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Budget puts Aquaculture sector in study waters in India

Aquaculture has emerged as one of the fastest-growing sectors of the food industry, providing sustainable sources of protein and other essential nutrients for the world's population. One of the primary challenges in aquaculture lies in ensuring environmental sustainability. The intensive farming practices employed in many aquaculture operations can lead to water pollution, habitat degradation and the transmission of diseases to wild populations

Dear Readers,

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

Mumbai Research Centre of ICAR-CIFT organized three days training-cum-demonstration programme for the SC community of Maharashtra. The program entitled "Empowering the Scheduled Castes community through harvest and post-harvest technology intervention in Maharashtra, India". The post -harvest technology intervention we conducted the Hygiene and handling and prepared the value added product from fishes was conducted from 29 to 31 January 2024 under Scheduled Caste Sub Plan scheme at Raigad, Maharashtra. The program was initiated and supported by Dr George Ninan, Director, ICAR-CIFT, Kochi, Dr A. Suresh, Principal Scientist and Nodal officer of SCSP, CIFT and Dr Asha K K, Principal Scientist and Scientist incharge MRC of CIFT, Vashi, Navi Mumbai.

In 2023, Bühler successfully navigated a complex and volatile global landscape and increased its profitability. The equity ratio also further improved. As an innovative solution provider, the company benefited from many opportunities and gained market share from transitions in its key markets. In local currencies, turnover grew strongly, and orders improved slightly. With a high order book of CHF 2.0 billion, Bühler is well positioned for 2024. "We are satisfied with the outcome of 2023 and have proved again that we are a reliable partner in this dynamic world," says Bühler CEO Stefan Scheiber.

Aquaculture sector assumes utmost importance in the country as India has a very long coastline and seafood production is carried out in over 200 districts across multiple coastal provinces of India. Inland and aquaculture production and seafood exports have doubled since a separate fisheries department was set up a few years back. India is the 3rd largest fish producing country with around 8 percent share in global fish production. Globally, India stands 2nd in aquaculture production and is one of the top shrimps producing and exporting nations. Coastal aquaculture, particularly shrimp farming, is the most vibrant food producing sector in India, earning high foreign exchange. Frozen shrimp contributed nearly 70 percent of USD 8 billion worth of seafood exports from the country during FY 2023. The Indian seafood industry has been struggling off late due to oversupply, falling prices and a competitive landscape. Ecuador that has been gaining market share in US, Europe and other geographies has replaced India as the shrimp export leader in recent years by offering its produce at cheaper prices. Therefore, the efforts to increase productivity and yields under this scheme should provide much-needed tailwinds for fisheries as well as shrimp exporters.

In the early 1990s, P Brahmanandam, who was a civil constructions contractor in Visakhapatnam, received an offer from a friend who owned fishing trawlers. Given the surplus cash he had from his business, would Brahmanandam be interested in investing in the lucrative marine export industry? He said he would. After pooling in their own money, and taking aRs 25 lakh loan from Union Bank of India, the two friends started Devi Sea Foods out of a leased facility in 1992, with the intention of buying shrimps from local farmers and selling them in the international market. Brahmanandam, who joined the company as its managing director (and remains so), quickly realised how high the margins were, and DSF turned profitable in a few months. In 1997, he bought out the 50 percent share his friend—whom he declined to name—had, and took full control of the company.

Contd on next page

NRS GROUP

Aqua International

Our Mission

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

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

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

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

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

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The biennial aquaculture business conference held from 10-12 June 2024 in Stavanger will feature Nobel prize-winning economist Paul Krugman as keynote speaker. The 15th edition of AquaVision will convene global aquaculture leaders to discuss the future of blue food and its role in feeding a growing global population. The conference takes place in Stavanger, Norway from 10-12 June 2024. AquaVision is a biennial aquaculture business conference focused on meaningful discussions surrounding the challenges and opportunities within the sector and has been organised by Skretting and Nutreco since 1996.

Agribusiness leaders and industry visionaries gathered in Dubai to attend the U.S. Soybean Export Council (USSEC)'s annual Sustainasummit 2024 conference. Discussions revolved around smart conservation initiatives, sustainable agricultural practices, ground breaking progress in food cultivation, production, distribution and consumption. According to the World Bank, South Asia is experiencing a "new climate normal" which is referred to as unpredictable weather including heat waves, cyclones, droughts, and floods. With a growing population and rising temperatures, South Asia needs to accelerate its efforts in addressing the impact of climate change on the region's food and nutrition security.

In the Articles section – Importance of Automation in Aquaculture, *authored by*Mr ShiwamDubey, Ms Amogha K R, Mr UmeshSuryawanshi andMr Narendra Kumar Maurya, informed that with the rapid development and widespread adoption of wireless sensors networks and wireless personal area networks, environment-driven information sensing and transmission has became faster and more practical. ZigBee short-range wireless transmission technologies, using the IEEE 802.15.4 standard, which has low-power, low-rate, low-cost, and other advantages. Numerous situations call for the use of ZigBee. Water quality has a huge impact on aquatic organisms' survival and growth. Water quality, including oxygen content, temperature and salinity is unsuitable for short-term use. The rapid spread of the pathogen infection through the water was sufficient to quickly bring about the demise of all biological farming.

Another article titled ***Insights and Solutions for Overcoming Aquaculture Challenges,*** *authored by*Mr Patekar Prakash, Mr Samad Sheikh, Mr NarsaleSwapniland Ms IndulataTekam,said thatAquaculture has emerged as one of the fastest-growing sectors of the food industry, providing sustainable sources of protein and other essential nutrients for the world's population. Global aquaculture production has grown at an average annual rate of 5.8% over the past decade and is expected to reach 109 million tons by 2030 (FAO, 2021). Despite its growth, the aquaculture industry has faced some challenges. Aquaculture producers have encountered numerous obstacles that threaten their sustainability and profitability, ranging from disease outbreaks to environmental degradation. One of the primary challenges in aquaculture lies in ensuring environmental sustainability. The intensive farming practices employed in many aquaculture operations can lead to water pollution, habitat degradation and the transmission of diseases to wild populations.

Article titled **Ecosystem- Based Fisheries Management: *A modern tool for tropical fisheries management and aquaculture,*** *authored by*Mr Pritam Das and Ms VedikaMasram, discussedthat Ecosystem based fisheries management can be defined as a holistic method of managing fisheries and marine resources with consideration into the entire ecosystem chiefly multispecies workplace being managed instead of one species work place .It is an extension of typical fisheries management recognising reciprocally between human wellbeing and ecosystem health and ought to maintain ecosystem productivity as gift for future generation. 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. Food and Agricultural organization of United Nations (FAO fisheries department 2003) described ecosystem approach in fisheries strives to balance numerous social objectives by taking into consideration the data like uncertainties regarding organic phenomenon, abiotic component, abiotic component, human activities of ecosystem and their interaction, applying an integrated approach to fisheries at intervals within ecologically purposeful boundaries.

Another article titled ***INTEGRATED TAXONOMY – New dimension to explore the fish diversity,*** *authored by*Mr Mahesh Chand Sonwal, Ms JyotiSaroj, Mr RameshwarVenkatraoBhosle and Mr R. Tamil Selvan, said that IMTA is the practice that combines the cultivated of fed aquaculture species (e.g., finfish/shrimp) with organic extractive aquaculture species (e.g., shellfish/herbivorous fish) and inorganic extractive aquaculture species (e.g., seaweed) to create balanced ecological systems for conservational sustainability and economic stability (product diversification and risk reduction. This system is different from the 'Polyculture' based system (Shah *et al.* 2017). Worldwide, mostly practiced the polyculture-based culture system in different coastal areas, but lacked a problem they face, like properly balanced feed.

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

Results in Shrimp, Fish and Crab farming can be achieved as per specifications when the pond management guidelines are followed. Farmers 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

Mumbai Research Centre of ICAR-CIFT Organizes training cum demonstration programme on "Empowering the Scheduled Castes community through harvest and post-harvest technology intervention in Maharashtra" under Scheduled Caste Sub Plan

Participants engaged in fillet preparation, Preparation of battered and breaded fish products

Mumbai Research Centre of ICAR-CIFT Organizes three days training cum demonstration programme for the SC community of Maharashtra. The program, entitled "Empowering the Scheduled Castes community through harvest and post-harvest technology intervention in Maharashtra, India". The post -harvest technology intervention we conducted the Hygiene and handling and prepared the value added product from fishes was conducted from 29 to 31 January 2024 under Scheduled Caste Sub Plan (SCSP) scheme at Village-Apti, Taluka-Khalapur, District-Raigad, Maharashtra. The program was initiated and supported by Dr George Ninan, Director, ICAR-CIFT, Kochi, Dr A. Suresh, Principal Scientist and Nodal officer of SCSP, ICAR-CIFT, Kochi and Dr Asha K K, Principal Scientist and (SIC) Scientist incharge MRC of ICAR-CIFT, Vashi, Navi Mumbai.

Dr Abhay Kumar, Scientist and program coordinator conducted the training cum demonstration program on 'Value addition and hygiene and handling of fish and fishery product''. In this program demonstration to farmers, how to maintain hygiene during handling the fish cleaning and cutting to make fillet and maintaining ice storage and preparation of different value-added fish products such as fish pickles, fish ball, fish cutlets, fish fingers, and butterfly shrimp etc. The trainees were also given a chance to prepared customized fish products based on the regional preferences of the ingredients. A total of 30 participant from of Village-Apti, Taluka-Khalapur, District-Raigad, Maharashtra benefited from the program. A training leaflet was distributed on the participant during inauguration function. The participants were from Ramabai Mahila Bachat Gud, Apti, Taluka-Khalapur, District-Raigad, Maharashtra groups, and provided processing equipment like Ice Boxes, Meat Mincer, Sealing Machine, Weighing Balance, Presser Cooker, Gas Stove and Mixer etc.) to help them start a small food venture shortly and improve their socio-economic condition. Present of the MRC of ICAR-CIFT staffs' members during training program was Ms Priyanka Nakwa (Technical Officer), Mr Tulshiram Wagmare (Senior Technician Assistant) Supriya Chautala (Young Professional II) and Suraj Patil (Young Professional -1).

Participant with prepared fish pickle, breaded and battered products with processing equipment

Uni-President

AQUACULTURE PROBIOTICS EXPERT

Nu Ri
NET 200 g BSL

Probiotics for water treatment

1. WATER QUALITY CONDITIONING

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

2. HIGH ACTIVITY OF SPORES

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

3. DECREASE AMMONIA CONTENT

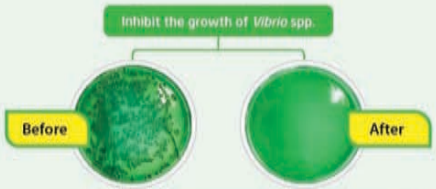
Prevent the accumulation of toxic substances such as NH_3, NO_2, etc.

4. IMPROVE WATER COLOR

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

5. ESTABLISH BALANCED POND BACTERIA SYSTEM

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



6. INCREASE AQUACULTURE PRODUCTION

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

* COMPOSITION:

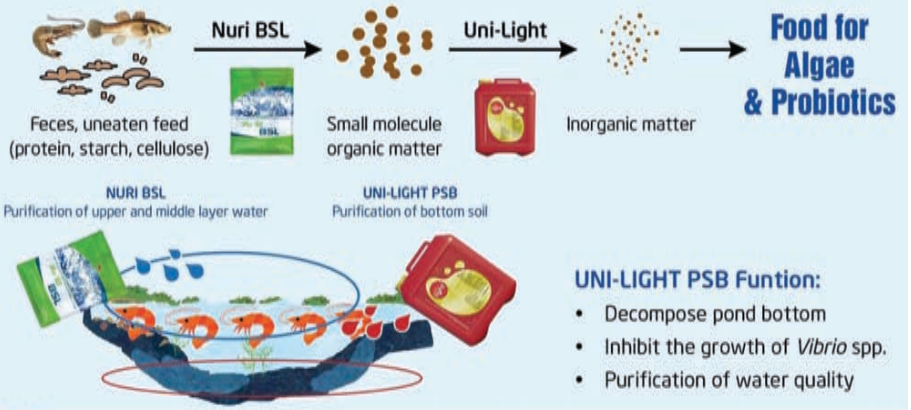
Bacillus spp. > 1x 10^{11} cfu/kg	15%
(Bacillus subtilis, Bacillus amyloliquefaciens, Bacillus licheniformis)	
Carrier (rice bran, corn gluten)	75%
Moisture	10%

* STORAGE:

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

* DIRECTION OF USE:

No cultivation is needed. Apply Nuri BSL with water-soluble bag near to the working water wheel or pour into the pond evenly. Recommend apply Uni-Light PSB together with Nuri-BSL on sunny day to achieve a clear pond more efficiently.



UNI-LIGHT PSB Funtion:

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

BSL Dosage:

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

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

UNI-PRESIDENT VIETNAM CO., LTD

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Annual results 2023: Reliability in a dynamic world Bühler improves profitability in 2023

Uzwil (Switzerland), February 13, 2024 – In 2023, Bühler successfully navigated a complex and volatile global landscape and increased its profitability. The equity ratio also further improved. As an innovative solution provider, the company benefited from many opportunities and gained market share from transitions in its key markets. In local currencies, turnover grew strongly, and orders improved slightly. With a high order book of CHF 2.0 billion, Bühler is well positioned for 2024. "We are satisfied with the outcome of 2023 and have proved again that we are a reliable partner in this dynamic world," says Bühler CEO Stefan Scheiber.

At Group level and in Swiss Francs, Bühler performed well with a slightly increased turnover of CHF 3.0 billion (+1.0%). Order intake was CHF 3.2 billion (-3.8%) and the order book remained high at CHF 2.0 billion. EBIT rose by 8.9% to CHF 216 million with a corresponding EBIT margin of 7.2% (prior year: 6.7%). Net profit increased by 16.3% to CHF 179 million (prior year: CHF 154 million), corresponding with a margin of 5.9% (prior year: 5.2%). The impact of foreign exchange rates was significant. In local currencies, orders improved by 2% to CHF 3.3 billion, turnover by 7% to CHF 3.2 billion, and EBIT by 17% to CHF 233 million.

In 2023, Bühler continued to strengthen its financial position, increasing the equity ratio to 51.1% (prior year: 49.8%).

Advanced Materials experienced another strong year

In 2023, the Advanced Materials business continued its success. Whereas turnover grew strongly by 15.9% to CHF 778 million, order intake fell by 11.2% to CHF 774 million, indicating that business volumes were normalizing. In local currencies, turnover increased by 22.9%, while order intake reduced by 5.3%. With these results, the Advanced Materials business confirmed that it is in an upswing mode after a particularly strong order intake in 2022, driven by transformation in its industries. This enabled it to reach a record high turnover in 2023.

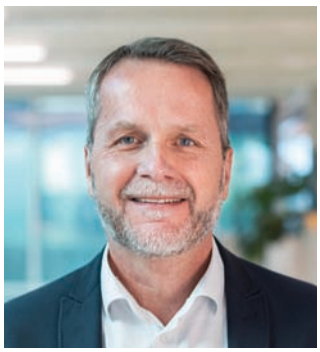
The Die Casting business area experienced significant growth reflecting the burgeoning demand for structural components for car bodies, including battery cases for electric vehicles,

Holger Feldhege

Ian Roberts

Irene Mark-Eisenring

Johannes Wick



Marcel Natterer

Mark Macus

Samuel Schar

Stephen Scheiber

Mr Burkhard Boendel, Mr Calvin Grieder and Mr Stefan Scheiber (from the left)

as well as for advanced megacasting solutions such as the new Carat 840 and 920 series. The Leybold Optics business area gained significantly from glass coaters for architectural applications and for car glass, from capacitors for e-mobility, grid applications, and the ongoing strong market trends in photonics and semiconductors.

Grains & Food performance driven by food security

In a challenging business environment, Grains & Food performed solidly. Turnover fell by 3.1% to CHF 2,204 million, while order intake was down 0.7% to CHF 2,357 million. In local currencies, turnover increased by 2.2% and order intake grew by 4.8%. The global demand to improve food security was a key driver for the Milling Solutions and Grain Quality & Supply business areas. While the challenging economic situation in China worked as a damper in most areas, especially in the Value Nutrition business, Grain Quality & Supply secured several larger orders for ship unloaders as a result of governmental efforts to improve food security.

Milling Solutions, the largest business area of Bühler, benefited from a global catch-up demand for large milling projects for grain processing, including numerous greenfield installations. Projects were awarded to Bühler from all over the world – United States, Saudi Arabia, Venezuela, Europe, Africa, and Southeast Asia, among others. Turnover growth was remarkable in the Chocolate & Coffee business area, and the Consumer Foods business area continued to recover both in volumes and profitability.

Services have become even more important for customers

Services continued to be a key strategic pillar in 2023, as they are the fastest lever to improve the productivity and consequently also the sustainability of Bühler customers' operations, by minimizing energy, waste, and water. Bühler's Customer Service business grew by 1.2% amounting to CHF 966 million, representing a 32% share of Group turnover.

Balanced global business footprint

While the economic environment differed strongly across key markets, Bühler's balanced geographical footprint allowed the company to benefit from market expansions and thus offset lower business volumes in other markets. The most notable developments were strong turnover growth in the Americas and significantly lower turnover volumes in China. Overall, Bühler's regional share of turnover was as follows: Americas 29%, Europe 28%, Asia 27%, Middle East Africa & India 16%.

Aerial View of Buhler Head Quarters in Uzwil, Switzerland

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Innovation as key success factor

In 2023, expenses for R&D remained at a high level at CHF 140 million (4.7% of turnover) and around 50 new customer solutions were launched. "We see profitable growth as a prerequisite for creating positive impact for a better world. This conviction guides our investments in the future development of our company, into innovative products and services, as well as in the development, education, and training of people," says Stefan Scheiber.

In 2023, Bühler focused on the further implementation of its sustainability strategy. The highest impact Bühler can thereby create is with its customer solutions (Scope 3). In this respect, Bühler has committed to having solutions ready to multiply by 2025 that reduce energy, waste, and water by 50% in the value chains of customers. For its own operations (Scopes 1 and 2), it has developed a pathway to achieve a 60% reduction of greenhouse gas emissions by 2030. By the end of 2023, Bühler achieved a reduction of nearly 20% compared to the 2019 baseline.

Training and education

In 2023, Bühler continued to focus on training and education of both customers and employees. Customers not only benefited from training at different specialist schools on all continents, but also from the broad offering of courses in the 25 Application & Training Centers around the world. With the opening of new locations in Brazil and Switzerland in 2023, Bühler added further to its capability to support its customers along complete value chains, from recipe development to final product development, and industrial scaling.

For its nearly 12,500 employees, Bühler built on its programs for development and lifelong learning. These enable its people to adapt and develop the skills needed to keep pace with a quickly changing and increasingly challenging work environment. Part of the concept is the Bühler Energy Center in Uzwil, Switzerland, which was opened in June. It contains three pillars: Health & Lifestyle, focusing on health management; Lifelong Learning, focusing on vocational and adult learning; and Prototyping & Production, focusing on new manufacturing technologies. In 2023, Bühler trained 544 apprentices globally, 293 of whom in Switzerland.

Outlook: stable starting position for 2024

The economic climate in 2024 is still likely to be characterized by continued volatility. Nevertheless, Bühler is \well positioned to navigate through dynamic times and to benefit from new opportunities that arise. A carryover of CHF 2.0 billion orders serves as a stable starting position for the business in 2024. Bühler remains committed to its strategic goal of profitable growth, its sustainability targets, and supporting the further development of its customers and employees.

Budget puts aquaculture sector in steady waters in India

Aquaculture sector assumes utmost importance in the country as India has a very long coastline of over 5,00 km, and seafood production is carried out in over 200 districts across multiple coastal provinces of India. Inland and aquaculture production and seafood exports have doubled since a separate fisheries department was set up a few years earlier.

India is the 3rd largest fish producing country with around 8 percent share in global fish production. Globally, India stands 2nd in aquaculture production and is one of the top shrimps producing and exporting nations. Coastal aquaculture, particularly shrimp farming, is the most vibrant food producing sector in India, earning high foreign exchange. Frozen shrimp contributed nearly 70 percent of USD 8 billion worth of seafood exports from the country during FY23.

In 2020, the Government of India launched the Pradhan Mantri Matsya Sampada Yojana (PMMSY) with the goal of transforming the country's fisheries and aquaculture sector. The PMMSY scheme focuses on developing and modernizing fishing harbours, landing centers, fish markets, and fish-landing centers and has witnessed a total outlay of almost Rs 20,000 crore over a period of five years, from 2020 to 2024-25.

During the Interim Budget 2024, the finance minister announced a new set of measures to boost the growth in the sector. Under the PMMSY, the government aims to double the aquaculture exports to nearly Rs 1 lakh crores and generate over 50 lakh job employment opportunities. Besides this, the government also plans to set up five integrated Aqua parks.

The Indian seafood industry has been struggling off late due to oversupply, falling prices and a competitive landscape. Ecuador that has been gaining market share in US, Europe and other geographies has replaced India as the shrimp export leader in recent years by offering its produce at cheaper prices. Therefore, the efforts to increase productivity and yields under this scheme should provide much-needed tailwinds for fisheries as well as shrimp exporters. The move augurs well for Avanti Feeds (largest producer of shrimp feed in India with a market share of 50 percent in the domestic feed business) and Apex Frozen Foods (integrated producer and exporter of frozen shrimp).

Devi Sea Foods: Getting under the shell of it

In the early 1990s, P Brahmanandam, who was a civil constructions contractor in Visakhapatnam, received an offer from a friend who owned fishing trawlers. Given the surplus cash he had from his business, would Brahmanandam be interested in investing in the lucrative marine export industry? He said he would.

After pooling in their own money, and taking a ₹25-lakh loan from Union Bank of India, the two friends started Devi Sea Foods (DSF) out of a leased facility in 1992, with the intention of buying shrimps from local farmers and selling them in the international market.

Brahmanandam, who joined the company as its managing director (and remains so), quickly realised how high the margins were, and DSF turned profitable in a few months. In 1997, he bought out the 50 percent share his friend—whom he declined to name—had, and took full control of the company.

By 1997, DSF had established itself in the Japanese market, with clients such as Mitsubishi Corporation and Hitachi Corporation, and was training its sights on the US market, one of the biggest markets for Indian shrimp exports. For this, he approached an old Australian client. In 1996, says Brahmanandam, this client, then a small-time shrimp importer, wanted to return a batch of DSF shrimps because they

P. Brahmanandam

were sub-standard, and he had readily agreed. By the time Brahmanandam was thinking of entering the US market, the Australian client had turned into a major vendor for Orlando-based Darden Restaurants, which owns eight restaurant chains in the US and Canada with 1,536 outlets and sales of $6.93 billion in 2016. He helped Brahmanandam get in touch with them. In 1999, DSF started supplying processed shrimps to Darden Restaurants.

Focusing on the US market has been the key to DSF's growth. In around two decades of entering the market, the company's turnover has reached ₹1,231 crore, clocking a net profit of ₹64.66 crore (as of March 31, 2017); on an average, other Indian shrimp exporters have a turnover of ₹600 crore.

Over the years, DSF has grown through internal accruals and not needed external capital in terms of debt or equity. "We never needed to look for capital as the business has been generating cash from year one. We have managed to fund all our expansion through our internal accruals," says Brahmanandam, 64. "If the company can manage with internal finances, there is no need to go for external equity. DSF is not averse to external equity and debt. But you need to be equally responsible and disciplined about it, whosoever's money you are using."

By sticking to its core business, DSF has made efficient use of capital, which can be measured in its high return on equity (RoE). Between 2012 and 2017, its net worth has gone up from ₹103 crore to ₹326 crore, with a consistent RoE of 20 percent.

I think what has really worked is that Brahmanandam is a people's person and the first thing that he looks at is the value-addition or benefit that he can create for other people.

The 1990s was a time when the Indian shrimp industry largely supplied whole, unprocessed black tiger shrimps to the Japanese and European markets. Till about 2001, the demand for black tiger shrimp was high. This was also a time when the US did not consider India as a source of shrimp imports as the country's farming and processing methods did not meet the quality and safety standards of the US Food and Drug Administration.

DSF took all these factors as opportunities and, moving away from convention, decided to focus on food service and retail supermarket customers in the US (instead of selling to importers) by supplying value-added products—shrimps that were cut, cleaned and processed according to the client's requirements. They also began to supply Pacific white shrimps, which have a higher yield, are more economical, and not as vulnerable to disease as black tiger shrimps.

In 2000, DSF purpose-built a new production facility, at a cost of ₹20 crore, in the town of Tanuku in Andhra Pradesh's West Godavari district, and started producing raw and ready-to-cook shrimps of various kinds: Head-on, headless shell-on, easy-peel, peeled and deveined, breaded or marinated or skewered. The company got technicians and trainers from Darden Restaurants to train its employees in the processing methods, and invested in liquid nitrogen freezers from Praxair in 2001 for quick-freezing the produce.

Starting with 100 employees, and processing 200 kgs of shrimp per day, DSF now has 250 employees and processes 15 tonnes of shrimp per day at its two production units (the first one at Ongole, in the Prakasam district of Andhra Pradesh, was started in 1995). These investments paid off in the form of higher profit margins: Brahmanandam says that while other shrimp export companies have margins of around 2 percent, DSF enjoys net margins of 10 percent.

But a flourishing trade in the US soon attracted anti-dumping regulations for Indian shrimp exporters. In 2004, American shrimp

producers filed a case with the US Department of Commerce against countries such as India, Thailand, Ecuador, Brazil and China. Indian companies such as DSF could export to the US only after payment of a 3.5 percent duty (they did not pay any earlier). After five years, when the issue came up for review, DSF presented a strong case for itself before the US authorities as a supplier of value-added products (which were exempt from duty) that was not hurting the domestic market. "They eventually cleared our name in 2009 and that was a big relief," says GS Rao, commercial director, DSF. "There are only three companies in Asia that have got such exemptions [the other two are from Thailand and China], and we are one of them." The amount of duty that DSF had to pay in the intervening years was also refunded.

The move towards value-added products also helped the company get high-value customers like Sysco Corporation, the world's largest food distributor, with more than $50 billion in annual revenues, in 2007. Netting Sysco as a client, however, was a lot of hard work, with DSF negotiating for almost a year to just get an appointment with its directors. Although the first meeting took place in 2006, at the company's Houston headquarters, Brahmanandam and Rao had a tough time convincing them of their credibility and their quality and safety standards.

Sysco finally agreed, but placed an initial order of 3.7 million pounds, a relatively small one by export standards. "We were happy to take the small order because we knew that we could deliver on it.

A larger order with so many processes would have been difficult," says Brahmanandam. Today, DSF in the US—the American subsidiary of the company was set up in 2005—supplies frozen shrimps worth $100 million (20 million pounds by weight) annually to Sysco, which is now DSF's largest client, with a 70 percent share of the company's exports.

Almost 90 percent of DSF's current exports are to the US market, while 6 to 7 percent is to Canada; it has stopped exporting to Japan after shifting its focus to the US. Brahmanandam's move towards value-added products gave him the advantage of higher margins that other shrimp exporters caught on to only later.

Exporters such as Falcon Marine, Devi Fisheries and Liberty Frozen Foods now supply value-added shrimps to the US. However, unlike DSF, they sell to importers and not to retail clients, which means their margins are lower. Although the initial investment into the processing plants was capital-intensive, DSF's business was generating free cash flows, which he was investing back into the business.

DSF's success can also be attributed to the fact that it focussed only on the shrimp business, and did not diversify into other products, such as fish. Most other shrimp exporters in India, who don't do any value-addition, export other marine food products as well.

"I think what has really worked for the company is the fact that Brahmanandam is a people's person and the first thing that he looks at is the value-addition or benefit that he can create for other people. Be it dealing with customers or suppliers, he values his people," says Rao.

The shrimp export business is labour intensive. DSF has built a reputation for itself among the shrimp farming community of Andhra Pradesh by making timely payments. It claims that other shrimp exporters are not prompt with their payments, which are sometimes made after 10 days of procurements. Earlier, DSF would procure shrimps from the farms, but from 2004 it started encouraging farmers to come to the plant directly; DSF would pay them within 30 minutes of the produce being delivered. The company claims that other exporters are now following similar procedures.

Although such payments mean DSF has an additional pressure on its working capital, Brahmanandam feels maintaining the company's reputation is paramount. "We feel the farmers should come to the plant only once and get their dues. This ensures we get good quality shrimps on time, and can easily maintain our inventories in the international market," he says.

Over the last two years, investment bankers and private equity players have been urging Brahmanandam to take the company public. "They are saying we can get a valuation of ₹4,000 crore. But we don't need the money. What will we do with it unless there is a need for expansion?" he says.

P. Brahmanandam at the DSF production facility at Tanuku in West Godavari district of Andhra Pradesh

DSF's growth plans revolve around the Asian and Western markets. With technological advancements, shrimp farming and production has been on the rise, and will continue to be so. Growing shrimp production also offers opportunities to allied industries, such as processing units and manufacturers of shrimp feed and seed.

According to the Ministry of Commerce and Industry, India exported 0.4 million metric tonnes (MMT) of shrimp, worth around $3.7 billion, in 2016-17. The US was the largest import market (0.16 MMT), followed by the European Union, Southeast Asia, Japan, the Middle East, China and other countries. Among all the seafood exports from India, frozen shrimp remained the top item, accounting for 38.28 percent by volume, and 64.50 percent by earnings (in US dollars); shrimp exports increased by 16.21 percent (by volume) over the previous year.

In the short term, DSF plans to build a new shrimp processing plant with a capacity of 10,000 metric tonnes per annum (MTPA) in Andhra Pradesh, with a capital (fixed and working) outlay of ₹100 crore; the plant is expected to be operational by mid-2018. This will take the company's production to 25,000 MTPA by March 2019. The increased capacity will meet demand from existing clients, as well as a few new ones in the pipeline.

In 2016, DSF forayed into manufacturing shrimp feed, by setting up a production unit near Kakinada in Andhra Pradesh. Plans are afoot to install another production unit, with a capacity of 40,000 MTPA, at a cost of ₹50 crore, to be functional by next March. Production of shrimp feed is expected to reach 0.1 MMTPA by March 2019, with revenues of ₹650 crore. By March 2019, DSF aims to cross ₹2,500 crore in revenues.

Over the long term, Brahmanandam plans to make DSF a global sourcing company and expand its footprint in European markets by replicating its US model. He also wants to build alliances across producers in Asia to ensure alternative supply sources.

In 2016, DSF and Avanti Group started an asset reconstruction business called Maximus by investing around ₹50 crore each. They plan to increase this to ₹100 crore in the next few years.

Brahmanandam feels there are many small companies that are unable to repay bank loans and have become non-performing assets. He plans to buy out these assets from the banks and help the companies restructure their business.

"It is a small gesture to help small businessmen who are in trouble. It is our way of lending a helping hand and providing capital to those who are a lot like us—companies that have the potential to grow," he says.

He looks at this venture as a challenge and an opportunity. "We have run a focussed business for 25 years. We wanted diversification and this is how we want to do it."

Courtesy: ***Forbes India***

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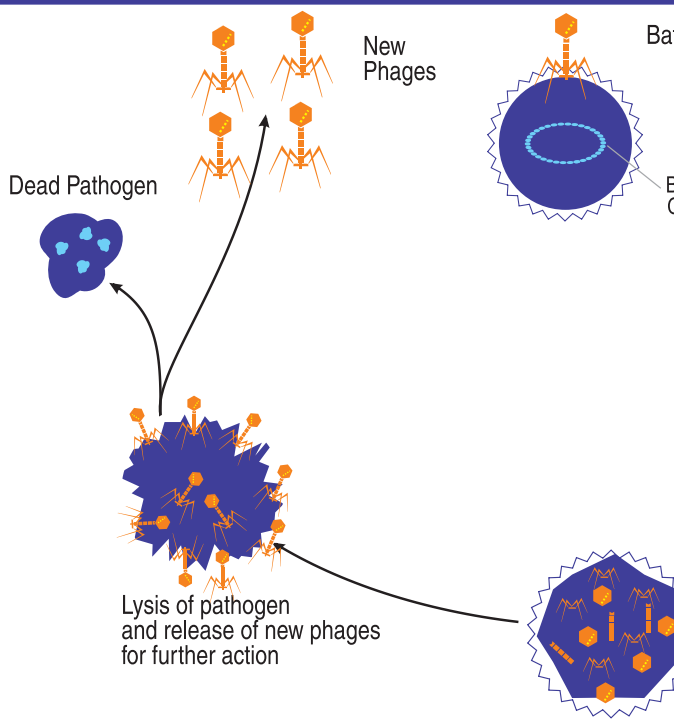

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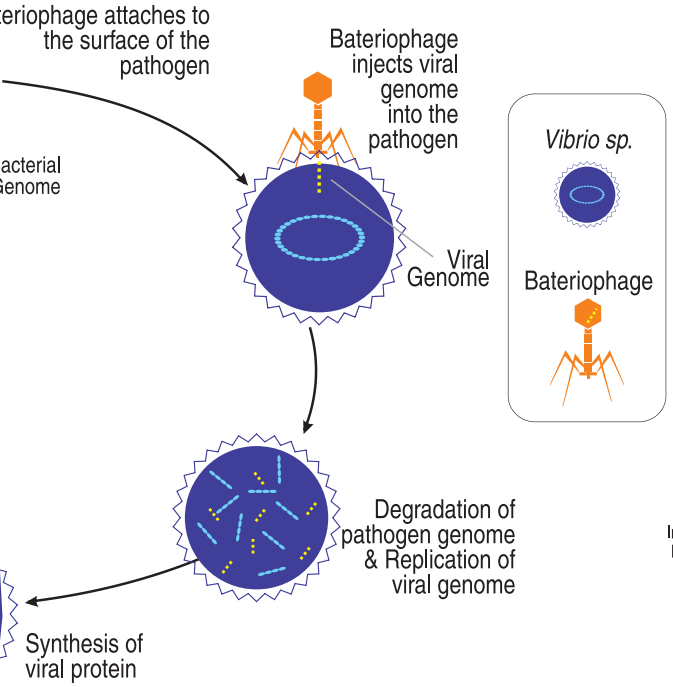

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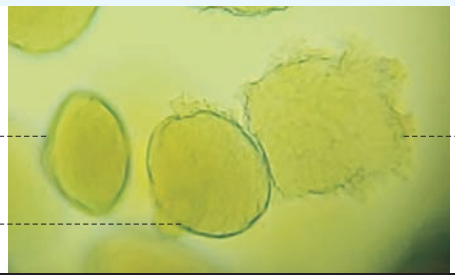
Stages of *Vibrio sp.* colonies infected with Bacteriophages & Progressive Lysis observed on an Agar plate, under Stereo Microscope



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

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

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

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AquaVision 2024 - Embracing the future of blue food

The biennial aquaculture business conference held from 10-12 June 2024 in Stavanger will feature Nobel prize-winning economist Paul Krugman as keynote speaker.

The 15th edition of AquaVision will convene global aquaculture leaders to discuss the future of blue food and its role in feeding a growing global population. The conference takes place in Stavanger, Norway from 10-12 June 2024.

AquaVision is a biennial aquaculture business conference focused on meaningful discussions surrounding the challenges and opportunities within the sector and has been organised by Skretting and Nutreco since 1996.

The three central themes of AquaVision 2024 are:

- Acting towards a sustainable future
- Dealing with market disruptions in an ever-changing world
- Beyond tomorrow

"We are very excited to share this year's central themes. The number of people suffering from acute food insecurity in the world grew 1.5 times between 2019 and 2022 and multiple external factors pushed food prices to all-time highs. It is now more important than ever to secure access to high quality protein in a sustainable, future-proof manner. Innovations such as artificial intelligence and other cutting-edge technologies have the potential to accelerate transformative change and support this ambition. I am looking forward to discussing this and more during AquaVision 2024," says Therese Log Bergjord, CEO of Skretting.

Internationally renowned speakers

AquaVision is recognised for featuring a lineup of inspiring and internationally renowned speakers. Distinguished figures such as Joseph Stiglitz, Kofi Annan, Sir Bob Geldof, Lord Sebastian Coe, and Ban Ki-moon have previously shared their unique insights with the industry as keynote speakers.

We are delighted to announce this year's keynote speaker: Paul Krugman. A distinguished scholar and professor of Economics at The Graduate Center, City University of New York, Krugman is one of the world's most renowned economists. In 2008, Krugman won the Nobel Memorial Prize in Economic Sciences for his contributions to new trade theory and new economic geography. In addition to the Nobel Prize, Krugman's work in economics has earned him widespread recognition from the economic press and numerous prestigious awards.

The event will be moderated by Solveig van Ness, CEO and Founder of Marine Prospects. She will be joined by hosts Therese Log Bergjord, CEO of Skretting, and Fulco van Lede, CEO of Nutreco.

Registration for AquaVision 2024 is now open. Visit aquavision.org for more information.

About Skretting

Skretting is a global leader in providing innovative and sustainable nutritional solutions and services for the aquaculture industry. Skretting has production facilities in 18 countries on five continents, and manufactures and delivers high quality feeds from hatching to harvest for more than 60 species. The total annual production volume of feed is more than 3 million tonnes. The head office is located in Stavanger, Norway. Skretting is the aquaculture division of Nutreco, a world leader in animal nutrition. Our purpose is Feeding the Future.

About Nutreco

Every day, Nutreco's 11,000 dedicated employees in more than 40 countries across the globe relentlessly pursue our purpose of Feeding the Future in a way that ensures sustainability is front and centre in all we do. Our solutions go beyond nutrition – we provide best-in-class advice and technology to help our customers produce more food, in a sustainable way, to feed our growing population.

At Nutreco, we bring over 100 years of experience and leadership through our globally respected business lines – Skretting for aquaculture and Trouw Nutrition for livestock and pets. As part of Trouw Nutrition, our feed additive brand, Selko, consists of feed additive solutions throughout the entire feed-to-food value chain. Our Nutreco Exploration team (NutEx) develops novel and proprietary ultra-specialties in the form of feed additives or functional feeds that raise the bar on how we tailor our solutions to meet customer needs through phytogenics, biotechnologies and physical chemistry. Our NuFrontiers team continuously works to identify, develop and invest in next-generation breakthrough innovations throughout the value chain.

In 2022, Nutreco had net revenues of €9 billion. The company is a subsidiary of SHV N.V., a family-owned multinational with net sales of €26 billion in 2022.

Yogesh Garg passes away

Mr Yogesh Kumar Garg, Vice President, Virbac Animal Health, passed away on 2 February 2024 at Hyderabad. Yogesh Garg was a pleasant and responsible senior executive in Aquaculture sector. He left behind his wife Kavitha Garg, daughter Kavyanshi and a son Yash Garg.

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Connect with us

USSEC's SUSTAINASUMMIT Drives Discussions on Advancing Food Security through Sustainable, Climate- Resilient Food Systems

The event championed the need for innovation and climate-smart food systems to sustainably feed the world.

Kevin Roepke, Regional Director-SAASSA, USSEC

[February 2024, Dubai, UAE] Agribusiness leaders and industry visionaries gathered in Dubai to attend the U.S. Soybean Export Council (USSEC)'s annual Sustainasummit 2024 conference. Discussions revolved around smart conservation initiatives, sustainable agricultural practices, ground breaking progress in food cultivation, production, distribution, and consumption.

According to the World Bank, South Asia is

Stan Born, Chairman, USSEC

experiencing a "new climate normal" [1] which is referred to as unpredictable weather including heat waves, cyclones, droughts, and floods. With agrowing population and rising temperatures, South Asia needs to accelerate its efforts in addressing the impact of climate change on the region's food and nutrition security.

Kevin Roepke, Regional Director, South Asia and Sub-Saharan Africa (SAASSA) at **USSEC** emphasized the need for building climate resilient food systems. He added, "With USSEC's Sustainasummit, we aim to ignite strategic dialogue among the food and agri- businesses about the importance of using sustainable ingredients such as U.S. Soy to develop arobust global food system. U.S. Soy is uniquely positioned to sustainably meet South Asia's growing demand for protein through its high nutritional bundle and reliable supply.

"Today's global consumers are increasingly vocal about their desire for sustainable products and

A view of participants in USSEC's SUSTAINSUMMIT

Abby Rinne, Director of Sustainability at USSEC and Imo Chicken and Agro Private Ltd formally sign the licensing agreement for the adoption of the 'Fed with Sustainable U.S. Soy' label on Imo Chicken and Agro Private Ltd's packaging.

Stan Born, Chairman at USSEC, Abby Rinne, Director of Sustainability at USSEC, Fortune Agro Industries Pvt. Ltd and Deeba Giannoulis, Regional Head of U.S. Soy Marketing & Sustainability – SAASSA, USSEC gather for a photo after signing the licensing agreement for the adoption of the 'Fed with Sustainable U.S. Soy' label on Fortune Agro Industries Pvt. Ltd's packaging.

greater transparency in raw material sourcing" added **Deeba Giannoulis, Regional Head of U.S.Soy Marketing & Sustainability – SAASSA at USSEC.** Sustainasummit represents our commitment to establishing comprehensive sustainability standards across industries, enabling businesses to procure resources responsibly.

For instance, the *'Fed with Sustainable U.S. Soy'* label, endorsed by eleven poultry companies in Sri Lanka, is just one example of our efforts.

This initiative ensures adherence to the stringent U.S. Soy Sustainability Assurance Protocol (SSAP), guaranteeing sustainable practices in areas such as biodiversity and production methods of U.S Soy Farmers. As we champion initiatives like Sustainasummit, we aim to catalyze similarinnovations that pave the way for a greener, more nutritious future."

Addressing the potential of science to achieve food security, **Dr Mahaletchumy Arujanan, Global Coordinator at ISAAA-BioTrust and Executive Director of the Malaysian Biotechnology Information Centre (MABIC)** added **"**The pillars for sustainability are built upon science. Science provides the solution to reduce the footprint created by

held on 15 February 2024 at Dubai, UAE

From left: ***Kevin Roepke, Regional Director – SAASSA, USSEC, Suzanne Shirbroun, President, Iowa Soybean Association, Abby Rinne, Director of Sustainability, USSEC, Brent Swart, President Elect, Iowa Soybean Association, Stan Born, Chairman, USSEC and Kirk Leeds, CEO, Iowa Soybean Association***

the agriculture industry by reducing greenhouse gases, increasing productivity, responsibly using chemicals, reducing waste and optimizing the use of resources. Science supports food security and booststhe economy. Biotechnology is at the centre of this, supporting environmental and socioeconomic wellbeing."

Reflecting on U.S. Soy's lowest carbon footprint compared to soy from other origins, **Abby Rinne, Director of Sustainability at USSEC** stated, "Our U.S. Soy farmers are committed to continuous improvement through innovation and technology to achieve their 2025 sustainabilitygoals. This includes **reducing total greenhouse gas emissions and land use by 10%** while **increasing energy efficiency by 10%.** U.S. Soy farmers are leading the way by producing morewhile using fewer resources, implementing farming practices that reduce carbon footprint, and are helping in preserving forestland."

M.A. Nazeer, Editor, Aqua International, with Stan Born, Chairman, USSEC during SUSTAINASUMMIT at Dubai on February 15

One recurring theme from Sustainasummit 2024 was that agriculture is not the problem; it is thesolution. Highlighting the need for a paradigm shift in policy frameworks to combat climate challenges, **Frank M. Mitloehner, Professor in Animal Science at UC Davis, California,** added "Farmers can be a part of a climate solution but to achieve this, we need to unleash the potential of voluntary and incentives-based policies."

During Sustainasummit, there was a noteworthy celebration as two more U.S. Soy customers from Sri Lanka; Imo Chicken and Agro Private Ltd and Fortune Agro Industries Pvt. Ltd signedlicensing agreements to adopt the '*Fed with Sustainable U.S. Soy*' label on their packaging. Thisbrings the total number of label users to eleven in less than a year. By embracing the label, U.S. Soy customers aim to elevate and differentiate their products in the market as they demonstrate their commitment to sustainability and supply chain transparency.

Supported by the Illinois Soybean Association, Iowa Soybean Association, and the United States Department of Agriculture (USDA), Sustainasummit 2024 hosted compelling conversations withindustry thought leaders, including; Stan Born, USSEC's Chairman, Suzanne Shirbroun, President, Iowa Soybean Association, Kirk Leeds, CEO, Iowa Soybean Association, Brent Swart, President Elect, Iowa Soybean Association, Puneet Tomar, Global Project Manager at Euromonitor International, Sameera Fernandes, Director Corporate Affairs & Sustainability, Century Financial, Sohel Tanvir Khan, Business Director, ACI Logistics Ltd (Shwapno) and Sanjeev Astana, CEO, Patanjali.

About the U.S. Soybean Export Council (USSEC): The U.S. Soybean Export Council (USSEC) focuses on differentiating, building preference, and elevating market access for the use of U.S. Soy for human consumption, aquaculture, and livestock feed in 80+ countries internationally. USSEC members represent the soy supply chain including U.S. Soy farmers, processors, commodity shippers, merchandisers, allied agribusinesses, and agricultural organizations. USSEC is funded by the U.S. soybean checkoff, USDA Foreign Agricultural Service (FAS) matching funds, and industry.

Indian Delegates

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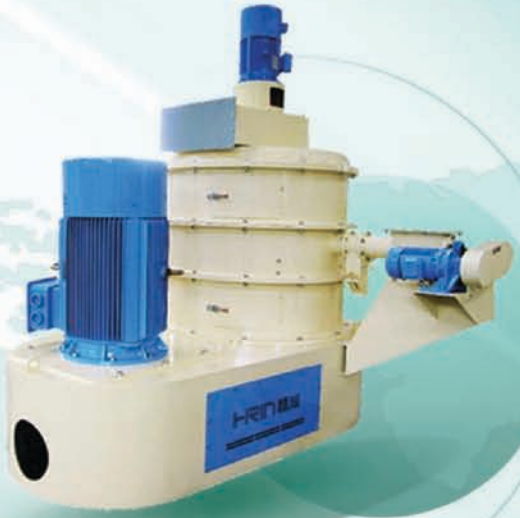

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Importance of Automation in Aquaculture

Shiwam Dubey, Amogha K R, Umesh Suryawanshi, Narendra Kumar Maurya

Karnataka Veterinary, Animal and Fisheries Sciences University, College of Fisheries, Mangaluru, Karnataka, India
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Automation generally refers to processes that operate, function, or self-regulate without human input. The word derives from the Greek word automaton, which means to behave autonomously, on their own, or spontaneously. Automation is the use of platforms-machines, tools, devices, installations, and systems-created by people to carry out a certain set of tasks without the need for human interaction. However, there are other various to this definition. For instance, mechanisation was a prevalent form of automation prior to contemporary automation, which has been specifically described in the modern context since roughly the 1950s. The difference between automation and mechanisation and its benefits became obvious when automatic control was added to mechanisation as an intelligence feature. This chapter examines the development of these linked definitions as well as how people around the world regard automation.

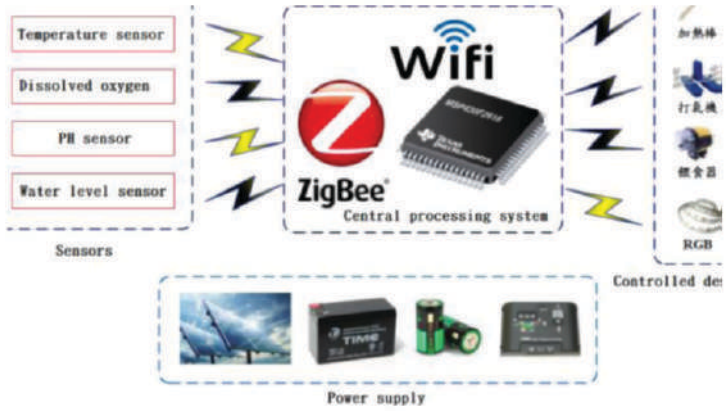
Introduction:

Technologies of Automation in Aquaculture field:

With the rapid development and widespread adoption of wireless sensors networks (WSN) and wireless personal area networks (WPAN), environment-driven information sensing and transmission has became faster and more practical. ZigBee short-range wireless transmission technologies, using the IEEE 802.15.4 standard, which has low-power, low-rate, low-cost, and other advantages. Numerous situations call for the use of ZigBee. Water quality has a huge impact on aquatic organisms' survival and growth. Water quality, including oxygen content, temperature, and salinity, is unsuitable for short-term use. The rapid spread of the pathogen infection through the water was sufficient to quickly bring about the demise of all biological farming. In addition to using a variety of sensors to track the environment for fish farming, adding automatic control systems, solar systems, and mobile devices will help achieve high economic efficiency.

Hardware division:

Each sensing node in the system is processed by a processor from the MSP430 series, and the communications interface for the wireless sensing network is ZigBee. Each sensor and controller is controlled by a home-made central processing system that uses MSP430 microcontrollers and ZigBee wireless transceivers to collect



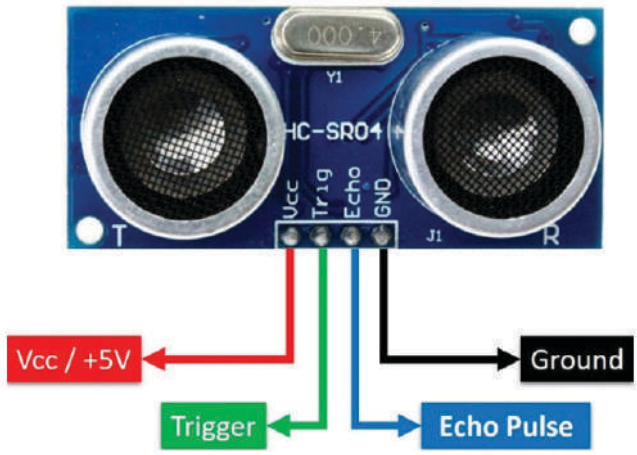
Hardware Architecture diagram

all of the sensed data. Through a central terminal that is outfitted with a WIFI transmission module, all environmental sensing data is then transmitted to the user's terminal equipment.

1. Module to detect temperature:
The PT100 sensor is used in the temperature detecting module. The element is made of platinum wire that has been twisted in coils and placed on an insulating cylinder to act as a positive temperature coefficient resistance sensor. The amount of physical change in resistance from the temperature sensor itself is transformed. To achieve this modification and get rid of common mode noise, a linear circuit and compensating circuit output voltage are used.

Temperature sensing module

2. Module to assess water level:
The water level sensing module emits sound waves to an ultrasonic receiver using an ultrasonic transmitter. The water level is calculated from the length of time that sound waves reflect. Distance attenuation has an impact on the acoustic wave's transmitted intensity. The main explanation is due to the energy loss from the expanding distribution area. The frequency of measurement should be raised to acquire higher resolution in order to ensure that the distance data is more accurate when using the time difference as an indicator for accurate echo determination.



Ultrasonic Sensor

3. pH and dissolved oxygen level sensor module:
The MAX3232 chip MSP430 converts the signal into transmission after the PH instrument and the dissolved oxygen instrument broadcast their measurement data. After being generated by the chip, the real value is sent for integration analysis via ZigBee chip central processing systems. Two serial communication ports connected to ZigBee and WiFi are used by the MSP430 microprocessor. All of the data is analyzed by the wireless sensor network architecture Master for the meta-analysis. The terminal equipment can be used by the user to alter environmental control parameters for regulating fish growth and keeping a stable environment.

Heaters:
When the temperature is below the range specified by the user, the central processing system will automatically send signals to turn on the switch to increase the water temperature by raising the picture heating rod load.

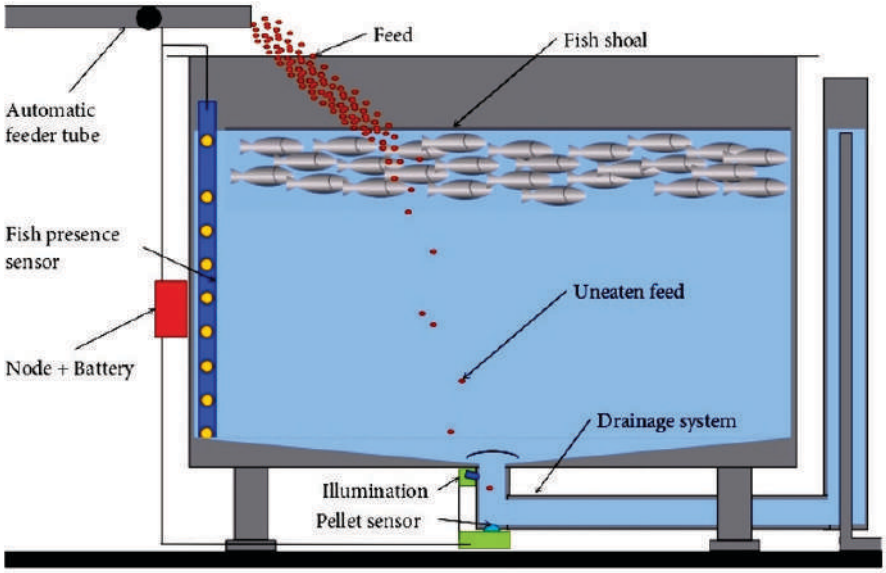
Feeding Sensor:
Aquaculture can present a number of challenges to the environment. Particularly, excess feeding is the cause of several of the adverse effects of fish farming (J. H. Primavera et al 2006). A CMOS sensor is used for feed detection. We get the histograms from the data gathered by the CMOS sensor. Moreover, light-dependent resistor (LDR) strips placed from the top to the bottom of the cage are used to determine the height at which fish are swimming. Our technology ensures that all fish

Heatrer

have enough time to eat and allows feed to be saved during feeding time, making aquaculture facilities more economically successful and environmentally sustainable. The system is consisted of an automatic feeder tube, which permits altering the feed supply velocity, Four different velocities can be selected: 100%, 50%, 25%, and 5% of the standard feed supply velocity. The system always starts to feed with the 100% of the velocity. The system is controlled by the Arduino which is mounted in the exterior of the tank. The fish presence sensors are put inside a Plexiglas tube total of 9 sensors are positioned along the tank at varying depths. The fish presence sensor is constructed of LDRs that are able to detect the variations in the received illumination owing to the swimming fish. The first LDR, LDR 1, is set at 5 cm below the sea surface. This is the location where the fish used to be during the feeding procedure. The second LDR, LDR 2, is placed at 30 cm from the water surface. The rest of the LDRs, LDR 2 to LDR 9, are placed 15 cm apart. The Plexiglas tube with the LDRs is fastened to the tank walls in the same side where the feeder tube dispenses the feed. The Plexiglas tube is sealed in both extremes. Finally, the falling feed detector is positioned at the bottom of the tank in the drainage tube. This sensor is composed by a pellet detecting sensor, and illumination is given by a white LED.

Automationm important for Aquaculture Pond:

According to traditional aquaculture, throughout operation technical procedures from water preparation, seed selection, feeding, and care during the growing process are carried out.Through aquaculture activities, there are various issues such as the process of water quality control in the aquaculture system, and normally people will take water samples twice a day in the morning and afternoon.This technique takes much time and it is also impossible to cleanse the water on time in some circumstances of rapid changes of water quality in ponds/tanks. For a smart aquaculture strategy, various



Feed Supply of Fish

smart sensors are incorporated into an environment specially structured to monitor cultivated environmental conditions in real time and then make decisions from the acquired data in automatically (Sharma, D.; Kumar, R. Et al 2021). Smart aquaculture is a smart production mode. It may be controlled in a distance and automation by using of IoT, big data, artificial intelligence, 5G, cloud computing, and robotics. On the other side, smart aquaculture may be managed by robot which can manage facilities, equipment, machineries to operate whole systems to achieve successful production.

FORM IV

Statement about ownership and other particulars about newspaper, Aqua International, to be published in the first issue every year after the last day of February.

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I, M.A. Nazeer, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Sd/-

Date: 1.3.2024 Signature of Publisher

Smart Aquaculture:
Smart aquaculture can perfect all stages from breeding, nursery to grow out stages of cultured species, as well as other processing like preparation of cultured water resource, manage the water quality, feed preparation, feeding, classification, grading, counting and cleaning the cultured systems. The final objective for developing the smart aquaculture is to obtain high aquaculture production to match world demand as well as protect environment.

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Insights and Solutions for Overcoming Aquaculture Challenges

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1. Aquaculture is a rapidly expanding food industry that supplies sustainable protein sources for global consumption.
2. Aquaculture encounters challenges such as diseases, water quality concerns, feed management and environmental effects.
3. Solutions consist of applying biosecurity measures, controlling water quality, employing sustainable feed and adopting closed containment systems.
4. Disease management, water treatment, enhanced feed practices and consistent environmental monitoring are essential for sustainable aquaculture.
5. The aquaculture industry actively learns from past experiences and invests in research and development to ensure a sustainable and responsible future.

Introduction

Aquaculture has emerged as one of the fastest-growing sectors of the food industry, providing sustainable sources of protein and other essential nutrients for the world's population. Global aquaculture production has grown at an average annual rate of 5.8% over the past decade and is expected to reach 109 million tons by 2030 (FAO, 2021). Despite its growth, the aquaculture industry has faced some challenges. Aquaculture producers have encountered numerous obstacles that threaten their sustainability and profitability, ranging from disease outbreaks to environmental degradation. One of the primary challenges in aquaculture lies in ensuring environmental sustainability. The intensive farming practices employed in many aquaculture operations can lead to water pollution, habitat degradation and the transmission of diseases to wild populations. Balancing the need for increased production with the preservation of fragile ecosystems is a critical task that requires innovative technologies, responsible management strategies and robust regulatory frameworks. This article explores the challenges facing aquaculture and examines lessons learned from past experiences, as well as the solutions implemented to address them.

Challenges in Aquaculture

Disease outbreaks: The outbreak of diseases in fish farms is one of the biggest challenges facing the aquaculture industry. Bacteria, viruses and parasites can cause these diseases, leading to significant economic losses for farmers. Furthermore, disease outbreaks can also impact wild fish populations as they can be transmitted from

farmed fish to their wild counterparts (Subasinghe, 2005). Stress factors such as fluctuations in water quality, poor nutrition and inadequate husbandry practices can further compromise the health of aquatic organisms raised in aquaculture systems. Consequently, these organisms become more susceptible to infections and diseases due to weakened immune systems. Another contributing factor is the risk of introducing new diseases to aquaculture systems through the movement of live animals between locations or countries.

A multidisciplinary approach is required to control and manage disease outbreaks in aquaculture. This approach involves implementing strict biosecurity measures, including regular stock monitoring and screening, disinfection protocols and restrictions on personnel and equipment movement. Early detection and diagnosis of diseases are crucial, followed by prompt intervention measures such as vaccines, antimicrobial treatments or probiotics to prevent their spread.

Water quality: In farms, water quality plays a crucial role in fish health and growth. Poor water quality can result in reduced growth rates, increased mortality rates and increased susceptibility to disease. Factors such as pollution, temperature and salinity can affect the quality of water.

Feed management: Feeding fish in farms presents a challenging task due to the varying nutritional requirements based on fish species, size and growth stage. Overfeeding or underfeeding can significantly impact fish health and growth, as well as contribute to waste and pollution issue (Munguti *et al*., 2014).

Environmental impacts: Aquaculture can have a significant impact on the environment if not managed properly. Waste and excessive feed can lead to pollution in surrounding water bodies, while escaped fish can adversely affect wild fish populations.

Lessons Learned

Biosecurity: Implementing biosecurity measures, such as disease screening and preventing the introduction of non-native species, is crucial to prevent disease outbreaks in fish farms.

Water quality management: Effectively managing water quality is essential in fish farms. This includes monitoring and controlling parameters such as temperature and salinity to ensure optimal water conditions for fish health and well-being.

Sustainable feed: The use of sustainable feed, such as plant-based feed, can help reduce the environmental impact of fish farms and ensure the health of the fish.

Closed containment systems: Closed containment systems, including recirculating aquaculture systems (RAS), play a vital role in reducing the environmental impact of fish farms. These systems allow for better control of waste and excess feed, preventing their release into the environment.

Solutions

Disease management: Implementing disease management practices, such as vaccination and treatment, is essential for preventing and controlling disease outbreaks in fish farms. These practices also play a crucial role in preventing the transmission of diseases to wild fish populations.

Water treatment: Utilizing water treatment systems, such as filtration and disinfection, is vital to maintaining high water quality standards in fish farms.

Feed management: Enhancing feed management practices, such as employing automated feeding systems and developing species-specific feeds, can effectively reduce waste and ensure optimal health and growth of fish.

Environmental monitoring: Regular monitoring of environmental impacts, including water quality and waste discharge, is necessary to ensure that fish farms operate in an environmentally sustainable manner.

Conclusion

Aquaculture is an important industry that has the potential to provide significant benefits to society, including a reliable source of food and employment opportunities. However, the industry also faces various challenges. Disease outbreaks, poor water quality, feed management, and environmental impacts are just a few of the challenges faced by the industry. Nevertheless, the aquaculture industry is actively learning from past experiences and implementing solutions to address these challenges. It is committed to operating in a sustainable and responsible manner. By investing in research and development, the aquaculture industry can continue to grow and provide long-term benefits. It is through these efforts that the industry can overcome the challenges it faces and ensure a sustainable future.

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Ecosystem-Based Fisheries Management: *A modern tool for tropical fisheries management and aquaculture*

EEBFM 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.

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

Why EBFM is important in fisheries management?

- ✓ Many of the world's fish populations measures over exploited and the ecosystems that sustain them are degraded**:** Unwanted consequences of fishing, including habitat destruction, incidental mortality of non target species, generation shifting in population demographics, and changes in function and structure of ecosystems, being progressively identified.

- ✓ Fisheries management thus far has typically been ineffective: it focuses on maximising the catch of one target species and sometimes ignores environment, predators and 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 thecomplexness 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.

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

Conventional Fisheries Management (CFM) VS EBFM

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

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.

References can be provided on request.

Potential of Integrated Multi-trophic Aquaculture System (IMTA)

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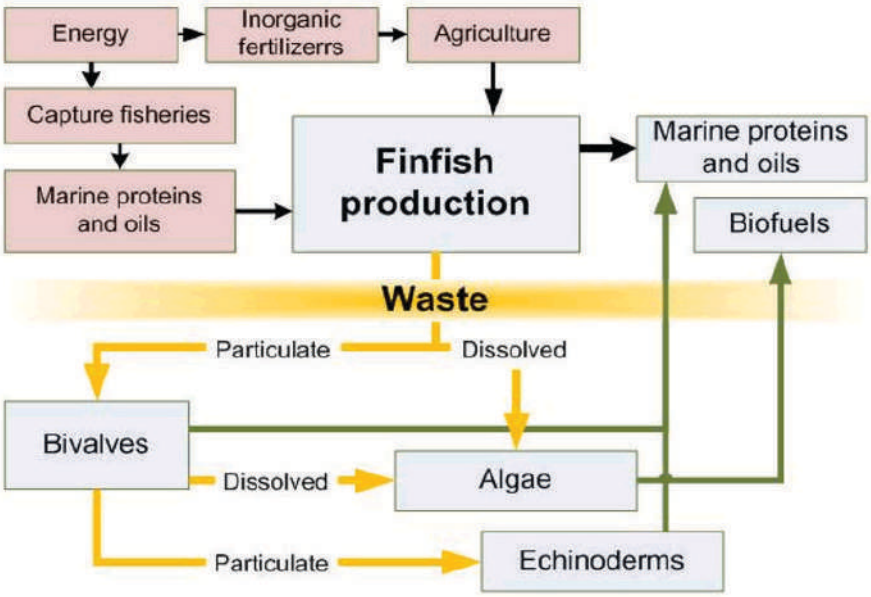
Introduction

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

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

In this system, selecting appropriate species and sizing the various populations to provide essential ecosystem functions allows the biological and chemical processes involved to achieve a stable balance, mutually benefiting the organisms and improving ecosystem health. Ideally, the co-cultured species each yield valuable commercial "crops." IMTA can synergistically increase total output, even if some of the crops yield less than they would, short-term, in a monoculture. The primary function of IMTA "Integrated" refers to intensive and synergistic cultivation, using waterborne nutrient and energy transfer. "Multitrophic" means that the various species occupy different trophic levels, i.e., different (but adjacent) links in the food chain. IMTA is a specialized form of the age-old practice of aquatic polyculture, which was the co-culture of various species, often without regard to trophic level. In this broader case, the organisms may share biological and chemical processes that are minimally complementary, potentially leading to significant ecosystem shifts / damage. Some traditional systems did culture species

- *Fisheries bioeconomics combines resource biology and ecology with fisher behaviour economics, considering the space, time and uncertainty dimensions.*
- *The size of the fish stock will be "too small" because there is "too much" fishing effort.*
- *An essential component of fisheries management is the use of bioeconomics.*
- *In fisheries management, time is essential.*
- *In open access fisheries, net returns will not be maximized, creating an inefficient level of effort.*



Layout of Integrated multi-trophic aquaculture System (IMTA)

that occupied multiple niches within the same pond but limited intensity and management.

The more general term "Integrated Aquaculture" is used to describe monocultures' integration through water transfer. The terms "IMTA" and "integrated aquaculture" differ primarily in their precision and are sometimes interchanged. Aquaponics, fractionated aquaculture, integrated agriculture-aquaculture-systems, integrated peri-urban-aquaculture-systems and integrated fisheries-aquaculture-systems are variations in the IMTA concept.

Layout of Integrated multi-trophic aquaculture System (IMTA)

The different step should be need development of IMTA

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

Selection of species

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

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

IMTA system designs:

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

Present studies of IMTA worldwide: - In this culture, technology beneficial to ecological and sustainability globally. Nowadays, IMTA commonly

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

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

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

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

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

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

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

Benefits:

- Mitigation of effluents through bio-filters is suited to the ecological niche of the aquaculture site. This can solve a number of the

environmental challenges posed by monoculture aquaculture.

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

Challenges in IMTA

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

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Gassen Plus

Bon Ammonia and obnoxious Gasses

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

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

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

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

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

PRESENTATION: 500 gms &1 kg

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