

Aqua International

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Ramakanta Nayak, Chairman

Big boost to aquaculture industry in A. P.

Don't Use Banned Antibiotics in shrimp culture: MPEDA

Ecosystem-Based Fisheries Management: A Modern tool for Tropical Fisheries Management and Aquaculture



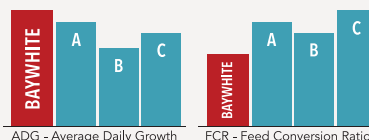
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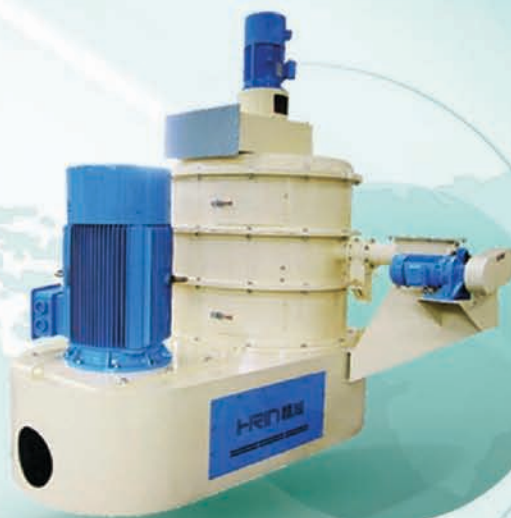
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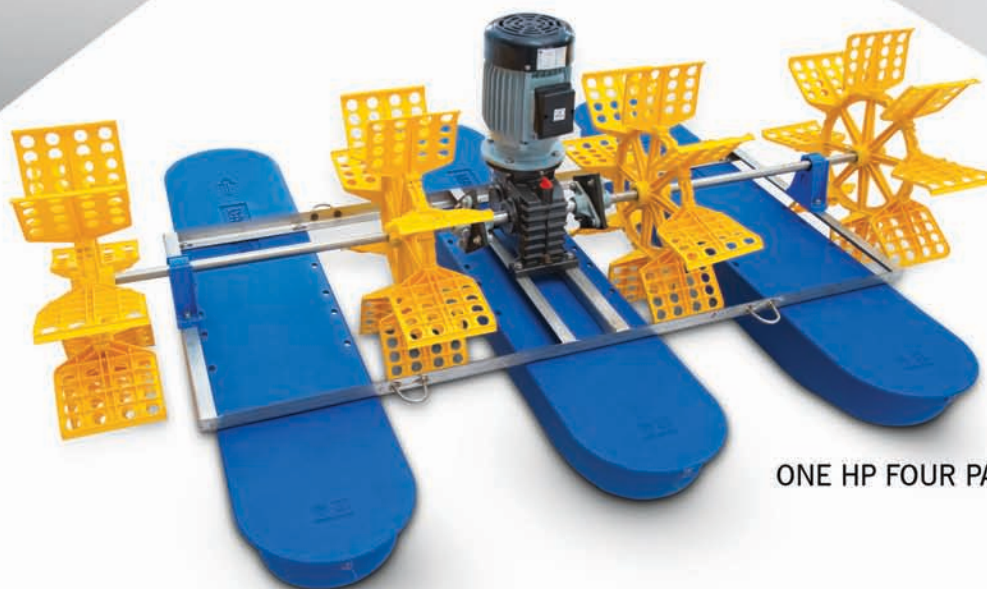
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BG-4, Venkataramana Apartments,
11-4-634, A.C.Guards,
Hyderabad - 500 004, India.
Tel: 040 - 2330 3989, 96666 89554
E-mail: info@aquainternational.in
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- Editor



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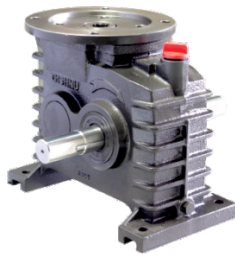


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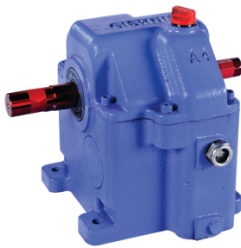
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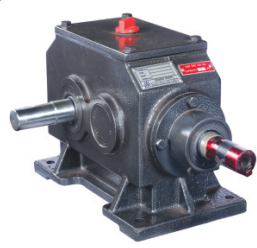
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Aquaculture industry facing worst ever crisis

It is high time that Government of India comes into the rescue of Aquaculture farmers and the industry. The Government should fairly understand the issues of Aquaculture sector and act immediately, otherwise irreversible damage will occur to the sector and to its stakeholders, who are producing and supplying nutritious and protein rich food such as fish, shrimp, crabs etc for the people. It requires effective follow up by the stakeholders with the ministers and the bureaucrats to resolve the problems of the sector.



Dear Readers,

The August 2021 issue of **Aqua International** is in your hands.

The Aquaculture industry in India is facing the worst crisis with the unexpected and abnormal increase in the

prices of shrimp feed due to abnormal hike in the prices of prime raw material like Soyameal and Fish oil. Soya price which was Rs 39 a kilo in February 2021 has gone up to Rs 100 today, and Fish meal / Fish oil which was Rs 85 a kilo has gone up to Rs 118. Shrimp feed contains 35% soya and 17% fish oil. Unable to bear the extreme hike in the feed and feed raw material prices, the Aquaculture farmers are facing worst crisis, and they reduced their stocking of shrimp seed by 20 to 30 per cent. All the prime segments such as farmers, hatcheries, feed manufacturers and processors are in a bad situation economically today. All this unexpected crisis occurred due to abnormal increase in soyameal and fishmeal prices due to these raw materials exports since January 2021.

Although a scare was created among people on the consumption of fish and shrimp products in the initial days of corona virus pandemic in March – April 2020, the Health and Nutrition experts recommended consumption of fish, shrimp, eggs and chicken to build immunity and good health in human body against corona virus, which helped Aquaculture sector in a positive way. Since that time the producers of fish and shrimp started feeling relief, but the present situation of abnormal hike in the cost of production of shrimp and fish is creating an alarm among the stakeholders of the industry. It would also affect the employment and the livelihood of lakhs of families.

It is high time that Government of India comes into the rescue of Aquaculture farmers and the industry. The Government should fairly understand the issues of Aquaculture sector and act immediately, otherwise irreversible damage will occur to the

sector and to its stakeholders, who are producing and supplying nutritious and protein rich food such as fish, shrimp, crabs etc for the people.

It is good to note that all the 36 shrimp and fish feed manufacturers in India formed a national body 'Shrimp Feed Manufacturers Association' Mr B. Masthan Rao as its President, and as a team they met the Union Ministers and top Officials at Delhi, and explained to them the serious issues of the industry. It requires effective follow up by the stakeholders with the ministers and the bureaucrats to resolve the problems of the sector.

In the News section, you may find news about –

A special feature and an interview with the newly appointed Chairman of Grobest Feeds Corporation (India) Pvt Ltd Mr Ramakanta Nayak, where he said: There is a huge prospect available to the feed industry in any livestock business and Aquaculture is not an exception to this. Nutrition plays an important role in aquaculture maintaining the growth and well-being of the culture animal. Considering the present status of the aquaculture business with the increasing production costs due to the increase in the cost of inputs, low market price, and disease issues, it is the need of the hour to find out alternative ingredients with no loss in the nutrient profile for the animal. We would like to continue our work in Shrimp and Fish nutrition in the days to come.

Grobest as a company is known to drive in the aqua feed bringing solutions to the farmers worries through its feed. Grobest launched its functional performance feed more than six years from now in challenging markets like Thailand, Vietnam and Indonesia for shrimp and high-value fish. In these markets, Grobest has shown the difference how farmers if they use our feed proactively have been able to harvest a successful crop. The same has been demonstrated several times since last year in many corporate farms in India. Grobest in India intends to be the differentiator and be the 'Farmers Friend' in providing solutions and driving this through the strong technical team.

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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The Marine Products Export Development Authority Chairman, Mr K. S. Srinivas asked aquaculture farmers to refrain from using any banned antibiotics in the shrimp culture system. He stressed the need to contain the detection of antibiotic residues in farmed shrimp consignments in markets such as the EU, the USA and Japan for enhancing India's market share. Srinivas was speaking at a virtual function to mark the inauguration of MPEDA's 13th Elisa laboratory at Pattukottai. The laboratory is expected to cater to the antibiotic testing needs of aqua farmers in Thanjavur, Ramanathapuram, Thoothukkudi and Kanyakumari in Tamil Nadu State.

Fisheries Department officials of Andhra Pradesh are planning to set up 100 aqua hubs and about 8,000 retail live fish vending kiosks across the State. Chief Minister Y.S. Jagan Mohan Reddy will launch the project, estimated to cost ₹ 300 crore, soon. A model aqua hub was recently opened at Ganguru on the outskirts of Vijayawada.

1,000 shrimp containers stuck in Chinese ports, half of them from Andhra Pradesh.

Andhra Pradesh is the largest producer of shrimp in the country and most of the seafood is exported to other countries. China is the second-largest importer of shrimp from India after the USA. It accounts for nearly 46.44 per cent of the volume of the shrimp exports.

How to distribute fish fry in Telangana? Contractors did not participate in the tenders for distribution of fish fry in Telangana State. The reason is that the Telangana government price is not affordable, and tenders were cancelled in 32 districts. Contractors are on their knees for the state government's free fish fry distribution program. The government is setting up a committee to review the prices of fish fry in response to the demand of the contractors, and the distribution of fish fry is being delayed as the committee report has not been received yet.

The Centre for Natural Resource Management, Climate Change and Disaster Mitigation (CNRM, CC&DM), National Institute of Rural Development and Panchayati Raj (Ministry of Rural Development, Government of India), Hyderabad, organized an online training programme entitled 'Livelihood Promotion through Pisciculture Activities under PMMSY' during July 12 - 16, 2021 in Webex platform.

Seaweed start-up gets \$ 9 m Series B funding. Sea6 Energy to use Aqua-spark investments in R&D, processing. Sea6 Energy, a seaweed farming and processing firm with operations in Tuticorin and Bali, has raised \$ 9 million (approx \$ 67 crore) in Series B funding led by Aqua-Spark, a Netherlands-based investment fund on sustainable agriculture. Singapore-based Silverstrand Capital is the co-investor in the Series B round.

In the Articles section -- Article titled **Ultrasonic Wave against Pathogens in Aquaculture and its Various Applications in Fisheries**, written by Anisha Valsalam and other authors highlighted Ultrasound technology is an emerging field in commercial aquaculture having varieties of applications. The sonic wave of resonance frequency helps in the removal of pathogens, parasites, and harmful algal blooms from the aquatic ecosystem. Sonic technology is an eco-friendly method targeting only the pathogen without seriously affecting the fishes in the culture environment.

Another article titled **Ecosystem-Based Fisheries Management (EBFM): A Modern Tool for Tropical Fisheries Management and Aquaculture**, written by Pritam Das and other authors highlighted that EBFM is a holistic approach of multispecies

management rather than a single fishery including every component of ecosystem. It is a modern strategic tool for tropical fisheries management as well as aquaculture. It differs in many ways from conventional fisheries management and can be used as a great tool for managing marine, inland as well as aquaculture resources. Ecopath, Ecosim, Ecospace and MPAs are the basic tools for the ecosystem management. Some of the actions taken in EU countries proved that it is a strategy to be used in managing and sustaining overall fishery resources.

The other article titled **Ecological Engineering in Pond Aquaculture System**, written by Suwendu Saha and other authors highlighted that Pond aquaculture undeniably offers the potential for food production worldwide. However, with the continuous expansion of this practice, environmental problems such as a high level of water consumption, aquaculture water deterioration and pollution from effluent and aquatic product quality decline seriously restrict the sustainable development of pond aquaculture. Thus pond aquaculture ecological engineering can be managed so as to improve animal welfare and the stability of water treatment systems, reducing the adverse effects on the environment and public health and enabling the sustainable development of pond aquaculture.

Readers are invited to send their views and comments on the news, special feature and articles published in the magazine which would be published under "Readers Column". Time to time, we shall try to update you on various aspects of Aquaculture sector. Keep reading the magazine Aqua International regularly and update yourself. Wish you all fruitful results in your efforts.

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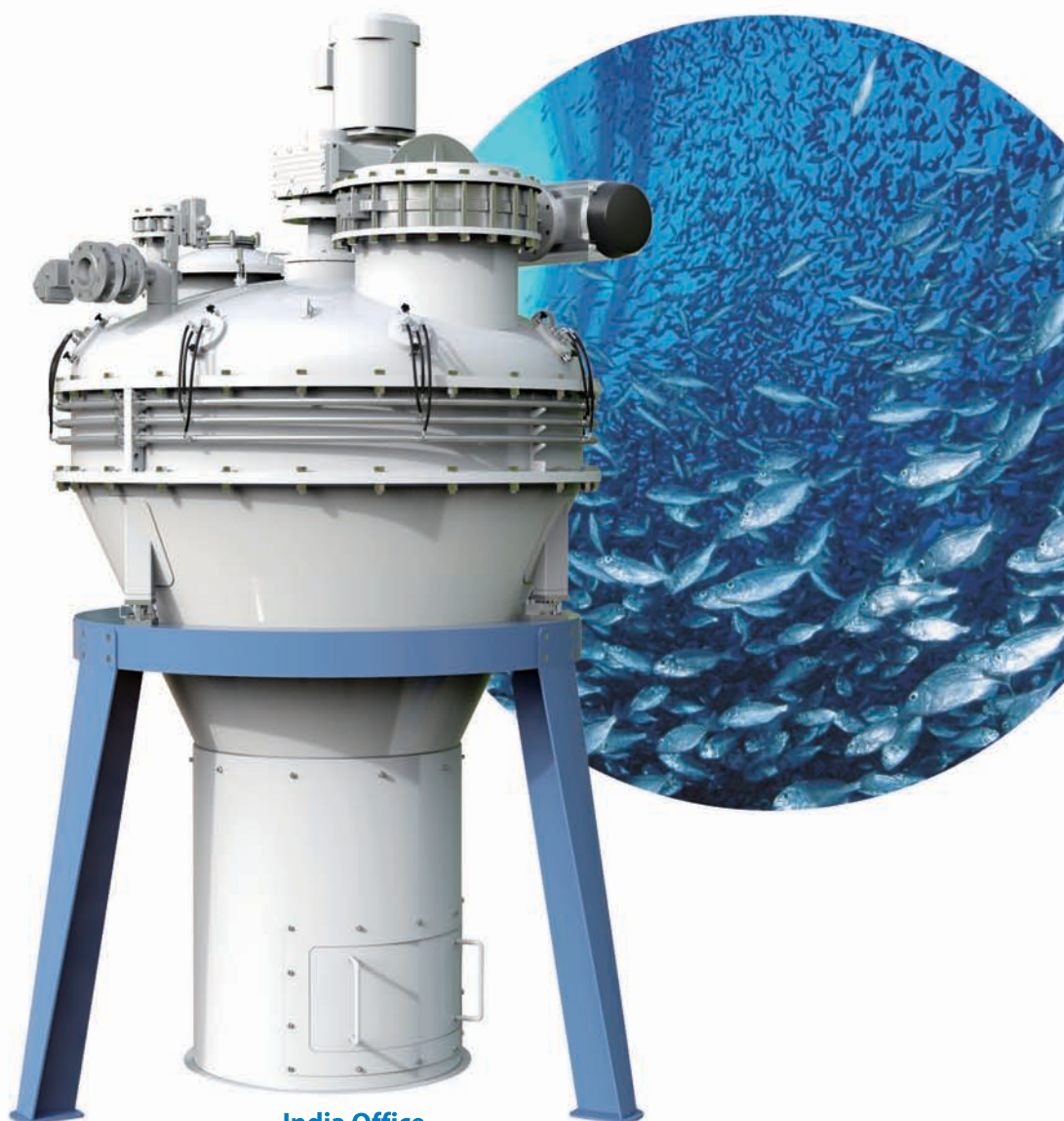
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Shrimp Feed Manufacturers Association team meets Union Ministers and officials at Delhi

"Resolve Aquaculture Sector's serious problems"

Fisheries, Aquaculture, Poultry and Dairy industries would collapse completely this year if these problems are not addressed immediately by Govt of India, and would also affect employment and livelihood of over 20,00,000 families.

New Delhi: To bring to the notice of the Central Government the serious problems the Indian aquaculture industry facing, Dr Beeda Masthan Rao, President, Shrimp Feed Manufacturers Association (SFMA) at national level, Mr A. Indra Kumar, President, Seafood Exporters Association, A. P. Region, Mr Gulrez Alam, Secretary and other office bearers of SFMA met Union Ministers and officials at Delhi and requested them to immediately solve the serious issues of Aquaculture industry.

Mr Mopidevi Venkataramana Rao,



Rajya Sabha member and others accompanied the SFMA and SEAI-AP team in meeting the Union Ministers Mr Piyush Goyal, Union Minister of Commerce & Industry; Mr Som Parkash, IAS (Retd.), Minister of State for Commerce and Industry; Mr Parshottam

Khodabhai Rupala, Minister of Fisheries, Animal Husbandry and Dairying; Mr Loganathan Murugan, Minister of State in the Ministry of Fisheries, Animal Husbandry and Dairying and Mr V. Vijayasai Reddy, Rajya Sabha Member and Chairman of the Parliamentary Standing

Committee on Commerce.

Talking to Aqua International, Dr Beeda Masthan Rao, President, Shrimp Feed Manufacturers Association (SFMA), said that Soya D-Oil Cake (DOC) is the main ingredient in prawn and fish diet. Soyabean DOC price increased from Rs 31,000 per MT on January 2021 to Rs 95,000 per MT as on 22 July 2021. He said prices had doubled in four months, including Rs 95,000 + GST. Soya stock holders have created an artificial shortage and stored the raw material illegally.

Currently, in India shrimp farming is done in about 1.60 lakh hectares of land and this industry is earning Rs 47,000 crores of foreign exchange through shrimp exports, and 100,000 Shrimp farmers and 500,000 workers depend on shrimp farming for their livelihood. In addition, 200,000 workers engaged in hatcheries, feed mills and shrimp processing plants in aquaculture sector.

The SFMA President said





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4. IMPROVE WATER COLOR

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



* COMPOSITION:

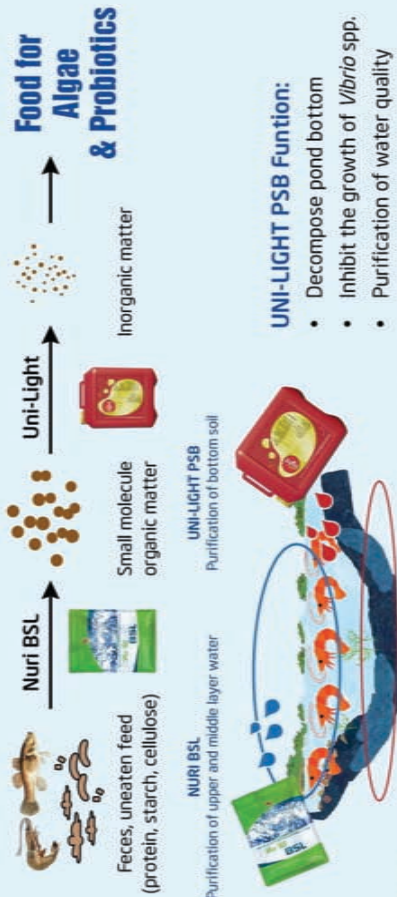
***Bacillus* spp. > 1×10^{11} cfu/kg**
(*Bacillus subtilis*, *Bacillus amyloliquefaciens*, *Bacillus licheniformis*)
Carrier (rice bran, corn gluten) 15%
Moisture 75%
10%

* STORAGE:

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

* DIRECTION OF USE:

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|----------------------------------|--|---|--------------------------------------|
| 7 days before stocking | 800 g - 1,000 g | 1,200 - 1,500 g | 1,200 - 1,500 g |
| Day of stocking | 300 g - 500 g | 800 g - 1,000 g | 800 g - 1,000 g |
| Every 7 - 10 days after stocking | 300 g - 500 g | 800 g - 1,000 g | 3 - 5 days / use 1,000g - 2,000g |

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

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that despite our efforts to reduce costs and drive the industry, due to the sharp rise in Soybean DOC prices, increasing the price of Shrimp feed has become inevitable and as a result shrimp production has become uneconomical for farmers as shrimp prices have not risen to the extent it is needed due to declining of exports due to Covid and other international sanctions and rejections.

Mr Masthan Rao said that the COVID-19 pandemic had also caused international market prices to fall sharply and exports also to fall sharply with China rejecting hundreds of containers of shrimp from India on suspicion of contamination. He said that in this epidemic situation, unfortunately, the rise in shrimp feed price will have a severe impact on the shrimp industry.

Mr A. Indra Kumar, President, Seafood Exporters Association, A. P. Region, said that Soy DOC is also used in the production of fish feeds. About 15 lakh farmers are involved in fish farming, in production, processing, transportation, marketing and other related livelihood activities. And, about 100 lakh people are engaged in this sector, he said, adding that the rise in feed price has also pushed up fish prices.

The poultry industry as an alternative to agriculture in our country is supporting rural families. He said the sector is growing at more than 10 % per annum and is likely to grow by more than 15 % if the industry can meet the Soy feed requirement, adding that Soy DOC high prices are also having an impact on poultry industry.

Whom SFMA team met at Delhi !



Piyush Goyal,
Union Minister of
Commerce & Industry.



Som Parkash, IAS (Retd.),
Minister of State for
Commerce and Industry.



**Parshottam
Khodabhai Rupala,**
Minister of Fisheries, Animal
Husbandry and Dairying.



Loganathan Murugan,
Minister of State in the
Ministry of Fisheries,
Animal Husbandry and
Dairying.



V. Vijayasai Reddy,
Rajya Sabha Member and
Chairman, Parliamentary
Standing Committee on
Commerce.



**Mopidevi
Venkataramana Rao,**
Rajya Sabha Member
accompanied the team to
meet the Ministers.

Mr Masthan Rao said that the above matters have been conveyed to the Hon'ble Prime Minister, Ministers of Fisheries, Animal Husbandry and Dairy. "We have previously requested that the Ministry of Commerce intervene and allow the import of 15 lakh MT of Soybean DOC", he said.

So far, the Ministry of Commerce has not issued final directions, he said. Under these circumstances, we are asking the Ministry of Commerce to import 15 lakh tonnes of Soy DOC.

BMR said the dairy, fisheries, aquaculture and

poultry industries would collapse completely this year if these problems were not addressed immediately, thereby adversely affecting the employment and livelihood of more than 20,00,000 families, and would also affect billions of people, hence, urging immediate intervention by Central Government to avert the crisis. Union ministers and officials responded by assuring that the central government would take an immediate decision on Soy DOC imports.

They asked the Central Government to implement Merchant Exporters

Incentives Scheme to exporters.

36 companies dealing with production of shrimp and fish feed are the members of Shrimp Feed Manufacturers Association. Below are the office bearers of SFMA:

President: B. Masthan Rao, BMR Group

Vice President: Narahari Reddy, Fedora Seafoods Pvt Ltd

Secretary: Gulrez Alam, IB Group

Joint Secretary: Narendra, Growel Feeds Pvt Ltd

Treasurer: Ramakanth V. Aakula, The Waterbase Ltd

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Big boost to aqua industry in A. P.

Govt plans to set up 100 aqua hubs and 8,000 retail live fish vending kiosks soon

Vijayawada, July 9: Here is a good news for fish lovers. Fisheries Department officials of Andhra Pradesh are planning to set up 100 aqua hubs and about 8,000 retail live fish vending kiosks across the State.

Chief Minister Y.S. Jagan Mohan Reddy will launch the project, estimated to cost ₹300 crore, soon.

A model aqua hub was recently opened at Ganguru on the outskirts of Vijayawada.

E-Marketing

“Aqua hubs will be established with a brand name and will have e-marketing facility too. The project will give a boost to the aqua industry in the State,” Commissioner of Fisheries K. Kannababu told The Hindu on 9 July 2021.

“The aim is to supply nutritious diet and sell fresh fish, shrimp and crabs at reasonable prices to the people. Aqua hubs will also help increase the domestic consumption and enhance marketing facility to the farmers,” he said.

The total production had increased from 20 lakh metric tonnes (MT) to 42 lakh MT in the last five years.

Production of inland fisheries had increased from 14 lakh MT to 30 lakh MT between 2015 and 2020. Contribution of the fisheries sector to the GSDP was 8.67 % with gross value

addition of ₹ 50,660 crore in 2019 - 20. The industry is providing employment to about 19 lakh people directly and indirectly in the State”, Mr Kannababu said.

“We are planning to set up eight to 10 aqua hubs in each district. The kiosks proposed at the town and village levels will be linked to the hubs. During the pandemic, the farmers have suffered huge losses due to poor marketing facilities. Aqua hubs will be addressing the marketing issues and providing remunerative prices in the future,” he said.

Joint Director (Marine) V. Venkateswarlu said the aqua hubs would be operated by the Aqua Farming Societies (AFS), promoted by the Fisheries Department.

The Fish Farmer Producer Organisations (FFPOs), individual farmers, fishermen and unemployed youth registered with the hubs could run the retail kiosks, he said.

“Depending on the demand, we will open more aqua hubs and retail fish kiosks, which will provide employment to more people, particularly in the rural areas,” he added.

“Aqua hubs and retail kiosks will provide employment to more than 20,000 people in the State,” Mr Venkateswarlu said.

Assistant Director B. Pavan, who is monitoring the

project, said the Fisheries Department would check the quality of the products being marketed through the aqua hubs at different levels.

“The project, supported by the Pradhan Manthri Matsya Sampada

Yojana (PMMSY) will be maintained with good standards. The Fisheries Department will set up the aqua hubs and hand them over to the AFS,” Mr Pavan said, according to a report published in The Hindu Business Line.

Don't Use Banned Antibiotics in shrimp culture: MPEDA

Kochi, 6 July 2021:

Marine Products Export Development Authority Chairman, K. S. Srinivas has asked aqua-culture farmers to refrain from using any banned antibiotics in the shrimp culture system. He stressed the need to contain the detection of antibiotic residues in farmed shrimp consignments in markets such as the EU, the USA and Japan for enhancing India's market share.

Srinivas was speaking at a virtual function to mark the inauguration of MPEDA's 13th Elisa laboratory at Pattukottai. The laboratory is expected to cater to the antibiotic testing needs of aqua farmers in Thanjavur, Ramanathapuram, Thoothukkudi and Kanyakumari.

He also urged the farmers to utilise the laboratory services to the maximum so that they will get a better sales value by ensuring the quality and traceability of the produce. He informed that the Pre-harvest testing process is completely made through an online platform so that farmers need not visit the lab to get the test done. The farmed shrimps meant for export to the EU are subject to pre-harvest testing in the Elisa laboratories set up by MPEDA. The raw material is screened for the presence of banned antibiotic residues such as Nitrofurans and Chloramphenicol, according to a report published in The Hindu Business Line.

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1,000 shrimp containers stuck in Chinese ports, half of them from Andhra Pradesh



China is the second-largest importer of shrimp from India after the USA. It accounts for nearly 46.44 per cent of the volume of the shrimp exports.

Vijayawada, 21 July 2021:

Andhra Pradesh is the largest producer of shrimp in the country and most of the seafood is exported to other countries.

Anywhere between 1,000 to 1,200 containers of shrimp exported from India are now stranded in the Chinese ports, locking up monetary transactions worth Rs 1,200 crore approximately. Reason: China suspects coronavirus traces on the outer packaging of the frozen shrimp exported from India. Each of these containers on an average has 16 tonnes of frozen shrimp. These exports belong to 50 seafood export companies from the country and of them, 25 are from Andhra Pradesh.

Andhra Pradesh is the largest producer of shrimp in the country and most of the seafood is exported to other countries. China is the second-largest importer of shrimp from India after the USA. It accounts for nearly 46.44 per cent of the volume of

the shrimp exports.

All the 50 companies have been suspended by China. In other words, they have been blacklisted, which has become a cause of worry for the shrimp exporters from Andhra Pradesh. "It has been nearly two months since our exports have been blocked. They are neither clearing the containers from the ports nor clarifying if we can bring them back. Though it has been frozen for exports, Shrimp is a perishable commodity, one more day of delay means, increase is in risk of losing it," said Aluri Indra Kumar, Seafood Exporters Association, AP Region president.

Speaking to TNIE, he said suspending the seafood export companies means they can no longer export shrimp to China, which means they have to suffer heavy losses. Though payment of aqua farmers have been cleared after procurement, the question is what will happen to the next crop or thereafter?

"Though not all shrimp exports are made to China, it accounts for a sizable share of exports. From AP, the majority of the small count (60-150 count) are exported to China, as it is the largest importer of that type of shrimp," he said.

There are around 80 seafood exporters in Andhra Pradesh and now 25 of them have been suspended (blacklisted) by China. Some of those 25 exporters are mostly dependent on China to do their business. "We have already approached the Ministry of Commerce and talks are on at diplomatic level with China to resolve

the issue," Indra Kumar said. Shrimp exports from Andhra are now having their fingers crossed and praying for a positive outcome.

Virus traces?

China suspects coronavirus traces on the outer packaging Rs 1,200 crore: value of the shrimp 50 companies have been suspended by China

China is second largest importer of shrimp from India after the USA

46.44 % of shrimp exports to China

Courtesy: The New Indian Express

How to distribute fish fry?

Contractors not participating in tenders. The reason is that the government price is not affordable. Tenders for fish and prawn cancelled in 32 districts. Committee with authorities to review prices

Hyderabad / Janagama,

July 11: Contractors are on their knees for the state government's free fish fry distribution program. The contractors were not allowed to participate in the tenders as the price fixed by the government was not affordable to them. If nothing else the Fisheries Department has cancelled the tenders. The government is setting up a committee to review the prices of fish fry in response to the demand of the contractors, and the distribution of fish fry is being delayed as the committee report has not been received yet.

The Fisheries Department has decided to release 93 crore fish fry in 28,704 water bodies (ponds, projects) across the state this monsoon season.

The government has allocated Rs 89 crore for this. Minister Talasani, who reviewed the target for distribution of fish on May 27, directed to complete the tender process within 10 days. In June, the Fisheries Commissionerate invited tenders through e-procurement. The price has been fixed at 60 paise for 35 - 40 mm long fish and Rs 1.51 paise for 80 - 100 mm long ones. Tenders were called separately for

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32 districts. However, the contractors demanded that the prices were not affordable and that the price of fish fry should be increased further. Formed a syndicate and boycotted tenders. The Fisheries Department cancelled the tenders in the absence of any more rum. A committee has been set up with the authorities to review the prices of fish fry. The Fisheries Commissioner decided to conduct re-tenders only after examining the market prices and submitting

a committee report. However, there is talk in the fisheries department that some contractors have appeased public representatives and boycotted tenders to raise prices. Over the past two-thirds of the year, a variety of queries have been put in place for the distribution of similar fish fry. The government has issued orders to take photos and videos following complaints that fishermen are being cheated and that small fish fry are being kept in ponds. However, there are allegations that

it was underused. As the rains continue, water is coming into the ponds and projects. So far the collection of fish fry has not started. The handling of tenders has already been delayed by a month. Information that the committee set up to review prices will take another ten days a week to arrive at the report. After that re-tenders are called and agreements are likely to take another fortnight.

Purchasing committees as dummies

There are district-wise

purchasing committees. The committee is chaired by the Additional Collector Chairperson, the District Fisheries Officer Convener, the Animal Husbandry Officer and another officer with experience in e-procurement. This committee works under the supervision of the District Collector. But, all the committees turned out to be dummies. On the other hand, on the 13th of this month, there is a meeting with fish and prawn farmers. It seems that there will be clarity on the discounted price.

Fish fingerling stocking in rivers and wetlands - in view of World Environment Day 2021 theme 'Ecosystem Restoration'

West Bengal, 5 June 2021:

Freshwater flowing and still open water resources in India have been subjected to increasing pollutant load from several sources and also over-exploitation of water resource, i.e., encroachment and abstraction to meet anthropogenic requirements and increasing intensive fishing pressure during past few decades.

These stress exerted have led to deteriorating physico-chemical parameters of water and shrinkage of freshwater resource, furthermore threatening the aquatic fauna, particularly fish communities inhabiting therein. Freshwater fish resource is valuable as it provides food and nutritional security to local farming and fishermen

communities in villages and income opportunities. Standing fish stock find hard to survive in inferior conditions such as eutrophication, silt sedimentation, high BOD content, increased turbidity, non-availability of natural food, reduced water depth and get susceptible to diseases.

Many rivers in India, including river Hooghly and others in West Bengal (WB) have become victims of pollution. Marked and severe depletion of prized fishes *Labeo rohita*, *Catla catla*, *Cirrhinus mrigala* have been reported to have occurred in river Hooghly.

Large perennial wetlands and beels in villages are the repository of valuable small indigenous fishes, upon which local people depend but wise and elderly villagers

have expressed about reduction in fish diversity in beels/wetlands and their availability in much lesser amounts in present times due to environmental perturbations.

As a conservation measure and to bring back pre-existing conditions, in 2016 and subsequent years, scientists at Central Inland Fisheries Research Institute at Barrackpore, Kolkata have stocked fingerlings of *L. rohita*, *C. catla* and *C. mrigala* (25-50gm size) from outside in specific zones (stretches) of river Hooghly (i.e., Bhagirathi) at specific ghats in WB as 'river fish ranching' measure and also in upper and middle stretches of river Ganga. Such fish fingerlings are raised from hatchery-produced spawn and fry stages in controlled pond condition in fish seed

farms. It is rehabilitation and re-establishment of riverine fish stock and its maintenance. Stocked fingerlings will grow, mature and reproduce; fish population will be naturally recruited in following years. This initiative of ICAR-CIFRI has been continuing as a part of ongoing 'Namami Gange' programme adopted by Gol.

River ranching scheme has also been implemented by WB Fisheries Department since recent past in different river stretches in different districts in every financial year to supplement natural fish stock. Furthermore, under initiative of this Department, in one developmental scheme, fingerlings of Indian major carps have been stocked in freshwater wetlands and beels; such large water bodies remain under possession of actively-functioning Primary Fishermen Cooperative Societies (PFCS) at Block level in different districts. Both fish seed and fish feed inputs been provided to PFCS beneficiaries.

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IMC fingerling stocking at Tangon river, Dakshin Dinajpur, WB

In another scheme, fingerlings of threatened indigenous small freshwater fishes (resident species) have been released in other freshwater wetlands in different places in WB. Local village fishermen have been advised and aware not to catch the just-stocked major carps and other fishes, which

must be allowed to grow and reach adult/mature stage. By virtue of stocking rivers and wetlands with artificially-bred fish fingerlings, fish wealth of wetlands will be boosted and their ecosystem will be restored and rejuvenated; as if it is 'Rebirth of spring' - well-managed water bodies with full of healthy fishes. Fish fingerling stocking in rivers and wetlands is a means of aquatic ecosystem restoration and an initiative of both State and Central Government. Subrato Ghosh prepared this concept note in connection with the World Environment Day 2021 theme 'Ecosystem Restoration'.

DDG (Fisheries Science), ICAR, New Delhi; 'Salient features of PMMSY' by Dr J. Balaji, IAS, Joint Secretary, Department of Fisheries, Ministry of Animal Husbandry, Dairying and Fisheries, GoI;

'Problem prioritization in fish marketing' by Dr Nikita Gopal, Principal Scientist, ICAR-CIFT, Kochi; 'Nutrition and feeding for sustainable fish culture' by Dr Narottam P. Sahu, Joint Director, ICAR-CIFE, Mumbai; 'Composite fish culture for livelihood security in rural areas' by Dr Himanshu S. Swain, Scientist, ICAR-CIFRI, Barrackpore; 'Livelihood options in coastal aquaculture including Biofloc technology' by Dr Akshaya K. Panigrahi, Principal Scientist, ICAR-CIBA,

Chennai; 'Convergence of PMMSY with flagship programmes of rural development' by Dr Subrat Kr. Mishra; 'Dependency to self-sufficiency: Meghalaya Aquaculture Mission - a case discussion' by Dr V. Suresh Babu, Associate Professor, NIRDPR-NERC, Guwahati;

'Integration of aquaculture with agriculture for sustainable livelihood including fish farming in pens and cages in India' by Dr Archan Kanti Das, Principal Scientist, ICAR-CIFRI, Barrackpore and 'Convergence of PMMSY with Gram Panchayat Development Plan' by Dr A. K. Bhanja, Associate Professor, Centre for Panchayati Raj, NIRDPR. It was enlightening three-hour training session in each of the five days.

E-Training on Livelihood Promotion through Pisciculture Activities

Hyderabad, 17 July 2021:

The Centre for Natural Resource Management, Climate Change and Disaster Mitigation (CNRM, CC&DM), National Institute of Rural Development and Panchayati Raj (Ministry of Rural Development, Government of India), Hyderabad organized an online training programme entitled 'Livelihood Promotion through Pisciculture Activities under PMMSY' during July 12-16, 2021 in Webex platform.

Dr Subrat Kr. Mishra, Associate Professor, CNRM, CC & DM of NIRDPR and one of the Course Directors anchored and coordinated this five-days' programme. Officers from State Government Departments and research

institutes, college and University teachers (faculty members) from different parts of India attentively participated in this programme (including News communicator Subrato Ghosh), who shared their experiences in brief and enthusiastically interacted with resource persons to learn and gain more knowledge.

In different thematic sessions, invited experts and scientists made highly informative audio-visual presentations and explained the subject matters comprehensively in detail.

The topics covered were: 'Fishery sector scenario of India - scope and prospects' by Dr J. K. Jena,

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Webinar on Maize & Soybean Market Driving Factors & Price Outlook 2021

9 July 2021: CLFMA OF INDIA, the apex organization and the voice

of the Country's dynamic livestock industry in association with AGCON

(a subsidiary of NCML) organized Webinar on Maize & Soybean Market



Agenda

- 4:00 – 4:05 PM : Introduction - Vijay Makhija
- 4:05 – 4:10 PM : Welcome address - Neeraj Kumar Srivastava
- 4:10 – 4:25 PM : Maize Production Estimates Rabi 20-21, Soybean & Maize Outlook Kharif 21 - Nalin Rawal
- 4:25 – 4:40 PM : Market Driving Factors & commodity price outlook for Soybean - Suresh Akkineni
- 4:40 – 4:55 PM : Market Driving Factors & commodity price outlook for Maize - Sreedhar Nandam
- 4:55 – 5:40 PM : Panelist Views, Q&A session - A. Janakiraman, Gaurav Mittal, Sandip Guha
- 5:40 – 5:45 PM : Vote of Thanks - Suresh Deora (Hon. Secretary, CLFMA)

Our Speakers



Nalin Rawal
CEO,
NCML AGCON



Suresh Akkineni
Asst. VP
- Commodity Research,
NCML AGCON



Sreedhar Nandam
Head
- Research & Consulting,
NCML AGCON



A. Janakiraman
General Manager
- Soya Business,
Suguna Foods Pvt Ltd



Gaurav Mittal
Head
- Central Buying Organization,
Godrej Agrovet Ltd



Sandip Guha
Chief Procurement Officer,
Noveltech Group



Neeraj Kumar Srivastava
Chairman,
CLFMA OF INDIA



Suresh Deora
Hon. Secretary,
CLFMA OF INDIA



Dr. Vijay Makhija
Managing Committee Member,
CLFMA OF INDIA

Driving Factors & Price Outlook 2021 on July 9, 2021

The main objective of the webinar is to discuss the Maize Production Estimate Rabi'2021 & Soybean & Maize Outlook Kharif'21, Market Driving factors and Price outlook for Maize and Soybean was discussed in detail.

The webinar was started by the moderator **Dr Vijay Makhija**, Managing Committee Member, CLFMA OF INDIA. **Mr Neeraj Kumar Srivastava**, Chairman, CLFMA OF INDIA delivered the welcome address and initiated the proceedings of the webinar. He Introduced the agenda by giving the preface of the webinar, Spotlighted the topics along with statistics which bound the participants to the webinar. Highlighted the existent Government policies, Challenges, limitations, export potentials, Facts, and Overview of the industry, he also accentuated the CLFMA of India initiatives which helped to mitigate the risk and solve the challenges.

Mr Nalin Rawal, CEO, NCML AGCON discussed about Maize Production Estimate Rabi'2021, Soybean & Maize Outlook Kharif'21. The highlights of the session are:

Maize:

- Maize acreages are lower by current Rabi season by 4.2%. & Production of Maize during the current Rabi season is lower by 9.5% in comparison to Rabi 19-20.
- Rainfall activity is subdued during second fortnight of June resulting in lower sown acreages
- Soybean acreages are 42% lower in comparison to last year during same time period, however under normal rains, total acreages are expected

Please register at :

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to be higher by 10-15% in comparison to last year

- Maize sowing ahead by 16% vis-à-vis last year as on date however planting to be expected lower by 5-10% during Kharif.

- Using remote Sensing technology and satellite, based indices acreage and crop production forecast can be done more accurately

Soyabean:

- Poultry industry is adversely affected by the rates of soybean, higher the soybean rates higher will be the cost of production
- Crop may be improved if Monsoon conditions goes in favourable.
- Movement of people to alternate proteins are due to high soyabean prices and is generally towards cotton DOC, Groundnut DOC etc
- Demand will remain subdued for next 3 months for soy DOC.

Mr Suresh Akkineni, Assistant AVP, Commodity Research, NCML AGCON presented the Soybean-Market driving factors and Price outlook. The major highlights of the session are

- Global soybean end stock 2021-22 season 4.45 MMT (as per USA front, Brazilian front, Argentina front and Chinese front).

- Global Soymeal end stock 2021-22 shall increase marginally by 0.11 MMT.
- Soybean prices are likely to be subdued around INR 8000 levels and ease lower towards INR 6500-6000 levels.

Mr Sreedhar Nandam, Head Research & Consulting, NCML AGCON discussed about Global maize market driving factors, and said the following

- 63 MMT downward revision in production estimates in last one year.
- Ending stocks for global corn 281 MMT, high probability of LA-NINA to resurface.
- 40% of the US corn crop exposed to drought.
- Game changers in corn trade may include push of green fuel mandates, Export tax increase, COVID impact, Asian Swine Flu.
- Global demand to grow by 4%, Opening stocks to decline by 17%.
- Maize acreages lower by 4.2 %, Production in current Rabi lower by 9.5 %.
- Taking look at ethanol policy in 2020-21, it is estimated that India would blend 332 Cr litre of Ethanol which is 8.5 % of blending %.
- ENA production from molasses will be lower

Highlights of Panellists-

Mr A. Jankiramana, GM, Soya Business, Suguna Foods Pvt. Ltd.

- Due to Export- supply tightness observed
- Poultry industry adversely affected by the rates of soybean, higher the soybean rates higher will be the cost of production
- Crop may be improved if Monsoon conditions goes in favourable phase.
- Movement of people to alternate proteins, due to prices generally to cotton DOC, Groundnut DOC etc
- Demand will remain subdued for next 3 months for soy DOC.

Mr Gaurav Mittal, Head, Central Buying Organization, GAVL

- Feed sector- input prices went up by approx. 30% in maize and 70% in soybean.
- Weather can affect most on prices, supply side is most critical element in balance sheet
- Chinese demand is key driver in prices in global markets.
- Brace for volatility, buyers have to be cautiously bold for prices, and focused on supply side.

Mr Sandip Guha, Chief Procurement Officer, Noveltech Group

- Impact due to covid- distraction in supply and demand situations.
- Weather related events- rains are erratic in various areas, farmer may shift to soybean from Maize
- Demand drivers- Poultry, egg, Starch is in spotlight.
- Export programme for maize and soybean are optimistic and attractive
- We should be able to mitigate risk, especially from market view, develop solid market linkages and be ready with multiple formulation for challenging times, proper capital allocation, need for scientific forecasting for better procurement.

Mr Amit Sachdev, Regional Consultant – South Asia (Bangladesh, India, Nepal, Sri Lanka), U S Grains Council

- India may not be able to export much due to Dollar value.
- Indian Maize prices may move up, it may depend on the alternate grain option available, and how much industry can replace.
- Pressure on Indian corn may be high.

Mr Jason John, Team Lead -India at U.S. Soybean Export Council (USSEC)

- Last year we were not able to fetch grain from any South Africa, Myanmar due to political situations
- Spotlighted GM/Non-GM crops, Digestible proteins.
- There will be some supply pressure from South Africa in coming years.

Mr Suresh Deora, Hon. Secretary, CLFMA OF INDIA extended his warm regards and vote of thanks to all panellists, Speakers and participants and concluded the webinar.

Seaweed start-up gets \$ 9 m Series B funding

Sea6 Energy to use Aqua-spark investments in R&D, processing

Bengaluru, 19 July 2021:

Sea6 Energy, a seaweed farming and processing firm with operations in Tuticorin and Bali, has raised \$ 9 million (approx \$ 67 crore) in Series B funding led by Aqua-Spark, a Netherlands-based investment fund on sustainable agriculture. Singapore-based Silverstrand Capital is the co-investor in the Series B round.

The Bengaluru-headquartered Sea6 Energy develops proprietary technologies for converting fresh tropical seaweeds into novel eco-friendly products for segments such as agriculture, animal health, food ingredients, bio-plastics and renewable chemicals. The company raised \$ 35 crore in the Series A funding from Tata Capital In-novation Fund in 2015.

Sea6 has already commercialised the seaweed based bio-stimulants for agriculture in India and overseas markets including the US, Sri Lanka and Vietnam. The company expects to commercialise the animal health products for shrimps and poultry segment soon.

"We plan to utilise the latest funding to augment our research and development, processing facility and strengthen marketing of our agricultural bio-stimulants and animal health products," said Shrikumar

Suryanaryan, Managing Director and Co-Founder, Sea6Energy.

Seacombine

The company has developed the proprietary sea combine, a fully mechanised cultivation system that can simultaneously harvest and re-plant seaweed in deep ocean waters, enabling cost competitive production at scale. The sea combine has been deployed in Indonesia, where the tropical seaweeds are widely grown. "The new funds will contribute

towards the financing of additional sea combine systems to increase supply of seaweed raw material," Suryanarayan said.

Sea6 expects to bring the sea combine to India with the pick-up in cultivation of tropical red seaweeds, which is still in early stages. Sea6 was founded in 2010 at UT Madras by Shrikumar Suryanarayan, former R&D Head of Biocon, who was an adjunct faculty and three biotechnology graduates from the institute - Sailaja Nori, Nelson Vadassery and Sowmya Balendiran. The company has about 60 employees of which about 25 are in the R&D.

"Sea6's first-of-its-kind innovation is well-positioned to impact how we farm seaweed and its utilisation across industries. Their SeaCombine makes

sustainably farming the ocean a possibility, while capturing CO₂ and transforming it into valuable products. The company's approach impressed us from the start, and we are eager to integrate them into our portfolio and begin to work together" said Mike Velings

and Amy Novogratz, co-founders of Aqua-Spark.

Mahindra Agri Business and Stanes are helping Sea6 to market its products for agriculture segment in the country, according to a report published in The Hindu Business Line.

Lallemand Animal Nutrition opens new office in South Korea

Blagnac, France, 23 July 2021:

Lallemand Animal Nutrition is pleased to announce the recent opening of its new office in Seoul, South Korea, to further enhance the company's commitment to customer service and innovation.

Lallemand Korea is dedicated to helping partners and customers optimize animal performance and wellbeing with specific, natural microbial products and service solutions. Its product portfolio offers high-value solutions for ruminants, swine, poultry, and companion animals. The new office will be led by Mrs Choi Si Yeong, Country Manager for Lallemand Animal Nutrition South Korea.

"Building a Lallemand team in Korea enables us to leverage international insights to efficiently and effectively support our local customers," she says. "I look forward to working closely with our clients and building new relationships."



Choi Si Yeong, Country Manager for Lallemand Animal Nutrition South Korea

"Expanding our presence into South Korea is a logical step in our business growth strategy in Southeast Asia," says Paul-Antoine Croizé, Business Area Director Southeast Asia.

"The launch of our Seoul office advances our corporate commitment to building strong relationships with customers. We are confident Lallemand Animal Nutrition solutions will service and support local livestock production in powerful, efficient, and innovative ways."



**Lallemand Animal Nutrition
South Korea team**

Contact:

Pau-Antoine CROIZE

Business Area Director

Tel: + 84 (0) 9025 27765

E-mail: pcroize@lallemand.com

About Lallemand Animal Nutrition

Lallemand Animal Nutrition is committed to optimizing animal performance and well-being with specific natural microbial products and service solutions. Using sound science, proven

results, and knowledge, Lallemand Animal Nutrition develops, produces, and markets high-value yeast and bacteria products - including probiotics, silage inoculants, and yeast derivatives. These innovative solutions positively benefit animal nutrition and well-being, forage management, and animal environment. Lallemand offers a higher level of expertise, leadership, and industry commitment with long-term and profitable solutions to move our partners Forward. Lallemand Animal Nutrition is Specific for your success.

For more information, please visit www.lallemandanimalnutrition.com

Not all products are available in all markets nor all claims allowed in all regions.

Prices of different Shrimp & Fishes in India

| S. No. | Name of the Fish | In Indian Rupees per Kg |
|--------|---------------------|-------------------------|
| 1 | Black Tiger Shrimp | 400 - 450 |
| 2 | Vannamei Shrimp | 250 - 350 |
| 3 | Frozen Tilapia Fish | 180 |
| 4 | Pungasius | 110 |
| 5 | Mud Crab | 400 |

Source: India Mart

Raw Material price

| S. No. | Name of Raw Material | In Indian Rupees per Kg |
|--------|---------------------------------------|-------------------------|
| 1 | Soybean Meal, High in Protein, Hi-pro | 100 |

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Get a Handle on Manure Storage and Odors with BCP 80

30 July 2021: Manure storage is a smelly, messy job that must be done, nevertheless. The end product can be applied as nutrient rich fertilizer or compost on fields and in garden beds. It can also be used as a biogas feedstock to create renewable natural



gas. By taking advantage of Bionetix® International's BCP80™ manure treatment, farmers and biogas producers can take a faster route to the benefits of manure while avoiding some of the odorous, inefficient detours.

Cut Costs of Manure Pit Maintenance

BCP80™ contains beneficial microorganisms and nutrients that accelerate the biodegradation of animal wastes and other wastes high in proteins. This helps ensure rapid biological startup at the beginning of manure storage. By speeding up the biological digestion of animal wastes, BCP80™ can also reduce costs of manure pit maintenance and ultimate drainage. BCP80™ helps with sludge accumulations and improves the overall ease and efficiency of manure handling by more quickly

breaking up solids and decreasing the organic content. The resulting fertilizer will also be more valuable because of the beneficial microorganisms at work in the manure to create a more uniform product and further benefit the soil.

Control the Odor

One of the most annoying aspects of manure storage is the smell, whether coming from manure lagoons, slurry storage tanks, or manure pits. These manure holding areas are periodically pumped out so that fertilizer can be spread on fields. In the meantime, the manure decomposes and can generate hundreds of odorous compounds, including hydrogen sulfide, ammonia, and methane. BCP80™ helps reduce the concentration of these odorous compounds so the smell becomes more manageable.

Boost Biogas Efficiency

The same microorganisms that break down manure into manageable waste can also be used to boost the efficiency of biogas operations that use animal waste for feedstock. Often,

biogas operations are held back from reaching their full potential because of limitations in the hydrolysis phase. Incomplete hydrolysis can result in excess hydrogen sulfide production, which makes matters worse by releasing additional bad odors. Adding BCP80™ to manure feedstock can accelerate anaerobic digestion, helping biogas plants reach higher efficiency while also reducing odors. It can be used in conjunction with BCP12™ or other biologicals for best results.

Slurry Lagoon Test

A slurry lagoon was treated with 5 kg of BCP80™ and 20 L of STIMULUS™ to examine their effect on manure and odor reduction. Seven days after the addition of microbes, some of the surface scum had already dissolved. Only 10% remained within 14 days, and the rest disappeared shortly thereafter and did not return. The five-month survey confirmed that no sludge sedimentation had occurred. The odor also improved within just two days of application and disappeared a week later.



The need for better manure storage and handling options is widespread. BCP80™ is an excellent biological option that meets that need by stimulating natural processes to accelerate waste digestion, reduce odors, and maximize the final value of manure for fertilizer or biogas. Learn more about BCP80™ manure treatment here:

<https://www.bionetix-international.com/products/waste-treatment/bcp80/>

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Bionetix International is a Canadian-based company that produces biological products used in thousands of field applications worldwide. We promote a healthy environment by providing superior, environmentally friendly alternatives to current treatment methods. Our customers are able to clean and remediate contaminated systems or boost agricultural productivity in a cost-effective, natural, and non-intrusive way through the application of our biological products. Headquartered in Quebec, Canada; Bionetix International is a subsidiary of Cortec Corporation. ISO 9001:2015 Certified.

Grobest Feeds committed to feeding the world through Development of innovative products to support safe and sustainable Aquaculture

Grobest as a company is known to drive in the aquafeed bringing solutions to the farmers worries through its feed. Grobest launched its functional performance feed more than six years from now in challenging markets like Thailand, Vietnam and Indonesia for shrimp and high-value fish. In these markets, Grobest has shown the difference how farmers if they use our feed proactively have been able to harvest a successful crop. The same has been demonstrated several times since last year in many corporate farms in India. Grobest in India intends to be the differentiator and be the Farmers Friend in providing solutions and driving this through the strong technical team, said the newly appointed Chairman of Grobest Feeds Corporation (India) Pvt Ltd in an interview with Mr M.A. Nazeer, Editor, Aqua International. Excerpts:



Ramakanta Nayak, the new Chairman

Grobest Group is one of Asia's biggest and most advanced producers of aquatic feeds. When Grobest was established in Taiwan in 1974, its primary goal was to produce top-quality aquatic feeds. Due to quality manufacturing and intensive research, the Grobest brand became established as the industry leader. Over the years, the business has grown, expanded abroad and successfully transformed itself into the Grobest Group, a vertically integrated aquaculture enterprise. Through knowledge and advanced technology acquired by decades of accumulated experience, the Group can provide a wide array of aquatic products and services to meet the highest quality standards required by our global customers. We are committed to feeding the

world through the development of innovative products to support safe and sustainable aquaculture.

Promoters of the company at global level

Grobest Group was established by two founders from Taiwan (The Ko and Chen families). In November 2018, a Global Investment firm, Permira has become the sole corporate shareholder of Grobest.

Grobest Feeds entry into India

Grobest Group Limited was founded in 1974 and is headquartered in Taiwan. Grobest Feeds Corporation (India) Pvt Ltd was started in India in 1999 and commenced activity by distributing imported Grobest feeds in the domestic market. The company started manufacturing operations

in 2002 with the state-of-art facility in Chennai. Catering to the farms in coastal Andhra Pradesh, Tamil Nadu, West Bengal, Odisha, Kerala, Karnataka, Goa, Gujarat and Haryana regions.

Brief profile of Ramakanta Nayak, the Chairman

Mr Ramakanta Nayak has joined Grobest India effective 19 July 2021. Before joining Grobest India as the Chairman, he has served as Grobest Group Marketing Director since June 2020. He has more than 15 years of experience in the animal industry. He has the vision to make a difference and contribute further to the strategic growth of the industry. He is more excited to work into developing models and solutions, understanding the needs of the industry.

Earlier, he was associated with various MNCs like Novozymes, Novo International, Nutreco and Trouw Nutrition in several executive roles, responsible for strategic planning and implementation to grow the business.

Head Quarters of the company in India & Worldwide

The global headquarters of Grobest is in Taiwan and Hong Kong, while its Indian operations headquarters is located in Chennai.

Key persons of the company

Mr Samson Li is the Chief Executive Officer.

Samson Li has served as Grobest Chief Executive Officer since November 2018. He started his career in Mitsui Hong Kong and Japan Fine Chemical industry responsible for the pharmaceuticals & agrochemicals trading and investments in Europe, Asia and China. His experience in animal and aqua nutrition reaches back to 2001 when he started to work for Novus, a US-based proprietary leader in global feed additives. Later, he developed several key management and executive roles in different stages of the value chain, ranging from feed additives through premixes to animal and aquaculture feed (Nutreco). Before joining Grobest in November 2018, he was the President of the Animal Nutrition Division of ADM, responsible for the overall global strategies and businesses of the division.

Grobest has 14 Feed Mills in Asia

In India, our feed mill is located in Chennai near Ponneri, Tamil Nadu. We have 14 feed mills in Asia. We are committed to becoming a global player through our expansion plans to provide high-quality standard feed and Functional Performance Feeds to shrimp farmers.

Categories of feed for Shrimp & Fish

Grobest Group produces freshwater fishes feed and shrimp feed. Grobest India is involved in the manufacturing of high-quality shrimp feeds. Though we produce daily health care feeds such as Pacific White, Aqua Best and Smart for both White and Black Tiger Shrimp, our focus remains on our high-quality Functional Performance Feeds.



Samson-Li, CEO, Grobest

Our nutritional approach on functional feeds remains our top priority with a dedication to helping farmers in combating diseases like WFS, EHP, Vibrio etc.

Grobest's R&D facilities

Grobest's R&D department consists of several sites in Taoyuan, Taiwan and Fuzhou, China and is dedicated to the development of additive products. We classify our R&D operations as product testing, animal testing, physicochemical analysis, fermented product development, microorganism development, Chinese herbs development and small-volume trial production. Understanding the challenges that prevails in the

cultural environment our R&D unit has designed compound solutions to boost up the immune system of the cultured animal. Our team of experts in immunology, nutrition, physiology and animal breeding work to further the development of ecologically balanced and environmentally sustainable solutions.

Commercial and Technical Services team in India

We have a strong Sales and Technical team that is experienced and skilled enough in the field of shrimp aquaculture. On their joining at Grobest, we conduct an orientation program on our products and recent developments in the field of aquaculture. The team also undergoes routine training by our in-house team and Grobest Group Commercial

"The team also undergoes routine training by our in-house team and Grobest Group Commercial Academy. Our team visits shrimp farms regularly and guides farmers on good farming practices from start to end to get a successful culture"

Academy. Our team visits shrimp farms regularly and guides farmers on good



Manufacturing Facility Fermentation System



Ramakanta Nayak

farming practices from start to end to get a successful culture. Also, the team helps the farmer in diagnosing diseases, detecting the overall health condition of the shrimps and offer environmentally friendly solutions to our customers.

Grobest's area of operations

Grobest has operations in Taiwan, Vietnam, Thailand, China, India, Indonesia, the Philippines and Malaysia. In addition to this broad presence across Asia, the world's largest aquaculture market, Grobest

"Our functional feeds contain speciality ingredients that help in strengthening the immune system of the shrimp and helps the shrimps to respond better during environmental stress. It has proven to strengthen and protect shrimp's vital organs, i.e. hepatopancreas, gill and intestine"

is also a pioneer and technological leader in an array of innovative and differentiated functional feed products, focused on preventing and combating diseases as well as

"The Grobest company provides a full range of services and technical assistance to farmers throughout Asia, including pond maintenance, water treatment, and soil and disease testing"

increasing yields. Furthermore, the company provides a full range of services and technical assistance to farmers throughout Asia, including pond maintenance, water treatment, and soil and disease testing.

Key Accounts and Dealership in India

Grobest India sells feeds to directly to Key Accounts and through its well-established dealer network. We have around 70 key accounts and dealers in India.

As the new Chairman, what are your priorities to establish Grobest Feeds in India ?

Grobest as a company is known to drive in the aquafeed bringing solutions to the farmers worries through its feed, Grobest launched its functional performance feed more than six years from now in challenging markets like Thailand, Vietnam and Indonesia for shrimp and high-value fish. In these markets, Grobest has shown the difference how farmers if they use our feed proactively have been able to harvest a successful crop. The same has been demonstrated several times since last year in many



Grobest Functional Performance Feed

corporate farms in India. Grobest in India intends to be the differentiator and be the *Farmers Friend* in providing solutions and driving this through the strong technical team.

Plans to expand product portfolio

Yes. We do have a plan to increase our product portfolio. In early August, we are planning to launch a new functional feed, Aqua Kare, that can serve the purpose of boosting immunity and enhancing the growth of shrimps.

Prospects of Feed & Nutrition segment in the sector

There is a huge prospect available to the feed industry in any livestock business and Aquaculture is not an exception to this. Nutrition plays an important role in aquaculture maintaining the growth and well-being of the culture



Grobest Feedmill in Taiwan

animal. Considering the present status of the aquaculture business with the increasing production costs due to the increase in the cost of inputs, low market price, and disease issues, it is the need of the hour to find out alternative ingredients with no loss in the nutrient profile for the animal. We would like to continue our work in Shrimp and Fish nutrition in the days to come.

How your nutritional approach on functional performance feeds serves the farmers need?

We are the first one to introduce Functional Performance Feed in the aquaculture sector. We have been dedicated to using a nutritional approach to develop Functional Performance Feeds such as Aqua Supreme and Aqua Prima to help to

"Our farmers are happy with the usage of functional feeds as it helps to reduce stress and improve the immune system to counteract the opportunistic pathogens present in the culture environment"

culture more healthier shrimps. Our functional feeds contain speciality ingredients that help in strengthening the immune system of the shrimp and helps the shrimps to respond better during environmental stress. It has proven to strengthen and



protect shrimp's vital organs, i.e. hepatopancreas, gill and intestine. The usage of Aqua Supreme is the best strategy in preventing diseases and it is recommended to use from the beginning of the crop. Feeding the shrimps with Aqua Supreme helps to improve the survival, growth and obtain better feed conversion. It also helps in minimizing the impact of White Feces disease and EHP. Our farmers are happy with the usage of functional feeds as it helps to reduce stress and improve the immune system to counteract the opportunistic pathogens present in the culture environment.

Company's strategy towards shrimp farmers

Our strategy is to help and support farmers in achieving a successful, disease-free culture for profitable farming. Our focus has been on

providing superior quality feeds to the farmers to get good profitability. We actively engage our farmers with our Market Support Programme (MSP) and encourage our happy customers to share their success stories with other farmers and our farmers have been extending their valuable feedback to the farmer community.

1. Comments heard that feed millers are using harmful chemicals and antibiotics in the feed? What do you say about it?

We completely disagree with these comments. We have Good Manufacturing Practices (GMPs) and strongly follow the regulations that every feed miller is doing. Nowadays, farmers are aware of the ingredients available in the feed which are detailed in the feed packages too. We continue our effort to bring the best to the farmer in all possible ways. Grobest provides a cost-effective solution through its unique functional performance feed to avoid the occurrence of diseases. Grobest functional performance feed includes a variety of special fermentation products and nutrient enhancers, which can make farmed species healthier and give farmers the confidence to say NO to antibiotics.

2. Vision and Mission for Grobest Feeds

Our mission is to feed the world by improving the health and growth of aquatic species through advanced nutrition. Our vision is becoming the leading feed producer in the Indian feed market.

Important Executives of Grobest Feeds in India with their names & positions.

1. Mr Ramakanta Nayak,
Chairman

2. Mr Samuel Johnson,
Head – Finance & Accounts

3. Mr Nagarajan,
National Sales Manager

4. Mr Mohan CH Murali,
Head – Operations

5. Mr Sekar,
Senior Manager – HR and Administration

6. Dr Rajaram,
Senior Manager - Formulations.



Ramakanta Nayak along with his overseas colleagues

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 BOD and COD levels.

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



COMPOSITION:

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

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For Specific Usage & Dosage

PRESENTATION: 500 gms & 1 kg



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COMPOSITION :

| | | |
|-----------------------|---|-----------|
| Vitamin-A | - | 5000IU |
| Vitamin-D3 | - | 1000 IU |
| Vitamin-E | - | 15 mg. |
| Vitamin-B1 | - | 1.86 mg. |
| Vitamin-B2 | - | 1.25 mg. |
| Vitamin-B6 | - | 0.62 mg. |
| Niacinamide | - | 30 mg. |
| D-Panthenol | - | 1.26 mg. |
| Inositol | - | 10 mg. |
| Folic Acid | - | 10 mg. |
| Biotin | - | 15 mcg. |
| Vitamin-B12 | - | 6.25 mcg. |
| L-Lysine | - | 175 mg. |
| DL-Methionine | - | 150 mg. |
| Vitamin-C | - | 200 mg. |
| Toxin Binders | - | 200 mg. |
| Hepato | | |
| Pancreatic stimulants | - | 100 mg. |
| LDLP | - | 15mg. |
| USFA | - | 5 mg. |
| APF | - | 30 mg. |
| Calcium Gluconate | - | 20 mg. |
| Magnesium | - | 25 mg. |
| Manganese | - | 15 mg. |
| Cobalt | - | 15 mg. |
| Zinc | - | 25 mg. |
| Selenium | - | 2.5 mcg. |
| Protein Hydrosylate | - | 1000 mg. |
| Betaine Hydrochloride | - | 1000 mg. |

BENEFITS :

Improves feed conversion and growth rate. Enhances resistance against diseases. Ensures uniform growth. Neutralizes imbalances of Vitamins, Minerals, Amino Acids and Proteins Detoxify toxic materials and improves health. Improves absorption of the Calcium, Phosphorous and reduce incidence of loose shell.

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and dosage.

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Ultrasonic Wave against Pathogens in Aquaculture and its Various Applications in Fisheries

anisha.aahpa901@cife.edu.in

Anisha Valsalam¹, MeghaKadam Bedekar²

¹PhD Student,

²Principal Scientist,

Aquatic Animal Health Management Department.

ICAR- Central Institute of fisheries Education,

Mumbai- 400 061, Maharashtra, India.

Highlight Points

- ▶ Ultrasound technology is an emerging field in commercial aquaculture having varieties of applications.
- ▶ The sonic wave of resonance frequency helps in the removal of pathogens, parasites, and harmful algal blooms from the aquatic ecosystem.
- ▶ Sonic technology is an eco-friendly method targeting only the pathogen without seriously affecting the fishes in the culture environment.

Abstract

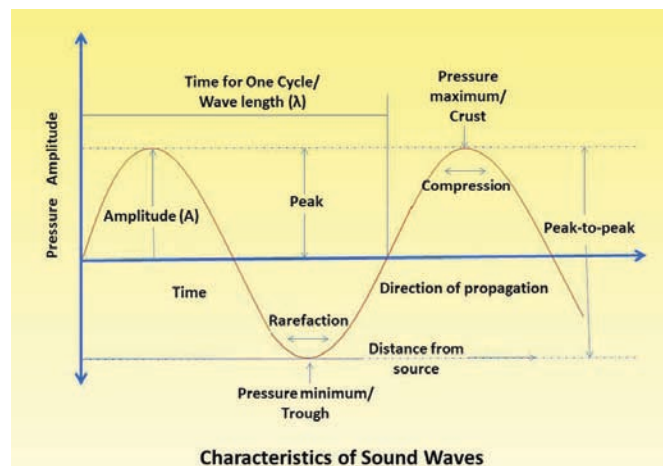
From time immemorial, the use of energy, frequency, and vibrations have been put forth by many. But, its many angles of utilities are yet to be explored; one such exploration is the application of sound waves to treat diseases by the destruction of pathogen or causative agent of the disease in the aquatic environment. The vibration of parasite cells or a microbe is the concept of destruction which is done utilizing the resonance frequency of the particular organism. Each organism's core frequency is called the resonance frequency at which the cells will vibrate in its nature. When this resonance frequency is applied to the particular organism, its cells break, resulting in death and this kind of technology is gaining importance in aquaculture, especially against sea lice infection of cultured cold water fishes. Although ultrasound technology has been successfully utilized in various fields, including medicine, its uses are not restricted. This article explains the applications of ultrasound and other sonic technologies in fisheries and aquaculture.

Introduction

As aquaculture intensifies, complications associated with management also emerge. Thus, to reduce and prevent circumstances such as the occurrence of diseases, low

water quality, and harmful algal blooms, remedies are being sorted out. Most of the therapeutics used as remedial measures for eliminating these dreadful situations are having their side effects in the culture organism. For this reason, the arrival of eco-friendly as well as the culture organism-friendly method is being welcomed. The application of ultrasonic waves in aquaculture is one among them. Even though sonic wave technology is applied in many branches of science, in aquaculture, it is a new advent which is expected to have a significant scope. More research is needed in this field against fish pathogens. Although the use of SONAR for marine fishing and navigation had started early, the core application of sound waves in other aspects of fisheries, aquaculture, and fish processing is a lot. Such explorations can be achieved by combining the capacities of fisheries engineers and fisheries biologist. An integrated approach is needed in expanding the branch of acoustics in the aquaculture sector along with its already existing applications in marine fisheries.

Technologies utilizing sound waves are used for various applications such as interior characterization, repulsion of insects, seismic imaging, audio data technology, acoustic tweezers, acoustic levitation, doppler ultrasonography (DUSG), scanning near-field ultrasound holography (SNFUH), and high intensity focused ultrasound (HIFU). Spectral ultrasound imaging (SUSI) is used for structural property and composition analysis of tissues in animals using sound waves. In the fisheries sector, sonic technology has been utilized for parasite control, pond algae control, extraction of lipids from microalgae, 'SONAR' for fishing and navigation, ocean floor mapping using interferometric synthetic aperture sonar, acoustic density estimation of dense fish shoals, and sonophoresis for enhanced vaccine



characteristics-of-sound- waves

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uptake. The ultrasonic treatment has been found to increase the yield of collagen extracted from the skin of fishes such as sea bass. Sonic wave technology has been shown to reduce the egg hatching time of marine fish. This technology also improves electricity generation in micro fuel cells. In the seaweed (*Gracilaria* sp) culture environment removal of fouling organisms and dirt from the algae is facilitated by sonic technology. Another important use of this technology is the ADDs (Acoustic Deterrent Devices), used for the avoidance of sea mammals in the fish cage culture provinces and alert for the presence of netting in the sea. Thus, sonic and ultrasonic methodologies are utilized in various aspects of fisheries and aquaculture.

What is an ultrasonic wave?

Sound is defined by Popper and Carlson (1998) as a density disturbance that propagates through a medium. 'Ultra' means high and 'sonic' denotes sound, which specifies the very high level of sound that's beyond the human hearing range and is above 20KHz. Naturally sound waves at this range are employed by some nocturnal creatures, marine animals, and insects. Examples include marine mammals such as whales, dolphins, orcas, porpoises, and other animals such as bats, rodents, and birds. This high-frequency sound wave is used in medicine to visualize the internal organs of the body or fetal imaging, and this process is called as Sonography.

Usage principle

Though the ultrasound wave technology has various applications, utilizing it for pathogen removal in aquaculture systems is still not commercialized in India. Eliciting sound waves of any frequency without regulation in our area of interest will not ascertain the expected result. Finding out the resonant frequency is the fundamental principle of using the ultrasonic wave. For instance, consider targeting a pathogen or a parasite from a fish. The 'fish' and the 'pathogen attached along with the fish' are having different resonant frequencies. So targeting the pathogen needs only to find out its resonant frequency to solve the problem, which is quite tricky because of the uniqueness of the frequency from one organism to another. Once the resonant frequency is known, the other environmental factors affecting the process need to be addressed. Proper utilization of ultrasonic resonance frequency breaks the cells of the pathogen resulting in its death. The spreading of energy using the sound wave over massive areas results

in the reduction of the power per area, which is called 'geometric scattering'. Hence the area of treatment should be near the source of the ultrasonic wave generator for better results. As the sound wave propagates, some energy is absorbed depending on the temperature, pressure, and salt content of the medium. The factors such as scattering, reflection, and deflection contribute to the weakening of the sound wave as the wave propagates to a more considerable distance.

Other criteria needed for consideration is the medium in which sound wave is used. Typically sound waves travel fast and work fine in the liquid medium than air. Hence, the net effect will be more in liquid medium than air. Also, air can be considered as a significant barrier in the case of using an animal specimen for imaging using the ultrasonic wave. Usages of sonic wave need the consideration of several other factors which includes the variables such as frequency, intensity, beam dimension, and duration for effective utilization.

Bacterial control

Pathogens in aquaculture include all the organisms which cause diseases comprising the bacteria, fungus, virus, and parasites. For controlling the bacterial population, ultrasonic wave usage was demonstrated by Drakopoulou *et al.*, (2009) in which the deactivation of the gram-positive as well as the gram-negative bacteria was done at 24KHz. Utilizing this new approach, the bacterial population in the wastewater effluents in addition to aquaculture systems can be controlled. This approach provides the safe side of reducing the bacterial load, including the pathogens rather than using antibiotics. The usage of antibiotics once called the 'boom in medicine' is now losing its power because of antimicrobial resistance (AMR) occurrence among the pathogens. Also, there are strict regulations for using antibiotics in aquaculture. Considering all this, the need for developing new techniques as remedies is essential in the case of pathogenic microbes which cause diseases. For this reason, the ultrasonic wave technology can be utilized since its use in the water system does not harm the fish under culture rather affects the target pathogen against which the frequency is used.

Reduction in the bacterial load occurs by using the pulsed sonicators of the resonant frequency. An increase in the power and treatment time results in the total coliform reduction in the water. Coliforms are considered as the indicators of faecal contamination in water, and their presence is undesirable in the drinking water. But to use sonication in an economically-friendly manner, the power usage can be reduced by increasing the pulsation off duration. Also, the bacterial load reduction was found to occur in log values among the bacterial species such as *Enterobacter aerogenes*, *Bacillus subtilis*, *Staphylococcus epidermidis*, with the use of ultrasound upon increasing the power. Besides the bacterium, *E. aerogenes* is found as more sensitive to the ultrasonic wave during its 'exponential growth stage', which is the faster multiplication stage of the bacteria. So this way of minimizing microorganism load can be done for yeast (*Aureobasidium pullulans*) and bacteria that are present in the water. This inactivation is carried out by the production of free radicals and reactive oxygen species that damage the

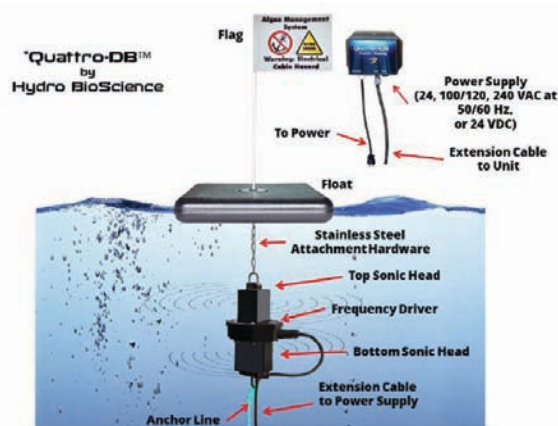


Illustration of Quattro DB ultrasound system

Vannamin® feeding

Lowers Cortisol Stress upto **-53.62%**

- Dr C S Bedi, Guybro Animal Health Pvt. Ltd., Mumbai



Stress is physiological response to Stressors. When fish/Shrimp are under stress, to fight stress effectively the body releases stress hormone – Cortisol at a rate of 0.02 - 0.20 mg/g body weight.

Essentially there are two types of Cortisol

- Resting (basal) cortisol which in everyday life is required for normal functions.
- Reactive cortisol level, which increases in response to stressors.

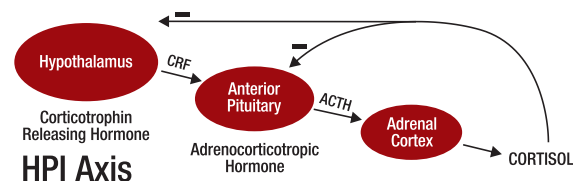
When fish/shrimp are under stress, they secrete cortisol. As the stress goes up, cortisol level goes up. To relieve stress they release cortisol in pond water through urine, faeces, seminal fluid, skin, gills in order to be free of stress – but they invite more problem – the water gets cortisol – the stress hormone which itself is a stressor to Fish/Shrimp feed.

The Solution is –

- Change or partly change pond water to reduce cortisol and/or
- Add **Vannamin** in pond water, also add **Vannamin** in feed

Vannamin with 77 hydrophilic Organic Minerals in Pond water is absorbed through oral Skin/Gill and meets total nutritional needs of aquatic animals and lowers cortisol level.

Reduced cortisol stress level, makes fish/shrimp free from stress – promoting growth.



Trials conducted found Vannamin feeding –

- Reduces Cortisol level -53.62%

Stress is the main cause of high level Cortisol hormone released by hypothalamus-pituitary-internal axis(HPI). Hypothalamus releases corticotrophin releasing factor (CRF) towards blood plasma circulation, further stimulates secretion of adrenocorticotrophic hormone (ACTH) from anterior pituitary gland which finally activates release of cortisol.

Vannamin feeding makes fish/shrimp free of stress – saves water exchange and promotes growth.

| Corisol (nmo/l) In fish before & after being stressed | | | |
|---|------------|-------------|----------|
| | Pre stress | Post stress | % change |
| Handling | 5 | 449 | 8980% |
| Crowding | 13 | 358 | 2753.85% |
| Capture & Transport | 33 | 480 | 1455% |
| Handling & Confinement | 77 | 698 | 906.50% |
| Sea Lice Challenge | 99 | 339 | 343% |

Ref. : i) Fish Handling affects cortisol in water of recirculating aqua system Aquaculture Vol. 468, Part J, 1 Feb 2007 Pg 255-261

ii) Measuring Cortisol in the water as indicator of stress caused by increased leading density in common carp. Aquaculture 218 (1) 685 – 693 March 2003 Neil Ruane and Hans. Komen

High level of Cortisol is bad for health :

- Stimulates catabolism
- Liver muscle enlargement
- Oxidative degeneration of fat
- Increased blood glucose

Effects on Fish & Shrimp :

- Sharp reduction in body weight
- Elevated FCR
- Low energy, low growth
- Morbidity/Mortality

Vannamin Feeding Suggestions :

| Through Water : per Acre/2 Ft depth/50000 PL : | |
|--|--|
| Antistress & Anticramping | 5 Kg every week till the normalcy restored |
| Full Moon & No Moon stress | 5 Kg 2 days before & 2 days after |
| Through Feed : | |
| Running Mortality/ Moulting Mortality Syndrome | 10 gm or more per Kg feed |

Vannamin Conc. with 77 hydrophilic organic minerals lowers cortisol stress and meets total mineral nutrient needs resulting in optimum development, growth and performance.

FEED Vannamin, IT WILL TRANSFORM YOUR FARM



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cell. The inactivation mechanism continues in the treated cells even after the sonication process is terminated. But there is a drawback in using this ultrasonic wave against capsulated bacteria as these bacteria are found to confer resistance to the sound wave. The capsules are external structures surrounding the bacteria comprising mucopolysaccharide which involve in various protective mechanisms of the bacteria. Hence, finding out the mechanism to disrupt the capsule of this kind of bacteria may aid in destruction.

Heckerman *et al.*, in 2010, have patented a system to disrupt pathogens using ultrasound. Wherein a computer-aided with the resonance frequency database of the pathogen is used to compare the average resonance frequency of the healthy cells surrounding the target material. But this ultrasound system is designed for treating targets in the cells and tissues of higher animals and not for application in the aquatic environment. However, this technique can be modified and adapted for the underwater system, for which invention is waiting to be made by the innovators.

Another approach of controlling the bacteria is combining the sonication with the traditional bacterial treatment process such as the use of antibiotics; wherein, the low dosage of the authorized antibacterial component is enough to act against the pathogen when used in combination with the quiet intensity sonication process. This process is useful against *Chlamydia*, planktonic bacteria, and bacterial biofilms. The low-intensity sonication alone is not effective against bacteria unless it is combined with an even low dose of antibiotics.

Parasite control

In temperate aquaculture, salmon farming is a profit yielding industry in some countries such as Norway. But the occurrence of parasitic infection is a common phenomenon in the cage culture provinces of the salmon farming industry. Sea lice are the ectoparasitic copepods coming under the family 'Caligidae'. They are found attached to the skin, gill, and fin of the fishes and feeds on the skin, mucous, and blood of the fishes. The lice create wounds in the fishes in the feeding area, thereby allowing the secondary pathogens to invade inside the fish through the scars. For controlling this parasitic infection, various chemicals are used, including cypermethrin, emamectin benzoate, teflubenzuron, hydrogen peroxide, dichlorvos, azamethiphos, and pyrethrum. But the use of chemicals will result in environmental impacts and other side effects in the farmed fishes. Also, the chemicals result in high treatment costs due to repetitive treatments. The Norwegian Food Safety Authority has set an upper limit of 0.5 sexually mature female lice per salmon as an acceptable limit in fish farms. When the limit exceeds, the treatment must be initiated in the culture system.

The Chilean sea lice (*Caligus rogercresseyi*) are the main parasite which corresponds to the loss of USD 300 million in the year 2009. This parasite is also found as a vector of transmitting Infectious Salmon Anaemia virus (ISA) among the fishes. Sea lice are attracted to light at the earlier life stage. By employing this strategy along with the sonic technology, a commercial sonicator is developed by a Chilean company called 'Usonic' which is created under CORFO (Chilean National agency of economic development). This



sea-lice

technology results in a 30-50% reduction in sea lice load. The company 'Usonic Ltd' has got the Global Aquaculture Alliance's innovation award for its development of the method of controlling the sea lice in 2014.

Further, removal of salmon lice, *Lepeophtheirus salmonis* was tried in a small scale study in which the sound waves with the frequency of 9.3KHz elicit cavitation effects on the parasite along with the reduction in the parasitic load in the host animal. However, field application of ultrasonic waves for the removal of *Lepeophtheirus salmonis* is not assured. Thus the technology needs optimization for every kind and size of the target organism.

Steven Alevy in 2017 had patented a device for removing the sea lice from the atlantic salmon using ultrasonic waves. Wherein he designed a herding passage tube for salmon in which the transducers are fitted on the periphery of the tube. The tube is lined interiorly with stainless steel and exteriorly with the sound-absorbing material. This tube is used for removing sea lice from salmon during the normal herding process. Still, the method can also be employed in the cage cultured salmon where the fishes should be fed in an enclosure, and white light should be used for attracting the parasitic sea lice along with the application of the ultrasound from the electronic sonicators which should be fitted at the inner periphery of the province. This method is encouraged in Indian cage culture systems for parasite removal.

Pond algae control

Non chemical algal control measures are cheered in the aquaculture industry for which the sonic system is the best approach. It is a cost-effective approach and can be even utilized for larger ponds. The sonic technology can be applied for the eradication of harmful algal blooms caused by Cyanobacteria such as *Microcystis aerogenosa*. Algal cells contain small vacuoles of air inside for buoyancy which gets vibrated by the ultrasonic waves resulting in its damage. Vibrations damage the cell wall and result in the condensing of the cell contents at the centre of the cell by which the normal nutrient uptake is avoided. This method does not affect the fishes but can be employed for the control of geosmin in water since the microorganisms produce geosmin. Filamentous algae can be controlled, but the larger macrophytes such as 'chara' and 'duckweed' are resistant to the sonic waves. Algal coagulation removal can be improved by 12.4% when combined with ultrasonic treatment at 40KHz and 60W for 15s. Algal removal commercial sonicators are available in the market, for example, Quattro DB ultrasonic algae control system, Mezzo ultrasonic algae control system, and ASMP ultrasonic sonic system. One of the ultrasonic algae and bio-organisms controlling apparatus is patented by Antonio Trigiani, U.S. This apparatus includes a power unit and a transducer that has a sonic head that can radiate from multiple angles. The frequencies used in this apparatus include the critical structural resonant frequency for each microorganism that is to be controlled.



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Prevention of fouling:

The marine ships and the water inlet pipes are in continuous contact with the aquatic environment resulting in the provision of substrate for fouling organisms. Fouling poses a severe threat to the small diameter pipes as they clog the inlet or outlet system by the assemblage of the macrofauna such as the mussels. For the avoidance of fouling, ultrasound waves were investigated by some researchers in which pulses generated for every 45 seconds significantly reduced fouling by zebra mussel up to 23m from the transducer. Usage of 200 W power transducer and 17-30KHz frequency range resulted in a marked reduction in fouling near the transducer. However, there are only a few studies with little consistent reporting when it comes to the practical use of ultrasound on ships (Legg et al., 2015). The product USAF (Ultrasonic Anti Fouling System) is a commercial ultrasound-based system to prevent fouling on boats. The product is manufactured and marketed by Luykx Ultrasound2 in the Netherlands. The manufacturer claims that the transducer creates cavitation bubbles in the water in the immediate vicinity and when these bubbles collapse generate shock waves that “scare away” scavengers and other organisms.

Control and modification of fish behaviour

Fishes use the sense organs such as the ear (otolith) and the lateral line system for detecting the vibrations in the water. The man-made sounds affect the behaviour of the fishes. Utilizing acoustic signals, modification of the action of the fishes was tried at the laboratory. Limited success has been achieved in the experimental change of behaviour of clupeids *Alosa pseudoharengus* and American shad to prevent them from entering into turbine intakes at dams. Yellow perch (*Perca flavescens*) and pumpkin seed (*Lepomis gibbosus*) adults were prevented from entering the inlet of the Nuclear Generation station using pneumatic poppers (which doesn't use ultrasound). Some species of clupeids can detect ultrasound such as alosids. In a study at the Vernon hydroelectric station, ultrasound helps in moving fish away from turbine intake. The acoustic guidance system can be used for migrating fishes such as eels for preventing them from entering hazardous places. Hence, more understanding about the behaviour of fish against the ultrasound will help in the future for avoiding the fishes being entered into turbines and other inlet sources of commercial application.

Non-invasive method for inducing fish growth

The effects of sound on fish growth performance were evaluated on ornamental fishes which showed good growth results upon playing the binaural beat complexes for 90-270 min. The binaural beat treatment also showed high feed efficiency in fishes. The sonic waves having slightly different frequencies are called binaural beats with both the frequencies lower than 1500 Hz, with the difference between them less than 35 Hz. Hence, binaural beats can be used in aquaculture for enhanced fish production.

Acoustic telemetry tags

It is one of the tracking applications in fisheries utilizing sound waves. The labels are fitted with the fish, and the fishes are released in the aquatic environment. 'Acoustic telemetry tags' emits sonic waves which help in the

tracking and monitoring of the behaviour of the fishes. The acoustic tags emit pulses of signals which in turn are received by the hydrophone receiver. These tags are more useful in studying the biology of the fish species, which are mainly migrants. The different development stages of the fish can be tagged to check the migration of the organism during the particular period of its lifecycle. The activity and movement levels of American lobster *Homarus americanus* in natural habitats quantified using ultrasonic telemetry in Canada. Similarly, this technique can be employed for tagging Indian migrant fishes and endangered species to study deeply about their life cycle.

Extraction from algae

Algae cells serve as a good source of lipid and various other components. Ultrasound technology helps in the extraction of lipids from the algal cells. Among the various methods utilized for algal lipid extraction, the 'Bligh and Dyer method' assisted by ultrasound was found to contain the highest yield from the algae *C. vulgaris* and is about 52.5% w/w. The various extraction processes from the macroalgae can also be improved with the combination of the ultrasound with the existing methods. The extraction of phycobiliproteins from the marine red macroalgae *Gelidium pusillum* was enhanced when the maceration of the algae is combined with the ultrasonication treatment. Usage of 300W ultrasound-assisted extraction (UAE) with the extraction time of 38.3 min was found to give the highest yield of taurine from *Porphyra yesoensis*.

For increased biogas production, sonic technology can be a powerful tool. At higher applied energy, the ultrasound treated cells show a higher rate of disintegration, resulting in increased biogas production. The ultrasound pre-treated *Hydrodictyon reticulatum* show increased biogas production by methane potential test than the non-treated one. Some other applications of ultrasound in fish processing technology include filtration, defoaming, depolymerization, drying, defrosting, freezing (by power-variable ultrasonic waves in saltwater immersion), and homogenization. Ultrasound treatment is found to accelerate the rehydration of dried sea cucumber in the processing industry. Thus various usage methods have been developed in the fish processing industry, enabling sonic technology.

Conclusion:

Ultrasonic technology is a promising alternative for therapeutics and antimicrobials. But the future extent of commercialization is not fully known even though the commercial algal control and sea lice removal equipment are available. Moreover, this technology does not harm the fish and has no negative effect, and reduces the physical handling of the fish for parasite removal. It is an environment-friendly method, hence ecologically advantageous. Though the technology applies for parasite and pathogen removal, the other mentioned uses of the technology are not limited, and innovations can be made utilizing the principle of the technology. But more research is needed in this sector for field application in tropical countries like India. The research trials can be initiated in the cage culture provinces in India for effective parasite removal from the systems.

***Reference can be provided on request**



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Ecosystem-Based Fisheries Management: A Modern tool for Tropical Fisheries Management and Aquaculture

pritam.frmma804@cife.edu.in

Pritam Das and Vedika Masram

ICAR-Central Institute of Fisheries Education, Andheri (West), Mumbai – 400 613.

College of Fisheries, GADVASU, Ludhiana, Punjab - 141 027.

Highlight Points

EBFM is a holistic approach of multispecies management rather than a single fishery including every component of ecosystem. It is a modern strategic tool for tropical fisheries management as well as aquaculture. It differs in many ways from conventional fisheries management and can be used as a great tool for managing marine, inland as well as aquaculture resources. Ecopath, Ecosim, Ecospace and MPAs are the basic tools for the ecosystem management. Some of the actions taken in EU countries proved that it is a strategy to be used in managing and sustaining overall fishery resources.

Introduction:

Ecosystem based fisheries management (EBFM) can be defined as a holistic method of managing fisheries and marine resources with consideration into the entire ecosystem chiefly multispecies workplace being managed instead of one species work place. It is an extension of typical fisheries management recognising reciprocally between human wellbeing and ecosystem health and ought to maintain ecosystem productivity as gift for future generation (Ward *et al.*, 2002). North Pacific fishery management council (Witherell *et al.*, 2000) says that ecosystem-based approach to fisheries management is outlined to regulate anthropogenic activity towards maintaining long run ecosystem property. Food and Agricultural organization of United Nations (FAO fisheries department 2003) described ecosystem approach in fisheries strives to balance numerous social objectives by taking into consideration the data like uncertainties regarding organic phenomenon, abiotic component, abiotic component, human activities of ecosystem and their interaction, applying an integrated approach to fisheries at intervals within ecologically purposeful boundaries. Nation research Council (NRC 1999)-Ecosystem-based managements are an approach that take major ecosystem service including both structural and purposeful in consideration of managing fisheries. It values habitats, embrace of multispecies prospective, and it committed to understanding ecosystem approach.

Why EBFM is important in fisheries management?

- ✓ Many of the world's fish populations measures over exploited and the ecosystems that sustain them are degraded: Unwanted consequences of fishing, including habitat destruction, incidental mortality of non target species, generation shifting in population demographics, and changes in function and structure of ecosystems, being progressively identified.
- ✓ Fisheries management thus far has typically been ineffective: it focuses on maximising the catch of one target species and sometimes ignores environment, predators and

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prey of the target species and alternative ecosystem components and interactions.

Objective of EBFM?

The overall objective of EBFM- is to sustain healthy marine ecosystems and the fisheries they support. In particular, EBFM should-

- ✓ Avoid degradation of ecosystems, as measured by indicator of environmental quality.
- ✓ Minimize the chance of irreversible amendment to natural assemblages of ecosystem structure.
- ✓ Obtain and maintain long socioeconomic edges while not compromising the ecosystem environment.
- ✓ Generate data knowledge of the ecosystem to grasp the doubtless consequences of human actions.

Characteristics of ecosystem approach in Fisheries management-

EBFM build protection and restoration of marine ecosystem and provide services with specialise in short term economic or social goals for single service. It considers accumulative effects of various activities on life variety and interaction of species, facilitate intermingling among and within marine ecosystem accounting for the import and export of larvae, nutrients, and foods. It acknowledges the inherent uncertainties in ecosystem-based management and account for dynamic changes in ecosystem. It generates complementary and coordinated policies at international, national, regional, and native scales. Maintain historical level of native biodiversity in ecosystem to producer resilience to each natural and human-induced amendment that need proof that an action won't hurt to ecosystem functioning before permitting that action to proceed. It develops multiple indicators to understand the ecosystem functioning, service provision and effectiveness of management effort and it involves all stakeholders through democratic governance that accounts for each local interest and people of the broader public.

What are the Principles of EBFM?

1. Human and ecosystem health
2. Resource insufficiency
3. Maximum acceptable fishing level
4. Maximum biological productivity
5. Impact changeability
6. Impact minimization
7. Reconstruction of resources
8. Ecosystem integrity
9. Species interdependency
10. Institutional integration
11. Uncertainty, risk and precaution
12. The polluters pay principle (PPP) - law enacted to form the party chargeable for manufacturing pollutants, chargeable for paying for the damage done to the natural environment.
13. The user plays principle (UPP)-evaluation approach supported the thought that the foremost economical allocation of resources happens once consumers pay the total price of the product that they consume.
14. Precautional principle and Precautional approach
15. Subsidiary, Decentralization and participation

Goal of EBFM

- ✓ To maintain ecosystem health, integrity.
- ✓ Protect the productive potential of the system aside from protecting an individual species or stock as a resource.
- ✓ Restoration of degraded ecosystem.
- ✓ Make call relating to equalisation human wants with resource productivity demand.
- ✓ The ecosystem approach conjointly acknowledges the complexness and uncertainty in predicting response to management actions.
- ✓ Species sustainability keeping biomass on top of level where recruitment could be affected.
- ✓ Ecosystem sustainability garmenting that any impacts on ecosystem structure and performance measures unbroken at acceptable levels.
- ✓ Optimize the economic profit to the community.
- ✓ Minimize the social impacts and negative angle associated the management of those resources.

Conventional fisheries management (CFM) VS EBFM

| CFM | EBFM |
|---|--|
| Mainly deals with target species | Focused on all major species in the ecosystem, particularly those impacted directly or indirectly by fishing activity. |
| Assessment strategies are Stock assessment, catch landings, CPUE, modelling | Multi species assessment, vulnerability assessment, risk assessment, ecosystem indicators and local information. |
| Lacks mechanism for implementation in data-poor condition | Can be used in information poor scenario |
| Management objective is principally biological, some economical | Ecological, economic and social |
| Decisions supported biological or fishery economics | Facilitates the trade-offs necessary to balance social and ecological well-being |
| Focus solely on fishers | Enables consideration of diverse stakeholder priorities |
| Mainly direct management on fishing (effort, gear) | Control of fishing directly or indirectly via non-fishery management (e.g. governance reform, restricted areas) |

Tools used for EBFM- Ecopath, Ecosim, Ecospace, MPAs

- ✓ **Ecopath**- Biologist use path models to estimate the direction and strength of all factors that influence the ecosystem functionality. The first ecopath model delineated energy flow through the reef food web. Once the ecopath model is made for associate in nursing system, it is easier to possess an outline of the resources and therefore the feeding interactions within the ecosystem providing the primary mean to model an ecosystems complexity.
- ✓ **Ecosim** - What distinguishes ecosim from existing systems is its capability to permit an integrated quantitative and chemical analysis of the surroundings in domains and sub-domains. It helps to predict the consequences of changes in fishing pressure and provide a statistical information on the relative impact of fisheries on surroundings (Ecosim software).
- ✓ **Ecospace** - Ecospace could be a special, dynamic version of ecopath, incorporating all key parts of ecosim. It depends on biogeographic region information derived from GIS and express link between biomass groups and well-liked habitat type. Well assessed and temporal dynamic assessment of fishery on a specific ecosystem may be designed for exploring impact of fisheries on ecosystem. It enables users to explore the potential role of MPAs and different explicit policies as tools to manage fisheries and numerous ecosystem effect of fishing.
- ✓ **MPAs**- The US government defines a Marine protected area is any space of the marine ecosystem that has been reserved by Federal, State, territorial, tribal, or native laws or rules to provide lasting protection for some or all of the natural and cultural resources in that (IUCN, 1996) says that MPA is a section of land/ or ocean specially dedicated to the protection of biological diversity and natural and associated cultural resources and managed through legal or other effective suggestions. It helps in conservation of ecosystem and diverseness, recreation, hindrance of abrasion from watersheds, provision of clean water, management of biological paste, preservation of medicative and genetic resources, nutrient sport, soil regeneration, carbon sequestration etc.

Actions to Promote EBFM:

- ✓ Delineate the geographic extend of ecosystem that occur within FMC (Fisheries management council) authority, together with characterization of biological, chemical and physical dynamics of ecosystem with alternative uses.
- ✓ Develop a conceptual and structural model of food web.
- ✓ Describe the habitat desires of various life history stages for all plant and animals that represent the significant food web and how they are considered in conservation and management of resources.
- ✓ Calculate total removal together with incidental mortality and show how they relate to standing biomass, Production, optimum yield, natural mortality

and biological process structure.

- ✓ Develop indices of ecosystem health as target for management.
- ✓ Asses the ecological, human and institutional elements of the ecosystem that the majority considerably have an impact on fisheries.

Merits of EBFM

- Potential simplification of management in moving from a complex stock-based management plans to fewer integrated plans for ecologically outlined areas.
- Simpler coordination of management actions for fisheries, protected resource species, diverseness conservation, and biogeography protection.
- Direct accounting for fishery interactions (e.g, bycatch) and biological phenomenon along with environmental change and variability within a single interval.
- Consideration of biological constrains on synchronic efforts to make stocks to sustain target levels and analysis of compatibility with stock-specific recovery plans.
- Increased stewardship from broader participation of stakeholders, wider sharing of ecological and fisheries information, and larger opportunities for developing place-based governance approaches and co-management.

Demerits of EBFM:

- EBFM is by no means that a well-defined method with set protocols and formulas. The complexness of ecosystem makes this impossible.
- EBFM cannot work while not up-to-date scientific knowledge on production level and ecosystem conditions.
- It involves significant complexness of cash.
- EBFM is sophisticated by the actual fact that ecosystems don't follow man made territorial boundaries. So, effective EBFM policy would force important regional and international cooperation.

Measurements taken at different level:

- ✓ Systems Analysis (Cybernetic) Metrics- Exergy, energy, total production, total biomass, energy flux, resilience, persistence, resistance, stability, free energy, information content
- ✓ Aggregate Metris- Mass flux, ascendancy, redundancy, biological process capability, lodge composition, biological process transfer potency, production and biomass in a very biological process level or cluster.
- ✓ Food Web Metrics- property, biological process links, modal chain length, % omnivore, nothing practice, linkage density, allocation of species across biological process levels, interaction strength, cycles, predator/ prey magnitude relation
- ✓ Community Metrics- Diversity indices, size spectra, species richness, evenness, dominance, overlap indices, interaction indices

- ✓ Single Species Metrics- MSY, FMAX, FMSY, F 0.1, F20 % MSP, SSB, MEY, YPR, F=M, Z, etc.

Ecosystem approach to aquaculture or ecosystem-based aquaculture management:

As for fisheries, the ecosystem approach to aquaculture (EAA) and ecosystem-based aquaculture management (EBAM) are variants of an equivalent approach and are single sector examples of the ecosystem approach. Both EAA and EBAM take into account the impacts of the environmental health and productivity of polite organisms and therefore the impacts that aquaculture has on all aspects of the marine ecosystem. As with its parallel in fisheries, EAA is a broader thought and conjointly focuses a lot of on the social and economic benefits that may be gained from aquaculture and post-harvest activities.

- **Integrated coastal management:** when fisheries managers were adopting a much broader ecosystem approach, environmental managers were adopting a way lot of people-orientated approach, associated overarching framework was conjointly being developed to facilitate the combination of sectoral management and environmental management. Within the coastal region, this came to be referred to as integrated coastal management(ICM)(also referred to as integrated coastal area management (ICAM), integrated coastal resource management (ICRM), coastal zone management (CZM), integrated coastal zone management (ICZM)), and in inland areas as integrated catchment management (ICM). ICM provides a convenient framework for fishery workplace agencies, ecosystem agencies and others to figure along to push accountable fishery supported a healthy environment, though there aren't several cases wherever this went on.
- **Sustainable livelihoods approach:** one more approach was additionally being developed by folks operating more at the grassroots level, particularly in poor villages and communities, adopted a holistic framework, referred to as the "sustainable livelihoods approach" supported on five groups in communities like natural, social, human, physical and monetary.
- **Wealth-based fisheries management:** Another variant of the ecosystem approach to fisheries is thought as wealth-based fisheries management (WBFM). This approach has been advocated by economists who manages wealth within the initial instance instead of objectives like environmental property. They argue that management that focuses on institution and social control of environmental limits tends to ignore the incentives as well as rights of the resource users. WBFM begins with the clear recognition that fish resources are inherently terribly valuable and this wealth exists within the variety of potential resources. The generation and acceptable use of resource rents can modify the action of varied existing goals (e.g. economic progress, poverty alleviation, resource conservation).
- **Large marine ecosystems and alternative approaches:** Other broader ideas like massive marine ecosystems, ecosystem-based management, and integrated ocean

management trot out the management of many sectors (e.g. fisheries, shipping, tourism, and mining) and measures simply a lot of generic cousins of the terms discussed above. All embrace a recognition that management must deal with the full set of ecological consequences of an activity and check out to optimize the social and economic advantage of that activity.

A case study on ICELAND, WHALING AND FISHERIES MANAGEMENT

Iceland folks and fishery both are greatly depends upon fisheries sector. Most of the time the island fisheries seen to be healthy scrutiny to the world because the annual quotas for fishing are supported by the scientific assessment of concerning stock. In recent years international council for exploration of the sea got wind that Iceland Cod, Caplin and Haddock estimated over exploited. Iceland researcher found the statement as true after observing samples. So, the government reduced the fishing quota for cod and haddock. Great Britain marine conservation society took a freelance call to chop short cod and haddock quota delivering to British shoppers and consumers. In 2006, the Iceland folks restarted whaling with much lesser catching than mounted quota. In 2007, the boat owners aforementioned that the quota for whale looking ought to be enlarged as a result of whales are feeding upon most of the remaining cod and haddock which are economically and commercially important. Additionally, the mink whale association also supported the scientific rationalization. On July 2007, the quotas for hunting of whale didn't over passed because they thought it is not ethical. They have collected field data information, non-manipulated study and natural experiment and applied in classical fishery, biological oceanography, traditional fishery as well as scientific knowledge for policy making. After 2006, the quantity of mink whales is reduced therewith Icelandic dolphin and some other fishes. However, it is observed fact that the quantity of Icelandic haddocks, Capelin and cod enlarged significantly. On 2010, they utterly enforced EBFM into their fisheries sector and manage the fisheries to take care of ecosystem health.

Conclusion:

The ecosystem-based approach to fisheries management sees the linkage between human and natural systems and acknowledges the requirement for management approaches that address this linkage. It is additionally an approach with a somebody's face and nation focus-fishermen and fishing communities, needs creativeness and innovation. Combinations of both and new unfamiliar management approaches will be used. The communities of fishermen, resource managers and researchers can have to be compelled to work along to come to a decision the most effective combination of approaches to deal with their state of affairs.

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ECOLOGICAL ENGINEERING IN POND AQUACULTURE SYSTEM

Suwendu Saha¹, T.K. Ghosh¹, A. K. Singh², Prasanta Jana²

¹Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences, Kolkata, West Bengal - 700 094, India

²College Fishery Sciences, Birsa Agricultural University, Ranchi, Jharkhand – 834 006, India.

Email: tkgffsc@gmail.com

Highlight Points

Pond aquaculture undeniably offers the potential for food production worldwide. However, with the continuous expansion of this practice, environmental problems such as a high level of water consumption, aquaculture water deterioration, and pollution from effluent and aquatic product quality decline seriously restrict the sustainable development of pond aquaculture. Thus pond aquaculture ecological engineering can be managed so as to improve animal welfare and the stability of water treatment systems, reducing the adverse effects on the environment and public health and enabling the sustainable development of pond aquaculture.

1. Introduction

Aquaculture is one of the fast-growing food producing sectors of the world and aims to increase productivity per unit space and play a significant role in food and nutrition security. In India, the fisheries sector provides livelihood to approximately 14.49 million people and also plays a significant role in the national economy as well as earning foreign exchange. In the last few years, aquaculture production has increased significantly. As being the major source of animal protein, the native people are accustomed to fish along with rice. It also recognized as a powerful income source and employment generator as it stimulates the growth of a number of subsidiary industries. Moreover, it is the source of livelihood for a large section of economically backward population in the rural sector, particularly among the landless labours, small and marginal farmers and women of the country. No wonder that it can be regarded as “poor man’s protein”.

World fish production from capture fisheries has remained

relatively stable over the past two decades while fish production through aquaculture has progressively increased. In India, freshwater aquaculture at present accounts for over 70% of total inland fish production. This sector alone is contributing to about one-third of the total fish production in the country. The production trend shows a consistent Annual Production Rate (APR) of 5% to 6% being significantly higher than in other sectors. India is now occupying the second position in production of fish and second largest aquaculture nation in the world after China. The total fish production during 2016-17 (provisional) is at 11.41 mmt with a contribution of 7.77 mmt from the inland sector and 3.64 mmt from marine sector. The inland fisheries sector presently has a share of 66.81% in the total fish production of the country. This sector contributed about 0.92% to the National Gross Value Added (GVA) and 5.23% to the agricultural GVP (2015-16) (Annual Report. DAHD, 2017-2018). The inland fishery resources of India consist of 0.19 million kilo metres of rivers and canals, 3.15 million hectare of reservoirs, 2.36 million hectares of ponds and tanks, 1.24 million hectare of brackish water areas and 1.2 million hectares of floodplain lakes (Annual Report. DAHD, 2017-2018). Since India has a huge potential for pond aquaculture activity but still lack of supporting technology and management for intensive culturing, the water quality in pond aquaculture has rapidly deteriorated, diseases have become frequent, pollution emissions have increased, and the production quality has declined, causing serious challenges to aquaculture development (Liu et al., 2018).

Thus to overcome such challenges a review has been made to discuss the research progress in pond aquaculture ecological engineering, and its application prospects to achieve environmental and economic sustainability, and improve the quantity and quality of aquatic products.

1. Pond aquaculture ecological engineering

In 1962, Howard T. Odum proposed the concept of ecological engineering and defined it as ‘environmental stimulation by man using small amounts of supplementary energy to control systems in which the main energy drives are coming from natural sources’ (Jensen, 1999).

Ecological engineering is defined as 'applying the principle of species symbiosis and material recycling regeneration in ecosystems, the principle of structure and function coordination, combined with the optimized method of system analysis, to design a production process system to promote the hierarchical and multi-level use of materials' (Ma, 1985). Pond aquaculture ecological engineering mainly includes two elements: ecological engineering techniques and an ecological engineering system.

2. Ecological engineering techniques

2.1. Eco-slope and eco-ditch

Ecological slopes are generally those created by 'using plants or plants alone, combined with civil engineering measures and non-living plant materials, to reduce slope instability and collapse, and reduce water bank erosion' (Liu, 2002). Ecological slopes can effectively prevent soil erosion and intercept and purify agricultural non-point pollution (Chen and Li, 2006). Using ecological slopes may significantly improve the water quality in ditches, significantly reduce the total nitrogen and total phosphorus contents, and increase biodiversity (Zhu et al., 2008). The application of three-dimensional vegetation net slopes in river regulation produces benefits (Wang et al., 2005a), and this provides a reference for using them in aquaculture pond slope protection and water purification. Eco-slopes can protect pond banks, regulate water quality, and have the characteristics of 'economy, ecology, and emission reduction'. Eco-ditch is an ecological purification system formed by a ditch, which has the functions of ecological water purification and environmental beautification (Liang et al., 2019). Eco-ditch construction mainly involves sectioning, facility layout and bottom structure. Sectioning refers to separating the ecological ditch into several sections, each of which has different aquatic plants or animals such as omnivorous fish and shellfish. Facility layout involves arranging the ditch with, for instance, a biological floating bed, biochemical framework and wetland. The bottom structure is used in drainage channels with large areas and involves shaping the bottom to facilitate the growth of different plants and water flows. Ecological ditches usually divided into different functional areas, such as the compound ecological area, algal area and floating plant planting area. (Liu, 2011). The purification effect of the eco-ditch is mainly influenced by the plants and animals it contains. Management and maintenance are very important for the purification efficiency of eco-ditches.

2.2. Eco-pond and eco-floating bed

Ecological ponds, also called efficient biological treatment ponds, are generally used for sewage treatment. In ecological ponds, aquatic plants, fish, ducks and geese are added to form a complex ecosystem with a complete food chain to improve the purification effect. The integrated biological pond is a new type of ecological pond based on traditional biological pond technology, and it uses ecological principles to combine components in certain proportions, with the dual function of sewage purification and water resource protection (RGSBP, 1991). Eco-floating beds are also known as biological floating islands, aquatic

plant floating beds and biological floating beds (Jing et al., 2003). The concept is based on soilless cultivation and ecological engineering technology using the aquatic plants and their root microorganisms to reduce pollutants in water (Ma et al., 2011).

In recent years, eco-floating beds have been commonly applied to pond aquaculture, mainly in the form of frame eco-floating beds, cage eco-floating beds, and composite eco-floating beds. Plants are the key component of floating beds. More than 80 types of plants are used in eco-floating beds (Liu et al., 2004), including food crops, vegetables, flowers and grasses, all annual or perennial herbs. Willows and other woody plants may also be used. However, in pond aquaculture, because of the short aquaculture period, woody plants are not suitable for eco-floating beds. Water spinach (*Ipomoea aquatica*) is frequently used in eco-floating beds. In compound eco-floating beds, digestion by aquatic animals improves the biodegradability of organic matter, and shellfish, such as mussels, snails and clams, are the most common aquatic organisms used (Liu et al., 2011). The plant roots in ecological floating beds are denser than those in wetlands, and the water treatment effect is more significant (Li et al., 2011). Because of root oxygen secretion, oxygen molecules diffuse to the biofilm, which easily forms a local oxygen-rich environment that is conducive to the formation of different dominant flora and the degradation of organic substances (Tang et al., 2011). At the same time, plant roots release secretions (such as biological enzymes) that can degrade organic substances, accelerating the degradation of organic pollutants (Liu et al., 1999). Environmental factors such as water temperature, pH and light conditions have a strong influence on eco-floating bed purification. The temperature has a pronounced effect on the removal of nitrogen and phosphorus, and the optimal water temperature for the floating beds is 25–29°C (Luo et al., 2010).

2.3. Composite constructed wetland

Constructed wetlands are based on the structure of natural wetlands. They are engineered systems similar to swamps but controlled by humans (Zhu et al., 1991). A constructed wetland can use the physical, chemical, and biological functions in the system to treat sewage. The composite wetland integrates the advantages of constructed wetlands and has a more efficient and flexible treatment effect. Using composite wetlands to treat aquaculture wastewater has many advantages. First, the composite wetlands can effectively remove TSS, nitrogen, and other eutrophic substances from aquaculture drainage (Costa-pierce, 1998). In addition, they can also support harvested plants for livestock feed (Lymbery et al., 2013). Constructed wetlands also efficiently remove heavy metals and antibiotics in water. The use of wetlands as land-intensive biological treatment systems has been applied to the purification of sewage by substrate filtration, plant adsorption, pollutant sedimentation, and exchange and microbiology oxidation.

3. Ecological engineering pond aquaculture system

Ecological engineering is the best way to achieve green development in pond aquaculture. In the past 30

years, many researchers have studied pond ecological engineering and made remarkable progress. ecologically engineered pond aquaculture could change traditional pond aquaculture and has the following advantages: (i) effectively improves yield and production efficiency; (ii) improves survival rate; (iii) improves the digestibility and absorption rate of feed; (iv) reduces production energy consumption; (v) recycles used water; (vi) improves labor efficiency; (vii) supports multilevel breeding, which can be well distributed to the market; (viii) reduces disease and drug use; (ix) is easy to manage and operate; (x) solves the problems of eutrophication and pollution of aquaculture, and (xi) is beneficial to the industrialized management of pond aquaculture.

4. Conclusion

Pond aquaculture not only provides a substantial amount of animal protein for people but also plays an important ecological role. Ecologically engineered pond aquaculture can continuously improve people's living standards. It enables the achievement of green development. Ecological engineering is an effective tool, but it needs to be based on knowledge of the ecology, physiology and behavior of aquaculture species. Therefore, it is necessary to focus on the study of the biological and ecological characteristics of aquaculture species such as crucian carp, special freshwater fish, shrimp, and crab and to fully understand the structure, capacity, environment, nutrition and disease control of aquaculture, in order to provide a solution for the precise ecological engineering of pond aquaculture. There are many problems in traditional pond aquaculture, such as heavy water consumption, high pollution rates, low utilisation of feed and abuse of fishery drugs. Therefore, it is necessary to focus on fry breeding, ecological culture, disease prevention, precise feeding, environmental management and production quality safety to establish ecological, clean, and accurate, healthy and efficient ecological engineering systems suitable for different aquaculture species. Regarding the 'green' goals of pond aquaculture, high quality and high efficiency, HACCP technical requirements, good agricultural practices (GAPs) and good manufacturing practices (GMPs) should be implemented throughout the process of pond aquaculture. This would promote the establishment of good environmental practices (BMPs) for ecologically engineered pond aquaculture systems, such as pond ecological aquaculture, comprehensive culturing, multi-nutrient level aquaculture, and graded sequential batch aquaculture. In addition, it would establish standardized systems for ecological, clean, and precise aquaculture.

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