English Monthly from Hyderabad, India

Aqua International

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Health • Nutrition • Management • Technology

August 2024

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Inside...


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Aqua International

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M. A. Nazeer

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High hopes for lower fishmeal prices

Aquaculture stands as a growing industry focused on the controlled feeding and maintenance of cultured organisms. However, challenges such as water quality deterioration and pathogen spread leading to farm runoff-induced outbreaks have resulted in substantial financial losses to farmers. To address these issues, the aqua mimicry technique is often employed, facilitating improved production and aligning with the principles of sustainable aquaculture

Dear Readers,

The August 2024 issue of Aqua International is in your hands. In the news section, you may find news about ...

Stable Beaching Powder is an effective, useful and farmers' user-friendly product to achieve proper disinfection in intake water. This product provides right environment for growth of shrimps. While saying so, it is also necessary for farmers to follow right operating practices & techniques to get the most out of SBP. It is always advisable to conduct detailed study of intake water first. Some of the key suggested parameters to be checked would be Chemical Oxygen Demand, Chlorine Demand, Oxidation Reduction potential, Dissolved oxygen etc. A proper disinfection of intake water would be a right baseline for proper growth of shrimps and this can be achieved following right free residual chlorine measurement techniques. Oxidation Reduction potential can be a technique can help in achieving adequate level of free residual chlorine level in water for disinfection. This can also help in optimizing the consumption of SBP yet to get to most out of SBP.

The Fish Farmers Day 2024 was celebrated by Fisheries Department, Government of West Bengal individually in most of the Community Development blocks in District South 24 Parganas on 10 July 2024. It was organized under the Scheme 'Pradhan Mantri Matsya Sampada Yojana. Focusing on production of more ornamental fish incorporating new species; Motivation of more and more rural youths for self employment in ornamental fishery sector; Increase in production of major carps by means of aquaculture by formation of FPGs in a long-term production-oriented view and other things were discussed during the event.

A new study has found that the nitrogen emissions associated with shrimp cultivation can be reduced by pairing the practice with oyster and seaweed farming in an integrated multitrophic aquaculture structure. New research conducted by researchers from the University of New Hampshire (UNH) has found that integrating shrimp aquaculture with the farming of oysters and seaweed – a method known as integrated multitropic aquaculture (IMTA) – can significantly reduce the nitrogen emissions produced during farming. As it stands currently, the demand for shrimp is booming, with much of the demand coming from the global West and being met by an industry largely based in Asia. However, one of the most pressing challenges faced by the shrimp industry in its current state is the lack of environmental regulation, which has led to severe results such as nutrient pollution, harmful algal blooms, and biodiversity loss.

SyAqua Group has announced the acquisition of Primo Broodstock USA, a company that has been known for its pioneering work in the development of specific pathogen free (SPF) and disease-tolerant shrimp lines."This strategic acquisition will not only bolster our existing portfolio but also pave the way for new market opportunities, and most importantly, to protect our strain security with another genetic nucleus and broodstock multiplication facility in the USA," the company stated in a press release.Primohas a strong legacy, according to SyAqua, as the first genetics company to use SPF vannamei populations out of Ecuador to address disease challenges in major markets like Mexico and China.

A novel genetic method for fisheries management Researchers at the AZTI Technology Centre have developed a genetic method for the rapid identification of prey species found in fish stomachs, facilitating greater understanding of

Contd on next page

Aqua International

Our Mission

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

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

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

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

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

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prey inventories and species interactions. Under directives such as the European Marine Strategy Framework, fisheries management for EU countries must ensure the sustainability of fish populations. In recent years, this management has started moving towards the more holistic ecosystem-based approach, which not only considers the abundance of the stock and the fishing pressure it is subjected to, but also how the species interacts with the other species in the ecosystem.

High hopes for lower fishmeal prices. The year' first anchovy season in Peru's north-central fishing zone ended in June with more than 98 percent of the quota fulfilled, according to the latest figures from IFFO - offering hope for a reduction in fishmeal and oil prices."The marine ingredients industry sees this as a very positive sign for the fishing and feed sectors, considering that Peru accounts for around one-fifth of global fishmeal supply in an average year.

Despite being a historic food staple in the Southern US, a myriad of challenges over recent years have stunted the growth of the catfish farming industry in Texas.Catfish has long been a staple food in the Southern United States and is a common sight at fish fries and barbecues alike. However, over the last two decades, the catfish aquaculture industry has received blow after blow, resulting in almost negligible growth.Stagnation of market prices, changes in customer preferences, increased production costs, and increased foreign competition have all contributed to the effects felt by the industry, according to Dr Todd Sink, Texas A& M aquaculture specialist.

Aker BioMarine has announced the sale of its feed ingredients business for USD 590 million, following its decision to focus on human health.The unit, which largely focuses on capturing Antarctic krill for use in aquafeeds, was acquired by American Industrial Partners (60 percent) and Aker Capital (40 percent)."We are pleased to announce the new ownership position for the feed ingredients business. This transaction is the result of a process that attracted interest from a wide range of reputable parties and not only demonstrates the value of feed ingredients but also underscores the value potential of Aker BioMarine as a whole," said Matts Johansen, CEO of Aker BioMarine, in a statement.

In the Articles Section, From Concept to Reality: Aquamimicry's Impact on Aquaculture Advancement authored by M.Porkodi, J.Rujan and S.Felix, said that in today's world, aquaculture stands as a growing industry focused on the controlled feeding and maintenance of cultured organisms. However, challenges such as water quality deterioration and pathogen spread leading to farm runoff-induced outbreaks have resulted in substantial financial losses to farmers. To address these issues, the aqua mimicry technique is often employed, facilitating improved production and aligning with the principles of sustainable aquaculture. This method is recognized for its environmental friendliness and favorable cost-benefit ratio, supporting economic and social sustainability by boosting production without significantly increasing natural resource usage (such as water and land).

Another Article titled, Role of Phytoplankton in Aquaculture, authored by Gurphale Nikita, Jadhav Amit, Dau Shri Vasudev Chandrakar Kamdhenu Vishwavidyalaya, informed that Phytoplankton is usually in great abundance in ponds. These organisms have a significant impact on the ecology of ponds and the quality of the water. Even though phytoplankton is generally beneficial, there are certain situations where it can be quite problematic for the growth of fish and shrimp. There are just a few things needed for phytoplankton to grow: water, light, an ideal temperature, and inorganic nutrients. There are species of phytoplankton that can flourish in almost any type of water because there is such a huge variety of them. Aquaculture organisms must get all of their nutritional needs from the food they consume, with the exception of a portion of their mineral needs. Phytoplankton is the primary source of food for many larval organisms.

Another Article titled ***Exploring Fisheries Cooperative for improving livelihood of fishers in India*** authored by Krishnaveni K.N, Lavanya K, Rajalakshmi, said that the fisheries cooperative system in India was devised with a view to providing assistance to the actual producers, the fishers. Fisheries co-operative societies are governed by a separate set of rules to channel government assistance on the principles of self-help and democratic management. Fisheries cooperative in which the people involved in the fishing industry pool resources, in their certain activities from farming, catching, distribution, and marketing of fish. The ultimate aim of the co-operative society is to contributing the socio-economic development of the fishers. Presently, there are one national leveI federation, 7 state level federations, 108 central Ievel federations and 12,427 primary fishery societies functioning in India. India has abundant fishery resources with great potential for substantial progress. Fish base mentions that 862 species of freshwater fish are found in India. A total of 788 marine fish species landed along Indian coasts in 2017.

Another Article titled ***3D FOOD PRINTING - NOT JUST FUN, BUT "FUN"CTIONAL*** authored by Rasheeda. M, Mohan, C. O, Remya, S, Bindu, J, informed that 3D food printing, also known as additive manufacturing is a novel technology which can fabricate food formulations in complicated design of consumer choice. It can combine multiple ingredients to develop foods to impart functionality as per individuals requirements. 3D printing can help in eradicating malnutrition by supplying designer foods of attractive shape and designs Fish is one of the ideal ingredient for 3D food printing due to its exceptional nutritional profiling. Three-Dimensional (3D) Food printing technology, a new star risen in the horizon of food industry, has been striding forward, in the realm of future foods.

Another Article titled ***Smart Aquaculture: How IOT Innovations Drive Energy Efficiency, Financial Savings and Yield Optimization*** authored by M. Porkodi and S.Felix**,** said that the increasing understanding of the nutritional benefits provided by seafood has contributed to a global surge in demand for it in recent years. Aquaculture farmers face great difficulty in meeting this demand while they have to increase production without sacrificing product quality. However, Internet of Things (IoT)-based system for monitoring water quality can be used to improve aquaculture productivity to address this problem. The technology ensures ideal conditions for aquatic life and minimizes waste generation by remotely monitoring and controlling the water quality parameters. Farmers can control and observation of the aqua farming process can be done remotely from any location in the world with the help of an Internet of Things (IoT)-based water quality monitoring device. The system keeps an eye on the salinity, pH, temperature, and dissolved oxygen levels in the water.

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Fish Farmers Day 2024 celebrated in South 24 Parganas, West Bengal

Matsya Karmadhyaksha, South 24 Parganas Zilla Parishad speaking

The Fish Farmers Day 2024 was celebrated by Fisheries Department, Government of West Bengal individually in most of the Community Development (CD) Blocks in District South 24 Parganas, West Bengal on 10 July 2024. It was organized under the Scheme 'Pradhan Mantri Matsya Sampada Yojana (PMMSY)'. In each Block, programme was organized in presence of Block Development Officer of respective Block, Joint BDO, Panchayat Samity Savapati, Sahakari Savapati, Karmadhyaksha of Matsya o Pranisampad Bikash Sthayee Samity, Karmadhyaksha of other sections/divisions, Panchayat Samity representatives, with overall anchoring, coordination and arrangement by Fishery Extension Officer of concerned Block. Total 30 to 70 nos of fish farmers by profession, both progressive and beginners (aqua-entrepreneurs/ youths), male and female from different Gram Panchayats of a concerned Block participated in each such one-day Block level programme. In each Block, total 2 - 5nos of noted progressive and successful fish farmers were awarded on this occasion to motivate them in their achievements and future endeavours. Their success stories were briefed to other participants. In the beginning, dignitaries and invitees were honoured with either ornamental flower saplings or aquarium fish in oxygenated packet. Training Books on Freshwater fish farming (published by South 24 Parganas Fisheries Department), pamphlet and pH paper strips/pH indicator were given to participating fish farmers. Quiz contest on inland aquaculture conducted where participants in the programme participated actively.

Synopsis of the discussion (topics) that took place on the occasion of 'Observation of Fish Farmers Day 2024' in different Blocks may be summarized as: Historical significance of this day 10th July and how it has motivated the latest generation fish farmers; Improvement of culture practice by introducing latest culture techniques; Significance and vision of West Bengal Fisheries Department, discussion on various farmer-oriented schemes with proper application to be made to local Panchayat Body; Focusing on production of more ornamental fish incorporating new species; Motivation of more and more rural youths for self employment in ornamental fishery sector; Increase in production of major carps by means of aquaculture by formation of FPGs in a long-term production-oriented view; Activation of function of those Primary Fishermen Cooperative Societies which are now in inactive condition by introducing new active members; Significance of PMMSY scheme, its components and upcoming target to be achieved at Block; Sustainable & cost-effective aquaculture techniques and its long term benefit.

Other topics of discussion included: How aquaculture can change rural socio-economic condition of village people in a sustainable manner; Air-breathing fish culture; Integrated fish farming with low budget as well as with ornamental fish; Importance of conservation

S. Ghosh speaking on induced fish breeding

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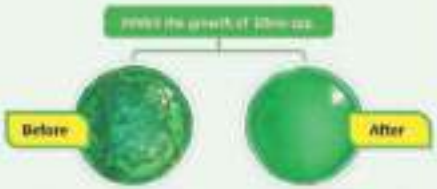

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* COMPOSITION:

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

* STORAGE:

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* DIRECTION OF USE:

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UNI-LIGHT PSB Funtion:

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

***Dosage can be adjusted according to the water conditions and practice.

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Grow-out carp culture in large freshwater body in Purba Medinipur

of wetlands; Extension and development of fishery and aquaculture; Necessity of adoption of scientific technology in fish farming; Matsyajibi Credit Card, Fisherman Identity Card and other schemes of West Bengal Fisheries Department; Prospects of brackishwater aquaculture with special reference to mud crab culture and *L. vannamei* culture; Encouraging fish farmers to form Fish Production Groups; Means of increasing overall fish production of Block, especially big fish production by practicing scientific (improved) fish culture techniques; Awareness regarding ban on the use of antibiotics and its detrimental effects on aquaculture; Sensitization regarding use of probiotics in aquaculture; Sensitization regarding Fishermen Registration and MJCC schemes; Focus on other State Government Schemes in fisheries and aquaculture; Sensitization regarding release of guppy in stagnant water bodies to combat vector-borne diseases, especially in rainy season; Practical demonstration on use of pH paper for detecting pond water pH; Present constraints and difficulties faced by fish farmers in fish farming and possible means to overcome them.

Discussion was also made on topics covering: PMMSY- application process, eligibility criteria, subsidy claim and other aspects; Importance of maintaining pH and other physico-chemical parameters in freshwater and brackishwater aquaculture ponds; Future project planning on increasing production of indigenous & rare fish species through FPGs and involvement of more women in fisheries sector; Discussion on relationship of fish farmers with bank officials for availing loan; Debate on sustainable brackishwater aquaculture without mangrove area destruction; Planning on increasing the extent of Integrated Farming (with organic vegetables farming and poultry) throughout Block; Monosex Tilapia culture and ornamental fish culture in pond for more profit; Benefits of FPG formation; Awareness regarding Matsya Jeebi Bandhu and Samudra Sathi schemes; Awareness regarding marine fishery rules & regulation; Towards successful implementation of development schemes of Fisheries Department at Block; Initiative on ornamental fish farming in some under-developed areas of Block; Focus on paddy-cum-fish farming and emphasis on giant freshwater prawn farming in ponds and freshwater canals.

On this occasion, News communicator Subrato Ghosh made a short audio-visual Presentation on 10 July 2024 afternoon at Bishnupur-II CD Block. He focused on contributions of Late Nilu Ghosh in hatchery-oriented fish seed production and few noted, elderly, progressive and experienced grow-out fish farmers of West Bengal in production and supply of big-sized major carps, new candidate fish species of commercial importance in inland aquaculture and newer fish farming systems. Scientific contributions of Late Dr Hiralal Chaudhuri and his epoch-making discovery of Induced fish breeding 67 years ago were also commemorated.

A novel IMTA approach to shrimp farming

A new study has found that the nitrogen emissions associated with shrimp cultivation can be reduced by pairing the practice with oyster and seaweed farming in an integrated multitrophic aquaculture (IMTA) structure.

New research conducted by researchers from the University of New Hampshire (UNH) has found that integrating shrimp aquaculture with the farming of oysters and seaweed – a method known as integrated multitropic aquaculture (IMTA) – can significantly reduce the nitrogen emissions produced during farming.

As it stands currently, the demand for shrimp is booming, with much of the demand coming from the global West and being met by an industry largely based in Asia. However, one of the most pressing challenges faced by the shrimp industry in its current state is the lack of environmental regulation, which has led to severe results such as nutrient pollution, harmful algal blooms, and biodiversity loss.

"Much of the shrimp we consume comes from overseas, where they don't need to follow the same environmental regulations as we do here in the U.S.," said Elizabeth Martin, the lead researcher of the study, in a press release.

Seeking to drive change within the shrimp industry, and move farming practices towards a more

UNH researcher Elizabeth Martin testing water samples

environmentally conscious approach, Martin and her fellow UNH researchers devised a study to test the ability of oysters and seaweed to absorb the excess nitrogen released during shrimp farming.

"We had three treatments – shrimp with the seaweed, shrimp with the seaweed and an oxygenator, and shrimp with the seaweed and oysters," said Martin.

"What we found was that the final treatment, the shrimp with the seaweed, which absorbs and stores nitrogen, and the oysters resulted in a reduced level of nitrogen -including ammonia, nitrite and nitrate - over time," she explained.

Not only would this novel approach improve the environmental impact of shrimp aquaculture, but it may also provide the opportunity for farmers to diversify their operation, with oysters and seaweed being a valuable by-product.

Courtesy: The Fish Site.

Scottish Sea Farms hosts Young Aquaculture Society visit

Nineteen members of the newly formed Young Aquaculture Society (YAS) visited three of Scottish Sea Farms' salmon facilities this week.

YAS members prepare to visit Scottish Sea Farms' Charlotte Bay salmon site

The YAS members included representatives from Aquascot, Bakkafrost, Cefetra, Moredun, The Roslin Institute, University of Glasgow, University of Stirling and WJ Knox, along with Salmon Scotland and Scottish Sea Farms.

The day-long visit, the first of its kind since YAS was officially launched by Scottish Labour leader Anas Sarwar at Aquaculture UK in Aviemore in May, began with a tour of Scottish Sea Farms' Barcaldine Hatchery, near Oban where the group learned about the incubation process and how salmon are nurtured from eggs to smolts.

This was followed by a Q&A session with the company's head of sustainability and development, Anne Anderson, focusing on the synergy between fish health and responsible farming practices.

The group, made up of young professionals from across the supply chain, research institutes, universities, producers, and sector body Salmon Scotland, were then hosted out on nearby grow-out farm, Charlotte's Bay.

There, under the guidance of long-serving farm manager Stephen Woods, the group were shown the camera-monitored feeding systems, fish welfare measures, and technology used to monitor water quality.

Completing the salmon lifecycle, the final leg of the inaugural tour took in Scottish Sea Farms' processing and packing facility at South Shian, where head of processing Donald Buchanan took the group through the company's high-welfare approach to humane harvesting.

Andrew Richardson, founder and president of YAS and technical and standards manager for Salmon Scotland, said the visit offered a valuable insight into the salmon farming sector.

"Because YAS is open to all working in and around the UK's aquaculture ecosystem, many of our members have not been on a salmon farm before. So, we value any opportunities like this for education, professional development, and networking. Scottish Sea Farms, one of the country's leading producers, has been very supportive of these values and this milestone visit has embodied them all."

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Scottish Sea Farms head of freshwater, Rory Conn, agreed that a first-hand view was the best way to learn more about the sector.

"To really understand salmon farming, nothing beats talking to the people who care for the fish daily, and witnessing their level of knowledge, experience, skill and passion. At Barcaldine, we have RAS technology at the cutting edge of aquaculture development and the team always take immense pride in sharing their work here with visitors. We want to give people the opportunity to form their own opinions about what they're seeing, so the more questions they ask and the more inquisitive they are, the better use of time it is for us."

Courtesy: The Fish Site.

Aker Biomarine sells off krill fishing and aquafeed businesses

Aker BioMarine has announced the sale of its feed ingredients business for $590 million, following its decision to focus on human health.

The company was the largest harvester of Antarctic krill on the planet

The unit, which largely focuses on capturing Antarctic krill for use in aquafeeds, was acquired by American Industrial Partners (60 percent) and Aker Capital (40 percent).

"We are pleased to announce the new ownership position for the feed ingredients business. This transaction is the result of a process that attracted interest from a wide range of reputable parties and not only demonstrates the value of feed ingredients but also underscores the value potential of Aker BioMarine as a whole," said Matts Johansen, CEO of Aker BioMarine, in a statement.

Following the transaction, Aker BioMarine says it will focus on human health and nutrition, via three business units: human health ingredients, consumer health ingredients and emerging businesses.

Aker Biomarine is selling off its krill catching and aquafeed assets

Aker BioMarine, which has recently built a dedicated algal oil production line in Texas, has entered into a long-term contract with their former feed ingredients unit for the supply of krill raw materials for the businesses that they have retained.

Courtesy : The Fish Site.

Market stagnancy for Texas catfish industry

Despite being a historic food staple in the Southern US, a myriad of challenges over recent years have stunted the growth of the catfish farming industry in Texas.

The Texas catfish industry has experienced minimal growth, despite high production rates

Catfish has long been a staple food in the Southern United States and is a common sight at fish fries and barbecues alike. However, over the last two decades, the catfish aquaculture industry has received blow after blow, resulting in almost negligible growth.

Stagnation of market prices, changes in customer preferences, increased production costs, and increased foreign competition have all contributed to the effects felt by the industry, according to Dr Todd Sink, Texas A & M aquaculture specialist.

In a little over two decades, the market price of the fish has ranged from 80 cents to $1.20 per pound, whilst feed costs more than doubled to $525 per tonne over the same period.

"There is very little profit margin, and tens of thousands, if not hundreds of thousands, of fish must be sold per year to support a farm enterprise," Sink said, in an article from Agrilife Today.

"Catfish is a product that has not achieved the same market increase with inflation as other products have," he added.

Whilst the stagnation of market price and increase in production costs alone would have a significant impact on the industry, a change in consumer

preferences for higher-value foods has further contributed to the troubles experienced by catfish farmers in Texas.

"People have become more affluent, and their taste in fish has changed over time. Catfish is considered to be a lower-value fish, and now people are trending more toward species they perceive to be of higher value like red drum, hybrid striped bass, corvina and red sea bream from Europe," explained Sink.

For these reasons many producers have chosen to abandon catfish in favour of more lucrative species, whilst others have left the aquaculture profession altogether. This is despite the outward appearance of success within the Texas catfish industry, which ranks amongst the top four catfish producing states in the US.

In light of the industry's continued struggles, federal intervention has helped to support Texan catfish producers in the past. For example, laws requiring correct labelling of imported products gave an edge to domestic catfish producers, and farmers raising fish for consumption can receive government compensation for losses from disease or extreme weather.

Whilst the future of the Texas catfish industry remains unclear, and market stagnancy is not a word that producers are often happy to hear, Sink predicts that, at least, the catfish industry will not sink significantly over the coming years.

Courtesy: The Fish Site.

State of Alaska shows support for Seagriculture USA 2024

The organisers of Seagriculture USA 2024 have announced a partnership with the State of Alaska Department of Commerce, Community, and Economic Development, which aims to support the event whilst adding prestige and resources.

DLG Benelux, the organiser of the Seagriculture conference series, has announced that the State of Alaska Department of Commerce, Community, and Economic Development, will support Seagriculture USA 2024 which is set to take place in Ketchikan, Alaska from 11 – 12 September 2024. The organisers hope that this support will greatly enhance the conference, adding significant prestige and resources to the event.

Since its successful launch in 2022, Seagriculture USA has provided a leading platform for knowledge exchange within the seaweed farming industry. This year, with the support of the State of Alaska, the Alaska Mariculture Cluster, and the Greater Ketchikan Chamber of Commerce, the upcoming edition will build on its previous reputation, cultivating an unmissable event for seaweed industry professionals.

"Thrilled by the opportunity to further develop Seagriculture USA, this partnership brings people in the seaweed sector together. We deeply appreciate the support of the State of Alaska, which adds significant value to our efforts. The team is looking forward to the collaboration and coming to Ketchikan, anticipation for the event is high," said DLG Benelux managing director Kuno Jacobs, in a press release.

Seagriculture USA 2024 promises an exciting array of sessions and site visits

The theme of this year's Seagriculture USA, Exploring New Frontiers, embodies the spirit of innovation and discovery of the seaweed industry's evolution in the United States. It resonates with the pioneering efforts in cultivating seaweed in Alaska's unique environment. It's an invitation to stakeholders from various sectors to come together, share ideas, and forge new paths, aiming to transform challenges into opportunities. This theme is a beacon for collective action, steering the future of the seaweed industry towards sustainable and economically viable paths.

"Seaweed farming holds tremendous economic potential for Alaska, with our businesses and research communities at the forefront of making it a significant economic driver. From best practices for farmers and harvesters to innovative applications for seaweed, and efforts to build a global market for seaweed products, the dialogue at Seagriculture USA is impactful and propels the industry forward," said Jim Andersen, a State of Alaska representative.

"Alaska's commitment to economic development through the seaweed industry underscores the importance of attracting partners from overseas to collaborate and invest in our region, fostering growth and sustainability for years to come," he added.

Whilst the conference programme is still being finalised, the organisers are already promising an exciting array of sessions and site visits, alongside a trade show and networking events. More information on the Seagriculture USA 2024 programme can be found on the event website.

Courtesy : The Fish Site.

Success for seafood apprenticeship programme

The first set of students to participate in a new South Carolina seafood apprenticeship programme have successfully completed the course, and now aim for careers in the fisheries and aquaculture sector.

The month-long course aimed to match apprentices with industry careers

The first intake of the new South Carolina Commercial Seafood Apprenticeship Programme recently completed the course, and are now aiming to land jobs in the fisheries and aquaculture sector. The group of six participants met daily in a classroom at a former public school in the fishing village of McClellanville, where they learned about everything from seamanship and business marketing, to shellfish rearing and small-engine maintenance.

The programme, organised and hosted by the South Carolina Sea Grant Consortium, aims to match students up with industry jobs when they finish the course. According to programme co-director Jocelyn Juliano, the students were extremely keen to get started in the industry.

"They are so eager to get started – they want to jump right in. Next time, we want to have job descriptions ahead of time from industry members looking to hire so the participants can meet the business owners right away and set up some jobs," said Juliano, in a press release.

South Carolina's seafood industry currently faces challenges including an aging workforce, aging dock space and facilities, competition from imported seafood, and development pressures that threaten marine ecosystems. The apprenticeship programme, which is supported by NOAA's National Sea Grant Office, aims to work towards solving these problems by encouraging young people to join the South Carolina seafood industry says *The Fish Site.*

SyAqua buys up Primo USA

SyAqua Group has announced the acquisition of Primo Broodstock USA, a company that has been known for its pioneering work in the development of specific pathogen free (SPF) and disease-tolerant shrimp lines.

"This strategic acquisition will not only bolster our existing portfolio but also pave the way for new market opportunities, and most importantly, to protect our strain security with another genetic nucleus and broodstock multiplication facility in the USA," the company stated in a press release.

Primo has a strong legacy, according to SyAqua, as the first genetics company to use SPF vannamei populations out of Ecuador to address disease challenges in major markets like Mexico and China.

"This acquisition allows us to tap into robust and well-established genetic resources while significantly expanding our US genetic nucleus and broodstock multiplication facilities," stated SyAqua.

"SyAqua now has the potential to tap new genetic stocks developed over years of selective breeding for disease tolerance. This strategic move opens potential for more innovative selection strategies that will bring our customers enhanced performance even in the most challenging production environments. We anticipate a significant increase in supply of our US broodstock production capacity by the end of 2024, targeting potential production of more than 230,000 broodstock per year," they add.

SyAqua has operations in India, Indonesia, Malaysia, Thailand and the USA

Meanwhile SyAqua says that it is continuing to refine its biofloc-based raceway production technologies.

As the company stated: "The acquisition of Primo enriches our genetic resources, aligning with our vision of business sustainability and our commitment to managing environmental impact of the blue economy, particularly in Asian shrimp farming.

"Furthermore, our alliance with Ocean 14 Capital Fund strengthens our dedication to sustainable practices and innovative solutions in aquaculture."

Mr A. Ramakrishna, Hatchery Techincian at Tuni informed *Aqua International* that the seed produced will be supplied in India too.

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:
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ALOEVERA
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BACILLUS POLYMIXA
BACILLUS LICHENIFORMIS
NITRASOMONAS
NITROBACTOR
STABILIZERS

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A novel genetic method for fisheries management

Researchers at the AZTI Technology Centre have developed a genetic method for the rapid identification of prey species found in fish stomachs, facilitating greater understanding of prey inventories and species interactions.

Under directives such as the European Marine Strategy Framework, fisheries management for EU countries must ensure the sustainability of fish populations. In recent years, this management has started moving towards the more holistic ecosystem-based approach, which not only considers the abundance of the stock and the fishing pressure it is subjected to, but also how the species interacts with the other species in the ecosystem.

For fisheries management plans to be able to take such a holistic approach, a better understanding of the trophic relationships in the marine environment and how they vary spatially and temporally is required.

The method has been validated for five commonly fished species, including mackerel, sardine and anchovy

This knowledge has been historically obtained through visual inspection of the stomach contents, which is a time-consuming task that requires high taxonomic expertise.

In response to this problem, a multidisciplinary team from the AZTI Technology Centre composed by genetics, marine ecology and ecosystem modelling experts, has developed and validated a novel method to facilitate and speed up the collection of trophic data for five highly commercial species in the Bay of Biscay: anchovy, sardine, hake, horse mackerel, and mackerel.

The researchers developed a protocol for the DNA analysis of the stomach contents of the commercial fish species, allowing the analysis of hundreds of samples simultaneously and the construction of a prey inventory for each species. This novel method has been shown to outperform visual inspection by identifying a wider range of prey, including fast-digesting prey such as jellyfish, usually overlooked by visual analysis.

"Our method represents a precise and reliable way to collect information on who eats whom and with what preference in the ocean - key data to increase our knowledge on the trophic structure of marine ecosystems," says Oriol Canals, a marine genetics expert at AZTI, in a press release.

"Moreover, this genetic method is not only applicable to the five species studied, but can also be easily adapted to other species," he added.

Courtesy : The Fish Site.

High hopes for lower fishmeal prices

The year' first anchovy season in Peru's north-central fishing zone ended in June with more than 98 percent of the quota fulfilled, according to the latest figures from IFFO - offering hope for a reduction in fishmeal and oil prices.

"The marine ingredients industry sees this as a very positive sign for the fishing and feed sectors, considering that Peru accounts for around one-fifth of global fishmeal supply in an average year. A second fishing season will take place later in the year, based on independently set quotas taking into account the size of the biomass," IFFO stated in a press release.

Peru generally accounts for 20 percent of global fishmeal supplies

The high quota fulfilment helps to explain why cumulative fishmeal production in the countries analysed in IFFO's report.

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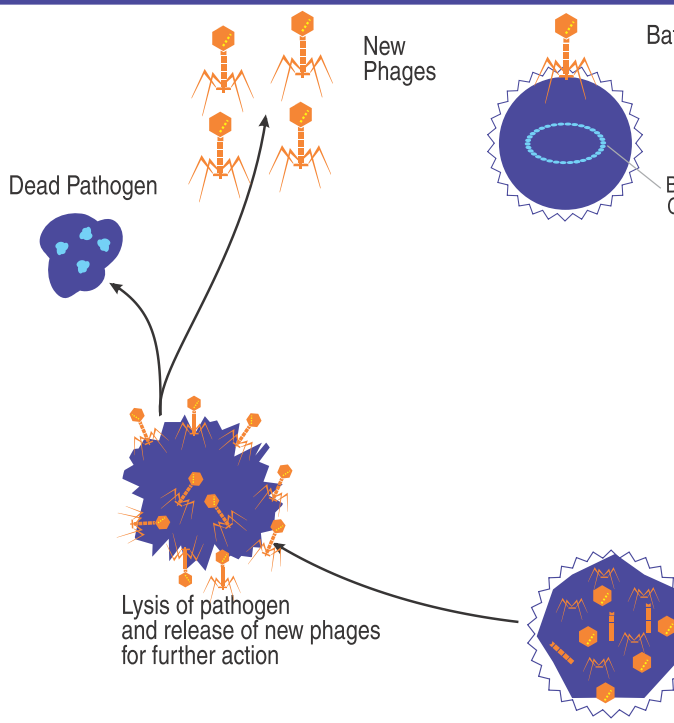
ILLUSTRATION OF ACTION OF PHA



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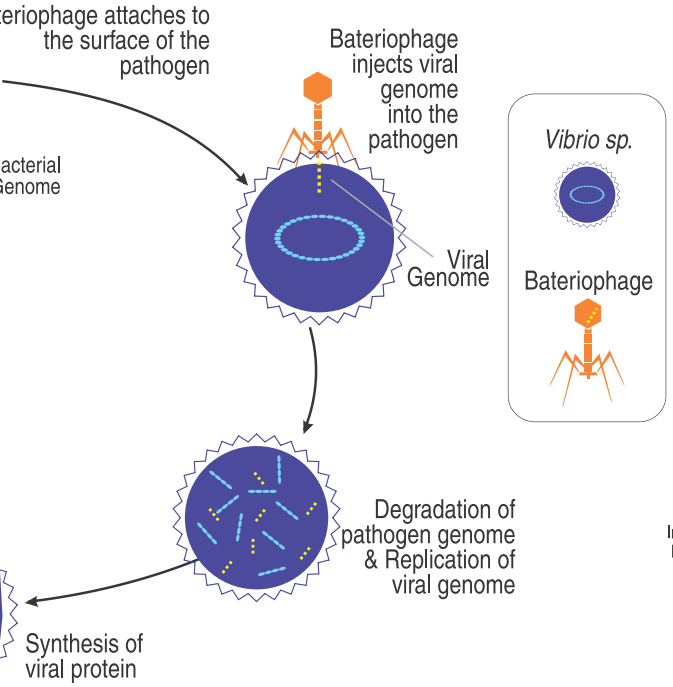

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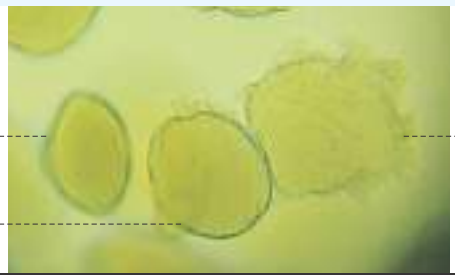
Stages of *Vibrio sp.* colonies infected with Bacteriophages & Progressive Lysis observed on an Agar plate, under Stereo Microscope



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

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

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

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In the first five months of the year increased by 40 percent compared to the same period in 2023.

When it comes to fish oil, cumulative output through May 2024 was approximately 10.8 percent higher year-over-year, again driven by the increased supply from Peru. All other regions analysed in this report showed a decline in their supplies of fish oil in comparison to the first months of the year 2023.

China's challenging conditions

Meanwhile, in China, a nationwide fishing ban running from May to mid-September is preventing the usage of wild captured fish for the production of fishmeal and fish oil, while the use of frozen fish is currently minimal due to the high prices of the raw material.

According to IFFO, cumulative imports of marine ingredients are decreasing, confirming the challenging conditions prevailing in both the pig and aquaculture markets.

Aquafeed production in the first half of the year 2024 remains below the amount reported during the same period in 2023. Despite some recent improvements in the farm-gate prices for certain farmed species, the reduced aquaculture activity in the first five months of 2024 might further weaken the demand for feed ingredients in the next quarter when most of these species will enter the grow-out phase, says *The Fish Site.*

Open letter calls for Norwegian salmon farming restrictions

An open letter to the Norwegian government calls for a ban on the sourcing of fish oil from West Africa following claims that the Norwegian salmon industry contributes to food insecurity in the region.

A recent report estimates the Norwegian salmon industry drives the extraction of 2 million tonnes of wild fish annually

Nearly 40 organisations have signed an open letter calling on the Norwegian government to ban the country's salmon farming industry from sourcing fish oil from West Africa. Signatories include groups from West Africa representing the region's small-scale fishing sector, which is suffering from the impacts of overfishing, in part driven by the production of fishmeal and fish oil for the global aquaculture industry.

The letter comes in the wake of a report from Feedback – an environmental campaign group – which claims that the Norwegian salmon farming industry contributes to food insecurity in the region.

"The fishmeal industry is a serious threat to food security and the future of fisheries in West Africa. This industry plunders our marine resources to feed intensive aquaculture in Asia and Europe, when local populations need it for their own food," said Greenpeace Africa senior campaign manager Dr Aliou Ba, in a press release.

"It is time that the fish of the poor stopped feeding the fish of the rich. Our oceans and our people deserve better," they added.

Fish oil is a common ingredient found in aquafeeds for salmonids and other aquaculture species, with the Norwegian industry sourcing a significant percentage of its fish oil from the West African region. The report calls out four major aquafeed producers – Mowi, Skretting, Cargill, and Biomar – all of which source fish oil from West Africa. According to Feedback, the fish used to produce the fish oil consumed by Norwegian salmon farms could have been used to feed up to 4 million people for a year.

In the open letter to the Norwegian government, the 39 signatories also call for Norway's leadership to stop further growth in the country's salmon farming sector and to mandate genuine transparency throughout corporate supply chains.

"The aquaculture industry claims that they feed the world's population when, in reality, they are taking away the livelihood of those who already have the least, the same people who are most affected by the disproportionately large greenhouse gas emissions of the Western countries. The politicians have to wake up, and take action regarding the feed production for the Norwegian aquaculture industry," said Gytis Blaževičius, leader of Young Friends of the Earth Norway, according to ***The Fish Site.***

Lesaffre Reinforces its Presence in Savory

Ingredients Market by Acquiring Dsm-firmenich's Yeast Extract Business.

Lesaffre, an independent key global player in fermentation and microorganisms, announces today the signing of a transaction with dsm-firmenich, a leading innovator in nutrition, health and beauty, regarding its yeast extract business.

Lesaffre and dsm-firmenich have reached agreement for a multi-part collaboration in yeast derivatives serving the savory ingredients space. Lesaffre will acquire dsm firmenich's yeast extract go-to-market organization and know-how, enabling production of dsm-firmenich's yeast extract products in Lesaffre's global manufacturing network.

This acquisition of talent and know-how and a technology partnership with dsm-firmenich will strengthen Lesaffre's trajectory in the savory ingredients market, bolstering its current R&D expertise and expanding its range of high-quality products. Acquiring dsm-firmenich's yeast extract processing technologies will enable Lesaffre to better serve customers in savory and other fermentation-based applications.

It is a transformative strategic step for **Biospringer by Lesaffre,** a global provider of innovative natural origin solutions from yeast fermentation. Biospringer will offer to its customers a wider range of products and solutions to improve taste, texture, and other desired properties in their various food applications.

For Brice-Audren Riche, CEO of Lesaffre, "This transaction completely fits in our strategy to become a true global specialist in yeast extracts and derivatives for the savory ingredients market. Close to our customers on all continents, we develop tailored solutions fitting to local cultures, consumer tastes and market trends. To maintain excellence in biomanufacturing, we also have invested in the last few years in new biosciences technologies including high-throughput strain screening. The collaboration with dsm-firmenich will help us keep pace in an ever-progressing industry and allow us to expand our business by integrating great people and new in-house supply capabilities. We very much look forward to welcome dsm-firmenich employees within our Group to pave with them the way for sustained growth and expanded customer diversification."

For Patrick Niels, dsm-firmenich BU President Taste, Texture & Health, "With a similar history of more than 150 years of purpose driven biotechnology R&D and innovation, to nourish people and our planet, we have found the perfect home for our yeast extract business and those employees who will join Lesaffre, where they will have the opportunity to further develop their careers. With this transaction, our customers are ensured of continuity of supply of the products and product brands they like and are used to - but now as part of Lesaffre's portfolio of innovative food solutions. We look forward to continuing to work closely with Lesaffre on the development of yeast extract knowledge and expertise through the technology partnership agreement".

dsm-firmenich is a Swiss-Dutch company, listed on the Euronext Amsterdam. Lesaffre and dsm-firmenich hope to close the transaction by the end of the year. Closing remains subject to the customary regulatory approvals and works council consultations at dsm-firmenich.

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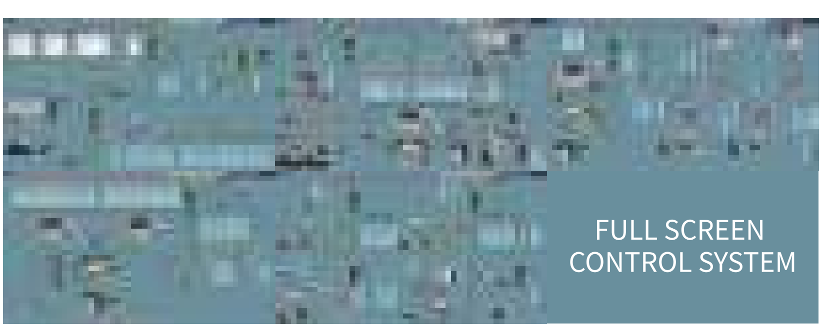

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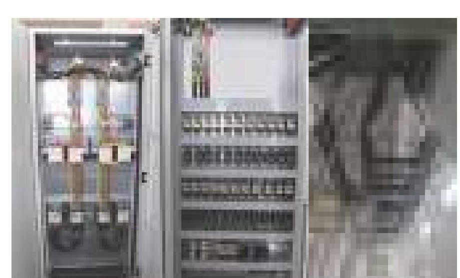

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Stable Bleaching Powder (SBP) an effective & useful disinfectant product; provides disease free water to Shrimps & facilitates high crop yield in Shrimp farming

Authors: Rajendra Parab, Chandrashekhar Kubal and Mehul Patel

Introduction:
Shrimp farming sector is one of the fastest growing segment in India today. This segment has widely spread across Indian coastal line. It involves raising of shrimps in an organized & professional manner to sell them as a food in domestic and international market. Shrimps carefully grown to a particular size and weight to attract better selling value.

Over the years, the Indian shrimp farming process have gone through various operational modifications. This is to overcome the difficulties & problems faced while shrimps grown in farming. Disease attack is one of such difficulty faced by famers across India. To achieve successful shrimp farming and protecting shrimps from disease, proper operational practices are prime necessary to follow. Disinfection of intake water to provide a safer environment to growing shrimps is one of such crucial activity. Stable Bleaching Powder (SBP) has proved to be the best economical yet safer product over the years in providing effective disinfection of intake water in which the shrimps are cultivated. A chlorine based Stable bleaching powder product has a strong ability to kill troublesome microorganisms present in intake water and provide a safer water quality to facilitate the healthy & high growth of shrimps. This paper discusses the proper handling &

proper utilization of this effective Disinfectant product to become the best friend of farmers and improving shrimp production yield in their farming.

Why Stable Bleaching Powder is a preferred choice?
Chlorine & chlorine-allied products are the most widely used disinfectants in various cases over several years globally. All the halogens from periodic table possess biocidal properties, however among them Chlorine is a popular, readily available and cheapest.

Many water treatment bodies worldwide consume chlorine in treating drinking water. Chlorine effectively kills various types of microorganisms from water.

Chlorine gas feeding & handling in aquaculture ponds is a high risk:
While Chlorine is a popular choice, regarding the use of gaseous Chlorine at shrimp ponds, one need to be extreme careful about and possibly avoid of using it at aquaculture ponds. Chlorine at ambient conditions observed as greenish-yellow gas with an irritating odor. It is about 2.5 times heavier than atmospheric air. Any mishandling or an unfortunate incident can lead to fatality. At Shrimp pond farming locations, we do not commonly see the availability of highest standards of safety infrastructural facilities, thus one need to think twice before opting to dose gaseous chlorine in shrimp pond and maintaining chlorine containers at farming area. In addition, it is utmost necessary for each of us to understand and strictly follow the policies & guidelines laid down by our various government & safety regulatory authorities on gaseous chlorine handling.

Stable Bleaching powder (SBP):
Among the currently market available disinfectant products, Stable bleaching Powder is most preferably used in aquaculture ponds across india due to its readily availability, low purchasing cost and user-friendly properties.

SBP is in various use to humankind since last many years. History references state that SBP widely used during First World War time for preventing spreading infectious dieses emerged out of war situation.

SBP is an inorganic compound baring Ca(OCl)2 chemical formulae. It is commercially and widely known as Stable Bleaching Powder in India. This white colored powdery solid- state compound offer around 35% Chlorine to user. It carries pungent chorine smell.

Chlorine gas and hydrated lime are the major compounds with which Stable Bleaching Powder manufactured in large industries. The right quality of hydrated lime & chlorine along with professionally managed manufacturing process plays a crucial role in producing superior quality of SBP product. This ensures an elimination the presence of

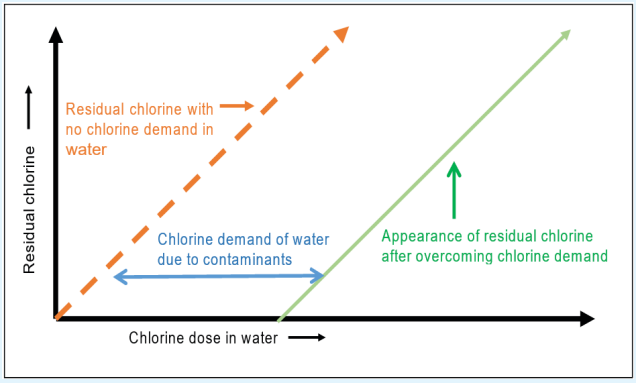
heavy metals in final product and thus providing safer water quality to shrimp and ultimately a safer food to the consumers.

Stable Bleaching powder reaction with water:

SBP when reacts with water, decomposes to liberate Chlorine. Chlorine is an excellent biocide as its strong oxidizing nature, pulls in electron while the victimized bacteria loses electron. Chlorine attack microorganisms by oxidizing cellular structure, passing through the cell wall and disturbing its metabolic activities. This killing mechanism arrest developing immunization effect by these microorganisms over chlorine and its allied products. That is why these products commonly used for disinfection over several years and yet they are still very effective against the microorganism. Chlorine and its allied products including Stable Bleaching Powder are called as oxidizing biocides

Right way of achieving residual chlorine from stable bleaching powder:

Generally, proper measurement of residual Chlorine, its monitoring and maintaining in pond water, help disinfecting water properly. Enough residual level of chlorine in water most times kill microorganisms present in pond water. This facilitates proper growth of shrimps in pond. At field site, there are couple of field test methods followed by farmers for measuring residual chlorine level in pond water. Sometimes some of these Free Residual Chlorine (FRC) measurement techniques does not differentiate free residual and combined residual of chlorine in water at absolute level. In such cases, it gives high residual chlorine values and bring satisfaction at farmer's end, however this can be misleading. This Combined Residual Chlorine (CRC) is observed when we feed Chlorine (through SBP product) reacts with contaminants present in water. These contaminants present in water eat up all the chlorine, we dose. This consumed chlorine for oxidizing contaminants present in water is not available for effective killing of microorganism. The amount of chlorine requires oxidizing inorganic & organic contaminants present in water called as "chlorine demand" of water. Such high presence of contaminants in water generate high chlorine demand and warrants higher quantity dosing of SBP product. There are some of geographical areas in our country, where nearby industrial effluent and city sewage water is being discharged in such creek water and unfortunately, the shrimp farming intake water location are also nearby to it. This create a high risk of contaminants entering in pond water and abnormally increasing chlorine demand of water. Some time, we also see that the shrimp pond water after harvesting, is also discharged near to someone else's intake point for fresh crop. This also ingresses contaminant's entry in fresh pond water. We need to note that in such contaminated water, unless we first oxidize all contaminants present in water, we will not able to reach true and helpful Chlorine residual level in pond water. It is advisable to check chlorine demand test of water as a first point. This will help you to understand the SBP requirement as a real case. This will also help farmers avoiding over as well as underfeeding



of SBP product in ponds. In case of presence of contamination in water, the further investigation

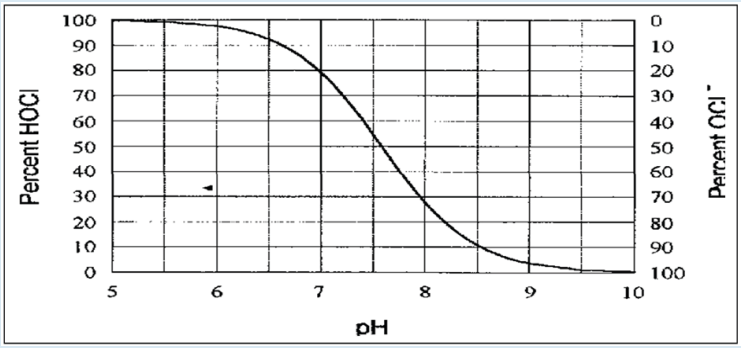
Chlorine Demand of water:
is also solicited for finding the nature & extent of contaminants. Sometime some of these contaminants can be detrimental to shrimp growth. Eg. Heavy metals..etc.

Generally, market available, BIS standard complying stable bleaching Powder possess 35% Chlorine in it. This states, to achieve about 1-part residual Chlorine in clean water with SBP product, one need to dose about 3 part of product assuming zero no presence of oxidizable contaminant in that water and possess zero chlorine demand.

Water pH:
When chlorine, come in contact with water, it forms Hypochlorous acid, Hydrochloric acid and hypochlorite Ions. pH of the water decides the extent of formation of above three. Acidic water pH favors Hydrochloric acid formation, whereas alkaline water pH >7.5, the hypochlorite ion formation starts predominating. While water pH window of 6.5-7.5

generate hypochloprous acid. HOCl- has found to be carrying the most capability of effectively killing microorganisms.

ORP technology:
Oxidation Reduction Potential is



an old and user-friendly gadget to monitor and maintain the residual Chlorine in water. This has been in use at various water treatment applications worldwide.

Oxidation Reduction Potential (ORP) is a potential of disinfectant to kill microorganisms present in water. It is a direct measure of disinfection power of any oxidizing disinfectant fed in water at a given circumstance. ORP measured in mili Volts. Higher ORP value indicate higher ability of disinfection power. More the contaminants & chlorine demand in water, lesser will the ORP values. Generally drinking water, swimming pool water are adequately disinfected at around 500 mV to 800 mV.

It advised to follow ORP measurement while chlorine is fed in water. ORP, measure only free residual chlorine and not combined chlorine. This is highly advantageous to optimize the SBP dosage in water yet earning maximum output from SBP. Very handy & portable (pocket carrying) ORP maters are much available in market and they have found it as a very useful tool at field.

On-field guidance from Grasim's technical team:
Superlative performance delivery from every chemical is depended on two major factors.

1) Manufacturing of superior quality product and 2) Adhering right product application knowledge to get the best out-put from that product.

We at Grasim provide utmost importance to both these factors and dedicatedly work on both these factors to see that the shrimp framer's purpose behind buying Grasim SBP fully achieved.

Grasim's expertise technical team spend time on field with shrimp farmers, carries field training workshops, testing demonstrations..etc to bring the right teaching & awareness to farmers on SBP product handling to get the best return from it.

Summary:
Stable Beaching Powder is an effective, useful & farmer's user-friendly product to achieve proper disinfection in intake water. This product provides right environment for growth of shrimps. While saying so, it is also necessary for farmers to follow right operating practices and techniques to get the most out of SBP. It is always advisable to conduct detailed study of intake water first. Some of the key suggested parameters to be checked would be Chemical Oxygen Demand (COD), Chlorine Demand, Oxidation Reduction potential (ORP), Dissolved oxygen etc. A proper disinfection of intake water would be a right baseline for proper growth of shrimps and this can be achieved following right free residual chlorine measurement techniques. Oxidation Reduction potential (ORP) can be a technique can help in achieving adequate level of free residual chlorine level in water for disinfection. This can also help in optimizing the consumption of SBP yet to get to most out of SBP.

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From Concept to Reality: Aquamimicry's Impact on Aquaculture Advancement

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Abstract

In today's world, aquaculture stands as a growing industry focused on the controlled feeding and maintenance of cultured organisms. However, challenges such as water quality deterioration and pathogen spread leading to farm runoff-induced outbreaks have resulted in substantial financial losses for farmers. To address these issues, the aquamimicry technique is often employed, facilitating improved production and aligning with the principles of sustainable aquaculture. This method is recognized for its environmental friendliness and favorable cost-benefit ratio, supporting economic and social sustainability by boosting production without significantly increasing natural resource usage (such as water and land). The use of fermented rice bran with appropriate probiotics enables low-cost additional feeding, promoting the proliferation of zooplankton blooms, which in turn aids in maintaining water quality and plankton diversity. Copepods, among the zooplankton species, emerge as dominant indicators of system maturity. The microbial population present in shrimp guts and surrounding areas plays a crucial role in the aquamimicry system, contributing to disease prevention during culture and establishing an ecological model. Naturally fed cultured species in this system often exhibit heightened immunocompetence and resistance to various diseases. Shrimp produced within this framework are organic, devoid of harmful chemicals or antibiotics.

Introduction

In the aquaculture industry, addressing environmental concerns and adopting organic technologies has become imperative. Recent years have witnessed the introduction of innovative technologies aimed at mitigating harmful environmental impacts, enhancing biosecurity measures, and ultimately reducing shrimp production costs. Various approaches to wastewater management and treatment have emerged, including bioaugmentation technology, advanced algal pond systems, utilization of nanomaterials such as nanofiber membranes and polymeric nanoadsorbents, aerobic fermentation for nutrient recovery from waste, and the application of intensive water treatment methods like biofloc technology.

Aquamimicry, an innovative approach in aquaculture, mimics natural estuarine conditions by fostering zooplankton diversity, primarily copepods, as an additional nutritional source for cultured shrimp. This method utilizes a fermented carbon source like rice bran combined with probiotics to promote phytoplankton and zooplankton populations, replicating pond-like conditions. By encouraging the growth of copepods, a key zooplankton species, aquamimicry enhances the nutritional profile and water quality in fish and shrimp cultures. The water within culture tanks closely emulates natural estuarine conditions, containing microalgae and zooplankton essential for nutrient cycling and food sources. This balanced ecosystem reduces the need for chemical interventions and antibiotics, as rice bran serves as a prebiotic, fostering the growth of beneficial bacteria and zooplankton. This natural approach minimizes physico- chemical fluctuations such as pH and dissolved oxygen levels. In high-density culture systems, aquamimicry can be implemented by establishing a central drainage system from grow-out ponds to

sedimentation ponds, ensuring efficient nutrient recycling and maintaining water quality.

Pond Preparation

To prepare the pond, a filter bag with a size ranging from 200 to 300 µm is filled to a depth of approximately 80 to 100 cm. Bacillus sp., a suitable probiotic, is then added, and the pond is chain-dragged over a period of seven days using lined ponds with heavy ropes to prevent liner damage. Gentle dragging is essential to prevent the formation of biofilms, which can be toxic to shrimp culture, and to ensure proper mixing of probiotics with the soil. Farmers typically supplement with tea seed cake at a concentration of 20 ppm, along with fermented rice bran or wheat bran at 50 to 100 ppm. Overdosing on these supplements can lead to excessive copepod blooms, typically occurring within two weeks. Adequate aeration is crucial for the proper mixing of tea seed cake, probiotics, and nutrients within the pond.

Grow out, sedimentation and bio filter Pond

Water circulation in the grow-out pond is typically facilitated by eight long-arm paddlewheels, each with a 3-hp motor operating at 85 rpm. These paddlewheels are strategically arranged to enhance circulation, encouraging solids to accumulate at the center of the pond. Various fish species such as catfish and milkfish are cultivated in these ponds, facilitating the mixing of detritus and the proliferation of oligochaete worms. These worms are particularly rich in essential amino acids like methionine and lysine, serving as a valuable food source for the fish.

To uphold water quality in grow-out ponds, regular addition of probiotics on a monthly basis is recommended. The sedimentary environment of these ponds promotes the proliferation of worms and other benthic invertebrates, serving as supplementary food sources for the fish. Ropes or lines present in the ponds are often heavily colonized by horse mussels. In sedimentation ponds, maintaining a depth of 4 meters at the center and 2 meters at the edges aids in sediment accumulation. Here, low-density stocking of bottom-dwelling fishes such as catfish and milkfish, depending on water salinity, helps in debris management and ecosystem cleaning, also providing a potential food source for farm workers. Water from the sedimentation pond overflows into a bio-filter pond to extend retention time, where low- density tilapia stocking can be considered. Subsequently, water flows back into the grow-out pond with minimal or no nitrogenous waste material. Proper cleaning of the sedimentation pond is recommended every three years. Trials are underway to significantly reduce the ratio of treatment ponds to grow-out ponds, which currently stands at 1:1, necessitating relatively large areas of land relative to production. These trials involve experimenting with water flow regulation, carbon inputs, and various combinations of live organisms in the treatment ponds.

Carbon Source preparation and use

Aquamimicry employs fermented rice bran (FRB) as a primary carbon source, supplemented with probiotics to foster phytoplankton and zooplankton blooms, thereby mimicking natural pond conditions. These planktonic organisms play a crucial role in enhancing water quality and serving as supplemental nutrition in fish and shrimp cultures (Vijayan, 2019). To prepare the composite carbon source, rice or wheat bran (without husk) is mixed with water at a ratio of 1:5 to 1:10 and combined with probiotics under aeration for 24 hours.

When the bran is finely powdered, the entire mixture is gradually added to the pond. Alternatively, if the bran is crumbled, the supernatant milk or juice is added to the pond while the bran solids are fed to fish in the biofilter pond. According to Romano (Stottrup, 2006), Fermented rice bran is prepared by mixing rice bran powder with water, hydrolyzing enzymes, and probiotics, allowing it to soak overnight. The pH of the incubation water should ideally range between 6 and 7 and be adjusted if necessary. After fermenting for 24 hours, the prepared mixture is added to cultured ponds at a rate of 500–1,000 kg per hectare (Romano, 2017). Following shrimp stocking, which can range from 30 to 100 animals per square meter, the amount of fermented rice bran added depends on the turbidity level and the system used. Generally, 1 ppm is recommended for extensive farming, while 2-4 ppm is used for intensive systems. Turbidity levels, measured using a Secchi disk, should ideally be around 30-40 cm for optimal shrimp culture. If turbidity levels are higher, less bran should be added, and vice versa. Throughout the grow-out period, additional probiotics should be added monthly to maintain water quality and promote the formation of biocolloids consisting of detritus, zooplankton, bacteria, and other components.

Process

The process begins with the addition of rice bran along with probiotics, left to ferment for approximately 24 hours. Fermented rice bran, ranging from 500 to 1000 kg per hectare, is then supplemented into the pond to promote the proliferation of dominant zooplankton species, such as copepods. Following this, post-larvae are stocked at a density of around 10-20 individuals per square meter after one week. Zooplankton diversity is sustained as a feed source by adding fermented rice bran at a rate of 1 ppm during early stocking and for creating minor biofloc levels (< 25 mL/L as measured by an Imhoff cone). Subsequently, fermented soybean meal is utilized for feeding, effectively reducing feed costs. The additional development of biofloc proves beneficial in meeting nutritional requirements and ultimately reducing feed costs.

As a natural food for shrimp

The abundance of natural planktonic communities in this system mimics

natural estuarine conditions, fostering the growth of cultured species while maintaining ecological balance. Shrimps primarily feed on natural resources within the water, including zooplankton, phytoplankton, and artemia (Romano, 2017). In this setup, prebiotic sources like fermented carbon, such as rice bran, combined with Bacillus sp. as probiotic sources, work synergistically to promote plankton diversity, particularly copepods, resembling natural conditions. These live foods serve as balanced nutrition for shrimp culture. Additionally, beneficial bacterial species contribute to creating suitable culture conditions for shrimp growth and well-being. The raised species in this system typically consume tiny organisms and bacteria that feed on phytoplankton, rather than directly consuming phytoplankton themselves. The cultivation of plankton and biofloc components aids in maintaining balanced water quality, closely resembling natural estuarine conditions. Consequently, the need for feed consumption and water exchange can be minimized. This technology demonstrates effective waste utilization, as continuous use of carbon sources and probiotics sustains planktonic growth.

Application of Probiotics in Aquamimicry system

The rapid growth of the aquaculture industry in recent decades has led to environmental degradation and reduced productivity in various crops. To address challenges such as increased disease resistance, improved growth of aquatic organisms, and enhanced feed efficiency, probiotics have been integrated into aquaculture practices. In this system, a combination of suitable carbon ingredients serving as energy sources, along with probiotics, helps to utilize unutilized nitrogen generated through feed and excreta. This process results in the conversion of nitrogen into floc, thereby maintaining the population of copepods as a valuable source of proteinaceous feed.

The use of probiotics in modern aquaculture is experiencing a significant surge. Beyond preserving the gut microbiota , probiotics play a crucial role in enhancing the nutritional value of plant feedstuffs through fermentation . Incorporating probiotics into aquaculture systems such as BFT and aquamimicry also enhances the zootechnical process of the system. Probiotics, defined as living microorganisms added to the aquaculture environment via food or water, exert beneficial effects on host health and growth performance by modulating gut microflora . They offer a viable alternative to therapeutics for controlling infectious diseases and can contribute to improving water quality . Probiotics produce enzymes that hinder the activity of pathogenic bacteria by reducing gut pH, creating an inhospitable environment for these bacteria to thrive. Additionally, probiotics employ quorum quenching mechanisms to disrupt quorum sensing among opportunistic bacteria.

Role of Copepods in Aquamimicry Technology

In both intensive and extensive fish culture systems, it is essential to manage the interactions between fishes and crustaceans, particularly those belonging to the subphylum Copepoda, to optimize fish production. Aquamimicry technology typically revolves around the cultivation

of copepods under natural conditions, which serve as a primary food source for shrimp species within the pond ecosystem.

This approach notably eliminates the need for intensive mixing, oxygenation, and external feed sources within the culture system. Copepods, crustaceans commonly utilized for their small size and short life cycle, serve multiple purposes including acting as food for marine animals, facilitating nutrient recycling, and contributing to energy conversion in the food chain

. They are particularly rich in LC-PUFA such as docosahexaenoic acid, arachidonic acid, and eicosapentaenoic acid, essential for the growth and development of cultured species, offering higher nutritional value compared to rotifers and artemia species . Furthermore, copepods are noted for their abundance of carotenoids, peptides, free amino acids (e.g., taurine), vitamins, and minerals including selenium, iodine, copper, and manganese .

Marine copepods are highly regarded as "nutritionally superior live feeds" for commercially important cultivable species. They serve as a valuable source of protein, lipids, carbohydrates, and various enzymes such as amylase, protease, exonuclease, and esterase, which play essential roles in larval survival, growth, digestion, and metamorphosis . Copepods are recognized for their superior digestibility and relatively high weight-specific caloric content. Beyond their nutritional and physical advantages as live feed, copepods are also highly suitable for culture due to their eurythermal and euryhaline characteristics, enabling them to withstand wide environmental fluctuations.

Conclusion

In recent years, Aquamimicry has emerged as a novel concept aimed at replicating natural estuarine conditions by fostering the growth of copepods, which serve as supplementary food for cultured species. This balanced approach in aquaculture, by enhancing both biofloc and microalgae, holds the potential to significantly increase production of cultivable species. Notably, Aquamimicry is renowned for reducing stress associated with fluctuating water quality and creating unfavorable environmental conditions for pathogens. The adoption of Aquamimicry in shrimp farming offers enhanced sustainability compared to conventional farming methods.

Role of Phytoplankton in Aquaculture

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Abstract: Phytoplankton is usually in great abundance in ponds. These organisms have a significant impact on the ecology of ponds and the quality of the water. Even though phytoplankton is generally beneficial, there are certain situations where it can be quite problematic for the growth of fish and shrimp. There are just a few things needed for phytoplankton to grow: water, light, an ideal temperature, and inorganic nutrients. There are species of phytoplankton that can flourish in almost any type of water because there is such a huge variety of them.

Introduction:

Aquaculture organisms must get all of their nutritional needs from the food they consume, with the exception of a portion of their mineral needs. Phytoplankton is the primary source of food for many larval organisms. This is most probably related to the size of the larvae at hatching. The majority of organisms in nature eat living things like plants and animals that they can find in their surroundings, but some do consume and may even use detritus and other species that are related to it (Kumar *et al.* 2020).

In the many aquatic ecosystems, phytoplankton composition and abundance are highly variable, sometimes displaying a distinct seasonal succession that is impacted by several variables including temperature and salinity (Muylaert *et al.*, 2000). As the base of a wide range of trophic chains and one of the major producers in marine, coastal, and continental water bodies, phytoplankton is one of the most significant groups in aquatic ecosystems. It provides food for the zooplankton, benthos, and nekton populations, which are the main consumers (Harris, 1986).

Many phytoplankton species, including *Chaetoceros* sp., *Tetraselmis* sp., *Isochrysis* sp., *Skeletonema* sp., *Spirulina* sp., and *Chlorella* sp., are extremely nourishing to many aquacultured species. During the early larval stages, these species are nutritious and essential for shrimp larval feeding. Additionally, a variety of phytoplankton species create omega-3 fatty acids, which offer numerous health advantages.

Natural food species like phytoplankton play an important role in fish nutrition. Plankton is the natural food of aquatic organisms. They enhance aquatic organisms' immunity (shell fish and fin fish). The water quality of the aquatic ponds is highly influenced by the plankton existence.

To understand the relationship between phytoplankton, zooplankton, and fish culture is essential for determining the water quality, natural productivity, and fish output.

Objectives that is associated with phytoplankton:

In case of aquaculture, aqua farmers place a lot of emphasis on the pond's water's colour. To put it another way, they concentrate growing phytoplankton in pond water. They

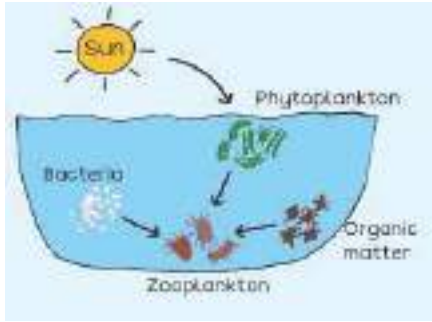

Fig .1 : Phytoplankton in freshwater

are typically created in nursery and grow-out ponds as a result of a biological cycle triggered by mineral fertilisers in the water. They convert the inorganic waste and carbonic acid in solution into organic matter in the form of vegetable tissues formed up of a variety of phytoplankton using the heat and light of the sun.

1. To reduce the number of pathogenic and undesirable microbes by vying for water's nutritional resources.
2. To give shelter and prevent cannibalism.
3. To raise and maintain the water's temperature.
4. To stabilise the quality of the pond's water and reduce the amount of hazardous substances.
5. Using plankton as a source of natural food.
6. To produce more dissolved oxygen in pond water and less hazardous by-products.
7. Fish and prawn larvae choose zooplankton as their natural food source.

8. The rotifer Brachionus species is a crucial live feed in aquaculture and can be mass-produced in enormous quantities.
9. The quantity and area of the water body as well as the level of plankton primary production affect the aquatic species in the ecosystem.
10. The majority of freshwater communities contain significant amounts of rotifers and cladocerans.
11. The quantity of acceptable food for aquatic species determines the zooplankton population.

Therefore, phytoplankton is crucial for regulating the entire pond ecology and reducing water quality changes.

Effect of phytoplankton on water quality :

Salinity adjustments can change the species composition and density of phytoplankton. Decimating the salinity helps in the growth of green algae populations. Salinity increases encourage the development of diatom colonies. By introducing phytoplankton from hatcheries that mass-produce phytoplankton, the species composition can also be altered. It can also be altered by adding chemicals like lime and dolomite. pH can be raised using zeolite, dolomite, and lime. Tea-seed cake may cause a pH drop. Aeration can enhance water quality while increasing water exchange rate can reduce phytoplankton density.

Relationship between water colour and plankton in aquaculture:

The fundamental factor causing the change in water colour is the variation and fluctuation of microorganisms, notably phytoplankton. Microorganisms, which include phytoplankton, zooplankton, and bacteria, are the major among all that can generate the visible colour. As a result, water colour typically correlates with productivity and nutrient load and has a big impact on output yield. In the absence of instrumentation, the farmer can evaluate the state of the pond by looking at the water's colour.

Colour	Causes
Reddish brown	*Chaetoceros, Navicula, Nirzschia, Skeleronema, Cyclotella, Synedia, Achnanthes, Amphora* and *Euglena.*
Bright green	*Chlorella, Dunaliella, Plarymonas, Carteria, Chlamydomonas.*
Blakish green	*Oscillatoria, Phormidium* and *Microcoleus.*
Dark brown	Over feeding, trash fish, rapid growth of dinoflagellates and brown algae.
Yellowish	*Chrysophyta.*
Foggy white	Die-off of algae or the deterioration of water quality with resulting propagation of bacteria.

Table no. 1 : Relationship between water colour and phytoplankton

Importance of phytoplankton

- Many phytoplankton species, including Chaetoceros sp., Tetraselmis sp., Isochrysis sp., Skeletonema sp., Spirulina sp., and Chlorella sp., are highly nutritious to many aquacultured species.
- During the early larval stages, phytoplankton species are nutritious and vital for shrimp larval nutrition.
- Omega-3 fatty acids are also produced by a variety of phytoplankton species, and they provide several health benefits, for example, a Schizochytrium sp.

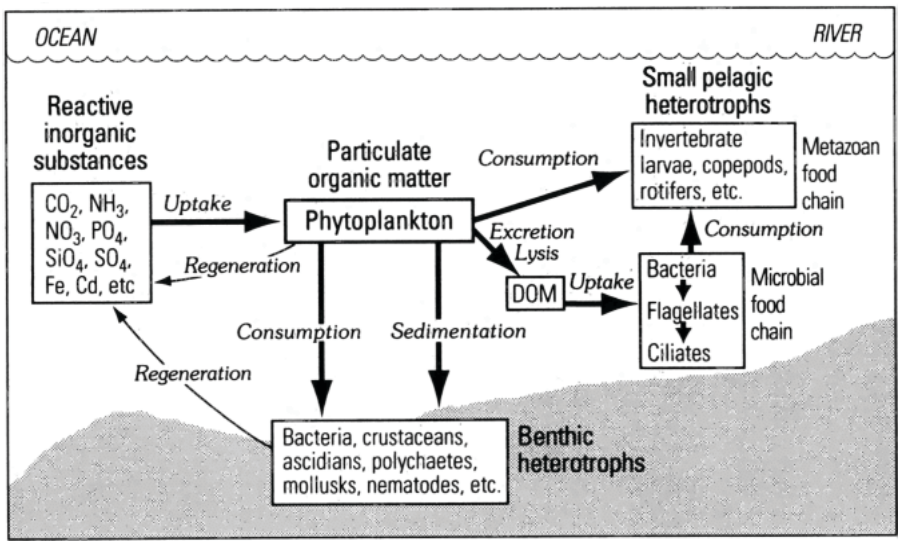

Fig no.2 : Role of Phytoplankton in freshwater

- The Chlorophyte microalgae Haematococcus pluvialis has high levels of the beneficial antioxidant astaxanthin, which is extremely effective in all stages of shrimp farming and a healthy food for humans.
- Ponds with high concentrations of diatoms or chlorella sp. ("green water") or other phytoplankton species ("brown water") have improved water quality.
- Ammonium, nitrate, and phosphate can utilize by phytoplankton to reduce their concentration in their pond waters.
- Phytoplankton also provides

shading and can limit or prevent the establishment of undesirable benthic algae species on pond bottoms.

Potential negative impacts

- Despite the fact that phytoplankton is beneficial in aquaculture ponds, their blooms can become excessive and have harmful consequences.
- Respiration by phytoplankton and other organisms during the night in ponds with dense phytoplankton blooms may causes in excessively low dissolved oxygen concentrations, which may stress or kill the culture species.
- A phytoplankton bloom in an un-aerated pond that decreases the depth of underwater visibility to less than 20-30 cm as measured with a Secchi disc is likely to cause an unusually low nighttime dissolved oxygen concentration.
- During daytime, high rates of photosynthesis may deplete water of free carbon dioxide leading to excessively high pH. Also, high levels of dissolved oxygen supersaturation may occur when photosynthesis is rapid. Oxygen super-saturation usually does not cause gas bubble trauma in aquatic animals in ponds, because culture animals usually can move to deeper water where the degree of oxygen saturation is lower. However, in ponds used to supply water to hatcheries, gas supersaturation in source water can have adverse effects on eggs or fry.
- During the day, high rates of photosynthesis may deplete water of free carbon dioxide, resulting in an unusually high pH. When photosynthesis is rapid, high levels of dissolved oxygen supersaturation may result. Because culture animals can go to deeper water where the degree of oxygen saturation is lower, oxygen super-saturation normally does not induce gas bubble trauma in aquatic animals in ponds. However, gas supersaturation in source water can affect eggs or fry in ponds used to supply water to hatcheries.

Preventive measures for algal bloom:

1. Partial exchange of water from affected pond (30 -50%).
2. Application of dolomite at standard rate.
3. Application of nutrients in pond water.
4. Aerate the pond water to settle-down the dead algal matter.

Exploring Fisheries Cooperative for improving livelihood of fishers in India

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Introduction

India has abundant fishery resources with great potential for substantial progress. Fish base mentions that 862 species of freshwater fish are found in India. A total of 788 marine fish species landed along Indian coasts in 2017. We possess more than 10% of global fish biodiversity. Moreover, Fisheries sector contributes more than 5% of the agricultural GDP. Some of these constraints may be as follows

- Most of the people engaged in fisheries for their livelihood belong to socioeconomically backward communities.
- Lack of proper institutional support like infrastructure and finance.
- Non-availability of quality seeds.

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- The fisheries cooperative system in India was devised with a view to providing assistance to the actual producers, the fishers.
- Fisheries co-operative societies are governed by a separate set of rules to channel government assistance on the principles of self-help and democratic management.
- Fisheries cooperative in which the people involved in the fishing industry pool resources, in their certain activities from farming, catching, distribution, and marketing of fish.
- The ultimate aim of the co-operative society is to contributing the socio-economic development of the fishers.
- Presently, there are one national leveI federation, 7 state level federations, 108 central Ievel federations and 12,427 primary fishery societies functioning in India.

- Lack of organized marketing.
- Non-availability of quick transport facilities.
- Poor technical skills of fish farmers.
- Paucity of funds/ Bank credits.
- Lack of participatory fisheries management.
- Social issue (Kleisner et al.,2013).

Origin and roles of fisheries cooperatives

Hence, it was realized that fishermen and women should be organized at community level to overcome their problems and to improve their socio-economic status by incorporation of appropriate inputs from education, finance, marketing, communication, technology, transport, seed availability, health and Government policies etc., This idea gave birth to Fisheries Co-operative Societies in India. As early as in 1913 the fishery co-operative movement in India began when the first fishermen's society was organized under the name of 'Karla Machhimar Cooperative Society' in Maharastra. Sir Frederic Nicholson, the then Director of Fisheries in the former Madras Province, was perhaps the first person who initiated the formation of Fishery Cooperatives in India. In 1944, 'fish sub-committee' on Agricultural policy committee recommended that both direct and indirect assistance should be given to the fishing industry. In 1946, the cooperative planning committee recommended that state aid for the development of fishing industry should be given largely through cooperative societies. These societies are responsible for extending financial assistance to their members. They are also responsible for stocking and selling of fishing crafts and gears. In addition, they have also been entrusted to ensure appropriate marketing of fishery resources, fair pricing of fish farmers' commodities and availability of improved seeds. However, the fishery cooperatives grew at a very slow pace in earlier period of their inception. By 1944, there were hardly 200 fishery cooperatives in whole of India. These societies were mostly lending societies, mainly concerned with providing credit to their members. They have not emphasized much for cooperative fishing, processing and marketing. A major boost for fisheries sector, however, was realized after the commencement of the 'Five Year Plans' when the importance of fishery cooperatives was recognized. Since then, a large number of fisheries cooperatives have been formed both in marine and inland sectors of the country. Presently, there are one National Level Federation, 7 state level federations, 108 central Level federations and 12,427 primary fishery societies functioning in different parts of India.

Types of fisheries co-operatives

Types of Fishery Co-operative Societies: Broad types of fisheries cooperatives operational in different Indian states are as follows

Producer's co-operative societies: Aims at production of goods and services based upon common ownership and management by a group of workers to eliminate the employee-employer relationship.

Fish consumer's societies: These are composed of agricultural workers and the middle class people who run a consumer store where fishes can be purchased at the wholesale prices and sold at market or lower price to the members.

Fisheries credit societies: These voluntary and mutual aid associations provide credit to their members on personal security or on the basis of nominal security.

Marketing co-operative societies: Run by the small producers for the promotion of their trade by selling the goods at reasonable prices and by eliminating middle men.

Insurance co-operative societies: To minimize the risk of their members and their produce these societies negotiate with insurance companies. Individual and group insurance policies for its member are purchased at comparatively lower premium.

Transport co-operative societies: They provide the services of vehicles and transport to their members at comparatively lower rates.

Storage co-operative societies: They provide storage facilities to their members for perishable items.

Scope of Fisheries Co-operatives

Fishery industry offers a big opportunity for exploitation of fishery resources of the coastal as well as inland waters. Despite a very high potential of fishery sector, the fishermen continued to remain socio-economically down trodden. They are mostly exploited by the middlemen and suffer a lot on account of their illiteracy, poor know how and technical inaptness. Institutional safeguards would be very effective against such exploitations. Fishery cooperatives are appropriate means to get rid of most of the demerits of fishing sector. They have enough potential to improve the socioeconomic conditions of the fishers. In fact, fishery co-operatives are directly involved in improving fishermen socially, physically and economically. This multidirectional influence is supposed to give a boost to rural development.

Efforts to strength fishery co-operative

FISHCOPFED- National Federation of Fishers Co-operatives Ltd.

The National Federation of Fishers Cooperatives Ltd. (FISHCOPFED) is a national level federation of fisheries cooperatives and the apex institution of Indian Fisheries Cooperative Movement. Its motto is to promote and develop the fishery cooperative movement in India, to educate, guide and assist fishers in their efforts to build up and expand the fishery cooperative sector and serve as an exponent of cooperative opinion in accordance with cooperative principles. It was established in 1980 as All India Federation of Fishermen Cooperatives and was rechristened as National Federation of Fishers Cooperatives Ltd. in 1982 (Mahanayak *et al*., 2021)

National cooperative Development Corporation (NCDC)

NCDC played a significant role in strengthening fisheries co-operatives by providing them assistance for building up of their share capital, establishment of service and repair centers for boats, setting up of canning units, fish oil and meal plants, net making units, construction of godowns, drying yards etc.

NCDC has formulated a comprehensive policy for providing assistance to fishery co-operatives for different purposes listed below

- Purchase of operational inputs such as fishing boat nets and engines.
- Creation of infrastructure facilities for marketing (transport vehicles, cold storages, retail outlets etc.
- Setting up of processing units including ice plants, cold storages etc.
- Development of inland fisheries, seed farms, hatcheries etc.
- Preparation of feasibility reports.
- Appointment of experts under technical and promotional cell schemes.
- Integrated fisheries projects (marine, inland and brackish water).

National Fisheries Development Board (NFDB),

NFDB, established in 2006, aims

- To realize untapped potential of fisheries sector
- To augment fish culture
- To promote fish processing and marketing
- To promote application of modern tools of research and development for optimizing fish production
- To provide special care and financial assistance to fishermen societies, Cooperative bodies, women, SC/ST, weaker sections and under developed regions

Conclusion

A fishery cooperative, or fishing co-op, is a cooperative in which the people involved in the fishing industry pool resources, in their certain activities. These societies are responsible for extending financial assistance to their members. They are also responsible for stocking and selling of fishing crafts and gears. In farmers point of view needed to strengthen the cooperatives. This article explain about the origin of fisheries cooperatives, different types, scope and efforts to strengthen.

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3D FOOD PRINTING – NOT JUST FUN, BUT "FUN"CTIONAL

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Three-Dimensional (3D) Food printing technology, a new star risen in the horizon of food industry, has been striding forward, in the realm of future foods. There exists a huge demand for 3D printed food products and it is expected that it can reach US $ 11.3 billion by 2030, at a very high CAGR of 50.2%. Reducing food wastage, demand for alternative plant based meat products and demand for gourmet food is driving this market demand. This technology has evolved as an extension of the traditional 3D printing technique, which has been employed since 1980's for constructing prototypes with materials like plastic and other photo polymers. Apart from the use of this technology in fields like aviation, medicine, military and jewelry designing, it's application in foods is expected to create a huge hike in the market size of future foods. Creation of customized foods is the main highlight of this technology. Printing foods in any complex designs, makes this technology exceptional and unique, when compared to other newly emerged processing techniques. Also, a wide variety of ingredients can be used as raw materials for printing, which creates printed foods with multi nutritional profiles. This feature of 3D printed foods, make it an inevitable item among the functional foods. In the current scenario, as the people are becoming increasingly health conscious, due to the increased rate of metabolic disorders like cardio vascular diseases, obesity, high blood pressure, atherosclerosis, 3D printed functional foods offer a solution for their quest for healthy foods having customized ingredients for various disorders. Also, the digestibility of 3D printed foods is very high, making it consumable by every category of the population. As these foods are categorized under soft foods, they are extremely suitable for elderly population.

Three -Dimensional (3D) printing, is a semi-robotic, digitally controlled process, which requires both software and hardware to operate together. Regarding the software part, a suitable CAD software is essential to create the designs, in which the food to be printed. Then the developed designs are converted to their respective STL files. The images are sliced using a slicing software and then the machine codes are generated, which facilitates printing. The final file containing the design, is fed to the 3D Food Printer for initiating the printing process. The raw materials for printing are loaded to the instrument, after filling in appropriate cartridges. Nozzles of different diameters are fitted to the slot at the lower end

- 3D food printing, also known as additive manufacturing is a novel technology which can fabricate food formulations in complicated design of consumer choice
- It can combine multiple ingredients to develop foods to impart functionality as per individuals requirements
- 3D printing can help in eradicating malnutrition by supplying designer foods of attractive shape and designs
- Fish is one of the ideal ingredient for 3D food printing due to its exceptional nutritional profiling

of the printer barrel. While printing, materials are deposited on the printing platform in layers to form the 3D pattern. From the time the researchers of the Cornell University had developed the first ever 3D Food Printer Fab@home in 2006, printers have been constructed with a lot more modifications, though the basic parts of printer remain the same. Figure 1 shows the Fab@ home printer developed by Cornell University. There are three major techniques of 3D Food Printing like Extrusion printing, Inkjet Printing and Binder Jet Printing. But Extrusion is the most commonly used technique in 3D printing of foods. In Extrusion printing, pastes and doughs with a low viscosity are printed well. A piston pushes the material in the cartridge through the nozzle in preferred designs. Figure 2 shows the schematic representation of an Extrusion Based 3D Food Printer. After printing, the prints are subjected to treatments like baking, frying, drying and steaming. These treatments are termed as Post Printing Treatments." They are mainly

done to meet the requirements of the customer as well as to preserve the

designs of the 3D prints developed. For products that are self-stable, this treatment could be avoided.

Figure 1. Fab@home, first 3D printer developed by Cornell University, USA

Figure 3. 3D-Printed Functional Foods

Figure2. Schematic diagram of extrusion type 3D Food printer

Functional foods have special ingredients in them, which have a positive influence on an individual's health. Their role in disease prevention has been proven, since the time they were emerged. In spite of all their health benefits, functional food industry is facing some setbacks, which has an adverse impact on the customer acceptability. One main reason for least consumer preference is the bland taste of most functional foods and the second reason is the lack of a novel technology to make these healthful recipes avail to the customers. The development of 3D printed functional foods is expected to tackle all these problems, as this technology has proven to provide personalized nutrition, as per the requirements of the customer. Though the initial works done in 3D Food printing was more on Chocolates and Cake Frostings, healthier products are being printed using wide variety of raw materials. Studies are being conducted on 3D printing of an array of materials from lemon juice, fruits and vegetables to cereal flours to meat and meat products and fish products, which are worth contributing to the enhancement of the industry. Fishes can be considered as an ideal raw material for printing, due to their highly healthy nutritional profile. As 3D printing facilitates efficient, incorporation of multiple ingredients, low fat fishes can be printed after fortification with omega 3 fatty acids and fish bone can be incorporated, to make the fishes enriched with minerals. Apart from fish meat, ingredients from secondary raw material can find its huge application in the 3D fish printing as they are rich in functional constituents. Adopting 3D food printing technology for fish based products is expected to optimum utilization of this high value products minimizing the post-harvest loss including optimum utilization of fishery waste. Figure 3 shows some 3D printed functional foods.

Three-dimensional(3D) printing is becoming an integral part of functional food industry, through its ability to provide personalized nutrition to those required. Also, fabrication of products in desired geometry will in turn attract the customers, due to the improved aesthetic appeal. As this technology is still evolving, much more possibilities are yet to be explored.

Advantages of 3D food printing

- ✓ Any complicated shape and design can be printed with ease, which is impossible manually
- ✓ Provides personalized nutrition as per individual needs
- ✓ Higher digestibility and hence suitable for elderly population
- ✓ Ideal for dysphagic community
- ✓ Requires very small size and area for housing the machine
- ✓ Easy to operate and maintain
- ✓ Time saving and can be operated from remote location in higher models

Dis-advantages of 3D food printing

- ✓ Limitations for bulk production
- ✓ Piracy of the digital files / designs used from open source may pose threat in the future
- ✓ Costly

Smart Aquaculture:How IOT Innovations Drive Energy Efficiency, Financial Savings, and Yield Optimization

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Abstract

The increasing understanding of the nutritional benefits provided by seafood has contributed to a global surge in demand for it in recent years. Aquaculture farmers face great difficulty in meeting this demand while they have to increase production without sacrificing product quality.However, Internet of Things (IoT)-based system for monitoring water quality can be used to improve aquaculture productivity to address this problem. The technology ensures ideal conditions for aquatic life and minimizes waste generation by remotely monitoring and controlling the water quality parameters. Farmers can control and observation of the aquafarming process can be done remotely from any location in the world with the help of an Internet of Things (IoT)-based water quality monitoring device. The system keeps an eye on the salinity, pH, temperature, and dissolved oxygen levels in the water. Thus using an Internet of Things-based system to monitor the water quality in aquaculture is a potential means to increase production, reduce expenses, and ensure the quality of growth. With this approach, farmers can reduce the environmental impact of aquaculture on the globe.

Introduction

Fish and crabs represent some of the aquatic creatures that can be farmed via aquaculture, commonly referred to as aquafarming. In many nations, this approach is essential to both food production and economic development. Land-based facilities, ponds, rivers, and coastal shorelines constitute some of the places where aquaculture is practiced. Since water covers over 71% of the earth's surface, 13% (10.2 million tons) of the fish produced worldwide are raised through aquaculture. 90% of aquaculture globally is produced in Asian nations, with China being the biggest producer at 70% of the total fish production. Fish farming, which involves the selective breeding of fish in freshwater or saltwater to provide a food source for consumption, is heavily reliant on water resources. Seafood, such as fish, is a great source of protein and contains important nutrients like omega-3 fatty acids and natural oils.

Farmers have to increase production while preserving the product's quality and safety to satisfy the increasing demand for seafood. Therefore, aquaculture is rapidly utilizing innovative technologies including the Internet of Things (IoT). It was recently recommended that aquaculture implement an Internet of Things-based water quality system to increase sustainability and productivity. The technology lowers energy, labor expenses, time, and the risks connected with conventional aquaculture methods by enabling remote monitoring of aquafarming from any location in the world without the need for direct human interaction.

The system additionally recommends a water recycling method to reduce the production of aquatic waste products. By establishing such a system in place, aquaculture revenues are increased, as well as growth quality is maintained.

IOT in Water Quality Management

The culturing of aquatic organisms is playing increasing importance in worldwide food production and economic development. In this regard, maximizing production efficiency, reducing labor and energy expenses, and ensuring the high-quality development of aquatic animals all depend on the design and implementation of an Internet of Things (IoT)-based water quality system for aquaculture.

The main objective of this project is to create an aquaculture water quality system utilizing the ESP32 microcontroller, relays, LEDs, a servo motor, a turbidity sensor, DS18b temperature sensor, air pump, and a water pump. The water's temperature and quality are measured by the DS18b temperature sensor and turbidity sensor, respectively. After processing the data from both sensors, the ESP32 microcontroller creates on a red LED to inform the user if the numbers go outside of the expected range. Green or yellow LEDs, on the other hand, turn on if the parameters stay within the typical range. Waste water is recycled by the water pump, while carbon dioxide is released into the water by the air pump . The fish are fed by the servo motor.

Once the ESP32 microcontroller is connected to the Blynk app via Wi-Fi, all of the observed parameters are shown on the app. Using the user-friendly Blynk platform, users can keep track on their hardware projects from their iOS and Android smartphones. The user can create a project dashboard and arrange buttons, sliders, graphs, and other widgets on the screen after downloading the Blynk software. This Internet of Things (IoT)-based water quality system for aquaculture offers many advantages, such as the ability to remotely monitor the system from any location without the need for direct human intervention, the reduction of energy, and labor costs, and time, a guarantee of growth quality, and an increase in revenue generated from aquaculture.

With all factors considered, the use of IoT in aquaculture is a potential way to meet the increasing demand for seafood, ensure its quality, and encourage environmentally friendly methods within the sector.

Importance of IOT in Aquaculture

A test device that efficiently monitors and maintains the temperature and quality of the water in an aquafarming system is used in the actual application of the IOT-based water quality system for aquaculture. Two sensors that are linked to the ESP32 launchpad are used by the system: a turbidity sensor and a temperature sensor (DS18b). The microcontroller receives the data from the sensors, which measure the temperature and water quality, respectively, and processes it. After processing the data, the microcontroller stores it for review and monitoring. After that, the data is sent to the user's interface, which is accessible from laptops and mobile phones among other devices.

The user may remotely monitor the aquafarming system through the user interface, which has a dashboard with real-time temperature and water quality data displayed. The system uses a buzzer and LED lights to notify the user if an anomaly in the data is found. In addition, the system is intended to alert the user of any anomalies discovered by sending an email and notification to the base station (Blynk app) .When everything is considered, this prototype provides a practical and effective way to keep the water in an aquafarming system at the proper temperature. To minimize any harm to the aquafarming system, the system offers early alarms and remote monitoring, which minimizes the need for human intervention.

CONCLUSION

The challenges that fish farmers experience in supplying the growing demand for seafood throughout the world can be greatly alleviated by implementing this creative IOT-based water quality system for aquaculture. This system can monitor the temperature and quality of the water used in aquafarming with the aid of sensors such as turbidity and temperature sensors (DS18b). After the data is processed by the ESP32 launchpad, it is transmitted back to the user interface, which can be accessed online by laptops and mobile phones. The findings are then shown on the interface. In addition to helping to increase production, this system lowers labor expenses, energy usage, and the amount of time needed for manual parameter monitoring.

Since traditional farming methods lack advancements in technology, they are not as effective as modern systems. Farmers may remotely adjust the parameters with this water quality device, eliminating the requirement for direct human involvement. This implies that by eliminating the requirement for on-site monitoring, farmers can save money and time. Furthermore, compared to conventional farming, aquaculture farming requires considerably less water. This is because aquafarming is more environmentally friendly. After all, the water is recovered and utilized repeatedly.

If the system's air pump is used to introduce oxygen into the water, which simultaneously releases carbon dioxide and promotes aquatic organisms' growth and health. In contrast, the fish are fed at regular intervals by the servo motor. Using the Blynk app is one of this system's most distinctive features. With this software, users can easily control the system and remotely monitor the parameters. Users can receive notifications via LED lights and buzzers anytime an anomaly is identified, and it offers real-time data on the temperature and quality of the water. In addition, if an anomaly is found, the system notifies the base station (the Blynk app) via email.

In conclusion, this IOT-based water quality system for aquaculture is a ground-breaking solution to the obstacles that farmers encounter in satisfying the growing demand for seafood. This system uses sensors, microcontrollers, pumps, and servos to efficiently monitor and manage aquafarming parameters remotely. Farmers may take immediate measures if any abnormality is discovered according to the warnings given to the base station and the user-friendly interface of the Blynk app. With all factors considered, this technique offers aquafarming a useful, cost-efficient, and effective response.

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