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Shrimp culture Growing well in North India

Fisheries sector serves as a crucial source of food and nutrition as it provides a substantial source of income and employment for a huge number of individuals around the world. Even though the world capture fisheries production increases annually, a stable and nearly constant production from it across the years have indicated that we have reached the peak. While on the other side, the aquaculture production tends to be dynamic and on the increasing trend.

Dear Readers,

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

With 10,500 tonnes feed, 600 Million Seed supply annually and 3,500 to 4,000 acres of land in use in Haryana, Rajasthan and Punjab states, shrimp culture is growing fast in the Northern Region of India. Shrimp farming development in Northern region started in 2017 – 18 with a few farmers going for Shrimp ponds in one to two acres land. While the farming in Haryana and Punjab is done in earthern ponds, in Rajasthan most of the Shrimp culture is done in P-Line ponds. Shrimp production in this region is increasing in a big way year after the year.

There is an urgent need of cold storage and processing facilities for shrimps produced in the Northern region of the country as the farmers are struggling to sell their produce.

Dr Mahapatra, retired Principal Scientist, Kolkata Centre of ICAR - Central Institute of Fisheries Education addressing an event recently stated that fishery in India progressed from hunting to hobby; to farming to industry. Scientists in late 1950s thought about quality fish seed production, tank improvement programme begun with bottom silt cleaning, oxygen augmentation for increasing stocking density (SD) and fish production, pond bottom treatment (faecal matter management), bottom silt cleaning during culture (Fish Toilet). Steadily fisheries and Aquaculture progressed as an industry - aeration with bottom cleaning, use of probiotics, RAS, aquaponics to absorb nitrite, Biofloc fish culture (nutrient recycling with probiotic and advantageous over conventional pond culture) and IMTA. He explained features of Aqua technologies for Entrepreneurship Development Programme. He also discussed principles of IMTA; *L. vannamei* monoculture with Better Management Practices in high SD; mud crab *Scylla olivacea* farming and fattening, cage culture/ box farming for producing soft-shelled crab; explained feed recycling pathway in Biofloc fish culture; principles of RAS, aquaponics; possible combinations of integrated farming with fish, its adoption percentage became higher with successful technology dissemination; fish farming in paddy plots.

Neeraj Kumar Srivastava, Chairman, CLFMA, in its recently held symposium said, change is the only constant. India's livestock industry is undergoing a transformation, in tandem with positive macroeconomic and demographic trends. Our current focus is the adoption of modern solutions to overcome existing and upcoming challenges. We appreciate the government's approachability, which is allowing for faster growth of the industry. Parshottam Rupala, Minister of Fisheries, Animal Husbandry and Dairying (AHD) department, Govt. of India said that India is heading down a new path to success and we are glad to be collaborating closely with the industry. The government will take cognizance of all innovations highlighted by technical experts. The achievements of this industry are building up the nation. He recommended implementing waste-to-wealth strategies for the disposal of dead animals. He added that the government is considering PPP (public-private-partnership) models for animal health in alignment with India's One Health vision.

Lack of production efficiency and transparency are the biggest challenges facing the Indian aquaculture sector. A major reason for this is the prevalence of traditional farming practices and

Contd on next page

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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 lack of awareness of technology. On the production front, tech can address prevailing challenges like overfeeding, water quality parameters and disease detection. Implementation of tech-driven tools can help farmers improve their problem sensing capabilities – especially real-time analytics that can identify production issues in advance and aid the farmers in taking countermeasures. More often than not, farmers end up overfeeding or underfeeding due to improper feed management, which adds to the production cost and reduces their profit margins, whereas auto-feeders can optimise feed usage and help farmers regulate daily feeding. On a similar note, IoT can help farmers closely monitor critical water quality parameters and take corrective actions.

Fish farming using technology is new for the farmers in Assam and given proper training and accessibility to new techniques and money, fish farming is surely bliss in the region. The province of Assam in the North Eastern region of India has a superb sub-tropical atmosphere for the expansion and improvement of fresh water fish culture in the state. Fish farming assumes a significant part in sustenance as well as in the provincial economy of the State. The state infers an amazing open door for improving the provincial economy through the improvement of small scale fish farming. Major push is required towards creating more awareness and improvement of the skill sets of the fish farmers and their farming practices so that later on they would be in a situation to extend their exercises with money made accessible locally. Fish farming using technology is new for the farmers in Assam and given proper training and accessibility to new techniques and money, fish farming is surely bliss in the region.

Gene manipulation is a molecular biology technique applied for stock improvement of cultivable fishes. Introduction of desirable genetic traits like faster/increased growth rates, improved freeze resistance, resistance to some microbial diseases are important expected benefits of gene technology in fisheries / aquaculture and utility, which will produce superior transgenic strains of cultivable fishes.

In the Articles section – *Carophyll Pink in Aquafeed to Influence the Pigmentation of Fish and Shrimp,* *authored by* Ajay Guru, Ms Purabi Sarkar, Mrs Prasanna Devi D, Mrs Pongomathi K, Mrs Nithya S, Dr Kasi Viswanathan, Dr Jesu Arockiaraj, SRM Research Institute, SRM Institute of Science and Technology, Kattankukathur, Chennai, discussed that Aquaculture is a fast-growing global industry that includes the cultivation of finfish, shellfish, and ornamental fish of various freshwater and marine species. A properly formulated feed and pigmentation system is a vital part of effective aquaculture. The pigmentation of the skin and muscle is responsible for the colouring of the organism. In the natural environment, aquatic organisms meet their carotenoid requirements by ingesting aquatic plants or food chains. However, they are not capable of synthesizing carotenoids *de novo*. Carotenoids must be introduced through the diet of the cultivated species. Pigmentation is one of the essential qualities of livestock for consumer acceptability. It is the most quality-related criterion apart from product freshness. To increase the skin redness of *Australian snapper*, *Pagrus auratus*, *Sparus aurata*, *Atlantic salmon* and many more, synthetic unesterified forms of astaxanthin as Carophyll pink were used successfully.

Another article titled ***Ecosystem-Based Fisheries Management (EBFM): A Modern Tool for Tropical Fisheries Management and Aquaculture,*** *authored by* Mr Pritam Das and Vedika Masram, ICAR-Central Institute of Fisheries Education, Andheri (West), Mumbai, College of Fisheries, GADVASU, Ludhiana, Punjab, said that 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 work place 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. North pacific fishery management council says that ecosystem-based approach to fisheries management is outlined to regulate anthropogenic activity towards maintaining long run ecosystem property.

Article titled ***Ballast Water: A Mask of Threat to Marine and Coastal Ecology,*** *authored by* Ms M. F. Panthi, Mr N. K. Suyani, Mr Mukesh Kumar Singh and Mr A. R. Hodar, College of Fisheries Science, Kamdhenu University, Veraval, Gujarat, informed that Maritime transport is the mainstay of the increasingly globalized economy and the international trade system. Sea transport has invariably the most liberalized sector of transport. In addition to economy and trade the various other driving forces for sea transport include connectivity, access, infrastructure and warehouses, energy and labour costs, regulations related to the safety and quality of transport, responsiveness to the increased requirements of customers across supply chains, and environmental and climate change hindrance.

Another article titled ***Adulterants in Aquafeeds,*** *authored by* K. Manikandan, N. Felix and E. Prabu, Directorate of Incubation and Vocational training in Aquaculture, Tamil Nadu Dr J. Jayalalithaa Fisheries University, ECR-Muttukadu, Chennai, said that there is a tremendous increase in the number of population across the whole world and estimated that the number may reach around 900 crores by the year 2050. The nutritional status of fishes are continuously reported and the importance is being published and many awareness is being created. This has resulted in increased demand and consumption of fish in recent decades. Fisheries sector serves as a crucial source of food and nutrition as it provides a substantial source of income and employment for a huge number of individuals around the world. Even though the world capture fisheries production increases annually, a stable and nearly constant production from it across the years have indicated that we have reached the peak. While on the other side, the aquaculture production tends to be dynamic and on the increasing trend.

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

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

M.A.Nazeer
Editor & Publisher
Aqua International

Navigating to the future of animal agriculture in India - Highlights of CLFMA's 63rd National Symposium 2022

Mumbai: The Compound Livestock Feed Manufacturers Association of India (CLFMA) conducted its **55th Annual General Meeting** and **63rd National Symposium 2022** in Mumbai on September 30 and October 1 at Hotel Leela, Mumbai. The theme of the event was **'Changing Dynamics of Indian Animal Agriculture'** which aimed to capture and assess industry trends, identify key challenges and plan the future for the sector.

About 450 participants representing all segments in the animal value chain - academicians, feed manufacturers, aqua farmers, animal health and nutrition experts - attended the forum.

Welcoming dignitaries, speakers and members,

Suresh Deora, Convenor & Secretary, CLFMA, said, "I would like to extend a warm welcome to our chief guest Mr Purshottam Rupala to the inaugural of our 63rd symposium. He has been a guiding force for welfare schemes for the betterment of farmers across India. I welcome Mr Jatindra Nath Swain who has been spearheading the Blue Revolution project, a central government scheme to help aqua farmers in the country and Balram Singh Yadav of Godrej Agrovet - a veteran of the industry. I would also like to welcome Mr Tarun Shridhar, Former Secretary AHD, a great supporter of the animal industry."

Union Minister for Fisheries Parshottam Rupala and other dignitaries lighting the lamp to mark the inauguration of CLFMA's 63rd National Symposium at Mumbai on 30 September 2022.

Introducing the session, **Neeraj Kumar Srivastava, Chairman, CLFMA,** said, "Change is the only constant. India's livestock industry is undergoing a transformation, in tandem with positive macroeconomic and demographic trends.

Our current focus is the adoption of modern solutions to overcome existing and upcoming challenges. We appreciate the government's approachability, which is allowing for faster growth of the industry".

"India is heading down a new path to success

and we are glad to be collaborating closely with the industry. The government will take cognizance of all innovations highlighted by technical experts. The achievements of this industry are building up the nation," said **Parshottam Rupala, Minister of Fisheries, Animal Husbandry and Dairying (AHD) department, Govt. of India** in his address as the Chief Guest at the Symposium.

He recommended implementing waste-to-wealth strategies for the disposal of dead animals. He added that the government is considering PPP (public-private-partnership) models for animal health in alignment with India's One Health vision.

This was followed by the CLFMA Award Ceremony. The Famous CLFMA awards were given to two leaders, who had diligently worked and contributed to the development of the livestock sector. The Life Time Achievement awards were presented to **Er. Anand Menon, FIE,** who had contributed a lot to the livestock sector, during his glorious forty years of service as CGM, KSEL, Kerala and CLFMA Award was presented to **Dr Rudra Nath Chatterjee, Director ICAR-Directorate of Poultry Research,** Hyderabad

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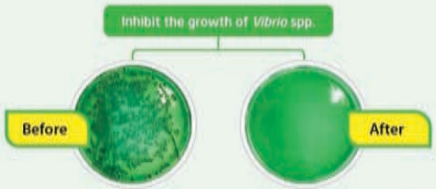

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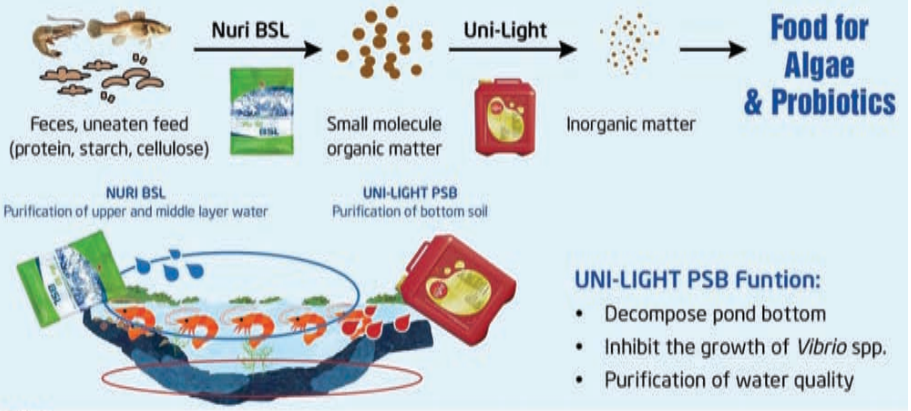

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- Purification of water quality

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/10,000 m³ Quantity	10 - 30 pl/m² tiger prawn or < 80 pl/m² Vannamei	For >30 pl/m² tiger prawn or > 80 pl/m² Vannamei	For > 150 pl/m² Vannamei
7 days before stocking	800 g - 1,000 g	1,200 - 1,500 g	1,200 - 1,500 g
Day of stocking	300 g - 500 g	800 g - 1,000 g	800 g - 1,000 g
Every 7 - 10 days after stocking	300 g - 500 g	800 g - 1,000 g	3 - 5 days / use 1,000g - 2,000g

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

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for their marvelous contribution to the Indian Livestock Sector. CLFMA Chairman congratulated all the CLFMA award winners.

Balram Singh Yadav, Managing Director of Godrej Agrovet, presented the journey of the industry, highlighting data on growth in production and efficiency over the last two decades. He shared the optimism of the industry, reflected in a CAGR of 7.5% this year. "The next decade is going to be explosive. Investments in animal husbandry will outstrip any industry. Our contribution to agriculture GDP will grow from 37% to 50% in the next 5-6 years," he said.

Jatindra Nath Swain (Secretary Fy.) said consumer demand is shifting to animal proteins, with a projected 4x rise in consumption by 2047. He urged the participants to adopt sustainable solutions to water and electricity consumption.

An industry survey report was also released on the occasion, followed by a vote of thanks by **Divya Kumar Gulati, Deputy Chairman, CLFMA of India.**

Cultural Event and Networking Dinner was enjoyed by all participants.

Day two of the Symposium began with the Welcome Address by Mr Neeraj Kumar Srivastava, Chairman, CLFMA of India. The first session brought up technology solutions with a focus on data and analytics. "Mitigating the challenges of price escalations of feed ingredients" was moderated by **Amit Saraogi, Managing Director of Sarawagi Agrovet.** "Our industry has seen unprecedented price hikes for crops like soybean and corn. There is a strong need for unbiased and robust data to prevent unfavourable situations from repeating."

RMSI Cropalytics' Kumarjit Mazumder shared a glimpse of the methodologies of their digital crop map tool. It uses satellite images to capture plots of standing crops.

A price outlook on relevant commodities like soymeal, mustard cake, cottonseed oil cake, bajra and maize was revealed by **Prerana Desai, head of research at Samunnati Agri**. She shared observations on the impact of feed substitution, margin pressures and global macroeconomic trends.

Kevin M. Roepke from USSEC talked about 'Chickenomics' with a comparison of India and Sri Lanka. He brought out the increase in USA crush capacity driven by the adoption of renewable fuel policies.

Hemant Bansal of Patanjali Foods, representing the Indian Vegetable Oil Producers Association, maintained that prices of crop feed need to be at a reasonable range to guarantee the sustainability of the ecosystem.

Building customer experiences, adopting innovation in branding and hyper-localizing for the domestic market were key call-outs from industry leaders participating in a panel discussion on go-to-market strategies for the livestock industry. The session was moderated by **Balram Singh Yadav, Managing Director of Godrej Agrovet.**

A view of cultural programme held on the occasion

Dan Meagher, President and CEO of Novus International, said, "The power of branding is very important. Processing of animal products is going to create a new customer experience. Brands are going to differentiate at the customer level." **Suguna Group's Soundararajan.**

Entrepreneur, **Dr Manoj Sharma of Mayank Aquaculture** shared their respective learnings from the poultry and shrimp sectors for the benefit of participants of the forum.

Bhupendra Suri of Creamline Dairy said, "The idea of private players in value-added categories like ghee, paneer and curd is rising fast, with opportunities for new categories like whey drinks."

In the final session, **Dr Parminder Singh, Professor of Animal Nutrition at Guru Angad Dev Veterinary and Animal Sciences University,** brought up the lacunae in the system. He spoke about technical challenges faced by livestock breeders in implementing standards.

Government representatives **Dr Amit Sharma of the Food Safety and Standards Authority of India (FSSAI) and Amit Choudhary of the Bureau of Indian Standards (BIS)** invited participants to liaise and get involved in developing and amending standards. Highlighting the challenges with verification of reports of milk contamination, **Dr Raghavendra Bhatta, Director of the National Institute of Animal Nutrition and Physiology,** said, "There is a need for scientific sampling with state-of-the-art laboratories set up to prevent non-compliance."

The session was moderated by **Dr P.S. Mahesh, Joint Commissioner and Director of Central Poultry Development Organisation and Training Institute, Govt. of India.** He encouraged members to approach and engage with the government's representatives for a better future.

Concluding the symposium, **Mr Tarun Shridhar, Former Secretary, AHD,** advised, "Rather than offering subsidies, an enabling policy environment and infrastructure support will nurture entrepreneurs and promote growth. We need to capitalize on our vast land resources, address our productivity issues and plan for changing consumer demands. We must also guard against misleading advertisements. Digitalizing and having a consolidated voice for the industry will be vital going forward."

CLFMA offered Mementos to Sponsors, Government Officials, Special Invitees, Moderators, Speakers, Associations, Press, Event Management Company, etc. as a token of appreciation for their continual support as always.

Mr Suresh Deora proposed the vote of thanks, sharing gratitude to the government representatives, speakers, sponsors, industry stakeholders, special invitees and attendees for their active participation.

The networking Dinner was enjoyed by all participants.

Overall, CLFMA interacted with various stakeholders in the industry and government on the topic Changing Dynamics of Animal Agriculture in India. The association has diverse membership from across the animal protein value chain including feed manufacturing; poultry, dairy, and aquaculture business; animal nutrition and health, veterinary services, machinery and equipment; processing, distribution, and retailing of meat. The program was well appreciated by all the participants.

Scaling up the Adoption of Technology in Indian Aquaculture

Indian aquaculture producers need better guidance from aquatech companies as well as access to government subsidies to help secure their productivity and livelihoods.

Lack of production efficiency and transparency are the biggest challenges facing the Indian aquaculture sector. A major reason for this is the prevalence of traditional farming practices and the lack of awareness of technology.

On the production front, tech can address prevailing challenges like overfeeding, water quality parameters and disease detection. Implementation of tech-driven tools can help farmers improve their problem sensing capabilities – especially real-time analytics that can identify production issues in advance and aid the farmers in taking countermeasures. More often than not, farmers end up overfeeding or underfeeding due to improper feed management, which adds to the production cost and reduces their profit margins, whereas auto-feeders can optimise feed usage and help farmers regulate daily feeding. On a similar note, IoT can help farmers closely monitor critical water quality parameters and take corrective actions. The advance of tech-driven solutions, powered by the data collected and AI, could be a game changer in predicting production problems and identifying countermeasures. Implementing such solutions for 5 million farmers, however, poses big hurdles.

Lack of Awareness Hinders the Adoption of Technology on the Farm

Juvenile farmed shrimp

As I stated earlier, awareness of innovations is very low among India's aqua farmers. There is a huge gap between the market and the farmers in accessing new products and understanding how these could change their day-to-day activities. Consider this: Palani Muthu, an aquaculture farmer from Sirkazhi in Tamil Nadu, has been farming shrimp for the last 17 years. It is the primary source of income for his family. However, he found it hard to address the problem of overfeeding and poor survival rates. Like Palani, numerous aqua farmers in India are unable to resolve issues owing to a lack of awareness about scientific farming practices. Many also face the stress of finding a buyer for their produce. Farmers often end up visiting several agents to find a suitable buyer and then have to wait 25 to 30 days for payments to be credited. The primary step to address such challenges is enabling and simplifying access to packages of practices, wherein farmers are guided throughout the culture cycle to adopt best management practices (BMPs). Adopting BMPs will accelerate the transition from traditional farming practices to smart and sustainable aquaculture.

Extending Last-Mile Support and Cost-Effective Technology Tools to Small or Medium Farms

Many tech companies in aquaculture sell products without guiding the farmers through their benefits or implementation. This often results in a knowledge gap between farmers and the technology, resulting in low acceptance rates. Developing a true scope for prosperity requires delivering the product or technology with guidance. A touch base for the farmer – like a kiosk or an outlet – can serve as an educational and orientational avenue.

Awareness of the products needs to be instilled by the tech providers as well. Simply buying an isolated technology or product will not be successful if the farmer is not apprised of its applications and benefits. This last-mile support can also be delivered in terms of equipping farms with IoT, but companies also need to take into account the affordability: implementing the latest technology on a large scale is cost-effective, but it is usually not an affordable option for small and medium-sized farms.

For instance, if a farmer wants to take a water quality test, they can approach a nearby laboratory every week and get a report for Rs 150 to Rs 200. Considering that a farmer takes 20 tests in a culture cycle for four months, it will cost a total of Rs 4,000 per culture, which is way less than an investment of Rs. 1 lakh per pond towards deploying IoT and related software.

Today, around 90 percent of India's aquaculture farmers are either small or medium-scale producers who own farms of three to five acres. Currently, most tech solutions are not tailor-made for these farmers and do not match their profit levels. The beneficiaries of smart tech are often large businesses or farm holders with larger parcels of land. To truly double farmer incomes, we need the fruits of tech to reach and benefit every farmer: big or small.

Incentivisation is Key to Accelerating Implementation of Technology

Innovations often fail to reach farmers due to a lack of support and incentives from the regulatory bodies. Support from the government in the form of subsidies and financial assistance can go a long way. For instance, the Government of India offers subsidies to the tune of Rs 1 lakh to buy a tractor, and a 30 percent to 50 percent subsidy is offered when purchasing other farm equipment. If such incentives are extended to aqua farmers as well, they will be encouraged to experience the benefits of tech first-hand, thereby encouraging more and more farmers to follow suit.

Water quality testing at a shrimp farm

Innovations often fail to reach farmers due to a lack of support and incentives from the regulatory bodies. Moreover, modern farming solutions need to be promoted aggressively to demonstrate their impact. This, however, solves only part of the equation, while value chain transparency poses another huge challenge. If we closely observe the Indian aquaculture landscape, we can identify that extensive efforts are required at a foundational level. Sourcing intelligence through non-intrusive ways (eg leveraging remote sensing satellites) is one way to bridge the gap. The advantages of such a methodology are varied – from bringing transparency to the value chain to helping stakeholders such as farm input producers assess the demand and supply. In the post-harvest value chain, this helps identify production volumes in the months ahead.

Hand-feeding a shrimp pond

Technology can Build Credit-Worthiness

There is a need to create a system of formal credit that can be accessed more easily by farmers. And formal credit infusion in aquaculture can become mainstream when the other part of the equation is well balanced – the risk and therefore insurance. Lack of insurance is a major concern that prevents the banks from extending credit to aquaculture farmers. Unlike their agricultural counterparts, aquaculture farmers are not offered any subsidies on insurance premiums, which further demotivates them from risk mitigation as it significantly adds to their production costs. If the government reduced the premiums on insurance, aquaculture farmers could mitigate production risks. This would also account for an increase in their working capital limit, thereby helping meet their farming expenses.

Summing up

To propel the Blue Revolution 2.0, farmers need digital solutions from pre-production to post-harvest. This will increase productivity, efficiency and traceability. For farmers to adopt modern technology like IoT devices, AI automation tools and a data-driven farming approach, improved guidance, affordable prices and subsidies are needed. The business style and psyche of Indian aquaculture farmers need to be understood to offer them better technological and financial solutions.

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Bon Ammonia and obnoxious Gasses

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

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

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

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

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

PRESENTATION: 500 gms &1 kg

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All About Aquaculture in Assam and Government Subsidies Provided to Fish Farmers

Assam in the North-Eastern region of India has a superb sub-tropical atmosphere for the expansion and improvement of freshwater fish culture in the state. Fish farming using technology is new for the farmers in Assam and given proper training and accessibility to new techniques and money, fish farming is surely bliss in the region.

The province of Assam in the North Eastern region of India has a superb sub-tropical atmosphere for the expansion and improvement of fresh water fish culture in the state. Fish farming assumes a significant part in sustenance as well as in the provincial economy of the State. The state infers an amazing open door for improving the provincial economy through the improvement of small scale fish farming. Major push is required towards creating more awareness and improvement of the skill sets of the fish farmers and their farming practices so that later on they would be in a situation to extend their exercises with money made accessible locally. Fish farming using technology is new for the farmers in Assam and given proper training and accessibility to new techniques and money, fish farming is surely bliss in the region.

Assam's Fishery Resources and Allocation:

Assam is blessed with more than 2.86 lakh ha of different water resources. Different water resources include ponds, rivers, tanks, beels etc. The state also has 2 major river systems namely Brahmaputra and Barak along with their tributaries. More than 90 percent of people in Assam eat fish and the fish market is on a rise. The fisheries sector acts as a major force behind the socioeconomic development of the state.

Fish production and related activities can create a lot of employment opportunities, specially for the rural Assam. The total number of freshwater species found in Assam is more than 200 and the fish production level of the state for the fiscal year 2016-17 stands at about 3.07 lakh MT.

The basic horizontal expansion strategy is achieved through formation of new ponds and lakes and through recovery and redesigning of the existing ones. Then again push on vertical development is given through efficiency upgrade with selection of improved and progressed culture practices and better maintainable administration practices.

Current condition of Development and Administration of Resources:

Despite the fact that the assets potential for fish creation is high, scientific fish cultivation is being rehearsed impressively in a little segment. Fisheries systems have been embraced in a portion of the beels and low-lying zones which has expanded the production to around 1600 kg/ha/Year.

Riverine fisheries systems in the state are currently under no or very minimal intervention, however the revenue fisheries , which covers the rivers and beels are leased out to interested individual or societies; are under the supervision of Assam Fisheries Development Corporation Ltd.

Resources and Water area:

S.No	Resource Name	Total No	Area
1	Beels / Ox-bow lakes	Registered:430, Unregistered:767	60215 (ha), 40600 (ha)
2	Forest Fisheries	71	5017 (ha)
3	Derelict water bodies/ swamps/ low-lying	3882	116444 (ha)
4	Reservoir fisheries	2	2553 (ha)
5	Individual Ponds	369304	56566 (ha)
6	Community Tank	6328	5152 (ha)

Fish and Seed production (Last 5 years data):

Year	Fish Production (lakh MT)	Fish Seed Production (Million nos.)
2012 - 13	2.54	4364
2013-14	2.67	4546
2014-15	2.82	4585
2015-16	2.94	5678
2016-17	3.07	6758

Assam Government Schemes: States Own Priority Development Programme (SOPD):

Major schemes under SOPD includes:

- "MatsyaJagaran- GhareGharePukhuriGhareGhareMaach":

This scheme is focusing on people keen on taking up fish culture through development of new ponds in a proper area with a mission to extend fish culture region and production of more fish through scientific farming, creation of independent work opportunity and financial upliftment.

Unit Cost and sharing pattern for the scheme:

		Govt Share	Beneficiary Share
Civil works (pond construction):	As per actual cost subjected to a ceiling of Rs. 7.00 lakh per ha	90%, subjected to a ceiling of Rs. 6.30 lakh per ha	10% ie. Rs. 0.70 lakh per ha
Input cost for fish culture:	As per actual cost subjected to a ceiling of Rs. 1.50 lakh per ha	90%, subjected to a ceiling of Rs. 1.35 lakh per ha	10% ie. Rs. 0.15 lakh per ha

Nearly 400 people will be profited under the plan and around 200 tons of fish will be created every year.

- Seed Bank Programme: Building new ponds for seed rearing (fish).

This Programme is focusing on those cultivators that are keen on pursuing fish seed raising business through development of new raising tanks or ponds in a reasonable land with the goals of making fish seed accessible as fingerlings, extension of fish seed raising territory, financial upliftment of the rural individuals and making independent work openings.

Unit Cost and sharing pattern for the scheme:

	Unit Share	Govt Share	Beneficiary Share
Civil works (construction of rearing pond):	As per actual cost subjected to a ceiling of Rs. 6.00 lakh per ha	90%, subjected to a ceiling of Rs. 5.40 lakh per ha	20% ie. Rs. 0.60 lakh per ha
Inputs for fish seed rearing:	As per actual cost subjected to a ceiling of Rs. 1.50 lakh per ha	90%, subjected to a ceiling of Rs. 1.35 lakh per ha	20% ie. Rs. 0.15 lakh per ha

Nearly 200 people will be profited under the plan and around 45 lakh fingerlings will be created every year.

- Majuli Development Programme

This scheme includes 2 sub schemes namely Seed Bank Programme and Fish Cum Pig Culture in the existing pond after renovation. Seed Bank Programme targets for an area coverage of 4 ha and expects an annual turnover of 6 lakh fingerlings which will benefit nearly 28 individuals. Fish Cum Pig Culture in the existing pond after renovation scheme is targeted to those farmers who have prior experience with pig husbandry. The individuals must be willing to take up this dual system of fish farming i.e. pig and fish together in the same system. The scheme specializes in the utilization of the same space in a more efficient way and also emphasizes an increase of income per unit area and reducing the cost of the overall fish farming process.

Unit Cost and sharing pattern for the scheme:

	Unit Cost	**Govt. share**	**Beneficiary share**
Civil works (renovation/ repairing/ readiness of pond and construction of pigsty)	**As per actual cost subjected to a ceiling of Rs. 5.00 lakh per ha**	**90%, subjected to a ceiling of Rs. 4.50 lakh per ha**	**10% ie. Rs. 0.50 lakh per ha**
Inputs cost for fish culture and pig husbandry	**As per actual cost subjected to a ceiling of Rs. 2.50 lakh per ha**	**90%, subjected to a ceiling of Rs. 2.25 lakh per ha**	**10% ie. Rs. 0.25 lakh per ha**

Nearly 25 people will be profited under the plan and around 35 MT fish and 24 MT pork will be created every year.

- Assistance to women self help groups (SHG) for production of other value added fish products:

In spite of the fact that locals of Assam prefer fresh fish, there is always a market for "ready to cook" items along with other fish items such as fish pickle, wafers, balls, dry fish and so on particularly for the urban territories.

Fishery department of Assam has started this building program in collaboration with Central Institute of Fisheries Technology (CIFT), Kochi and College of Fisheries, Raha for interested ladies and groups.

This scheme is proposed to help chosen women SHGs with the goal of strengthening women entrepreneurship in the fisheries field along with women empowerment. This scheme greatly promotes the value added fish products in the market. Nearly 15 women SHGs will be selected by the District Fishery Development Officers.

- Training of scheme beneficiaries and farmers:

Before availing the above mentioned schemes, most of the farmers are using old techniques in their farming. With improvement and asset usage, the fish production and the pay can be expanded to a significant degree. In order to instill a creation program on a scientific basis, building the capacity of the farmers is exceptionally fundamental. This scheme is planning on building the capacity of the farmers and the scheme recipients by implementing scientific procedures and providing guidance and knowledge. Around 450 farmers are focused under the plan.

Relevance of Molecular Biology to Aquaculture and Commemorating Har Gobind Khorana on Birth Centenary Year 2022

Gene manipulation is a molecular biology technique applied for stock improvement of cultivable fishes. Introduction of desirable genetic traits like faster/increased growth rates, improved freeze resistance, resistance to some microbial diseases are important expected benefits of gene technology in fisheries/ aquaculture and utility, which will produce superior transgenic strains of cultivable fishes. Finfishes are much suited for gene transfer experiments. Transgenic goldfish could be produced using human growth hormone gene. Transgenic brightly-fluorescent ornamental fish or 'glofish zebrafish' contains genes isolated from jellyfish and sea anemone. Injections of bovine growth hormone showed increase in weight in transgenic coho salmon *Oncorhynchus kisutch*. At Madurai Kamaraj University, growth hormone gene-introduced transgenic *Labeo rohita* could be generated that was six-times fast growing than the respective controls. The fundamental concepts and principles of molecular biology like Central Dogma; recombinant DNA technology; gene amplification and expression; PCR; isolation, cloning and sequencing of fish antifreeze protein gene, growth hormone gene of fishes, etc; Southern Blot hybridization are involved in transgenic fish production. Indian scientists Late Radha Kanta Mandal at Bose Institute, Dr Kshitish Majumdar at CSIR-CCMB, Prof. T. J. Pandian at afore-mentioned University, Dr W. S. Lakra at ICAR-CIFE worked intensively on fish transgenics research. Scientists at ICAR-CMFRI, ICAR-NBFGR worked on isolation and characterization of salt tolerant genes from Indian mangrove plants.

In this esteemed magazine on fishery/aquaculture, it will not be completely out of context to commemorate the life and contributions of a world-renowned Indian-borne molecular biologist on his Birth Centenary Year 2022. Padma Vibhushan Late Har Gobind Khorana (9/1/1922 - 9/11/2011) was the first person from India and also Asia continent to receive the Nobel Prize in Physiology or Medicine (with two American biochemists M. W. Nirenberg and R. W. Holley), which was in 1968. Addressing all three of them, it was mentioned in Award ceremony/ Presentation speech: '….. Together you have written the most exciting chapter in modern biology'. Prof. Khorana rose to such prominence, served as faculty at MIT, one of the top academic institutions in world but unbelievably was brought up from a small economically-poor village of north-western India (undivided) and was son of an ordinary village agricultural tax collecting clerk. An organic chemist-turned-molecular biologist and referred as 'Founding father of chemical biology', Prof. Khorana confirmed that language or rule by which information in molecular sequence of DNA-encoded mRNA is translated into amino acid sequences of proteins, is composed of 64 distinct three-letter 'words', *i.e.*, specific sequences of every three nucleotides in mRNA, that dictate the order of 20 possible amino acids in polypeptide chain. This triplet-nucleotide-based genetic code is common and fundamental to all forms of living organisms, who use it to read the information in DNA.

Co-recipient of Nobel Prize M. W Nirenberg has mentioned: 'Gobind Khorana was at that time one of the best organic chemists in the world working in the field of nucleic acids. He synthesized the 64 triplet chemical, and also repeating polymers with known repeating doublets or triplets. He used them all to determine nucleotide sequences of RNA codons'. As Professor and Co-Director at the Institute for Enzyme Research, Department of Biochemistry, University of Wisconsin-Madison in 1962 and few years that followed, Prof. Khorana worked painstakingly to synthesize and characterize all possible triplet trinucleotides precisely. Four ribonucleotides when combined in 3-letter codes yielded 64 possible combinations. He used synthetic messenger RNAs to instruct protein synthesis by ribosome, built different RNA chains with help of enzymes to produce proteins, determined their amino acid sequence and also how each possible combination of A, T, C, G ultimately code for a different amino acid.

With complete codon assignments established, it could be elucidated how information in mRNA is translated into 20 encoded amino acids, *i.e.*, how the alphabet of nucleic acids dictates that of proteins. Synthetic nucleic acids, oligonucleotides and nucleotide co-factors prepared by him (the methods he devised) is said to be pre-requisite for establishing the full details of genetic code and revealing identities of codons that instructed cell to stop manufacture of proteins. This work on

specific polyribonucleotide synthesis helped us to understand how triplets of nucleotides encode different amino acids.

Transfer ribonucleic acid molecules allow translation of messenger RNA sequences into amino acid sequences of proteins. While concentrating on study of gene expression and strategy for enzymatic gene synthesis in 1972, as Professor at Departments of Chemistry and Biology at MIT, Prof. Khorana and co-researchers described for first time the chemical synthesis of a functional gene completely, *i.e.*, the 77bp structural gene for an alanine transfer RNA from yeast. He synthesized the long double-stranded DNA sequence in laboratory which coded for this specific tRNA. Coding region of this synthetic (wholly artificial) gene could be assembled using the enzyme DNA (polynucleotide) ligase. That sequence when inserted into a living bacterium, it resulted in successful production of the tRNA, a synthetic one, which functioned identically to the naturally expressed gene. Prof. Khorana also described the process of chemical synthesis of yet another 126bp gene for *Escherichia coli* tyrosine suppressor tRNA, which (final 207bp *E. coli* tyrosine suppressor construct containing required regulatory elements needed to express the gene in bacterium) could be injected into living *E. coli* and shown to carry out its full biological function in it; its suppressor activity (suppressing a stop mutation) could be demonstrated. He determined sequence of 29 nucleotides immediately preceding the starting point of transcription of this man-made gene.

Subsequently, Prof. Khorana studied on determining structure and function of rhodopsin, a light-sensitive receptor protein and primary photo-receptor (light-sensing) molecule of vision found in retina of vertebrates. First he studied bacteriorhodopsin in light-sensitive bacteria *Halobacterium halobium* and worked out its complete amino acid sequence; it converts sunlight energy into proton gradients that serve as energy source of cell. He inquired into basic molecular mechanisms of the cell-signaling pathways of vision in vertebrate system, studied key structural features of active sites of rhodopsin and mutations in it associated with Retinitis Pigmentosa (RP; responsible for night blindness in humans), carried out characterization and structural studies on misfolding of rhodopsin in RP mutants. In initial years of research, in early 1950s, Prof. Khorana developed a process of using dicyclohexyl-carbodiimide to form pyrophosphate bonds, which led to the first large-scale synthesis of acetyl coenzyme-A.

On 12/12/1968, Prof. Khorana mentioned in his Nobel Lecture entitled 'Nucleic acid synthesis and the genetic code': "….. *This was the first time that a direct sequence correlation between DNA and a protein had been established. With the 3-letter and non-overlapping properties of genetic code proved and with information on codon assignments, the problem of the genetic code at least in the restricted one-dimensional sense (linear correlation of nucleotide sequence of polynucleotides with that of amino acid sequence of polypeptides) would appear to have been solved. This knowledge is hoped to serve as a basis for further work in molecular and developmental biology.*" According to Prof. T. P. Sakmar, member of Prof. Khorana's research group at MIT in late 1980s: 'I saw a man still totally focused on laboratory work, following an almost relentless weekly schedule. He thought constantly about effort and commitment, exuded an almost childlike enthusiasm and energy but with a laser-like focus'.

Prof. A. Z. Ansari, Dept of Biochemistry at University of Wisconsin-Madison mentioned: 'Khorana's mentorship for doctoral and post-doctoral students involved rigorous intellectual training and hard work. It did not matter if none of the experiments worked (at least for impossible problems), but complete 24/7 engagement was expected'. Prof. C. Kaiser, Former Head, Department of Biology at MIT had mentioned: 'Khorana had the vision and leadership to convince a team to follow him to an unknown place, and had the supreme confidence that he would know what to do once he got there'.

Prof. Kary Mullis was awarded Nobel Prize in Chemistry in 1993 for inventing Polymerase Chain Reaction; this process is believed to be a development of Prof. Khorana's pioneering description on step-wise amplification of synthetic genes. Co-recipient of this Prize Prof. M. Smith previously undertook post-doctoral research under mentorship of Prof. Khorana. By year 1980, many molecular biology laboratories followed Prof. Khorana's 'repair replication' process; nucleotide bases and DNA polymerase used to copy DNA segments by extending two synthetic primers. Many scientists have asserted that Dr K. Kleppe and his mentor Prof. Khorana have better claim to the invention of PCR; their work accomplished at the time twenty-two years earlier from year 1993 is believed to be early precursor to PCR and framework built for PCR-based DNA amplification strategy. Year 2022 is the Birth Centennial of Indian-born Nobel Laureate biologist Har Gobind Khorana, whom we know as 'Interpreter of the language of genetic code' or 'Decoder of genetic code'. *On this occasion, News communicator Subrato Ghosh expresses humble regards to this great scientist and presented some lesser-known facts.*

With 10,500 tonnes feed, 600 Million Seed Market and 4,000 acres of land in use

Shrimp culture Growing well in North India

Hisar: With 10,500 tonnes feed, 600 Million Seed supply annually and 3,500 to 4,000 acres of land in use in Haryana, Rajasthan and Punjab states, shrimp culture is growing fast in the Northern Region of India.

Shrimp farming development in Northern region started in 2017 – 18 with a few farmers going for Shrimp ponds in one to two acres land. While the farming in Haryana and Punjab is done in earthern ponds, in Rajasthan most of the Shrimp culture is done in P-Line ponds.

Farmers in these states take part themselves personally in pond preparation, seeding, feeding and the maintenance and they invest their hard earned money in Shrimp culture. Though awareness is less about shrimp farming the farmers in the region are quick learners.

There are no shrimp processing plants and hatcheries in the region and the farmers depend on hatcheries from east coast for the seeds supply and the processing units in different parts of the country for the harvested shrimp material sale.

A few shrimp storage facilities are coming up in Haryana, Punjab and Rajasthan states to cater to the needs of farmers for storage of harvested shrimp material.

North , a cash market

North is a cash market and the farmers invest their own money for shrimp culture. As shrimp culture is assured for profitable farming, the agriculture farmers are also preferring to take up shrimp culture resulting fast expansion of shrimp culture in Northern region of the country. As the soil is suitable farmers are getting good harvest of shrimps, but they are not able to get good farm gate price for the shrimp as they are no shrimp processing plants nearby.

Subsidy given by Haryana Govt for Shrimp Culture

1) Cost of project for 1 hectare Rs 14 Lakhs

(Construction and Infrastructure for Shrimp pond Rs 800,000 & for running cost like Seed, Feed, Medicines, Labour, Diesel, Electricity Rs 600,000).

The farmers are requesting the government to increase the subsidy to Rs 20 Lakhs per hectare per individual.

Dealers in Haryana, Punjab and Rajasthan states in Northern Region of India

1) Haryana Aqua Food,
Fatehabad, Haryana.
Mr Ravinder Singh
M: 93543 08899
Dealer : Cargill Feed, Medicines, Aerators etc.

2) Royal Health Food,
Sri Muktsar Sahib, Punjab.
Mr Karan Kalra
M: 92162 00008
Dealer : Waterbase Feed, Medicines, Aerators etc.

3) Mr Rajveer Singh
Bahadur Kheda, Punjab.
M: 86993 99323
Dealer : Growel Feeds, Medicines, Aerators etc.

4) Gurunanak Trading Company
Mr Karan Singh
M: 86993 99323
Dealer : Growel Feeds, Medicines, Aerators etc.

5) Mr Ram Rai Trading Company
Sirsa, Haryana.
Manish Kumar Patel
M: 94583 59038, 87082 93407
Dealer : Shenglong Feed, Medicines, Aerators etc.

6) GSR Trading Company
Mr Gurupreet Sing Rohal
M: 98174 34164
Dealer : Devi Sea Feeds, Medicines, Aerators etc.

7) Sharma Feed Suppliments Punjab,
Mr Rajkumar Sharma,
M: 83602 88151, 94468 06080
Dealer : IB Group Feed, Medicines, Aerators etc.

8) S.R. Trading Company,
Mr Suneel
M: 78886 84788
Dealer : Avanti Feeds, Medicines, Aerators etc.

9) Mr Shukhpal Singh
M: 94643 06792
Dealer : C.P. Feeds, Medicines, Aerators etc.

10) B.S Trading Company
Thuian, Haryana.
Mr Jitender
M: 86077 13645, 98128 40051
Dealer : Godrej Agrovet Feed, Medicines, Aerators etc.

11) Sarika Aqua Food
Ratanpura, Churu.
Mr Ramesh Dagar
M: 82337 93050
Dealer : Avanti Feed, Medicines, Aerators etc.

12) Rajasthan Aqua Food
Jaipur, Rajasthan.
Mr Krishan Punier
M: 98133 22209
Mr Sitaram Rohlam
M: 99504 57215
Dealer : Godrej Agrovet Feed, Medicines, Aerators etc.

13) Mr Sandeep Punia
M: 80034 52309
Dealer : Growel Feed, Medicines, Aerators etc.

14) 14) Purina Aqua Food
Mr Jagdeep
M: 97117 87456
Dealer : Cargill Feed, Medicines, Aerators etc.

15) Shri Lakshmi Fisheries
Mr Lokesh Prajapat
M: 96945 81694
Dealer : C.P. Feed, Medicines, Aerators etc.

16) Doctor Atar Aqua
Mr Sandeep Sangwan
M: 94975 58294
Dealer : OM Feed, Medicines, Aerators etc.

17) Envozyme Technologies, Haryana
Dealer : Envo Feed, Medicines & other products.

Note : The above are a part of the Dealers list in Northern region of the country, supplying Seed, Feed, Medicines, Aerators, Motors, Equipment etc.

Sunil Lathor gets 23 count, finds Shrimp culture a lucrative business

I am doing shrimp farming in 8 acres since 2021 and got 18 tons production. I have six ponds of each 150 x 150 feet size. I got 30 tons shrimp production with 23 count. I spend most of the time in ponds and I am happy with the good results I am getting in shrimp culture.

My ponds are located in Jhuppa Khurd village in Bhiwani district in Haryana state. I found good prospects in shrimp culture, it's a lucrative business.

Sunil Lathor,
Village Sarpanch & Shrimp Farmer,
Jhuppa Khurd, Bhiwani District, Haryana.

We target to develop North India shrimp feed market to 40,000 tonnes in the coming five years

The biggest shrimp farmer & Feed Dealer in North India, Ravinder Singh speaks to Aqua Internationa Editor M.A.Nazeer

Fatehabad, Haryana:
Born and brought up in Fatehabad, Mr Ravinder Singh with an academic qualification of MBA – Marketing & HR, is the sole Promoter of Haryana Aqua Food and started shrimp farming in 2017 in 2.5 acres and in 2018 took up trading business of feed, feed supplements and other aquaculture products with head quarters at Fatehabad. Now we achieved good progress in aquaculture business, said Mr Ravinder Singh in an interview to Aqua International Editor M.A. Nazeer.

Ravinder Singh, Promoter, Haryana Aqua Food Group

Branches at Rajasthan, Haryana and Punjab
We have three branches at Ghotyabadi, Rajasthan by name Puran Aqua Food; at Malot, Punjab by name Punjab Aqua Food and at Kalawali, Sirsa, Haryana by name Haryana Aqua Food. We deal with feed, feed supplements, seed and other aquaculture products. We have godowns in these 3 states with a capacity of 6,000 square feet each, he informed.

We are dealing with Cargill India Feed company, The Himalaya Drug company, Sanzyme Biologics and Tablets India Pvt Ltd for their products in Northern region. We have technical persons in every area in the region to provide services to the farmers and our customer farmers are highly satisfied with our products and services, he stated.

Ravinder Singh is not only the biggest shrimp farmer, but also the biggest Dealer / Distributor supplying Cargill Feed, and kept Cargill Shrimp feed in No. 1 position with about 30% market share for feed in northern region of the country.

Mr Ravinder Singh informed that his group has achieved a turnover of Rs 38 crores in 2021-22.

HAF provides safety guidance to its staff time to time and provide accidental insurance to the staff.

Haryana Aqua Food Group will do its best for the growth of Aquaculture sector in North India and our target is to increase shrimp culture in 10,000 acres in the next 5 years, and also increase total feed sale market from the present 10,000 tonnes to 40,000 tonnes in the coming five years.

In shrimp culture role of nutrition and health care products is important because all things are dependent on good quality products, he stated. We are also providing financial and good quality products to agriculture farmers for the last many years as a grain merchant.

We provide time to time technical guidance to every farmer in a week through our technical team. Farmers also give proper response to our team.

Replying to a question, Mr Ravinder Singh said, entry into shrimp culture as a farmer itself is a turning point in my career and i achieved good growth in aquaculture sector. After one year of my shrimp farming experience helped me to start trading business in this sector.

One Mr Jagdeep Singh who started shrimp farming before me in 2016 had helped me through providing technical advise, products and aquaculture sector knowledge.

Gurunanak Trading company, New Sharma Feed Supplements, B.S. Trading company, S.R. Trading company and Shri Ram Trading company are the other five leading feed and healthcare products distributors in the region, he stated.

Ravinder Singh advised farmers and the stakeholders to put efforts to make sustainable shrimp farming and use quality seed, feed and feed supplements.

Ravinder Singh with Aqua International Editor M.A. Nazeer

Karan Kalra aims to expand his Shrimp farm to 100 Acres in 3 years

Karan Kalra, Proprietor, Royal Health Food

Sri Muktsar Sahib: Mr Karan Kalra, Proprietor, Royal Health Food, started his business in aquaculture in 2018-19 with shrimp farming in 8 acres and in 2019-20 he added another 5 acres ponds. In 2020-21 he developed another shrimp farm of 7 acres making it a 20 acre shrimp culture with Vannamei in Punjab state.

Karan took seed dealership of Golden Marine Harvest in 2021 and sold over 30 Million seed in the first year and also got feed, medicines and supplements dealership of The Waterbase Limited, Chennai. In the first year he had a business of Rs 50 lakhs for feed and healthcare products and in 2021-22 he achieved a business turnover of Rs 3 crores with one branch at its headquarters at Sri Muktsar Sahib in Punjab.

Royal Health Food is dealing with supply of shrimp seed, feed and healthcare products in Punjab, Haryana and Rajasthan states and has godown facility to store these products besides service network to the customers. They are also having distributionship for the Aerators of Century Aqua Products.

Karan Kalra said that his products are the best and has got good feedback from farmers. We compare our products according to bacteria level, consumption quantity and the results, he added.

I want to increase my aquaculture farming area from the present 20 acres to 100 acres in the next 3 years and I target to promote good aquaculture practices for the survival of this industry in northern region, Karan Kalra stated.

Nutrition and healthcare products play a very important role in aquaculture. Without these products it is difficult to improve immunity in shrimps and there is no power to fight with diseases. Hence these products are very necessary for healthy aquaculture farming, he told.

I have organised seminars for farmers to educate them and to promote aquaculture in the region. I advise the farmer customers to implement biosecurity and good management practices.

Baymin, Whitekure, Nutri Pond, VC-9, Pond Guard, Nutri Gut, Nutri Feast, Nutri Sorb, Amminovita, Enrich C, Zeolife, Oxylife of Baylife are the products we supply of Waterbase Ltd.

Most of the farmers have shrimp farming in 3 to 5 acres in north and they personally look after their farms in every aspect of culture.

Mr Paramjeet Singh Warar is coming up with cold storage facility of 500 metric tonnes capacity for shrimp material at Mollianwali, Fazilka district in Punjab. The second plant with 30 metric tonnes capacity is coming up at Malout in Punjab under Blue Revolution Scheme by the Government of India.

The dealers in Punjab are putting efforts to form a shrimp farmers association of the state to help them resolve their day to day problems. The state has about 300 shrimp farmers with farming in about 1000 acres. Farmers stock 125,000 seed per acre and they are getting good results.

Karan Kalra with Aqua International Editor M.A. Nazeer at Royal Health Food office in Sri Muktsar Sahib

Karan Kalra is also having a B.Ed College, Rice Shellers, Solvent Extraction Plant and Physical Refinery. Karan Kalra is a graduate and has his spouse Ms Shilpa Kalra and daughter Baani Kalra.

Cargill, the No.1 in Shrimp feed supply in North India

Hisar: Cargill India Pvt Ltd has achieved No.1 position in its shrimp feed supply with the largest market share in feed market in northern region of India, said the company's Northern Region Territory Lead Dr Deepak Kumar Sharma. Due to quality feed, good FCR at 0.8 to 1.2 and the timely technical support by Cargill Feeds and its dynamic distributor, we are able to achieve No.1 position in feed market in North India, he stated.

Deepak Sharma, Territory Lead, Cargill Feeds

Cargill has no credit policy and North India Aquaculture is a cash market. Farmers in this region involve themselves personally in selection of seed, feed and healthcare products, and maintenance of the ponds. Farmers identified Cargill as a good feed. We have corporate farmers as our customers with 60 acres of culture like Mr Netrapal Rao, Jhajjar, Haryana who is producing 160 to 180 tonnes of shrimp material, said Deepak Sharma.

Cargill's policy is different from other feed companies, hence not able to get big market in other states, he added.

I make weekly visit to the farmers in north. We have three technical persons providing technical service to farmers, said the 12 years experienced sales and technical services providing senior executive Deepak Sharma.

Dr Deepak Kumar Sharma, native of Muzaffar Nagar, Uttar Pradesh did his B.Sc Zoology – Botany from CCS University, Meerut; B.V.Sc & A.H, NDUAT, Kumarganj, Faizabad and M.F.Sc – ABVH, University, Bhopal. His father Siyanand Sharma is in government service while his mother Roshni Devi is a housewife. His wife Ms Sakshi Sharma is M.Sc Maths.

Dr Deepak Sharma started his career with Pancham Aquaculture Farm, Safala, Maharashtra in 2010 and worked there for 3 years. Later worked in The Waterbase Ltd for 4 years at Gujarat and Godrej Agrovet for 6 months. Since 1st September 2017 he has been in Cargill India Pvt. Ltd based at Fatehabad, Haryana.

Annually 60 to 70 B.F.Sc students from different fisheries colleges come to us to get training at the farms and they go back with adequate knowledge on the subject.

When I came to North India, it was a 200 acres shrimp farming and I had 50 tonnes feed market. I also contributed for the development of P – Line shrimp farming providing technical knowledge arranging seed, feed and buyback system under the umbrella of Haryana Aqua Food which has brought manifold growth in shrimp production in North India. I want to continue to be the No.1 with sales and quality of feed and I will put best of my efforts for it, Dr Deepak Sharma stated.

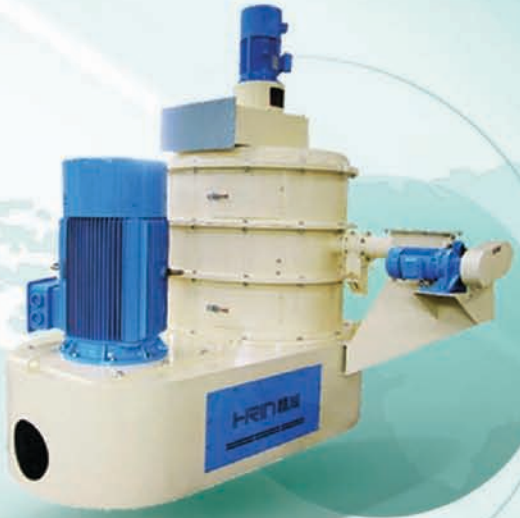
Deepak Sharma and Ravinder Singh with farmers

Deepak Sharma explaining to fisheries students about shrimp ponds and management.

I learnt well from Mr Ajit Sinha Patil, Director of Pancham Aquaculture, Maharasthra, Mr Animesh Chowdhary, Director, Cargill Feeds, India and Dr Ashok Singh, Senior Scientist, CIFE, Lahli, Rohtak. Now Ajit's son Captain Ranjeet Patil is looking after Pancham Aquaculture in 1500 acres shrimp farming in Maharashtra.

B.F.Sc students in training at Shrimp farms in Haryana

Professional Feed Machinery Manufacturer



Hengrun SWFL Series Vertical Pulverizer

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

Hengrun HRYTZ Series Vacuum Sprayer

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

Carophyll Pink in Aquafeed to Influence the Pigmentation of Fish and Shrimp

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Highlight Points

1. Carophyll pink is the concentrated form of synthetic astaxanthin, which can be used for bright red coloration in brood stocks and larval rearing.
2. It is the carotenoid that is purely responsible for the pinkish-red pigmentation of fish, shrimps and other crustaceans.
3. It is safe for all aquatic animals; it can be used as feed colorant and it helps to increase the antioxidant level in fish or shrimp.

Introduction

Aquaculture is a fast-growing global industry that includes the cultivation of finfish, shellfish, and ornamental fish of various freshwater and marine species. A properly formulated feed and pigmentation system is a vital part of effective aquaculture. The pigmentation of the skin and muscle is responsible for the coloring of the organism. In the natural environment, aquatic organisms meet their carotenoid requirements by ingesting aquatic plants or food chains. However, they are not capable of synthesizing carotenoids *de novo*. Carotenoids must be introduced through the diet of the cultivated species. Pigmentation is one of the essential qualities of livestock for consumer acceptability. It is the most quality-related criterion apart from product freshness. To increase the skin redness of *Australian snapper*, *Pagrus auratus*, *Sparus aurata*, *Atlantic salmon*and many more, synthetic unesterified forms of astaxanthin as Carophyll pink were used successfully. Throughout this overview, we discussed the value of Carophyll pink from DSM Animal Nutrition for aquaculture and their benefits in influencing the pigmentation of fish.

Carophyll Pink

Carotenoids have an essential role to play in aquaculture feed. They are antioxidants and even precursors to vitamin A. Their most important function in aquaculture is to improve the color of fish meat. Carophyll pink is a carotenoid additive that enables farmers to provide authentic and pigmented food safely and consistently. The Carophyll pink (Fig. 1) from DSM Animal nutritionis a man-made astaxanthin in a cornstarch-coated matrix of lignosulfonate and corn oil (Fig.2). It mimics astaxanthin, a naturally occurring caroteroid that gives shrimp, lobster, crab, and salmon their bright hue. Carophyll pink enhances diet and product formulation by creating enhanced efficiency for farmed fish. Carophyll pink consists of free-flowing particles (beadlets) from violet-brown to brown-violet, and Ethoxyquin is added as an antioxidant. Ethoxyquin is a synthetic antioxidant used as a preservative in certain animal foods to protect fats and fat-soluble vitamins from oxidative degradation.

Chromatophores

The fish skin has chromatophores, a type of cell that contains color pigments. Chromatophores are found in the epidermis and are the most common in the dermis. The chromatophore color depends on the light absorption of pigments. Chromatophore cells can be classified into five basic color categories, namely black (melanophore), yellow (xanthophore), red or orange (erythrophore), sheen reflection cells (iridophore) and white (leucophore). The main component of color pigment forming is carotenoid, a component of natural pigment that contributes quite well to the red and orange colors. In general, fish absorb astaxanthin from feed and use it directly as a red pigment

cell. Astaxanthin is commonly added to feed to prevent the absence of color pigments in aquaculture. For example, The green swordtail fish, *Xyphophorus helleri* is one of the popular ornamental fish. It has a green sword-like tail shape and a red body color that make the good-looking uniqueness. The market value and the level of customer demand depend on its body color. Therefore, to increase its quality, the color must be improved. Manipulation of pigment techniques by enriching chromatophore cells› quality in the fish›s body by feeding with carophyll pink is one of the ways to obtain bright and colored fish.

Importance of pigmentation in aquaculture

Due to the direct relationship between colors and the appetizing appearance of a food product, there is a strong demand for artificial food pigments ; this is particularly true in the aquaculture industry. Salmon, especially Atlantic salmon, is one of the most important groups of fish in aquaculture. In American supermarkets, as much as 95% of Atlantic salmon sold is farm-raised. Although fish farms have significantly increased the quantity of salmon available for consumption, these farms are not conducive to developing distinctly vibrant pink and orange salmon colors. The pigments of the farmed salmon's flesh are significantly less vibrant relative to its wild salmon flesh. The flesh of farmed salmon is typically an unappetizing greyish color. In order to be marketable to consumers, farm-raised salmon must be colored. The dietary inclusion of carophyll pink in the Atlantic salmon diet was sufficient to impart the desirable coloration of flesh required for the customer's acceptance to solve this problem. Dietary carophyll pink has enhanced the antioxidant status in juvenile Atlantic salmon and also directly improves pigmentation. Highly esterified astaxanthin molecules cause lower serum absorption and reduced astaxanthin uptake in Atlantic salmon flesh, as molecules must be hydrolyzed before they are available. The deposition of carophyll pink in salmon fish, on the other hand, is more effective as it is non-esterified or free.

Carophyll pink in brood stock diet

Numerous parameters, such as brood stock nutrition, environmental conditions, and husbandry practices, have been documented to influence egg quality. Manipulation of brood stock diets should provide a realistic means of enhancing egg quality by supplementing essential nutrients if nutritional factors are responsible for quality issues. For brood stock, nutrition is particularly important because farm-reared fish may be conditioned for spawning in tanks. The addition of carophyll pink to brood stock diets results in egg absorption and improvements in the quality of eggs. The effectiveness of supplementation with carophyll pink could be linked to stress reduction and immune function enhancement. Because in natural spawning of cod, the eggs are released into the upper layers of the ocean, which are both highly illuminated and oxygen-rich, presenting an ideal environment for a free radical generation. Therefore, when diets are supplemented with carophyll pink, the quality of egg and larvae in farmed cod could be by enhanced antioxidant activity in the diet.

Fig.1.*Carophyll pink packet*

Carophyll pink in shrimp diet

In recent years, a line of synthetic carotenoids has been widely added to shrimp feeds to promote or augment flesh pigmentation in cultured shrimp, especially during the final stage (e.g. 8 to 16 weeks) of production. Regardless of the source, currently available natural feed ingredients high in carotenoid pigments are expensive and add significantly to the cost of shrimp diets. The lack of shell color detracts from the acceptance of shrimp by commercial markets. Plant carotenoid maintains the pigmentation of the crustacean shell and can improve other nutritional deficiencies due to artificial diets, thereby improving growth rates. It is beneficial to use carophyll pink for incorporation into pelleted diets. It was found that the carophyll pink pigment concentration influenced the abdominal shrimp muscle and exoskeleton pigmentation in the diet after 15 days of feeding (Fig.3).

Carophyll pink in ornamental fish

On turning *Cichlasomasynspilum* to red, synthetic astaxanthin which is more commercially

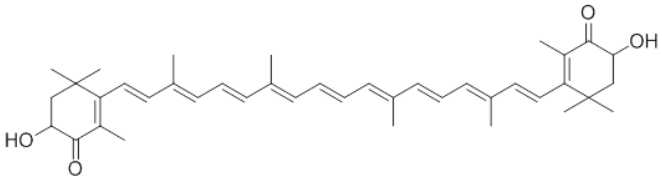

Fig.2. *Chemical structure (Courtesy: ChemDraw JS) of Carophyll pink*

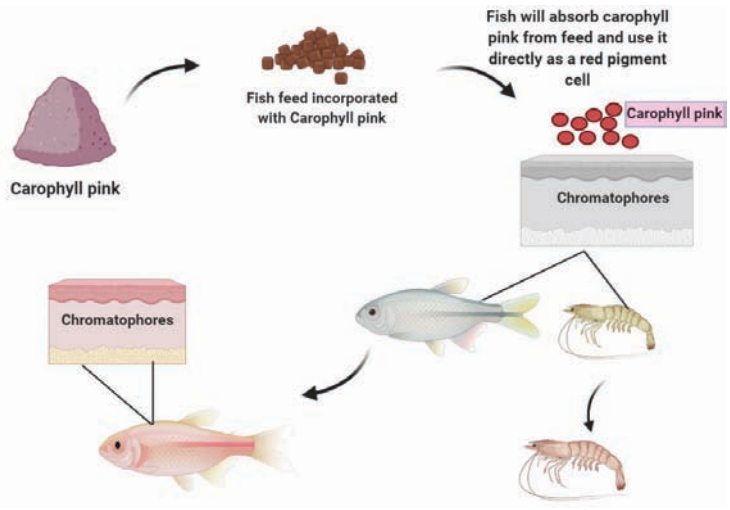

Fig.3. *Carophyll pink for pigmentation in fishes (Image created with Biorender.com)*

competitive than natural astaxanthin sources from *Phaffiarhodozyma* and *Haematococcuspluvialis*. It might be associated with their dark red appearance from light color skin. Carophyll pink was shown more effectively in inhibiting the accumulation of lipid peroxidation in plasma than the rest of astaxanthin diets. It means that this carophyll pink can improve the antioxidant capacity of *Cichlasomasynspilum* effectively, and deposition of pigment is mainly stored on its skin and scale, which causes an acceptable red natural color.

Conclusion

Synthetic and natural astaxanthin sources are included in fish diets for which pigmentation is essential. Many people are concerned about the synthetic pigments produced by industries. Over time, these synthetic pigments have developed an excellent reputation for efficacy and safety towards their application in the aquatic feed. Carophyll pink does not possess a significant additional risk to the environment compared with natural Astaxanthin, and it is effective in coloring the flesh of fish and in pigmenting the skin of ornamental fish.

Ecosystem-Based Fisheries Management (EBFM): A Modern Tool for Tropical Fisheries Management and Aquaculture

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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 action 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 work place 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 department2003) describedeco systemapproach 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 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 esilience 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 dealswith 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 deliniated energy flow through thereef 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 manmade 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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**More can be provided on request.*

Ballast Water: A Mask of Threat to Marine and Coastal Ecology

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Highlight Points

Ballast water is the water put on board a vessel for safety, providing stability, reducing stress, improving propulsion and maneuverability, redress loss of fuel weight and water consumption. It is essential to commercial shipping. Ballast weight generally equates 25 to 30 % of a ship's dead weight tonnage. Thousands of aquatic species that may be carried in ship's ballast water, including bacteria and other microbes, micro-algae, different life history stages of aquatic plant and animal species from one port to another. Worldwide it is commended that discharge of ballast water into sea is potentially the greatest accidental manner of introducing the exotic organisms. Thus it impacts the ecological, economical and human health functions. As a result, various researchers, policy makers and resources managers/ stakeholders are required to look into the technologies for the treatment and management of ballast water.

Introduction:

Maritime transport is the mainstay of the increasingly globalized economy and the international trade system. Sea transport has invariably the most liberalized sector of transport. In addition to economy and trade the various other driving forces for sea transport include connectivity, access, infrastructure and warehouses, energy and labour costs, regulations related to the safety and quality of transport, responsiveness to the increased requirements of customers across supply chains, and environmental and climate change hindrance (Profillidis and Botzoris, 2019). For centenary, ships carried hard ballast in the shape of rocks, sand, beach debris and various other heavy materials. During 1880s, the ships started using water as ballast weight, consequently avoiding time consuming loading of solid materials and instabilities resulting from the shifting of solid ballast during a voyage. With the introduction of steel-hulled ships and pumping technology, water became the choice of ballast because of easy pumping and lesser manpower. When ships need ballast, water is pumped from the sea where the ship is located into the ships' ballast water tanks, which adds weight to key parts of the ship. Ballast water is discharged at sea when it is no longer needed or when the weight of the ship needs to be lightened.

Ballast is elucidated as any solid or liquid placed in a ship to regulate the stability, increase the draft, to change the trim, or to maintain stress loads within acceptable limits. Ballast water (BW) is essential for the safe operation of ships. It is used to provide stability and maneuverability during a voyage when ships are not carrying cargo, not carrying heavy enough cargo, or when more stability is required due to rough seas. BW may also be used to add weight so that a ship sinks low enough in the water to pass under bridges and other structures. Today, ocean going vessels have ballast tanks incorporated into various designs. The number and size of ballast tanks varies according to type of ship and its design. Most ships are equipped with a range of ballast capabilities and capacities, but generally ballast equates to 25 to 30% of a ship's dead weight tonnage. It includes water and sediment that accumulates in ballast tanks of ships, which may be discharged during voyage completion from port to port. This discharged BW could possibly contain bacteria, microbes, marine organisms, small invertebrates, eggs, cysts and larvae of various invasive species. Thus the release of BW may introduce non-native organisms or bio invaders into the port of discharge. While most transported species do not survive when the ballast water is discharged, some thrive in their new environment. With absence of natural predators, they outcompete and kill native species. In such cases, they pose serious risks to local ecosystems, human health and regional economies. They can cause severe and irreversible damage, and attempts to limit further destruction are often costly (Anon, 2017).

Importance:
BW is used to adjust the overall weight of the vessel and its internal distribution. It is used to compensate for different cargo loads that a ship may carry at different times during loading and unloading. It is essential for safe and efficient modern shipping operations.

Threats:
Presently, it is recognized that BW discharge into sea is potentially the greatest accidental manner of introducing undesirable exotic organisms into ports throughout the world. The introduction of non indigenous species is a leading agent of global biodiversity change. Ship-mediated vectors like hull bio fouling, ballast water and ballast sediments are considered primary pathways for unintentional introductions of aquatic organism worldwide (Williams*et al.,* 2013). Worldwide it has been estimated that harshly 3,500 million tonnes of BW and associated biota including microbes, benthos, phytoplankton, zooplankton, fish and other aquatic organisms are transferred annually by merchant shipping vessels. Due to the great volume of water used as ballast in modern ships, the spreading of organisms around the globe has increased, causing damage to human health, biodiversity, fishing activities, mariculture activities, etc.

Impacts:
BW was first suspected as a vector of biota in 1903, when the discovery of an Asian diatom (phytoplankton) in the North Sea had no other explanation than transport by ship (Carlton, 1985). According to International Maritime Organization (IMO) the impacts caused by BW is divided into three main categories.

Ecological: It includes disruption of native biodiversity and/or ecological processes by invading species. It includes predation, parasitism, competition, introduction of new pathogens, genetic changes, habitat alterations, species shifts or loss of biodiversity. Under suitable circumstances discharged organisms will survive and reproduce and become invasive species. In some cases there is a high probability that the organism will become a dominant species, potentially resulting in the extinction of native species, effects on local and regional biodiversity, habitat alteration and act as vectors for various diseases or parasites, hybridism with native species, and increased risk for threatened organisms.

Economical: It impacts on industrial and municipal water uses, nuclear power plants and other water sports. It also poses risk to levees/dams, commercial and recreational activities.

Human health: when toxic organisms, diseases and pathogens are introduced through ballast water, potentially causing illness and even death in humans. It includes Cholera risk, different shellfish poisoning like PSP, DSP, ASP and NSP through different harmful blooms.

Ballast water management and treatment:
In order to overwhelm the ballast water problem, International Convention for the Control and Management of Ship's Ballast Water and Sediments was adopted in 2004 which entered into force in 2017. The convention is also called as Ballast Water Management (BWM) Convention, which aims to prevent, minimize and eliminate the risk of introduction of harmful aquatic organisms from one region to another, by establishing standards and procedures for the management and control of ship ballast water and sediments. The primarily guidelines also suggests that all the vessels should exchange their BW in deep ocean area (depths >2000 m) prior to discharge within the system.

There are various technologies for the treatment of BW, they are as follows:

- Filtration systems (physical)
- Chemical disinfection (oxidizing and non-oxidizing biocides)
- Ultra-violet treatment
- Deoxygenating treatment
- Heat (thermal treatment)
- Acoustic (cavitation treatment)
- Electric pulse / pulse plasma systems
- Magnetic Field Treatment

Conclusion:
Ballast water waste management is a serious maritime issue. It poses serious ecological, economical and public health concerns for host ecosystems and countries where these waste are deposited. As a result, it is crucial that such waste are processed and dispose of properly. The most appropriate technique for preventing the spread of exotic species is the change of BW in high sea. Also, it is apparent that the current legislations and policies in place are not being enforced properly. However, immense efforts and systematic examination for preventing the spread of contagious and non-indigenous organisms by virtue of BW are required.

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Adulterants in Aquafeeds

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Highlight Points

- Adulteration in food is defined as the mixing of some cheaper or low-quality substances with pure or costly materials and is a longstanding and common problem globally.
- The most commonly adulterated feed ingredients in the aquafeed preparation are the fishmeal and oilseed cakes.
- The use of adulterants in aquafeeds are ever-growing and knowledge on adulterant is as important as that of understanding the quality of feed ingredients.
- The unethical use of these toxic substances in feed ingredients should be discouraged.

Introduction

There is a tremendous increase in the number of population across the whole world and estimated that the number may reach around 900 crores by the year 2050. The nutritional status of fishes are continuously reported and the importance is being published and many awareness is being created. This has resulted in increased demand and consumption of fish in recent decades. Fisheries sector serves as a crucial source of food and nutrition as it provides a substantial source of income and employment for a huge number of individuals around the world. Even though the world capture fisheries production increases annually, a stable and nearly constant production from it across the years have indicated that we have reached the peak. While on the other side, the aquaculture production tends to be dynamic and on the increasing trend.

The feed which is given to the cultured animals is the most important factor to be considered in the farming of aquatic animals. They become so irresistible that the feed given alone contributes to about 50 – 60% of the total operational cost in the culture practices. Formulation issues, explicitly the supply of species-specific feeds to necessitate the nutritional requirements of various developmental phases of the farmed species, remain an essential topic for both commercial and farm-made feed production sectors.The efficiency of feed utilization in the aquatic organisms and the development of the aquafeed industry of the country is dependent upon the quality of feed used for the culture of animals. The quality of compounded animal feeds is based on the quality of the feed ingredients used. The common feed ingredients which are used in the preparation of the aquafeeds are fishmeal, oilseed meals, cereals, cereal by-products, agro-industrial products and their by-products, etc. A quality feed would be able to supply all nutrients in adequate quantity with higher palatability and digestibility.

Adulteration

Adulteration is defined as the mixingof some cheaper or low-quality substances with pure or costly materials. Adulteration in food generally occurs globally and can be seen in almost all food commodities. It is a longstanding and a common problem encountered in much low income and developing countries, rarely found in some developed countries also. Adulteration in food can be broadly classified into two groups, namely, intentional and incidental food adulteration. Incidental adulteration occurs when foreign substances are added to a portion of food as a result of ignorance, negligence, or improper facilities. Intentional adulteration involves the deliberate addition of low-grade materials to a food to increasethe appearance, quality and to improve therevenues.Apart from the economic problems, they may also lead to very serious health problems for the ones who consumed the adulterated products. In recent years, very sophisticated methods have been used for adulteration of foods to minimize the detection levels. Hence, reliable and very efficient procedures and techniques should be developed for the detection of fraudulent manipulations.

Adulteration in aquafeeds

Adulteration in aquafeeds is advertent and deliberate by mixing main or costly feed ingredient with other ingredients of low quality or price as compared to the main ingredient and selling them by declaring it as a pure feedstuff. This affects the quality of raw materials. It is also described as deliberate or intentional mixing or replacement of raw or wholesome ingredient with a substandard and cheaper ingredient or removal of a raw ingredient just to gain benefit in the form of money.

Common adulterants in feed ingredients

The most commonly used feed ingredients in the aquafeed preparation are the fishmeal and oilseed cakes. Oilseed cakes are often adulterated by mixing them with urea, husk, and some non-edible oilseed cakes to increase the protein contents. Costly feed ingredients like fishmeal are often adulterated by spraying urea to increase the nitrogen content, as the common traditional detection of protein content in the feed and feed ingredients involved is the analysis of nitrogen content in the product and thereby converting them to protein. The commonly adulterated feed ingredients and the common adulterants are shown in Table 1.

Table 1: Feed ingredients and their common adulterants

Feed ingredients	Common adulterants
Groundnut cake	Groundnut husk, urea, non-edible oil cakes
Mustard cake	*Argemone mexicana* seeds, fibrous feed ingredients, urea
Soybean meal	Urea, raw soybean, hulls
De-oiled rice bran, wheat bran	Ground rice husk, sawdust
Mineral mixture	Common salt, marble powder, sand, limestone
Molasses	Water
Maize	Cobs, cob dust, sand
Broken rice	Marble, grit

(Source: Uppal et al., 2004)

Evaluation of quality feed

Three types are commonly used for evaluating the quality of the feeds. They are:

- Physical
- Chemical
- Biological

Physical Evaluation

Evaluation by physical means is very easy, but the accuracy cannot be obtained. The persons who are involving in the physical evaluation should be highly trained to identify the changes that are seen in the pure raw feed ingredients or feeds. Physical evaluation can be done in the following aspects:

- **Colour**
- **Size**
- **Homogeneity**
- **Smell**
- **Taste**
- **Touch**

Colour

The appearance of the ingredient will reveal its quality. The colour change of the feed ingredients could be easily related to the maturity of the grain, storage conditions, presence of toxins, contamination due to sand, possible use of insecticides/fungicides which gives the dull and dusty appearance. For example, Red or orange-red colour of the sorghum can be an indication of high tannin content. Improper storage of the ingredient may lead to browning or blackening, thereby reducing the nutritive value. Black coloured fish meal indicates the rancidity of fish oils.

Size

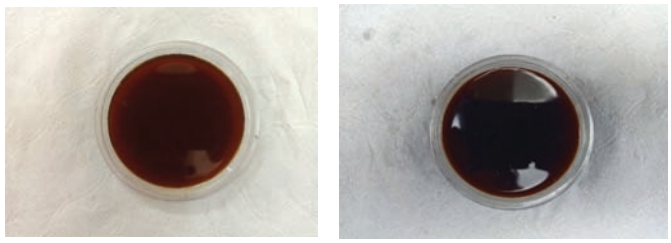
The energy value of the grains is determined by the size of the grains. Smaller the grain lower will be the Metabolizable Energy (ME) value due to more proportion of coater hulls. To evaluate the weight of the cereal, a fixed number of grains usually 100 grains or fixed volume is taken. Higher weight indicates a higher ME value. The difference in the original or actual size of the grain may indicate that the ingredient is adulterated. By sieving the feed ingredients, we can be able to differentiate contaminants based on particle size.

Homogeneity

Similarity or evenness in the ingredient is determined by homogeneity. Closer observation of the feed ingredients like oilseed cakes might reveal the presence of fibrous materials, exclusively seen in de-oiled groundnut cake. The oil cakes with hulls containing 20 to 25% crude fibre can be visually identified. Mineral ingredients with clumps are not suitable for premixing.

Smell

Any stinking or abnormal smell from the stock may be used for identifying the rancidity, contamination and adulteration in the raw materials. The leathery smell in the meat meal may be used as an indication of adulteration of the meat meal with the leather meal. The smell can also be used for detecting the rancidity of oil-rich feed ingredients by the rancid smell.



Difference between animal grade fish oil and rancid fish oil

Taste

Each ingredient has a different taste, any change in the taste like bitterness in the grains, soya, sunflower oil meal and groundnut cake indicates the presence of mycotoxins. 'The level of salt can be detected by tasting the ingredient and the feed. The bitter taste of rice polish indicates the rancidity of the fatty acids.

Touch

Sensing the raw materials by touching them may reveal the difference between pure raw materials and adulterants. It

requires a high knowledge on the appearance, size and the feeling of the raw materials and the common adulterants used in the raw materials.

Raw fishmeal A

Adulterated fishmeal

Chemical Evaluation

Analysing the feed ingredient in an analytical laboratory and the accurate estimation/determination of the nutrient content present in the feed ingredients and contaminants should be given utmost importance. The feed ingredients are commonly analysed for their proximate values. This may indicate the possible changes in the feed ingredients in the aspects of their original crude fibre, lipid and total ash values. Low crude protein and high crude fibre in the oilseeds may be used as an indication of adulteration with some cheaper fibrous materials. High crude fibre values alone could be used as an indication of adulteration with urea or other low-quality feed ingredients like mahua, Karanja or castor oil cakes. To determine the amount of sand or other dirt adulterants in the feed ingredients, acid insoluble ash determination would be a good indicator. Fishmeal is usually contaminated or adulterated with sand during the drying process.

To determine the rancidity of oils, oily materials like fish oil are subjected to free fatty acid evaluation. The chemical composition of various animal feeds is laid down by the BIS which act as guidelines for the suppliers. Ingredients which are mainly used as a protein source in the aquafeeds should be analysed for their amino acid contents, as the common adulterant used is urea which increases the nitrogen content alone and not the amino acid content. These fraudulentprotein substitutes are added to feeds to misleadthe industry where traditional methods areemployed to determine the protein content, basedon the total nitrogen content.

Raw soybean meal

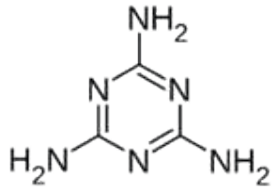
Adulterated soybean meal with sand

Biological evaluation

Biological evaluation of the feed ingredients and the prepared aquafeeds involves the use of aquatic animals like fishes and shrimps to conduct the digestion process and metabolic trials and to determine the outcome. This method of evaluation is time-consuming and labour intensive.

Melamine in aquafeed

Melamine (2,4,6-triamino-1,3,5-triazine) is aheterocyclic compound containing six atoms ofnitrogen and is commonly used for manufacturingplastics. Melamine has a high nitrogen content(66.6% by weight), which makes it an excellentadulterant in feed ingredients. Production of melamine increased considerably in the 1990s in China. Worldwide production of melamine was estimated to be 1.2 million tons. Melamine and their related triazines were found in protein sources like wheat gluten meal and rice protein extract in the USA which were exported from China to prepare the animal feed. Few reports have indicated the negative effects of melamine on the aquatic animals also. Studies of melamine on the growth performances, blood components and alteration in the histology of catfish were also depicted. They can also influence the skin of the aquatic animals. However, there is not much information on the effects of this compound on thegrowth of major finfish species as well as on melamine-inflicted pathology. The findings on the inclusion of melamine adulterated feed would help the aqua industry to understand the consequences of using adulteratedfeeds for farmed fish. Though the protein content in fishthat has consumed melamine will be higher thanin normal fish, this cannot be an excuse forallowing the inclusion of melamine in aquatic feeds.



Melamine structure

Dioxins in fish oil

A global increase in contamination due to polychlorinateddibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and coplanar polychlorinated biphenyls (cPCBs), which are lipophilic, persistent, bioaccumulative, and toxic, has caused grave concerns due to their adverse effects on the environment. For humans, dietary intakes are the primary intake sources of these contaminants. The main sources are fish,seafood, oil, and fat. In particular, it was recently revealed that the concentrations of these contaminants are significantly greater in farmed fish as compared to wild fish. This is due to the contamination of feedstuffs for farmed fish, which comprise fish oil and fishmeal. Because fish oil is a unique source of highly unsaturated fatty acids, it is widely used not only as feed ingredient but also as food products and dietary supplements. Therefore, the research and development regarding the technology for the removal of contaminants from fish oil assume considerable importance for reducing health risks to humans.

Feed microscopy

Feed microscopy is usually used for checking the

adulteration and detecting the adulterants. Feed ingredients, adulterants and contaminants are studied under highandlow magnification for distinctive features whether coarsely or finely ground. The physical characteristics like shape, size, colour, softness-hardness and texture of the feeds are observed at low magnification of 8x to 50x. It is a useful method for identifying impurities or contaminants and estimating the quality of feed ingredients. It also serves as a useful method for identifying omitted/mislead ingredients in prepared aquafeeds. Higher magnifications of 100x to 500x are used for observing plant cells and structural features of the feed ingredients since they are retained after grinding or even after powdering the feed ingredients.

Conclusion

Adulteration is very common nowadays and the use of adulterants destroy the actual purpose of the feed formulation and preparation. Knowledge on adulterant is as important as that of understanding the quality of feed ingredients. Recent advances in science lead to developed identification methods of adulterants. Though advanced methods have been standardized, the use of adulterants in aquafeeds are ever-growing and therefore updating information on this aspect is key to the success in feed manufacturing. In recent years, Near Infrared spectroscopy have been successfully applied for the analysis of adulterants in the feed ingredients. More importantly, the unethical use of these toxic substances as a feed ingredient should be discouraged.

SEAGRASSES

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Highlight Points

- Significance of marine seagrass ecosystem.
- Conservation and protection of Seagrass.
- Major threats to seagrass habitats.

What is seagrass?

Seagrasses are flowering plants that grow in the Marine environment, found on all continents except Antarctica. They have roots, stems, and leaves and produce flowers and fruits. They are closely related to land plants, and probably evolved from land-living angiosperms (flowering plants). The closest relatives to seagrass, on land, are the monocots – grasses, lilies, and palms.

Seagrasses are an unusual group of marine angiosperms, all having a somewhat grass-like appearance (they are not true grasses). They are found growing in soft substrates, and often forming extensive underwater meadows. As with mangroves, they are not particularly diverse as a group, being made up of about 48 species from two families. The global composition of seagrass ranges from 0.1 to 0.2 % of the aquatic flora. Seagrasses provide a habitat for *Dugong dugon*, the only herbivore that exists in the sea. They also provide exceptional habitats for a wide variety of marine organisms, both plants, and animals. These include

meiofauna and flora, benthic flora and fauna, epiphytic organisms, plankton, and fish, not to mention parasitic organisms. Sixty species of seagrasses are described from the world's ocean. Fourteen species of seagrass under 6 genera are known from the Indian seas.

Species from Palk Bay include *C. serrulata, H. ovalis*sub sp. *ovalis*, *K.pinifolia*, and *S. isoetifolium*. Thirteen species occur in Gulf of Mannar Biosphere Reserve, with *Halophila, Halodule, Enhalus,* and *Cymodocea* are common among them. *Thalassiahemprichii* and *Cymodocearotundata*aredominant, occur in Andaman and Nicobar Islands. From the Lakshadweep Islands, seven species are known, among which *Thalassiahemprichii* is dominant.

The importance of seagrass for the environment

Where are seagrass found?
Seagrasses are found along the coast, in clear, shallow waters that allow light for photosynthesis, to penetrate. Some species occupy the intertidal zone, the area between the high tide line and the lowest tide line, from which the sea retreats at low tide to expose the seabed.

Importance:
Despite their low species richness, they remain of critical importance and, in many areas, account for a large proportion of inshore marine productivity. Seagrass meadows account for 15% of the ocean's total carbon storage. The ocean currently absorbs 25% of global carbon emissions.

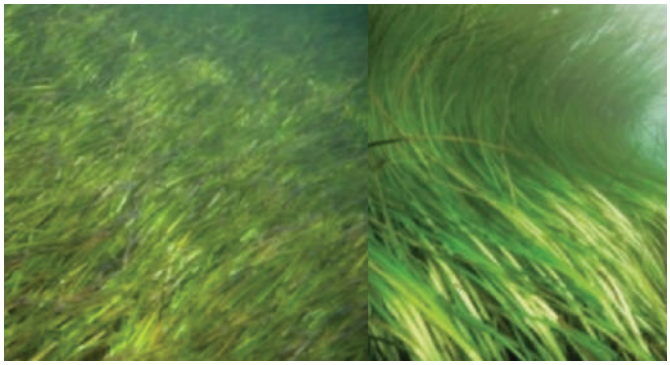
Moreover, they serve as an important habitat, adding structural complexity as well as a source of nutrition for many species. Unlike mangroves, seagrass communities are widely distributed in both tropical and temperate seas. They provide more directly tangible economic benefits through their importance to many artisanal and commercial fisheries. Seagrass habitat is vital as the feeding ground for several threatened species, notably seahorses, green turtles, and dugongs.They are a major input to food chains, which provide an indirect source of food for many marine organisms (Sea urchins, turtles). The high primary production rates of sea grass are closely linked to the high production rates of associated fisheries. The associated economic values of seagrass beds are also very large, although not always easy to quantify.

What are the ecosystem services that seagrasses provide?
Dense seagrass growth traps flowing sediment and nutrients, and creates a world where life can thrive. Seagrass form the basis of one of the most productive ecosystems of the world, providing food and shelter to a diverse community of animals. The leafy canopies support a bewildering diversity of tiny plants that grow as epiphytes (like moss on trees) and small marine invertebrates, which in turn attract sea anemones and fish, and mega herbivores like green sea turtles and dugongs.

The seagrass meadows with their extensive rhizome and root systems, and leaf growth and epiphytic growth together accumulate a huge amount of biomass.

Why we must conserve the world's seagrass:

1. Protection and restoration of seagrass can play a significant role in mitigating climate change.
2. Seagrasses are flowering plants that grow submerged in shallow marine waters like bays and lagoons. With tiny flowers and strap-like or oval leaves, they require sunlight for photosynthesis.
3. Terrestrial plants evolved about 850 million years ago from a group of green algae. Seagrass evolved from terrestrial plants that recolonized the ocean 70-100 million years ago. 60 species belong to four families in the order *Alismatales*.
4. Seagrass occur all along the coastal areas of India. They are abundant in the Palk Strait and Gulf of Mannar in Tamil Nadu.
5. Seagrassinhabits all types of substrates (layers) from mud to rock, the lush green seagrass beds are found extensively in muddy and sandy substrates.There are 21 islands in the Gulf of Mannar. Seagrassabounds in the waters around the islands of Kurusadi, Pumarichan, Pullivasal and Thalaiyari. All six genera and 11 species of seagrasses are found here.
6. The important seagrassis Sea Cow Grass (*Cymodoceaserrulata*), the ready. Seagrass (*Cymodocearotundata*), Needle Seagrass (*Syringodiumisoetifolium*), Flat-tipped Seagrass (*Haloduleuninervis*), Spoon Seagrass (*Halophilaovalis*) and Ribbon Grass (*Enhalusacoroides*). These were once abundant in the Gulf of Mannar region but are now threatened.
7. Like terrestrial plants, seagrass also photosynthesize and manufacture their own food and release oxygen.
8. Seagrassreproduces through both sexual and asexual methods. The pollen from the flower of the male plant is transferred to the ovary of the female flower through the sexual reproduction method.This is known as submarine pollination. Most species undergo this process and complete their life cycle underwater.
9. Seagrass can also reproduce asexually by branching off at their rhizomes (modified subterranean plant stem that sends out roots and shoots from its nodes). Because of this character, they can recover after being cut by grazers like dugongs or disturbed by storms.

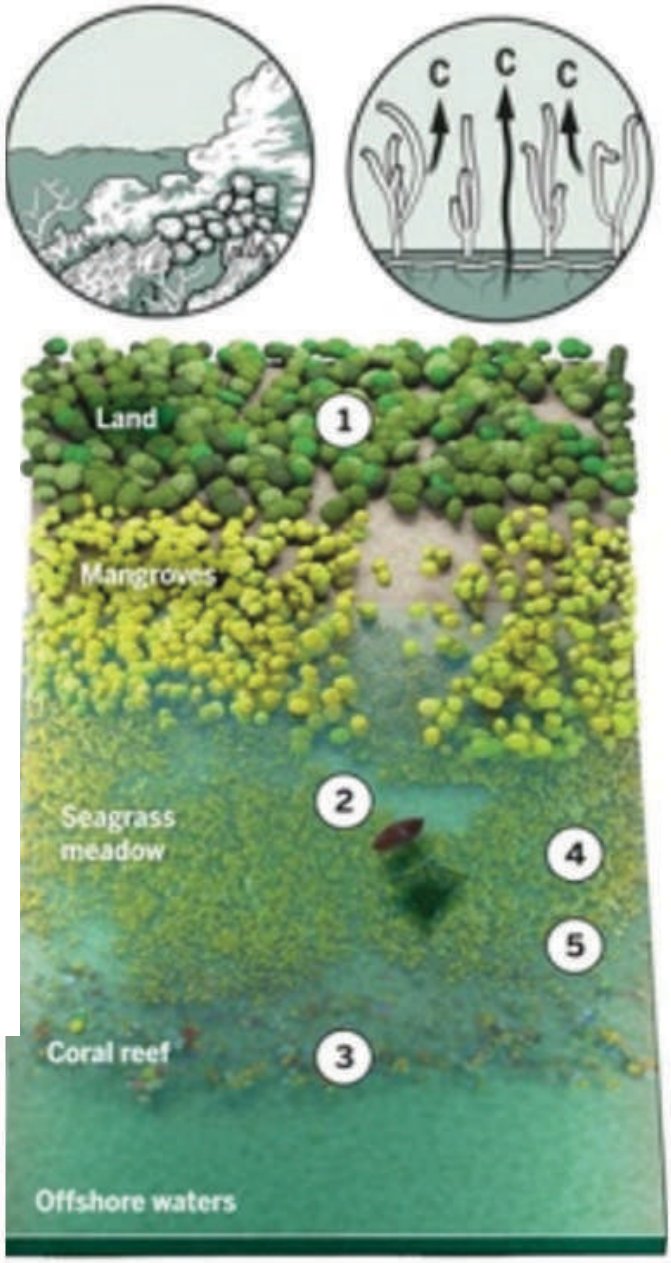


The ecological value of seagrass beds

What are the main threats to seagrasses?

The natural causes of seagrass destruction are cyclones, intensive grazing, fungal, heat waves, temperature, and other infestations and diseases. Seagrass in the intertidal habitat is prone to drying out. In estuaries, increased freshwater incursion and siltation can also destroy seagrass beds.

- The most significant threat is from various human activities that threaten the health of the seagrass ecosystem.
- Pollution from agriculture and industrial sources.
- Disposal of mining wastes.
- Overfishing –disruption of ecological interaction.
- Sediment movement from boat propellers.
- Dredging of harbors, ports and shipping lanes



Diverse threats to seagrass ecosystems and impacts of habitat destruction

Threats to seagrass meadows:

Seagrass meadows supply a vast site of ecosystem services such as carbon sequestration, Fisheries support, and coastal protection. They are part of an interconnected seascape; degradation of any habitat in this seascape has negative consequences for the other component habitats.

Major threats:

1. Habitat destruction, coastal development, and aquaculture lead to increased input of nutrients and other pollutants into the sea, threatening coastal habitats.
2. Overfishing threatens biodiversity, ecosystem resilience, and the food security of local people. Anchors and moorings result in direct physical damage to seagrass meadows.

Consequences

3. Local buffering of ocean acidification by healthy seagrass meadows may help to reduce the negative impact of changing pH on nearby calcifying organisms such as corals.

4. Seagrass meadows store large amounts of carbon in both the plants and the sediments below. If their integrity is disturbed, this carbon is released.
5. Seagrass meadows are important habitats for marine herbivores such as turtles and dugongs. The loss of these habitats threatens the survival of these species.

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