean, supporting higher productivity.
- You can't go green without blue- "No blue without green - nor green without blue".
- Humanity's relationship with the ocean is changing, offering new business opportunities in the process.
- According to the Ellen MacArthur Foundation 'By 2050, there could be more plastic - by weight - in the ocean than fish.

What is a Blue Economy?

"Blue economy" is an economic term linked to exploitation and conservation of the maritime environment, sometimes referred to as a "sustainable ocean-based economy". The UN specifies Blue Economy as a range of economic activities related to oceans, seas and coastal areas, and whether these activities are sustainable and socially equitable. An important key point of the Blue Economy is sustainable fishing, ocean health, wildlife, and stopping pollution.



The blue economy is "the sustainable use of marine resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystems."

-The World Bank

As defined earlier, the blue economy consists of sectors whose returns are linked to the living "renewable" resources of the oceans (such as fisheries) as well as those related to non-living and therefore "non-renewable" resources (including extractive industries, such as dredging, seabed mining, and offshore oil and gas, when undertaken in a manner that does not cause irreversible damage to the ecosystem).

What does the Blue Economy include?

The Blue Economy encompasses all sectoral and cross-sectoral economic activities based on or related to the oceans, seas and coasts:

1. Marine-based activities: include the activities undertaken in the ocean, sea and coastal areas, such as marine living resources (capture fisheries and aquaculture), marine minerals, marine renewable energy, desalination, maritime transport and coastal tourism.

2. Marine-related activities: which use products and/or produce products and services from the ocean or marine-based activities like seafood processing, biotechnology, shipbuilding and repair, port activities, technology and equipment, digital services, etc.

Figure 2: Common marine-based and related activities (Source: KPMG, 2021)

Blue Biotechnologies involve the exploitation of living organisms (Algae, microalgae, sponges, bacteria, etc.), in engineering, technology and other fields requiring bioproducts. Blue biotechnology value chains include research and development, demonstration and test, cultivation and production.

Importance of Blue Economy:

The blue economy moves beyond business as usual to consider economic development and ocean health as compatible propositions. Blue Economy traditional sectors have great potential for boosting the economic growth by providing direct jobs, employment, food security and emerging innovative Blue Economy sectors, such as ocean renewable energy, blue biotechnology, deep-sea minerals, security etc. SDG Target 14.7 of the U.N. Sustainable Development Goals focuses on enhancing the economythrough the sustainable use of ocean resources.

A blue economy is low-carbon, efficient, and clean. It is also an economy that is based on sharing, circularity, collaboration, solidarity, resilience, opportunity, and interdependence (UNEP, 2015). Its growth is driven by investments that reduce carbon emissions and pollution, enhance the energy efficiency, harness the power of natural capital—such as the oceans—and halt the loss of biodiversity and the benefits that ecosystems provide (UNEP, 2013).

The worldwide ocean economy is valued at around $1.5 trillion per year, making it the 7thlargest economy in the world. It is set to double by 2030 to $3 trillion. The total value of ocean assets (natural capital) has been estimated at $24 trillion.

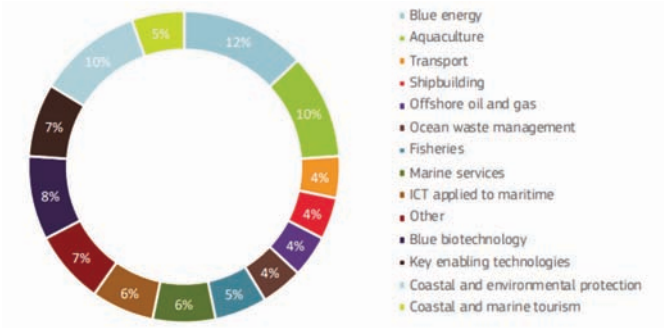


Figure 3: Distribution of companies funded by Blue Invest per sector

Indian Blue Economy: How significant is India's Blue Economy?

India is blessed with an 8129km long coastline spread across nine coastal maritime states, and four union territories (UTs) - including two island UTs, 12 major, and 200 minor ports. There is much potential for India if it leverages the blue economy. The Indian Ocean is abundant with resources, particularly in the sectors of fisheries, aquaculture, fishing, fish processing, ocean energy, sea-bed mining &minerals, and provides tremendous economic opportunities to develop marine tourism, shipping activities and port activities.

India's blue economy is a subset of the national economy, supports 95% of the country's business through transportation and contributes 4% to its Gross Domestic Product (GDP). India is also the 3rdlargest fish producing and 2ndlargest aquaculture fish producing country in the world. The marine sector is the backbone of India's blue economy, becominga 10 trillion dollar economy by 2022. The Indian Ocean is a major conduit of trade with as much as 80% of global oil trade happening through it. Better connectivity in the region will significantly cut the transport cost and maritime wastage of resources making the trade sustainable and cost-effective.

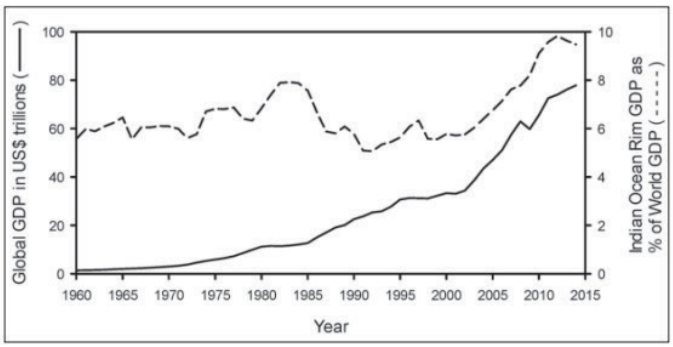


Figure 4: Global GDP (US$) since 1960 and 11% contribution of Indian Ocean nations.

India stands committed to promoting the Blue Economy. Prime Minister Narendra Modi has spoken about it on several occasions at national and international levels. He observed: "To me, the Blue chakra or wheel in India's national flag represents the potential of the Blue Revolution or the Ocean Economy. That is how central the ocean economy is to us." He endorsed Blue Economy as a new pillar of economic activity in the coastal areas through sustainable use of marine resources and announced his vision for the seas through "Security and Growth for All in the Region" (SAGAR).

Developments initiated by Indian

1. **Sagarmala Project:** The concept of Sagarmala was approved by the Union Cabinet on 25th March 2015 and released by the Hon'ble Prime Minister, on 14th April 2016 at the Maritime India Summit 2016.
2. This flagship programmeislaunched by the Ministry of Shippingto promoteport-led developmentfor the modernization of ports. The development of Coastal Economic Zones (CEZ) under Sagarmala would become a microcosm of the blue economy, wherein industries and townships that depend on the sea will contribute to global trade.
   - **Goal:** develop Inland waterways and coastal shipping which will revolutionize maritime logistics, createmillionsof new jobs, reduce logistics costs etc.
   - In addition, Sagarmala aspires to reduce carbon emissions from the transportation sector by 12.5 MT/ annum.
   - Sagarmala aspires to reduce logistics costs for EXIM and domestic cargo leading to overall cost savings of INR 35,000 to 40,000 cr. per annum.
   - It focuses on the development of coastal communities and people in the sustainable use of ocean resources, modern fishing techniques and coastal tourism.
   - India has an umbrella scheme named O-SMART, which aims to regulate the use of oceans and marine resources for sustainable development.
3. Integrated Coastal Zone Management focuses on the conservation of coastal and marine resources, improving livelihood opportunities for coastal communities etc.
4. India has a National Fisheries policy for promoting the 'Blue Growth Initiative' which focuses on sustainable utilization of fisheries wealth from marine and other aquatic resources.
5. The maiden Maritime India Summit 2016 in Mumbai witnessed investment commitments of nearly INR 83,000 crore (US$ 13 billion) in the shipping, ports and allied sectors.

The Government of India's Vision of New India by 2030 highlighted the Blue Economy as one of the ten core dimensions of growth. Additionally, the Indian Ocean Region is of strategic importance to India's economic growth as most of the country's oil, and gas is imported through the sea.

Challenges to the Global Blue Economy:

The key component of the blue economy is the need to balance the economic, social, and environmental dimensions of sustainable development with the ocean. It is also a difficult balance to reach in practice, given that marine resources are limited and oceans health has drastically declined due to anthropogenic activities—ranging from damage caused by Co_2 emissions to nutrient, chemical and plastics pollution, unsustainable fishing, habitat destruction, and the introduction of invasive species. Some common following challenges,

Sustainable use of ocean resources – The natural capital of many marine and coastal ecosystems have been degraded, impacting the provision of services and livelihoods. Approximately 20% of the world's coral reefs have been lost and another 20% degraded. Mangroves have been reduced to 30-50% and it is estimated that 29% of seagrass habitats have disappeared since the late eighteen hundreds. Currently, only some 2% of our oceans are protected, despite the CBD / WSSD 2012 target of a representative 10% area, whereas approximately 12% of terrestrial areas are under protection.

Food security – The "blue economy" is critical to food security and the fight against poverty. Over 3 billion people depend on marine resources for their livelihoods, and marine fisheries directly or indirectly employ over 200 million people. The fisheries and aquaculture sector is a vital source of livelihoods, nutritious food and economic opportunities, and has a key role to play in meeting one of the world's greatest challenges: feeding a population set to rise to 9.6 billion people by 2050. Fisheries and aquaculture play a significant role in eliminating hunger, promoting health and reducing poverty.

Unsustainable Fisheries – FAO estimates that approximately 57% of fish stocks are fully exploited and another 30% are over-exploited, depleted, or recovering (FAO, 2016). Fish stocks are further exploited by illegal, unreported, and unregulated fishing, which is responsible for roughly 11–26 million tons of fish caught annually, or US$10–22 billion in unlawful or undocumented revenue.

Habitat destruction – Physical alterations and destruction of marine and coastal habitats and landscapes due largely to coastal development, deforestation, and mining. Coastal erosion also destroys infrastructure and livelihoods.

The threat of sea-borne terror – piracy and armed robbery, maritime terrorism, illicit trade in crude oil, arms, drug and human trafficking and smuggling of contraband etc.

Natural Disasters - every year tsunamis, cyclones, hurricanes typhoons etc. leave thousands of people stranded and property worth millions destroyed.

Man-Made problems – Oil spills, and climate change continue to risk the stability of the maritime domain.

Climate change and managing carbon budgets – changes in sea temperature, and acidity, threaten marine life, habitats, and the communities that depend on them. Sea level rise andchange in ecosystem status due to temperature fluctuation, from coral bleaching to impacts upon migration patterns. Relatively new challenges on the agenda, however, are Ocean Acidification and Blue Carbon. The ocean absorbs over 25% of all anthropogenic emissions from the atmosphere each year, resulting in a 26% increase in the acidity of the Ocean. Ocean acidification refers to a reduction in the pH of the ocean, caused primarily by the uptake of carbon dioxide (CO_2) from the atmosphere, which has a significant impact on marine life. This makes it more difficult for marine organisms, such as corals and some plankton, to form their shells and skeletons, and existing shells may begin to dissolve.

"Blue carbon" is the carbon captured in oceans and coastal ecosystems, such as mangroves, tidal marshes and seagrass meadows sequester is more effective at the long-term sequestration of carbon per unit area than terrestrial ecosystem and plays a vital role in mitigating climate change. These "blue carbon sinks" can sequester up to five times the amounts of carbon absorbed by tropical forests. Mangroves have been reduced to 30- 50% of their historical cover and 29% of seagrass habitats are estimated to have been lost in the last 150 years.

Marine pollution – in the form of excess nutrients from untreated sewage, agricultural runoff, and marine debris such as plastics. At least 14 million tons of plastic end up in the ocean every year, and plastic makes up 80% of all marine debris found from surface waters to deep-sea sediments.

Tourism – Marine and coastal tourism are important to many developing countries. Coastal tourism is at the forefront of BE's economic sectors, offering job opportunities or sharing in the Gross Value Added (GVA). Approximately 30% of global tourism activities take place in coastal areas and regions. The coastal tourism sector contributes about USD 220 billion of ocean consumer products and services globally. Tourism brings challenges in terms of increased: greenhouse gas emissions, water consumption, sewage, waste generation and loss or degradation of coastal habitat, biodiversity and ecosystem services.

How can we increase the Blues Economy?

In summary, some of the elements required for the transition to a blue economy include the following.

1. Effective implementation of the principle of the Code of Conduct for Responsible Fisheries (CCRF), well govern & well manage fisheries for long-term contribution to the blue economy.
2. Effective implementation of UNCLOS
3. An assessment of the value of marine resources and their corresponding ecosystem services
4. Increased reliance on evidence-based decision making
5. A framework for ecosystem-based management
6. Improved governance to grow a blue economy
7. New data that can sway decision-makers
8. Broad and resilient partnerships for coordination and collaboration of blue economy projects and initiatives.
9. Innovative financing to direct investments into economic activities that can enhance ocean health.
10. Indicators to measure and track progress.

Conclusion: The Ocean has a role to play in strengthening resilience to economic and environmental disruptions. Investing in shipping decarbonisation, sustainable seafood production and ocean-based renewable energy provide for better outcomes, richer biodiversity, more secure jobs and a safer planet for generations to come.

Today, Blue Growth is recognised to be an economic opportunity, source of jobs and driver of sustainable development in the world. Blue economy essentially refers to the multitude of ocean resources available in the country that can be harnessed to aid the production of goods and

services because of its linkages with economic growth, environmental sustainability, and national security.

Blue economy, as a macro economy concept, involves every aspect of national and global governance, economic development, environmental protection and sustainability and international communication. According to Organisation for Economic Co-operation and Development, the blue economy is emerging as an economic force for the 21st century that could generate $3 trillion in revenue for the global economy by 2030.

Challenges in the sustainable use of marine resources—such as the impacts of climate change in the form of rising sea levels, increased frequency of extreme natural events, and rising temperature, have direct and indirect impacts on marine sectors, such as fisheries, aquaculture, and tourism, on maritime transport infrastructure, such as ports, with broader implications for international trade and the development prospects of the most vulnerable nations.

For increasing the blue growth of India, we are recommending the following: installing desalination (freshwater generation) plants; producing renewable marine (off-shore) energy; developing maritime transport; ports and related services; shipping; shipbuilding; waste disposal management etc.

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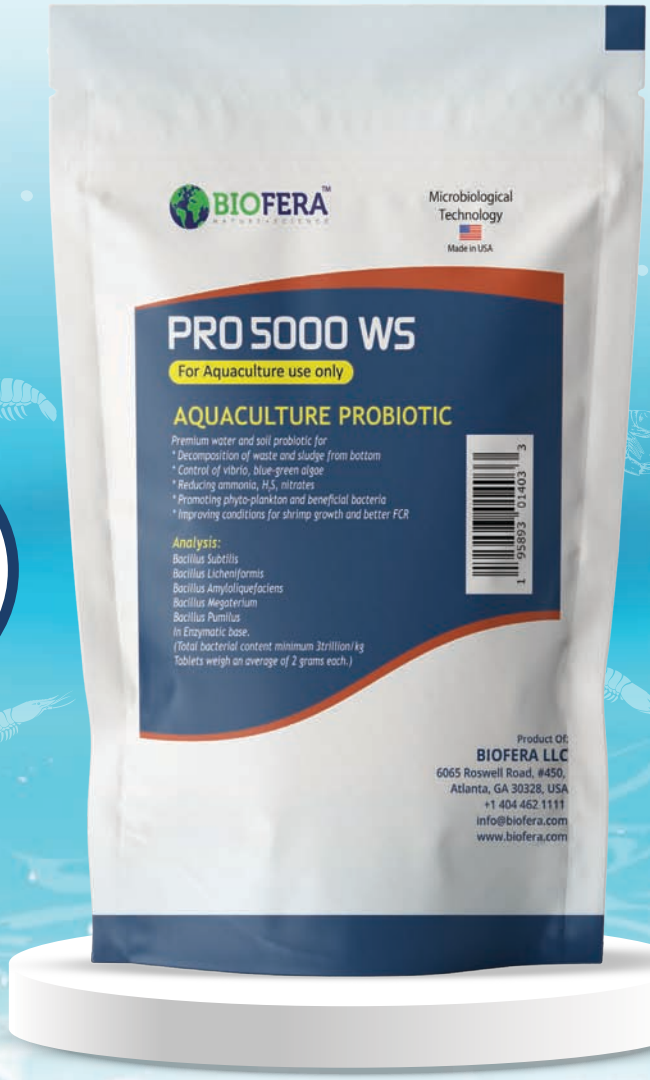

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